Muswellbrook Shire Council

CONSTRUCTION SPECIFICATION

AUS-SPEC (Cot 09)

0171 General Requirements

Version 01

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
0	No amendment has been made	all	Nil		13 June 2012

Contents

0171 GENERAL REQUIREMENTS

1 GENERAL

1.1 RESPONSIBILITIES

Design

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

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

Existing services

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

Noise levels

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

Structural performance

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

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

Selections: As documented.

Cooling and heating performance

Air quantities: Achieve air quantities under operating conditions given that the air quantities in the contract documents are for standard dry air with a density of 1.2 kg/m^3.

Indoor conditions: Maintain the conditioned areas, as measured at the points of control in accordance with the Indoor design conditions schedule when loads imposed by the outdoor conditions stated in the Outdoor design conditions schedule are not exceeded.

Electrical systems

Electrical performance

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

Performance criteria: Meet the performance criteria, as documented.

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

1.2 PRECEDENCE

General

Worksections and standards:

- Requirements of other worksections of the specification override conflicting requirements of this worksection.
- The technical requirements of worksections override conflicting requirements of their cited standards.
- The requirements of cited standards are minimum requirements.

1.3 CROSS REFERENCES

General

Requirement: Conform to the following:

- *Demolition*.
- *Service trenching*.
- *Motors and starters*.

Common requirements

Requirement: Conform to the following:

- *Adhesives, sealants and fasteners*.
- *Fire-stopping*.

- *Metals and prefinishes*.
- *Termite management*.
- *Timber products, finishes and treatment*.
- *Building IT components*.

Cross referencing
Within the text:
- Worksection titles are indicated by *Italicised* text.
- Clause titles are indicated by **Bold** text.

1.4 REFERENCED DOCUMENTS

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

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

1.5 STANDARDS - BUILDING SERVICES

General
Electrical services: To Part 2 of AS/NZS 3000 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.

Mechanical ventilation and airconditioning: To AS/NZS 1668.1 and AS 1668.2, as required by the Building Code of Australia.

Microbial control: To AS/NZS 3666.1, AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32.

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

Sanitary plumbing and drainage: To AS/NZS 3500.2.

Water supply: To AS/NZS 3500.1.

Plumbing and drainage: To AS/NZS 3500.0, AS/NZS 3500.1, AS/NZS 3500.2, AS/NZS 3500.3 and AS/NZS 3500.4 and the PCA.

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

1.6 INTERPRETATION

Abbreviations
General: For the purposes of this contract the abbreviations given below apply.
- AS: Australian Standard.
- BCA: Building Code of Australia.
- CFC: Compressed fibre cement.
- CSIRO CMSE: ActivFire Register of Fire Protection Equipment.
- DPC: Damp proof course.
- EMC: Electromagnetic compatibility.
- MS: Mild steel.
- MSDS: Material safety data sheets.
- NATA: National Association of Testing Authorities.
- NZS: New Zealand Standard.
- PCA: Plumbing Code of Australia.
- SS: Stainless steel.
- VOC: Volatile organic compound.

Definitions
General: For the purposes of this contract the definitions given below apply.
- Accessible: Readily accessible to AS/NZS 3000.

- Attendance: ‘Attendance’, ‘provide attendance’ and similar expressions mean ‘give assistance for examination and testing’.
- Contract administrator: ‘Contract administrator’ has the same meaning as ‘architect’ or ‘superintendent’ and is the person appointed by the ‘owner’ or ‘principal’ under the contract.
- Default: Specified value, product or installation method which is to be provided unless otherwise documented.
- Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
- Documented: ‘Documented’, ‘as documented’ and similar terms mean contained in the contract documents.
- Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: ‘Give notice’, ‘submit’, ‘advise’, ‘inform’ and similar expressions mean ‘give notice (submit, advise, inform) in writing to the contract administrator’.
- High level interface: Systems transfer information in a digital format using an open system interface.
- Hold point: The activity cannot proceed without the approval of the contract administrator.
- Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
- IP: ‘IP’, ‘IP code’, ‘IP rating’ and similar expression have the same meaning as ‘IP Code’ in AS 60529.
- Local government authority: A body established for the purposes of local government by or under a law applying in a State or Territory.
- Low level interface: Systems transfer information via terminals and voltage free contacts.
- Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:

Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses.

- Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.
- Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.
- Network Utility Operator: A person who undertakes the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or a stormwater system.
- Network Distributor: Body responsible for the distribution and control of electricity.
- Obtain: ‘Obtain’, ‘seek’ and similar expressions mean ‘obtain (seek) in writing from the contract administrator’.
- Pipe: Includes pipe and tube.
- Principal: ‘Principal’ has the same meaning as ‘owner’, ‘client’ and ‘proprietor’ and is the party to whom the contractor is legally bound to construct the works.
- Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- Proprietary: ‘Proprietary’ means identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: ‘Provide’ and similar expressions mean ‘supply and install’ and include development of the design beyond that documented.
- Registered testing authority:
  . An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
  . An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  . An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Means required by the documents, the local council or statutory authorities.
- If required: A conditional specification term for work which may be shown in the documents or be a legislative requirement.
- Samples: Includes samples, prototypes and sample panels.

- Statutory authority: A public sector entity created by legislation, that is, a specific law of the Commonwealth.
- Supply: 'Supply', 'furnish' and similar expressions mean 'supply only'.
- Tests:
  . Pre-completion tests: Tests carried out before completion tests.
    * Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
    * Production tests: Tests carried out on a purchased item, before delivery to the site.
    * Progressive tests: Tests carried out during installation to demonstrate performance in according with this specification.
    * Site tests: Tests carried out on site.
  . Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The superintendent may direct that completion tests be carried out after the date for practical completion.
- Tolerance: The permitted difference between the upper limit and the lower limit of dimension, value or quantity.
- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.
- Witness points: Provides an opportunity to attend an activity but does not involve an obligation. The activity can proceed without approval from the contract administrator.

1.7 CONTRACT DOCUMENTS

Services diagrammatic layouts

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

Before commencing work:

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

Levels

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

Drawings and manuals for existing services

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

1.8 INSPECTION

Notice

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

Minimum notice for inspections to be made: Conform to the **Notices schedule.**

Light level requirements: to AS/NZS 1680.2.4.

Tests

General: Give notice of the time and place of nominated tests.

Minimum notice for witnessing of tests: Conform to the **Notices schedule**.

Attendance

General: Provide attendance for documented inspections and tests.

1.9 SUBMISSIONS

General

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

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

- Shop drawings:
- Samples and prototypes:
- Manufacturers' or suppliers' recommendations:

- Product data:
- Product/design substitution or modification:

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

Submissions - electronic copies

File format:

Transmission medium:

Submissions - hard copy

Quantity:

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

Standard contract drawing size:

Authorities

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

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

Building penetrations

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

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

Certification

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

Electrical loading information for mechanical and hydraulic services

General: Submit electrical loading information for all equipment before completion of the main switchboard shop drawings.

Electric motors: Ensure motor efficiency and power factor are in accordance with the *Motors and starters* worksection.

Loading and connection: Submit the information for items not supplied from the services switchboards.

Starting characteristics: Submit details for motors with reduced current starting. Ensure starting characteristics are within the characteristics of the respective submain protection devices.

Switchboards: Submit the following information for each building services switchboard:

- Board location and designation.
- For each submain connected to the board, submit the following for each item connected to it:
- Submain designation.
- Item designation and name.
- Power rating in kW.
- Number of phases.
- Full load amps per phase.
- Power factor.
- Total amps on each phase for respective sub main.

Errors

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

Execution details

General: Before starting the respective portions of the installation, submit the following:

- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing of services to structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

Identification

General: Identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification. Identify proposals for non-compliance with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Inspection and testing plan

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

Test reports: Submit written reports on nominated tests.

Marking and labelling

General: Before marking and labelling submit:

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

Materials and components

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

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

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.
  . Additional product data for services equipment:
  . Model name, designation and number.
  . Country of origin and manufacture.
  . Capacity of all system elements.
  . Size, including required clearances for installation.
  . Materials used in the construction.

