

**PROPOSED MINISTRY OF JUSTICE COURTS AND ADMINSTRATION’S (MJCA) NEW COURTHOUSE & JUDGES RESIDENCE AT SALELOLOGA, SAVAII**

Building Services Performance Specification

# November 2022

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**SECTION A – GENERAL**

**1.0 INTRODUCTION**

**1 DESIGN INTENT**

### Mechanical Design Intent Air Conditioning System

The air conditioning (AC) system is to be designed and constructed with the aim of ensuring that the system operates at an optimal level with considerations given to the life cycle costs of the system, peak cooling loads, the materials used, plant space allocations and environmental impact by the system. The air conditioning system for the overall project which includes the Courthouse building and the Judges Residence building, is to be designed on a combination of direct expansion (DX) Variable Refrigerant Flow (VRF) system and Split type DX system. Detailed heat load calculations needs to be carried out using the ACADS BSG Camel software or equal equivalent with reference to the Australian Institute of refrigeration, air conditioning and heating (AIRAH) DA09 application handbook. All calculations need to be provided for the Mechanical Engineer Superintendent review.

The Courthouse Building contain the 3 main branches of the Ministry of Justice & Courts Administration (MJCA) Judiciary System which are the Lands and Titles Court (LTC), Administration branch, and the Supreme & District Courts. All 3 branches are proposed to be air conditioned with split type air conditioning systems. Large open areas or general offices are proposed to be air conditioned with split ducted fan coil units (FCUs) while small private offices, including Deliberation rooms, Interview rooms are proposed to be air conditioned with split wall mounted or split ceiling cassette units. Large private offices, conference or mediation rooms, courtrooms, etc. with high outside air requirements are to be designed with split ceiling cassettes units in lieu of wall mount units. All wall mount units are to be complete with (c/w) silent type condensate pumps.

File / Records Strong rooms, archives or exhibit room, staff kitchen or the like are to be indirectly conditioned with spill air from the conditioned areas through transfer air grilles and door grilles. Power supply to split system and VRF units shall be from a mechanical services switch board (MSSB) located either in a switch room or in close proximity to the condenser units. Contractor to ensure that the MSSB is IP rated if it is exposed to weather. Each indoor unit is to be provided with separate isolators / GPOs located in close proximity of the unit. Indoor unit GPOs or isolators to be mounted in ceiling space except for wall mounted units which need to be on wall.

Special areas that require continuous cooling need to be designed to facilitate redundancy. This includes the main switchboard (MSB) room and Server room air conditioning systems. These rooms are to be air conditioned with duty / standby split type wall mounted air conditioning systems. Wall mount units to be c/w condensate pumps. Each unit to have individual wall mounted hard wired control panels with built-in feature of automatic On/Off timer settings. This feature is to be utilized for changeover of duty/standby units every 12hrs. If this feature is not available, the contractor is to provide a separate auto changeover control panel for the required changeover every 12hrs.

The air conditioning system shall be designed and installed to achieve indoor condition of 23°C dry bulb (DB) and 50% uncontrolled relative humidity (RH) in general areas whereas the MSB room & the server room are to be designed to achieve 21°C DB and 50% uncontrolled RH. The average ambient condition considered for the system is 32°C DB and 80% RH.

VRF outdoor condenser units are to be mounted at a single location. They need to be mounted on ground floor, in the designated plant area of the architectural preliminary drawings. Outdoor condenser units for split system are to be wall mounted on angle support frames at high level of ground floor. The above location has been selected to ensure minimum refrigerant pipe runs, reduce noise transmission to occupied spaces and easy access for maintenance. Power supply to VRF outdoor units and split system shall be from the MSSB with GPOs and isolators located within close proximityof the units.

The air conditioning units for the building need to be high efficiency type Mitsubishi Electric or equal approved. The maintenance space clearance is to be based on Mitsubishi Electric installation manual requirement or equal approved. The intent is that, during the construction phase, the mechanical contractor will design effectively by coordinating with site spatial requirements to ensure sufficient clearance from roof edges and equipment by others. Both indoor evaporator units and outdoor condensing units are to be provided with separate isolator switch panels for maintenance purposes.

### Ventilation System

All occupied areas (in the Courthouse & Judges Residence buildings) along with archives or vault are to be supplied with fresh air through either ducted inline fans or roof mounted fans. Fresh air is to be supplied through in ceiling ducted inline fans. Each of the Courthouse’s 3 branches is to have its own separate fresh air fan supplying ambient air directly to cooling cowls. Weather proof outdoor air louvers are to be provided for intake of fresh air at high level of ground floor for each branch. All fresh air are to be filters through an inline panel filter duct mounted with its own complete plenum. The vault or strong room is to be provided this transfer air duct and grilles for relief of air being introduced. Contractor to ensure that burglar bars and steel mess are installed at all duct penetrations of vault.

Fresh air for holding cell rooms are to be supplied through a roof mounted fan. Ambient fresh air is to be filtered before being supplied directly to cooling coils of fan coils units of the VRF system. Where fresh air cannot be supplied directly to the cooling coils, fresh air will be supplied to air grilles/diffusers. Fresh air quantities designed for each occupied space are to be as per the requirements of AS1668 part 2.

Ablution areas such as washrooms, both male and female along with any shower facility are to be mechanically extracted through extract grilles, in-line duct mounted exhaust air fans, flexible ductwork and discharged to the exterior of the building either through weather proof louvers or roof mounted cowl.

Each of the 3 branches in the Courthouse is to have its own separate mechanical extract air ventilation system for the ablutions facilities. Extract air are to be discharged at the same level through wall mounted weatherproof louvers. Each exhaust air fan is to be interlocked with the lighting control system for operation and be c/w run on timers set to 2mins. All exhaust grilles will be installed complete with volume control dampers.

Kitchen facilities are to be provided with a proprietary exhaust air re- circulating type rangehood if cooking is carried out in these kitchens. All exhaust air of the rangehood is to be discharge through a roof mounted vertical exhaust air fan complying with the requirements of AS 1668.2. Make-up air shall be provided for the kitchen exhaust air rangehood as well.

Contractor is to ensure that all outdoor air louvers are drainable weather proof type and c/w vermin proof screen and security grilles. Roof mounted fans are to be c/w vermin proof screen as well. Access panels are to be provided for access of fans and filters. Make-up air is to be provided through door and transfer grilles. All intake air points of the building need meet the required distances of any exhaust air point and comply with the requirements of AS 1668.2.

### Mechanical Ductwork, Pipework and Access

All ductwork (supply and extract) shall be concealed in ceiling void with access panels provided, in areas with fixed ceiling, for maintenance as required. Similarly, all mechanical pipework shall be concealed in ceiling space. Cladding/trunking is to be provided for all exposed piping and ductwork with cladding/trunking color to match the wall color.

All ductwork and pipework for air conditioning systems are to be adequately insulated to prevent condensation. All ducted fan coil units are to be provided with secondary insulated drip trays. All ductwork located externally are to be internally insulated and cross broken by the contractor to avoid ponding.

Fire dampers and collars are to be installed where ductwork or pipework penetrate the floor or any other fire compartment. Duct mounted access panels shall be provided at appropriate locations for access and maintenance of these fire dampers. All penetrations are to be adequately sealed and achieve the required fire rating as per this specification.

### Environment Sustainable Design (E.S.D)

ESD initiatives need to be incorporated in the mechanical services design to enhance energy efficiency and minimize greenhouse gas emissions. All material used for the air conditioning system shall be environmentally friendly. All refrigerant type shall be environmentally friendly with low Global Warming Potential and zero Ozone Depletion Potential. All pipework and duct layout need to be optimized to ensure minimum material usage.

To further assist in energy minimization, the air conditioning unit’s procured need to be MEPS (Minimum Energy Performance Standards) approved. Fans shall be Eurovent certified to confirm that the equipment meet the required energy efficiency ratings.

### Standardization, Supportability and Maintainability of Equipment

All mechanical equipment shall, as far as practicable, be standardized. All equipment shall be readily and adequately supported in Samoa where possible. Adequate spares for important equipment shall be available in Samoa and all equipment shall be fully supported by the equipment manufacturers and suppliers. For major equipment, the design contractor shall include the requirement for the supplier to provide a Statement of Supportability addressing the commitment of the supplier to support the equipment through life, the prospective life and guarantees/warranties.

Mechanical installations shall allow for appropriate and easy access for the purpose of operations, maintenance, repair and replacement of major components.

### Hydraulics Design Intent Mains Water Connection

Water supply for the two new buildings shall be from the existing Samoa Water Authority (SWA) water mains pipe. A bulk above ground water meter is provided complete with RPZD back flow prevention device shall be provided. This is to allow the client to read the water usage from the water meter and if there is any surcharge within the site, the RPZD backflow prevention device will prevent the SWA mains from getting contaminated. After the water meter, water pipe shall be reticulated to fire protection services, on-site water storage and by-pass to the building. All water connection points and installation shall be coordinated with SWA.

### Cold Water Supply

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Water reticulation around the two new buildings shall be easily isolated by means of isolation valves installed at accessible locations.

Water usage shall be calculated on a probable simultaneous flow basis. Potable water shall be supplied with a minimum pressure of 150kPa and with a maximum pressure of 500kPa at fixture outlets. Potable water pipes shall be sized with a maximum velocity in pipe of 2.0 m/s. Pressure reducing valves shall be provided to control pressure.

Water pipe reticulation shall be located in ceiling void and will drop down to serve fixtures. Potable water will be supplied to all water fixtures, air-conditioning units make up water, and where required.

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### Hot Water System

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Hot water boiler system shall be provided for the Courthouse Kitchens and for the Judges Residence kitchen and shall be mounted on wall just above the sinks.

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### Wastewater Drainage

Sewer wastewater from the two buildings plumbing fixtures shall be reticulated via a main drain pipe to on- site septic tank. All pipes shall have inspection openings for maintenance purposes. Vent pipe from the main drain pipe and as relief from stack is provided such that negative and positive pressure within the system is neutralized. Vent pipe shall be terminated above roof level.

Grease trap shall be provided for the kitchen sinks. Pipe from the sinks shall reticulate to the grease trap before discharging to septic tank. Grease trap shall be located such that it is easy to maintain and clean. Vent pipe shall be provided for the grease trap to discharge to above roof level.

Tundish drainage shall be provided for the hot water boiling unit and connected to sink drainage above flood level.

### Stormwater Drainage

The stormwater drainage system for each of the two building shall be adequately sized to cater for peak rainfall intensity for the site. A secondary overflow provision shall be provided in the drainage channel.

For the upper roof area, eaves gutter shall be provided with dome guard (leaf guard) downpipes. The downpipe shall be located external to the building where possible. All downpipe shall be reticulated to nearest stormwater drain.

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### Environmentally Sustainable Design (ESD)

The following Hydraulic Energy Consumption design initiatives shall be considered:

* Environmental friendly pipework
* Rain water harvesting
* Pipe insulation for hot water and hot water return pipework
* Low flow plumbing fixtures (All plumbing fixtures as per architectural specification)

### Standardization, Supportability and Maintainability of Equipment

All hydraulic services equipment shall be standardized. All equipment to be used shall be readily and adequately supported in Samoa as much as possible. Adequate spares for important equipment shall be available in Samoa and all equipment shall be fully supported by the equipment manufacturers and suppliers.

### Electrical Design Intent Main Supply System

Mains power to the two Buildings will be provided by Samoa Power Electric Corporation (EPC) by way of extending the existing power supply in the area, this supply terminates at the property.

The electrical contractor has to liaise with the EPC to confirm to install and the location of the transformer to cater for the power demand for the two buildings.

The Electrical contractor is to provide a 100% full load back -up generator (~145KVA generator), to the proposed location. All electrical calculation and datasheets is to be submitted to the Superintendent for review and approvals. .

**Stand-by Power Generation System**

The Electrical contractor is to provide a standby power by a diesel generator. The rated generator set

has to be designed for the 100% back-up power supply to Main Switchboard via Automatic Transfer Switch (ATS) to start after 10 seconds delay. Adequate sound attenuated enclosures shall be provided. This standby generator will be situated in the electrical bund and would be located next to the transformer.

The standby power generating system shall be a 100% back up power supply to the two facilities and shall be diesel engine driven. The automatic transfer switch shall consist of a motorized contactor and logic for the automatic control (start, stop and sequencing) of the standby generator in the event of a mains failure inclusive of phase failure relays Standby Generator will be enclosed unit and will use diesel as fuel. And it will be complete with sound attenuated enclosures in the dedicated Generator Site as illustrated on the Site Plan Drawing.

For the fuel tank system, has to design to client’s approval for the stand by time frame. The fuel tank shall be designed and built by the contractor.

### Main Switchboard

The Main switchboard is to be designed as a free standing custom built enclosure to form 3a separation and adhering to the design parameters. The enclosure will be provided with switchgears, Main switch, Circuit breakers, Metering, Power Factor Correction, and Surge Diverter. The main switchboard will have 20% spare capacity for future provisions. The MSB shall have future province for connection to the Solar system.

The role of this main switchboard is to allow the division of the current supplied to the smaller distribution board and to provide switching and current protection for those various currents. In other words the main switchboard will distribute power to distribution boards via bus bar trucking and ultimately to individual system loads.

MSB is to be connected to the SPEC supplied from a proposed distribution transformer .The MSB shall be installed in a weatherproof accessible enclosure room. The Enclosure room size shall be able to house the MSB, Automatic Transfer Switch, solar system and switchgears and shall be easily accessible for installation and maintenance purposes. The MSB room shall be ventilated and be provided with Emergency light and socket outlets.

### Local Distribution Boards

The power supply for the proposed local distribution boards shall be supplied from the proposed Main Switchboard (MSB). The new local distribution boards (DB) shall be wall mounted, metallic, Form 2b separation and adhering to the design parameters.

The enclosure shall be provided with the following, switchgear & circuit breakers - main switch and all circuit breakers, residual-current devices (RCD) type circuit breakers incorporating over-current protection will be provided to all circuits except for applications such as pumps and motors. The distribution board shall have 20% spare pole capacity for future provisions. HVAC equipment will be connected to its own Mechanical Services Switchboard (MSSB by others). The board shall have MCBs installed and the main switch shall have the appropriate fault current rating.

### Metering

Low Voltage metering to be approved by SPEC shall be installed on the line side of the MSB. The LV metering system for these facilities have been designed with the use of a three (3) phase tariff meter which will be located inside the MSB and to be approved by the local supply authority. Current

transformers (CT) are a series connected type of instrument transformer. They are designed to present negligible

load to the supply being measured and have an accurate current ratio and phase relationship to enable accurate connected metering.

### General Lighting and External Lighting

The design intent for suitable lighting solutions selected for this installation has focused on the cost implementations, economic life, environmental impact, functionality, maintenance requirements and system efficiencies of the available lighting systems. Generally the lighting solution selected for the interior areas shall be LED. Sensors will control lighting in the toilets and offices.

The lighting solutions selected for the interior areas include LED range of lighting. Any external led lighting will be polycarbonate high impact vandal resistant weather proof type fittings rated to IP56 minimum. Lighting will be controlled via photoelectric sensors with a manual override switch located in the board. All lighting will be diffused and to comply with minimum recommended light levels for the specific area

### Exterior Lighting

For exterior lightings, weatherproof LED lighting with their respective IP Ratings as per documented in the Legend Sheet or equal approved shall be used. The exterior lightings include carpark lightings, site lightings and lightings mounted to each building’s exterior walls or to awnings. And they are to be LED type fixtures. The carpark and site lightings have been designed to be controlled automatically via photoelectric sensors or timing control. Alternatively, solar lighting system is also recommended for the carpark and site lightings.

### Emergency and Exit Lighting

All Emergency and Exit Lighting has been designed to help guide occupants to safety in the event of an emergency and will be provided throughout the Courthouse building with this intention. Emergency and Exit Lighting will be provided in accordance with AS2293.

Exterior emergency lighting shall be allowed for at each exit door and egress paths as required. All Emergency lighting will be battery packed luminaries.

### Access Control, Security and CCTV

Access control, Security and CCTV system shall be provided for the Courthouse building as it will be essential to control access of public in restricted areas. Access control will be provided at doors which divides the public area from the staff area.

A duress alarm will be installed at the reception area for employee safety. As soon as the alarm button is pressed, it will immediately notify security personnel to come for assistance. CCTV will be provided at public areas, and exterior areas. The administrator station shall be located in the Office Room.

### Mechanical / Hydraulic Services Equipment

Dedicated sub-mains cabling will be provided from the MSB to the MSSB for the mechanical services equipment. Also dedicated final sub-circuit cabling will be provided from the local distribution boards to the following hydraulic and fire services equipment; water pump, UV filter and electric hot water heaters.

### General Power

General power distribution includes general 3 pin 240V 10A or 15A socket outlets. Minimum general power outlets have been provided to the specific areas and where socket outlet earth leakage protection is required it has been provided. All socket outlets shall be Clipsal Medilec series or equal approved for body and cardiac protected areas, Clipsal Classic C2000 Series or equal approved shall be used everywhere else.

### Telecommunications and Data

The subcontractor shall allow for telecommunications underground conduit provisions for the incoming optic fibre /copper cables for the Telecommunication Utility (Sky Blue Samoa) cabling. The underground cables will be terminated at the Building/Campus Distributor (Main Distribution Frame – MDF) located in the IT Server room. Single voice outlets will be provided to all spaces nominated. The cabling will be CAT 6 to RJ45 outlets. The telephone system is to be nominated by the client.

### Uninterruptible Power Supply

The uninterruptible power supply, also uninterruptible power source, UPS has been designed to provide emergency power to a load when the input power source, typically mains power, fails. The UPS differs from an auxiliary or emergency power system or standby generator in that it will provide near-instantaneous protection from input power interruptions.

A centralized uninterruptible power supply has been provided to the server room equipment and the GPOs at workstations. UPS and its equipment will be located in the IT Server room. UPS shall be modular static type and has been housed in a dedicated ventilated room. Battery replacements are required in 5-7 years.

### Mechanical / Hydraulic Services Equipment

Dedicated Mechanical Services Switchboard (MSSB) is to provide power to all the mechanical services equipment. The electrical contractor shall provide the sub-mains cabling for MSSB for connection by the mechanical contractor.

Final sub-circuit cabling shall be provided from the local distribution boards to the hydraulic and fire services equipment. External isolators/ GPOs shall be to the appropriate IP rating. MSSB will be supplied and installed by the mechanical contractor.

### Earthing and Bonding

The earthing/grounding and bonding system has been designed as a circuitry which connects parts of the electric circuit with the ground, thus defining the electric potential of the conductors relative to the Earth's conductive surface. The earthing system will affect the safety and electromagnetic compatibility of the power supply. In particular it affects the magnitude and distribution of short circuit

currents through the system, and the effects it creates on equipment and people in the proximity of the circuit. If a fault within an electrical device connects a live supply conductor to an exposed conductive surface, anyone touching it while electrically connected to the earth will complete a circuit back to the earthed supply conductor and receive an electric shock.

The electrical earthing has been designed to be provided to all switchboards and exposed conductive parts to provide a safe electrical system. A multiple earth neutral (MEN) system of earthing shall be utilized. The earthing shall be via earth cables run with sub-mains from DB’s back to the MEN located within the MSB earth electrode. Additionally, all exposed conductive parts such as metallic pipe work, ducts and metallic fixtures such as sinks, cable trays and supports shall be bonded to the common earth to protect the occupants in an event of an electrical wiring fault.

A soil resistivity should be undertaken by the contractor to confirm earth resistivity and earth rod requirements. The building earth will be as documented. The system has been designed in accordance with AS3000.

### Cable Management Systems

New sub-mains cable for local distribution boards and incomer communication cable shall be via overhead cable trays, underground trench, conduits and cable pits. All cabling for lighting, power, data etc. shall run in conduits, cable tray and catenary wiring as required. All cables shall be installed with at least 3 metre minimum loop to allow for future space changes.

### Conduits

All conduits in accordance with statutory requirements. All conduits are used for cables that are run in underground trenches. All run in vertical and horizontal directions and rigidly saddled at frequent intervals.

### Environmentally Sustainable Design (ESD)

The following Electrical Energy Consumption design initiatives shall be considered:

* Energy efficient LED lights
* Use of natural lighting during a bright day via skylights.
* Low V.O.C emitting paints.

### Standardization, Supportability and Maintainability of Equipment

In practical terms; Electrical equipment shall be standardized. All equipment to be used shall be readily and adequately supported in Samoa as much as possible. Adequate spares for important equipment shall be available in Samoa and all equipment shall be fully supported by the equipment manufacturers and suppliers.

For major equipment, the design consultant shall include the requirement for the supplier to provide a Statement of Supportability addressing the commitment of the supplier to support the equipment life, the prospective life of the equipment and equipment guarantees warranties.

HV Electrical installations shall allow for appropriate and easy access for the purpose of operations, maintenance, repair and replacement of major components.

All cabling from the Main Switchboard to the Distribution Board will be via cable tray and through the service ducts.

The cabling for exterior lightings integrated to awning over and the wall building will be in conduits and run in concealed ceiling and wall and will be fed from the Distribution Board.

### Fire Protection Services Design Intent Fire Hydrant System

Based on the size and the class of the two buildings, fire hydrant coverage is mandatory for the proposed buildings. The fire hydrant system will comprise and internal fire hydrants throughout the site as required by AS 2419.1 and building code of Samoa. To provide a backup to the fire water pump, a fire brigade booster assembly has been incorporated into the system and is directly supplied from the mains water supply. The fire brigade booster assembly will be located near the security and will be a point of attachment for the fire brigade to provide additional boost to the system. Internal fire hydrant shall be located in fire isolated stairs.

Fire water storage shall be provided with minimum storage of 144,000 liters. Fire water tanks shall be steel construction and provided with inlet, manhole, overflow and outlet for fire brigade suction. Supply to the fire hydrant system shall be from the SWA mains after the water meter.

### Fire Hose Reel System

For initial fire suppression, fire hose reels shall be provided throughout the building as required by AS 2441 and building code of Samoa. All fire hose reels will be mounted on wall and will be in a recessed cabinet for protection against vandalism. Fire hose reels have been located within 4m of a required exit. Fire hose reels will provide the required 36m hose length + 4m spray coverage to all parts of the building. The fire hose reel system will comprise a connection into the cold water mains pipe serving the building.

### Fire Extinguisher and Fire Blanket

Fire extinguisher and fire blankets shall be provided throughout the two buildings. Fire extinguishers and fire blankets will be mounted on proprietary hooks and will be complete with all signage as required by AS 2444. Fire extinguisher shall be chosen based on the risk type being protected.

### Fire Detection and Alarm System

For an early and safe evacuation of occupants of each of the two buildings, an addressable fire detection and alarm system has been provided in accordance with AS 1670. The detection and alarm system consists of strobes and smoke detectors connected in multiple loops with warning speakers to an addressable Fire Indicator Panel (FIP). The FIP has been located near the entrance to the building, so that firefighting operations or other emergency procedure is controlled from one location. Visual indicating devices (strobe light) have been strategically located close to the FIP for visual indication during emergency. The FIP will be programmed to suit the workface. To avoid any delays a Transponder Unit has been also provided for direct and automatic connection to the nearest local Fire Authority Station.

The FIP is to be located near the main entrance to the Courthouse building that contains visual status indication for all smoke control fans and other fire safety equipment installed in the building. The fire contractor will need to liaise and co-ordinate with the mechanical contractor. The contractor shall develop a Dry Fire Matrix to identify interfaces with all other services equipment.

The access control system will be linked to the FIP such that doors automatically release during the fire mode for access to all areas by fire fighters. The fire contractor will need to liaise with the mechanical contractor, and security contractor and coordinate during installation.

### Standardization, Supportability and Maintainability of Equipment

All fire protection equipment shall be standardized. All equipment to be used shall be readily and adequately supported in Samoa as much as possible. Adequate spares for important equipment shall be available in Samoa and all equipment shall be fully supported by the equipment manufacturers and suppliers.

**2.0 QUALITY**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide a project Quality Management System, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
* [complete/delete]

## STANDARDS

### General

Standard: To AS/NZS ISO 9001.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the definitions given in AS/NZS ISO 9000 and the following apply:

* + - Quality package: A designated part of the works, which may include the whole works, for which an individual quality system is required.
    - Service: After sales service, repairs and maintenance.

## SUBMISSIONS

### Quality Plan

Quality package: Submit a Quality Plan for each quality package, at least 10 working days before work on that package commences. Keep on site a copy of each approved quality plan.

### Authority approvals

General: Provide project Quality Management System documents to the following authority:

* [complete/delete]

### Calculations

Statistical techniques: Provide the methodology for statistical evaluation.

### Execution details

Requirement: Provide the procedure for sign-off and audit.

## INSPECTION

### Notice

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

* [complete/delete]

## PROJECT QUALITY MANAGEMENT SYSTEM REQUIREMENTS

* 1. **DOCUMENTATION REQUIREMENTS**

### Quality Plan

Standard: Conform to the recommendations of AS/NZS ISO 10005. Include inspection and test plans.

### Documented Procedures

Review: Provide evidence of revision(s) (including dates), approval and status of each procedure.

Register: Maintain a register of documented procedures including the title, identifier and revision status.

## DESIGN AND DEVELOPMENT

### General

Plan and control of product design and development: As documented in the **Design and development schedule**.

## PURCHASING

### General

External audits: Perform pre-tender surveys of subcontractors and suppliers and audit subcontractors and suppliers, as necessary by an approved auditor. Include audit and surveillance proposals in the quality package Quality Plan along with results of pre-tender surveys.

Verification: The contract administrator may verify at source, or upon receipt, that purchased product conforms to requirements.

## PRODUCTION AND SERVICE PROVISION

### Product Identification and Traceability

General: As documented in the **Product identification and traceability schedule**. Identification: Identify by lot / number / barcode all items of work, samples and site records. Traceability: Provide and maintain records of components for audit.

### Service

General: As documented in the **Service schedule**.

## MONITORING AND MEASUREMENT

* 1. **DOCUMENT CONTROL**

### Changes to documents

Revision: Review and approve changes to documents using the same functions or organizations that performed the original review and approval of the documents, except as described in the **Document control schedule**.

Retention: As documented in the **Quality records retention schedule**.

Evaluation: Make quality records available to the contract administrator for evaluation, within 2 days of the initial request.

Period of evaluation: Agree for each request, but at least 5 working days.

## INSPECTION AND TEST PLANS

### Content

Plan: Include the following:

* + - Detail all inspections and tests required including **Hold points**.
    - Identify acceptance criteria, sampling and testing and frequency of sampling/testing.
    - Identify responsibilities for inspection and testing and product/service approval.

### Control of non-conforming product

Acceptance of concession: Before the provision or repair of a non-conforming product, obtain permission to use the product.

### Hold points

Stages: Hold points during the construction/manufacturing process require release by the contract administrator.

Release: Requirements for release of a **Hold point** may include the following:

* + - Provision of information required by the technical specifications.
    - Certification of design/construction or installation.
    - Submission of any checklists or non-conformance forms as required.
    - Inspection/demonstration of works.

### Frequency of testing

Schedule: Conform to the **Frequency of testing schedule** for test requirements specific to the appropriate work section and the relevant standards.

## AUDITING

### General

Audit plan: Conform to the recommendations of AS/NZS ISO 19011 clauses 6.4 and 6.5. Initial systems audit: Carry out before date of site possession.

Compliance audits frequency: [complete/delete] Compliance activities: [complete/delete]

### Testing services

Testing authority: [complete/delete]

### External audits

Nominated auditor: [complete/delete]

## CORRECTIVE ACTION

### General

Review: Provide procedure to review the various control methods to minimize non-conformance. Record amendments to the project Quality Management System resulting from corrective action.

Non-conforming works: Include in the Quality Plan the procedure for reporting any non-conforming works to the contract administrator and any corrective action requests.

**3.0 GENERAL REQUIREMENTS**

## GENERAL

* 1. **RESPONSIBILITIES**

### Design

Design development: The works include development of the design beyond that documented, as required.

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

### Noise levels

General: Install systems within the limits of the contract design and documented equipment performance and as documented.

### Performance

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

* Fixed accessways: To AS 1657.
* Structural design actions: To the AS 1170 series.

## PRECEDENCE

### General

Work sections and referenced documents:

* + - The requirements of other work sections of the specification override conflicting requirements of this work section.
    - The requirements of the work sections override conflicting requirements of their referenced documents.
    - The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

### Common requirements

Requirement: Conform to the following work sections:

* *Adhesives, sealants and fasteners*.
* *Fire-stopping*.
* *Metals and prefinishes*.
* *Building IT components*. **Cross referencing styles** Within the text:
* Work section titles are indicated by *Italicized* text.
* Subsection titles are indicated by **BOLD** text.
* Clause titles are indicated by **BOLD** text.
* Subclause titles are indicated by **Bold** text.

## 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.

## INTERPRETATION

### Documentation conventions

Imperative mood and streamlined language: The words shall or shall be are implied where a colon is used following a keyword or within a sentence or sentence fragment.

Subject of sentences and phrases: Specification requirements are to be performed by the contractor, unless stated otherwise.

### Abbreviations

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

* AS: Australian Standard.
* BCA: National Construction Code Series Volume One: Building Code of Australia Class 2 to 9 Buildings and Volume Two: Building Code of Australia Class 1 and Class 10 Buildings.
* GRP: Glass Reinforced Plastic.
* IP: Ingress protection.
* NATA: National Association of Testing Authorities.
* NCC: National Construction Code.
* NZS: New Zealand Standard.
* PCA: National Construction Code Series Volume 3: Plumbing Code of Australia.
* PVC: Polyvinyl Chloride.
* PVC-U: Unplasticised Polyvinyl Chloride. Also known as UPVC.
* SDS: Safety data sheets.
* VOC: Volatile Organic Compound.
* WHS: Work Health and Safety.

### Definitions

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

* Access for maintenance: Includes access for maintenance, inspection, measurement, operation, adjustment, repair, replacement and other maintenance related tasks.
* Accessible, readily: Readily accessible, easily accessible, easy access and similar terms mean capable of being reached quickly and without climbing over or removing obstructions, mounting upon a chair, or using a movable ladder, and in any case not more than 2.0 m above the ground, floor or platform.
* 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.
* Contractor: Contractor has the same meaning as builder and is the person or organization bound to carry out and complete the work under the contract.
* Default: Specified value, product or installation method which is to be provided unless otherwise documented.
* Design life: The period of time for which it is assumed, in the design, that an asset will be able to perform its intended purpose with only anticipated maintenance but no major repair or replacement being necessary.
* Documented: Documented, as documented and similar terms mean contained in the contract documents.
* Economic life: The period of time from the acquisition of an asset to when the asset, while still physically capable of fulfilling its function and with only anticipated maintenance, ceases to be the lowest cost alternative for satisfying that function.
* Electricity distributor: Any person or organization that provides electricity from an electricity distribution system to one or more electrical installations. Includes distributor, supply authority, network operator, local network service provider, electricity retailer or electricity entity, as may be appropriate in the relevant jurisdiction.
* Fire hazard properties: To BCA A2.4.
* Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
* Give notice: Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the contract administrator.
* High level interface: Systems transfer information in a digital format using an open system interface.
* Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
* Ingress protection: IP, IP code, IP rating and similar expression have the same meaning as IP Code in AS 60529.
* Joints:

. Construction joint: A joint with continuous reinforcement provided to suit construction sequence.

. Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.

. Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.

. Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.

. Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.

. Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.

. Structural control joint: A control joints (contraction, expansion and isolation) in structural elements when used with applied material and finishes.

. Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.

. Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.

* Local (government) authority: A body established for the purposes of local government by or under a law applying in a state or territory.
* Low level interface: Systems transfer information via terminals and voltage free contacts.
* Manufacturer’s recommendations: Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer and/or supplier relating to the suitability, use, installation, storage and/or handling of a product.
* Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:

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

. Ferrous open sections zinc coated by an in-line process: To AS/NZS 4791.

. Ferrous hollow sections zinc coated by a continuous or specialised process: To AS/NZS 4792.

* Network utility operator: The entity undertaking the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or external stormwater drainage system.
* Obtain: Obtain, seek and similar expressions mean obtain (seek) in writing from the contract administrator.
* Pipe: Includes pipe and tube.
* Practical completion or Defects free completion: The requirements for these stages of completion are defined in the relevant building contract for the project.
* Principal: Principal has the same meaning as owner, client and proprietor and is the party to whom the contractor is legally bound to construct the works.
* Professional engineer: As defined by the BCA.
* Proprietary: 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.
* Prototype: A full size mock-up of components, systems or elements to demonstrate or test construction methods, junctions and finishes, and to define the level of quality.
* Record drawings: Record drawings has the same meaning as as-installed drawings, as-built drawings and work-as-executed drawings.
* Referenced documents: Standards and other documents whose requirements are included in this specification by reference.
* Registered testing authority:

. An organization outside Australia registered by an authority recognized by NATA through a mutual recognition agreement; or

. An organization recognized as being a Registered Testing Authority under legislation at the time the test was undertaken; or

. An organization registered by the National Association of Testing Authorities (NATA) to test in the relevant field.

* Required: Required by the documents, the local council or statutory authorities.
* If required: A conditional specification term for work which may be shown in the documents or is a legislative requirement.
* Sample: A physical example that illustrates products, workmanship, materials, or equipment and establish standards by which the work will be judged. It includes samples, prototypes and sample panels.
* Statutory authority: A public sector entity created by a specific law of the Commonwealth, State or Territory.
* Supply: Supply, furnish and similar expressions mean supply only.
* Tests - completion: 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 contract administrator may direct that completion tests be carried out after the date for practical completion.
* Tests - pre-completion: Tests carried out before completion tests, including:

. Production: Tests carried out on a purchased item, before delivery to the site.

. Progressive: Tests carried out during installation to demonstrate performance in according with this specification.

. Site: Tests carried out on the site.

. Type: Tests carried out on an item identical with a production item, before delivery to the site.

* 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.

## 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

Subsurface services: Information shown on the drawings relating to underground or submerged services is accurate to the following quality level:

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

## SUBMISSIONS

### Requirement

General: Submit the following, as documented:

* + - Authority approvals: Notes of meetings with authorities whose requirements apply to the work and evidence that notices, fees and permits have been sought and paid, that authority connections are complete and that statutory approvals by the authorities whose requirements apply to the work have been received.
    - Building penetrations: Details of the methods to maintain the required structural, fire and other properties to EXECUTION, **BUILDING PENETRATIONS**.
    - Certification: Certification of conformance to documented requirements, including certification that the plant and equipment submitted meets all requirements of the contract documents and that each installation is operating correctly.
    - Design: Design data and certification of proposed work, if required and as documented.
    - Electronic facility and asset management information: For the whole of the work to EXECUTION,

## ELECTRONIC FACILITY AND ASSET MANAGEMENT INFORMATION.

* + - Execution details: Execution programs, schedules and details of proposed methods and equipment. For building services include the following:

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

. Fixing of services: Typical details of locations, types and methods of fixing services to the building structure.

. Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.

* + - Marking and labelling: Samples and schedules of proposed marking and labels to EXECUTION,

## MARKING AND LABELLING.

* + - Operation and maintenance manuals: For the whole of the work to **EXECUTION**, **OPERATION AND MAINTENANCE MANUALS**.
    - Products: Products and materials data, including manufacturer’s technical specifications and drawing, evidence of conformance to product certification schemes, performance and rating tables and installation and maintenance recommendations.
    - Prototypes: Prototypes of components, systems or elements.
    - Records: As-built documents, photographs, system diagrams, schedules and logbooks to EXECUTION, **RECORD DRAWINGS**.
    - Samples: Representative of proposed products and materials and including proposals to incorporate samples into the works, if any to EXECUTION, **SAMPLES**.
    - Shop drawings: To EXECUTION, **SHOP DRAWINGS**.
    - Substitutions: To PRODUCTS**, GENERAL, Substitutions**.
    - Tests:

. Inspection and testing plan consistent with the construction program including details of test stages and procedures.

. Certificates for type tests.

. Fire hazard properties: Evidence of conformance of proposed proprietary products to documented requirements for fire hazard properties.

. Test reports for testing performed under the contract to EXECUTION, **TESTS**.

* + - Warranties: To EXECUTION, **WARRANTIES**.

Contractor review: Before submissions, review each submission item and check for coordination with other work of the contract and conformance to contract documents.

### Submission times

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

Submission response times: Allow in the construction program for at least the following times:

* Shop drawings: 5 working days
* Samples and prototypes: 5 working days
* Manufacturers’ or suppliers’ recommendations: 5 working days
* Product data: 5 working days
* Product/design substitution or modification: 5 working days

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

### Identification

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

Non-conformance: Identify proposals that do not conform with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

### Errors

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

### Electronic submissions

Electronic copies file format: As required Transmission medium: As required **Hard copy submissions**

Hard copy quantity: As required

* + - 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: As required

## INSPECTION

### Notice

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

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

### Light levels

Requirements: To AS/NZS 1680.2.4.

### Attendance

General: Provide attendance for documented inspections and tests.

## PRODUCTS

* 1. **GENERAL**

### Manufacturers’ or suppliers’ recommendations

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

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

Project modifications: Advise of activities that supplement, or are contrary to the recommendations of the manufacturers or supplier.

