

Electrical Services Specification

Farina Investment Trust

Project Number: A0733-1E

147 Marion Road, Richmond

Revision 00 – Preliminary

SABECT QA SYSTEM.

Reason For Issue:

Review

Issue date:

21/4/17

Authorisation:

by: *B Fleming*

Verification of Latest Amendment.

By: *B Fleming*

1 SCOPE OF WORK

The work covered by this section of the specification includes, but is not limited to the design, supply, installation, termination, connection, testing, commissioning and maintenance during the Defects Liability Period of the following.

(Note: Refer to documentation provided by the Building Owner for details of the layout and equipment within the individual apartments and Office areas, and allow to provide a separate price for this work)

- a) Consumer's mains cabling from a new SA Power Networks service point to the main switchboard (MSB).
- b) New main switchboard (MSB) with integral retailer metering panel .
- c) Common area load centres at ground & first floors (DB-CSG & DB-CS1).
- d) Metered sub-mains cables between the retailer metering panel and individual apartment switchboards and Offices 1, 2 & 3.
- e) Distribution boards in Offices 1, 2 & 3 and Apartments 1, 2 & 3.
- f) Common area light and power final sub-circuit cabling, conduits and cable support systems.
- g) Common area luminaires.
- h) Lighting controls.
- i) Power circuits and power isolators to equipment where shown, including lift submain.
- j) Telstra lead-in cable pathway – 63 ID PVC conduit wall with thickness 3.45mm, and draw cord.
- k) Comms block cabling.
- l) Design, supply and installation of an MATV system complete with outlets, cabling, amplifiers, splitters etc. *
- m) Multi-tenant entry security system (video intercommunication system). *
- n) Security control panel code pad access, with provision for:
 - Connection of common area smoke and thermal detectors (by Fire Services Contractor) for remote monitoring of the detectors.
 - Future connection of 3 separate intruder alarm zones.
 - Connection to remote monitoring station, including payment of all initial connection costs and 12 months monitoring service.
- o) Protective and communications earthing systems.
- p) 2 hour fire-rating of all penetrations through fire-rated elements for services covered by this section of the specification.
- q) Testing and commissioning.
- r) Operating and maintenance manuals, 'as-installed' drawings and provision of Certificates of Compliance for all works (certifying that all works comply with the contract documents, and all Authorities' requirements).
- s) Maintenance during the Defects Liability Period.

* Note: All works within the boundaries of the apartments will need to be coordinated with the Proprietor.

2. ASSOCIATED WORKS

The following works associated with this section of the specification will be carried out by others or other trades at no cost to this Contractor:

2.1 Building Trades:

- a) Provision of openings, penetrations and chases, and making good, in roofs, ceilings, walls and slabs as required to allow for installation of luminaires, power outlets, switches, cabling, cable supports, outlets, etc.

Note: Allow to mark-out sizes and locations of all penetrations, openings and chases required for installation of the documented services.

- b) Provision of cutout in main entry door for the electric door strike.
- c) Final connection of power to motorized gates from local power isolators provided by the Electrical Contractor.

2.2 Plumbing Contractor:

- a) Final connection of power to hot water units from local socket outlets provided by the Electrical Contractor.

2.3 Lift Contractor:

- a) Final connection of power to lift control panel from local power isolator provided by the Electrical Contractor.

2.4 Telstra:

- a) Supply, installation and commissioning of lead-in cabling.

2.5 Fire Contractor:

- a) Connection of smoke and thermal detectors to the security control panel provided by the Electrical Contractor.

4 GENERAL

4.1 STANDARDS

REFERENCED DOCUMENTS: The following standards are applicable to the work in this Section of the Specification. The current issue of each standard is applicable:

AS 1125	Conductors in insulated electric cables and flexible cords
AS 1345	Identification of the contents of piping, conduits and ducts
AS 1650	Galvanized coatings
AS 1775	Low voltage switchgear and controlgear Air-break switches, isolators and fuse connection units (up to and including 1000 V a.c. and 1200 V d.c.)
AS 1882	Earth and bonding clamps
AS 2053	Non-metallic conduits and fittings
AS 2381.1	Cabling in Class 1 hazardous areas
AS 2430.3	Specific Occupancies
AS/NZS 3000	Wiring Rules
AS/NZS 3008	Electrical installations - Selection of cables
	Part 1 - Cables for alternating voltages up to and including 0.6/1 kV
AS 3012	Electrical installations - Construction and demolition sites
AS 3112	Approval and test specification - Plugs and plug socket outlets
AS 3131	Approval and test specification - Plugs and socket-outlets for use in installation wiring systems

AS 3133	Approval and test specification - Air break switches
AS 3147	Approval and test specification - Electric cables - Thermoplastic insulated for working voltages up to and including 0.6/1 kV
AS 3190	Approval and test specification - Residual current devices (current operated earth-leakage devices)
AS 3191	Approval and test specification for electric flexible cords
AS 3760	In-service safety inspection and testing of electrical equipment

4.2 SHOP DRAWINGS

REQUIREMENT: Supply shop drawings showing:

- Switchboards.
- General arrangement: Including layout, clearances around, and access to the equipment;
- Cable layout: Showing arrangement, location, and identification of interconnecting wiring, cabling, and underground services.
- Schematic diagram of the video intercom system arrangement and connections.
- Design and block cabling diagram for the MATV system
- Labelling: Details of labelling and engraving;
- Earthing: Earthing electrodes layout and bonding connections to other incoming services.

NUMBER OF COPIES: Three.

4.3 SAMPLES

Submit samples for review where specified, or where 10 or more of the one item are to be supplied under this contract, and once accepted retain as the reference benchmark for quality, workmanship, materials and finish of the final installed item. Any deviation in the final installed item from the submitted samples may be cause for their rejection. Where an article is too large to submit as a sample arrange for the item to be made available for review at a suitable location.

Submit other samples where clarification is required for additional items not specified as requiring samples. Once accepted, retain the samples and treat in the same manner as specified samples.

Samples shall:

- be submitted within sufficient time to permit modifications to be made if such are deemed necessary and allowing not less than seven working days for comment
- be submitted with copies of relevant approval certificates and technical data where associated with essential services and emergency systems
- be complete in every detail and labelled to include; name of Contractor, date submitted, and make, model no., purpose of sample and relationship to these documents
be submitted with a complete list of those non complying features where deviations from specification in the samples exist Should such a list not be provided, the Contractor shall be responsible for full compliance with the specification, irrespective of any review by the Engineer.
- be held on site after review until built into the works as the final unit

Documentation submitted with samples shall be returned:

- marked acceptable, subject to any comments applicable or
- marked resubmit, which shall require the rejected sample to be amended as required and resubmitted

Allow minimum 7 working days for comment.

Samples shall be as follows:

- Common area luminaires.
- All common area lighting control items, all types of lighting switches.
- All common area power outlet and isolator types.
- Cable trays.
- All comms items: MDF, FDF, cable types, and voice outlets and labelling protocol.
- All AV outlets.

- Video intercom door and indoor stations.

4.4 WORK-AS-EXECUTED DRAWINGS

REQUIREMENT: Before the Date of Practical Completion supply work-as-executed drawings showing the same level of information as the tender drawings.

NUMBER OF COPIES: Three hard copies, and one CAD file (AutoCad 2014 format).

5 INSPECTIONS , TESTING , COMMISSIONING & MAINTENANCE

5.1 INSPECTIONS

NOTICE: Give sufficient notice so that inspection may be made at the following stages:

- Concealed conduits: Prior to concrete pours, etc.;
- Conduits laid: Prior to any backfilling;
- Cabling: Commencement of cabling installation;
- Cables laid: After laying underground cables and before and after laying protective covering and marker tape;
- Connection: Connection of cabling and wiring;
- Earthing: Installation and connection of all types of earthing systems;
- Acceptance: Installation ready for acceptance;

Minimum notice required: 7 Days

5.2 TESTING

NOTICE: Give sufficient notice so that tests may be witnessed by the Superintendent.

Minimum notice required: 48 hours.

TEST CERTIFICATES: Provide test certificates for approval.