Substitution

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

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

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

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

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

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

Samples

Submission: Submit nominated samples.

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

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

Shop drawings

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

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

Submission medium:

Checking: Ensure that the drawings have been checked before submission.

Building services shop drawings

General: Minimum A1 drawing size.

Standard: To AS 1100 Parts 101, 201, 301, 401 and 501 as applicable.

Building work drawings: Submit detailed dimensioned drawings showing all:

- Access doors and panels.
- Conduits to be cast in slabs.
- Holding down bolts and other anchorage and/or fixings required complete with loads to be imposed on the structure during installation and operation.
- Openings, penetrations and block-outs.
- Sleeves.
- Plinths, kerbs and bases.
- Required external openings.
- Detailed drawings, at 1:100 scale or larger, showing:
  - . Plant room layouts and sections.
  - . Seismic restraint details.
  - . Relevant performance data for each item of equipment including make, model, speed, capacity etc., as appropriate.
- Submission drawings required by authorities.
- Wiring diagrams.

Mechanical services drawings: Submit the following:

- Detailed drawings, at 1:50 scale or larger, showing:
- Fire and smoke dampers including dimensional tolerances.
- Floor wastes.
- Ductwork, pipework and equipment layouts and sections. Show the location of fire rated building elements.
- For refrigerant piping include slope of horizontal runs, oil traps, double risers and valving.
- Diffuser and grille reference numbers corresponding to commissioning test results.
- Riser layouts and sections.
- Plant room layouts and sections.
- Locations of automatic control sensors, motors and valves.
- Acoustic details.
- Conditioner construction details.
- Seismic restraint details.
- Relevant performance data for each item of equipment including make, model, speed, capacity etc., as appropriate.

- Piping and other schematic drawings including numbering of each valve to correspond to the valve tag notation.
- Submission drawings required by authorities.
- Automatic control details.
- Switchboard details.
- Wiring diagrams.

Hydraulic services drawings: Submit the following:

- Pipework and equipment layout and sections showing the work to be installed in strata, that is, shown at the level that the services are installed. Do not submit 'glass floor' drawings.
- Long sections of below ground drainage.
- Riser layouts and sections.
- Piping and other schematic drawings including numbering of each valve to correspond to valve tags notation.
- Inclusions: Include the following on the drawings:
- Access openings, cover plates, valve boxes and access pits.
- Details of control panels including control and power diagrams.
- Insulation of piping, fittings and tanks.
- Location, capacity, type and other relevant details of water heaters, including supports and safe trays.
- Location, type, grade and finish of piping, fittings, valves, meters and pipe supports.
- On-site detention pondage areas.
- Provision of a temporary fire hydrant service in the construction period.
- Provision of blue metal back fill to seepage drain system.
- Provision of erosion control measures.
- Provision of road barriers and lighting.
- Provision of site treatment and fire vehicle parking as required adjacent to the fire hydrant booster inlet valve station.
- Provision of temporary sanitary accommodation for construction workers.
- Provision of trafficable cover plates in the public domain.
- Relevant survey levels.
- Removal of excavation spoil.
- Site and floor set out points.
- Surface restoration.
- Tank stands and supporting structures.

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 services technical data

General: Take note that documented fan pressures and pump heads are based on provisional equipment selections and estimated pressure drops.

Selections: Before ordering equipment, calculate the respective system pressure losses based on the equipment offered and layouts shown on the shop drawings and submit the proposed selections.

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

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

- Assumptions.
- Calculations.
- Model name, designation and number.
- Capacity of all system elements.
- Country of origin and manufacture.
- Materials used in the construction.
- Size, including required clearances for installation.
- Certification of compliance with the applicable code or standard.

- Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
- Manufacturers' technical literature.
- Type-test reports.

2 PRODUCTS

2.1 GENERAL

Manufacturers' or suppliers' recommendations

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

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

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

Sealed containers

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

2.2 TESTS

Attendance

General: Provide attendance on tests.