### Sealed containers

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

### Prohibited materials

General: Do not provide the following:

* Materials, exceeding the limits of those listed, in the Safe Work Australia Hazardous Substances Information System (HSIS).
* Materials that use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) in the manufacturing process.

### Substitutions

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

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

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

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

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

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

## 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 4312 and the AS/NZS 2312 series.

### Galvanizing

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

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

## EXECUTION

* 1. **SAMPLES**

### General

Incorporation of samples: Only 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.

Unincorporated samples: Remove on completion.

## SHOP DRAWINGS

### General

Documentation: 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 prepare dimensioned set-out drawings.

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

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

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

Submission medium: As required Drawing size: As required Standard: As required

Building work drawings for building services: On dimensioned drawings show 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.

## OFF-SITE DISPOSAL

### Removal of material

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

## WALL CHASING

### Holes and chases

General: If holes and chases are required in masonry walls, make sure structural integrity of the wall is maintained. Do not chase walls nominated as fire-resistance or acoustic rated.

Parallel chases or recesses on opposite faces of a wall: Not closer than 600 mm to each other.

Chasing in blockwork: Only in core-filled hollow blocks or in solid blocks which are not designated as structural.

**Concrete blockwork chasing table**

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

## FIXING

### General

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

### Fasteners

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

## 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.

## SERVICES INSTALLATION

### General

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

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

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

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

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

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

### Dissimilar metals

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

### Temporary capping

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

### Piping

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

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

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

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

Embedded pipes: Do not embed pipes that operate under pressure in concrete or surfacing material. Valve groupings: If possible, locate valves in groups.

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

### Differential movement

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

* Arrangement: Arrange pipes and conduits to minimize the number of control joints.
* Magnitude: Accommodate the predicted movements.

## BUILDING PENETRATIONS

### Penetrations

Requirement: Maintain the required structural, fire and other properties when penetrating or fixing to the following:

* + - 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.

### Sealing

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

Non fire-resisting 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-U sleeves formed from pipe sections as follows:

* + - Movement: Arrange to permit normal pipe or conduit movement.
    - Diameter (for non fire-resisting 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-resisting 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 or greater.

. PVC-U: 3 mm or greater.

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

## CONCRETE PLINTHS

### Construction

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

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

## SUPPORT AND STRUCTURE

### General

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

## 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 greater than 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 5.6.4. Provide additional brackets, clips or hangers to prevent pipe movement caused by water pressure effects.

Sanitary plumbing: To AS/NZS 3500.2 Table 10.2.1. Fuel gas: To AS/NZS 5601.1 Table 5.5.

Other pipes: To AS/NZS 3500.1 Table 5.6.4.

**Hanger size table**

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

## PLANT AND EQUIPMENT

### General

Location: Locate so that failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents including water sensitive equipment or finishes.

Safe tray and an overflow pipe: Provide to each tank, hot water heater and storage vessel.

## ACCESS FOR MAINTENANCE

### General

Requirement: Provide access for maintenance of plant and equipment.

Standards: Conform to the relevant requirements of AS 1470, AS 1657, AS/NZS 1892.1, AS 2865 and AS/NZS 3666.1.

Work Health and Safety: Conform to the requirements of the applicable Work Health and Safety regulations.

Protection from injury: Protect personnel from injury caused by contact with objects including those that are sharp, hot or protrude at low level.

Plant room flooring surfaces: R10 Slip resistance classification to AS 4586.

Trip hazards: Do not run small services including drains and conduits across floors where they may be a trip hazard.

Manufacturer's standard equipment: Modify manufacturer’s standard equipment when necessary to provide the plant access documented.

### Clearances

Minimum clearances for access: Conform to the following:

* ≥ 2100 mm clear vertically above horizontal floors, ground and platforms.
* Preferably ≥ 750 m clear, but in no case less than 600 mm horizontally between equipment or between equipment and building features including walls.
* If tools are required to operate, adjust or remove equipment, provide sufficient space so that the tools can be used in their normal manner and without requiring the user to employ undue or awkward force.
* If equipment components are hinged or removable, allow the space recommended by the manufacturer.
* Within plant items: Conform to the preceding requirements, and in no case less than the clearances recommended in BS 8313.

### Elevated services other than in occupied areas

Access classifications:

* Access class A: Readily accessible. Provide clear and immediate access to and around plant items. If plant or equipment is located more than 2.0 m above the ground, floor or platform, provide a platform with handrails accessible by a stair, all to AS 1657.
* Access class B: If the plant item requiring access is located more than 2.0 m above the ground, floor or platform, provide a platform with handrails accessible by a non-vertical ladder, all to AS 1657.
* Access class C: Locate plant so that temporary means of access conforming to Work health and Safety regulations can be provided.

Temporary means of access: Make sure there is adequate provision in place which is safe and effective.

Areas in which access is restricted to authorized maintenance personnel: Provide access as follows:

* Instruments, gauges and indicators (including warning and indicating lights) requiring inspection at any frequency: Readily accessible.
* Access required monthly or more frequently: Access class A.
* Access required between monthly and six monthly: Access class A or B.
* Access required less frequently than six monthly: Access class A, B or C. Other areas: Provide access as follows:
* Locate to minimize inconvenience and disruption to building occupants or damage to the building structure or finishes.
* In suspended ceilings, locate items of equipment that require inspection and/or maintenance above tiled parts. If not possible, provide access panels where located above set plaster or other inaccessible ceilings. Arrange services and plant locations to reduce the number of access panels. Coordinate with other trades to use common access panels where feasible.
* Do not locate equipment requiring access above partitions.
* Instruments, gauges and other items requiring inspection at any frequency: Readily accessible.
* Labelling: If equipment is concealed in ceilings, provide marking to **MARKING AND LABELLING**, **Equipment concealed in ceilings**.

### Facilities for equipment removal and replacement

Requirement: Provide facilities to permit removal from the building and replacement of plant and equipment, including space large enough to accommodate it and any required lifting and/or transportation equipment. Arrange plant so that large and/or heavy items can be moved with the minimum of changes of direction.

Removal of components: Allow sufficient space for removal and replacement of equipment components including air filters, tubes of shell and tube heat exchangers, removable heat exchanger bundles, coils and fan shafts. Provide access panels or doors large enough to permit the safe removal and replacement of components within air handling units.

### Facilities for access

Equipment behind hinged doors: Provide doors opening at least 150°.

Equipment behind removable panels: Provide panels with quick release fasteners or captive metal thread screws.

Removable panels: Provide handles to permit easy and safe removal and replacement.

Insulated plant and services: If insulation must be removed to access plant and services provide access for maintenance, arranged so it can be repeatedly removed and replaced without damage.

### Piping

Requirement: Conform to the following:

* Provide access and clearance at fittings which require maintenance, inspection 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.
* Preferably run piping, conduits, cable trays and ducts at high level and drop vertically to equipment.

### Electrical and controls

Electrical equipment: Provide clearances and access space to AS/NZS 3000.

Switchboards and electrical control equipment: Locate near the main entrance to plant space. Arrange plant so that, to the greatest extent possible, switchboards are visible from the plant being operated.

Control panels: Locate near and visible from the plant controlled.

## VIBRATION SUPPRESSION

### General

Requirement: Minimize the transmission of vibration from rotating or reciprocating equipment to other building elements.

### Standard

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

### Speeds

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

### Connections

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

### Inertia bases

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

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

### Vibration isolation mountings

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

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

## SEISMIC RESTRAINT OF NON-STRUCTURAL COMPONENTS

### General

Requirement: Seismic restraint to AS 1170.4: As required Earthquake design category: As required

## FINISHES TO BUILDING SERVICES

### General

Requirement: If exposed to view (including in plant rooms), paint new building services and equipment. Surfaces painted or finished off-site: Conform to the *0183 Metals and prefinishes* work section.

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

Standard: Conform to the recommendations of AS/NZS 2311 Sections 3, 6 and 7 or AS/NZS 2312.1

Sections 6, 7 and 8, as applicable.

### Powder coating

Standard:

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

### Painting systems

New unpainted interior surfaces: To AS/NZS 2311 Table 5.1. New unpainted exterior surfaces: To AS/NZS 2311 Table 5.2. **Paint application**

Coats: Apply the first coat immediately after substrate preparation and before contamination of the

substrate can occur. Make sure each coat of paint or clear finish is uniform in colour, gloss, thickness and texture and free of runs, sags, blisters or other discontinuities.

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

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

### Underground metal piping

Corrosion protection: Provide corrosion protection for the following:

* Underground ferrous piping.
* Underground non-ferrous metal piping in corrosive environments. Protection methods: Select from the following:
* Cathodic protection: Sacrificial anodes or impressed current. Incorporate a facility for periodic testing. Conform to the recommendations of AS 2832.1.
* Continuous wrapping using proprietary petroleum taping material.
* Impermeable flexible plastic coating.
* Sealed polyethylene sleeve.

### Low VOC emitting paints

Paint types: To the recommendations of AS/NZS 2311 Table 4.2.

## MARKING AND LABELLING

### General

Requirement: Mark and label services and equipment for identification purposes as follows:

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

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

Asset management labels and tags: As required

### Label samples and schedules

Submission timing: Before marking or labelling.

Schedule: For each item or type of item include the following:

* + - A description of the item or type of item for identification.
    - The proposed text for marking or labelling.
    - The proposed location of the marking and labelling.

### Electrical accessories

Circuit identification: Label isolating switches and outlets to identify circuit origin.

### Operable devices

Requirement: Mark to identify the following:

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

### 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 terminals).
    - Fire and smoke dampers.
    - Isolating valves not directly connected to items otherwise labelled.
    - Motorised dampers.
    - Wall mounted equipment in occupied areas: Provide labels on wall mounted items in occupied areas including the following:

. Services control switches.

. Temperature and humidity sensors.

### Points lists

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

### Pressure vessels

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

### Valves and pumps

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

### Underground services

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

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

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

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

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

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

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

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

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

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

### Labels and notices

Materials: Select from the following:

* + - Cast metal.
    - For indoor applications only, engraved two-colour laminated plastic.
    - Proprietary pre-printed self-adhesive flexible plastic labels with machine printed black lettering.
    - Stainless steel or brass minimum 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.

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

Lettering heights:

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

. Labels less than 2000 mm above floor: 3 mm on 6 mm wide tape.

. Labels minimum 2000 mm above floor: 8 mm on 12 mm wide tape.

. Other locations: Minimum 3 mm.

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

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

* + - If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
    - Use aluminium or monel rivets for aluminium labels. Vapour barriers: Do not penetrate vapour barriers.

## SOFTWARE

### General

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

## WARRANTIES

### General

Requirement: If a warranty is documented, name the principal as warrantee. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Warranty period: Start warranty periods at acceptance of installation.

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.

## RECORD DRAWINGS

### General

Requirement: Show the following:

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

### Recording, format and submission

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

Drawing layout: Use the same borders and title block as the contract drawings. Quantity and format: Conform to **SUBMISSIONS.**

Endorsement: Sign and date all record drawings.

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

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

### Services record drawings

General: To **General** and **Recording, format and submission** and the following:

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

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

* + - Controls.
    - Piping including all valves and valve identification tags.
    - Principal items of equipment.
    - Single line wiring diagrams.
    - Acoustic and thermal insulation.
    - Access provisions and space allowances.
    - Fixings.
    - Fixtures.
    - 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.

CAD base drawings: As required

Subsurface services: Record information on underground or submerged services to the documented quality level, conforming to AS 5488.

Subsurface services recording quality level: As required

## OPERATION AND MAINTENANCE MANUALS

### General

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 work sections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

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

### Contents

Requirement: Include the following:

* Table of contents: For each volume. Title to match cover.
* Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, sub consultants, contractor, subcontractors and names of responsible parties.
* Record drawings: Complete set of record drawings, full size.
* Drawings and technical data: As necessary for the efficient operation and maintenance of the installation. Include:

. 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.

* Installation description: General description of the installation.
* Systems descriptions and performance: Technical description of the systems installed and mode of operation, presented in a clear and concise format readily understandable by the principal’s staff. Identify function, normal operating characteristics, and limiting conditions.
* Systems performance: Technical description of the mode of operation of the systems installed.
* Baseline data: To AS 1851.
* Documentation to AS 1851 including the schedule of essential functionality and performance requirements.
* Digital photographic records to **Underground services**.
* Equipment descriptions:

. Name, address, email address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.

. Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.

. Manufacturers’ technical literature for equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation.

. Supplements to product data to illustrate relations of component parts. Include typed text as necessary.

* Certificates:

. Certificates from authorities.

. Copies of manufacturers’ warranties.

. Product certification.

. Test certificates for each service installation and all equipment.

. Test reports

. Test, balancing and commissioning reports.

. Control system testing and commissioning results.

* 7 day record of all trends at commissioning.
* Operation procedures:

. Manufacturers’ technical literature as appropriate.

. Safe starting up, running-in, operating and shutting down procedures for systems installed.

Include logical step-by-step sequence of instructions for each procedure.

. Control sequences and flow diagrams for systems installed.

. Legend for colour-codes services.

. Schedules of fixed and variable equipment settings established during commissioning and maintenance.

. Procedures for seasonal changeovers.

. If the installation includes cooling towers, a water efficiency management plan.

* Maintenance procedures:

. Detailed recommendations for periodic maintenance and procedures, including schedule of maintenance work including frequency and manufacturers’ recommended tests.

. Manufacturer’s technical literature as appropriate. Register with manufacturer as necessary.

Retain copies delivered with equipment.

. Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.

. Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.

. Schedule of normal consumable items, local sources of supply ,and expected replacement intervals up to a running time of 40 000 hours. Include lubrication schedules for equipment.

. Schedules for recording recommissioning data so that changes in the system over time can be identified.

. Instructions for use of tools and testing equipment.

. Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding.

. Safety data sheets (SDS).

. Instructions and schedules conforming to AS 1851, AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4.

* Maintenance records:

. Prototype service records conforming to AS 1851 prepared to include project specific details.

. Prototype periodic maintenance records and report to AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4 as appropriate, prepared to include project specific details.

. For hard copies: In binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.

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

### Format – electronic copies

Scope: Provide the same material as documented for hardcopy in electronic format. Quantity and format: Conform to **Submissions – electronic submissions**.

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

### Format – hard copy

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

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

Number of copies: 3.

### Date for submission

Draft submission: The earlier of the following:

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

Final submission: Within 2 weeks after practical completion.

## ELECTRONIC FACILITY AND ASSET MANAGEMENT INFORMATION

Facility and asset data: As required Data exchange schema: As required

Software compatibility requirements: As required File format: As required

Timing: As required

## TOOLS AND SPARE PARTS

### Spare Parts

General: Provide spare parts listed in the appropriate work sections. Replacement: Replace spare parts used during the maintenance period. **Tools and Spare Parts Schedule**

Submission timing: At least 8 weeks before the date for practical completion.

Requirement: Prepare a schedule of tools, portable instruments and spare parts necessary for maintenance of the installation. For each item state the recommended quantity and the manufacturer’s current price. Include the following in the prices:

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

Replacement: Replace spare parts used during the maintenance period.

## TESTS

### Attendance

General: Provide attendance on tests.

### Testing authorities

General: Except for site tests, have tests carried out by a Registered testing authority. Test instruments: Use instruments calibrated by a Registered testing authority.

### Test reports

General: Indicate observations and results of tests and conformance or non-conformance 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.

### 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 conformance with the documented performance requirements of the installation.

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

Type test reports: Required, as evidence of conformance 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.

### Certification

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

## TRAINING

### General

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

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

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

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

### Demonstrators

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

### Maintenance

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

### Operation

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

### Seasonal operation

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

## CLEANING

### Final cleaning

General: Before the date for 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.

## PERIODIC MAINTENANCE OF SERVICES

### General

Requirement: 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 documented 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: Record in binders provided with the Operation and maintenance manuals.

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

Certificates: Include test and approval certificates.

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

### Site control

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

## POST-CONSTRUCTION MANDATORY INSPECTIONS AND MAINTENANCE

### General

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

- 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.

Annual inspection: Perform an annual inspection and maintenance immediately before the end of the defects liability period.

**4.0 ADHESIVES, SEALANTS AND FASTENERS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide adhesives, sealants and fasteners, as documented.

### Performance

Requirements:

* Fitness for purpose: Capable of transmitting imposed loads, sufficient to make sure the rigidity of the assembly, or integrity of the joint.
* Finished surface: That will not cause discoloration.
* Compatibility: Compatible with the products to which they are applied.
* Sealant replacement: Capable of safe removal without compromising the application of the replacement sealant for future refurbishment.
* Movement: If an adhered or sealed joint is subject to movement, select a system certified to accommodate the projected movement under the conditions of service.
* Fasteners: Accredited for the particular use, capable of transmitting imposed loads and maintaining the rigidity of the assembly.

## PRECEDENCE

### General

Work sections and referenced documents:

* + - The requirements of other work sections of the specification override conflicting requirements of this work section.
    - The requirements of this work section override conflicting requirements of its referenced documents.
    - The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *0171 General requirements*.

## SUBMISSIONS

### Samples

Visible joint sealants: Submit colour samples.

### Technical data

Sealants: Submit technical data sheets.

### Tests

Other tests: Submit results as follows:

* Installed sealant tests: As required

Compatibility testing: Submit adhesion and compatibility testing data demonstrating that adhesive, sealant or fastener is compatible with materials to be fixed and is suitable for the project conditions.

### Warranties

Manufacturer’s warranty: Submit the manufacturer’s published product warranties.

## INSPECTION

### Notice

Inspection: Give notice so that inspection may be made of prepared joints and penetrations for each sealant application.

## PRODUCTS

* 1. **ADHESIVES**

### Standards

Mastic adhesive: To AS 2329.

Polymer emulsion adhesive for timber: To AS 2754.2, not inferior to Type 3.

### High strength adhesive tape

General description: A foam of cross linked polyethylene or closed cell acrylic coated both sides with a high performance acrylic adhesive system, encased in release liners of paper or polyester.

Product classification: Select tape to suit substrate as follows:

* Firm high strength foam tapes: For high energy surfaces including most bare metals such as stainless steel and aluminium.
* Conformable high strength foam: For the following:

. Medium energy surfaces including many plastics and paints, and bare metals.

. Lower energy surfaces including many plastics, most paints and powder coatings, and bare metals.

Thickness: Select the tape to make sure a mismatch between surfaces does not exceed half the tape thickness under the applied lamination pressure.

## SEALANTS

### Standards

General: To ISO 11600.

### External masonry joints

General: Provide sealant and bond breaking materials which are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.

Bond breaking backing:

* Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
* Foamed materials: Closed-cell or impregnated, not water-absorbing.

### Fire-resisting control joints

General: Provide sealant materials that maintain the nominated fire-resistance level (FRL).

* Fire-stopping: To AS 4072.1.

### Lightweight building element joints

Joints subject to rapid changes of movement: Provide sealants that accommodate the movement of the contact materials.

### Floor control joints

General: Provide trafficable sealants. Bond breaking backing:

* Bond breaking materials: Non-adhesive to sealant, or faced with a non-adhering material.
* Foamed materials: Closed-cell or impregnated, not water-absorbing.

## FASTENERS

### General

Masonry anchors: Proprietary expansion or bonded type anchors conforming to **SELECTIONS, ANCHORS**.

Plain washers: To AS 1237.1.

* Provide washers to the heads and nuts of bolts, and the nuts of coach bolts. Plugs: Proprietary purpose-made plastic.

Powder-actuated fasteners: To AS/NZS 1873.4. Stainless steel fasteners: To ASTM A240/A240M. Steel nails: To AS 2334.

* Length: At least 2.5 times the thickness of the member being secured, and at least 4 times the thickness if the member is plywood or building board less than 10 mm thick.

Unified hexagon bolts, screws and nuts: To AS/NZS 2465. Fasteners in CCA treated timber: Epoxy coated or stainless steel. **Bolts**

Coach bolts: To AS/NZS 1390.

Hexagon bolts Grades A and B: To AS 1110.1. Hexagon bolts Grade C: To AS 1111.1.

### Corrosion resistance

Atmospheric corrosivity category: To the *0171 General requirements* work section.

Steel products: Conform to the **Corrosion-resistance table** or provide proprietary products with metallic and/or organic coatings of equivalent corrosion-resistance.

### Corrosion-resistance table

|  |  |  |  |
| --- | --- | --- | --- |
| Atmospheric corrosivity category to AS 4312 | Threaded fasteners and anchors | | Powder actuated fasteners |
| Material | Minimum local metallic coating thickness (µm) | Material |
| C1 and C2 | Electroplated zinc or Hot- dip galvanized | 30 | Stainless steel 316 |
| C3 | Hot-dip galvanized | 50 | Stainless steel 316 |
| C4 and T | Stainless steel 316 | - | Stainless steel 316 |

**Finishes**

Electroplating:

* Metric thread: To AS 1897.
* Imperial thread: To AS 4397. Galvanizing:
* Threaded fasteners: To AS 1214.
* Other fasteners: To AS/NZS 4680. Mild steel fasteners: Galvanize if:
* Embedded in masonry.
* In external timbers.
* In contact with chemically treated timber other than CCA treated timber. Epoxy coated:
* CCA Treated timber.

### Nuts

Hexagon chamfered thin nuts Grades A and B: To AS 1112.4. Hexagon nuts Grade C: To AS 1112.3.

Hexagon nuts Style 1 Grades A and B: To AS 1112.1. Hexagon nuts Style 2 Grades A and B: To AS 1112.2. **Screws**

Coach screws: To AS/NZS 1393.

Hexagon screws Grades A and B: To AS 1110.2. Hexagon screws Grade C: To AS 1111.2.

Hexagon socket screws: To AS 1420 and AS/NZS 1421. Machine screws: To AS/NZS 1427.

Self-drilling screws: To AS 3566.1.

Self-tapping screws:

* Crossed recessed countersunk (flat – common head style): To AS/NZS 4407.
* Crossed recessed pan: To AS/NZS 4406.
* Crossed recessed raised countersunk (oval): To AS/NZS 4408.
* Hexagon: To AS/NZS 4402.
* Hexagon flange: To AS/NZS 4410.
* Hexagon washer: To AS/NZS 4409.
* Slotted countersunk (flat – common head style): To AS/NZS 4404.
* Slotted pan: To AS/NZS 4403.
* Slotted raised countersunk (oval – common head style): To AS/NZS 4405.

### Blind rivets

Description: Expanding end type with snap mandrel.

Type: Closed end for external application, open end for internal application. End material:

* Aluminium base alloy for metallic-coated or prepainted steel.
* Stainless steel for stainless steel sheet.
* Copper for copper sheet. Size:
* For sheet metal to sheet metal: 3 mm.
* For sheet metal to supports, brackets and rolled steel angles: 4.8 mm.

### Performance

Loads: Provide fasteners capable of transmitting the loads imposed, and sufficient to make sure the rigidity of the assembly.

## EXECUTION

* 1. **ADHESIVES**

### General

Requirement: Install to the manufacturer’s recommendations.

### Preparation

Substrates: Conform to the following:

* Remove any deposit or finish which may impair adhesion.
* If framed or discontinuous, provide support members in full lengths without splicing.
* If solid or continuous, remove excessive projections.
* If previously painted, remove cracked or flaking paint and lightly sand the surface.

### Contact adhesive

Precautions: Do not use contact adhesive if:

* A substrate is polystyrene foam.
* A PVC substrate may allow plasticizer migration.
* The adhesive solvent can discolour the finished surface.
* Dispersal of the adhesive solvent is impaired.

Two-way method: Immediately after application, press firmly to transfer adhesive and then pull both surfaces apart. Allow to tack off and then reposition and press firmly together. Tap areas in contact with a hammer and padded block.

One-way method: Immediately after application, bring substrates together and maintain maximum surface contact for 24 hours by clamps, nails or screws as appropriate. If highly stressed, employ permanent mechanical fasteners.

### High strength adhesive tape

Preparation:

* Non-porous surfaces: Clean with surface cleaning solvents such as isopropyl alcohol/water, wash down and allow to dry.
* Porous surfaces: Prime the surface with a contact adhesive compatible with the tape adhesive system.

Follow the recommendations of the manufacturer for application to the following: Copper, brass, plasticized vinyl and hydrophilic surfaces such as glass and ceramics in a high humidity environment.

Applied lamination pressure: Make sure the tape experiences 100 kPa. Application temperature: Generally above 10°C, consult the manufacturer. Completion: Do not apply loads to the assembly for 72 hours at 21°C.

## JOINT SEALING

### General

Requirement: Install to the manufacturer’s recommendations.

### Joint preparation

Cleaning: Cut flush joint surface protrusions and rectify if required. Mechanically clean joint surfaces free of any deposit or finish which may impair adhesion of the sealant. Immediately before sealant application, remove loose particles from the joint, using oil-free compressed air.

Bond breaking: Install bond breaking backing material.

Taping: Protect the surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of sealant application, remove the tape and remove any stains or marks from adjacent surfaces.

Primer: Apply the recommended primer to the surfaces in contact with sealant materials.

### Sealant joint proportions

General weatherproofing joints (width:depth):

* 1:1 for joint widths less than 12 mm.
* 2:1 for joint widths greater than 12 mm.

### Sealant application

General: Apply the sealant to dry joint surfaces using a pneumatic applicator gun. Make sure the sealant completely fills the joint to the required depth, provides good contact with the full depth of the sides of the joint and traps no air in the joint. Do not apply the sealant outside the recommended working time for the material or the primer.

### Weather conditions

Two pack polyurethanes: Do not apply the sealant if ambient conditions are outside the following:

* Temperature: Less than 5°C or greater than 40°C.
* Humidity: To the manufacturer’s recommendations.

### Joint finish

General: Force the sealant into the joint and finish with a smooth, slightly concave surface using a tool designed for the purpose.

Excess sealant: Remove from adjoining surfaces using cleaning material nominated by the sealant manufacturer.

### Protection

General: Protect the joint from inclement weather during the setting or curing period of the material.

### Rectification

General: Cut out and remove damaged portion of joint sealant and reinstall so repaired area is indistinguishable from undamaged portion.

## TESTING

### Installed sealant tests

Sampling: For each sealant test, take 3 samples of installed and cured sealant, each at least 50 mm long, from completed joints.

Reinstatement: Repair-as-new the joints from which the samples were taken.

## FASTENERS

### General

Requirement: Install to the manufacturer’s recommendations.

### Fastening to wood and steel

Timber substrates: To AS 1720.1 Section 4.

Self drilling screws: To AS 3566.1 for timber and steel substrates.

### Masonry anchors

Installation: To the manufacturer’s recommendations.

**5.0 FIRE-STOPPING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fire-stopping, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *0171 General requirements*.

## PRECEDENCE

### General

Work sections and referenced documents:

* + - The requirements of other work sections of the specification override conflicting requirements of this work section.
    - The requirements of this work section override conflicting requirements of its referenced documents.
    - The requirements of the referenced documents are minimum requirements.

## STANDARDS

### General

Service penetration fire-stopping systems: To BCA C3.15. Control joint fire-stopping systems: To AS 4072.1.

## SUBMISSIONS

### Certification

General: Submit evidence of conformance with the recommendations of AS 4072.1 Appendix B.

Certification: Submit a completed certification list and schedule for installed fire-stopped penetrations and control joints.

* List form: To AS 4072.1 Figure B1.
* Schedule form: To AS 4072.1 Figure B2.

### Execution

General: Give notice, if substrates or penetrants or both are not suitable for fire-stopping.

### Manual

General: For fire-stopping systems which are intended to be modified in service, submit a user manual.

### Manufacturers’ information

General: If fire-stopping is documented without reference to brand, submit the following:

* Evidence that systems conform to documented requirements.
* Copies of relevant manufacturers’ instructions.
* Safety data sheets (SDS).

### Sample panels

General: Supply a sample panel of each fire-stopping assembly, on representative substrates. If built into the works, identify by marking it as a control sample.

Size: 500 mm run for junction seals and 500 x 500 mm area for penetration seals.

### Subcontractors

General: Submit names and contact details of proposed suppliers and installers. Evidence of experience: As required

### Tests

Type tests: Submit type test certificates for each combination of fire-stopping system, application, type of service, substrate, penetration orientation and drawings of tested details. Include for:

* Service penetration fire-stopping systems: Fire resistance tested to AS 1530.4.
* Fire stop mortars: Resistance to explosive spalling to AS 1774.36.
* Control joint fire-stopping systems: Fire resistance tested to AS 1530.4.

## INSPECTION

### Pre-installation meeting

General: Hold a meeting at the project site with the fire-stopping materials manufacturer and installer to review the fire-stopping requirements. Give notice.

### Notice

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

* Service penetrations completed and ready for fire-stopping.
* Finished fire-stopping, before being concealed.
* Authority inspections: As required

## PRODUCTS

* 1. **MATERIALS**

### General

Shelf life: Use materials that have not exceeded their shelf life.

Toxic materials: Free of asbestos and lead and free of, nor requiring the use of, toxic solvents. Toxicity in fire: Non-toxic.

### Fire-stop mortars

Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant. Insoluble in water, after setting.

### Formulated compound of incombustible fibres

Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

### Fibre stuffing

Material: Mineral fibre stuffing insulation, dry and free of other contaminants. Standard: AS/NZS 4859.1 Section 8.

Sealant: As required **Intumescent fire pillows** Product: As required

### Fire-stop composite sheets

Product: As required

### Fire-stop sealants

Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant. Capable of providing a smoke-tight, gas-tight and waterproof seal when properly installed. Insoluble in water after setting.

### Fire-stop foams

Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant. Insoluble in water after setting.

### Fire-stop putty

Material: Single component, moldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which conforms to the following:

* Expands on exposure to surface heat gain to form a high-volume thermally insulating char that closes gaps and voids.
* Resists the turbulence of a severe fire.
* Can be placed by hand to form an immediate fire seal.
* Insoluble in water after setting. **Product certification** Certification scheme: As required

Conformance: Address the following:

* Statutory and performance requirements.
* Adequacy of application/installation.

Appointment: In the joint names of the contractor and the principal.

## COMPONENTS

### Fire-stop collars

Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

### Fire-stop pillows

Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

### Accessories

Primer: As required

Permanent dam material: Non-combustible.

* Type: As required Metal lath: As required

Installation accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

### Product certification

Certification scheme: As required

## EXECUTION

* 1. **INSTALLATION**

### General

Extent: Fire-stop and smoke-stop interruptions to fire-resistance rated assemblies, materials and components, including penetrations through fire-resisting elements, breaks within fire-resisting elements (e.g. expansion joints), and junctions between fire-resisting elements.

Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.

Installer qualifications: As required

Ventilation: Supply ventilation for non-aqueous solvent-cured materials. Density: Apply fire-stopping material to a uniform density.

Fire-stopping exposed to view: Finish surfaces to a uniform and level condition. Cable separation: Maintain cable separation.

Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping. Protect completed fire-stopping from damage arising from other work.

Loose or damaged fire-stopping material: Remove and replace.

Penetrations by pipes and ducts: Allow for thermal movement of the pipes and ducts.

Preventing displacement: Reinforce or support fire-stopping materials with non-combustible materials when:

* The unsupported span of the fire-stopping materials is greater than 100 mm.
* The fire-stopping materials are non-rigid (unless shown to be satisfactory by test). Environmental management: As required

Ambient conditions: To local conditions as applicable

Large openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.

### Preparation

Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect the bond of fire-stop material.

Primer: Clean and dry substrates for primers and sealants.

Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

## SYSTEMS

### Fire-stop mortars

Ambient conditions: Do not install below 5°C. **Formulated compound of incombustible fibres** Installation: As required

### Fibre stuffing

Installation: Compress to 40% of its uncompressed volume.

### Fire-stop composite sheets

Installation: As required

### Fire-stop sealants

Ambient conditions: Do not store above 32°C. Do not install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

### Fire-stop foams

Ambient conditions: Do not store above 32°C. Do not install below 15°C or above 32°C. Do not apply when temperature of substrate and air is below 15°C. Maintain this minimum temperature before, during and for 3 days after installation.

Installation: Test substrates for adhesion and prime if necessary. Place in layers for homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

### Fire-stop putty

Ambient conditions: Do not install below 5°C. Do not allow the material to freeze. Installation: As required

**Fire-stop collars** Installation: As required **Fire-stop pillows**

Ambient conditions: Do not install in conditions outside the manufacturer’s recommendations.

### Labelling

General: Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:

* Manufacturer’s name.
* Name and address of installer.
* Date of installation.

## COMPLETION

### Cleaning

Requirement: Remove spilled and excess fire-stopping materials without damaging other work.

**6.0 METALS AND PREFINISHES**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirements: Provide metal and prefinishes as documented.

### Performance

Requirement: Provide metals in sections of strength and stiffness suited to their required function, finish and method of fabrication.

## PRECEDENCE

### General

Work sections and referenced documents:

* + - The requirements of other work sections of the specification override conflicting requirements of this work section.
    - The requirements of this work section override conflicting requirements of its referenced documents.
    - The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *0171 General requirements*.

## SUBMISSIONS

### Samples

General: Submit samples of the following:

* + - Stainless steel: One sample of every documented surface finish.
    - Anodizing: One sample of every colour and finishing option.

## PRODUCTS

* 1. **METALS**

### Aluminium and aluminium alloys

Drawn pipe: To AS/NZS 1867.

Drawn rod, bar and strip: To AS/NZS 1865. Extrusions: To AS/NZS 1866.

Plate and sheets: To AS/NZS 1734.

### Coated steel

Electrogalvanized (zinc) coating on ferrous hollow and open sections: To AS 4750. Metallic-coated: Steel coated with zinc or aluminium-zinc alloy as follows:

* Ferrous open sections by an in-line process: To AS/NZS 4791.
* Ferrous hollow sections by a continuous or specialized process: To AS/NZS 4792.
* Metallic-coated steel sheet: To AS 1397. Metal thicknesses specified are base metal thicknesses. Steel wire: To AS/NZS 4534.

### Copper and copper alloys

Casting: To AS 1565.

Plate, sheet and strip: To AS 1566.

Rods, bars and sections: To AS/NZS 1567. Composition and designations: To AS 2738. **Stainless steel**

Bars: To ASTM A276/A276M.

Plate, sheet and strip: To ASTM A240/A240M. Welded pipe (plumbing applications): To AS 1769.

Welded pipe (round, square, rectangular): To ASTM A554.

### Steel

Sheet: To AS/NZS 1595.

Structural bars and sections: To AS/NZS 3679.1. Structural hollow section: To AS/NZS 1163.

### Steel for prefinishes

Cold rolled bar: To AS 1443 - Bright. Cold rolled sheet: To AS/NZS 1595.

* Designation: CA2S-E.

Electric resistance welded tube: To AS 1450.

## EXECUTION

* 1. **GENERAL**

### Metal separation

Incompatible sheet metals: Provide separation by one of the following:

* + - Apply an anti-corrosion low moisture transmission coating such as alkyd zinc phosphate primer or aluminium pigmented bituminous paint to contact surfaces.
    - Insert a concealed separation layer such as polyethylene film, adhesive tape, or bituminous felt. Incompatible fixings: Do not use.

Incompatible service pipes: Install lagging or grommets. Do not use absorbent, fibrous or paper products.

### Brazing

General: Make sure brazed joints have sufficient lap to provide a mechanically sound joint.

Butt joints: Do not use butt jointing for joints subject to load. If butt joints are used, do not rely on the filler metal fillet only.

Filler metal: To AS/NZS 1167.1.

### Finishing

Visible joints: Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanizing or electroplating. Make sure self-finished metals are without surface colour variations after jointing.

### Preparation

General: Before applying decorative or protective prefinishes to metal components, complete welding, cutting, drilling and other fabrication, and prepare the surface using a suitable method.

Standard: To AS 1627 series.

Priming steel surfaces: If site painting is documented to otherwise uncoated mild steel or similar surfaces, prime as follows:

* + - After fabrication and before delivery to the works.
    - After installation, repair damaged priming and complete the coverage to unprimed surfaces.

### Welding

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6. Steel: To AS/NZS 1554.1.

## STAINLESS STEEL FINISHES

### General

Requirement: Provide a surface finish to match the approved sample. Sample identification: As required

### Pre-assembly

Mechanically polished and brushed finishes: Apply grit faced belts or fibre brushes that achieve uni- directional finishes with buffing, as required to provide the following:

* Finish designation: As required

Bead blasted finish: Provide a uniform non-directional low reflective surface by bead blasting. Do not use sand, iron or carbon steel shot. Blast both sides of austenitic grades or stainless steel to equalize induced stress.

Electrolytically coloured finish: Provide the following:

* Colour: As required Patterned/textured: Provide the following:
* Product: As required

### Post-assembly pre-treatment

Heat discolouration: Remove by pickling.

Welds: Grind excess material, brush, and polish to match the pre-assembly finish.

### Post-assembly finish

Electropolish finish for external installations: Provide an electro-chemical process to stainless steel type 316.

Brushed electropolish finish: Conform to the following:

* Pre-assembly finish: No. 4 brushed finish.
* Post-assembly finish: Provide an electro-chemical processed finish to achieve a No. 7 to No. 8 brushed finish.