WORKS TESTING: Provide certificates of manufacturer's works testing for the following:

SITE TESTING: Include the following:

- Insulation resistance measurements:
 - on motors and major medium voltage equipment items, at 1000 V d.c.;
 - on cables and wiring to AS 3000 clause 1.5;
- Functional checks: Full functional and operational checks on energized control equipment and circuits, including adjustments for the correct operation of safety devices;
- Motor rotation: Checking and where necessary altering connections for the correct motor rotation;
- Earth resistance measurement: To AS 3000 clause 1.5;
- Earthing: Confirmation of effective earthing of the exposed metal of electrical equipment, building structure, bonding of incoming metallic services pipework, lightning earth termination, telecommunications system.

CONSTRUCTION AND DEMOLITION SITES: To AS 3012 and AS 3760.

APPROVAL FOR ENERGIZING: Obtain approval before energizing newly installed or reconnected wiring or equipment.

FAULTY INSTALLATION: During testing, replace fuses and equipment damaged as a result of incorrect installation work.

5.3 COMMISSIONING

NOTICE: Give sufficient notice that commissioning of the electrical services is to commence.

Minimum notice required: 7 Days

PHASE SEQUENCE: Ensure the correct phase sequence at the main switchboard after connection of the supply.

BALANCING OF LOAD: Balance the load as evenly as practicable at Practical Completion. Recheck and, where necessary, rebalance the load at completion of the Defects Liability Period.

CIRCUIT PROTECTION: Confirm that circuit protective devices are sized and adjusted, where necessary, to protect the installed circuits.

LUMINAIRES: Clean the luminaire reflectors, mirrors and diffusers. Replace faulty lamps.

5.4 MAINTENANCE

Safe Working Procedures

PERSONNEL: Submit for approval the names of experienced persons to be responsible for safe working procedures during the maintenance period.

PROCEDURES: Establish safe working procedures applicable to the site and provide danger notices, danger tags, and the like, for use during the maintenance period. Submit the procedures for approval.

Operational Maintenance

MAINTENANCE PERIOD: Co-extensive with the Defects Liability Period.

REQUIREMENT: During the maintenance period:

- Carry out periodic inspections and perform maintenance work at the frequencies and following the procedures recommended by the manufacturers of the supplied equipment.
- Promptly rectify faults. Replace faulty materials and equipment, including luminaire lamps, and accessories.

CERTIFICATION: At the end of the maintenance period make a final service visit and, upon satisfactory completion of the above procedures, certify in writing that the installation is operating correctly.

OPERATIONAL INSTRUCTION: Coinciding with the routine inspection visits, at times to be agreed with the Superintendent, instruct the Principal's operational maintenance staff in the recommended methods of operation and maintenance of the system.

Manuals

REQUIREMENT: Before commencement of operational maintenance, provide the specified number of copies of a combined operator's manual and technical manual, written in clear concise English, containing a title page listing suppliers' names, addresses and telephone numbers, a table of contents, and the following data:

Operator's manual:

- Safe working procedures: For switching and isolating the supply and distribution system;
- Operation and maintenance: Information for the satisfactory long-term operation and maintenance of the installation;
- Maintenance procedures: Recommended maintenance periods and procedures;
- Tools: Particulars of maintenance equipment and tools provided, with instructions for their use.

Technical manual:

- Diagram: A copy of the single line diagram for the supply and distribution system;
- Equipment: A technical description of the equipment supplied, with diagrams and illustrations where appropriate;
- Dismantling: Where necessary, procedures for dismantling and re-assembling equipment;
- Spare parts: A list of the spare parts provided;
- Drawings: The work-as-executed drawings.

Form: A4 size, printed or typed on durable printing paper and neatly bound in durable vinyl or similar hard covers.

NUMBER OF COPIES: Three.

Prototype copy: Provide a prototype copy for approval before proceeding.

CIRCUIT DIAGRAMS: Provide circuit diagrams of all electronic and electro-mechanical equipment showing plug and active element connections with voltages or calibrated wave-forms at no signal or specified typical operating conditions. Show measuring instrument type.

Show the value, power rating and voltage rating of all components or alternatively show the catalogue part number where catalogues are readily available. Provide catalogues on request. Identify active elements by type number. Provide a cross referenced circuit diagram with component location diagram for printed circuit boards.

6 UNDERGROUND SERVICES

6.1 UNDERGROUND CABLES

STANDARDS: To AS 3000 and to AS 3012 for construction and demolition sites.

6.2 TRENCHING

SPECIFICATION REFERENCES: SERVICE TRENCHES - GROUNDWORKS.

7 GROUNDWORK

7.1 SERVICE TRENCHES

EXCAVATION: Excavate to the lines, levels and grades as required for underground services specified in the relevant services sections, including drainage, hydraulic, electrical, and the like. Unless otherwise specified make the trenches straight between manholes, inspection pits, junctions and the like, with vertical side and uniform grades.

LAYING PROGRAM: Excavate trenches in sections of suitable length, and after the relevant service length has been laid and bedded backfill the trench section, with the minimum of delay, and if possible on the same working day.

TRENCH WIDTHS: Subject to regulatory authority requirements, keep trench widths to the minimum consistent with the laying and bedding of the relevant service, and the construction of manholes and pits.

TRENCH DEPTHS: As required by the relevant service and its bedding method.

OBSTRUCTIONS: Cut back roots encountered in trenches to not less than 600mm clear of the relevant service. .

7.2 BORING

REQUIREMENT: For services required to pass under existing roads, provide under-road boring, by an approved specialist subcontractor, in lieu of trenches. Make the bored dimension slightly less than the relevant service pipe to ensure a tight fit. If voids are encountered, fill by pressure grouting.

If boring is not possible, saw-cut concrete paving, and reinstate as specified in clause 7.6.

7.3 TRENCHING

EXISTING SURFACES: Saw cut existing concrete or bitumen surfaces in a straight line to a minimum depth of 75mm before excavation is commenced. Lift and store paving slabs for later reinstatement.

EXCAVATION: After excavation, clear trenches of sharp projections. Agree the installation depth with the Superintendent when rock is encountered in the excavation.

EXCAVATIONS BEYOND SITE BOUNDARY: Notify, and obtain approval from, the appropriate owner before excavation commences. Carry out the excavation to the Superintendent's requirements. Reinstall all surfaces to match existing.

7.4 CABLES IN TRENCHES

DRAW CORDS: Provide polypropylene draw cords in conduits not in use.

SAND: Provide clean sharp sand around conduits installed underground.

SAND QUANTITY: To AS 3000

UNDER ROADWAYS: Under roadways and areas subject to traffic movement, install cables in a duct or conduit extending to not less than 1m on either side of the sealed surface or trafficable area and encase in concrete having a minimum cover thickness of 100mm.

SEALING DUCTS AND CONDUITS: Seal the buried entries to ducts and conduits with a pliable non-setting waterproof compound. Seal spare ducts or conduits with screwed caps immediately after installation. Seal the others after the cable installation.

7.5 BACKFILLING TRENCHES

GENERALLY: Backfill and compact service trenches as soon as possible after approval of laid and bedded service, generally as specified.

Note:

BACKFILL MATERIAL: Unless otherwise specified, backfill with general filling, with no stones retained on a 25mm sieve occurring within 150mm of the service.

TOPSOIL: Where service excavations occur in topsoil areas, complete the backfilling with topsoil.

7.6 PLACING AND COMPACTION

Placing Filling

EXTENT: Place and compact filling to the dimensions, levels, grades, and cross sections as shown on the Drawings, so that the surface is always self draining.

LAYERS: Place filling in layers not exceeding the specified maximum layer thickness, and compact each layer as specified in COMPACTION - GROUNDWORKS.

Maximum layer thickness: 150mm.

PLACING AGAINST CONCRETE: Do not place filling against concrete until the concrete has been in place for fourteen days.

PLACING AT STRUCTURES: Place and compact filling in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading.

Compaction

DENSITY: Compact each layer of filling to the required depth and density.

PROTECTION: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.

GARDEN AREAS: Backfill the top 150mm of the trench with topsoil.

LAWN AREAS: Re-loam the top 150mm and re-sow trenches passing through existing lawned areas.

EXCESS SOIL: Remove from the site unless otherwise directed.

EXISTING ASSETS: Reinstate existing surfaces and assets disturbed or removed as a result of the excavations of trenching.

CONCRETE SURFACES: Reinstate concrete surfaces to the original level using approved reinforcing steel, keyed to the existing and laid to prevent the reinstalled concrete from subsiding and cracking.

