

## SECTION 13 ELECTRICAL GENERAL REQUIREMENTS

### 1 GENERAL

#### 1.1 RESPONSIBILITIES

##### General

General: Provide electrical systems as documented.

#### 1.2 CROSS REFERENCES

##### General

Requirement: Conform to the following:

- *General Requirements*; and
- *Service Trenching*.

##### Precedence

Technical worksections: The requirements of subsequent electrical services worksections of the specification override conflicting requirements in this worksection.

#### 1.3 STANDARDS

##### General

General: To AS/NZS 3000 Part 2 unless otherwise documented.

Electrical systems: To AS/NZS 3008.1.1 and SAA HB 301.

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

EMC: To AS/NZS 61000.

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

#### 1.4 INTERPRETATIONS

##### Abbreviations

General: For the purposes of this contract the abbreviations given below apply.

- EMC: Electromagnetic compatibility.
- EMI: Electromagnetic interference.

##### Definitions

General: For the purposes of this contract the definitions given below apply:

- Accessible: Readily accessible to AS/NZS 3000.
- 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.
  - . 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 coated by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections coated by a continuous or specialised process: To AS/NZS 4792.

- Industrial: IP56 to AS/NZS 60529.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Weatherproof: IPX6 to AS/NZS 60529.

## 1.5 DRAWINGS AND MANUALS FOR EXISTING SERVICES

### General

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

## 1.6 SUBMISSIONS

### General

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

### Drawings

General: Minimum A1 drawing size.

Standard: To AS 1100 Parts 101 and 301, AS 1102 Parts 101, 102, 103, 106, 107, 108, and 111, and AS/NZS 3085.1 as applicable.

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

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

### 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.

### Technical data

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

- Assumptions.
- Calculations.
- Certification of compliance with the applicable code or standard.
- Design basis and performance parameters.
- Drawings.
- Installation and maintenance requirements.
- Manufacturers' technical literature.
- Risk assessment.
- Samples where relevant.
- Sketch, single line diagram, flowchart.

- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.

**Certification**

General: Submit certification that the plant and equipment submitted meets all requirements and capacities of the contract documents except for departures that are identified in the submission.

**2 PRODUCTS**

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**2.1 ACCESSORIES**

**General**

Responsibilities: Provide accessories as documented.

Proprietary equipment: The requirements of this specification over-ride the specifications inherent in the selection of a particular make and model of accessory.

Uniformity: All accessories and outlets located in close proximity are to be the same manufacture, size, finish and material.

Default finish: To be selected from the manufacturer's standard range.

**3 EXECUTION**

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**3.1 PERFORMANCE**

**General**

Performance criteria: Meet the performance criteria as documented.

**3.2 WORK ON EXISTING SYSTEMS**

**General**

General: Before starting work on existing systems, measure existing conditions. Submit the results for information.

- If the existing conditions are less than necessary to meet the requirements in the contract documents, submit proposals to rectify the deficiencies with related costing, time and other impacts.
- Subject to the results from the preceding work on existing systems, achieve the performance in the contract documents.

**3.3 INSTALLATION**

**General**

Fixing: If non-structural building elements are not suitable for fixing equipment and 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: Conceal all cables, ducts, trays, pipes etc. unless installed in plant spaces, ceilings, riser cupboards, etc. or unless otherwise documented. 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 > 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.

**Cable systems**

Systems: Provide the following:

- Accessible concealed spaces: Thermoplastic insulated and sheathed cables.
- Inaccessible concealed spaces: Cable in PVC-U conduit.
- Plant rooms: Cable in heavy duty PVC-U conduit, or on tray or in duct.
- Plastered or rendered surfaces: Cable in PVC-U conduit.
- Stud walls without bulk insulation: Thermoplastic insulated and sheathed cables.
- Walls filled with bulk thermal insulation: Cables in PVC conduit.
- Plant rooms: Cable in heavy duty UPVC conduit, or on tray or in duct.

**Installation of accessories**

General: Unless installed on purpose built ductwork. Install accessories in conformance with the Installation of accessories table.

Location: Final location of all outlets and equipment to be confirmed on site prior to installation.

Spacing from adjacent horizontal surface:  $\geq 75$  mm to the centre of accessory socket.

Default mounting heights to centre of accessory plate:

Outlets	Nominally 300 mm, but match any pattern formed by existing elements.
Switches and controls	Nominally 1100 mm, but match any pattern formed by existing elements.

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.

**Installation of accessories table**

Wall construction	Installation and concealed cabling facilities
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

**Differential movement**

General: If the geotechnical site investigation report predicts differential movements between buildings and the ground in which conduits are buried, provide movement control joints in the conduits.

- Location: Adjacent to the conduit supports which are closest to the perimeter of the building.
- Arrangement: Arrange conduits to minimise the number of movement control joints.
- Magnitude: Accommodate the predicted movements.