Mirror electropolish finish:

* Pre-assembly finish: Mill finish 2B or mirror polished finish.
* Post-assembly finish: Provide an electro-chemical processed finish to achieve a No. 8 mirror finish.

### Completion

Cleaning: Clean and rinse to an acid free condition and allow to dry. Do not use carbon steel abrasives or materials containing chloride.

Protection: Secure packaging or strippable plastic sheet.

## NON-FERROUS FINISHING

### Mechanical finishes

Bright finished copper alloy surfaces: For indoor applications, apply a clear lacquer protecting coating.

## ELECTROPLATING

### Electroplated coatings

Chromium on metals: To AS 1192.

* + - Service condition number: At least 2. Nickel on metals: To AS 1192.
    - Service condition number: At least 2. Zinc on iron or steel: To AS 1789.

## ANODISING

### General

Standard: To AS 1231.

Thickness grade: To AS 1231 Table H1. Application: As required

Description: As required Colour: As required Finish: As required Warranty: As required **Sample**

General: Provide a finish to match the sample in terms of colour and finishing options.

Sample identification: As required

## METAL SPRAYING

### Metal spray

Standard: To ISO 2063.

Minimum thicknesses:

* Indoor applications: 125 µm.
* Outdoor applications: 175 µm. Process: Electric arc.

Seal coat: Cover the metal spray finish with two coats of vinyl seal to a total dry film thickness of 80 µm.

## PREPAINTING

**Air-drying enamel** Application: Spray or brush. Finish: Full gloss.

General use:

* + - Primer: Two-pack epoxy primer to AS/NZS 3750.13.
    - Top coats: 2 coats to AS 3730.6. Oil resistant use:
    - Primer: Two-pack epoxy primer to AS/NZS 3750.13.
    - Top coats: 2 coats to AS/NZS 3750.22.

### Equipment paint system

Description: Brush or spray application using paint as follows:

* + - Full gloss enamel finish coats, oil and petrol resistant: To AS/NZS 3750.22, two coats.
    - Prime coat to metal surfaces generally: To AS/NZS 3750.19 or AS/NZS 3750.20.
    - Prime coat to zinc-coated steel: To AS 3730.15 or AS/NZS 3750.16.
    - Undercoat: To AS/NZS 3750.21. **Prepainted metal products** Standard: To AS/NZS 2728. Product finish: As required

Product type as noted in AS/NZS 2728: Not lower than the type appropriate to the field of application.

**Stoving enamel** Application: Spray or dip. Internal use:

* Primer: As required
* Topcoat: As required **Two-pack liquid coating** Application: Spray. Finish: Full gloss.

Primer: Two pack epoxy primer to AS/NZS 3750.13. Topcoat:

* + - Internal use: Proprietary polyurethane or epoxy acrylic system.
    - External use: Proprietary polyurethane system.

## COMPLETION

### Damage

Damaged prefinishes: Remove and replace items, including damage caused by unauthorized site cutting or drilling.

### Repair

Metallic-coated sheet: If repair is required to metallic-coated sheet or electro galvanizing on inline galvanized steel products, clean the affected area and apply a two-pack organic primer to AS/NZS 3750.9.

**7.0 SERVICE TRENCHING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide trenching for underground services, as documented.

### Design

Steel shoring and trench lining systems: To AS 4744.1. Hydraulic shoring and trench lining equipment: To AS 5047. Authority requirements: As required

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *0171 General requirements*.

## STANDARDS

### General

Earthworks: To AS 3798.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - CBR value: California Bearing Ratio value.

## TOLERANCES

### General

Earthworks: As required.

## SUBMISSIONS

### General

Extent: Submit a plan of trench works noting the location and type of service. Notice: Advise proposed duration of open excavation.

Construction: Submit details of proposed equipment and method of excavation.

Stability: If shuttering and/or bracing of the sides of a trench is required for safety and stability, provide proposals.

Geotechnical data: Provide a geotechnical report supporting the procedures proposed for trenching and/or boring.

Hazards: Identify WHS hazards that may be encountered with deep trenches including toxic gases and liquids.

Boring: Submit proposals for the following:

* Limits on length.
* Existence of other services and method of protection.
* Pressure grouting to voids.
* The effect of pressure grouting on other services, ground heave and proposals for minimizing such effects.
* Access to properties outside the site.
* Council permits.
* Service interruptions including a plan for minimizing unintended interruptions.

### Off-site disposal

Disposal location: Submit the locations and evidence of compliance with the relevant authorities for the disposal of material required to be removed from the site.

## INSPECTION

### Notice

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

* + - Service trenches excavated before laying the service.
    - Services laid in trenches and ready for backfilling.

## PRODUCTS

* 1. **FILL MATERIALS**

### General

Requirement: Provide fill materials including borrow or imported fill as approved.

## EXECUTION

* 1. **EXISTING SERVICES**

### Location

Requirement: Before commencing service trenching, locate and mark existing underground services in the areas which will be affected by the service trenching operations.

Utility services: Contact DIAL BEFORE YOU DIG to identify location of underground utility services pipes and cables.

### Excavation

General: Do not excavate by machine within 1 m of existing underground services.

## EXISTING SURFACES

### Concrete and asphalt pavements

Method: Sawcut trench set out lines for the full depths of the bound pavement layers except where the set out line is located along expansion joints.

Removal of concrete and asphalt: Break out concrete or asphalt pavement material between the trench set out lines, remove and dispose of off-site.

### Segmental paving units

Removal: Take up segmental paving units both full and cut by hand, between the trench set out lines, and neatly stack on wooden pallets.

Concrete edging: Break out, remove and dispose of off-site. Concrete subbase: If present, sawcut along the trench set-out lines. **Grass**

Removal method: Neatly cut grass turf between trench set-out lines into 300 mm squares.

Grass suitable for re-use: Take up and store the turf and water during the storage period, otherwise remove and dispose of it off-site.

### Small plants, shrubs and trees

Small plants required for re-planting: Take up and store. Wrap the rootball in a hessian or plastic bag with drain holes and water during the storage period.

Unsuitable vegetation: Remove and dispose of off-site.

## EXCAVATING

### Site preparation

As found site conditions: As approved.

Records of measurement: If Records of measurement are required, to as approved. Remove topsoil: As approved

General: Excavate for underground services in conformance with the following:

* To required lines and levels, with uniform grades.
* Straight between access chambers, inspection points and junctions.
* With stable sides.
* Width tolerance: ± 50 mm, unless constrained by adjacent structures.
* Excavation: As approved.

### Trench widths

General: Keep trench widths to the minimum, consistent with the laying and bedding of the relevant service and construction of access chambers and pits.

### Trench depths

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

Adjacent to footings: If excavation is necessary below the zone of influence of the underside of adjacent footings, give notice, and provide support for the footings as instructed.

### Obstructions

General: Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Tree protection: To AS 4970.

### Dewatering

General: Keep trenches free of water. Place bedding material, services and backfilling on firm ground, free of surface water.

Pumping: Provide pump-out from adjacent sumps or install well points. Adjacent subsidence: Provide recharge points to isolate the dewatering zone. **Excess excavation**

General: If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing

value using compacted bedding material or sand stabilized with 1 part of cement to 20 parts of sand by volume.

### Stockpiles

Excavated material for backfill: If required, segregate the earth and rock material and stockpile, for re- use in backfilling operations.

Locations: Do not stockpile excavated material against tree trunks, buildings, fences or obstruct the free flow of water along gutters where stockpiling is permitted along the line of the trench excavation.

Disposal: If stockpiling is not permitted, dispose of excavated material off-site.

### Unsuitable material

Disposal: Remove unsuitable material from the bottom of the trench or at foundation level and dispose of off-site. Replace with backfill material as approved

Subcontractor: If under road boring is required instead of trenches, engage a suitably qualified subcontractor to do the work.

## TRENCH BACKFILL

### General

Timing: Backfill service trenches as soon as possible after laying and bedding the service, if possible on the same working day.

Marking services: Underground marking tape to AS/NZS 2648.1. Place fill: As approved.

### Bedding, haunch, side and overlay zones

Installation and material: To the particular utility authority or utility service requirements. Secure pipes against floatation.

Overlay zone thickness: Maximum 300 mm immediately over the utility service. Topsoil areas: Complete the backfilling with at least 100 mm of topsoil.

Material in reactive clay areas: In sites classified M, M-D, H1, H1-D, H2, H2-D, E or E-D to AS 2870, re-use excavated site material at a moisture content within ± 1% of that of the adjoining in situ clay.

### Selected material zone

Extent: The section of trench within the zone, if applicable.

Backfill material: Selected material free from stones larger than 100 mm maximum dimension and the fraction passing a 19 mm Australian Standard sieve to have a 4 day soaked CBR value, in conformance with AS 1289.6.1.2, and not less than that of the adjacent selected material zone.

### Trees

Backfill at trees: Backfill minimum 300 mm thick, around tree roots with a topsoil mixture. Place and compact in layers of 150 mm minimum depth to a dry density equal to that of the surrounding soil.

Do not place backfill: Above the original ground surface around tree trunks or over the root zone. Watering: Thoroughly water immediately after backfilling the tree root zone.

### Compaction

Control moisture within backfill: As approved.

Layers: Compact all material in layers not exceeding 150 mm compacted thickness. Compact each layer to the required relative compaction before starting the next layer.

Compaction: As approved.

Frequency of testing: To AS 3798 clause 8.7.

Precautions: If compacting adjacent to utility services, use compaction methods which do not cause damage or misalignment.

### Density tests

Testing authority: Carry out density tests of pipe bedding and backfilling by a registered testing authority.

Test methods: Conform to the following

* Compaction control tests: To AS 1289.5.4.1 or AS 1289.5.7.1.

- Field dry density: AS 1289.5.3.2 or AS 1289.5.3.5.

* Standard maximum dry density: AS 1289.5.1.1.
* Dry density ratio: AS 1289.5.4.1.
* Density index: AS 1289.5.6.1.

## SURFACE RESTORATION

### Subbase and base

Material: Crushed rock, DGS20 or DGB20 material configured in layers and depths to match existing and adjacent work.

Supply and installation: As approved.

Compaction: Uniformly compact each layer of the subbase and base courses over the full area and depth within the trench to a relative compaction of 100% when tested in conformance with

AS 1289.5.4.1.

Compaction test frequency: Minimum 1/every second layer/50 m² of restoration surface area.

### Pathways and paved areas generally

Restoration materials: Consistent with the surface existing before commencement of the works.

Subbase: 150 mm crushed stone DGB20 compacted to 100% relative compaction in conformance with AS 1289.5.4.1.

Lippage at patches: Match the surface level at any point along the patch’s edge with the adjoining footpath surface within ± 5 mm.

### Concrete surfaces

Construction: Conform to the following:

* Prime coat the cut edges of the existing surfaces with cement slurry. Lay and compact concrete so that the edges are flush and the centre is cambered 10 mm above the adjoining existing surfaces.
* Material: 25 MPa concrete.
* Surface finish and pattern: Match existing adjoining work.
* Minimum thickness: 75 mm or the adjacent pavement thickness, whichever is thicker.
* Reinforcement and dowels: If required, provide steel reinforcement with dowels into the adjacent concrete.
* Expansion joints: 15 mm thick preformed jointing material of bituminous fibreboard placed where new concrete abuts existing concrete and in line with joints in existing concrete.
* Control joints:

. Form control joints strictly in line with the control joints in existing concrete.

. Around electricity supply poles: Terminate the concrete paving 200 mm from the pole and fill the resulting space with cold mix asphalt.

Curing: Cure by keeping continuously wet for 7 days.

### Asphalt footpaths

Materials and installation: As approved.

Thickness: Match the adjoining footpath. Finish: Compact to a smooth even surface. **Segmental paving units**

Materials and installation: As approved and as follows:

* Laying: Re-lay to match the pattern and surface levels of the existing paving.
* Damaged paving units unsuitable for relaying: Replace paving units with new units of the same material, type, size and colour as the existing.

### Landscaped areas

In topsoil areas: Complete the backfilling with topsoil for at least the top 100 mm.

Lawn: Re-lay stockpiled turf. If existing turf is no longer viable, re-sow the lawn over the trench and other disturbed areas.

Planted areas: Overfill to allow for settlement.

**SECTION B – MECHANICAL SYSTEMS**

**1.0 MECHANICAL SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide the mechanical services, as documented. Summary: The mechanical services are summarized as follows:

### Mechanical Services Scope of Works

Mechanical services scope of works for the project shall be as follows:

The complete fabrication, supply, delivery, off-loading, hoisting into position, installation, testing, commissioning, setting to work, demonstrating, training and maintenance of the following necessary to complete the intent of the project:

* + 1. Design and documentation of mechanical services air conditioning and ventilation for the project as per the stated design intent in this specification.
    2. All VRF and split type air conditioning units including wall mounted units, ceiling cassette units, in-ceiling ducted fan coil unit with all associated outdoor condenser units, wall mounted hard wired control panels, insulated refrigerant pipework, insulated condensate pipework, condensate pumps, insulated secondary drip tray for fan coil units, cladding, fittings and all associated accessories.
    3. MSB & Server room air conditioning duty/standby units including wall mounted units with all associated outdoor condenser units, wall mounted hard wired control panels, wall mounted hard wired auto-changeover control panels, cable trays, insulated refrigerant pipework, insulated condensate pipework, condensate pumps, cladding, fittings and associated accessories.
    4. Complete fresh air ventilation system fans including inline fans, roof mounted fans, VSDs, interlocking to AC units for operation, vibration mounting kits, cladding and all associated accessories.
    5. Complete washroom exhaust air ventilation system including in-line duct mounted fans c/w speed controllers, run on timers set to 2mins, interlocking to light switches of toilets, cladding and all associated accessories.
    6. Complete kitchen extract & make-up air ventilation system including fans, stainless steel hoods, proprietary rangehoods, stainless steel ductwork, fan control panels and all associated accessories.
    7. All air distribution system ductwork including externally & internally insulated rigid ductwork, un-insulated fresh air and extract air ventilation ductwork, insulated flexible ductwork for air conditioning, un-insulated flexible ductwork for fresh air extract air ventilation system, insulated transfer air ductwork, duct mounted access panels, spigots and associated accessories.
    8. All air distribution system accessories including extract air grilles, supply air diffusers, transfer air grilles, door grilles, weatherproof louvers c/w security grilles and vermin mesh, registers, volume control dampers, cowls, filters c/w plenum, seismic restraints, fire dampers, fire collars and all associated accessories.
    9. A complete Form 2B mechanical services switch board (MSSB) including all MCCBs, switch gear and all associated accessories (Power cable from MSB to MSSB by electrical contractor).
    10. All power and controls cabling for all mechanical equipment from MSSB to all mechanical equipment including isolators / GPOs located in close proximity for all mechanical equipment, conduits, cladding, cable trays and all associated accessories.
    11. Provide a warning sign for kitchen exhaust air fan to be left operation if already running or to be manually stated ruing fire mode in absence of an FIP. Sign to read as follows: “WARNING: VENTILATION SYSTEM SHALL NOT BE TURNED OFF DURING FIRE”.
    12. Testing and commissioning of the entire mechanical services installation.

Attendance at meetings, contract administration and coordination with the client’s representatives, other trades, utility providers, local authorities, etc.

Any omission from the above scope does not relieve the contractor of the design intent.

### Mechanical Services Associated Works by Others

The following associated work shall be provided under the main contract by the various trades but not limited to, to ensure the successful completion of the mechanical services installation.

Builders Works as follows but not limited to:

1. Forming of penetrations for ductwork and pipework;
2. Opening in fixed ceiling;
3. Fitting of door grilles (door grilles to be supplied by mechanical contractor);
4. Weatherproofing/flash roof and wall penetration passing through the external envelope of the building;
5. Concealing of services, cladding;
6. Access doors and ceiling access panels to readily access and maintain services;
7. Water proofing of concrete roof after mounting of condenser units and mechanical equipment on roof in the mechanical plant area only;
8. Fire sealing of services and penetrations;

Electrical Services

1. Supply electrical sub-main cables for MSSB board from MSB. Coordinate electrical loading of MSSB from the mechanical contractor and supply cable with sufficient power;

Hydraulics Services

1. All required drainage points for condensate discharge, including in ceiling/wall tundishes.
2. Hose taps on roof for in mechanical plant space (VRF condenser location).

Fire Services

1. Interlocking of all major air handling units (>1000L/s) with FIP for shutdown during fire mode.
2. Shut down of kitchen make-up air fan during fire mode.

### Mechanical Services Controls Strategy

The Mechanical equipment specified shall be controlled based on their function and suitability. A brief control strategy for each is described below;

Air Conditioning

1. All split air conditioning equipment shall be switched ON/OFF via their Individual hard wired wall mounted controllers. These controllers shall be used by occupants for altering of unit set point temperature for individual comfort as well.
2. All VRF air conditioning equipment shall be switched ON/OFF via their Individual hard wired wall mounted controllers. These controllers shall be used by occupants for altering of unit set point temperature for individual comfort as well.
3. Indoor units shall be interlinked with the outdoor condenser units so that in event of any of the indoor units being switched ON, the respective outdoor condenser units shall come online.
4. Server room split units to be switched ON/OFF automatically through the unit mounted controllers. Outdoor condenser units to come online when their respective indoor unit is switched ON. The duty unit shall operate with its condenser unit for 12hrs and on completion of 12hrs, the duty unit shall shut down and the standby unit shall start. The standby unit shall then operate with its respective condenser for another 12hrs. This auto changeover cycle shall continue every 12hrs. (Contractor to provide an auto changeover panel if the controllers of the units do not have the feature to change over via timer settings.)

Mechanical Ventilation

1. Fresh air ventilation system fans shall be interlocked with their respective VRF systems for operation. The unit shall also be interlocked with all indoor AC units so that in the event of any AC unit being turned ON, the fresh air fan comes online. Fresh air fan to be c/w speed controller.
2. Toilets exhaust fans for the each tenancy to be interlocked with Ultra Sonic Sensor / light switches for its operation. Fans to be c/w speed controller and run on timer set to 2mins.
3. Kitchen exhaust air proprietary rangehoods to be c/w built-in control panels for switching On/Off and controlling speed.
4. Kitchen exhaust air rangehood fans for heavy / commercial cooking shall be switched On/Off via a fan control panel with speed controller. Make-up air fan to be interlocked with Kitchen exhaust fan for operation.
5. Make-up air fan to be provided with emergency stop button to cut off power in case of fire alarms. Operation to confirm to AS 1668.1.

In the event of power failure, either blackout or brownout, all equipment shall restart to the original set point upon resumption of power.

### Mechanical Services Design Conditions General

Location: Savaii, Samoa.

Building Type: Courthouse / Office Building & Residential (Judges Residence)

Building Class: Class 5

### External Conditions

Summer: 32°C DB, 80% RH

### Internal Conditions

Summer:

General Offices: 23°C DB, 50% RH (Uncontrolled)

Server Room: 21°C DB, 50% RH (Controlled)

Conference Room: 23°C DB, 50% RH (Uncontrolled)

### Outside Air Flow rates:

(AS 1668.2, Appendix A)

Room 10 L/s/person

### Duct pressure Drops:

Main Ducts: 0.8pa/m

Branch ducts: 0.8pa/m

### Duct Velocities:

Main Duct: 6m/s

Branches: 5m/s

Run Off: 3m/s

Neck Velocity of Supply Air 3m/s

|  |  |  |
| --- | --- | --- |
| **Sound Level:** |  | |
| (AS/NZS 2107)  Offices |  | NR 45 |
| Server Room |  | NR 45 |
| Mediation Plant Area | Room | NR 40  NR 70 |
| **Reference List** |  |  |

|  |  |
| --- | --- |
|  | Building Code of Samoa |
|  | Building Code of Australia (NCC 2016 BCA) |
| AS 1023 | Thermal Protection of Electric Motors |
| AS 1100 | Drawing Practice |
| AS 1101 | Graphic Symbols for General Engineering  Methods of Test for Air Filters for Use in and General Ventilation and Air Conditioning  Glossary of Terms for Air Filters for Use in Air Conditioning and General  Ventilation |
| AS 1324 | Air Filters for Use in Air Conditioning and General Ventilation |
| AS/NZS 1571 | Seamless Copper Tubes for Use in Refrigeration |
| AS 1682 | Fire Dampers |
| AS/NZS 1677 | Refrigerating systems |
| AS/NZS 1668 | Mechanical Ventilation and Air Conditioning Code |
| AS/NZS 2107 | Acoustics—Recommended design sound levels and reverberation times for building interiors |
| AS/NZS 2312 | Guide to the Protection of Iron and Steel against Exterior Atmospheric Corrosion |
| AS 2625 | Rotating and Reciprocating Machinery - Mechanical Vibration |
| AS 2700 | Colours Standards for General Purposes |
| AS 2768 | Electrical Insulating Materials |
| AS 2936 | Fan Test Code |
| AS/NZS 3000 | S.A.A. Wiring Rules |
| AS/NZS 3500 | Plumbing and Drainage |
| AS/NZS 3666 | Air-handling and water systems of buildings - Microbial control -Design, installation and commissioning |
| AS 4254 | Ductwork for Air Handling systems in Buildings |

## DESIGN

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

### Outdoor design conditions

General: As documented. **Indoor design conditions** General: As documented.

* An energy source with a greenhouse gas intensity less than 100 g CO₂ -e/MJ.
* An on-site renewable energy source.
* Energy from another process as reclaimed energy.

## PRECEDENCE

### General

Work sections and referenced documents:

* The requirements of other work sections of the specification override conflicting requirements of this work section.
* The requirements of the work sections override conflicting requirements of their referenced documents.
* The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

- *General requirements*.

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

## REFERENCED DOCUMENTS

### General

Requirement: Conform to the *General requirements* work section.

## STANDARDS

### General

Mechanical ventilation and air conditioning: To AS/NZS 1668.1 and AS 1668.2.

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

## INTERPRETATION

### Definitions

General: For the purposes of this work section the definitions given in the *General requirements*

work section apply.

## CONTRACT DOCUMENTS

### General

Requirement: Conform to the *General requirements* work section.

## SUBMISSIONS

### General

Requirement: Conform to the *General requirements* work section.

### Certification

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

### Electrical loading information for mechanical services

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

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

Starting characteristics: Submit details for motors with reduced current starting. Make sure 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 submain.

### Mechanical services shop drawings

Requirement: Submit the following detail drawings at minimum 1:100 scale or larger, showing:

* Fire and smoke dampers including dimensional tolerances.
* Floor wastes.
* Ductwork, plinths, pipework and equipment layouts and sections. Show the location of fire-resisting building elements.
* Diffuser, grille and terminal reference numbers corresponding to design values and commissioning test results.
* Each item of equipment with its identifying name or code and key performance data.
* Riser layouts and sections.
* Plant space layouts and sections.
* Acoustic details.
* Conditioner construction details.
* Seismic restraint details.
* Provisions for access for maintenance and removal of components to *General requirements* clause

## ACCESS FOR MAINTENANCE.

* Lifting provisions for heavy items.
* Piping and other schematic drawings including numbering of each valve to correspond to the valve tag notation. For refrigerant piping include slope of horizontal runs, oil traps, double risers and valving.
* Submission drawings required by authorities.
* Connections to other services.
* Switchboard details.
* Wiring diagrams.

### Operations and maintenance manuals

Requirement: Conform to the *General requirements* work section.

### Technical data

Equipment: 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 conformance to 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.

## INSPECTION

### Notice

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

* All mechanical equipment and accessories installed.

## EXECUTION

* 1. **SUPPORT OF PLANT AND EQUIPMENT**

### Support of roof mounted plant and equipment

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

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

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

. The total load from any unit of plant or equipment exceeds 500 kg.

. The load from a unit of plant or equipment to any single support point exceeds 100 kg.

. The average loading of plant and equipment over the area extending 1 m on all sides beyond the plant and equipment exceeds 25 kg/m².

- Sloping roofs:

. Roof slope ≥ 10°: Adopt the roof material manufacturer’s documented installation procedures or seek the advice of a professional engineer.

. Roof slope < 10°: Provide appropriate continuous supporting members, compatible with the roof material, laid parallel to the span of the roof sheeting. Extend the continuous support members in both directions to the first purlin or joist that is more than 1 m from the face of the plant or equipment it supports.

### Support of ground level plant and equipment

Ground level:

* If the ground slope is 15° or more, 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.

**2.0 MECHANICAL DESIGN AND CONSTRUCTION (DESIGN)**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Complete the design and documentation of the documented mechanical systems and components.

### Performance

Requirements: Provide and document a design that can be verified and validated as conforming to the documented design parameters.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Design parameters / conditions: Information used as the basis for design. It includes *design requirements*, *performance criteria*, *performance parameters* and similar terms.

## SUBMISSIONS

### Staged submissions

Requirement: Submit the documented items at the stages listed in **Schematic design stage**, **Design development stage** and **Completion of design stage**.

### Before commencing design

Requirement: Submit the names, qualifications, experience and registration details of persons responsible for design and certification.

### Schematic design stage

Requirement: Submit the following when the design documents are an average of 10% complete:

* A summary of all systems with capacities.
* Details of each proposed system including:

. Description of the system.

. Areas or functions served.

. Calculated capacities.

. Check figures appropriate to the system type.

. Details of fire provisions.

. Evidence that the proposed system conforms to BCA and other mandatory requirements.

. Single line or similar schematic drawings.

. Description of proposed plant types.

. Proposed plant locations.

. Details of any proposed departures from this specification.

### Design development stage

Requirement: Submit the following when the design documents are an average of 50% complete:

* Details submitted in schematic design developed to show:

. Documented shop drawing information.

. Equipment selections and related technical data.

* Detail departures from the schematic design submissions.

### Completion of design stage

Requirement: Submit the following when the design documents are 100% complete:

* All design documents and documented design information.
* Detail departures from previous submissions.
* Certification that the design conforms to all statutory requirements.
* Certification that the design conforms to the documents. If the documented design requirements have been amended, list all amendments and certify conformance.

### Other submissions

Requirement: Make documented submissions, not listed above progressively, before completion of design.

### Authority approvals

Requirement: Obtain authority approvals for the work documented to meet the construction program. Submissions: Submit the approval documents.

### Drawings

Requirement: To the same standard as documented for shop drawings in the *General requirements*

and *Mechanical systems* work sections.

Drawing registers: Submit drawing registers with the drawings showing current and previous drawing issues.

## DESIGN

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* 1. **ALTERNATIVE DESIGN SOLUTIONS**

### Conforming alternative design solutions

Requirement: If alternative design solutions are available within the documented requirements, submit the proposed solution with a comparison to alternatives. Compare the alternatives including for the following factors:

* Anticipated life.
* Energy consumption.
* Greenhouse gas emissions.
* Maintenance requirements.
* Flexibility for future changes.
* Safety of building occupants including maintenance personnel.
* Safety of equipment.
* Sustainability.
* Other information required for submission in **Substitutions** in *General requirements*.

### Non-conforming alternative design solutions

Requirement: If the proposed design solution does not conform to the documented requirements, conform to **Substitutions** in *General requirements*.

### Costs

Requirement: Pay the cost of submissions and of evaluations and tests of proposed alternatives, whether subsequently adopted or not. The costs will be calculated at the current charge-out rates of the relevant consultant(s).

## DOCUMENTS

### Technical data

Requirement: Conform to the *General requirements* and the *Mechanical systems* work sections.

**3.0 PACKAGED AIR CONDITIONING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide packaged air conditioning plant, as documented.

Split systems: Supply indoor and outdoor condensing units of split systems designed and rated by the manufacturer to operate together.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.
    - *Ductwork*.
    - *Ductwork insulation*.

## STANDARDS

### General

Refrigeration systems: To AS/NZS 1677.2 and the recommendations of SAA HB 40.1 and SAA HB 40.2.

Flammable refrigerants: To the recommendations of AIRAH Flammable Refrigerants - Safety Guide. Microbial control: To AS/NZS 3666.1 and the recommendations of SAA/SNZ HB 32.

Ductwork and insulation: To AS 4254.2.

Air filter performance and construction: To AS 1324.1.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - DX: Direct expansion.
    - kW(e): kilowatts electrical input.
    - kW(r): kilowatts refrigeration capacity.
    - kW: kW(e) or kW(r) as the context requires.
    - MEPS: Minimum Energy Performance Standard.
    - VRF: Variable Refrigerant Flow.

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Packaged air conditioning: DX one-piece package or split system with total cooling capacity when tested to AS/NZS 3823.1.1 or AS/NZS 3823.1.2, Standard test condition T1:

. Room air conditioner: < 8 kW(r).

. Packaged air conditioner: ≥ 8 kW(r).

* + - VRF system: A DX refrigeration system consisting of multiple indoor units connected to a single outdoor unit. VRF system has the same meaning as multiple split system.

## PRODUCTS

* 1. **GENERAL**

### Operating conditions

Requirement: Provide equipment that operates within an ambient temperature range of 0°C to 45°C, without excessive head pressure, unstable operation or icing.

### Split systems

Outdoor units: Provide packaged outdoor condensing units consisting of refrigerant condensers, compressors and associated piping and electrical connections, mounted within the condenser enclosure.

Indoor units: Provide units consisting of coils, piping, supply air fan, accessories and electrical connections, mounted within an insulated enclosure.

### Tests

Pre-completion tests: Provide air conditioning equipment that has been subjected to physical test in conformance to the following:

* Non-ducted air conditioners: To AS/NZS 3823.1.1, Standard test condition T1.
* Ducted air conditioners: To AS/NZS 3823.1.2, Standard test condition T1.
* Multiple split systems: To AS/NZS 3823.1.4.

## MARKING

### Labelling

Required: To AS/NZS 3823.2.

Refrigerant: Show the type of refrigerant at the charging point and on indicator panels.

## VARIABLE REFRIGERANT FLOW (VRF) SYSTEMS

### General

Requirement: Conform to the requirements for the respective package air conditioner components except as modified by the requirements of this clause.

### Integration

Provide indoor and outdoor units from the same manufacturer, designed and automatically controlled to operate as an integrated whole, under the documented operating conditions and over the whole capacity range of the system.

### Capacity

Indoor units: Select each indoor unit to achieve the documented duty for the space served.

Outdoor (condensing) units: Select to suit the combined capacities of the connected indoor units over the entire operating range of the system.

### Condensing units

Single compressor: If the condensing unit incorporates only one compressor, provide inverter speed control of the compressor to vary the unit capacity over a range from the maximum capacity of all indoor units combined to the minimum capacity of the smallest capacity indoor unit.

Multiple compressors: If the condensing unit incorporates more than one compressor, provide inverter speed control on at least one compressor so that the combination of compressors can vary the unit capacity over a range from the maximum capacity of all indoor units combined to the minimum capacity of the smallest capacity indoor unit.

### System controls

Requirement: Provide an integrated automatic control system to operate the refrigeration system safely and efficiently to achieve the documented performance and functions.

Controller: Provide a microprocessor control unit to control the operation of the whole system and respond to call-up by individual controllers located within the spaces served by the indoor units and as follows:

* Two pipe refrigeration systems: Operate all indoor units in response to space controllers in either cooling mode or in heating mode.

### Room controllers

Controllers: Provide a separate controller within the space served by each indoor unit to control that indoor unit. Provide the following minimum functions in each controller:

* Unit on/off.
* Temperature set point for that unit.
* Evaporator fan speed.
* Timer control for that unit.

Master control: For two pipe systems, designate one room controller as the master control for changeover between cooling and heating modes.

### Refrigeration piping

Requirement: Conform to the refrigeration equipment manufacturer's recommendations for VRF systems.

Refrigeration components: Provide the refrigeration system manufacturer's pipeline components designed to make sure oil returns from all indoor units under all operating conditions.

## EQUIPMENT ENCLOSURES

### General

Requirement: Provide enclosures, materials and finishes that are weatherproof and corrosion- resistant, assembled and reinforced to prevent flexing and drumming.

### Material and finishes

Materials: Conform to the following:

* Metallic-coated steel:

. Base and legs: ≥ 1.6 mm.

. Panels: ≥ 1.0 mm.

* Aluminium:

. Base and legs: ≥ 2.0 mm

. Panels: ≥ 1.6 mm.

Outdoor equipment finishes: Powder coat all metallic-coated steel interior and exterior surfaces to AS 3715 or AS 4506 as appropriate.

Indoor equipment finish: Manufacturer’s standard finish.

Moisture retention: Design and install so that all parts are free draining with no pockets for condensation and/or rainwater retention.

### Access

General: Provide access to the interior of the unit for routine inspection and maintenance and for removal of major components. Provide doors and panels with handles and captive fasteners and, where they are for access to the conditioned air stream, provide soft gaskets for an airtight seal. Provide weatherproof doors and panels on outdoor enclosures. Do not use self-tapping screws on removable panels.

Access: As a minimum, provide access to the following:

* Condensate tray (locate underside of access panel within 300 mm of tray).
* Supply fan motor and drive.
* Compressor section.
* Condenser section.
* Filter section.

Access panel fasteners:

* Units < 1000 L/s: Metal thread screws or camlock fasteners.
* Units ≥ 1000 L/s: Camlock fasteners.

Handles: Provide handles to permit easy and safe removal and replacement of panels.

* < 450 mm diagonal panel dimension: 1 handle.
* ≥ 450 mm diagonal panel dimension: 2 handles.

### Insulation

Requirement: Insulate enclosures to prevent external surface condensation under all operating conditions. Fix insulation to panels with waterproof adhesive applied to at least 50% of the panel area.

Material properties: Conform to the following:

* Thermal conductivity: ≤ 0.035 W/m.K.
* Material R-Value: ≥ 0.7 m².K/W.
* Facing: Reinforced aluminium foil.
* Moisture absorption: Non-hygroscopic.
* Fire hazard properties: To AS 4254.2 clause 2.7.1.
* No CFC or HCFC used as blowing agents in the manufacturing process.

### Condensate trays

General: Provide a tray under each cooling coil extending downstream to collect water carry over, and under any other components on which condensation may occur. Grade trays and sumps to the outlet to prevent water retention. Provide radiused corners and arrange to facilitate cleaning.

Material: Fabricate wetted parts from aluminium to AS/NZS 1734 or stainless steel sheet grade 304L.

### Protection

General: Provide easily removable powder coat finished metallic-coated steel mesh protection to outdoor fans and exposed faces of outdoor coils.

## SUPPLY FAN

### Performance

Requirement: Select fans and fan motors so the air flow can be increased not less than 5% above the documented design air flow rate, against the corresponding increased system resistance by fan speed change alone and without unstable operation.

Fans with multi-speed motors: Select for required duty at second highest speed.

### Construction

Forward curved impellers: Metallic-coated steel blades and wheel.

Backward inclined impellers: Backward inclined, steel or extruded aluminium, aerofoil or single thickness blades, and non-overloading power characteristic.

Casing: Metallic-coated steel sheet, riveted or spot-welded with joints sealed. Provide 1.2 mm minimum thickness scroll and 2 mm minimum thickness side plates.

Bases: Formed from pressed metallic-coated steel sheets, bolted to casings. Provide at least 4 brackets for mounting.

Inlet bells: Shaped for aerodynamically efficient air entry and small clearance from impeller. Shaft: Steel treated with solvent removable petroleum based protective coating.

Bearings: Self-aligning sealed for life ball or roller type.

Finish: Brush and prime spot welds with organic zinc-rich organic primer to AS/NZS 3750.9.

### Drive

Type: Direct or belt drive, as documented.

Direct drive: Multi speed or electronic variable speed.

Belt drive: To suit a minimum 125% of motor power and capable of transmitting the full starting torque without slip. Provide adjustable motor pulley. Provide pulleys with shaft keys or taper lock bushes.

## CONDENSER FANS

### Type

Propeller fan: Direct drive with single thickness fixed pitch aluminium or ultraviolet light protected polypropylene blades.

Aerofoil axial flow fan: Direct drive with adjustable pitch aerofoil section blades of ultraviolet light protected glass reinforced plastic or polypropylene, or aluminium.

Centrifugal fan: Conform to the following:

* Drive: Direct or belt driven, as documented.
* Impeller: Forward curved or backward inclined, as documented.
* Construction: Conform to **SUPPLY FAN**.
* Belt drive: If belt drive is documented, conform to **SUPPLY FAN**.

Multiple fans: If multiple fans operate in sequence for capacity control, provide baffles in the condenser to prevent air short circuiting through idle fans.

Guards: Provide easily removable powder coat finished metallic-coated steel guards over condenser fans.

Power consumption: ≤ 0.015 kW(e)/kW(r) total heat rejected by the condenser when tested to AHRI 460.

## FAN MOTORS

### General

Power rating of supply fans: At least the power required by the fan when the air flow is increased by 10% above the design air flow rate documented, against the corresponding increased system resistance as installed.

Single phase motors: ≤ 0.37 kW only. Speed: < 25 rev/s.

Bearings: Sealed for life ball bearings. Minimum degree of protection:

* Supply fans: IP54.
* Condenser fans: IP55. Insulation to AS 60034.1:
* Single phase motors: Minimum Class B.
* Three phase motors: Minimum Class F.