8 CABLE PITS AND UNDERGROUND CABLE ROUTES

Pits

REQUIREMENT: Provide draw-in pits where shown on the Drawings. The sizes shown refer to the inside dimensions.

CONSTRUCTION: Walls and bottom shall be rendered brickwork, 75mm thick concrete, or moulded fibre cement. Incorporate an additive to render or concrete to prevent the ingress of water.

PRECAST CONCRETE PITS:

Minimum size: 450 x 450 x 1000mm deep unless otherwise specified, with 'Gatic' lid.

PVC OR FIBREGLASS PITS:

This type of pit may be used for communications or fire services cabling

MARKING: Mould the word 'ELECTRIC' into a lid for use on any pit containing electrical power cables, 'COMMUNICATIONS' into the lid for use on any pit containing telephone and/or computer cabling, and 'FIRE' into the lid for use on any pit containing fire service cabling.

DRAINAGE HOLE: Provide each pit with a drain hole in the base, positioned to drain into a drainage pit.

DRAINAGE PIT: Provide a drainage pit filled with rubble, graded away from each cable pit for 2000mm. Minimum size: 300mm wide x 300mm deep.

Underground Cable Routes

LOCATION: Accurately locate underground cables using route markers placed at intervals of not more than 100m for straight distances, and at all joints, route junctions, changes of direction, terminations and entry points to buildings.

DIRECTION INDICATORS: Mark the direction of the cable run by marker plate direction indicators. Provide four distinct versions of the marker plate containing 'single', 'through', 'L', and 'T' arrows, with the latter three containing a centre marking. A group of two or more plates may be required at some route junctions.

MARKER PLATE INSTALLATION: Set the marker plate flush in a 200mm minimum diameter concrete base, not less than 200mm deep.

MARKER LOCATION: Set the marker flush to the surface in footpaths, roadways, paved areas, etc., and protruding 25mm above other surfaces.

9 ACCESSORIES

9.1 ACCESSORIES STANDARDS

GENERALLY: To AS 3000 and to AS 3012 for construction and demolition sites.

AIR-BREAK SWITCHES, ISOLATORS AND FUSE COMBINATION UNITS: To AS 1775.

PLUGS AND SOCKET OUTLETS: To AS 3112 and to AS 3131 where applicable.

HAZARDOUS AREA PLUGS AND SOCKET OUTLETS: EX-Proof IP55 EExe II T3.

LIGHTING AND SOCKET OUTLET SWITCHES: To AS 3133.

RESIDUAL CURRENT DEVICES: To AS 3190.

MOUNTING HEIGHTS: Unless otherwise indicated mounting heights are measured to the bottom of the item.

9.2 ACCESSORIES INSTALLATION

FLUSH MOUNTING: Unless otherwise specified, install flush mounted accessories in wall boxes.

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

INSTALLATION METHODS:

All cables installed shall be able to be withdrawn for replacement if required

10 CABLES AND INSTALLATION

10.1 CABLE MANUFACTURE

STANDARDS:

Conductors: To AS 1125.

PVC insulated cables: To AS 3147.

Flexible cords: To AS 3191.

10.2 CABLE SELECTION

STANDARDS: To AS 3000 and AS 3008.1. To AS 3012 for construction and demolition sites.

RATINGS: Unless otherwise specified use AS 3008.1 for the determination of current ratings and voltage drop.

CONDUCTORS: Unless otherwise specified, and where available, use multi-stranded copper conductors.

Minimum size 2.5mm² for lighting and power circuits.

PVC INSULATED CABLES: Unless otherwise specified use V75 insulation.

10.3 CABLE INSTALLATION

STANDARDS: To AS/NZS 3000 and AS/NZS 3013. To AS 3012 for construction and demolition sites.

MANUFACTURERS' RECOMMENDATIONS: Unless otherwise specified, install, terminate and joint cables in accordance with manufacturers' recommendations.

REDUNDANT EQUIPMENT: Remove redundant equipment and wiring, including that in accessible ceiling spaces, and make good exposed surfaces before commencing the installation of new wiring.

HANDLING CABLES: Handle cables so as to avoid damage to insulation and serving or sheathing. Report all damage and replace or repair damaged cable as directed.

STRAIGHT-THROUGH JOINTS: Unless unavoidable due to length or difficult installation conditions, run cables for their entire route length without intermediate straight-through joints. Locate approved joints as directed.

INSTALLATION: Install and adequately support fixed wiring as specified throughout the installation. For cabling routes not specified in detail, submit a proposed route layout.

For specific application: To AS 3013.

CONDUCTORS:

Colours: For fixed wiring colour the conductor insulation as follows:

- Active conductors in single phase circuits: Red.
- Active conductors in polyphase circuits:
 - . A phase - Red
 - . B phase - White
 - . C phase - Blue
- All neutral conductors - Black
- Switched active conductors to fittings: - White.

Sheathing colour: White for flat TPS Cable, Orange for circular cables.

TAGGING: Identify multicore cables and trefoil groups at each end and at crowded intermediate points by means of stamped, non-ferrous tags, clipped around each cable, or trefoil group.

10.4 COPPER CONDUCTOR TERMINATIONS

REQUIREMENT: Unless otherwise approved, terminate copper conductors to equipment, other than small accessory and luminaire terminals, by means of compression-type lugs of the correct size for the conductor, compressed only by the correct tool.

WITHIN SWITCHBOARDS AND EQUIPMENT: Loom and lace together, with PVC straps or string, all conductors from within the same cable or conduit from the point of cable sheath or conduit termination to the terminal block. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Identification ferrules: Where core identification is required, fit to each core durable numbered ferrules permanently engraved with numbers and/or letters to suit the specified connection diagrams.

Spare cores: Terminate and identify any spare cores into spare terminals, if available; otherwise neatly insulate and bind with PVC string, the spare cores to the terminated cores.

11 CONDUITS AND CABLE SUPPORTS

11.1 CONDUITS GENERALLY

STANDARDS:

Non-metallic conduits and fittings: To AS 2053.

Installation: To AS 3000.

MINIMUM SIZES:

Metallic and non-metallic conduits: 20mm.

FIXINGS: Provide two fixings per conduit saddle.

To masonry: Conduit matching saddles and round head cadmium-plated steel screws screwed

into expanded lead or other proprietary type plugs neatly fitting into drilled holes.

To steelwork: Cadmium-plated steel metal-thread screws. Drill and tap the steelwork for each saddle.

SUPPORT: Unless otherwise specified, fix conduit saddles at a maximum of 1m intervals in horizontal runs and 2m intervals in vertical runs. Ensure that installed conduits are fully supported during construction.

PROTECTION IN ROOF SPACE: Protect UPVC conduits installed in accessible roof spaces and the like by timber battens.

LENGTHS: Up to the commercially obtainable conduit lengths of run, install conduits without joints. Remove all rags, burrs, and sharp edges from each length before completing each conduit joint. Fit moulded plastic screwed bushes to the free ends of metallic conduit runs before installing the conductors.

INSPECTION FITTINGS: Inspection fittings and the like shall be accessible.

DRAW-IN BOXES: Provide draw-in boxes at suitable intervals not exceeding 30m in straight runs, and at intervals not exceeding 25m in other runs including directional changes.

UNDERGROUND BOXES: Fit draw-in boxes installed underground with gasketed covers and seal them against entry of moisture.

11.2 CONCEALED CONDUITS

ROUTE OF RUN: Run conduits concealed in wall chases, embedded in floor slabs and installed in inaccessible locations, direct between points of termination with a minimum number of sets. Do not conceal conduit fittings.

LOCATION: Locate conduits run in concrete slabs entirely within the structural slab. Do not run conduits in the concrete topping unless approved.

STEEL CONDUIT: Steel conduit shall be screwed, galvanized .

FIXING: Fix conduits directly to the reinforcing where the conduits pass above a single layer of reinforcing, or fix midway between double layers of reinforcing. Route the conduits in slabs so as to avoid crossovers and to keep the number of conduits in any one location to a minimum. Space conduits 75mm apart in slabs.

ATTENDANCE AT POURS: Ensure that conduits are not displaced, broken, or damaged during concrete pours.