Testing authorities

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

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

2.3 MATERIALS AND COMPONENTS

Consistency

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

Corrosion resistance

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

Situation

The following classification of situation applies to the Corrosion resistance and durability tables.

- Internal:
  - Building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.
- External:
  - Includes external leaf and air spaces behind external leaf brickwork or blockwork walls.

Galvanizing

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

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

PVC products

Verification: Provide third party verification to demonstrate that PVC products proposed for the project satisfy the criteria required by the GBCA for their Credit in the Materials category of Green star assessment.

Bushfire resistance

Bushfire Attack Level (BAL) to AS 3959:

2.4 ELECTRICAL 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 manufacturers standard range.

3 EXECUTION

3.1 OFF SITE DISPOSAL

Removal of material

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

3.2 WALL CHASING

Holes and chases

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

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

Concrete blockwork chasing table

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

3.3 FIXING

General

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

Fasteners

Use proprietary fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

3.4 WORK ON EXISTING SYSTEMS

General

General: 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.

Demolition

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

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

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

Airconditioning installations

Air and water systems: Before starting work on existing air and water systems, for equipment to be worked on:

- Measure existing air and water quantities.
- Measure total flows and pressure drops.

- Measure total and static pressures at significant points in the system.

3.5 SERVICES CONNECTIONS

Connections

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

Network distributors' requirements

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

3.6 SERVICES 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. 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.

Piping

General: Install piping in straight lines at uniform grades with no sags. Arrange to prevent air locks. Provide sufficient unions, flanges and isolating valves to allow removal of piping and fittings for maintenance or replacement of plant. If possible, use bends and sets instead of elbows.

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

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

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

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

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

Accessibility: Provide access and clearance at fittings which require maintenance or servicing, including control valves and joints intended to permit pipe removal. Arrange piping so that it does not interfere with the removal or servicing of associated equipment or valves or block access or ventilation openings.

Valve locations: If possible, locate valves in groups and in easily accessible locations.

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

Differential movement

If there is no geotechnical site investigation report predicting differential movement, delete reference to the report and specify a value or values of movements to be accommodated under Magnitude. If no provision is required, delete this clause in its entirety.

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

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

Cable systems

Systems: Provide the following:

- Inaccessible concealed spaces: Cable in UPVC conduit.

- Face, plastered or rendered masonry surfaces: Cable in UPVC conduit.
- 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 electrical accessories

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

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

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

Default mounting heights to centre of accessory plate:

Outlets	300 mm
Switches and controls	1100 mm

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

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

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

Surface mounting: Proprietary mounting blocks.

Installation of electrical 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

Installation of ceiling mounted appliances

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

Mounting: Mount appliances independent of ceiling tiles and suspended ceiling material.

Connections for fixed equipment: Provide concealed permanent connections.

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

3.7 BUILDING PENETRATIONS

Embedded pipes

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

Penetrations

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

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

Sleeves

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

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

  . In floors draining to floor wastes: 50 mm above finished floor.
  . Elsewhere: 5 mm beyond finished building surface.
- Termite management: To AS 3660.1.
- Thickness:
- Metal: ≥ 1 mm.
- PVC: ≥ 3 mm.

Sleeves for cables

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

3.8 CONCRETE PLINTHS

Construction

General: Provide plinths conforming to the **Concrete plinths schedule**.

3.9 SUPPORT AND STRUCTURES

General

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

Support of roof mounted plant and equipment

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

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

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

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

Sloping roofs:

- Roof slope ≥ 10º: Adopt the manufactures' documented installation procedures, or seek the advice of a professional engineer.
- Roof slope < 10º: Provide treated timbers (90 x 45 mm) under each support point laid parallel to the span of the roof sheeting or the roof pitch extending to the first purlin, rafter or batten more than 1 m from that plant or equipment.

Support of ground level plant and equipment

Ground level:

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

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

3.10 PIPE SUPPORTS

Support systems

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

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

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

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

Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipes:

- Spacers: Provide spacers at least as thick as the insulation between piping supports and pipes. Extend either side of the support by at least 20 mm.

- Spacer material: Rigid insulation material of sufficient strength to support the piping and suitable for the temperature application.