## ADDITIONAL FAN CORROSION PROTECTION

### General

Requirement: If additional corrosion protection is documented for supply or condenser fans, provide the following:

* + - Finish: Powder coating system to the inside and outside of the fan scroll and wheel or impeller to AS 3715 or AS 4506 as appropriate.
    - Shaft: Stainless steel type 304.
    - Drain: Provide 2 – DN 20 drain connections. Pipe to waste conforming to **EXECUTION, CONDENSATE DRAINS.**

## COMPRESSORS

### General

Enclosure: Welded or accessible hermetic steel enclosure with minimum 3 mounting feet. Provide the following:

* + - Mounting: Vibration isolating mountings.
    - Service valves: Packed and capped, back seating refrigerant suction valve.
    - Charging connections: Schrader type connections for evacuation and refrigerant charging.

Crankcase heaters: Provide integral positive temperature coefficient type crankcase heaters if required for safe compressor operation.

Scroll compressors: Provide reverse rotation protection.

## COILS

### Design

Coil face velocity: ≤ 2.5 m/s. Fin pitch: ≤ 550 fins/m.

Cooling coil air pressure drop: ≤ 150 Pa when wet.

### Construction

Tubes: Copper to AS/NZS 1571 or AS 1572 designation C12200.

Fins: Aluminium alloy plate fins ≥ 0.12 mm thick to AS 2848.1, designation 3003 or 8011. Coil frames:

* Aluminium alloy to AS 2848.1, designation 5005.
* Metallic-coated steel sheet coating class Z275. Condenser coil: To provide at least 5 K subcooling. **Access**

General: Arrange coils and casing so that both sides of coils are readily accessible for inspection and

cleaning.

### Additional coil corrosion treatment

General: If the atmospheric corrosivity category documented in the *General requirements* work section is C3 or C4, provide proprietary coil corrosion protection coating as follows:

* Type: Factory applied coating resistant to dilute acids, dilute alkalis, solvents, inorganic salts and salt laden air.
* Application: Apply after coil fabrication.
* Performance: When tested to ASTM B117, show no sign of attack after 3000 hours in salt spray.

## FILTERS

### General

Filters: Type 1 to AS 1324.1 with Class and Performance rating, as documented but not less than:

* + - Test Dust No. 1 to AS 1324.2: ≥ 20% efficiency.
    - Test Dust No. 4 to AS 1324.2: ≥ 85% arrestance. Filter class to AS 1324.1: As documented.

Filter performance rating to AS 1324.1: As documented. Minimum dust holding capacity: As documented.

Filters and media: Supply filters and media that are odourless, non-toxic, non-migrating, non- evaporating, non-hardening, resistant to microbial growth, and which do not shed fibres in service.

Access: Make sure individual filter inspection and maintenance can be readily carried out without disturbing the filter bank.

## REFRIGERATION SYSTEM

### Components

Copper pipe: To AS/NZS 1571.

Pipe insulation within unit: Insulate pipes that operate below ambient temperature with elastomeric foam to BCA Spec J5.2c .

Multiple compressor units: Provide separate refrigeration circuit for each compressor. Refrigerant expansion device:

* < 20 kW(r) total capacity: Eliminator or similar, non-capillary expansion device, thermostatic expansion valve or electronic expansion valve.
* ≥ 20 kW(r) total capacity: Thermostatic expansion valve or electronic expansion valve.

Refrigeration circuits: Provide each refrigeration circuit with a sight glass-moisture indicator, filter dryer and manual reset high pressure and auto reset low pressure cut-outs. Provide a suction accumulator if compressor is liable to damage by liquid slugs.

Reverse cycle units: Provide refrigerant reversing valve and an effective outdoor coil defrost facility that prevents room temperature dropping more than 2 K during defrost.

## REFRIGERATION PIPE INSULATION

### Material

Material R-Value: To BCA Spec J5.2c.

Type: Chemically blown closed cell nitrile rubber or polyethylene in tubular form. Physical properties:

* Maximum thermal conductivity: 0.04 /mK at 0°C.
* Moisture absorption: Non-hygroscopic.
* Water vapour permeability: ≤ 0.065 nh/Pa.m.s.
* Fire hazard properties:

. Spread-of-flame index: 0.

. Smoke-developed index: ≤ 3.

## CONDENSATE DRAINS

### Material

Material: As documented.

* + - PVC-U: To AS/NZS 1477, installed to AS/NZS 2032. Size: The greater of unit drain connection size and DN 20.

## CONTROLS AND ELECTRICAL

### Components

General: Provide factory wired control panel for each unit containing the following:

* + - Plug-in relays.
    - Terminal strips numbered to correspond to wiring diagram.
    - Starter and overload protection for each motor.
    - Short circuit protection: Provide each compressor and each 3-phase motor with short circuit protection by either:

. High rupture coefficient (HRC) fuses, or

. Circuit breaker with interrupting capacity selected to suit the anticipated short circuit current, or

. Starter contactor with manual reset thermal or magnetic overload.

* + - Provide automatic lead/lag changeover for units with multiple compressors.
    - Short cycle timer function: To limit compressor starts.
    - Separate control and electrical circuit for each compressor.
    - HRC fuse or circuit breaker short circuit protection for each crankcase heater (if fitted) and control circuit.
    - Phase failure protection on motors ≥ 5.5 kW.
    - Terminals for remote indication of run and fault conditions.
    - Permanent, weatherproof, wiring diagram fixed on or next to the control panel.

Safety controls: Arrange so that tripping of one item does not shut down other items that are not directly dependent on its operation.

Isolating switch: Provide system isolator for each system.

Condenser head pressure control: If documented, provide electronic condenser fan speed control to maintain minimum condenser head pressure at all operating ambient conditions.

Pump-down control: If documented, provide solenoid valve and automatic pump-down control.

## EXECUTION

* 1. **BUILT-UP PLENUMS**

### Casing

Construction: Metallic-coated steel panels, folded to 450 mm maximum width with 50 mm edges and 15 mm returns.

Joints: Weld, or fold and bolt together using galvanized nuts, bolts and washers. Seal joints airtight and water tight with silicone sealant.

Material thickness: 1.6 mm minimum. Provide 50 x 50 x 5 mm galvanized steel bracing angles.

### Access

General: Provide at least one air tight and gasketed access door or access panel conforming to the

*Ductwork* work section.

Size: Large enough to permit removal of components inside.

### Casing insulation

Insulation material: Semi-rigid or batt form in conformance with **MATERIALS** in the *Ductwork insulation* work section.

Insulation facing:

* Facing in filter access section of units ≥ 1000 L/s: Apply to all sides, ceiling and floor, 0.55 mm thick perforated metallic-coated steel sheet with perforations of 2.5 mm diameter providing 10% open area.
* Facing in other locations: Factory applied perforated aluminium foil laminate conforming to

**INTERNAL - LAMINATE FACED** in the *Ductwork insulation* work section.

Installation of perforated steel facing:

* Supports: 0.55 mm metallic-coated steel Z sections sized to suit insulation thickness.
* Fixing: Space supports at 600 mm maximum centres with the lowest at 150 mm above the floor and with section flanges on the facing side turning down. Fix supports to sheet metal housings with rivets, with heads on the outside and to masonry housings with expanding masonry anchors.

Overlap facing 25 mm minimum at all joints and fix to supports with rivets at 150 mm maximum centres. Trim edges at openings with Z sections.

* Cold bridging: In cold deck chambers, prevent cold bridging between housing panels and support sections.
* Perimeter: Trim with 40 x 40 x 0.55 mm angles riveted to facing at 300 mm maximum centres.
* Floor: Provide Z section supports sufficient to support the weight of a person without deforming the perforated steel facing. Space at maximum 200 mm centres.

### Service lights

Units ≥ 500 L/s: Provide an 18 watt compact waterproof fluorescent luminaire in each compartment with an access door or removable panel.

Switching: Connect to a common switch located outside the chamber. If exposed to weather, provide a weatherproof switch. Label the switch and provide a pilot light to indicate when the lights are on.

## REFRIGERATION PIPING

### General

Requirement: Conform to equipment manufacturer's recommendations for the refrigerant used. Provide refrigeration piping designed and installed so that the complete system meets the documented performance under the documented operating conditions.

### Design

Standards: Conform to the recommendations of one or more of the following:

* Equipment: To manufacturer’s recommendation for the refrigerant used.
* AIRAH Design Application Manuals.
* ASHRAE Handbooks.
* CIBSE Guides.

Methods of calculation: Manual or software that employs the data and methods in the applicable standard.

Suction lines: Size for pressure drop less than 1.0 K saturated suction temperature at documented supply air flow, documented cooling coil entering conditions, documented condenser air entering condition and unit manufacturer’s rated total capacity, saturated condensing temperature and saturated suction temperature under the above conditions.

Oil return: Size for oil return to compressor. If velocity for oil return would result in the suction line pressure drop exceeding pressure drop limit, provide double suction risers. Prevent oil draining back on the off cycle.

Liquid lines: Size for pressure drop less than 1.0 K saturated liquid temperature when handling the manufacturer’s unit capacity under the documented operating temperatures.

### Layout

General: Install pipework in straight lines and uniform grades without sags. Grade horizontal hot gas lines and suction lines at not less than 1 in 200 in the direction of gas flow.

Location: When possible, run suction and liquid lines inside common insulation.

### Pipe support

General: Provide hangers, brackets, saddles, clips, and support system components, incorporating provisions for adjustment of spacing, alignment, grading and load distribution. Support pipework from associated equipment or building structure. Support valves, strainers and major line fittings so that no load is placed on adjacent tubes or transmitted to them during operation and maintenance.

Support type: Proprietary metallic-coated steel channel section with clamps and hangers sized to match external diameter of pipe being supported.

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 or over. Uninsulated pipes: Clamp piping supports directly to pipes.

Insulated pipe support:

* 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.
* Vapour barriers: For cold pipes apply aluminium foil tape over the circumference of the spacer to form a vapour barrier.
* Metal sheathing: Provide a 0.55 mm thick metallic-coated steel band between the aluminium foil tape and the support, for the full width of the spacer.

### Pipe support spacing table

|  |  |  |
| --- | --- | --- |
| **Nominal pipe size, DN** | **Maximum spacing (m)** | |
| **Horizontal** | **Vertical** |
| 10 | 1 | 2 |
| ≥ 15, ≤ 20 | 1.5 | 2.5 |
| 25 | 2 | 3 |
| 32 | 2.5 | 3 |
| 40 | 2.5 | 4 |
| 50 | 3 | 4 |
| 65 | 3 | 4 |

**Pipes**

Piping: Provide copper tubes as follows:

* ≤ DN 15: To AS/NZS 1571, 0 temper.
* > DN 15: To AS/NZS 1571, 1/2H temper. Use annealed (0 temper) copper only for pulled bends. Pipe wall thickness:
* Pipes ≤ DN 50: To AS 1432 Type B.
* Pipes > DN 50: ≥ 1.6 mm.

### Bends

Pulled bends: Form bends without flattening or wrinkling with an inside radius minimum 3 pipe diameters using the correct tool size for the pipe diameter.

### Pipe fittings

Copper alloy fittings: To AS 3688, dezincification resistant, welded, brazed or compression type only.

Pre-formed fittings: Pre-formed refrigerant capillary line tees, bushes, couplings and elbows. Wherever possible, make reductions at elbows, tees, line devices or equipment connections with reducing fittings, otherwise provide reducing bushes or reducing couplings.

Compression fittings: Flareless twin ferrule, torque free, mechanical grip fittings which can be gauged using a precision ground and hardened metal gap inspection gauge.

Screwed joints: Use only if equipment items are not available with flare, flanged or brazed capillary connections.

### Brazed joints

General: Provide pre-formed capillary fittings or form capillary unions by expanding one pipe end. Prevent flux and brazing alloy from entering pipes. Use dry nitrogen to purge air from pipes before brazing. During brazing, maintain a flow of dry nitrogen through pipes to prevent oxidation.

Brazing alloy: To AS/NZS 1167.1 Table 2 alloy B4 ≥ 15% silver content.

Brazing alloy for jointing dissimilar metals: To AS/NZS 1167.1 Table 1 alloy A18 or an alloy with an equivalent silver content (≥ 34%) and impurity levels.

### Sleeves

General: Provide pipe sleeves where pipes pass through building elements.

### Valves

General: Provide valves of the type and in the location recommended by SAA HB 40.1. Make provision for charging and withdrawal of refrigerant. If a gauge is not permanently connected (for example commissioning connections), seal the outlet of the isolating valve with a flared seal cap nut.

### Valve types

Service valves: Back-seating type with gasketed cap.

Solenoid line valves: Solenoid coil and valve parts replaceable without disturbing valve body or refrigerant piping.

### Refrigeration pipe insulation

General: Insulate all refrigerant piping that may sweat. Apply insulation un-slit where possible. If slit, refix slit faces with adhesive applied to full area.

Joining: Use only an adhesive or jointing system recommended by the insulation manufacturer. Timing: Leak test piping before insulating joints, fittings and valves.

## CONDENSATE DRAINS

### General

Condensate drains: Provide trapped drain lines with uniform and continuous fall to connect condensate trays to the nearest building drain point. Provide drains from the following:

* + - Each indoor coil.
    - Each outdoor coil unless casing freely drains to a roof or other location where condensate and/or rain water will not cause damage or pond.
    - Each safety tray.

Pipe support spacing: To AS/NZS 3500.1 Table 5.6.4. Sealing: Seal drain pipes where they penetrate casing.

Termination: Terminate drains to allow visual inspection of condensate flow.

Traps: To withstand more than 2 times fan static pressure and constructed from either:

* + - Transparent, kink-resistant hose.
    - PVC-U trap with removable caps and a visible air break.

Falls and drains: Check that the condensate tray falls conform to AS/NZS 3666.1 and in particular that trays and sumps are graded to the outlet to prevent moisture retention. Test drains by pouring a measured quantity of water into upstream end.

## SAFETY TRAY

### Location

General: If leaks or condensation can damage or become a nuisance to the building or its contents, provide a safety tray under packaged unit and indoor unit of split systems.

Reverse cycle units: If reverse cycle outdoor units do not have drain connections, locate safety tray below unit and pipe drain to waste.

### Construction

General: Metallic-coated steel sheet, 1.2 mm thick folded and stiffened, edges turned over and with all joints sealed. Sides at least 50 mm high.

Size: Extend tray at least 150 mm beyond unit casing and any components that may leak or drip condensation.

Drainage: Provide fall in tray and provide drain at lowest point. Run drain to visible waste.

## UNIT INSTALLATION

### General

Requirement: Supply all necessary components, including but not limited to the following:

* + - Means of attachment to the structure.
    - Anti-vibration mounting.
    - Appropriate flexible connections.
    - Trim and sealing around openings.
    - Electrical connections.
    - Drainage connections.
    - Field connection of refrigerant lines in split systems.

Alignment: Install units level, plumb and to manufacturer’s recommendations. Fixing: Bolt units in place with minimum 4 anchors or suspension rods.

### Outdoor equipment

Arrangement: Provide clearance around units for condenser air flow and maintenance access. Make sure discharge air does not short-circuit to condenser intake.

Plinths: If located on grassed or similar permeable surfaces, provide concrete plinths under outdoor equipment.

### Duct connections

Supply duct: Provide internal or external flexible duct connection. Conform to **FLEXIBLE CONNECTIONS** in the *Ductwork* work section.

Return, outside air and condenser duct connections: Provide external flexible duct connection.

### Vibration isolation

General: Provide to each assembly at least four mountings, located to give uniform deflection under the applied load.

Isolation efficiency: ≥ 90%. Suspended units:

* + - Suspended from lightweight structures: Metal spring or rubber-in-shear isolation mountings with at least 25 mm static deflection. Provide each mounting with a levelling screw and locknut.
    - Suspended from heavyweight structure: Double deflection neoprene or rubber in shear mountings static deflection greater than or equal to 15 mm.

Floor mounted units: Mount on neoprene waffle pads.

## COMMISSIONING

### General

Packaged equipment: Conform to the manufacturer's recommendations and record results. Refrigeration systems: Conform to the recommendations of SAA HB 40.1.

Evacuation: If using the deep vacuum method to SAA HB 40.1, pull a vacuum to the lowest pressure achievable with the available equipment but less than 130 Pa absolute (1000 microns of mercury).

**4.0 FANS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fans, as documented.

### Centrifugal fans

Requirement: Select fans so the air flow can be increased ≥ 5% above the rate documented as follows:

* Against the corresponding increased system resistance as installed.
* Without unstable operation.
* By speed change alone.

### Axial flow fans

Requirement: Select fans so the air flow can be increased not less than 5% above the rate documented as follows:

* Against the corresponding increased system resistance as installed.
* Without unstable operation.
* By pitch angle change alone.

### Variable volume systems

Variable volume systems: Provide fans for variable volume systems selected for:

* Maximum fan efficiency at 70% to 80% of design air flow rate.
* Operation from 30% to 110% of design air flow without going into a surge condition.

### Fans with variable speed drives

Fans with variable speed drives: Conform to the following:

* All fans: Provide fans selected to operate at no more than 50 Hz under all conditions.
* Fans with belt drives: Adjust fan speed during commissioning for motor to operate at no more than 50 Hz under all conditions.

### Fans with multi-speed motors

Fans with multi-speed motors: Conform to the following:

* Two speed fans: Provide fans selected to perform duties documented.
* Fans with 3 or more speeds and single phase fans with adjustable speed control: Provide fans selected to achieve the duty documented at a speed not more than 80% of highest speed.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## SUBMISSIONS

### Tests

Type tests: Provide only fans type-tested by a Registered testing authority. Submit evidence of type tests as follows:

* + - Fan performance: To AS ISO 5801.
    - Fan sound power levels: To BS EN ISO 5136 or ISO 10302-1.

## PRODUCTS

* 1. **MARKING**

### Labels

Show the following:

* + - Manufacturer’s name.
    - Model.
    - Serial number.
    - Size.
    - Direction of rotation, marked on casing.

## MATERIALS

### Galvanized steel components

Hot dip galvanized components: Conform to AS/NZS 4680. Coating thickness and mass: To AS/NZS 4680 Table 1.

## CENTRIFUGAL FANS – GENERAL PURPOSE

### Casings

Construction: Welded steel scroll and side plates, reinforced to prevent flexing and drumming. Split casing: If the fan impeller is more than 1200 mm diameter, provide a horizontally split casing. Inlet bells: Removable, shaped for aerodynamically efficient air entry and close approach to impeller.

Access panels: Provide inspection/access panels to casings of fans with impellers ≥ 650 mm diameter. Seal panels airtight with neoprene gaskets.

Outlets: Provide flanged or spigoted outlets to suit connected ductwork or equipment.

Guards: For fans not connected to ductwork provide removable inlet guards, discharge guards or both.

Drain point: Where moisture is likely to enter or condense inside a fan provide a 25 mm drain point welded into base of scroll and stopped with non-ferrous screwed plug.

### Minimum casings thickness table

|  |  |  |
| --- | --- | --- |
| **Impeller diameter (mm)** | **Side plates (mm)** | **Scroll (mm)** |
| ≤ 450 | 2 | 1.6 |
| > 450, ≤ 800 | 2.5 | 2 |
| > 800, ≤ 1000 | 3 | 2.5 |
| > 1000, ≤ 1500 | 3 | 3 |
| > 1500 | 5 | 3 |

**Bases**

General: Form from fully welded steel sections integral with or bolted to casings. Mounting brackets: Provide at least 4 height saving mounting brackets.

### Impellers

Blade type: Backward inclined aerofoil or laminar single thickness type, flat or curved section, with non-overloading power characteristics, as documented in **FAN SCHEDULES**.

Characteristics: Provide the following:

* Statically and dynamically balanced.
* Keyed to drive shafts by means of taper-lock fixing devices or taper keys.
* For overhung driven fans more than 1000 mm diameter, retained onto drive shafts by positive devices such as washers and set screws into tapped holes in shaft ends.
* Countersink in shaft for tachometer.

### Bearings

For single width fans with impellers < 1250 mm diameter and double width fans with impellers

< 950 mm diameter: Provide pillow-block mounted, self aligning ball bearings, sealed for life, with a minimum rating fatigue life of 40 000 hours.

For single width fans with impellers ≥ 1250 mm diameter and double width fans with impellers ≥

950 mm diameter: Provide plummer-block mounted roller bearings to AS 2729, with seals and grease relief, with a minimum rating fatigue life of 20 000 hours. Extend grease nipples for ready access.

### Motors

General: Provide electric motors that are compatible with fan requirements, providing efficient non- overloading fan units.

Power rating: The greater of the following:

* The fan limit load power at speed required for the air flow and resistance required in **Design**.
* The power required by the fan when the air flow is increased by 5% above the design air flow rate required in **Design**, against the corresponding increased system resistance.

Motor protection: Minimum IP54.

### Belt drives

Drive sizing: Size for at least 125% of motor power and capable of transmitting the full starting torque without slip.

Belts: Wedge belts to AS 2784, consisting of matched sets of at least 2 belts. Mark belt size in a prominent location on the fan casing.

Belt tensioning: Provide adjustment of belt drive tension by either movement of motor on slide rails or by pivoting support. Do not use the weight of motors to provide belt tension. Restrain motors with locknuts on bolts, clamping motors in place.

### Drive shafts

Characteristics: Provide the following:

* Designed so that the first critical resonant speed of the shaft is at least 130% of design maximum operating speed.
* Double width fans with shaft diameter more than 60 mm: Filleted stepped type to permit easy impeller removal.
* Keyed with taper-lock fixing devices for fixing of pulleys.
* Countersunk ends for tachometer application or, where the end of the shaft is not accessible, make provision for use of stroboscope or optical tachometer.
* Material: Mild steel or high tensile steel, as appropriate for the duty. Provide corrosion protection by solvent removable petroleum based protective coating formulated for machinery shafts and parts.

### Drive guards

Requirement: Provide rigid, removable belt guards on all fans where drive is accessible while motor is running. Provide the following:

* Tachometer opening.
* Perforated sides on double width, double inlet fans.
* Weatherproof construction, ventilated and drained where exposed to weather. Material: Open mesh or perforated metallic-coated sheet steel.

### Finishes

Primer: Prime all surfaces with zinc phosphate primer to AS/NZS 3750.20 and apply manufacturer’s standard paint system to external surfaces.

### High temperature exhaust fans

Requirement: Provide heat slingers and guards on shafts between the in-board bearings and fan casings. Locate in-board bearings clear of fire-resistance rated insulation applied to fan casings.

### Kitchen exhaust fans

Additional requirements: Provide the following:

* Access for cleaning: Provide a large gasketed access panel.
* Drain: Provide trapped drain from lowest point in casing. Provide unions at connection and arrange drain for easy cleaning. Pipe drain to waste.
* Finish: Internally zinc sprayed.
* Fire-resistance rating: If fan is installed in a fire rated duct system and not installed in a separate fire-resistance rated room or enclosure, provide fire-resistance rating to the same standard as duct. Make sure that fire-resistance rating provisions permit easy access for inspection, cleaning and maintenance.

## CENTRIFUGAL FANS – SHEET METAL

### Standard

General: **To Centrifugal fans – general purpose** except as varied in **Casing construction** and

### Motors:

**Casing construction**

General: Metallic-coated steel sheet, riveted or spot welded with joints sealed.

* Scroll: 1.2 mm minimum thickness.
* Side plates: 2 mm minimum thickness.

Bases: Formed from pressed metallic-coated steel sheets, bolted to casings. Provide at least 4 brackets for mounting.

Impellers:

* Type: Backward or forward curved section, laminar or aerofoil, as documented.
* Construction: Extruded aluminium or metallic-coated steel blades secured between reinforced galvanized steel plates.

Bearings: Self-aligning sealed for life ball or roller type.

Finish: Brush and prime spot welds with zinc-rich organic primer to AS/NZS 3750.9.

### Motors

Minimum degree of protection: IP51.

## CENTRIFUGAL FANS – IN-LINE

### General

Requirement: Non-overloading power characteristics.

### Casings

Casing types: Rectangular or circular with spigot or flanges for duct mounting, with construction as follows:

* Steel: Metallic-coated steel sheet, spot welded. Brush and prime spot welds with zinc-rich organic primer to AS/NZS 3750.9.
* Glass reinforced plastic (GRP) or plastic: Moulded GRP or impact resistant plastic with integral support foot.

### Impellers

Requirement: Backward inclined or forward curved style, as documented. Construction: Metallic-coated steel, extruded aluminium or polypropylene. Balance: Balance impellers statically and dynamically.

Motors: Direct mounted to impellers with minimum thermal class 155 (F) insulation to IEC 60085. Bearings: Sealed for life bearings with a minimum rating fatigue life of 40 000 hours at 40oC ambient. Electrical connection: Terminal box external to fan casing and wired to fan motor.

Access to impellers up to 350 mm diameter: Manufacturer's standard fast clamps both sides of the fan to permit removal of the impeller-motor assembly or fan as a whole.

## AXIAL FLOW FANS

### General

Requirement: Non-overloading power characteristics.

### Casings

Type: Tubular, flanged at each end, constructed from mild steel, fully welded, hot-dip galvanized after fabrication.

Access:

* < 1000 mm diameter: Sight hole in casing plugged with an airtight removable closure.
* ≥ 1000 mm diameter: Provide access panels, securely bolted to casings and sealed with neoprene gaskets, for maintenance.

### Impellers

Requirement: Aerofoil section blades constructed from cast aluminium alloy or glass reinforced plastic. Material: As documented in the **Axial flow fan schedule**.

Pitch angle: Manually adjustable.

Balancing: Balance impellers, statically and/or dynamically.

### Unducted inlets/outlets

Inlet cones: Provide aerodynamically shaped cones to inlets of fans.

Outlets: Provide manufacturer’s standard 15 conical diffuser to convert velocity head to static pressure.

Guards: Provide galvanized steel or bronze mesh guards.

### Motors

General: Direct mount to impellers with minimum thermal Class 155 insulation to IEC 60085.

Bearings: Provide sealed for life bearings or grease packed bearings fitted with lubrication lines extending through the casing. Provide bearings with a minimum rating fatigue life of 17,500 hours, suitable for horizontal or vertical mounting as appropriate.

Motor protection: Minimum IP54.

### Electrical connection

General: Provide terminal box external to fan casings and wire to fan motors.

### Kitchen exhaust fans

Type: Axial flow with non-combustible casing and cowl (if fitted). Access for cleaning: Large gasketed access panels.

Finish: Hot-dip galvanized then epoxy painted.

Fire-resistance rating: If fan is installed in a fire-resistance rated duct system and not installed in a separate fire-resistance rated room or enclosure, provide fire-resistance rating to the same standard as the duct. Make sure that fire-resistance provisions do not prevent fans from being readily accessible for inspection, cleaning and maintenance.

Materials generally: Except for minor items such as grommets, junction boxes, etc., construct from materials with a temperature of fusion > 1000°C.

## ROOF MOUNTED FANS

### Types

General: Centrifugal, mixed flow, aerofoil axial or propeller. Axial flow and propeller: Conform to **AXIAL FLOW FANS**.

Centrifugal fans: To **Centrifugal fans - general purpose** except as varied in the following:

* Casing: Scroll at least 1.2 mm and side plates at least 2 mm thick zinc-coated steel, riveted or spot welded with joints sealed.
* Bases: Metallic-coated steel sheets bolted to casings with at least 4 mounting brackets.
* Impellers: Constructed with extruded aluminium or zinc-coated steel blades secured between reinforced galvanized steel plates.
* Bearings: Self-aligning sealed for life ball or roller type.
* Finish: Brush and prime spot welds with zinc-rich organic primer to AS/NZS 3750.9.
* Motor minimum degree of protection: IP44. Mixed flow fans:
* Impeller: Mixed flow with rotating parts vibration isolated from the unit casings by suitable resilient mountings.
* Arrangement: Position the motor above the impeller to allow servicing from above the roof.

### Housing

Requirement: Compact bases fitted with weathering skirts and a hinged or removable weatherproof cowl with bird screen.

Material: UV stabilized ABS, polypropylene, polyethylene, glass-fibre reinforced polyester or steel, hot- dip galvanized (HDG) after manufacture, as documented.

### Vertical discharge

Requirement: Weatherproof galvanized steel, plastic or aluminium backdraft dampers where the weather may enter when units are stopped.

Backdraft damper closure: Counterweighted or electrically driven.

Backdraft dampers on smoke spill fans: Conform to AS/NZS 1668.1 Unless all compartments served by the smoke spill fan are protected by a sprinkler system, arrange dampers to latch open or fail in the open position in the event of a fire. Provide temperature independent latch open device.

Vermin mesh: Where backdraft dampers are not fitted, provide vermin mesh guards. Comply with AS/NZS 3666.1 clause 2.2.1.

### Motors

Bearings: Sealed for life or grease-packed, fitted with lubrication lines extending through roof cowls. Provide bearings with a minimum rating fatigue life of 40 000 hours. Provide access to grease relief ports.

Minimum degree of protection: IP55. Drive: Belt or direct as appropriate.

Belt drive: Comply with **Centrifugal fans - general purpose**. **Electrical connection**

Provide terminal boxes external to fan casings and wired to fan motors.

### Kitchen exhaust fans

Housing, base and casing: Hot-dip galvanized steel or stainless steel only.

Materials generally: Except for minor items such as grommets, junction boxes, etc., construct from materials with a temperature of fusion > 1000°C.

## EXECUTION

* 1. **INSTALLATION**

### Access

General: Arrange fans and accessories to allow service access for maintenance, removal or replacement of assemblies and component parts, without disturbance of other items of plant, fire rating material and/or the building structure.

### Duct connections

Flexible connections: Provide flexible connections to prevent transmission of vibration to ductwork. If under negative pressure, make sure that flexible connection does not reduce fan inlet area. If necessary, provide spacer pieces between fans and flexible connections.

### Drains

General: Where moisture is likely to enter or condense inside a fan provide a trapped drain in conformance with AS/NZS 3666.1.

### Vibration isolation

General: Provide each assembly with at least four anti-vibration mountings, selected to give an isolation efficiency not less than 95%.

Type: As recommended by the fan manufacturer to achieve the required isolation efficiency for the specific fan under the documented operating conditions. Provide levelling screws and locknuts on metal spring mounts.

Location: Locate the mountings so that the mounts deflect uniformly when the fan is operating and subject to all loads, including those imposed by the duct.

Duct connections: Arrange flexible duct connections so that the fan vibration isolation efficiency is not adversely affected.

**5.0 AIR FILTERS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide air filters, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## STANDARDS

### Air filters

Performance and construction: To AS 1324.1.

Microbial control: To AS/NZS 3666.1 as required by the BCA and the recommendations of SAA/SNZ HB 32.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following definitions apply:

* + - DOP: Dioctylpthalate.
    - HEPA: High efficiency particulate arrestance.
    - MEPA: Medium efficiency particulate arrestance.

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Filter class: To AS 1324.1.
    - Filter type: To AS 1324.1.

## SUBMISSIONS

### Tests

Type tests: For each type of filter, submit evidence of filter type tests conducted by a Registered testing authority within the past 5 years.

Standards: Conform to the following:

* HEPA and MEPA filters: To AS 4260.
* Other particulate filters: To AS 1324.2.

Filter size for test: 610 x 610 mm face dimension.

## INSPECTION

### Notice

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

* + - HEPA filters: Site filter tests.

## PRODUCTS

* 1. **MATERIALS**

### General

Sealants performance: Resistant to air, entrained water and oil, and microbial growth. Adhesive performance:

* + - Characteristics under environmental conditions: Odourless, non-toxic, non-migrating, non- evaporating and non-hardening, and resistant to microbial growth.
    - Environmental conditions: Normal temperature, sustained temperatures up to 60°C, and operating air velocities.

## COMPONENTS

### Component sizes

General: Standardized throughout the installation as far as practicable.

### Filters

Consistency: For filters of the same type provide filters from only one manufacturer.

### Filter performance

Minimum performance: To AS 1668.2.

### Metal components

Material: Stainless steel or metallic-coated steel with powder coat finish.

### Cell frames

Design: Capable of withstanding distortion arising from the final pressure drop across the filter. Air by-pass: Frames must stop air by-passing the filter media.

### Holding frames

General: True and square. Provide gaskets and clamping systems which maintain an airtight seal between the frame and the filter.

### Filters and media

Requirement: Supply filters and media that are odourless, non-toxic, non-migrating, non-evaporating, non-hardening, resistant to microbial growth, and which do not shed fibres in service.

## DRY MEDIA FILTERS (TYPE 1) AND VISCOUS IMPINGEMENT FILTERS (TYPE 2)

### Filter performance rating

Performance: If filters are documented by performance rating to AS 1324.1 clause 2.1.1, conform to the following:

* + - ≥ 20% average efficiency when tested with AS 1324.2 Test Dust No. 1.
    - ≥ 85% average arrestance when tested with AS 1324.2 Test Dust No. 4.

### Filter media

General: Provide filter media:

* + - That does not support microbial growth and is resistant to fungal and vermin attack.
    - That does not shed fibres in service.

### Class B and C filters

Construction: Provide a rigid metal frame into which the medium is installed.

Mounting: Support the medium on the mounting frame to provide even air flow. Shape pre-formed media to fit the frame. Hold the medium in place with clips, tabs or similar devices so it does not move in service.

## HEPA FILTERS

### General

Standard: To AS 4260.

Type and grade: Type 1 (dry) and Class A (fully disposable) to AS 1324.1 arranged so the filter cell can be removed without disturbing the mounting frame.

### Performance

Face size for performance below: 600 x 600 mm. Filter performance: As documented.

Initial resistance: < 250 Pa at the rated air flow for the cell.

Air flow per cell: Not less than the capacity in AS 4260 Table 3.2.3 for an initial resistance of 250 Pa. Media: Provide media to either of the following:

* MILSPEC to US Military Standard F-51079.
* Non-MILSPEC to AS 4260.

Operating environment: Provide filters suitable for continuous operation at 40°C and 100% relative humidity.

### Seals

Seal type: Provide seals as follows:

* Horizontal cells, vertical air flow: Fluid type.
* Other situations: Closed cell neoprene gasket compressive type.

Frames generally: Support each cell in a mounting frame fitted with spring-loaded screw type clamps or equivalent fasteners. Adjust the clamps for even pressure to achieve an airtight seal under all conditions of service.

Fluid seal frames: Provide a formed channel to accommodate the edge skirts of the filter cell frames to form an airtight seal with the filter frame edge skirt when filled with a non-Newtonian fluid that does not support microbial growth.

### Installation

General: Install filters to enable testing to AS 1807.6 to be performed including access to the air entering and leaving faces and provision for injection of the test medium.

### Testing

Filters Grade 2, 3 or 4 to AS 4260:

* Production test: Test and mark each cell to AS 4260.
* Initial site testing: Test on site and certify to AS 1807.6 on installation.
* Repeat site testing: At not more than 12 month intervals until the end of the maintenance period.

## MEPA FILTERS

### General

Construction and performance: Conform to **HEPA FILTERS** except as follows:

* + - Filter performance: ≥ 95% filtration efficiency for nominal 0.3 μm diameter particles when passing the rated air flow.
    - Initial resistance: < 100 Pa at the rated air flow for the cell.
    - Testing: Not required.

## FILTER TERMINALS

### General

Type: Proprietary filter terminals intended for use with HEPA or MEPA filters and arranged so the casing remains in position when the filter cell is replaced.

### Construction

Casing: 1.2 mm metallic-coated steel with a spigot duct connection. Conform to *0741 Ductwork*. Insulation: To match the associated rigid supply duct.

Screen: Provide a removable perforated 0.6 mm stainless steel screen mounted below the filter face.

Access: Arrange the terminal so all access for inspection, testing, medium injection and filter removal is from the air leaving side.

### Fans

General: If documented provide a resiliently mounted direct drive variable speed centrifugal fan mounted in the filter terminal.

Speed control: Provide a solid state electronic speed control device adjustable from the air leaving side.

## GREASE FILTERS

### General

Construction: Crimped mesh filter media, in a holding frame with handles. Material: Aluminium or stainless steel.

Installation: Hold in place with quick release catches. Mount within 30° of vertical. Frames: Provide mounting frames and install to minimise air leakage around the filter. Thickness: 50 mm nominal.

Installation: To AS 1668.2.

Clean pressure drop: < 30 Pa at 1.8 m/s face velocity. Face velocity: ≤ 1.8 m/s.

## MARKING

### Standards

Marking: To AS 1324.1.

### Filter

General: Permanently and legibly mark, on a suitable section of the filter, the following:

* Filter type and class.
* Direction of airflow.
* Proprietary type, model and serial number.
* Filter performance rating to AS 1324.1.

### Replaceable element

General: On the clean air side, fix the name of the supplier, proprietary type, filter type to AS 1324.1 and filter performance rating to AS 1324.1.

## EXECUTION

* 1. **INSTALLATION GENERALLY**

### Attachment

General: Rigidly attach filter frames to the air handling plant casing (such as duct, or return air plenum) with a system of bolting or blind pop riveting. Locate bolts or rivets clear of the filter element. Do not fix to the casing insulation. Make sure that the installation of the filter does not reduce its rated performance.

Access: Make sure that individual filter inspection and maintenance can be readily carried out without disturbing the filter bank.