11.3 NON-METALLIC CONDUITS AND FITTINGS

TYPE: Unless otherwise specified, use heavy duty type. Associated fittings shall be of the same material as specified for the conduit.

COLOUR: Use orange conduit for HD type and Grey for LD type.

JOINTS: Use cemented joints. Adopt the manufacturer's recommended procedure for making joints.

WALL BOXES: Standard size wall boxes shall be of the same material as the conduit. Where special size boxes are specified, and where such boxes are not obtainable in UPVC, use pre-fabricated metal boxes.

FITTINGS: Use inspection-type fittings in accessible and exposed locations.

CONDUIT SETTING: Where practicable have conduits preformed by the manufacturer. At site, use correctly sized springs to form sets in UPVC conduit. Bends shall be of large radii and, after setting, shall maintain effective diameter and shape. Reject conduit sets distorted by kinks, wrinkles, flats or heating.

EXPANSION JOINTS: Install flexible couplings where structural expansion joints occur in buildings and in straight runs not embedded in wall chases or floor slabs. Space the flexible couplings in straight runs at intervals of not more than 4m. Install conduit saddles close to the flexible coupling in a manner which allows free movement for expansion and contraction.

MECHANICAL DAMAGE: In situations where the conduit is exposed to mechanical damage and external to buildings, provide mechanical protection to UPVC conduit for a height of not less than 3m above ground or platform level.

11.4 FLEXIBLE CONDUIT

TYPE: Use PVC flexible conduit with associated fittings unless otherwise specified.

Colour: Grey

USE: In addition to its use on expansion joints, fit flexible conduit to equipment and plant subjected to vibration or where necessary for adjustment or ease of maintenance.

LENGTH: The maximum length of a flexible conduit connection shall be 600mm.

11.6 CABLE TROUGHING (CABLE DUCT)

Cable troughing shall:-

- Be fabricated from not less than 0.8mm thick mild steel.
- Be of not less than 75mm x 50mm in cross-section and shall be filled with cables to not more than 50% of its useable capacity.
- Be employed to replace multiple runs of conduit in accessible locations in addition to the instances where specifically indicated providing that this does not incur additional cable derating factors as per AS 3000.
- Be equipped with screw fixed readily removable covers, of maximum length 1200mm.
- Be provided with removable cable retaining straps along the length to permit covers being removed and replaced without interference to the cables enclosed.
- Be equipped with couplings between adjacent lengths to facilitate electrical conductivity and mechanical union.
- Be fitted with integral partitions throughout the length of ducting where it is necessary to accommodate services of different voltages, frequencies or natures within a common trunking run, such that each service shall be mutually segregated and completely surrounded by earthed metal.
- Be installed in straight runs true, horizontal or perpendicular to reduce the number of bends and sets to a minimum.
- Be run square or parallel to the building lines unless specifically stated otherwise.
- Where necessary be fitted with purpose made bends, sets, end sections and intersection pieces which shall be formed with gussets such that the effective wiring space is maintained.
- Be supported at intervals not exceeding 1200mm.
- Be installed completed with all requisite accessories.

- Be supported such that the maximum deflection between supports does not exceed 10mm when fully loaded.

11.7 OTHER WIRING ENCLOSURES

DUCTING:

Type: Generally uPVC with firmly fitting clip-on cover.

Entries: Round off sharp edges and provide PVC bushes or the like for cable entries into metallic ducting.

Support: Rigidly support the duct in all locations.

12 LUMINAIRES

12.1 LUMINAIRE MANUFACTURE

Refer to Architectural documents for types of luminaires.

12.2 LUMINAIRE INSTALLATION

MOUNTING: Mount luminaires on proprietary manufactured supports, brackets and hangers where available. Where the specified mountings cannot be used, submit proposed mounting arrangements for approval.

FABRICATED SUPPORTS: Jig position fixings so that similar fittings may be easily interchanged.

LOCATION: Where the exact locations of luminaires are not shown on the Drawings or specified, locate the luminaires so that:

- They are accessible for maintenance without affecting personnel safety;
- They are not likely to be subjected to vibration;
- They will provide a maximum of effective lighting for the activities intended to be performed in the area, for example operating and maintenance activities in plant rooms and similar areas where service piping, ductwork, and the like equipment is installed.

OUTSIDE LIGHTING: Adjust the aim of floodlights under night lighting conditions to provide the required area lighting levels.

13 APPLIANCES

13.1 WIRING TO AND CONNECTION OF EQUIPMENT SUPPLIES BY OTHERS

EQUIPMENT STATUS: Generally equipment will be supplied, internally wired and complete with control switches, controllers or connecting links.

CONNECTION: Wire to an isolating switch mounted adjacent the equipment, unless a plug top is provided.

THREE PHASE WIRING: Provide a neutral cable with all three phase wiring.

FINAL CONNECTION: Connection from the local isolating switch to the equipment will be by Others.

14 ELECTRICAL SERVICES INSTALLATION

14.1 INSTALLATION GENERALLY

STANDARDS: To AS/NZS 3000 and AS 3012 for construction and demolition sites.

Setting Out Of Reticulation

CABLE ROUTES: The routes shown on the Drawings are approximate only. Determine the final routes to suit the building structure or site conditions.

APPROVAL: Obtain approval for the final routes prior to installing submains and feeder cables

CONCEALMENT: In amenities areas, conceal and protect cables and conduits. Elsewhere cables and conduits shall be surface run and fixed to wall and roof purlins, or cable tray/ladder.

ARRANGEMENT: Arrange cables and conduits parallel with walls, ceilings and floors.

SEPARATE CONDUITS: Run circuits originating at different distribution boards in separate conduits.

14.2 PENETRATIONS

FIRE WALLS AND STRUCTURAL MEMBERS: Do not penetrate without approval.

DAMP COURSES: Do not penetrate.

FLOOR SLAB: Run pipes entering a building at ground level under the waterproof membrane and vertically penetrate the membrane and the floor slab.

ROOF: Provide a suitable seal between the pipe and the roofing material.

EXISTING STRUCTURES: Obtain approval for penetrations through existing structures.

SLEEVES: Fit a UPVC sleeve for each penetration through ground floor slabs, ground floor beams and external walls for cables not enclosed in conduit. In addition, for MIMS cables fit a sleeve for each masonry penetration.

PENETRATION SIZE: Provide a penetration of diameter 10mm greater than the pipe or sleeve diameter for pipes and sleeves penetrating existing external walls, ground slab, or ground floor beams.

SEALING: Seal penetrations around conduits and sleeves with a weak sand:cement mix, or similar sealing compound approved by the Superintendent. Seal the space between cables within sleeves with a pliable waterproof compound.

14.3 EARTHING SYSTEM

UNDERGROUND EARTHING SYSTEM: Provide the following earthing system:

Type: To Supply Authority requirements.

Material: Copper

CONNECTIONS: For the connection of the main earthing conductor and interconnecting bonding use clamps to AS 1882.

Location: Locate connections within a pit having a removable cover. Size the pit and cover to allow access for testing, disconnection and reconnection.

Connection height: Install the pit cover flush with the surrounding finished ground level and make the connection to the earthing system not less than 150mm above the level of the ground within the pit.

INSTALLATION IN ROCK: Where electrodes are to be installed in rock, fill the gap between the rock and electrode with a bentonite clay or resin compound or as otherwise approved.

ELECTRODES IN CORROSIVE SOIL: Install each copper electrode in a 200mm bore hole, backfill with a conductive metallic grouting compound and compact with a vibrator.

14.4 LABELLING

LABEL TYPES: Unless otherwise specified, provide the following label types:

- For interior use: Engraved two-colour laminated plastic.
 - For exterior use: Engraved and filled stainless steel.
 - For interior power outlets, switches, isolators and appliances: Push-in circular tags.
- Label edges: Round or bevel the edges of labels exceeding 1.5mm thickness.

COLOURS:

Warning notices: White letters on a red background.

Other labels: Black lettering on white background.

FIXING: Fix each label by not less than two cadmium plated screws. Where adjacent to terminations, locate the label so that the installed wiring does not mask the label.

LETTERING HEIGHT: Generally not less than the following:

Isolating switches: 10mm
Other equipment: 4mm
Warning notices: 4mm
Inside enclosures: 3mm

15 SCHEDULES

15.1 OPERATING ENVIRONMENT SCHEDULE - ELECTRICAL SERVICES

SUPPLY SYSTEM:

Source of supply: SA Power Networks

Nominal voltages:

- Line: 230V.