Support spacing

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

Sanitary plumbing: To AS/NZS 3500.2 Table 9.1.

Fuel gas: To AS 5601 Table 4.2.

Other pipes: To AS/NZS 3500.1 Table 5.2.

Hangers

Conform to the **Hanger size table**.

Hanger size table

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

3.11 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 including water sensitive equipment or finishes.
- Inspection and maintenance operations can be arranged to minimise inconvenience and disruption to building occupants or damage to the building structure or finishes.
- Safe tray and an overflow pipe are provided to each tank, hot water heater and storage vessel.
- 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, AS 2865 and AS/NZS 3666.1.
- If parts of the plant (including high level tanks) require regular inspection and maintenance either locate plant so it is safely and readily 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.

3.12 VIBRATION SUPPRESSION

General

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

Connections

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

Inertia bases

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

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

Speeds

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

Vibration isolation mountings

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

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

For static deflections ≥ 15 mm: Spring mountings.

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

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

Spring mountings: Provide freestanding laterally stable springs as follows:

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

3.13 SEISMIC RESTRAINT OF BUILDING SERVICES

Provisions

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

Anti-vibration mounts: Use horizontally restrained type.

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

3.14 FINISHES TO BUILDING SERVICES

General

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

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

Painting systems

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

New unpainted exterior surfaces: To AAS/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.

Underground metal piping

Corrosion protection: Provide corrosion protection for the following:

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

Protection methods: Select from the following:

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

Low VOC emitting paints

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

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

Underground metal piping

Corrosion protection: Provide corrosion protection for the following:

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

Protection methods: Select from the following:

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

3.15 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 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.

Labels and notices

Materials: Select from the following:

- Cast metal.
- For indoor applications only, engraved two-colour laminated plastic.
- Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering.

- Stainless steel or brass ≥ 1 mm thick with black filled engraved lettering.

Emergency functions: To AS 1319.

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

- Danger, warning labels: White lettering on red background.
- Main switch and caution labels: Red lettering on white background.
- Edges: If labels exceed 1.5 mm thickness, radius or bevel the edges.
- Fixing: Fix labels securely using screws, rivets, proprietary self-adhesive labels or double-sided adhesive tape.
- 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: ≥ 10 mm for main heading, ≥ 5 mm for remainder.
- Equipment labels within cabinets: ≥ 3.5 mm.
- Equipment nameplates: ≥ 40 mm.
- Identifying labels on outside of cabinets: ≥ 5 mm.
- Isolating switches: ≥ 5 mm.
- Switchboards, main assembly designation: ≥ 25 mm.
- Switchboards, outgoing functional units: ≥ 8 mm.
- Switchboards, sub assembly designations: ≥ 15 mm.
- Valves: ≥ 20 mm.
- Self-adhesive flexible plastic labels :
  - . Labels < 2000 mm above floor: 3 mm on 6 mm wide tape.
  - . Labels ≥ 2000 mm above floor: 8 mm on 12 mm wide tape.
- Other locations: ≥ 3 mm.

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

- Controls.
- Indicators, gauges, meters.
- Isolating switches.
- Vapour barriers: Do not penetrate vapour barriers.

Piping

General: Identify piping to AS 1345 throughout its length, including in concealed spaces.

Pressure vessels

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

Valves and pumps

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

Points lists

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

Underground piping

Marker plates: Provide 75 x 75 x 3 mm screw fixed metal marker plates at ground level at each change of direction in the underground services, engraved to show the direction of the line and the name of the service. Inset marker plates in 150 x 150 x 150 mm concrete blocks, with the tops set flush with the ground level.

Material: Stainless steel or brass with black filled engraved lettering.

Accessories

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

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.

Equipment concealed in ceilings

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

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

3.16 SOFTWARE

General

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

3.17 WARRANTIES

General

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

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

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

3.18 RECORD DRAWINGS

General

General: Submit record drawings. Show the 'as installed' locations of building elements, plant and equipment. Include 'as installed' amendments to shop drawings. Show off-the-grid dimensions where applicable.

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

Services: 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.