Sealing: Make sure that there are no leaks between the filter holding frame and the casing. Seal individual filter units to each other. Seal filter connections to adjoining equipment, panelling or supporting framing. Do not use adhesive tapes for sealing.

Slide-in filter units: Do not use.

Plinth: Where possible, provide a 50 mm high plinth below the filter bank.

### Cell frames

Access: Install filters so that they are accessible for maintenance and do not accumulate moisture. Sealing: Seal filter frames to the plenum or duct in which they are installed.

### Blanking plates

General: Close gaps where the dimensions of the filter plenum do not match those of the framing. Seal air tight to make sure no air bypasses the filters.

Material: ≥ 0.8 mm metallic-coated steel or grade 304 stainless steel sheet.

### Additional bracing

General: Provide stiffeners between or behind the joint of every second column along the narrowest dimension of the plenum.

Stiffeners: Fabricate from ≥ 1.6 mm metallic-coated steel or grade 304 stainless steel.

Maximum deflection of filter bank under operating conditions (ratio of deflection: height or width): 1:500 under maximum system final resistance.

### Manometers

General: Provide a manometer on each filter bank with more than one cell or handling more than 600 L/s.

Type: Minimum 75 mm diameter non-liquid, diaphragm type marked to show differential pressure across each filter bank.

Differential pressure gauge unit: Include pipework, termination and fittings necessary for correct operation and maintenance.

Indicator scale: Mark in 10 Pa divisions with full scale deflection no more than twice the maximum dirty filter condition.

Location: Outside unit casing in a readily readable location.

Marking: Mark clean and maximum dirty pressure drops on manometer scale.

### Filter banks

General: Provide holding frames.

### Filter access platforms

General: Make sure that platforms and ladders do not obstruct filter access. Standard: To AS 1657.

## CLEANING

### Cleaning

General: Before start-up, make sure that the installation is free from debris and dirt, and check the integrity of the filter bank and plenum installation.

### Temporary pre-filters

General: If provided, remove at completion of commissioning.

**6.0 DUCTWORK**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide ductwork, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.
    - *Ductwork insulation*.
    - *Mechanical commissioning*.

## STANDARDS

### General

Flexible ductwork: To AS 4254.1. Rigid ductwork: To AS 4254.2.

### Proprietary and non-standard systems

Standard: Conform to functional criteria in AS 4254.2.

### Microbial control

Microbial control: To AS/NZS 3666.1 as required by the BCA and the recommendations of SAA/SNZ HB 32.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - FRL: Fire-resistance level.

## SUBMISSIONS

### Certification

Certification of fire-resistance rated ductwork: Before the date for practical completion, submit certification that the installed ductwork fire protection meets the required FRL when tested to AS 1530.4.

Fire and smoke dampers: Submit test certificates showing conformance as follows:

* Fire and smoke dampers: To AS 1682.1 for air leakage.
* Fire dampers: To AS 1530.4 for FRL.

Flexible duct: Submit a flexible duct conformance report summary to AS 4254.1 Appendix A as certification of conformance with AS 4254.1.

### Execution details

Access panels: Submit proposed alternative sizes, if any.

Mechanical fire dampers: For positions where dampers cannot be installed to close in the direction of the air flow, submit proposed installation details.

Sealing: Submit details of proposed sealing methods and materials. Include the following:

* Proposals for conforming to the sealing requirements of AS 4254.2 and this specification.
* Proposed sealing materials including mastics and tapes.
* Proposed standard for leakage testing.
* Proposals for sealing builders’ work components incorporated into the air path including, but not limited, to plenum ceilings, outside and return air plenums and risers.
* For each system to be leakage tested, a drawing showing the extent of the system to be tested including the total surface area of the system and the surface area of the portion to be tested.

### Fire hazard properties

General: Submit evidence of conformance to **Fire hazard properties** in **MATERIALS AND COMPONENTS**.

### Samples

Flexible duct: Submit sample 2 metre length of 300 mm diameter flexible duct with sheet metal spigot attached.

### Tests

Leakage testing reports: Submit a report on each system tested. Include in the report:

* Details of the system tested including a sketch of the portions of the system tested.
* Test pressure in Pa and as a percentage of the design operating pressure.
* The measured leakage rate in L/s and as a percentage of the design air quantity.
* If the section tested exceeded the maximum permissible leakage rate under test, provide details of the leakage sources identified and measures taken to rectify them.

Leakage retesting: If a system is retested, provide additional reports containing the information above.

Rigid ductwork: Submit test data verifying the assembled ductwork conforms to AS 4254.2 clause 2.1.2

Type tests: Submit type test certificates showing conformance with the following standards:

* Sealants: To AS/NZS 1530.3.

## INSPECTION

### Notice

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

* + - Leakage testing of each duct system documented to be tested.

## PRODUCTS

* 1. **MATERIALS AND COMPONENTS**

### Corrosion resistance

General: Conform to the **Corrosion resistance table** for the external and internal atmospheric corrosivity categories documented in *General requirements*. Alternatively, provide proprietary products with metallic and/or organic coatings of equivalent or higher corrosion resistance.

External category includes:

* Ductwork outside the building.
* Fire, smoke and motorized dampers in ductwork outside the building.
* Fire, smoke and motorized dampers located in the discharge air path within 3 m of the point of discharge from the building.
* Fire, smoke and motorized dampers located in the outside air or mixed air/recycle air path up to the filters.

Internal category includes:

* Ductwork inside the building not included in external situation.

### Corrosion resistance table

|  |  |  |
| --- | --- | --- |
| **Atmospheric corrosivity category to AS 4312** | **Fire, smoke and motorized dampers** | **Ductwork** |
| C1 and C2 | Metallic-coated sheet Z275/AZ150 | Metallic-coated sheet Z275/AZ150 |
| C3 | Stainless 316 | Metallic-coated sheet Z275/AZ150 |
| C4, C5, T | Stainless 316 | Stainless 316 |

**Adhesive duct tapes**

Mechanical properties: Equal to or better than AS 1599 tape serial number F11. Adhesive: Non-toxic, high tack, synthetic pressure-sensitive type.

### Fire hazard properties

Spread-of-flame index: 0 when tested in conformance with AS/NZS 1530.3.

Smoke-developed index: ≤ 3 when tested in conformance with AS/NZS 1530.3. Flammability index of facing materials: ≤ 5 when tested to AS 1530.2.

Assembled duct systems: Pass the UL 181 burning test.

Fire protection of duct systems: Achieves the required FRL to AS 1530.4.

## SHEET METAL DUCTWORK

### Material

General: Galvanized steel duct and mild steel components less than 3 mm thick: Prime quality lockforming galvanized steel, to AS 1397 Grade G2 or G3 to AS 2338 with Z275 coating to AS 1397.

Thickness: To AS 2338.

Components for stainless steel and aluminium ductwork: Use materials with corrosion resistance not less than that of the duct wall material.

### Fasteners

Rivets: Expanding solid end type, aluminium base alloy for galvanized and aluminium duct, stainless steel for stainless steel duct, minimum size as follows:

* For sheet metal to sheet metal: 3 mm.
* For sheet metal to supports, brackets and rolled steel angles: 4.8 mm.

Self tapping screws: Zinc-plated for galvanized duct, stainless steel and aluminium duct.

Self drilling and tapping screws: Zinc-plated for galvanized duct, stainless steel for stainless steel and aluminium duct. Provide only if base material into which they screw is thicker than 1.5 mm and they are unlikely to be removed or replaced.

Bolts, nuts, washers and drop rods:

* Galvanized duct: Zinc-plated steel, service condition number 2.
* Stainless steel and aluminium duct: Stainless steel except that parts not in contact with the air stream or corrosive conditions may be zinc-plated steel, service condition number 2.

Washers: Provide washers under nuts and bolt heads.

### Draw bands

Material: Select from the following:

* Metallic-coated steel or stainless steel worm drive hose clamps.
* Metallic-coated steel or stainless steel packaging binders tensioned with a proprietary device designed for the material used.

### Duct sealing

Duct seal class: Not lower than Class C to AS 4254.2 Table 2.2.1 regardless of duct pressure or location.

Extent of sealing:

* Where the expression "Use duct sealant throughout" is used in AS 4254.2, apply sealant to the full length of all joints so no gaps or holes remain through which air might leak.
* Seal all holes, gaps and other openings in ductwork including, but not limited to branches, access doors, access panels, and connections to equipment.
* Seal as specified for ductwork all associated air handling equipment including but not limited to air handling units, fan coil units, diffusers and grilles, plenum and cushion head boxes, terminal equipment including VAV terminals and chilled beams.
* Seal holes for pipes, conduits, cables and rotating shafts including damper shafts. Sealant materials: Use only sealants that:
* Do not foster microbial growth.
* Have a smoke-developed index less than 3 and a spread-of-flame index of 0 when tested to AS/NZS 1530.3.
* Will maintain their sealing performance for the life of the duct system.
* Bond to the surface of application without primers.
* Are resistant to oils, refrigerants and water after curing.
* Are non-toxic.
* Have high elastomeric properties over the range of operating temperatures after curing.
* Are suitable for application by gun or hand tools.

Adhesive duct tapes: Do not use duct tape as the primary duct sealing agent. Use only as a secondary sealant on joints sealed by other means such as mastic, liquids or gaskets. Do not use duct tapes for non-sealant purposes.

Machine rolled flanges: Use mastic at corners.

## FLEXIBLE DUCT

### Standard

Requirement: To AS 4254.1.

### Materials

Uninsulated flexible duct: Select from the following:

* Aluminized fabric clamped on a formed metal helix. Do not use adhesives. Reinforce lap joints in the fabric.
* Coated steel wire laminated between two layers of aluminized polyester fabric using fire-resistance rated adhesive. Reinforce lap joints in the fabric.

Insulated flexible duct: As for uninsulated flexible duct with flexible blanket insulation wrapped around duct and covered with an outer vapour barrier.

Material R-value: To BCA Spec J5.2b.

Insulation material: Conform to the *Ductwork insulation* work section.

## KITCHEN EXHAUST DUCTWORK

### Standard

To AS/NZS 1668.1 Section 1.

### Construction

Ductwork: Do not crossbreak.

Grading: To AS 4254.2 and AS/NZS 1668.1. Joints: Seal to AS 4254.2 clause 2.2.2.

Access: Provide liquid-tight cleanouts to AS 4254.2 and in addition at:

* The bottom of kitchen exhaust risers.
* Sprinkler head locations.

Drains: Provide a grease gutter and DN 25 drain socket and plug as follows:

* At the lowest point of each run of ducting.
* At the bottom of vertical risers.

## FIRE PROTECTION OF DUCTWORK

### Sprayed coatings

Type: Fire resistant sprayed coating to achieve the required FRL when tested to AS 1530.4. Provide additional cement hard set finishing coat in locations requiring protection against damage or water.

### Composite systems

Type: Wraps or modular duct systems to achieve the required FRL when tested to AS 1530.4.

### Access

Fire damper access: Where access is required to the duct interior such as at fire damper access panels and damper quadrants, provide easily removable panels of FRL equivalent to the required FRL of the duct.

Exhaust fan access: For items such as smoke exhaust and kitchen exhaust fans that are too large or heavy to remove through access panels provide a fire-resistance rated enclosure around the item with fire-resistance rated doors or removable fire-resistance rated panels large enough to permit removal of the item.

## FLEXIBLE CONNECTIONS

### General

Requirement: Isolate fans and conditioner casings from ductwork, by means of airtight flexible connections.

Materials:

* Generally: Heavy duty, waterproof.
* In kitchen exhaust ductwork: To AS 4254.2 clause 2.1.3.

Length: Provide sufficient slack free movement and vibration isolation under operating and static conditions.

Alignment: Align openings of connected equipment.

Fixing: Fix to attachments with metallic-coated steel strip. Seal joints. Do not paint flexible material. Fire protection: To achieve the FRL of the attached duct when tested to AS 1530.4.

Maintenance: Arrange to permit easy removal and replacement without disturbing ductwork or plant.

Restriction: Do not protrude connections or frames into the airstream where this would be detrimental to the air flow.

## DAMPERS – GENERAL

### Location

Balancing dampers: At each branch duct or tee, as follows:

* + - Splitter type: Use only for supply branches up to 300 mm maximum dimension and with velocity in main less than 10 m/s. Do not use on return or exhaust ducts.
    - Opposed blade dampers: Use for any size supply and for all return and exhaust ducts. Locate in each branch.

## VOLUME CONTROL DAMPERS

### General

Requirement: Provide dampers which are free of rattles, fluttering or slack movement and capable of adjustment over the necessary range without excessive self-generated noise or the need for special tools.

Face dimensions: Duct size.

Connections: Mating angle flanged cross joints.

Frames: 1.6 mm minimum thickness metallic-coated steel or 2 mm minimum thickness aluminium folded to form channel sections at least 150 mm wide and welded at corners.

Dampers required to provide tight shut-off: Comply with the **MOTORISE DAMPERS** clause. Dampers in smoke-spill systems: Metallic-coated steel or stainless steel blades and frames. **Blades**

Material: Metallic-coated steel, aluminium or stainless steel.

Form: No sharp edges. Sufficiently rigid to eliminate movement when locked. Minimum thickness:

* Metallic-coated sheet steel and stainless steel:

. Single thickness blades: 1.6 mm.

. Double thickness blades: 1.2 mm.

* Aluminium:

. Single thickness blades: 2.4 mm.

. Double thickness blades: 1.8 mm.

Maximum length: 1200 mm. If necessary provide intermediate mullions. Single blade dampers:

* For single thickness blades: 600 mm maximum length, 600 mm maximum width or 600 mm maximum diameter.
* For single thickness blades with 6 mm minimum edge breaks: 1200 mm maximum length x 175 mm minimum width.
* For double thickness blades: 1200 mm maximum length x 300 mm minimum width. Multi-blade dampers:
* For single thickness blades with 6 mm minimum edge breaks: 1200 mm maximum length 175 mm minimum width.

### Bearings

Type: Oil impregnated sintered bronze bearings, sealed-for-life ball bearings or engineering plastic sleeve bearings that do not require lubrication for the life of the duct system. If the operating temperature is more than 50°C, provide sealed-for-life ball bearings only.

Housings: Rivet to damper frames.

### Spindles

Material: Stainless steel in stainless steel dampers, zinc-plated steel or stainless steel otherwise. Construction: Securely fix to damper blades.

Minimum diameter:

* Blade lengths ≤ 600 mm: 10 mm.
* Blade lengths > 600, ≤ 1200 mm: 12 mm.

### Linkages

Fixing: Fix securely to blades so that the blades rotate equally and close tightly without slip.

### Damper adjustment

Requirement: Provide a way to adjust the damper and lock it in position. Locate in an accessible position. Label the open and closed positions clearly and permanently.

## NON-RETURN DAMPERS

### Construction

Requirement: Conform to **Volume control dampers**. Counterweight the assembly so that it:

* + - Offers minimum resistance to air flow.
    - Closes by gravity.

## FIRE AND SMOKE DAMPERS

### General

Requirement: Provide free cross section area at least 85% of the face area. Provide oversize damper and enlarge duct both sides of damper if necessary to achieve this.

Material: As documented in the **Fire damper schedule**. **Links**

Mechanical fire dampers: Provide frangible bulb or fusible links.

Smoke dampers: Provide fusible links activated by either local heat or a low power external electrical impulse.

Installation: Mount for easy replacement.

### Access panels

General: Provide for maintenance of dampers and replacement of links.

## ACCESS OPENINGS – LOCATION

### Access doors

Location: Provide an access door in each section of air handling units where access is required for maintenance, inspection or removal of components. Removable panels may be used instead of doors where access is required only for removal of coils.

### Access panels

Location: Conform to the following:

- Next to each component located inside the duct requiring regular inspection and maintenance including, but not limited to:

. Fire and smoke dampers.

. Smoke detectors.

. Filters.

. On the air entering side of electric duct heaters.

. On the air entering side of duct mounted heating coils.

* In air handling units where unit size is insufficient to fit an access door.
* Where specified in **Kitchen exhaust**.
* In the vicinity of moisture producing equipment, to AS/NZS 3666.1 clause 2.11.3.
* In other locations documented.

## ACCESS PANELS

### Sizes

Access panels: Minimum clear opening:

* + - Personnel access: 600 x 600 mm.
    - Hand access: 300 x 300 mm.

### Construction

Type: Double panel, deep formed, zinc-coated steel construction, insulated to match the duct, or filled with at least 25 mm glass wool or rock wool insulation.

Cold bridging: Arrange to prevent condensation on cold surfaces.

Frames: Provide rigid matching galvanized steel frames securely attached to the duct. Do not protrude any part of the panel or frame into the airstream.

Seals: Mechanically fixed to either the panel or the frame for an airtight seal against the operating pressure when latched in the closed position. Use a fixing method that permits easy replacement - as follows: Conform to the following:

* + - Fire-resistance rated seals: Woven ceramic fibre material.
    - Other seals, Silicone rubber or soft neoprene. Latches: Wedge type sash latches.

Number of latches:

* + - For personnel access: 4.
    - For hand access: 2.

Handles: Provide a ‘D’ handle on access panels for personnel access.

## ACCESS DOORS

### Construction

General: Provide rigid, reinforced access doors. Thickness: ≥ 50 mm.

Construction: Provide either:

* Sandwich panel: As documented for wall and ceiling panels. Form door edging with a heavy gauge aluminium extrusion with double web seal to both skins. Mitre corner and firmly secure to panel with countersunk head screws.
* Folded: Two-piece press formed or machine folded from zinc coated steel at least 1.6 mm thick. Size: 1350 mm high x 600 mm wide clear opening or larger dimensions if:
* Necessary to permit safe removal of equipment inside the section, or
* Chamber: To BCA G1.2 in which case the minimum clear opening is 1500 mm high X 600 mm wide.

Door swing: Except where the pressure differential would require an excessive force to open the door, swing doors against air pressure as follows:

* Doors on the inlet side of the fan: To open outwards
* Doors on the discharge side of the fan: To open inwards.

Cold bridging: Arrange to prevent condensation on cold surfaces.

Jamb, stiles and head: Rigid matching ≥ 2.5 mm zinc coated steel, or ≥ 3.0 mm PVC or fibreglass securely mounted.

Door hardware:

* Catches: Provide at least 2 heavy duty proprietary clamping-type latches with permanently attached handles that can be operated from both the inside and the outside of the door. Provide satin chrome plated finish to exterior components.
* Hinges: Hang doors on edge-mounted, rising butt type self-closing hinges capable of holding the door fully open. Construct from chrome plated brass or heavy duty aluminium alloy. Provide stainless steel hinge shaft and nylon bearing surfaces.
* Installation: Securely bolt hardware to the door and frame by a method which minimises cold bridging and prevents the forming of condensation on the outside of the conditioner.

Seals: Mechanically fix to the door to create an airtight seal when latched closed. Use a fixing method that permits easy replacement.

* Fire-resistance rated seals: Woven ceramic fibre material.
* Other seals: Silicone rubber or soft neoprene.

Insulation: 50 mm thick. Construction and insulation properties to match the insulation of the duct, plenum or casing in which the door is located.

## KITCHEN HOODS

### Materials

Material: As documented.

* + - Stainless steel: 1.2 mm thick, 2B finish. Continuously weld seams. Grind the weld smooth and polish affected areas.
    - Metallic-coated steel: Metallic-coated sheet Z275/AZ150.

### Volume dampers

General: If there is more than one duct take off, provide a volume damper at each duct take off, to enable adjustment of air flow over the face of the hood.

### Luminaires

General: Provide access doors for the installation of luminaires.

Glass panels: Heat resistant and sealed to the hood with gaskets, to prevent entry of grease and moisture but allowing expansion.

## EXECUTION

* 1. **DUCTWORK INSTALLATION**

### Arrangement

Ductwork: Arrange ductwork neatly. Provide access to ductwork components which require inspection, entry, maintenance and repairs. Where possible, arrange duct runs adjacent and parallel to each other and to building elements.

### Spacing

Provide minimum clear spacing, additional to duct insulation, as follows:

* 25 mm between adjacent ducts.
* 25 mm between duct flanges or upper surfaces of ducts and undersides of beams and slabs.
* 50 mm between ducts and electric cables.
* 150 mm between ducts and ground, below suspended floors.

### Flexible duct

General: Install flexible duct as straight as possible with minimum number of bends. Maximize bend radius but not less than required by AS 4254.1 clause 2.5.3(i).

Length: Cut flexible duct to lengths that achieve this and to minimize the number of bands.

Joints: Securely fix flexible duct to rigid spigots and sleeves using sealant and draw band encased in duct sealing tape as detailed in AS 4254.1. Place mastic between the flexible and rigid duct, not as a fillet.

Joints between flexible ducts: Join lengths of flexible duct only for the purpose of providing an air tight or acoustic sleeve at a partition.

Support: To AS 4254.1. Limit sag to less than 40 mm/m.

Maximum length of flexible duct sections: 6 metres including the length of any rigid duct or sleeves used to join lengths of flexible duct.

Substitution: If rigid duct is shown on the drawings do not substitute flexible duct.

Flexible ducts used for air containing free moisture: Locate supporting helix outside airstream.

### Cleaning

During installation progressively remove construction debris and foreign material from inside ducts.

### Drainage

Provide drainage to AS/NZS 3666.1 at locations in ductwork where moisture may accumulate including at outside air intakes.

### Ductwork exposed to weather

Requirements:

* Seal all parts of all ductwork joints.
* Provide watertight protective shields over joints.
* Seal all duct supports where they attach to the duct.
* Seal all reinforcement attachments so that moisture is not retained in any gap or crevice.
* Profile or cover the top side of ductwork to shed water.

## LEAKAGE TESTING

### Standard

Leakage testing methods: Select from the following:

* + - SMACNA 016.
    - The Building and Engineering Services Association publication B&ES DW/143. Test pressure: To AS 4254.2

Maximum leakage rate under test: Less than 5% of the total design air quality of the duct system, times the ratio of the duct surface area under test to the total duct surface area of the system.

### Test method

Amount of system to be tested: At least 10% of the total surface area of the system including a pro- rata proportion of the following:

* + - Floor distribution ducts.
    - Each seam, joint and sealing construction type.
    - Longitudinal seams.
    - Circumferential joints.
    - Rigid ductwork.
    - Flexible ducts.
    - Flexible connections.
    - Diffusers grilles and other terminal devices.
    - Air handling plant and plenums.
    - Supply, return, outside air and exhaust ducts.
    - Builders' work risers used in lieu of sheet metal ducts.

Duration of the test: Maintain the test pressure within ±5% for at least 5 minutes. Instruments: Conform to *Mechanical commissioning.*

Leakage flow rate measurement: Use instruments that have been certified by a Registered testing authority in the past 12 months and have:

* + - Accuracy: Better than ± 5% of measured value.
    - Resolution: Better than 1% of measured value.

### Failure under test

Requirement: If the leakage in the duct system exceeds the documented maximum leakage rate under test:

* + - Locate leaks and mark their position on the outside of the duct.
    - Rectify leaks.
    - Record the generic location of leaks and corrective action.
    - Retest the system as above but with at least 20% of the total surface area of the system.

Repeat test: If the leakage in the duct system under retest exceeds the documented maximum leakage rate under test, retest with 100% of the total surface area of the system.

### Reports

Requirement: Conform to **SUBMISSIONS**.

**7.0 DUCTWORK INSULATION**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide insulation of ductwork and related items, as documented.

### Alternative insulation methods and materials

General: Do not submit alternatives for materials or methods that have lesser quality or characteristics in terms of the following:

* Cold bridging.
* Corrosion resistance.
* Durability during and after installation.
* Performance.
* R-Value.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## STANDARDS

### General

Flexible ducts: To AS 4254.1.

Ductwork insulation: To AS 4254.1 and AS 4254.2. Performance and technical provisions: To AS/NZS 4859.1. **Installation of glass wool and rock wool insulation**

Glass Wool and Rock Wool insulation: Conform to the ICANZ Industry Code of Practice for the Safe

Use of Glass Wool and Rock Wool.

Marking: Deliver mineral wool products to site in packaging labelled FBS-1 BIOSOLUBLE INSULATION.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - FBS-1 (fibre-bio-soluble) mineral wool: Insulation composed of bio-soluble glass or rock fibres.
    - Fire hazard properties: Means the Average Specific Extinction Area, Critical Radiant Flux, Flammability Index, Smoke-Developed Index, Smoke Growth Rate Index, Smoke Development Rate or Spread-of-Flame Index of a material or assembly that indicate how they behave under specific fire test conditions.
    - Material R-Value: The thermal resistance (m2.K/W) of a component calculated in conformance with AS/NZS 4859.1 clause 2.3.3.8. Material R-Value does not include air space or surface resistances.

## SUBMISSIONS

### Fire hazard properties

General: Submit evidence of conformance with the **Fire hazard properties** in **INSULATION MATERIALS**, including assembled duct systems.

### Products

Thermal insulation performance: Submit evidence of conformance to AS/NZS 4859.1.

### Samples

Samples: Submit samples of the following:

- Each type of insulation, applied to a sample 1.5 m long section of ductwork, including a site applied insulated transverse joint.

Cutaway sections: For each sample, provide cutaway sections to permit inspection of application details including insulation materials, adhesives, mastics, fixings and sheathing.

### Technical data

Alternative insulation methods and materials: If offering alternatives, submit evidence that they are equal or superior quality and characteristics than that documented. Include comparison of the following:

* Cold bridging.
* Corrosion resistance.
* Durability during and after installation.
* Suitability for the operating temperature range.
* Thermal and other performance.

## PRODUCTS

* 1. **INSULATION PERFORMANCE**

### General

Insulation material R-Value: To BCA Spec J5.2b and as documented.

**Thermal conductivity: ≥ 0.030 W/(m.K).**

## INSULATION MATERIALS

### Type

Form: Batt, board or blanket. Select from the following:

* + - Glass wool.
    - Rock wool.
    - Polyester: Thermally bonded polyester fibres.
    - Polyolefin: Closed cell cross-linked polyolefin foam produced using non-CFC blowing agent.

### Fire hazard properties

General: Fire hazard indices for all materials when tested in conformance with AS/NZS 1530.3:

* + - Spread-of-flame index: 0.
    - Smoke-developed index: ≤ 3. Facing materials:
    - Flammability index when tested in conformance with AS 1530.2: ≤ 5. Assembled duct systems: Pass the UL 181 burning test.

Materials with reflective facing: Test to AS/NZS 1530.3 clause A6. Standard: To AS/NZS 4859.1.

### Vapour barrier

Standard: If vapour barrier performance is documented, provide a system with a vapour barrier classification of High to AS/NZS 4200.1 (permeance ≤ 0.002 µg/N.s).

### Semi-rigid insulation

General: Physical properties:

* + - Alkalinity: pH 7 to 9.
    - Moisture absorption: Non-hygroscopic.

Type: Batt or board form with a maximum mean deflection of 6 mm for 50 mm thick material and 20 mm for 25 mm thick material, tested as follows:

* + - Freely support a 900 x 1500 mm test piece on its longer sides.
    - Allow the test piece to stand for 10 minutes and measure the vertical deflection.
    - Turn the test piece over and repeat the test.
    - Average the results.

### Minimum absorption coefficients table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Insulation** | **Absorption coefficients (nominal) to AS ISO 354 at** | | | | | |
| **125 Hz** | **250 Hz** | **500 Hz** | **1000 Hz** | **2000 Hz** | **4000 Hz** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Perforated foil faced: R | 0.12 | 0.48 | 0.84 | 0.96 | 0.97 | 0.94 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Insulation** | **Absorption coefficients (nominal) to AS ISO 354 at** | | | | | |
| 0.9 to  AS 4508 |  |  |  |  |  |  |
| R 1.5 to  AS 4508 | 0.23 | 0.62 | 1.00 | 1.07 | 1.12 | 0.78 |

**Adhesives**

Type: Suitable for bonding facing to the insulation. Apply in an even coat. Fire hazard properties:

* + - Smoke developed index: 0. **Aluminium foil laminate sheet** Standard: To AS/NZS 4200.1 as follows:
    - Internal insulation: Heavy duty before perforation.
    - External insulation: Heavy duty unperforated.

Test criteria: To UL 181 with performance to AS 4254.1.

### Adhesive duct tapes

Mechanical properties: Equal to or better than AS 1599 tape serial number F11. Adhesive: Non toxic, high tack, synthetic pressure-sensitive type.

Liner: Silicone coated paper. Backing: Aluminium foil laminate. **Elastomeric foam insulation**

Material: Chemically blown closed cell nitrile rubber in sheets or rolls. Provide with a smooth natural

finish and vapour barrier properties. Standard: To ASTM C534.

Physical properties:

* + - Thermal performance: As for the attached duct.
    - Moisture absorption: Non-hygroscopic.
    - Water vapour permeability: ≤ 0.065 ng/Pa.m.s.

Adhesives: Adhesive fix and seal exterior joints. Provide only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

Protection: Metal sheath insulation where:

* + - Exposed to sunlight.
    - Subject to mechanical damage.

Alternative protection: Where exposed to sunlight but not exposed to mechanical damage, provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

## EXECUTION

* 1. **GENERAL**

### Fixing devices

Standard: To AS 4254.2 clause 2.7.

Pins: Stud welded fully annealed metallic-coated steel.

Speed clips: Bevel edged metallic-coated steel with an area not less than that of a 25 mm circle. Secure speed clips flush to the face of the insulation.

Protection: Cut off excess length of pins after insulation and speed clips have been applied or bend parallel with the insulation surface. Cover fixing pins and speed nuts on external insulation with aluminium foil laminate tape.

### Insulation overlap

General: Provide an overlap of at least 300 mm where insulation changes from the inside of the duct to the outside.

### Joints

Joints: Install insulation with the least number of joints practicable.

Use of multiple layers: If insulation is applied in more than one layer, stagger longitudinal and end joints.

### Insulation near moisture producing equipment

General: If the likelihood exists of moisture accumulation inside ducts, in the vicinity of moisture producing equipment use only external insulation.

Metal sheath insulation: In plant rooms and as documented in the **Ductwork insulation schedule**. **Vapour barriers**

Type: Free from perforations and leaks, continuous, and sealed continuously at penetrations.

Location: Place vapour barriers on the side of the insulation that will be warm during cooling mode operation.

### Application of tapes

Tape width: ≥ 72 mm.

Make sure surfaces are dry and free of dust and grease before applying tapes.

### Completion of fabrication

General: After each length of duct or each fitting has been insulated inspect and remove any off cuts, drill swarf or other loose material.

Storage: Store under cover and protected from weather and the entry of foreign matter.

### Internal insulation of ductwork connected to evaporative coolers

Protection: Moisture resistant or protected with a moisture resistant membrane.

## INTERNAL INSULATION – LAMINATE FACED

### System description

Insulation type: Semi-rigid board or batt.

Surface facing: Factory applied perforated aluminium foil laminate.

### Application

General: Cover parts of ducts designated to be insulated, with individual pieces of insulation for each side of the duct. Where this is not possible, butt join edges of adjacent pieces. Where multi-layers are used (round or oval ducts) stagger all joints.

### Joins in insulation

General: Cover joins with 100 mm wide strip of facing material or tape located centrally over the join. Longitudinal joins: Locate behind corner angles or cover strips.

### Fixing method

Method: Select from the following:

* Corner angle and end nosing method.
* Free edge method.

Fixing pins: Provide to AS 4254.2 clause 2.7.1. **Corner angle and end nosing method** Installation: Conform to the following:

* Overlap insulation on adjacent sides at corners.
* Hold insulation in position with metallic-coated steel corner angles.
* Fix corner angles under the turn back of the end nosing.
* For corner angles longer than 1600 mm, provide additional fixing at 1600 mm maximum centres. Corner angles:
* Ducts with faces < 300 mm: 25 x 25 x 0.55 mm, minimum.
* Other ducts: 40 x 40 x 0.55 mm, minimum.

End nosings: At ends of ducts, hold insulation in position with U-shaped metallic-coated steel end nosings, with edges crimped towards the surface. Rivet end nosings to ducts.

Size: 0.55 mm thick with a minimum 50 mm turn back over the insulation.

Butt joints: Square cut and butt tightly together edges of adjacent pieces of insulation. Cover with 50 x

0.55 mm metallic-coated steel strip. Rivet cover strips under corner angles or under turn-back of end nosings. For cover strips longer than 1600 mm, provide additional fixing at 1600 mm maximum centres.

Fixing pins: For ducts with faces ≥ 300 mm, fix the insulation at 300 mm maximum centres with at least one row per duct face.

### Free edge method

General: Use only where larger duct side is no more than 300 mm.

Edges: Extend insulation proud of ductwork at each end, to provide cushion joints that fully seal during assembly.

## EXTERNAL INSULATION – LAMINATE FACED

### System description

Insulation type: Flexible batts or blanket.

Surface facing: Factory applied aluminium foil laminate.

### Application

General: Wrap insulation around the outside of ducts, covering the parts designated to be insulated. Minimize the number of joints.

Joints: Square cut and butt together the edges of adjacent pieces of insulation.

Insulation of bends: Apply a single piece of insulation to each face of a bend or transition. Insulate bends and transitions on round and flat oval ducts with individually mitred gores cut to fit the fitting.

Vapour sealing: Seal the vapour barrier at joints with 100 mm wide aluminium foil laminate tape, applied centrally over the joint. Where the insulation is impaled over pins, seal the vapour barrier by covering pins with water-based mastic vapour barrier or reinforced aluminium foil faced tape at least 100 x 100 mm.

Flanges, stiffeners and joints: Maintain insulation thickness over flanges, joints, stiffeners and other items that protrude from the face of the duct. Use one of the following methods:

* Carry the insulation material over the protruding item without cutting or joins.
* Insulate with 150 mm wide strip of the same material as used for the duct. Fix with a row of pins and speed nuts on each side of the protruding item. Provide a continuous vapour barrier.

Polyolefin foam insulation: Apply proprietary 120 mm wide polyolefin foam flange strips over flanges, joints and stiffeners.

### Fixing method

Materials other than polyolefin foam: Select from the following:

* Pin method: Provide pins to each face of the duct as follows:

. Horizontal ducts < 380 mm wide: Pins not required.

. Horizontal ducts > 380, < 760 mm wide: One row of pins along centreline to side and bottom duct faces at 380 mm maximum centres.

. Horizontal ducts ≥ 760 mm wide: Pins spaced at 380 mm maximum centres.

. Vertical ducts < 610 mm wide: Pins not required.

. Vertical ducts ≥ 610 mm wide: Pins spaced at 380 mm maximum centres.

* Strap and pin method: Provide 12 mm wide polypropylene strapping at maximum 600 mm intervals.

. Horizontal ducts ≥ 600 mm wide: Hold insulation in position on the underside with fixing pins spaced at 400 mm maximum centres with at least one row per duct face.

. Vertical ducts ≥ 600 mm wide: Provide pins to all faces at 400 mm maximum centres.

* Corner angle and strap method: Provide metallic-coated sheet steel corner angles on all four sides of the duct. Retain with 12 mm wide polypropylene strapping at maximum 750 mm intervals. Provide angles as follows:

. 25 mm nominal thickness insulation: 38 x 38 mm.

. 50 mm nominal thickness insulation: 63 x 63 mm.

Polyolefin foam: Provide pins spaced 50 mm from all edges and spaced 200 to 300 mm apart in all directions.

## EXTERNAL INSULATION – LAMINATE FACED AND METAL SHEATHED

### System description

Insulation type: Semi-rigid batts.

Surface facing: Factory applied aluminium foil laminate.

External protection: Metal sheathing.

### Application

General: Conform to **EXTERNAL INSULATION – LAMINATE FACED**, **Application**.

Support: Support insulation against the duct surfaces with 0.55 mm metallic-coated steel cut and folded to the outside dimensions of the insulated duct.

Joints in sheathing: Lap joints in sheathing at least 30 mm and rivet at 100 mm centres. Factory made joints may be of the grooved seam or spot welded type. Where necessary, provide for sheathing removal for maintenance or access, by providing self tapping screws that do not penetrate the vapour barrier.

Sealing: If exposed to weather, seal joints with silicone mastic sealant.

## INSULATION OF DUCTWORK COMPONENTS AND FITTINGS

### Extent

Requirement: Except for packaged air conditioning plant required to conform to MEPS, insulate all components and fittings carrying cooled and/or heated air, including the following:

* + - Access doors and panels.
    - Air handling units.
    - Dampers.
    - Fan coil units.
    - Fans not inside insulated air handling units.
    - Plenums and cushion head boxes on air grilles.
    - Other fittings and duct-mounted components, and builder’s work items having the above functions.

### Material R-Value

Minimum: To BCA Spec J5.2b Table 3.

### Installation

Access for maintenance: Arrange insulation to permit easy access to items within requiring routine inspection or maintenance.

Operation: Arrange insulation so that it does not impede the operation of dampers, fans and other components.

### Plenum and cushion head boxes on air grilles

Insulation type: Internal insulation, with perforated aluminium foil laminate, black finish.

Insulation fixing: Turn facing back over raw edges of insulation for at least 75 mm and bond the turn back to the insulation before installation. Provide fixing pins at 250 mm maximum centres with at least one pin per face. Fully bond insulation around neck with adhesive.