- Phase: 400V

Frequency: (Hz): 50.

Number of phases: 3.

Number of wires: 4.

SERVICE CONDITIONS:

Ambient air temperature range: (°C): 0 to 45.

Maximum relative humidity: (%): 100%.

15.2 INSTALLATION SCHEDULE

GENERAL:

Accessories: Generally surface mounted with proprietary mounting bases. Recessed in enclosed amenities areas as indicated on drawings.

WIRING SYSTEMS:

Wiring shall be in accordance with AS/NZS 3000, and wiring generally shall be:

> XLPE/PVC for mains and submains, and PVC/PVC for final subcircuit cables.

WIRING INSTALLATION:

Wiring shall be concealed, and run in wall cavities, conduits in the floor slab, joinery items and the like. Wiring with false ceiling spaces may be unenclosed, and tied to catenary wire supports run parallel and perpendicular to building elements.

COPPER CONDUCTOR TERMINATIONS:

Identification ferrules: Required on all control and indication circuits.

CONDUITS:

Metallic conduit material: Galvanised steel

uPVC conduit: Medium duty

16 SWITCHBOARDS**16.1 GENERAL****Standards**

REFERENCED DOCUMENTS: The following standards are referred to in this Section:

AS 1044	Limits of electromagnetic interference for electrical appliances and equipment
AS 1136	Low voltage switchgear and controlgear assemblies Part 1 - General requirements
AS 1243	Voltage transformers for measurement and protection
AS 1675	Current transformers for measurement and protection
AS 1775	Low voltage switchgear and controlgear - Air-break switches, isolators, fuse combination units (up to and including 1000 V a.c., 1200 V d.c.)
AS 1795	Sheets and boards for electrical purposes
AS 1939	Classification of degrees of protection provided by enclosures for electrical equipment
AS 2700	Colour standards for general purposes
AS 3000	SAA Wiring Rules
AS 3008	Electrical installations - Selection of cables(Part 1 - Cables for alternating voltages up to and including 0.6/1 kV
AS 3012	Electrical installations - Construction and demolition sites
AS 3100	Approval and test specification - General requirements for electrical equipment
AS 3111	Approval and test specification for miniature overcurrent circuit breakers
AS 3133	Approval and test specification for air break switches
AS 3147	Approval and test specification - Electric cables - Thermoplastic insulated for working voltages up to and including 0.6/1 kV
AS 3190	Approval and test specification for current-operated (core balance) earth-leakage devices Approval and test specification - Residual current devices (current-operated earth-leakage devices)
AS 3585	Low voltage switchgear and controlgear - Circuit-breakers
AS 3650	Low voltage switchgear and controlgear - Common requirements

Authorities' Approvals

WORKS BY AUTHORITY: If the responsible authority, pursuant to statutory powers vested in it, elects to perform or supply part of the Works, make the necessary arrangements with the authority.

Approved Sub-Contractors

MANUFACTURE: Obtain the switchboard from an approved specialist switchboard manufacturer.

Shop Drawings

REQUIREMENT: Supply shop drawings showing:

- The general arrangement including layout of equipment, busbars and connections;
- Type and rating of equipment items;
- Structural and enclosing elements including sheet metal and sealing details;
- Terminal block layouts and identification;
- Details of labels and engraving.

NUMBER OF COPIES: Three.

Work-As-Executed Drawings

REQUIREMENT: Before the Date for Practical Completion supply work-as-executed drawings showing the same level of information as the shop drawings.

Number of copies: 3.

Inspection

REQUIREMENT: Give sufficient notice so that inspection may be made at the following stages:

- Switchboard installed and connected.
-
- Acceptance.

MINIMUM NOTICE REQUIRED: 7 days.

Testing

TYPE TESTS: To AS 1136.1 clause 8.2. Supply copies of a 'certificate of verifications and tests' to AS 1136.1 Table 8.1 stating the testing authority, manufacturer, and details of parameters and results for each test. Provide documentation to verify that the tests were carried out on a switchboard of essentially identical design to that specified. The manufacturer shall hold available certificates of type tests showing evidence of compliance with AS 1136.1, together with detailed particulars of the equipment as tested and a record of any alterations that have been made to the equipment subsequent to the type test.

Number of copies: 1.

ROUTINE TESTS: To AS 1136 Part 1, carried out at the manufacturer's works and repeated at the site. The electrical function test shall use externally connected simulated circuits and equipment at the works and be repeated after connection of permanent wiring and equipment at the site.

NOTICE: Give sufficient notice of testing so that the Superintendent may witness the tests.

Minimum notice required: 7 days.

CERTIFICATES: Provide certificates stating the results of routine testing.

Operational Maintenance

MAINTENANCE PERIOD: Co-extensive with the Defects Liability Period.

REQUIREMENT: During the maintenance period:

- Carry out periodic inspections and maintain the switchboard installation in a condition to meet the specified performance.
- Promptly rectify faults. Replace faulty materials and equipment without charge.
- Provide written reports on maintenance activities.

CERTIFICATION: At the end of the maintenance period make a final inspection of the installation and upon satisfactory completion certify in writing that the installation is operating correctly.

Manuals

REQUIREMENT: Provide the specified number of copies of a combined operator's manual and technical manual written in clear concise English, containing a title page listing the supplier's name, address and telephone number, a table of contents, and the following data:

Operator's manual:

- Information necessary for the satisfactory long-term operation and regular maintenance of the installation;
- Recommended maintenance periods and procedures;

- Particulars of maintenance tools or equipment provided and instructions for their use.

Technical manual:

- Detailed technical description of each equipment item and its function, and instructions for use;
- Where necessary, procedures for dismantling and re-assembly of equipment;
- List of spare parts provided;
- The 'work-as-executed' drawings.

FORM: A4 size, printed or typed on durable printing paper, neatly bound in durable vinyl or similar hard covers.

NUMBER OF COPIES: 3.

Prototype copy: Provide a prototype copy for approval before proceeding.

16.2 INSTALLATION

Site Erection

INSTALLATION: To AS/NZS 3000 and to AS 3012 for construction and demolition sites.

WALL MOUNTING SWITCHBOARDS: Fix the switchboard rigidly into position by not less than four fixing screws of minimum size 10mm. Use masonry anchors for brickwork and concrete work.

FLOOR MOUNTING SWITCHBOARDS: Install the switchboard level and plumb using neatly cut and fitted packing plates under the channel base. Align shipping sections and bolt together. Fix the base to the floor by means of minimum 12mm fixing screws, front and rear, at either end and at intervals of 2 m along the length of the board. Complete busbar connections after alignment and bolting procedures are completed. Neatly pack the space under the base after levelling with sand-cement grout. Complete the interpanel wiring.

16.3 DESIGN AND CONSTRUCTION

General Design

MANUFACTURED SWITCHGEAR ASSEMBLIES: To AS 1136 Part 1.

SWITCHBOARDS AND CONTROL PANELS: Comprising equipment where the installation requirement is less than 100 A per phase and the prospective fault level is less than 5 kA: To AS 3000 clauses 2.22, 2.23, 2.25 and 2.26.

SWITCHBOARDS FOR CONSTRUCTION AND DEMOLITION SITES: To AS 3012.

TRANSIENT PROTECTION: Provide equipment and accessories which generally incorporate protection of semiconductor components against damage caused by switching and other external transients.

External Design

REQUIREMENT: Provide an enclosure comprising panels, doors and the like, of non-combustible materials and giving the specified enclosure, segregation and degree of protection, including all openings sealed against smoke egress as required by BCA-D2.

DESIGN AND CONSTRUCTION: To AS 1136 Part 1.

Degree of protection: To AS 1939.

SUPPORTING STRUCTURE: Fabricate supporting frames from rolled, cold formed or extruded metal sections, with joints fully welded and ground smooth. Provide concealed fixing or brackets located to allow the assembly to be mounted and fixed in the specified location without removal of equipment.

PANELS: Machine fold sheet metal angles, corners and edges with a minimum return of 25mm around the edges of front and rear panels, and 13mm minimum return edge around doors. Provide stiffening to panels and doors where necessary to prevent distortion or drumming.