Services below ground: If services and fittings are below ground, show the depth and dimensioned references that will allow the future location of the service for maintenance or expansion.

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.

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

- Controls.
- Piping including all valves and valve identification tags.
- Dimensioned location, depth and other details of buried or otherwise concealed services.
- Principal items of equipment.
- Wiring.
- Acoustic and thermal insulation.
- All access provisions.
- Controls.
- Fixings.
- Fixtures.
- Piping including all valves and valve identification tags.
- Principal items of equipment.
- Wiring.

Detention: If on-site detention tanks or pondage are provided include the volume required on the drawing and the permitted flow rate to the connected system.

Domestic cold water or fire mains: Show the pressure available at the initial connection point and the pressure available at the most disadvantaged location on each major section of the works.

Stormwater: If storm water pipes are shown include the pipe size and pipe grade together with the maximum acceptable flow and the actual design flow.

Accuracy

Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.

Endorsement: Sign and date all record drawings. Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.

Drawing layout

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

Quantity and format

General: Conform to Submissions.

3.19 OPERATION AND MAINTENANCE MANUALS

General

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

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

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

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

Date for draft submission: 2 weeks prior to commencement of training.

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

Contents

General: Include the following:

- Table of contents: For each volume. Title to match cover.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.

- Drawings: Complete set of record drawings, full size.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
  - . Instructions and schedules: To AS 1851, AS/NZS 3666.2 and AS/NZS 3666.3 prepared to included project specific details.
  - . Instructions on the use of special pipe jointing methods including the use of special tools.
  - . Single line electrical diagrams.
  - . Electrical service route layouts.
- Switchgear and controlgear assembly circuit schedules including electrical service characteristics, controls and communications.
- Installation description: General description of the installation.
- Systems descriptions: Technical description of the systems installed, written to make sure 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 system installed.
- Equipment descriptions:
  - . Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
  - . Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
  - . Manufacturers' technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.
  - . Supplements to product data to illustrate relations of component parts. Include typed text as necessary.
  - . Certificates:
  - . Certificates from authorities.
  - . Copies of manufacturers' warranties.
  - . Product certification.
  - . Copies of test certificates for the mechanical installation and equipment used in the installation.
  - . Test and balancing reports.
  - . All control system testing and commissioning results.
- 7 day record of all trends at commissioning.
- 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-codes services.
  - . Schedules of fixed and variable equipment settings established during commissioning and maintenance.
  - . Procedures for seasonal changeovers.
  - . If the installation includes cooling towers, a water efficiency management plan.
- Maintenance procedures:
  - . Detailed recommendations for preventative maintenance frequency and procedures.
  - . Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
  - . Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
  - . Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.

  - . Schedule of normal consumable items, local sources of supply ,and expected replacement intervals up to a running time of 40 000 hours. Include lubrication schedules for equipment.
  - . Schedule of maintenance work including frequency and manufacturers' recommended tests.
  - . 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).
- Electrical equipment certificates:
- Copies of test certificates for the installation and equipment used in the installation.
- Test reports.
- Electrical drawings:
- Single line diagrams for all systems included and/or affected by the works.
- Service route layouts.
- Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.
- Maintenance records:
  - . Documentation to AS 1851 clause 18.2.5.
- Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.
- Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.
- Operation procedures:
  - . Manufacturers' technical literature as appropriate.
- Mechanical drawings:
  - . Switchgear and control gear assembly circuit schedules including electrical service characteristics, controls and communications.
  - . Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Recommissioning instructions.
- Prototype periodic maintenance and performance report.
- Documentation to AS 1851 clause 18.2.4 including the schedule of essential functionality and performance requirements.
- Prototype periodic maintenance records for compliance with AS 1851 prepared to include project specific details.
- Schedules to be used for recording recommissioning data so that changes in the system over time can be identified.
- Instructions and schedules for conforming to AS 1851, AS/NZS 3666.2 and AS/NZS 3666.3.

Format – electronic copies

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

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

Quantity and format: Conform to Electronic submissions.

Format – hard copy

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

- Cover: Identify each binder with typed or printed title 'OPERATION AND MAINTENANCE MANUA*L*', to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.