### Dampers

Internal: Leave clearance between insulation and edges of the splitter or manually operated damper blades.

External: For manual and motorized dampers, provide removable insulated sheet metal top hat sections to encase dampers.

### Access doors and panels

General: Provide insulation to access doors and panels. Arrange to prevent condensation on cold surfaces.

## INSULATION OF DUCT FLEXIBLE CONNECTIONS

### General

Requirement: Insulate duct flexible connections if the temperature of the air inside the duct may cause condensation on the outside of the flexible connection.

Material R-Value: Same as the connected duct.

### Method

General: If the insulation of the connecting ductwork is:

- External laminate faced on one or both sides of the flexible connection: Insulate duct flexible connection as required in the **EXTERNAL INSULATION – LAMINATE FACED** clause.

Any other insulation system: Insulate duct flexible connection with elastomeric foam as required in the

**ELASTOMERIC FOAM INSULATION** clause.

**8.0 AIR GRILLES**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide air grilles, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.
    - *Ductwork insulation.*

## STANDARDS

### General

General: AS 4254.1 and AS 4254.2.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - VAV: Variable air volume.

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Air grille: A generic term referring to an air grille of metal or other material fitted to the inlet or outlet end of an air duct, or within walls, floors ceilings or doors. It includes all types of diffusers, registers and other grilles included in this work section.
    - Diffuser: A supply air grille mounted in a ceiling or on the underside of a duct through which air is supplied and distributed within a room or interior space of a building.
    - Register: A supply air grille mounted in a wall or on the side of duct.
    - Cushion head box: A plenum box fitted above a diffuser.
    - Louvres - Horizontal: Louvres that span between frame, stiles, mullions or vertical supports.
    - Plenum box: A lower velocity (larger volume) duct element behind an air grille intended to allow equalization of air flow over the air grille.

## SUBMISSIONS

### Samples

General: Submit a sample of each type of air grille. Include plenum box or cushion head box and blanking plates, as documented.

### Tests

Type tests: Submit test results as follows:

- Acoustic performance: To ISO 5135 or ANSI/ASHRAE 70.

## PRODUCTS

* 1. **MANUFACTURE**

### General

Proprietary air grilles: Conform to the following:

* + - Free from distortion, bends, surface defects, irregular joints, exposed fastenings and operation vibration.
    - With flange corners neatly mitred, butted and buffed, with no joint gaps. Material: Steel or aluminium.

Finish:

* + - Exposed surfaces: Powder coated to the nominated colour.
    - Visible internal elements: Matt black enamel.

Fixings: Provide secure, concealed fixings that allow removal without damage to surrounds or air grilles.

### Variable volume systems

General: Provide air grilles tested for variable volume applications.

## VOLUME CONTROL DAMPERS

### Dampers controlling a single air grille attached to flexible duct

General: Provide damper as follows:

* + - Duct spigot located above tiled or accessible ceiling: Provide a butterfly damper in the rigid duct spigot.
    - Duct spigot not located above tiled or accessible ceiling: Provide an opposed blade damper behind the face of the air grille.

### Butterfly dampers

Type: Single-blade round dampers with external locking quadrant indicating butterfly damper position. Location: Conform to **Dampers controlling a single air grille attached to flexible duct**.

### Opposed blade dampers

Type: Multi-blade type with blades linked for ganged operation. If located at the air grille, provide adjustment accessible through the grille face. If visible through the air grille, paint the damper matt black.

Location:

* + - At the at end of duct spigot take-offs.
    - Location: Conform to **Dampers controlling a single air grille attached to flexible duct**.
    - Behind supply air grilles attached to flexible duct if the spigot at the rigid duct is not accessible through the ceiling.
    - Behind return and exhaust air grilles connected to ducts.

## AIR GRILLE TYPES

**Air grilles in suspended ceilings** Physical compatibility: To AS 2946. **Louvre ceiling diffusers**

Type: Select from:

* + - Multi-bladed, removable core 4-way blow configuration, fitted with a blanking plate for 1-, 2-, or 3- way blow, as appropriate; or
    - Multi-bladed, removable core 1-, 2-, 3- or 4-way blow configuration.

Reducer necks: If the outlet neck is smaller than the outlet necessary to suit the louvre face size, provide a reducer neck.

Frame: To suit the type of ceiling and ceiling grid mounting requirements.

Cushion head: If the diffuser is connected to a flexible duct, provide a cushion head box. Air volume control: Conform to **VOLUME CONTROL DAMPERS**.

### Weatherproof louvre grilles

Type: Extruded aluminium with fixed horizontal blades set into a fixed frame.

Louvre blades: Set at nominal 45° angle and incorporating at least one hooked edge to prevent ingress of water under all operating conditions. Brace and stiffen to prevent rattling or movement.

Frame: Flanged or channel to suit the installation profile. Pressure drop: ≤ 15 Pa at the documented air flow.

Screens: Provide metallic-coated steel wire or PVC mesh screens behind louvres to prevent the entry of vermin, birds, rodents and wind-blown extraneous material such as leaves and papers.

### Return or exhaust air grilles – indoor

Type: Extruded aluminium with fixed horizontal blades set into a fixed support frame with mitred corners. Fit blades tightly into the frame to prevent rattling or movement. Brace and stiffen to produce a rigid assembly.

Pressure drop: ≤ 10 Pa at the documented air flow. Blades:

* + - Half chevron type: Blades at nominal 45° angle on a nominal 25 mm pitch.
    - Chevron type: Blades at nominal 25 mm pitch. Provide a telescopic frame with clip-on pattern surround frames on both sides.
    - Light proof grilles: Chevron type but with double chevron blades, blade pitch and edge detail designed to stop light penetration.

Air volume control: If the air grille is connected to a duct, provide an opposed blade damper behind the grille core, key operated without removing the core.

### Egg crate return or exhaust air grilles

Type: Nominal 12 x 12 mm square, 12 mm deep egg crate type aluminium core fixed in an extruded aluminium frame with mitred corners. Fit core tightly into the frame to prevent rattling or movement.

Free Area: ≥ 90% of nominal face area.

Air volume control: If the air grille is connected to a duct, provide an opposed blade damper behind the grille core, key operated without removing the core.

## EXECUTION

* 1. **INSTALLATION OF AIR GRILLES**

### Protection

Wrapping: Leave protective wrappings in place until final mounting.

### Mounting

General: Provide a matching escutcheon to close gaps between the air grille and its surrounds. Provide air grilles with flanges to cover penetrations and irregularities in surrounds.

Tiled ceilings: Locate air grilles to minimise cut tiles. Otherwise, locate the air grille symmetrically in the tile.

Appearance: Install square.

### Fixing

Accessibility: Provide fasteners which allow removal of the air grille without damage to surrounds or air grille.

Gaskets: Provide foam type gaskets under air grille flanges or flanged supports.

### Plenum and cushion head boxes

General: Provide side entry plenum or cushion head boxes to air grilles connected to flexible ductwork.

Design: To achieve even air flow across the face of the air grille.

Material: Prime quality lockforming galvanized steel, to AS 1397 Grade G2 or G3 with Z275 coating. Insulation: Conform to the *Ductwork insulation* worksection.

Painting: Paint the interior of plenum box matt black, if visible through the air grille. Flexible duct connections: To AS 4254.1. Provide round or oval spigots on plenum boxes. Support of plenum boxes: For louvre ceiling and slot diffusers, support the plenum either:

* From above and independently of the ceiling; or
* From the ceiling main Tees, provided the load is less than the ceiling system manufacturer's recommended maximum.

**9.0 MECHANICAL ELECTRICAL**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide mechanical electrical installations, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## ELECTRICAL ACCESSORIES

### General

Responsibilities: Provide accessories are documented.

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

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

Default finish: Select from the manufacturers standard range.

## LOW VOLTAGE POWER SYSTEMS

* 1. **GENERAL**

### System description

Supply: Conform to the following:

* + - Nominal supply voltage: 240/415 V.
    - Number of phases: 3.
    - Frequency: 50 Hz.
    - Number of wires – system: 4.
    - Neutral connection: MEN.

### Standards

General: To AS/NZS 3000 Part 2, unless otherwise documented. Electrical systems: To AS/NZS 3000 and SAA HB 301.

Selection of cables: To AS/NZS 3008.1.1. Degrees of protection (IP code): To AS 60529. EMC: To AS/NZS 61000.

Telecommunications systems: To AS/CA S008, AS/CA S009, AS/NZS 3080 and AS/NZS ISO/IEC 14763.2.

### Interpretation

Definitions: For the purposes of this work section the following definitions apply:

* + - Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c.
    - Low voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

### Samples

Requirement: Submit samples of all visible accessories and equipment.

### Submissions

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

* + - Single line diagram.
    - Fault Levels at switchboards.
    - Maximum demand calculations.
    - Cable and conductor cross sectional area and insulation type.
    - Cable operating temperature at design load conditions.
    - Voltage drop calculations at design load conditions.
    - Touch potential calculations.
    - Protective device characteristics, e.g. curves, I2t.
    - Discrimination and grading of protective devices.
    - Prospective short circuit current automatic disconnection times.
    - Final subcircuits may be treated as typical for common route lengths, loads and cable sizes.
    - Touch potential automatic disconnection times.
    - Earth fault loop impedance for testing and verification.
    - Certify compliance with AS/NZS 3000, for electrical services.

## PRODUCTS

### Wiring systems

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

### Earthing systems

Earthing systems: Provide an earthing system complying with AS/NZS 3000 Section 5.

### Power cables

Standard: Polymeric cables to AS/NZS 5000.1. Cable: Use multi-stranded copper cable generally. Default insulation: V-75.

Default sheathing: 4V-75. Minimum size:

* Power sub-circuits: 2.5 mm2.
* Sub-mains: 6 mm2.

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

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

Distribution cables: To AS/NZS 4961.

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

Active conductors in single phase circuits: Red. Active conductors in polyphase circuits:

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

### Accessories

General: Provide accessories as documented.

Conformity: All accessories and outlets located in close proximity are to be the same manufacture, size and material if available.

Emergency stop switches:

* Standard: To AS/NZS 3947.5.5.

## EXECUTION

### Power cables

Standard: Classifications to AS/NZS 3013.

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

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

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

Cable joints: Locate in accessible positions in junction boxes.

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

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

Marking: Identify the origin of all wiring by means of legible indelible marking. Cable 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-U conduit.

### Fire-resistance rated cables

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

### Copper conductor terminations

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

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

Alternative: Run cables in PVC-U cable duct with fitted cover.

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

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

### Completion tests

Site tests:

* Inspection: Visually inspect the installation to before testing. Record on a checklist.
* Test and verify the installation to AS/NZS 3000 Section 8, using the methods outlined in AS/NZS 3017. Record the results of all tests.

### Spare parts

Spare parts: As documented.

## CABLE SUPPORT AND DUCT SYSTEMS

* 1. **GENERAL**

### Standards

Cable trunking systems: To AS/NZS 4296.

Conduits and fittings for electrical installations: To AS/NZS 2053.3, AS/NZS 61386.1, AS/NZS 61386.21, AS/NZS 61386.22 and AS/NZS 61386.23.

### Submissions

Shop drawings: Submit shop drawings showing the following:

* Cable tray and trunking routes.
* Layout of cable supports and enclosures on the current architectural background coordinated with the structure and other services.

Technical data: Submit technical data for the following:

* Ducted wiring enclosure systems.
* Cable support systems.

## PRODUCTS

### Conduits

Sizes:

* + - Conduits: ≥ 20 mm.
    - Underground: ≥ 25 mm.

Fixing saddles: Double sided fixed. Galvanized water pipe:

* + - Medium or heavy: To AS 1074.

### Metallic conduits and fittings

Standards: To AS/NZS 61386.21 and AS/NZS 61386.23. Type: Screwed steel.

Fixing saddles:

* + - Internal: Zinc plated.
    - External: Hot-dipped galvanized. Corrosion protection:
    - Steel conduits: Paint ends and joint threads with zinc rich organic primer to AS/NZS 3750.9.

### Non-metallic conduits and fittings

Standards: To AS/NZS 2053.3, AS/NZS 61386.21, AS/NZS 61386.22 or AS/NZS 61386.23.

Solar radiation protection: Required for exposed conduits and fittings.

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

Associated fittings:

* + - Type: The same type and material as the conduit.
    - Wall boxes on PVC-U conduits: For special size wall boxes not available in PVC-U, provide prefabricated earthed metal boxes.

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

Joints: Cemented or snap-on joints. **Ducted wiring enclosures** Standards:

* + - Cable duct/trunking systems: To AS/NZS 4296.

**Cable duct** Material: Metal. Construction: Solid. Covers:

* + - Accessible locations: Screw-fixed or clip-on type removable only with the use of tools. Accessories: Purpose-made to match the duct system.

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

### Cable tray/ladder support systems

System: Provide a complete cable support system consisting of trays or ladders and including brackets, fixings.

Selection: Run cables < 13 mm diameter on cable trays or in ducts. Standard: NEMA VE-1.

Type tests: To NEMA VE-1.

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

Selection: Select cable tray/ladder in conjunction with support system installation to achieve the documented loading and deflection requirements.

Spare capacity: ≥ 50%.

## EXECUTION

### Unsheathed cables – installation

General: Provide permanently fixed enclosure systems, assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

### Conduit systems – installation

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

Conduits in roof spaces: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

Inspection fittings: Locate in accessible positions.

Draw cords: Provide 5 mm2 polypropylene draw cords in conduits not in use. Draw-in boxes: Provide draw-in boxes as follows:

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

Underground draw-in boxes: Provide casketed covers and seal against moisture.

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

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

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

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

Conduits in concrete slabs: Conform to the following:

* Route: Do not run in concrete toppings. Do not run within pretensioning cable zones. Cross pretensioning cable zones at right angles. Route to avoid crossovers and minimize the number of conduits in any location. Space parallel conduits ≥ 50 mm apart.
* Conduits in mechanical plant room slabs: Avoid installation of conduits in plant room slabs (boiler rooms, mechanical plant rooms and tank rooms) if conduits and cables are likely to experience high temperatures, be subject to core hole drilling, drilling of large anchor bolt points or if exact plant locations are unknown at time slab is poured.
* Minimum cover: The greater of the conduit diameter and 20 mm.
* Fixing: Fix directly to top of the bottom layer of reinforcing.

Hollow-block floors: Locate conduits in the core-filled sections of precast hollow-block type floors. Columns: Conduits in columns:

* ≤ 4 per column.
* ≤ 25 mm diameter.
* Locate conduits centrally in each column.

Bends: Enter columns via ≥ 150 mm radius sweep bends. Do not use elbows. Chasing: Do not chase columns.

### Cables in trenches – installation

General: Conform to the *Service trenching* work section.

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

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

* Spare ducts and conduits: Immediately after installation.
* Other ducts and conduits: After cable installation. **Cable tray/ladder support systems – installation** Cable trays: Galvanized steel.

Fixing to building structure: Fix supports to the building structure or fabric by means of direct fixing hangers or brackets.

Cable fixing: Provide strapping or saddles suitable for fixing cable ties. MIMS cables: Provide non-magnetic straps.

Bend radius: Provide bends with an inside radius ≥ 12 times the outside diameter of the largest diameter cable carried.

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

Access: Locate trays and ladders to provide ≥ 150 mm free space above and ≥ 600 mm free space on at least one side.

Clearances:

* From hot water pipes: > 200 mm.
* From boilers or furnaces: > 500 mm.
* EMI: Locate support systems for electrical power cabling and communication cabling to minimize electromagnetic interference.

## SWITCHBOARDS

* 1. **GENERAL**

### Responsibilities

General: Provide custom-built switchboards as follows and as documented. Standard: To AS/NZS 3439.1.

### Interpretation

Definitions: For the purposes of this work section the following definitions apply:

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

### Submissions

Product data: Submit the following:

* Makes, types and model numbers of items of equipment.
* Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data.
* Design calculations of non-type-tested and non- proprietary busbar assemblies.
* Overall dimensions.
* Fault level.
* IP rating.
* Rated current of components.
* Number of poles and spare capacity.
* Mounting details.
* Door swings.
* Paint colours and finishes.
* Access details.
* Schedule of labels.

## PRODUCTS

### Custom-built switchboard construction

General: Custom built switchboards as documented. IP rating:

* + - General: IP 42.
    - Weatherproof: IP 56 minimum. Separation: Form 2B.

Spare pole capacity: ≥ 20%.

Layout: Specify cabinet arrangement and safety measures e.g. safety measure number and accessibility. Refer to AS/NZS 3439.1 clause 7.7 for guidance on safety measures by constructional means or installation, and requirements relating to accessibility in service. Position equipment so it is safe and readily accessible for operation and maintenance. Group devices by function.

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

Form 1 enclosures: Separate into compartments by means of partitions at 1.8 m maximum centres.

Segregation: Segregate BCA emergency equipment from non-emergency equipment by means of metal partitions designed to prevent the spread of a fault from non-emergency equipment to emergency equipment.

Enclosure materials:

* + - Fabricate from sheet metal of rigid folded and welded construction.
    - Material: ≥ 1.6 mm thick metallic-coated sheet steel.
    - Coating class:

. Indoor assemblies: Z200.

. Outdoor assemblies: Z450.

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

Insect proofing: Cover ventilation openings with non-combustible and corrosion resistant 1 mm mesh. Equipment mounting panels: To support the weight of mounted equipment.

Equipment fixing: Bolts, set screws fitted into tapped holes in metal mounting panels, studs or proprietary attachment clips. Provide accessible equipment fixings which allow equipment changes after assembly commissioning. For lightweight equipment, provide combination rails and proprietary clips.

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

Supporting structure:

* + - Wall mounted: ≤ 2 m2.
    - Floor mounted: > 2 m2.

Supporting structure: Provide concealed fixings or brackets to allow assemblies to be mounted and fixed in position without removing equipment.

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

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

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

Gland plates: Provide removable gland plates fitted with gaskets to maintain the degree of protection. Gland plate materials: 1.5 mm thick steel, 5 mm thick composite material or laminated phenolic.

### Doors and covers

Door layout:

* + - Maximum width: 900 mm.
    - Minimum swing: At least 90º.
    - Door stays: Provide stays to outdoor assembly doors.
    - Adjacent doors: Space adjacent doors to allow both to open to 90º at the same time.

### Door construction

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

Hinges: Provide the following:

* + - Generally: Corrosion-resistant pintle hinges or integrally constructed hinges to support doors.
    - For removable doors: Staggered pin lengths to achieve progressive engagement as doors are fitted.
    - For doors higher than 1000 mm: 3 hinges.
    - For non lift-off doors: Restraining devices and opposed hinges. Door hardware: Provide the following:
    - Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
    - Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
    - Captive, corrosion resistant knurled thumb screws as an alternative to handles.

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

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

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

Covers:

* + - Maximum dimensions: 900 mm wide and 1.2 m2 surface area.
    - Covers fixing: Fix to frames with at least 4 fixings using corrosion-resistant acorn nuts with serrated washers if the cover exceeds 600 mm in width. Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.
    - Handles: Provide corrosion resistant D type handles.

Escutcheons: For doors or removable covers enclosing circuit breakers, provide escutcheon plates as barriers between operating mechanisms and live parts.

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

Escutcheon plate maximum dimensions: 900 mm wide and 1.2 m2 surface area.

### Factory finishes

Standard: To AS 2700.

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

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

### Factory finish colours

Mounting structure (brackets): To match enclosure. Enclosure - indoor:

* + - Indoor assemblies: Orange X15.
    - Assembly interior: Orange X15. Enclosure - outdoor:
    - Outdoor assemblies: Avocado green G34.
    - Assembly interior: White.

Escutcheons - removable equipment panels:

* + - Internal assemblies: Orange X15.
    - External assemblies: Off white Y35.

Doors: To match enclosure. Plinths: Black.

### Busbars

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

Type: Multiple proprietary insulated busbar assemblies, verified for short circuit capacity and temperature – rise limits by type tests.

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

### Neutral links and earth bars

Terminals: Provide terminals for future circuits.

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

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

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars. Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm2: Provide bolts or studs.

### Internal wiring

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

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

* + - ≥ 1.5 mm2 internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
    - Run cables clear of busbars and metal edges.
    - Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.
    - Provide for installation of wiring for future equipment without removal of existing equipment.
    - Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.
    - If recommended by device manufacturers, provide shielded wiring.

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

Cables > 6 mm2: Terminations:

* + - Tunnel terminals: Single cables.
    - Other connection points or terminals: ≤ 2 cables. Cables > 6 mm2: Supports:
    - Spacing at enclosure: ≤ 200 mm from a termination.
    - Spacing generally: ≤ 400 mm.
    - Strength: Capable of withstanding forces exerted during fault conditions. Control and indication circuits: Minimum size: 1 mm2 with 32/0.2 stranding. Control and indication circuits: Cable colours: Colour code wiring as follows:
    - A phase: Red.
    - B phase: White.
    - C phase: Blue.
    - Neutral: Black.
    - Earthing: Green-yellow.

## EXECUTION

### Assembly installation

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

### Assembly entries

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

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

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

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

## SWITCHBOARD COMPONENTS

* 1. **PRODUCTS**

### General

Rated duty: Uninterrupted in non-ventilated enclosure.

Rated making capacity (peak): ≥ 2.1 x fault level (r.m.s.) at assembly incoming terminals.

Utilization category: To AS/NZS IEC 60947.1 clause 4.4 and the recommendations of AS/NZS IEC 60947.1 Annex A.

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

Coordination: Select and adjust protective devices to discriminate under over-current and earth faults. Enclosure: IP4X minimum.

### Switch-isolator units

Standard: To AS/NZS IEC 60947.1 and AS/NZS 3947.3. Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator. Shrouding: Effective over range of switch positions.

Fault make/fault break switch-isolators:

* Rated breaking capacity: To AS/NZS 3947.3 Table 3.
* Rated short-time withstand current: To AS/NZS IEC 60947.1 clause 4.3.6 and the manufacturer’s recommendation to meet the prospective fault current conditions applying.
* Rated short-circuit making capacity: To AS/NZS IEC 60947.1 clause 4.3.6 and the manufacturer’s recommendation to meet the prospective fault current conditions applying.
* Rated short-circuit breaking capacity: To AS/NZS IEC 60947.1 clause 4.3.6 and the manufacturer’s recommendation to meet the prospective fault current conditions applying.

Load make/load break switch-isolators:

* Rated breaking capacity: To AS/NZS 3947.3 Table 3.
* Rated short-time withstand current: To AS/NZS IEC 60947.1 clause 4.3.5 and the manufacturer’s recommendation to meet the current conditions applying.
* Rated making capacity: To AS/NZS IEC 60947.1 clause 4.3.5 and the manufacturer’s recommendation to meet the current conditions applying.
* Rated breaking capacity: To AS/NZS IEC 60947.1 clause 4.3.5 and the manufacturer’s recommendation to meet the current conditions applying.

### Fuse-switch units

Operation: Provide an extendable operating handle.

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

### Moulded case and miniature circuit breakers

Moulded case breakers: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.2.

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

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

Operation: Independent manual operation including positive ON/OFF indicator. Trip type: Conform to the following:

* Moulded case breakers: Required.
* Miniature circuit breakers: Fixed thermal, fixed magnetic. Isolation facility: Required.

Current limiting: Conform to the following:

* Moulded case breakers: Required.

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

Utilization category: Moulded case breakers:

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

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

Trip units: Connect interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

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

### Fuses with enclosed fuse links

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

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

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

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier. Breaking range and utilization category:

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

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

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

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

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

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

### Contactors

Standard: To AS/NZS IEC 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic. Poles: 3.

Rated operational current: The greater of:

* Full load current of the load controlled.

- ≥ 16 A.

Mechanical durability: 10 million cycles to AS/NZS IEC 60947.4.1.

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

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

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

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

### Control devices and switching elements

Standards: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.5.1.

Switching elements:

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

Rotary switches: Cam operated type with switch positions arranged with displacement of 60º.

* Off position: Locate at the 12 o’clock position. Test positions must spring return to off position.
* Rated operational current: At least 6 A at 230 V a.c.
* Escutcheon plates: Provide rectangular plates securely fixed to the assembly panel. Identify switch position and function.

Time switches:

* Type: 7 day fully programmable with holiday override function.
* Daylight saving switch: Required.
* Mains failure operation: 100 hour minimum operating capacity.
* Contact rating: ≥ 16 A at 230 V a.c. resistive load.
* Construction: Provide readily accessible means of adjustment. Provide operational settings which are clearly visible when switch cover is fitted.
* Dial: Digital with hour and minute display. Override switch (manual): Required. Control relays:
* Standards: To AS/NZS IEC 60947.5.1.
* Operation: Suitable for continuous operation. Provide relays selected in conformance with the

### Control relay selection table.

* Construction: Plug-in types. Receptacle bases with captive clips which can be operated without using tools.
* Contact elements: Electrically separate, double break with silver alloy, non-welding contacts.
* Configuration: For standard relays, provide assemblies with ≥ 2 sets of contacts and expandable to 8 sets of contacts in the same assembly. Provide at least one normally-open and one normally- closed contact.

Plug-in types: If required provide the following:

* Receptacle bases with captive clips which can be operated without using tools.
* Changeover type contacts to allow either normally-open or one normally-closed configuration. Time delay relays:
* Adjustable range: Adjustable over the full timing range with timing repeatability within ±12.5% of nominal setting.
* Electronic relays: Incorporate light emitting diodes indicating energization states of relays.
* Pneumatic relays: Provide sealed chamber type with internal circulating air with linear calibrated time adjustment.

### Control relay selection table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Relay type** | **Minimum mechanical life (million operations)** | **Base** | **Minimum contact rating** | **Inter- changeable** | **Minimum number of contact elements** |
| 1 | 5 | Plug-in | 1.25IL | Yes | 2 |
| 2 | 10 | Plug-in | 5 A at 240 V | Yes | 2 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Relay type** | **Minimum mechanical life (million operations)** | **Base** | **Minimum contact rating** | **Inter- changeable** | **Minimum number of contact elements** |
| 3 | 10 | Fixed mounting | 5 A at 240 V | Yes | 4 |

**Indicator lights**

Standard: To AS/NZS IEC 60947.5.1.

Incandescent indicators: Incandescent oil tight type minimum 22 mm diameter or 22 x 22 mm. Lamps: Changeable from front of panel without removing the holder.

Lamp rating: 1.2 – 5 W.

Neon indicators: 240 V, 12 mm diameter with in-built resistor.

LED indicators: 12 or 24 V as necessary, in corrosion-resistant bezel, nominal 5 mm diameter. Press-to-test:

* Compartments/subsections with < 5 indicating lights: Provide each indicating light with a fitted integral press-to-test lamp actuator.
* Compartments/subsections with ≥ 5 indicating lights: Provide a common press-to-test lamp push- button.

### Spares cabinet

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

Location: Either of the following:

* Incorporated into assembly enclosure.
* Wall mounted in main switchroom. Finish: To match assembly.

## EXECUTION

### Marking and labelling

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

Labels on assembly exteriors: Conform to the following:

* Manufacturer’s name: Required.
* Assemblies: Label with essential markings.
* Designation labels: For other than main assemblies, provide designation label stating source of electrical supply. Identify separate sections of enclosures.
* Assembly controls: Label controls and fault current limiters, including the following:

. Circuit designation for main switches, main controls and submains controls.

. Details of consumers mains and submains.

. Use different colours on labels to distinguish operational requirements such as normal operation, operation under fire or emergency conditions.

. Incoming busbar or cable rating to first tee-off.

. Fuse link size.

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

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

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

Danger, warning and caution notices:

* Busbars: If polymer membrane coating is used without further insulation, provide warning notices on the front cover near the main switch or local main switch and on rear covers, indicating that busbars are not insulated.
* Fault current limiters: In assembly sections containing fault current limiter fuses provide caution notices fixed next to the fault current limiters, stating that replacement fuse links are to match the installed fuse link ratings, make and characteristics. Provide separate label stating make and fault current limiting fuse ratings.
* Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.
* Stand-by power: Provide warning notices stating that assemblies may be energized from the stand- by supply at any time.
* Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti- condensation heaters.
* Insulation and shrouding: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energizing assemblies.
* Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

Marking cables: Identify the origin and cable size of wiring with legible indelible marking.

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

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

**10.0 MOTORS AND STARTERS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide electric motors and starters, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - LED: Light emitting diode.
    - VSD: Variable speed drive.

## SUBMISSIONS

### Calculations

General: Submit the following:

* + - Calculations supporting motor selection in relation to load characteristics.
    - Calculated input power factor and harmonic content for variable speed drives.

### Technical data

General: Submit manufacturer's technical data for all motors, starters and protection equipment.

### Tests

Type tests: Submit reports of type tests for variable speed drives.

## PRODUCTS

* 1. **MOTORS**

### General

General: Provide motors selected in conformance with AS 60034.1, the application load characteristics, motor manufacturers’ recommendations and the following:

* + - Motors ≥ 0.75 kW: Three phase.

### Rating

Standard: To AS 60034.1.

Maximum power rating: The greater of the documented minimum motor size and next preferred standard frame size above the maximum load of the driven equipment.

Duty: ≥ S1.

Class of rating: Continuous running duty. Speed: ≤ 1500 r/min.

### Starting performance

Minimum designation: Design N to AS 60034.12.

Speed and torque: Provide motors with sufficient torque relative to the starting load of the driven machine to run up to full speed steadily and within a time period compatible with motor winding temperatures, class of insulation and rating of the starting equipment.

### Efficiency

Motors documented as high efficiency: To AS/NZS 1359.5 Table A3 or Table B3. All other motors: To AS/NZS 1359.5 Section 2.

### Environment

Site operating conditions: To AS 60034.1. Electrical operating conditions: To AS 60034.1.

### Enclosure

General: Provide enclosures appropriate to the environment in which the motor operates. Motor enclosure classification: ≥ IP44 to AS 60529 and AS 60034.5.

### Cooling

Standard: To AS 1359.106. Classification: ≥ IC01.

### Marking

Terminals: To AS 60034.8.

### Mounting

Standard: IM classification to AS 60034.7.

### Noise

Standard: To AS 60034.9.

### Vibration

Standard: To AS 1359.114. Grade: ≥ N (normal).

## MOTORS FOR VARIABLE SPEED DRIVE

### General

Requirement: If supplied for variable speed drives, provide motors that, in addition to the above, conform to the following:

* + - Standard: To AS 61800.2.
    - Cooling: Select cooling system and internal wiring to maintain the required thermal conditions under all operating situations including running at low speeds corresponding to 10 Hz.
    - Insulation: Select insulation of wiring and components to withstand the pulse voltages generated by the VSD controller, and its associated filter and using a nominal cable length of 30 m, without a reduction in the guaranteed motor service life.
    - Noise: Conform to acoustic and electrical noise limits under all operating situations.
    - Mounting: Conform to vibration limits under all operating situations.

## STARTERS

### Standard

General: To AS/NZS IEC 60947.1 and AS 60034.12.

Electromechanical motor starters: To AS/NZS IEC 60947.4.1.

### Selection

General: Provide motor starters with the following characteristics:

* Electricity distribution network limitations for starting currents and voltage flicker.
* Torque requirements for the motor load.
* Heating effects on the motor.
* Voltage drop during start due to starting currents.
* Time required to accelerate from rest to full speed.
* Number of starts per hour.

Motors with a limited number of starts per hour: Provide lockout timers in the motor control circuit to prevent motor restart within the designated non-restart time and which cannot be set by any manual resetting of the motor protection system.

### Performance

Rated operational current: At least the full load current of the load controlled. Rated duty: Intermittent class 12.

Utilization category: AC-3.

Mechanical durability: ≥ 3 million cycles to AS/NZS IEC 60947.4.1.

Electric durability: ≥ 1 million operations at AC-3 to AS/NZS IEC 60947.4.1.

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

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

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

### Direct-on-line starters

Type: Direct-switching electromagnetic contactor.

### Reversing starters

General: Conform to **Direct-on-line starters** and the following:

* 2 main line contactors, mechanically and electrically interlocked to prevent simultaneous closure.
* Time delay relay with nominal 0 to 30 s adjustable time delay, to prevent plugging of the motor.
* Emergency stop push-button.

### Multi-speed starters

General: Comply with **Direct-on-line starters** and the following:

* Mechanically and electrically interlocked.
* Time delay relay with nominal 0 to 30 s adjustable time delay.

### Star-delta starters

General: Provide electromagnetically operated control gear incorporating the following:

* Main line contactor or equivalent.
* Star and delta contactors, mechanically and electrically interlocked to prevent simultaneous operation.
* Time delay relay with nominal 0 to 30 s adjustable time delay, to control the star to delta switching contactors.

### Secondary resistance starters

Type: Rheostatic rotor starters.

Number of accelerating steps: At least 3.

Construction: Mount air cooled resistors in separated ventilated enclosures matching appearance of other starter cabinets. Label resistor tappings and identify connecting wiring with heat resisting tags.

Labelling: Label resistor tappings and identify connecting wiring with heat resisting tags.

Overheat protection: Provide a thermostat or thermistor operated relay to isolate starter in the event of resistor overheating. Locate measurement device in optimum position to detect abnormal heating.

Overheat indication: Provide warning light in starter cabinet.

### Semiconductor starters

Standard: To AS/NZS IEC 60947.4.2.

Characteristics: Provide gate firing circuits in each phase and over-temperature protection for the starter. Provide automatic voltage control to suit load, variable control of starting current and torque, adjustable starting current limit, and silicon control rectifier (SCR) loss-of-phase protection.

Voltage regulation: Electronically controlled thyristors.

### Part winding starters

General: To the machine manufacturer’s recommendations. Provide suitable motor protection devices.

## MOTOR PROTECTION

### General

General: Provide over-current protection with manual reset giving overload protection in each phase of supply as part of the equipment assembly for each motor starter.

Standard: To AS 60034.11.

Contacts: Provide at least one normally-open and one normally-closed set of contacts rated at the starter control circuit voltage and minimum 4 A. Connect contacts to open the starter at the setting temperature.

Utilization category: AC-11.

Mounting: Make sure relays are not affected by the shock of mechanical contactor operation. Provide sufficient clear space for the disconnection, removal and replacement of heaters, without disconnecting other equipment and wiring.

### Single phase motor protection

General: Provide overload units matching the motor heating curve characteristics.

### 3-phase motor protection - Thermal overload protection

General: Provide thermal overload protection relays for each motor.

Triple pole relays: Provide differential trip bar operation for single phase protection, and ambient temperature compensation.

Thermal overloads: Connect directly to contactor by means of proprietary links, except where operated separately by current transformers.

Star-delta starters: Triple pole thermal overload relay connected into motor phase winding circuits. Provide a name plate fixed to starter, stating full load current of motor phase winding.

Placement of sensors: If the configuration of the starter contactors is unsuitable for the placement of thermal overload sensors in each motor phase winding, fit to the line contactor.

### 3-phase motor protection - Thermistor protection

Standard: AS/NZS IEC 60947.8.

General: Motors ≥ 22 kW: Provide motors with embedded winding temperature thermistors complying with AS/NZS IEC 60947.8 in each phase. Match trip operating temperature to motor winding insulation classification

Thermistor control unit: If documented, provide a thermistor control unit and connect to embedded thermistors in the motor windings. Provide a thermistor control unit compatible with thermistors installed in the motor.

Type: Automatic reset following power failure. Arrange the circuit so that thermistor failure, failure of other control system components, or excessive winding temperature, causes the motor circuit to trip.

Reset: Manual, to restore the motor circuit when tripped due to excessive winding temperature.

Light emitting diode indication: Provide on the thermistor control unit, to indicate that circuit is in normal operating mode.

### Electronic motor protection relays

Standard: AS/NZS IEC 60947.4.1.

Characteristics: Provide the following:

* Single phasing protection and phase sequence protection.
* Thermal overload protection.
* Loss of load protection.
* Excessive motor run-up and stall protection.
* Earth fault protection.
* Adjustable settings of protection parameters: LED indication of fault conditions.
* Manual reset.
* One normally-open and one normally-closed set of auxiliary contacts with minimum current rating of 4 A at 240 V a.c.
* Facilities for relay testing.

### Current transformers

General: Saturating at 10 to 15 times full load current, Class 10P. Provide adjustment facilities allowing matching of current transformer characteristics.

### Programmable electronic motor protection relays

Characteristics: Provide the following:

* Programmable micro-processor based protection: Comply with **Electronic motor protection relays**.
* Diagnostic data gathering and retrieval to determine the cause of shut-down.
* Interrogation and display of data to give actual running conditions at time of interrogation.
* Non-volatile memory retaining program and data upon loss of power.
* RS422 communications port.
* Programming key pad.
* Software for communications with IBM-compatible personal computers.

## VARIABLE SPEED DRIVES

### Standard

General: To AS 61800.2 and AS 61800.3.

### Type

General: Microprocessor controlled, solid-state electronic type, providing motor speed control of 3 phase squirrel cage induction motors by means of stepless variable frequency, variable voltage pulse width modulated (PWM) output.

Application: Suitable for the documented applications.