EQUIPMENT FIXING: Provide equipment mounting panels fixed to threaded metal inserts located inside the enclosure at the rear of the mounting panels.

LIFTING PROVISIONS: Provide fixings in the supporting structure, and removable attachments, for lifting switchboard assemblies whose shipping dimensions exceed 1.8 m high x 0.6 m wide.

FLOOR-MOUNTING: Provide a metal plinth channel, not less than 75mm high, for mounting the complete switchboard assembly on site. Drill sufficient clearance holes for 12mm diameter bolts, in the switchboard and the plinth, to rigidly fix the switchboard assembly to the plinth and the plinth to the floor.

WALL-MOUNTING:

For flush or semi-flush switchboards: Provide a facing flange, of the same material and finish as the enclosure, and of a section which incorporates a return allowing the outside edge to fit neatly against the wall.

Minimum flange width: 32mm.

WEATHERPROOFING: For protection designations of IP55 or higher second characteristic numeral to AS 1939, provide the following:

Roof: Strengthened to support a person without roof distortion, free of openings and fastenings, graded away from entries to the enclosure, and with a 50mm minimum overhang on all sides.

Ventilation: A ventilated air space between the roof and the top of the cubicle, and louvred openings at the top and bottom of the internal cubicle panels to give convective heat dissipation.

Screening: Non-ferrous insect screen material, unpainted, to ventilation and cable entry openings, to prevent entry of vermin, and guarded to provide the specified degree of protection.

Flanges to openings: To form a drip tray and prevent the entry of water when doors or covers are open.

16.4 CABLE ENTRIES

REQUIREMENT: Provide sufficient clear space within each enclosure, adjacent to the cable entries, to allow the incoming cables and wiring to be neatly run and terminated, without overcrowding.

SIZE OF ENTRY: For cable entry and internal distribution, provide cable entries of not less than 100mm depth by the full width of cubicle space which is unrestricted by equipment or internal wiring.

For distribution boards provide knock out pattens in top and bottom gland plates.

GLAND PLATES: Provide to each entry a removable gland plate fitted with a gasket to maintain the specified degree of protection.

16.5 DOORS

MAXIMUM WIDTH: 750mm.

MINIMUM DOOR SWING: Through 135°.

HANGING: Hang doors on heavy-duty chromium-plated steel hinges which allow easy removal of the door when in the open position.

DOOR HARDWARE: Provide a chromium plated lever-type handle to each door, operating a latching system with latching bar and guides.

For distribution boards provide square key operated budget lock and chrome flap.

LOCKING: Incorporate a cylinder lock in the latching system. All the locks of one installation shall be keyed alike.

DUST SEALS: Provide a resilient strip seal, of foamed neoprene or the like, around each door, housed in a suitable channel or housing and fixed with an approved industrial adhesive.

Seal contact:

- Indoor locations: Positive contact with a flat surface of the enclosure at least as wide as the seal strip.
- Weatherproof switchboards: A continuous positive line of contact.

16.6 ESCUTCHEON PLATES

REQUIREMENT: Provide removable escutcheon plates with neat cut-outs for circuit breaker handles and the like. Fit chromium plated lifting handles or knobs to each escutcheon plate.

FRAME: Provide a continuous 12mm wide support frame for the fixing of each escutcheon plate, including additional support where necessary to prevent panel distortion.

FIXING: Fix each plate to the frame with metal fixings held captive in the plate and spaced uniformly.
MAXIMUM HEIGHT: 1200mm.

HANGING: Hang escutcheon plates on hinges which allow opening through a minimum of 90° and permit the removal of the escutcheon when in the open position.

16.7 FINISHES

SURFACE PREPARATION: Where metal surfaces are to be painted, prepare them as specified in **SUBSTRATE PREPARATION - PAINTING, METAL SURFACES GENERALLY - PAINTING, and IRON AND STEEL SURFACES - PAINTING.**

16.8 PAINTING

SUBSTRATES

Substrate Preparation

STANDARDS: To AS 2311 Sections 2 and 3, and AS 2312 Section 5, as applicable.

GENERALLY: Prepare substrates to receive the systems specified. Procedures shall include, but not necessarily be limited to, the following:

Cleaning: Clean down and remove oil, grease and loose foreign matter, including laitance, efflorescence, moss, lichen, mould, mildew, dirt and corrosion products, in a manner which causes neither undue damage to the substrate nor damage to, or contamination of, the surroundings.

Glossy surfaces: Adequately scuff and/or solvent or chemically etch as appropriate to provide satisfactory adhesion for subsequent paint coats.

Filling: Fill cracks and holes with fillers, sealants or grouting cements as appropriate for the finishing system and substrate, and sand smooth.

Drying: Unless otherwise specified, ensure that surfaces are cured and dry before painting commences.

Recontamination: Apply the first coat of paint immediately after cleaning and before contamination of the substrate can occur. Where contamination of intermediate coats occurs, clean in accordance with the coating manufacturer's recommendations and to the Superintendent's approval immediately prior to over-coating.

METAL SURFACES GENERALLY

METHODS: To AS 1627, as appropriate to the requirements of this Specification.

Iron And Steel Surfaces

GENERALLY: Remove weld spatter, slag, burrs, or any other objectionable surface irregularities.

DEGREASING: To AS 1627 Part 1, by solvent or alkaline cleaning.

HAND OR POWER TOOL CLEANING: To AS 1627 Part 2 or Part 7. Provide a final surface at least equal to preparation grade 'St2' of AS 1627 Part 9.

BLAST CLEANING: To AS 1627 Part 4, to the class specified in the specified protective treatment. Provide a surface roughness appropriate for the specified treatment.

PAINT SYSTEMS:

For indoor locations: A system not inferior to FULL GLOSS, SOLVENT-BORNE: INTERIOR - PAINTING.

For exterior locations: A system not inferior to FULL GLOSS, SOLVENT-BORNE: EXTERIOR - PAINTING.

For indoor locations: Paint to be full gloss solvent-borne:

- For iron and steel substrate:
 - 1st coat - metal primer iron and steel
 - 2nd coat - full gloss solvent-borne interior
 - 3rd coat - full gloss solvent-borne interior
- For galvanised and zinalume:
 - 1st coat - metal primer for zinc coated surfaces
 - 2nd coat - full gloss solvent-borne interior
 - 3rd coat - full gloss solvent-borne interior

For exterior locations: Paint to be full gloss solvent-borne

- For iron and steel:
 - 1st coat - metal primer iron and steel
 - 2nd coat - metal primer iron and steel
 - 3rd coat - full gloss solvent-borne exterior
 - 4th coat - full gloss solvent-borne exterior
- For galvanised and zinalume:
 - 1st coat - metal primer for zinc coated surfaces
 - 2nd coat - full gloss solvent-borne exterior
 - 3rd coat - full gloss solvent-borne exterior

PAINT COLOURS: To AS 2700.

UNPAINTED METAL FINISHES: Linishing, sanding, sand blasting, etching and the like shall be within the range of approved samples.

Linishing: Provide a linish finish to AS 1100.201 Roughness grade N4.

Sanding: Use an orbital sander with No.60 emery paper. Wipe over on completion with a kerosene soaked cloth.

Etching: An alkaline process. Clean thoroughly on completion.

Sand blasting: Produce a fine even satin finish.

16.9 CONDUCTORS:

BUSBARS

REQUIREMENT: Provide busbar circuits within the switchboard, extending from the termination of the incoming unit to the line side of protective equipment for outgoing circuits.

SEGREGATION: Divide the busbar system into separate 'essential' and 'non-essential' circuits, each segregated from the other by fixed and continuous barriers. Clearly label each segregated section of the busbar system.

FUTURE EXTENSIONS: Pre-drill the main busbar for future extension and extend busbar droppers to spare locations. Drill each dropper to suit connection of future equipment of the same type as that specified.

CROSS SECTION: Radius edges and corners to prevent damage to insulation.

SUPPORT: Provide support sufficient to withstand without damage the maximum prospective fault currents.

JOINTING: Make busbar joints with high tensile bolts and nuts, locked in position with lock nuts or locking tabs. Tighten bolts to the manufacturer's recommendation with a tension wrench. Do not use tapped holes and studs or the like for jointing current-carrying sections.

INSULATION: Insulate busbars as follows:

Active and neutral busbars: A fully-insulated system using the specified insulation material.