**3.4 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 UPVC 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:  $\geq 1$  mm.
  - . UPVC:  $\geq 3$  mm.

#### **Sleeves for cables**

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

### **3.5 SUPPORT AND STRUCTURES**

#### **General**

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

### **3.6 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 Occupational 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.
- Inspection and maintenance operations can be arranged to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
- 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:
  - . Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1 and AS/NZS 2865.
  - . If parts of the plant require regular inspection and maintenance either locate plant so it is safely accessible from floor level or provide permanent access platforms and ladders.

- . In false ceilings locate items of equipment that require inspection and maintenance above tiled parts where possible. If this is not possible (for example if above set plaster or other inaccessible ceilings) provide access panels. 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.

### 3.7 PAINTING AND FINISHES

#### **General**

General: If exposed to view (including in plant rooms) paint new services and equipment.

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 in this clause.

#### **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: To AS 4506.

Application: Thermoset powder coatings applied to metal substrates including extruded, sheet and cast aluminium, with the exception of aluminium for architectural applications.

Atmospheric classification to AS/NZS 2312.

- Interior locations: B – low.
- Exterior locations:
  - . Moderate: C2 – medium.
  - . Marine industrial: D – high.
  - . Tropical: F.

#### **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: < 90 g/litre.

#### **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. Ensure 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.

### 3.8 MARKING AND LABELLING

#### General

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

- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label to AS 1345.
- Cables: Label at each end 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.

Operating and maintenance manuals: Provide marking and labelling text identical to the text and terminology used in operating and maintenance manuals.

#### Accessories

Label isolating switches and outlets to identify circuit origin.

#### Labels and notices

General: Select from the following materials:

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

Emergency functions: To AS 1319.

Colours: Generally in conformance with 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.

- 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.

Label text: To correspond to terminology and identifying number of the respective item as shown on the record drawings and documents.

Lettering heights:

- Danger, warning and caution notices:  $\geq 10$  mm for main heading,  $\geq 5$  mm for remainder.
- Equipment labels within cabinets:  $\geq 3.5$  mm.

- Identifying labels on outside of cabinets:  $\geq 5$  mm.
- Other locations:  $\geq 3$  mm.

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

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

#### **Underground cable routes**

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

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

Location marking: Accurately mark the location of underground cables with route markers consisting of a marker plate set flush in a concrete base.

Markers: Place markers 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 run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, aluminium or mild steel hot-dipped galvanized, 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.

### **3.9 OPERATION AND MAINTENANCE MANUALS**

#### **Additional information**

General: Provide maintenance manuals including the following in addition to that specified in the *General Requirements* worksection:

- Installation description: General description of the installation.
- Systems descriptions: Technical description of the systems installed, written to ensure that the principal's staff fully understand the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.
- Systems performance: Technical description of the mode of operation of the systems installed.
- Equipment descriptions:
  - . 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.
- Operation procedures:
  - . 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-coded services.
  - . Schedules of fixed and variable equipment settings established during commissioning and maintenance.
- Maintenance procedures:
  - . Schedule of normal consumable items, local sources of supply, and expected replacement intervals up to a running time of 40 000 hours. Include lubricant and lubrication schedules for equipment.
  - . 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).
- Certificates:
  - . Copies of test certificates for the installation and equipment used in the installation.
  - . Test reports.
- Drawings:
  - . Single line diagrams.
  - . Service route layouts.
  - . Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.

### **3.10 RECORD DRAWINGS**

#### **General**

General: Show dimensions, types and location of the services in relation to permanent site features and other underground services. Show the spatial relationship to building structure and other services. Include all changes made during commissioning and the maintenance period.

Drawings: Include all documented shop drawings.

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.

### **3.11 TOOLS AND SPARE PARTS**

#### **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 accordance 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.

**Spares**

General: Provide spare parts listed in the appropriate worksections.

Replacement: Replace spare parts consumed during the maintenance period.

**3.12 COMMISSIONING**

**Circuit protection**

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

**Controls**

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

**Notice**

General: Give sufficient notice for inspection to be made of the commissioning of the installation.

**Reports**

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

**3.13 CLEANING**

**General**

Practical completion: At practical completion hand over the following in a clean state:

- Insides of switchgear and controlgear assemblies.
- Luminaires.
- Switchgear and contactors, and other electrical contacts.

**3.14 COMPLETION TESTS**

**General**

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

**Functional checks**

General: 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**

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

**Test instruments**

General: Use instruments calibrated by a registered testing authority.

**3.15 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.

**3.16 MAINTENANCE**

**General**

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

Emergencies: Attend emergency calls promptly.

**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: 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.

Certificates: Include test and approval certificates.

Certification: Prior to the date of completion, submit certificates stating that each installation is operating correctly.

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

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.

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