### Selection

General: Provide variable speed motor drive controllers selected for the following:

* Rating: Continuously rated to suit the full load current stated on the motor nameplate and the length and type of cable feeding the motor.
* Service conditions: To AS 61800.2 Section 4.
* Speed ranges: Suitable for the load duties.
* Control deviation band: To suit the controls functional specification. Design: Provide the following:
* Soft start (initially start motors on low speed).
* Adjustable maximum current limit.
* Automatic reset/restart of system after removal of fault or power failure condition. If the number of reset/restart attempts is limited for safety and equipment protection, provide for safe shut down and manual restart in the event of an unsuccessful attempt at the reset/restart sequence.
* Ability to immediately restart a motor following momentary interruption of supply, even if the motor is rotating, or rotating in the reverse direction.

Protection: Provide protection against:

* Instantaneous power failure.
* Instantaneous over current.
* Internal and external overload.
* Under and over voltage.
* Over temperature of the controller.
* Earth fault.
* Contact with live parts without the removal of fixed covers or panels. Motor protection:
* General: Provide automatic, electronic motor thermal overload protection facility wherein the tripping time is based on the motor’s running frequency, actual motor current, operating time, and the rated current.
* Motors ≥ 22Kw: Provide PTC thermistor input to initiate motor shutdown under fault conditions.

### Controls

Provide facilities for local display and control, including the following:

* Indication of run condition, motor speed or output frequency, input control parameters, output current and voltage, and alarm conditions.
* Indication of power on, zero speed, enable, earth fault, short circuit, over current, under voltage, over temperature and remote trip.
* Facilities for automatic/off/manual control. Under manual control provide facility to manually set motor speed
* Local and remote analogue input, to control frequency output of controller when in manual or automatic mode.
* For remote control, interfaces for analogue input and output associated with speed control, start/stop, and voltage free contacts for alarm fault indication.

### Harmonics and EMC

General: Provide integrated harmonic suppression filters to limit the harmonics to within the value prescribed by the electricity distributor for the motor load and environment.

Standard: To AS/NZS 61000 and AS 61800.3 Category C1 for the actual length and type of cable feeding the motor.

Authorities: Comply with the requirements of the Australian Communications Authority.

### Installation

Switchboard mounting: Install each controller, together with associated equipment, in separate ventilated subsections of the motor control switchboard with hinged door, meeting the level of separation, ventilation and screening for the overall enclosure.

Wall mounting: Install in an IP54 rated enclosure.

### Testing

Routine tests: Standard separate device and power drive system tests to AS 61800.2 and AS 61800.3.

Site tests: Test input power factor and harmonic content on completed installation.

**11.0 MECHANICAL COMMISSIONING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide commissioning of all mechanical systems, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.
    - *Mechanical piping*.
    - *Mechanical piping insulation*.

## STANDARDS

### General

Measurement of fan and duct air quantities > 1000 L/s: To ISO 5802.

Testing, balancing and commissioning except fan and duct air quantity measurement: Select from the following:

* ASHRAE STD 111.
* CIBSE CCA,CIBSE CCB, CIBSE CCC,CIBSE CCR and CIBSE CCW.
* National Environmental Balancing Bureau (NEBB) Procedural Standards.
* AIRAH DA24.
* AIRAH DA27.
* AIRAH DA28.

Statistical analysis: To ASHRAE Guideline 2.

Fire operation of air handling systems: To AS/NZS 1668.1. Orifice plates and venturi meters: To BS 1042.

Microbial control: To AS/NZS 3666.1 as required by BCA and the recommendations of SAA/SNZ HB 32.

Pressure equipment: To AS/NZS 3788. Fume cupboards: To AS/NZS 2243.8.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Accuracy: The closeness of the agreement between the result of a measurement and he true value of the particular quantity being measured.
    - Branch: A duct with no terminals connected to it.
    - Error: The measured value minus the true value of the particular quantity being measured.
    - Resolution: The smallest difference between indications of a displaying device that can be meaningfully distinguished.
    - Sub-branch: A duct connected to one or more terminals.
    - Terminal: A supply, return or exhaust diffuser, grille or equivalent device discharging air into, or drawing air from, a space.
    - Total air quantity: The sum of air flows to the connected terminals, branches or sub-branches under the conditions of measurement.

## INDEPENDENT CERTIFICATION OF COMMISSIONING AGENT

### General

Requirement: Use only a Registered testing authority.

## SUBMISSIONS

### Certification

Instrumentation: On request, submit copies of current calibration certificates issued by a Registered testing authority.

Conformance to contract documents: Submit certification of conformance to the contract documents. Statutory requirements: Submit certification of conformance to the relevant statutory requirements. **Completion program**

Submissions: Submit a program consistent with, and forming part of, the construction program as

follows:

* Set out the proposed program for completion, commissioning, testing and instruction.
* Identify related works and timing of the works prerequisite to successful and timely completion of the works.

Revisions: Submit revisions of the program as the project proceeds.

Plant operating period: Include time in the program for the documented plant operating period before the date for practical completion.

### Records

Report: Submit a report demonstrating that equipment has been properly installed and is functioning correctly, including the following.

* Air balance: To **AIR BALANCE REPORTS**.
* Air flow rate: To **AIR BALANCE REPORTS**. Show on the reports where return and exhaust quantities have been varied from design values to achieve differential pressures.
* Room air pressure differential: Submit the measured or detected room pressure differentials to

## ROOM AIR PRESSURE DIFFERENTIALS.

* 1. **INSPECTION**

### Notice

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

* + - Starting up each item (5 working days).
    - Commissioning of the installation.

## EXECUTION

* 1. **COMMISSIONING**

### General

Requirement: Commission mechanical services when:

* + - The respective systems or parts of systems are complete.
    - The building work on which commissioning depends is complete.

Requirement: Make the adjustments necessary to achieve the documented performance under continuous operating service conditions, including balancing, setting the controls, checking the operation of overload and safety devices, and correcting malfunctions.

### Fire Safety

Requirement: Complete testing and certification of all fire safety measures before occupation of the building.

### Reports

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

### Starting up

General: Coordinate schedules for starting up of various systems and equipment.

Checks: Before starting, verify that each piece of equipment has been checked for proper lubrication, drive rotation, belt tension, control sequence, circuit protection or for other conditions which may cause damage.

Tests: Verify that tests, meter readings, and documented electrical characteristics agree with those required by the manufacturer.

Wiring: Verify wiring and support components for equipment are complete and tested.

Manufacturers' representatives: If respective work sections require the attendance of a manufacturer’s representative, have the manufacturers' representatives present on site to inspect and/or check the system installation before starting up, and to supervise placing the equipment and operation.

Starting up: If documented in the respective work section, execute starting up under the supervision of manufacturers' representative and appropriate contractors' personnel, in conformance with manufacturers' recommendations.

## RELATED TESTS

### Retesting

Failure to meet documented performance: Identify and correct the cause of failure and repeat the test.

### Statutory authorities

General: Provide demonstrations and tests for witnessing by the statutory authorities. Complete testing of systems before witness testing by the statutory authorities.

### Other trades

General: Provide assistance to other trades for testing related non-mechanical systems.

## INSTRUMENTATION

### Calibration and certification

General: Use only instruments that have current calibration certificates issued by a Registered testing authority.

Maximum period since last calibration: As recommended by manufacturer but not more than 12 months, except as documented.

### Air quantity at diffusers, outlets and grilles

Hood adjustment factors: Determine adjustment factor for each hood and associated anemometer by one of the following methods:

* Certified by a Registered testing authority for the type, size and configuration of diffuser or grille and direction of air flow being measured.
* Determined by duct pitot traverse for the particular type, size and configuration of diffuser or grille and direction of air flow being used on the project.

Instruments:

* Accuracy: Better than ± 5% of measured value.
* Resolution: Better than 1% of measured value.
* Range: Measured velocity within 17% to 83% of the instrument calibrated range.

### Air pressures and differential pressures

Instrument specifications:

* Pressures ≤ 50 Pa: Electronic meter or inclined manometer with 50 Pa full scale, accuracy better than 5% full scale.
* Pressures > 50 Pa: Electronic meter, mechanical meter or inclined manometer with full scale not more than 400% measured value, accuracy better than 2.5% full scale.

### Temperature

Air temperature instruments specifications:

* Accuracy: ± 0.2 K or better at measured value. Instrument specifications for other temperature applications:
* Accuracy: ± 0.5 K or better at measured value.
* Scale divisions (mercury-in-glass): 1.0 K or better.

### Humidity

Instruments specifications: Sling psychrometer, aspirated psychrometer or electronic humidity meter.

* Accuracy:

. ± 3% from 10 to 90% relative humidity where measured value tolerance is ≥ ± 5% relative humidity.

. ± half measured value tolerance from 10 to 90% relative humidity where measured value tolerance is < ± 5% relative humidity.

### Electrical

Instrument specifications:

* Voltage < 600 V a.c.: Accuracy ± 3% of full scale.
* Voltage < 30 V d.c.: Accuracy ± 3% of full scale.
* Currents < 100 A: Accuracy ± 3% of full scale.
* Maximum period between calibration: To the manufacturer’s recommendations but not more than 6 months.

### Rotational speed

Instrument specifications:

* Accuracy: ± 5% of measured value.
* Maximum period between calibration: To the manufacturer’s recommendations but not more than 24 months.

### Recording instruments

Specifications for instruments collecting measured values over time:

* Accuracy: At least equal to that specified for the corresponding physical parameter above.
* Type: Electronic data logger with appropriate sensors or thermohydrograph. Thermohydrographs: Charge sensing element before use to the manufacturer’s recommendations.

## SOUND PRESSURE LEVEL MEASUREMENTS

### General

Sound pressure level measurements: Provide sound pressure measurements as documented.

### Sound pressure level measurements

Internal: To AS/NZS 2107. External: To AS 1055.1.

Sound pressure levels: Measure the A-weighted sound pressure levels and the A-weighted background sound pressure levels at the documented positions.

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 documented positions.

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

Measurement positions: If a test position is documented only by reference to a room or space, do not take measurements less than 1 m from the floor, ground or walls.

## AIR BALANCING

### General

Requirement: Balance each air handling system.

Completion: Balancing is complete when all the following conditions are met:

* All air quantities are within the tolerances in the **Air quantity tolerance table**.
* For the same component, each measured air quantity deviates by less than the instrument accuracy from the previous measured air quantity.
* Resistance across the cooling coil bank (if present) is equal to the wetted coil resistance. If necessary to achieve this, simulate wet coil resistance by blanking or other means.
* Resistance of the filter bank (if present) is equal to the average of its clean resistance and resistance of the filter when fully loaded with dirt. If necessary to achieve this, simulate filter resistance by blanking.
* For fans with variable speed drives, the frequency to the motor is no more than 50 Hz.
* At least one outlet on each branch has its damper at the minimum pressure drop position.
* At least one sub-branch damper is at the minimum pressure drop position.
* At least one branch damper is at the minimum pressure drop position.
* The fan speed or pitch angle is at the lowest value consistent with the above.

### Air quantity tolerance table

|  |  |  |  |
| --- | --- | --- | --- |
| **System type** | **Terminal air quantity tolerance** | **Branch air quantity tolerance** | **Total air quantity tolerance** |
| Low velocity supply, return or | + 20% | + 10% | + 10% |
| exhaust system where all | - 0% | - 0% | - 0% |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| **System type** | **Terminal air quantity tolerance** | **Branch air quantity tolerance** | **Total air quantity tolerance** |
| terminals on any one sub-branch serve the same space |  |  |  |
| Low velocity supply, return or exhaust system where the terminals on any one sub-branch serve more than one space | +15%  - 0% | + 10%  - 0% | + 10%  - 0% |
| Supply systems for induction | + 5% | + 5% | + 10% |
| units | - 0% | - 0% | - 0% |

**Measurement methods**

Air quantities > 1000 L/s including system total and branch air quantities: Measure in situ to ISO 5802. Other air quantities: Use balancing and measurement methods recommended by ASHRAE or CIBSE. Prohibited: Do not use the following methods for air quantity measurement:

* Coil, damper or filter traverse using any kind of instrument.
* Measurement using an instrument operating with air flow in the reverse direction to that for which it has been calibrated.
* Air quantity measurement derived from fan curves or fan performance tables.

### Preparation for air balancing

General: Before starting air balancing make sure that:

* All building work that may affect the air balance is complete, including:

. All ceiling tiles are in place.

. All doors are hung and door grilles (if applicable) are installed.

. All doors and windows are open or shut consistent with their normal state.

. The building is airtight.

. The builder's work ducts, shafts and ceiling plenums are sealed airtight.

* All ductwork is complete and its interior clean.
* Systems for which leakage testing is documented: Leakage testing and leak rectification to the

*Ductwork* work section is complete.

* Other systems: There are no air leaks that can be felt. Check for leaks through doors, access panels, penetrations and joints in air handling units.
* Flexible duct is installed as documented and has not been damaged.
* All fire and balancing dampers are open.
* All interrelated air handling systems are complete and operating concurrently.
* Fans, coils filters and other mechanical components are complete and operating correctly.
* All electrical components including overloads and safety devices are complete and operating correctly.
* All other related work is complete and operating correctly.

### Additional adjustment of air quantities

General: Even if air quantities have been measured and are within tolerance, if directed, adjust space air quantities to:

* Minimize drafts.
* Achieve temperatures in individual rooms or parts of rooms that are within the documented design conditions.

Resubmit reports: If air quantities are altered after submission of air balance reports, resubmit reports showing new values.

### On completion of air balancing

General: When air balancing is complete:

* Mark final position of dampers.
* Seal test holes in ductwork as follows:

. Duct pressure class to AS 4254.2 ≤ 500: Provide rubber or plastic plugs.

. Duct pressure class to AS 4254.2 > 500: Provide gasketted cover plates of the same material as the duct.

* Set system into normal operation.

## MANUFACTURER'S RECOMMENDED COMMISSIONING PROCEDURES

### General

Requirement: If manufacturers provide commissioning procedures, commission to those recommendations subject to the following:

* + - Instrumentation: Conform to the performance and calibration requirements in **Instrumentation** for the variable measured.
    - Tolerances on measured values: Within the limits documented.

## FIRE MODE OPERATION

### General

General: Test all systems required to operate in fire mode. Standards: To AS/NZS 1668.1 and AS 1668.3.

Related systems: Test air handling systems for correct operation in conjunction with fire protection and other related systems.

Reset: Verify that all systems return to normal operating mode after fire mode operation.

Fire and smoke dampers: Commission to AS 1682.2. Test that fire and/or smoke dampers close fully with fans operating.

Fire isolated exit pressurization: Test to AS/NZS 1668.1 including door velocity, door opening force and pressure differentials.

Timing: Complete testing before the date for practical completion.

## AIR BALANCE REPORTS

### General

General: Include the following on the air balance reports:

* + - Cover sheet for each system:

. Project and system identification.

. Date, time and place of test.

. Instrumentation used and its date of calibration.

. Name, position and signature of person responsible for test and certifying the correctness of the results.

. Ambient temperature and/or other relevant factors.

. Summary of design values and commissioned performance.

* + - For each terminal, grille and diffuser:

. The reference number of the item as shown on the shop drawings. List on a branch by branch basis.

. Design air quantity.

. Measured value (e.g. L/s, m/s).

. Hood or instrument factor.

. Manufacturer's area or similar factor for the item, if applicable.

. Site measured air quantity in L/s calculated from the above.

. Measured air quantity as a percentage of design air quantity.

. Sum of measured branch and system air quantities and percentage of design.

* + - For each fan:

. Fan designation and location.

. Measurement method used to determine total air quantity.

. Location of measurement point.

. Simulated wet cooling coil pressure drop and dirty filter pressure drop, if applicable.

. Design air quantity.

. Pitot readings (if used) or other measured values used to independently determine total fan air quantity.

. Site measured air quantity in L/s calculated from the above.

. Measured air quantity as a percentage of design air quantity.

. Measured air quantity as a percentage of the sum of the individual diffuser and grille air quantities.

. Blade pitch and/or fan speed as applicable.

. If a variable speed drive is provided, the variable speed drive output frequency.

. Measured motor current and nameplate full load current.

. A fan performance curve, marking the final operating point on the curve.

* + - Outside air quantity: Maximum and minimum values and quantities under varying system conditions.
    - Static pressure differentials across:

. Each filter bank when clean, that is, after removal of simulated dirty pressure drop.

. Each cooling and heating coil except where access for test points is not possible or contrary to manufacturer's recommendations.

. Each fan.

* + - Duct static pressure at:

. Entry to filters.

. Entry to each fan.

. The duct discharge from air handling unit.

. Each riser connection for supply and return systems serving multiple floors.

## ROOM AIR PRESSURE DIFFERENTIALS

### General

General: Adjust air flows and controls (where available) to achieve documented differential pressures between spaces or required to meet applicable codes and standards. Adjust systems to achieve the required sequence of differential pressures between successive rooms.

Pressure differentials without numerical value: Adjust the systems so that the required air flow or pressure differential between the rooms is detectable.

Test conditions: Adjust systems with the rooms in normal operating condition and doors closed except where the normal operating condition requires that the doors be open.

Notification: Report locations of excessive building air leakage so they can be sealed.

### Procedure

General: Adjust systems in the following sequence:

* Balance supply air to documented values and tolerances.
* Balance return and exhaust air to documented values and tolerances.
* Adjust controls (if applicable) to documented functions.
* Measure differential pressures.
* Re-adjust return and exhaust air quantities to achieve documented differential pressures if not achieved through the above. Do not alter supply air quantities from documented values.

## AUTOMATIC CONTROLS

### General

Requirement: Test all controls hardware and software for correct operation.

### Sensor calibration

General: Calibrate all sensors to within the documented accuracy of the sensor.

## SAFETY CONTROLS

### Testing

General: Test each safety control and facility by simulating the unsafe condition that the control is intended to protect against.

Monitoring: Make sure that monitoring and safety measures are in place for the test to protect personnel from injury and the building and equipment from damage.

## PLANT OPERATION PERIOD

### General

Requirement: Provide a plant operation period after the installation has passed completion tests and before the date for practical completion.

Plant operation period: ≥ 5 days.

Plant operation: Operate the mechanical systems continuously during the plant operation period. Provide one or more experienced operators in constant attendance in working hours and on call at other times to monitor the plant operation and make necessary adjustments to keep it operating properly.

## COMPLETION TESTS

### General

General: Carry out completion tests.

### Air conditioning performance tests

General: In addition to balancing and commissioning, test performance of air conditioning systems during the maintenance period.

Instrumentation: Select from the following:

* Electronic data logger with temperature and humidity sensors or thermohydrograph. Conform to

### Instrumentation.

* If the automatic control system has been documented to have facilities for logging sensed values, provide trend logs of sensor values over the same periods.

Performance: Record dry-bulb and relative humidity at each location continuously for 2 separate periods of at least 24 hours.

Reports: Provide graphical printout of values recorded by instrument together with control system log graphs where this facility is provided.

### Motors

Motor-driven equipment performance tests: Test for performance. Adjust thermal overloads to suit the actual currents. Record the measured currents and overload settings.

**12.0 MECHANICAL MAINTENANCE**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide maintenance of the mechanical systems for the documented maintenance period so that the performance and service delivery including indoor conditions and indoor air quality, reliability, service life, compliance with statutory requirements, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period in parallel with and including:

* + - Periodic and statutory maintenance, cleaning and replacement of consumables.
    - Emergency repairs.

Maintenance period: As documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Mechanical systems*.
    - *Mechanical commissioning*.

## STANDARDS

### General

Air handling system maintenance: To AS 1851. Microbial control: To AS/NZS 3666.2.

Pressure equipment:

* Maintain to AS 3873.
* Inspect to AS/NZS 3788.

Respiratory protective devices: Maintain to AS/NZS 1715.

## INTERPRETATION

### Definitions

General: For the purpose of this work section the following definition applies:

* + - Consumable: Materials or components intended to be replaced within the service life of the associated plant or equipment.
    - Periodic maintenance: Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
    - Repairs: Unplanned/corrective maintenance (reactive).
    - Emergency repairs: Repairs to restore the normal operating state or safety of the plant or systems.
    - Replacement: Upgrading of a higher value component on regular cycle, including repainting and replacement of air conditioning equipment.
    - HEPA: High efficiency particulate air, using or containing a filter designed to remove 99.97% of airborne particles, measuring 0.3 µm or greater in diameter passing through it.

## SUBMISSIONS

### Records

Maintenance records: Conform to the *General requirements* work section.

Periodic maintenance and performance report: At the frequency documented, submit reports summarizing the maintenance performed and the performance of the mechanical plant in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

* Dates and number of site labour hours for periodic maintenance. Exclude travelling time.
* Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time.
* Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
* Quantity and type of refrigerant used.
* Peak load and load profile for electrical power consumed by mechanical plant.
* For each separately metered item, the water or energy use for each month of the reporting period.
* Flow rates and pressure drops across heat exchangers.
* Mechanical plant electrical power consumption and load profile
* List of any motors for which the motor current varied by more than 10% from the current measured during commissioning.
* Results of recommissioning if scheduled for the period.
* Flow rates and pressure drops across heat exchangers.
* Details of energy efficiency maintenance undertaken including any corrective action.
* Recommended action by the principal.

### Statutory certification

Annual and other certification: Inspect and submit certification for all items required to be inspected annually or more frequently under statutory requirements including but not limited to air handling systems required for fire and smoke control, boilers, pressure vessels, cooling towers and warm water systems.

### Statutory reporting

Requirement: Submit statutory reports to AS 1851, AS/NZS 3666.2, AS/NZS 3666.3 and AS/NZS 3666.4 including those required for pressure vessels.

## INSPECTION

### Notice

Inspection: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

## PRODUCTS

* 1. **GENERAL**

### Product selection

Proprietary items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance, energy profile and construction characteristics.

## EXECUTION

* 1. **MAINTENANCE REQUIREMENTS**

### General

General: Provide all labour and material necessary to maintain the mechanical installation including, but not limited, to filter media, belts, refrigerants, lubricants and all items commonly referred to as consumable.

### Maintenance required

Minimum level: To the operations and maintenance manual and the manufacturer’s recommendations.

Frequency: Carry out the actions, at no lower frequency than the intervals recommended in AIRAH DA19.

## EMERGENCY REPAIRS

### General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs . Rectify faults and replace faulty materials and equipment.

Remedial work: Carry out any remedial work, including temporary work, necessary to restore each system to safe and satisfactory operation. Verify each system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary work: Promptly replace temporary work with permanent rectification.

### Contact details

General: Provide contact details including mobile phone numbers for normal working hours and emergency call outs.

### Response time

Emergency repair: Attend site for emergency service within the documented response time. Response period: Starts at the time of notification to the contractor’s nominated contact point.

## PERIODIC MAINTENANCE

### General

Routine visits: Make routine service visits at the frequency documented. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals and the manufacturer’s recommendations.

Notification of defects: When defects in the mechanical services systems are identified, give notice.

Requirement: Conform to the recommendations of AIRAH DA19 including, but not limited, to the following:

* Check for and repair corrosion.
* Check for and rectify any unsafe conditions.
* Replace faulty or damaged parts and consumable components.
* Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly.
* Maintain pipe, conduit and duct identification to AS 1345.
* Maintain safety signs to AS 1319.

System and component maintenance: In addition to the requirements documented below, conform to the recommendations of AIRAH DA19 for the following:

* Air handling systems.
* Air filters.
* Air quality.
* Automatic controls.
* Drives.
* Ductwork including kitchen exhaust ducts and hoods.
* Electrical systems.
* Electric motors.
* Electrical switchboards.
* Fans.
* Fire and smoke dampers.
* Insulation of ductwork and piping.
* Packaged air conditioning plant and room air conditioners.

Manufacturer’s recommendations: Conform to the manufacturer’s recommendations for maintenance and frequency of maintenance.

### Replacement materials and consumables

Requirement: Provide replacement materials and consumables of the same brand, type and model as those in the existing systems.

Substitution: If proposing substitution of materials or consumables, submit the following:

* Evidence that replacement materials of the same brand, type and model as the original are no longer available.
* Evidence that the performance of the proposed substitution is equal to or greater than the original.
* Evidence of conformity of the proposed substitution to cited standards.
* Essential technical information relating to the proposed substitution, in English.
* Statement of cost implications including costs outside the contract.
* Statement of consequent alterations to other parts of the works.

### Maintenance for energy efficiency

Requirement: Carry out tasks necessary to maintain the energy efficiency of the systems is equal to or better than that at the beginning of the maintenance period. Conform to the recommendations of AIRAH DA19 and

*Guide to Best Practice Maintenance & Operation of HVAC Systems for Energy Efficiency*. Include the following:

* Verify sensor calibration is within tolerance.
* Verify correct operation of economy cycles.
* Adjust operation of terminal and zone devices including VAV boxes and chilled beams for energy efficient operation.

### Cleaning

Requirement: At the end of the maintenance period:

* Remove waste, inspect and, if necessary, clean all parts of the installation.
* Inspect and clean interior of switchboards, switchgear, contactors and other electrical contacts.
* Inspect and clean interior or air handling plant.
* Inspect and clean strainer baskets.

Contamination: If a product or process is likely to be contaminated, provide adequate containment and protection.

Disposal of contaminated materials: In a manner appropriate to the contaminant.

### Time tolerances for periodic maintenance table

|  |  |
| --- | --- |
| **Service intervals** | **Maximum time before/after the required date** |
| Quarterly (3 months or 13 weeks) | 1 week |
| Half yearly (6 months or 26 weeks) | 2 weeks |
| Annually (12 months or 52 weeks) | 2 weeks |
| Biennially (24 months or 104 weeks) | 1 month |
| Triennially (36 months or 156 weeks) | 1 month |

**Air handling systems**

Requirement: For each air handling and ventilation system, conform to the following:

* Carry out maintenance routines to AS 1851.
* Carry out maintenance required by AS/NZS 3666.2 or AS/NZS 3666.4 as documented including inspecting and, if necessary, cleaning both sides of cooling coils and condensate pans.
* Check coils for fin damage and repair.
* Check and clean fan impellers and blades.
* Check fan balance. Rebalance out of balance fans.
* Rectify air leaks including leaks in air handling units.
* Check motorized damper operation and lubricate linkages. Rectify defective operation.
* Check that motorized dampers seal tight when closed. Repair or replace defective seals.
* Check air handling and water systems for temperature, pressure, flow and leakage. Adjust if necessary. Repair all leaks.
* Check penetrations and outside air intakes and exhaust outlets for foreign matter water entry and leaks. Clean where necessary.
* Check condition of insulation and vapour barriers for damage and repair.
* Air filters: Carry out maintenance in conformance with **Air filters**.
* Inspect the interior of ductwork near moisture producing equipment to AS/NZS 3666.2 or AS/NZS 3666.4 as documented.
* Inspect and maintain kitchen exhaust systems to AS 1851 including checking interior of ducts for accumulated grease. Clean if found.

### Air filters

Requirement: Conform to the following:

* Air filters: To AS 1324.1 Section 3.
* Grease filters: To AS 1851.

HEPA filters: Test integrity annually to AS 1807.6 or AS 1807.7, as appropriate to the method of mounting.

### Air intake and discharge

Requirement: Inspect and maintain to AS/NZS 3666.2 or AS/NZS 3666.4, as documented.

### Air pressure differentials

Requirement: If spaces are documented to have an air pressure differential between them, test as documented and rectify if necessary.

### Air quality

Requirement: Check and report to the recommendations of AIRAH DA19.

### Automatic controls

Requirement: Conform to the following:

* Check operation and safety controls for variable speed drives. Check and record output frequency. Adjust if incorrect. Rectify defects.
* Record readings of thermometers, gauges, meters, current draw of motors and heaters, sample readings, control set points and controlled space conditions.
* Check sensor calibration. Recalibrate if incorrect.
* Check electrical and control systems, including safety limits for temperature, pressure and humidity. Adjust if incorrect. Rectify defects.

### Drives

General: Conform to the following:

* Check drives and couplings. Rectify faults.
* Check belt drives for belt wear and tension. Replace worn or broken belts.
* Check pulley alignment and re-align if out of alignment.
* Check motors and machinery for excessive operating temperature, bearing noise and excessive vibration. Rectify defects.
* Lubricate equipment.

### Ductwork including kitchen exhaust ducts and hoods

Cleanliness: Inspect and maintain to AS 1851, AS/NZS 3666.2 or AS/NZS 3666.4, as documented.

### Electrical systems

General: Conform to the following:

* Check for hot joints, burnt insulation, burn contacts and repair.
* Check electrical connections for tightness. Tighten loose connections.
* Check operation of all electrical components. Rectify defects.
* Check indicating lights and replace defective lamps.
* Check and record motor currents.
* Check overload settings. Adjust if necessary.
* Check and report any changes to controls and wiring. Standards:
* Electrical equipment generally: To AS/NZS 3760.
* Repair and overhaul of rotating electrical equipment: To AS 4307.1.

### Electrical switchboards

Standards: To AS 2467 and AS 1851. Requirement: Conform to the following:

* Check for hot joints and burnt insulation. Scan joints and cable terminations using an infrared temperature detector or cameras and repair any joints showing high temperatures.
* Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
* Inspect and maintain the assembly, including battery systems, monthly.

### Fire and smoke dampers

Requirement: Inspect and maintain to AS 1851.

### Packaged air conditioning plant and room air conditioners

Requirement: Conform to the following:

* Carry out maintenance in conformance with **Air filters**.
* Carry out maintenance in conformance with **Air handling systems.**
* Carry out maintenance in conformance with **Refrigeration systems**. **Refrigeration systems**

Requirement: Conform to the following:

* Check refrigeration systems for temperature, pressure including analysis of oil and refrigerant. Record results and rectify defects.
* Check refrigerant charge by measuring and recording superheat and subcooling. Adjust charge and superheat to the manufacturer's recommendations. Record amount of refrigerant added or removed.
* Hermetic compressors: Analyze refrigerant gas. Determine the acid and moisture content of the gas. Record results.
* Check refrigeration system controls and adjust if necessary.
* Check for leaks using electronic leak detector. Rectify leaks.
* Check air cooled condenser coils for fin damage, dirt or obstruction. Clean and repair.
* Carry out wet system maintenance required by AS/NZS 3666.2 or AS/NZS 3666.4, as documented. Flammable refrigerants: To the recommendations of AIRAH Flammable Refrigerants - Safety Guide.

## END OF MAINTENANCE PERIOD SERVICE

### General

Requirement: Within one month before the end of the maintenance period, carry out the following service tasks:

* + - Undertake all work scheduled to be carried out on an annual basis.
    - Replace air filter media if the resistance exceeds 80% of the dirty resistance of the filter bank.
    - Drain, dismantle, inspect and reinstate boilers and pressure vessels to AS/NZS 3788.
    - Clean moisture eliminators and cooling coil surfaces.
    - Remove external scale and corrosion, prepare and repaint the affected surfaces.
    - Provide infra-red scan of switchboards.

## RECOMMISSIONING

### General

Requirement: To the manufacturer’s recommendations.

## COMPLETION

### Maintenance records

Service records: Record maintenance undertaken in the schedules in the operation and maintenance manuals .

Maintenance reports: Prepare maintenance reports as documented.

### Restitution after maintenance tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete, including the following:

* Replace insulation and sheathing.
* Seal vapour barriers.
* Replace access panels.
* Replace and/or clean removed ceiling tiles.
* Clean and remove any waste generated by the maintenance task. Standard: Equal to the condition of the original installation.

**SECTION C – HYDRAULIC SERVICES**

**1.0 HYDRAULIC SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

General: Provide the hydraulic services, as documented. Summary: The hydraulic services are summarized as follows:

## HYDRAULIC SERVICES SCOPE OF WORKS

The work covered by this specification and associated drawings shall be carried out by the Hydraulics Sub-Contractor and consists of the following but not limited to;

The complete fabrication, supply, delivery, off-loading, hoisting into position, installation, testing, commissioning, setting to work, demonstrating, training and maintenance of the following necessary to complete the intent of the project:

### Cold Water System

* + 1. Mains water connection to Samoa Water Authority existing mains pipe with water meter and RPZD backflow prevention device.
    2. Cold water system including water tanks, inlet fill-up, outlet for domestic cold water, overflow from water tanks and outlet tanks to water pump, pipework, isolation valves, check valves, pressure reducing valves, fittings, supports and all other associated accessories.
    3. Cold water (potable) pump set with duty/standby configurations, control panel, pressure gauges, pressure switches, pressure tank, steel base frame, isolation valves, check valves, pipework from water tanks to pump, fittings, support and all other associated accessories.
    4. Water filters and UV filters, UV lamp, fittings, support and all other associated accessories.
    5. Cold water pipe reticulation to plumbing fixtures, flexible pipe connection, compression angle outlets, pipe supports and all other associated accessories.
    6. Water pump enclosure with lockable ventilated door, lights and all other associated accessories.
    7. All cold water system installation shall have necessary sign / labelling as per required standards.

### Hot Water System

1. Solar / Electric hot water system complete with storage cylinders, structural mounting supports, electrical heating element, fittings, support and all other associated accessories.
2. Hot water pipe reticulation to plumbing fixtures, flexible pipe connection, compression angle outlets, hot water tempering valves, thermostatic mixing valve, pipe supports and all other associated accessories.
3. Connection to fixture, pipework, fittings, supports and all other associated accessories.

### Wastewater Drainage

1. Connection from plumbing fixture, pipework, fixture waste traps, tundish, inspection openings, pipeworks, vent pipe, floor gullies, grease trap, venting, fittings, support and all other associated accessories.

### Stormwater System

1. Roof gutters, dome guards (leaf guards), downpipes, overflows, channel drains, pipeworks, fittings, support and all other associated accessories.

Attendance at meetings, contract administration and coordination with the client’s representatives, other trades, utility providers, local authorities, etc.

Any omission from the above scope does not relieve the contractor of the design intent.

## HYDRAULIC SERVICES DESIGN CONDITIONS

### General

|  |  |
| --- | --- |
| Building Type: | Class 5 |

Rainfall: rainfall intensity based on 1 in 100 year storm

### Utilities

Available incoming mains water supply

### Fixture Flow Rates

As per current AS/NZS 3500.1 from Table 3.1

### Flow rates and loading units

|  |  |  |  |
| --- | --- | --- | --- |
| ***Fixture/appliances*** | ***Flow rates (L/S)*** | ***Flow Rate (L/Min)*** | ***Loading Units*** |
| ***Water Closet Cistern*** | ***0.10*** | ***6*** | ***2*** |
| ***Basin (standard outlet)*** | ***0.10*** | ***6*** | ***1*** |
| ***Sink (standard tap)*** | ***0.12*** | ***7*** | ***3*** |
| ***Mains pressure water heater*** | ***0.20*** | ***12*** | ***8*** |
| ***Hose tap (20 nom, size)*** | ***0.30*** | ***18*** | ***8*** |

**Hot Water Supply Temperatures**

Shower: 50°C

Hand Basin: 40°C

### Velocity in Pipe

Cold water supply Maximum 2.0 m/s

Minimum pressure at fixture outlet 150kPa

## HYDRAULIC SERVICES ASSOCIATED WORKS BY OTHERS

The following associated works shall be provided under the main contractor by the various trades but not limited to, to ensure the successful completion of the hydraulic services installation;

Builders Works as follows but not limited to:

1. Forming of penetrations for pipework;
2. All required chase in walls and floors;
3. Fire sealing of all penetration passing through a fire rated compartment or structure;
4. Weatherproofing / flash roof and wall penetration passing through the external envelope of the building;
5. Concealing of services;
6. Access to ceiling voids, services shaft, partition and block walls;
7. Concrete plinths.

Electrical Services

1. Power supply in close proximity to hydraulic equipment i.e cold water pump, UV filter, solar/electric hot water system.

Mechanical Services

1. Condensate pipework to discharge to tundish in ceiling void.

Civil Services

1. Stormwater and sewer connections from building boundary.

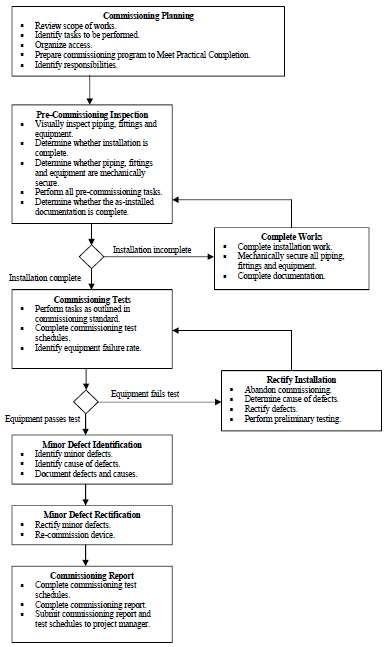
## HYDRAULIC SERVICES REFERENCED DOCUMENTS

|  |  |
| --- | --- |
|  | Australian National Construction Code Series - 2016 |
|  | National Building Code of Samoa |
| AS/NZS 3500.0:2003 | Plumbing and Drainage – Glossary of Terms |
| AS/NZS 3500.1:2015 | Plumbing and Drainage – Water Services |
| AS/NZS 3500.2:2015 | Plumbing and Drainage – Sanitary Plumbing And Drainage |
| AS/NZS 3500.3:2015 | Plumbing and Drainage – Stormwater Drainage |
| AS/NZS 3500.4:2015 | Plumbing and Drainage – Heated Water Services |
| AS 4426: 1997 | Thermal Insulation of Pipework, Ductwork and Equipment – Selection, Installation and Finish. |
| AS 1345 | Identification of the Contents of pipes, conduits and ducts |
| AS 1432 | Copper Tubes for plumbing, gas fitting and drainage applications |
| AS 2129 | Flanges for pipes, valves and fittings |
| AS 2700 | Colour Standards for general purposes |
| AS 2845 | Water Supply – Backflow prevention devices |
| AS/NZS 1260 | PVC-U pipes and fittings for drains, waste and vent applications |
| AS/NZS 1477 | PVC pipes and fittings for pressure applications |
| AS/NZS 2032 | Installation of PVC pipe systems |
| AS/NZS 2648 | Underground marking tapes |
| AS/NZS 5601.1:2010 | Gas Installation |
| AS 1940:2004 | The storage and handling of flammable and combustible liquids |

**HYDRAULICS SERVICES COMMISSIONING PLANS**

Upon completion of the installation, pre-commissioning of the installation and equipment shall be conducted by the contractor. All pre-commissioning test results shall be recorded. Prior to notifying the engineers of the final commissioning, a commissioning plan needs to be provided for review. The commissioning plan shall include the following.