Joints: Insulate either by taping or plastic coating, as follows:

- Taped joints: Apply a non-adhesive stop-off type tape, coloured to match the specified colour coding, half lapped to achieve a thickness of not less than that of the solid insulation.
- Plastic-coated joints: Apply, in accordance with the manufacturer's recommendations, and to a minimum thickness equal to that of the solid insulation, an air-drying plastic coating material which achieves a tensile strength in excess of 17 MPa, and a minimum elongation of 300%.

COLOUR CODING: Colour the insulation as follows:

Active busbars: Red, white or blue.

Neutral busbars: Black.

Earth busbar: Green and yellow.

NEUTRAL BUSBAR: Extend the neutral busbar into each switchboard compartment containing outgoing circuits with neutral connections. Provide terminals or drill the busbar for neutral connections.

Identification: Clearly mark and number terminal connections.

MEN LINK: Provide a bolted removable link in the incoming compartment, between the neutral and earth busbars.

NEUTRAL AND EARTH LINKS

LOCATION: Locate neutral and earth links within 0.6m of each cable entry for small switchboards and distribution boards.

CONNECTIONS: Provide stud connections for cables of cross section 16mm² or larger.

TERMINALS: Provide terminals for incoming and outgoing neutral and earth conductors, including the MEN link. Provide additional terminals for future circuits.

Identification: Clearly mark and number terminals.

WIRING

CABLE TYPE: Unless otherwise specified, provide 0.6 kV V-75 PVC insulated cables to AS 3147, for general internal wiring and heat resisting insulated cables for connection to equipment capable of raising the insulation temperatures above 75°C.

POWER CIRCUITS: Provide cables sized to suit a current carrying capacity of not less than the maximum continuous rating of the equipment mounted within the switchboard, or sized to withstand the 'let-through' energy of the circuit protective device, whichever is the greater. If the conductors are to be bunched or installed within wiring ducts, apply appropriate de-rating factors to AS 3008 Part 1 when determining conductor size. The minimum size power conductor shall be multistrand 2.5mm².

CONTROL AND INDICATION CIRCUITS: Provide conductors of not less than 1.0mm² with 32/0.2 stranding and otherwise sized to suit the current carrying capacity of the particular circuit.

CABLE COLOURS: Colour code the wiring as follows:

A Phase:	Red
B Phase:	White
C Phase:	Blue
Neutral:	Black
Earthing:	Green/Yellow
Control & Indication:	To manufacturer's standard.

WIRING SUPPORT: Unless otherwise specified install wiring within PVC wiring ducts. The total cross section of the wiring within any one duct, including allowance for outgoing connections, shall not exceed 40% of the duct cross sectional area. If wiring is not installed in ducts, neatly bunch, support and lace it with PVC ties or strips. Provide protective insulation where bunched wiring or cables are in contact with metal, or pass through cut-outs in sheet metal.

External circuit cables: If no provision is made in wiring ducts for external connecting cables, install a galvanized perforated cable tray between terminal blocks and cable entries, of a size, and with available access space, sufficient to permit ready installation of this external wiring.

Segregation: Segregate electric circuits subject to possible interference, and the like.

TERMINATIONS:

Terminals: For connections up to 15 kW load provide rail-mounted, spring-loaded, tunnel type terminal blocks. For connections to circuits above 15 kW load provide stud type terminals of a size to continuously carry the load and not less than 5mm diameter. Fit washers and lock washers to each stud, and barriers between adjacent studs.

Connection: For tunnel type terminals connect one conductor only into each end of the tunnel and interconnect terminal groups, where necessary, by standard cross connectors.

Lugs: Terminate wiring into terminal blocks using compression type lugs compatible with the terminals, and crimped by the use of the correct tool. Lugs for connection to tunnel type blocks shall be of pre-insulated lipped blade type.

Arrangement: Terminate internal wiring to the one side of the terminal block, leaving the other side for outgoing circuits.

Grouping: Segregate terminal groups and install together terminals for each outgoing circuit, in the same order throughout, as follows:

- Terminals for power wiring: 3 phases or phase and neutral;
- Control terminals: In numerical or alphabetical order of wire identification, with the lowest number or letter next to the power terminals.

Spare terminal space: Provide sufficient space on mounting rails for future outgoing circuits possible in any cabling compartment.

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

Wiring identification: Identify, by markers, each control core with the identification shown on the Drawings.

16.10 SWITCHGEAR AND CONTROLGEAR

SWITCHGEAR

REQUIREMENT: Provide mains switching, outgoing circuit switching, motor controls and starters, protection and auxiliary equipment as shown on the Drawings.

Moulded Case And Miniature Circuit Breakers

STANDARDS: To AS 3858 for fault capacities of 10 kA or more. To AS 3111 for miniature overcurrent circuit breakers up to 100 A current rating and less than 10 kA fault capacity.

TYPE: Provide circuit breakers which are all of the same manufacture.

MOUNTING: Mount the circuit breakers so that the 'ON-OFF' and current rating indications are clearly visible with the cover or escutcheon in position, and so that arc discharges from the circuit breakers are directed away from live metal and insulation. Align operating toggles in the same plane.

CLIP TRAY CHASSIS: For miniature overcurrent circuit breakers provide clip tray assemblies, capable of accepting the installation of single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for all unused portions of the chassis.

CLEARANCE: Maintain sufficient space around the circuit breakers to allow all incoming and outgoing cables, including cables to spare poles, to be installed and terminated without overcrowding. For clip tray chassis mountings the clearance between the circuit breaker terminals and compartment walls shall not be less than 90mm up to 36 poles and 115mm above 36 poles.

ACCESSORIES: Provide auxiliary contacts and other required accessories.

Earth Leakage Devices

STANDARD: To AS 3190 and AS 3111.

CORE BALANCE TYPE: To AS 3190.

INTEGRAL TYPE: Shall incorporate earth leakage in the circuit breaker protection operation, and be suitable for mounting in the same manner as specified for moulded case and miniature circuit breakers.

MAXIMUM TRIPPING TIME: To AS 3190.

Switch-Isolator

STANDARD: To AS 1775.

RATED THERMAL CURRENT: As applicable to the unit when installed in the specified enclosure.

RATED SHORT-CIRCUIT MAKING CAPACITY: Not less than the switchboard fault level or as otherwise specified.

UTILIZATION CATEGORY: For circuits comprising essentially motor or other highly inductive loads, not less than AC-23. For other circuits, not less than AC-22.

OPERATION: Independent manual operation with a positive manually operated ON-OFF indicator. Provide a facility to lock the unit in the OFF position.

DESIGN: Totally enclosed unit incorporating arc control devices and shrouded stationary contacts.

Air Break Switches

STANDARD: To AS 3133 and AS 3100.

CATEGORY: Category 1 to AS 3100 clause 2.36.

16.11 ACCESSORIES, INSTRUMENTS, METERS

SUPPLY AUTHORITY METERING: Provide space for the accommodation of supply authority metering. Include for any segregation requirements and pre-drill the panels to the approval of the supply authority.

16.12 LABELS

MARKING: To AS 1136, Part 1, Section 5 and AS 3000. Marking shall include labels for each switchboard control, circuit designations and ratings, fuses fitted to fuse holders, current-limiting fuses, warning notices for operational and maintenance personnel, and the like.

SAMPLES: Provide samples of proposed label material, label sizes, lettering sizes and lettering text for approval.

LOCATION: Screw-fix each label adjacent to its relevant item of equipment, but not on the equipment.

MATERIAL: Two-colour laminated plastic or photo-anodized rigid aluminium.

COLOURS:

Warning notices: White letters on red background.

LETTERING HEIGHT: Generally not less than the following:

Main switchboard designation: 25mm.

Main switches: 20mm.

Feeder control switches: 10mm.

Identifying labels: (on outside of cubicle rear covers, etc.): 4mm.

Equipment labels within cubicles: 3mm.

Warning notices: 4mm.

SCHEDULE CARDS: For light and general power distribution provide schedule cards of minimum size 200mm x 150mm with text typewritten to show:

- Sub-main designation and rating;
- Light and power circuit number, type and area supplied;

Approval: Submit the proposed schedule for approval.