- Pagination: Number pages.
- Ring size: 50 mm maximum, with compressor bars.
- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Number of copies: 3.

3.20 MAINTENANCE

General

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

Emergencies: Attend emergency calls promptly.

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

Maintenance period: The greater of the defects liability period and the period nominated in the **Maintenance Requirements Schedule**.

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: On satisfactory completion of the installation and before the date of practical 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.

3.21 TOOLS AND SPARE PARTS

Spare parts

General: Provide spare parts listed in the appropriate worksections.

Tools and spare parts schedule

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

- Checking receipt, marking and numbering in 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.

Replacement: Replace spare parts consumed during the maintenance period.

3.22 COMMISSIONING AND COMPLETION TESTS

Reports

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

Notice

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

Controls

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

Samples

General: Remove unincorporated samples on completion.

Circuit protection

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

Completion tests

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

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

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

Sound pressure level measurements: Conform to the following:

- Correction for background noise: To AS/NZS 2107 Table B1.
- External: To AS 1055.1.
- Internal: To AS/NZS 2107.
- Measurement positions: If a test position is designated only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.
- Sound pressure level analysis: Measure the sound pressure level and the background sound pressure level over the full range of octave band centre frequencies from 31.5 Hz to 8 kHz at the designated positions.
- Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the designated positions.

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

3.23 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.

List the training requirements for the project. Delete if none required. A schedule may be appropriate.

Seasonal operation

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

3.24 CLEANING

Final cleaning

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

Labels: Remove all labels not required for maintenance.

3.25 POST-CONSTRUCTION MANDATORY INSPECTIONS AND MAINTENANCE

General

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

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

Records: Provide mandatory records.

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

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

4 SELECTIONS

4.1 SCHEDULES

Structural design actions schedule

Quantity and symbol	**Type or location**		
	A	**B**	**C**
Importance level, to AS/NZS 1170.0			
Permanent, imposed and other actions			
Additional to AS/NZS 1170.0			
Earthquake actions (to AS 1170.4)			
Probability factor, k_p			
Hazard factor, Z			
Site sub-soil class			
Earthquake design category			
Spectral shape factor, $C_h(0)$			
Snow and ice actions (to AS/NZS 1170.3**)**			
Characteristic value of snow load on ground, s_q			
Exposure reduction coefficient, C_e			
Hill shape multiplier, M_h			
Wind actions (to AS/NZS 1170.2**)**			
Direction multiplier, M_d			
Regional ultimate limit state design wind speed, $V_{R(ultimate)}$			
Regional serviceability limit state design wind speed, $V_{R(serviceability)}$			
Shielding multiplier, M_s			
Terrain category			
Topographic multiplier, M_t			

Notices schedule

Item	**Minimum notice**

Green Star verification schedule

Item	**Minimum notice**

Item	Minimum notice

4.2 MAINTENANCE

Maintenance requirements schedule

Provision	Maintenance period (months)	Requirement

4.3 MECHANICAL DESIGN CONDITIONS

Indoor design conditions schedule

	Type or location		
	A	B	C
Cooling			
Dry bulb			
Relative humidity			
Heating			

Outdoor design conditions schedule

	Type or location		
	A	C	A
Cooling			
Dry bulb			
Wet bulb			
Solar load			
Heating			
Dry bulb			
Wet bulb			
Solar load			

Noise level schedule

	Type or location		
	A	B	C
Upper limit of noise caused by services			

4.4 PLINTHS

Concrete plinths schedule

	Type or location		
	A	B	C

4.5 ELECTRICAL SYSTEMS

Electrical systems schedule

Electrical systems required	
Low voltage power systems	
Power factor correction equipment	
Cable support and duct systems	
Generating sets	
Uninterruptible power supply	
Switchboards – proprietary	
Switchboards – custom built	
Switchboard components	
Motor starters	
Lighting	
Luminaires – custom built	
Emergency evacuation lighting systems	
Telecommunications cabling systems	
Emergency warning and intercommunications systems	
Fire detection/alarm system	
Television distribution system	
Electronic security systems	
Lightning protection system	