Mounting: Mount the schedule card in a holder fixed to the inside of the enclosure door, adjacent to the distribution circuit switches, and protect the schedule with a hard plastic cover.

16.13 CONSTRUCTION SCHEDULE

SWITCHBOARD DESIGNATION:	MSB	Apartments and Common Area Switchboards
MOUNTING:	Floor	Wall
DEGREE OF PROTECTION: Numerical designation:	IP41	Proprietary switchboards, flush-mounted with hinged door , lockable.
Enclosure category: '1' enclosure at atmospheric pressure.		

FORM OF SEGREGATION:	2	1
EQUIPMENT CONNECTION: Front.		

SAFETY MEASURES:		
Safety measure number:	1	1

FAULT RATING (kA (rms) 1 sec)	25	6
-------------------------------	----	---

MATERIALS AND FINISH:
Definitions: To AS 1136 Part 1, Section 2.

	Material:	Finish:
Supporting structure (frame):	Steel Section	Painted
Mounting structure (brackets):	Steel Section	Painted
Mounting panels (To AS 1795):	Type A	Painted
Enclosure:	1.6mm bonderised zinc coated steel	Painted
Escutcheons:	1.6mm bonderised zinc coated steel	Painted
Doors: 1.6mm bonderised zinc coated steel	Painted	
Plinths: 6mm Steel channel	Painted	
Painting: Paint Colour shall be AS 1345 No. 557 Light Orange for exterior surfaces and Gloss White for interior surfaces.		

CABLE ENTRIES:
Location: Top and bottom entry.

DOORS:
Hinge type: Exposed.
Number of latching points: 2.
Lock type: 604 Type with 2 keys.

CONDUCTORS SCHEDULE - SWITCHBOARDS

BUSBARS:
Number of phases: 3
Number of busbars: 4
Busbar material: Copper.
Joint mating surface treatment: Abade copper surfaces.

TERMINATIONS:
Tunnel type terminal: Up to and including 10mm² cable.
Stud type terminal: Above 10mm² cable.
Wiring identification marker: For distribution boards provide ferrules on each neutral and each conductor to correspond to respective circuit.
For switchboards provide labels on each neutral and earth cable to identify respective circuit or submains identification.

17 AUDIO VISUAL SYSTEMS

Supply, install, test and commission the following systems:

17.1 MATV

Design, supply and construct a Master Antenna Television system installed to distribute free-to-air television signals to outlets shown within each apartment and offices 1, 2 & 3 as directed by the Building Owner.

Detailed work to be carried out includes, but is not necessary limited to the following:

- Provision of Master Antenna Television system including antenna, terminators, outlets etc

- Provision of baluns and media converters

Requirements:

- a) System Impedance: 75 ohm nominal.
- b) Suitable for Analogue and Digital television broadcasts and FM radio broadcasts, including at least all local, analogue and digital, terrestrial open broadcasts on FM radio, VHF and UHF television.
- c) Capacity: > 20 Channels.

Frequency response:

- a) FM, VHF and UHF broadcast reception: 5 MHz to 862 MHz.

UHF / VHF roof-top antenna:

- a) The UHF / VHF analog and digital compatible antenna shall comply with the following requirements:
 - Complies with AS 1417.1 and AS 1417.2.
 - 23 elements
 - Digital anti-reflection Matching system
 - Capable of receiving VHF channels 2-12
 - Capable of receiving UHF channels 28-38
 - Maximum VHF channel 2 gain of 5dB
- b) Provide and adjust the antenna and obtain the maximum signal level and minimize ghosting.
- c) Install a pre-amplifier at the masthead if the signal level at the distribution amplifier is less than 46dB (uV).
- d) The gain shall be sufficient to achieve minimum signal level of 46 dB (uV) at the distribution amplifiers.

Distribution amplifiers:

- a) Provide distribution amplifiers if required to suit the required system performance.
- b) Provide adjustable output levels to enable signal levels to be maintained within the limits specified.
- c) The gain shall be sufficient to provide specified signal levels whilst maintaining at least 6 dB reserve gain.
- d) The distribution amplifier shall have the following requirements:
 - 1 or 4 outputs with the following minimum gains:
 - 1 output: 13.5 dB
 - 4 output: 6 dB

Repeat amplifiers:

Supply and install repeat amplifiers if required to achieve specified signal levels.

Passive elements:

- a) Install termination impedances on unused splitter and tap-off outlets at the end of each line.
- b) The attenuators and terminators shall have the following requirements:
 - 360 deg conical tin plate beryllium copper seizure mechanisms
 - Nickel plated housing

c) The splitters shall have the following requirements:

- Internal printed circuitry
- 120 dB minimum EMI isolation
- Nickel plated housing
- 1 GHz bandwidth

17.2 MULTI-TENANT ENTRY SECURITY SYSTEM

The system shall comprise the following, and be equivalent to Aiphone "GT Series":

a) Door Station at Main Entry:

Digital scrolling to allow calling by:

- Display tenant name you want to call and press call button.
- Make call by either of the following:
 - 1) Name scrolling.
 - 2) Entering room number.
 - 3) Entering letters and selecting corresponding name.

The station shall be equal to Aiphone GT-NS.

b) Tenant Station – one per apartment and Office 3.

- Press to talk to Door Station.
- Press to release Main Entry door electric strike mechanism.

c) All controls and floor shunts (splitters) required.

d) Electric strike on front door – equivalent to Padde ES2000.

e) Proximity card reader outside the Main Entry Door HID iClass Multi format RP10SE proximity reader for activating the door strike, 30 programmed cards and door controller.

f) All 230V and ELV power supplies.

g) All cabling and cabling supports.

ELECTRICAL SERVICES SCHEDULE OF TECHNICAL DATA

The following schedule of technical data is required to be completed and submitted **WITH THE TENDER**.

Tenders not accompanied by completed schedules may not be considered:

Item	Make/Type/Model/Size
------	----------------------

Consumers mains

New Main Switchboard

- Manufacturer
- Multi Function Meters
- Circuit protectors
- Fault rating
- Form of segregation
- Safety measure
- Degree of protection

Distribution boards:

- Manufacturer
- Circuit breakers
- Fault rating
- Form of segregation
- Safety measure
- Degree of protection

Luminaires: Attach a complete list of luminaires offered

Comms cabling:

Comms Cabling Contractor:

GPO's:

IP56 power outlets:

IP56 isolators:

Light switches:

Video intercom system:

MATV & satellite TV system:

- Installer
- Antennae
- Outlets.
- Amplifiers
- Splitters
- Cables

Security Panel:

Contractor

Signature

Date

ELECTRICAL SERVICES SCHEDULE OF SEPARATE PRICES

The following schedule of separate prices is required to be completed and submitted **WITH THE TENDER**, and may be used to assess progress claims.

Tenders not accompanied by completed schedules may not be considered:

Item	\$
Consumer's mains	.....
Main Switchboard	.....
Submains cables	.....
Distribution boards:	
- Common areas	.....
- Apartments	.....
- Offices	.....
Light and power installation:	
- Ground floor	.....
- First floor	.....
Communications cabling	.....
Video intercom system	.....
MATV System	.....
Security System	.....
Testing and commissioning	.....
Operating and maintenance manuals and as-installed drawings	.....
Maintenance during the DLP	.....
Other (provide list)	.....
TENDER PRICE	\$
GST	\$
TOTAL	\$
Contractor	
Signature	

Date

ELECTRICAL SERVICES SCHEDULE OF UNIT PRICES

The following schedule of technical data is required to be completed and submitted, and may be used to assess contract variation quotations – additions and subtractions – for works not commenced on site at the time of variation quotation request issue.

Tenders not accompanied by completed schedules will not be considered:

<u>Item</u>	<u>\$</u>
1. Provision of additional wall mounted double 10A GPO, with up to 20m of cable, and connection to existing circuit.	.....
2. Provision of additional lighting outlet, connection to an existing circuit within 15m	.....
3. Provision of an additional 10A, 16A or 20A SP, 30mA ELCB	.....
4. Provision of an additional 20A or 32A TP, 30mA ELCB	.....
5. Provision of an additional door access control electric strike, card reader and door controller	.....
6. Provision of an additional exit or emergency light.	.....
7. Mark-up and profit on materials (%)
8. Labour rate charge:	
- Tradesperson	.....
- Apprentice	.....

Contractor

Signature

Date