The contractor shall allow to coordinate with the other services contractors for the implementation of the commissioning plan.



## DESIGN

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

## PRECEDENCE

### General

Work sections and referenced documents:

* The requirements of other work sections of the specification override conflicting requirements of this work section.
* The requirements of the work sections override conflicting requirements of their referenced documents.
* The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* *General requirements*.
* *Hydraulics System*
* *Service Trenching*
* *Electrical Systems*
* *Mechanical Systems*
* *Fire Systems*

The contractor shall also adhere to the project environmental impact plan as well as risk and OH&S reports for the project.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the definitions given in the *General requirements*

Work section apply.

## STANDARDS

### General

Refer to reference to documents above of the list of reference standards.

## CONTRACT DOCUMENTS

Requirement: Conform to the *General requirements* work section.

The contract drawings only indicate the known services within the site and have been prepared from available records. The Contractor is to investigate the site for the exact number, location, depth and size of all existing services so as to avoid damage during construction. Deviations of services other than that indicated are to be brought to the attention of the Superintendent prior to the commencement of any excavation and/or installation relating to such deviation.

All testing shall be the same as specified for new piping and equipment. Testing to be carried out at the commencement of the works and prior to any installation of pipework.

Advise the superintendent of the results of all tests on existing services. Services that are proven to be defective after inspection and testing shall be replaced with new pipework.

Existing services to be retained that are damaged during construction shall be repaired/replaced to the satisfaction of the Authority, Owner of the service, and the Superintendent.

## SUBMISSIONS

### General

Requirement: Conform to the *General requirements* work section.

### Certification

During the progress of the works the Contractor shall produce and issue a monthly certificate to the Superintendent to state that the “Hydraulic Services have been installed in accordance with the Contract Documents, Authorities Requirements and Australian Standards

This Certificate must be signed and issued to the Superintendent prior to any application for a monthly progress payment.

At the completion of the works and prior to the submission for final payment the Contractor shall make all necessary applications, pay all fees, obtain and issue to the Superintendent Certificates indicating that the works:

* Comply with the current regulations
* Comply with the requirements of the relevant Authority
* Comply with the requirements of the Contract Documents
* Have been tested and commissioned for the full operating conditions

### Electrical loading

Electrical loading: Submit for all equipment before completion of the main switchboard shop drawings. 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.

### Maintenance program

After completion of the warranty period, the operation, running and preventive maintenance of all plant, equipment and services will become the responsibility of the Proprietor. The supplier such major plants, equipment and services shall furnish the Hydraulic Trade Contractor with all details necessary for him to include in a proposal for an annual maintenance contract four weeks before the end of the warranty period.

These supply contractors shall provide a fully detailed maintenance programme for the twelve-month period from practical completion. This programme will provide the necessary service and maintenance required to keep the plants, equipment or services in peak operational condition.

Submit the maintenance programme for approval prior to practical completion. Show the cost of carrying out this programme.

### As-built, Operation and Maintenance Manuals

The supplier shall provide the trade contractor installing the equipment supplied under the supply contract with revised sets of shop drawings, together with concise operating and maintenance instructions, schedules and commissioning records to comply with the requirements specified below. A complete set of transparencies shall also be supplied.

The supplier shall provide one set of as installed drawings in AutoCAD Version 2016 drawings on compact disk.

The Hydraulic Contractor will bind these into the operating and maintenance manual.

An operation and maintenance manual shall be prepared and supplied for all services installed in the trade contract before the issue of the certificate of practical completion of the trade contract works.

This manual, together with the shop drawings and as built drawings, shall be sufficient to permit a safe and trouble free start up, the establishment of an operational sequence and preventive maintenance programme to allow the Principal to operate and manage the whole installation efficiently and other contractors to service, maintain and repair it.

The manual shall give a clear, comprehensive description of all the equipment, components and sub- components, principle of operation, method of operation and maintenance procedures. The descriptions shall be accompanied by line diagrams and any other illustrations necessary to achieve the required objective.

Before the issue of the Certificate of Practical Completion supply four bound revised sets of the Shop Drawings and Diagrams together with concise Operating and Maintenance Instructions, schedules and commissioning records specified below.

The manuals, together with the Shop Drawings specified earlier, shall be sufficient to permit a safe and trouble free start up, the establishment of an operational sequence and preventive maintenance programme to allow the Principal to operate and manage the whole installation efficiently and specialists to service, maintain and repair it.

The descriptions shall be accompanied by flow diagrams, line diagrams and any other illustrations necessary to achieve the required objective.

The Operation and Maintenance Manuals and associated drawings shall be supplied as a quality publication and shall be as follows:

All material contained in the manual shall be printed by an approved process on approved quality paper. This requirement includes all illustrative material.

A draft of the manual, including illustrative material and drawings, shall be submitted for approval three weeks prior to the date for Practical Completion.

Following approval of the draft, three complete Operating and Maintenance Manuals and one set of "As Installed" Drawings shall be submitted prior to Practical Completion.

The following type and range of date and information shall be included in the manual:

* General description and performance data for all equipment.
* Parts list - a schedule of parts duly illustrated and showing name of Manufacturer, part number and quantity.
* Installation instructions - to describe original installation procedures, alignment diagrams and figures, fit tolerances, and future removal and replacement procedures for all major equipment.
* Operating instructions - include all details necessary for correct start up procedure and sequence of operation.
* Maintenance instructions - include all phases of preventive maintenance including such items as a detailed lubrication chart, grade and type of lubricant, correct quantities of oils and greases, and procedures for drain and refill.
* Valves - include a complete list of valves for all systems, services or special plant items. Include the make, type, valve model number and location of each valves.
* Imported equipment - include certified data from the manufacturer for works accepted equivalents, winding diagrams and conductor details for imported electric motors.
* Maintenance schedules - include detailed schedules of periodic checks and maintenance and replacement procedures.
* Test data - include copies of all test certificates including physical test of materials, as well as machine performance data, noise and vibration test figures and all progressive test data obtained during construction and installation.
* Drawing list - a complete list of drawings and numbers showing final revision suffix with their titles
* The operation and maintenance manual shall be supplied as a quality publication. Page size shall be A4. The method of binding shall be four ring binders.
* All material contained in the manual shall be printed by an approved process on approved quality paper. This requirement includes all illustrative material.
* All material for inclusion in the manual shall be submitted to the trade contractor at the time of delivery of the equipment. The trade contractor will submit this to the Project Engineer for approval.

Following approval of the draft, six complete operating and maintenance manuals shall be sent to the Superintendent prior to practical completion of the trade contract works

### Operation Manual

The operation manual written for use by the Site Hydraulic Contractor shall contain but not be limited to the following.

* Description of the equipment supplied and systems installed.
* Step by step of plants and systems start-up and shut-down procedures.
* Instruction for normal operations.
* Instructions on monitoring and sample log sheets for each equipment item, to be filled-in by operators on a routine basis.
* Basic maintenance procedures for equipment.
* ‘Do’s and don’ts in operation.

Operator’s attention shall be drawn to all operations considered to be dangerous to personnel or likely to cause damage to plant and equipment.

* Trouble-shooting chart containing problems, possible causes and remedies.
* A3 size copies of all drawings folded to A4 size.

Operation manual shall be simple and written in either non-technical or semi-technical language. Wherever possible, the operation manual shall be presented in a tabulated easy to understand form.

### Maintenance Manual

The Maintenance Manual shall include but not be limited to the following:

* checking, testing and replacement procedures to be carried out on all electrical plant items and systems on a daily, weekly, monthly or at longer intervals to ensure trouble free operation. This information shall be presented in a tabulated form.
* fault location and remedy charts to enable tracing the cause of the problems and correcting them;
* a spare parts schedule which shall consist of a complete list of itemized spare parts for the electrical plant items with ordering references and part numbers;
* A complete list of manufacturers and suppliers. The list shall be tabulated in alphabetical order, giving the name, address, telephone numbers, and fax and telex numbers;
* A complete list of manufacturer's instructions for operation and maintenance of all equipment purchased. The list shall be tabulated in alphabetical order giving the supplier information of the item, model number and the literature provided including instructions leaflets and drawing numbers.

### Shop drawings

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

* Pipework and equipment layout and sections showing the work to be installed on 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.

### Products

. 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.

. 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.

. Site and floor set out points.

. Tank stands and supporting structures.

Equipment: Documented pump heads are based on provisional equipment selections and estimated pressure drops. 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: 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 conformance to 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.

If it is proposed to use alternative materials and systems to those specified, a submission shall be made and the approval obtained prior to ordering and commencement of the respective sections of the work. Full details will be requested to support any submission. The client reserves the right to reject the use of alternative products or materials to those specified.

### As-Built Drawings

A set of drawings shall be kept on site and progressively marked up by the Contractor as the work proceeds to record the locations, inverts and details of all installed services, equipment and valves.

Before applying for the Certificate of Practical Completion, a set of "Works as Executed" drawings (comprising all floor plans, Diagrammatics and Details) prepared by the Contractor on reproducible material and electronic format to a minimum scale of 1:100 and relevant bound manuals indicating all items of service or equipment, shall be submitted to the Superintendent for review. Standard of drafting and minimum scales shall be equal to design documents, accurately plotted, showing dimensions of pipes, valves and services.

The Works as Executed Documents shall incorporate all new and existing services and equipment to form a comprehensive set of documents on completion.

## PRACTICAL COMPLETION

Practical completion will not be given until Authorities approvals and guarantees are handed over to the Superintendent.

Documentation to include but not limited to:

* Installing contractor’s certification of compliance with each individual code requirement
* Water Authority Compliance Certification
* Backflow prevention compliance and schedule of RPZD’s
* Schedule of Thermostatic Mixing Valves and commissioning certification
* As Built Drawings
* Maintenance manuals
* Fire Rating certification for all penetrations
* Completed schedule of installation tests
* Certification for Sterilization and Disinfection of potable water supplies

## OCCUPATIONAL HEALTH & SAFETY

Comply with all of the latest requirements of the Occupational Health and Safety Act for Samoa regulations including Work cover in terms of the installation, operation, maintenance, and exposure to the Public of all items of equipment supplied and installed in the Project.

Advise the Superintendent of any component of the work that contravenes the requirements of the Samoa OH&S regulations.

Where necessary provide signage alerting operators, maintenance personnel, of any OH & S requirements or danger to personnel or public.

Signage shall include for the operation and maintenance of hot water use applications & rainwater tanks.

Provide signage over all hot water boiling units outlets that exceed 50ºC warning users that hot water temperature exceeds 50ºC and can burn.

## FEES AND CHARGES

The Contractor shall be responsible for paying all fees and charges rendered by the respective Authorities in reference to the project which shall include but not be limited to the following:

* Commencement of Work fees
* Inspection Fees
* Document inspection fees
* Road Opening fees
* Service Connection Charges

## CERTIFICATION OF WORKS

During the progress of the works the Contractor shall produce and issue a monthly certificate to the Superintendent to state that the “Hydraulic Services have been installed in accordance with the Contract Documents, Authorities Requirements and Australian Standards

This Certificate must be signed and issued to the Superintendent prior to any application for a monthly progress payment.

At the completion of the works and prior to the submission for final payment the Contractor shall make all necessary applications, pay all fees, obtain and issue to the Superintendent Certificates indicating that the works:

* Comply with the current regulations
* Comply with the requirements of the relevant Authority
* Comply with the requirements of the Contract Documents
* Have been tested and commissioned for the full operating conditions

Wherever applicable the relevant Authority shall issue a Certificate of Compliance. Where this is not standard practice the Contractor shall provide a Certificate or Letter of Certification which will guarantee that the final installed works comply with the relevant Authorities regulations, requirements and conditions.

Refer to Clause “Completion Certificates” for list of minimum required certificates

## QUALITY ASSURANCE

The Contractor is to have a Quality Assurance system complying with the requirements of AS/NZS ISO 9002.

Within fourteen (14) days of the award of the sub-contract, the Contractor shall submit details of their proposed Quality System to the Superintendent and will nominate a Quality Representative who will have the responsibility and authority for implementation of the Quality System.

The Contractor shall prepare and submit a Quality Manual in accordance with the relevant code. Inspection and Test Plans (ITP) are to be prepared and submitted indicating:

* The systems or components covered by the ITP.
* Who shall carry out the work
* The acceptance criteria
* The record form to be used for documenting inspections and testing

The ITP submitted by the Contractor will be assessed by the Superintendent. The Contractor will incorporate any additional requirements requested by the Superintendent.

The Contractor shall provide all documentation relating to Quality Systems for the purposes of auditing and compiling Quality Records.

Provide to the Superintendent an Audit Report of the Quality Assurance procedures as set down in the Manual all in accordance with the relevant Standard. Audit report is to be carried out at six monthly intervals.

Prior to practical completion and following all commissioning checks, including Contractor's final inspections of the works as defined in the Quality Assurance procedures, provide in writing notification so that Final Inspections can be carried out with or by the Superintendent. Notification shall be provided after the various zones, areas or levels nominated have been fully inspected, commissioned and all defects have been rectified.

Practical completion will not be given until all inspection; testing & commissioning forms are satisfactorily completed and accepted by the Superintendent.

## TENDER DRAWINGS

The accompanying tender drawings indicate the approximate positions and number of sanitary fixtures and other items requiring connection to the hydraulic services and must be read in conjunction with all other project drawings, specifications and contract documents,

The drawings require further development to identify coordination issues and other details.

Allow for all necessary diversions and minor adjustments of pipe work and equipment as may be necessary to carry out the work as required and as necessary to complete the works. Refer to all drawings produced for the Project for the location of equipment and co-ordination with other services.

Refer to Architectural drawings for set out of fixtures and equipment.

## INSPECTION

### Notice

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

* Excavated surfaces.
* Concealed or underground services.

Refer to section 1.1 for the commissioning plan.

### Testing

Allow for the cost of carrying out all necessary tests and commissioning to prove the adequacy of the installation and as set out on the drawings, in the specification or as required by the respective authorities.

Supply all plugs, apparatus, and other materials necessary for the tests.

It shall be the Contractor’s responsibility to test all underground or enclosed work before it is covered or concealed from view and approved by the authority concerned.

The Contractor shall keep an up to date record of all tests carried out as the works proceeds. The record of the tests shall be provided to the Superintendent on a monthly basis and as requested during construction.

On completion of the works the Contractor shall carry out any procedure required by the Superintendent and/or authorities, to prove that the respective systems are operational under normal and maximum working conditions, as requested

Provide a minimum of two (2) working day notice to the Superintendent before the commencement of testing.

Maintain a separate set of drawings on site to record progress of testing. Remedy any defects in the piping found during testing and re-test as specified under each section of work.

The complete signed record of all pressure and commissioning tests shall be provided to the Superintendent before application practical completion. Any damage to the installation or project caused by using the installation prior to and after commissioning and completion tests, shall be the responsibility of the Contractor.

## EXECUTION

* 1. **WORK ON EXISTING SYSTEMS**

### Existing systems

Condition of existing systems:

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

### Connections to Network Utility Operator mains

General: Excavate to locate and expose the connection points and connect to the Network Utility Operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

Contractor to liaise with Samoa Water Authority for connection into the mains and full fill all works requirement by the authority to get water supply to the site.

## INSTALLATION

### Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

## PIPING

All piping shall be new and conform to the standards and descriptions and be in accordance with materials and sizes shown on the drawings and/or detailed in the specification.

Pipelines shall be installed using the longest practicable length of tube/pipe to eliminate unnecessary jointing. Building up lengths from short off-cuts shall not be permitted.

All joints in piping shall be located so that they can be repaired without causing structural damage to the building.

Make adequate allowance to accommodate the expansion and contraction of the selected piping material throughout the full operating range of the installation. without causing stresses on pipework, fittings and equipment. Pipework, fittings equipment and finishes damaged as a result of inadequate allowances for expansion and contraction shall be replaced by the contractor.

## CAPPING OFF

During construction, leave all unfinished work in a safe condition and protect the works against damage or loss through any cause whatsoever. At all times open ends of pipes shall be sealed off in such a manner as to prevent the entry of foreign matter into the lines. Plugs of rags, paper or wood will not be acceptable for this purpose.

## FIXING AND SUPPORTING OF PIPES

### General

Pipework and fittings shall be:

1. Only fixed in approved locations.
2. Adequately secured to the structure to support the pipework under full load conditions with a safety margin of 2:1.
3. Kept clear of structure and other services.
4. Provided with 0.75mm galvanized sheet metal sleeves where passing through structure. Space between pipe and fire rated building element to be scaled using a system to AS 4072.1 equalling fire rating of structure through which pipe passes.
5. Installed to allow for adequate expansion and contraction without causing stress on pipes or joints.
6. Fixed on hanger brackets to allow adjustment for fall.
7. Not be fixed with explosive power tools.
8. Cleaned of all cement dropping on completion.
9. Purpose designed to support the selected piping material.
10. Be installed at strategic locations to either restrain the pipework or to allow movement between restraining points all as recommended by the piping manufacturer and necessary for the installation
11. Pipes fixed in steel stud walls shall be provided with rubber sleeves where passing through a hole in the steel stud so as to separate the pipework from a sharp edge.
12. Provide rubber insulation between support brackets and steel studs to reduce the incidence of noise transference.

### Materials

1. Use purpose made galvanized mild steel channel equal to "Uni-Strut P1000" complete with galvanized purpose made fittings. Provide plastic end caps on exposed brackets.
2. Obtain approval for any alternative fixing methods before commencement of work. All mild steel must be hot dipped galvanized.
3. Use 4mm thick PVC between copper pipes and steel brackets.
4. Use silicon based rubber lined brackets for plastic pipes.
5. Use galvanized bolts and fixings of adequate size.
6. Use patented masonry metal anchors for fixing into masonry elements.

### Spacing

Fix piping at the following maximum intervals.

1. Sanitary, Vents and Downpipes - Non Pressure Lines

|  |  |  |
| --- | --- | --- |
| **Pipe Material** | **Vertical** | **Horizontal/Graded** |
| Copper |  |  |
| Internal | 1.8 m | 1.8 m |
| External | 1.8 m | 0.9 m |
| Plastic |  |  |
| Internal | 1.8 m | 1.0 m |
| External | 1.8 m | 1.0 m |
| HDPE | Refer to Manufacture for fixing details | |

In the case of rubber ring jointed pipes there shall be a fixing at least at each collar or pipe fitting. Brackets shall be adequate to restrain the effect of the internal forces of piping, including sideways movement.

1. Pressure Lines

|  |  |  |
| --- | --- | --- |
| **Size** | **Stainless or Copper Pipe** | **Plastic Pipe** |
| 15 mm | 1.5 m | 0.6 m |
| 20 mm | 1.5 m | 0.7 m |

|  |  |  |
| --- | --- | --- |
| 25 mm | 2.0 m | 0.75 m |
| 32 mm | 2.5 m | 0.85 m |
| 40 mm | 2.5 m | 0.9 m |
| 50 mm | 2.5 m | 1.05 m |
| 65 mm | 3.0 m | 1.2 m |
| 80mm | 3.5 m | 1.35m |
| 100 mm | 3.5 m | 1.5 m |

## EXPOSED PIPEWORK TREATMENT

1. Chromium Plating

Except as otherwise specified or directed all internal exposed piping adjacent to plumbing fixtures, including traps and fittings shall be chromium plated finished and where passing through a finished wall, floor or ceiling, shall be fitted with approved chrome plates. All other exposed piping shall be cleaned free of cement droppings, and painted.

1. Painting

All piping exposed to view or situated in plant rooms, corridors, car park areas and ducts, including fire services in fire stairs and passages, shall be painted continuously in selected colours and fitted with identification labels.

Painting shall be carried out by experienced painters as specified under Painter.

Painting to pipework shall be in accordance to the colour coding as indicated in the Schedule of Colours for Identification of Piping in AS 1345 - Identification of the Contents of Piping, Conduits and Ducts.

Where piping is specified to be painted, the supports and brackets shall be similarly painted in selected colours.

Copper pipes shall be painted with a suitable etching paint before applying finishing enamel. Paint cast iron pipes with all metal undercoat and finishing enamel. All steel pipes shall be painted with one coat of zinc chromate primer and undercoat before application of finishing enamel. Plastic pipes shall be painted in accordance with pipe manufacturer's recommendations.

## IDENTIFICATION

1. Pipework

Identification labels shall be secured to all pipework throughout the entire project except for vent pipes where terminating above a roof level.

Labels shall be installed in accordance with AS 1345 - Identification of the Contents of Piping, Conduits and Ducts and be equal to Safetyman pattern positioned on each side of valves, bends and junctions and along the length of the pipeline at maximum 3000mm centres. Where pipes are installed within ducts or false ceiling areas, additional labels shall be installed so as to be visible at the access panel position.

Pipework below ground shall be provided with 300mm wide plastic marker tape in the trench located directly 150mm above the pipe. Marker tape will be coloured coded and indicate the service at 1m intervals. All pipework below ground shall be similarly marked for grey water.

Pipe underground shall be provided with marking tape: To AS/NZS 2648.1.

1. Equipment

Equipment identification shall be with Traffolyte labels or equal - having white letters on black background. Equipment labels must be screw fixed, or riveted.

1. Valves

All valves are to be identified by brass discs, engraved and fixed to the hand wheel with screws, bolts or fixed with tie wire... Comprehensive schedule of valve and relative function shall be incorporated in the maintenance schedule.

## CORE HOLES & SLEEVES

Set out all core holes and sleeves in floors, walls, beams and columns in conjunction with the fixing of formwork and/or placing of concrete. To prevent weakening of the building structure, obtain approval from the Structural Engineer for all core hole and sleeve locations prior to placing in concrete.

## PIPE SLEEVES

General: Provide metal or UPVC sleeves formed from pipe sections, for piping penetrations through building elements.

Sleeve diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12mm.

Minimum sleeve thickness:

* Metal: 1mm
* UPVC: 3mm

Sleeve terminations:

* If cover plates are fitted: Flush with the finished building surface.
* In floors draining to floor wastes: 50mm above finished floor.
* In fire-rated and acoustic-rated building elements: 50mm beyond finished building surface.
* Elsewhere: 5mm beyond finished building surface. Finish: Prime paint ferrous surfaces.

## FIRE RATED PENETRATIONS

Seal penetrations with a system conforming to BCA.

Provide fire rating of penetrations through walls, floors and other structures to maintain the fire rating required to meet code requirements. Allow for all costs associated with maintaining the fire rating and filling in core holes and openings.

## CONCEALED PIPING

Unless otherwise approved or directed, pipes shall be concealed or run in stud walls.

All chasing in walls for pipes and equipment shall be carried out with a mechanical saw. Chasing will not be allowed in concrete walls unless agreement in writing is obtained from the Superintendent.

In general, chases in block work shall not exceed 1200mm horizontally and not closer than 600mm to supporting elements vertically. No face walls shall be chased. Where pipes cannot be chased they shall be built in as the work proceeds. Discuss with the Superintendent the location of services in masonry walls. Where pipes are concealed in walls they shall be insulated. The insulation shall be placed on the pipes in such a manner that expansion and contraction will be unhindered and the wall finish will not be cracked or otherwise damaged.

Pipework located in metal studs and supports shall be protected from damage due to sharp edges and the effect of pipe movement.

## MECHANICAL SERVICES CO-ORDINATION

Position of cold water, floor wastes and drainage points in Plant Room and Duct areas are indicative only. Contractor shall co-ordinate with the Mechanical Services Sub-Contractor to ensure the correct position for final choice of equipment and appliances.

## SOUND TRANSMISSION & INSULATION

Ensure the acoustic performance of the hydraulic services installation complies with Part F5 of the Building Code of Australia and other Code and Authorities’ requirements concerning sound transmissions and insulation.

Isolate the Hydraulic installation from the building structure with noise insulation barriers at brackets and/or where passing through walls, floors and other structural elements.

The hydraulic installation is to operate without causing any noise nuisance to occupants under expected operating conditions.

All pipework, fittings, fixtures and equipment shall be selected, installed, fixed and commissioned so that under normal operating conditions any noise generated does comply with the acceptable weighted sound reduction index required by codes.

Pipes in selected areas as shown on the drawings and over habitable areas and/or specified, shall be insulated with a proprietary insulation system to meet Building Code STC ratings of all 30 & 45 in non habitable & habitable rooms respectively. Include for all components & features of the installation system proposed and ensure all components are suitably secured to retain in place.

The installation must not exceed the following noise criteria:

|  |  |
| --- | --- |
| SPACE/ACTIVITY TYPE | NOISE LEVEL dB(A) |
| Office Areas | 35 |
| Bathrooms/Ensuites | 45 |

## HYDRAULIC SHOCK (WATER HAMMER)

The Contractor is to install all pipework and equipment so that the installation is free of vibration and noise from water hammer. Suitably cushion pipework in contact with lightweight walls & ceilings. If water hammer occurs, allow to investigate the cause and modify the installation to the approval of the Superintendent so that water hammer and its effects are eliminated from the installation.

Water hammer is a temporary change in pressure in a pipeline due to a change in the velocity of flow in a pipe with respect to time e.g. a valve opens or closes or a pump stops and starts.

The effects are exacerbated by:

* Fast closing/stopping valves/pumps
* High water velocities
* Air in the line
* Poor layout of pipe network, positioning of pumps, etc.
* Certain tapware

## SUPPLY OF MATERIALS

Supply and fix all materials required to complete the works. All materials shall be first quality and the best of their respective kinds. Second quality or inferior materials shall be rejected. All costs associated with replacement of rejected materials shall be borne by the Contractor. All materials shall conform to the latest Australian Standard Specification, Code or Interim Code. If no Australian Standard exists they shall conform to the latest British Standard or the American Society for Testing and Materials in that order.

All materials or components used in the installation must have either a Standards mark Licence or a Watermark license and comply with the requirements of Australian Standard MP 52. Materials and components must be clearly marked for compliance.

The Contractor is to obtain from the materials supplier a warranty that the materials and components supplied are satisfactory for the service life of the installation as required under the National Plumbing Code AS/NZS 3500 Materials Sections Part 2.

Any goods, substances, materials, products, or equipment not in conformity with any relevant Australian Standard and Building Code of Australia or which are generally known at the time of use to be deleterious to health and safety or to the durability of the building and/or other structures and/or plant and machinery in the particular circumstances in which they are used in the construction, will not be allowed for use on the project. Any materials and equipment that contravenes this clause must be removed from the project at the contractor’s expense.

Where pipe sizes are indicated on drawings for water supply they refer to nominal copper pipe sizes as stated in AS 3500.1.2 clause 1.5 Table 1.1. Pipe materials other than copper pipe must not be less than the equivalent pipe sizes in Table 1.1.

All pipes, fittings and materials used on the installation must be rated for the required operational pressures, test pressures and maximum operating temperature. All pressure piping and fittings must be at least suitable for a minimum operating pressure of 1200 kPa at the maximum possible water temperature. Pumped systems are to be rated at least 1.5 times the operating pressure.

If it is proposed to use alternative materials and systems to those specified, a submission shall be made and the approval obtained prior to ordering and commencement of the respective sections of the work. Full details will be requested to support any submission. The client reserves the right to reject the use of alternative products or materials to those specified.

## SAMPLES

Supply samples of materials when requested. Samples shall be labelled showing the location of their installation. After approval all subsequent work shall conform to the quality of the sample.

## COPPER TUBE & FITTINGS

Reticulation in the building shall be copper pipes. Mains water connection shall be Type B copper with polylag or Denso tape wrapping. All below ground mains supply shall be HDPE PN16 pipe.

* + 1. Copper tube shall:
       1. Conform to Australian Standard AS 1432 – Type B Copper Tubes for Plumbing, Gas Fitting and Drainage Applications.
       2. Be approved by local authority.
       3. Be jointed with silver solder containing not less than 15% silver for pressure piping and 5% silver for all other copper tube.
    2. Fittings for Copper Tube shall:
       1. Conform to Australian Standard AS 3688 - Water Supply - Copper and Copper Alloy Compression and Capillary Fittings and Threaded End Connectors.
       2. Be approved by Local Authority.
       3. Be 70/30 dezincified brass or copper suitable for jointing by silver solder.
       4. Minimum wall thickness shall be not less than the tube thickness it serves.
       5. Be first quality high pressure fittings.

## STAINLESS STEEL MATERIALS

Stainless steel sections shall:

1. Conform to AS 1769 - Welded Stainless Steel Tubes for Plumbing Applications - for pipe sections.
2. Conform to AS 1449 - Wrought Alloy Steels - Stainless and Heat Resisting Steel Plate Sheet and Strip - for fabricated sections.
3. Grade 316 for special corrosive agents.
4. Grade 304 for general fabrication.
5. Approved by Local Authority.
6. Joints shall be lapped and argon arc welded.
7. Compression fittings are only to be used on seamless stainless steel tubing.

## UPVC PIPES AND FITTINGS - SEWER DRAINAGE

All UPVC pipes and fittings shall:

1. Be in conformity with AS 1260 - Unplasticized PVC (UPVC) Pipes and Fittings for Sewerage Applications.
2. Be approved by Local Authority.
3. Be solvent weld jointed in accordance with the manufacturer's instructions.
4. Incorporate fittings of similar manufacture to the pipe used.
5. Shall not be used to convey hot grease wastes.

## POLYETHYLENE PIPE & FITTINGS FOR SEWER DRAINAGE & SANITARY PLUMBING (HDPE)

All HDPE pipes & fittings shall be:

1. Be in conformity with AS 2033
2. Be approved by Local Authority
3. Be butt welded or electro fusion jointed in accordance with manufacturer
4. Be supported as recommended by the manufacturer

## VALVES

Unless otherwise indicated all valves shall be:

1. Approved by the relevant local authority.
2. To the respective Australian Standard as noted and bear the Australian Standard's mark and manufacturer's SAA licence number.
3. Installed in an accessible position for means of operation and/or removal.
4. Of bronze material for valves up to and including 80mm diameter.
5. Of cast iron with bronze trim for valves of 100mm diameter and larger except where installed for hot water reticulation in which case the valve construction shall be all bronze.
6. Of screwed pattern with a union fitted to the outlet each side of valves up to and including 50mm diameter.
7. Of flanged bolted pattern for valves of 65mm diameter and larger.
8. Of non-rising spindle pattern, with clockwise closing.

## CONTROL VALVES - (COLD WATER SUPPLY)

Unless otherwise indicated control valves shall be:

1. Loose jumper valve type fitted with "O" ring seals to the spindle or ball valve with Teflon seals.
2. Approved by the Local Authority.
3. Manufactured and tested in conformity with AS 1718 - Water Supply - Copper Alloy Screw-Down Pattern Taps - Specified by Dimensions.
4. Constructed of materials and have the method of connection as specified before for gate valves.
5. Fitted with unions on each side of the valve for maintenance/removal. Alternatively one union can be deleted provided an approved screwed joint is substituted.

## REFLUX (CHECK) VALVE – WATER

Unless otherwise indicated reflux valves shall be:

1. Approved by Local Authority.
2. Manufactured and tested in conformity with AS 1628 - Water Supply - Copper Alloy Gate, Globe and Non-return Valves for valves up to and including 100mm diameter and AS 3578 Cast Iron Non-return Valves for General Purposes for valves larger than 100mm diameter.
3. Horizontal pattern with a gunmetal swing check fitted with limit stop to prevent sticking in the open position. [Have a non water hammer characteristic incorporating spring loaded bronze valve and seat].
4. Body fitted with screw headed inspection cap.
5. Constructed of materials and have the method of connection as specified before for Gate Valves.
6. Check valves on water services and rising mains 50mm diameter and over shall be spring loaded Duo Check valve manufacture with corrosion resistant components.

## BALL VALVES (NON SLAM BALL CHECK VALVES)

Unless otherwise indicated gas valves shall be:

1. Approved by Local Authority.
2. Suitable for oil, water and gas applications.
3. Manufactured and tested in conformity with AS-1271.
4. Be of brass or stainless steel body with stainless steel ball and teflon seat.

## TESTABLE BACKFLOW PREVENTION DEVICES

Backflow prevention devices shall be:

1. Comply with AS/NZS 3500 and Local Water Authority requirements
2. Body of all bronze construction
3. Fitted with incoming strainer
4. Provided with test cocks
5. Same size as incoming pipework
6. Rated for the class of hazard protection
7. Be of approved manufacture
8. Registered with local Authority on completion
9. Be selected for minimum head loss at design flow

## JOINTING MATERIALS

Allowable jointing materials are as follows:

Copper Tube

1. 15% silver solder and 6 mm lapped joints for pressure supply pipes.
2. 5% silver solder and 6 mm lapped joints for non-pressure applications.
3. Mechanical Victaulic couplings for diameters 100 mm & larger.

UPVC

1. Solvent weld cement as recommended by manufacturer and approved by authority. Rubber ring joints as recommended by manufacturer and approved by authority shall be used where pipework exists the building.

Stainless Steel Pipe

1. Joints shall be lapped and argon arc welded for sheet metal.
2. Victaulic jointing system for pressure piping.
3. Rubber ring push fit for drainage systems. HDPE
4. Electrofusion butt-welding or electrofusion socket welding.
5. Manufacturers proprietary jointing system with guarantee.

Flanges

1. 4mm thick reinforced rubber insertion or 3mm thick general purpose fibre gasket with nitrile binder.
2. Galvanized steel bolts for steel piping.
3. Bronze bolts for brass flanges.
4. Stainless steel bolts below ground.
5. Bolts fitted with nylon isolating sleeves and bushes.

**2.0 HYDRAULIC DESIGN AND INSTALL**

## HYDRAULIC SYSTEMS

* 1. **RESPONSIBILITIES**

### General

General: Provide the hydraulic services, as documented.

## DESIGN

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

### Hydraulic system design

General: Design and provide systems as documented.

* + - Cold water service
    - Heated water service
    - Water heater
    - Sanitary plumbing and drainage
    - Stormwater
    - Rainwater storage systems
    - LP Gas Maintenance:

Authority submissions: Make submissions (including notices) to authorities relating to the works.

Designer qualification: Use only appropriately experienced and qualified persons to undertake design work. If requested, provide documents verifying the qualification and experience.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

- *General requirements*.

## STANDARDS

### General

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

Copper pipe and fittings-installation and commissioning: To AS 4809. Gas: To AS/NZS 5601.1.

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

### Authorized products

Authorized products: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.

### Labelling

Water efficiency labelling: Provide products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* LPG: Liquefied petroleum gas.

### Definitions

General: For the purposes of this work section the following definitions apply:

* Hot-dip galvanized: Zinc coated to AS/NZS 4680 after fabrication with coating thickness and mass to AS/NZS 4680 Table 1.
* Network Utility Operator: The entity undertaking the piped distribution of drinking water or natural gas for supply or is the operator of a sewerage system or an external stormwater drainage system.

## SUBMISSIONS

### Authority approvals

Authority submissions: Make submissions (including notices) to authorities relating to the works.

### Certification

General: Submit evidence that proposed fixtures are listed in the WaterMark Product Database.

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

### Operation and maintenance manuals

Requirement: Submit recommendations for the operation, care and maintenance of replacement gas appliances, storage tanks, valves, regulators and their associated fittings.

### Products

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

### Shop drawings

Standard: To AS 1100.101, AS 1100.201, AS 1100.301, AS 1100.401 and AS/NZS 1100.501 as

applicable.

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

* Pipework and equipment layout and sections showing the work to be installed on 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.

. Site and floor set out points.

. Tank stands and supporting structures.

## INSPECTION

### Notice

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

* Excavated surfaces.
* Concealed or underground services.

## INSTALLATION

### Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating valves: In addition to valves required to meet statutory requirements, provide valves so that isolation of parts of the system for safe isolation of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

### Connections to Network Utility Operator mains

General: Excavate to locate and expose the connection points and connect to the Network Utility Operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

## PAINTING, FINISHES MARKING

### Finishes

General: Finish exposed piping, including fittings and supports, as follows:

* In internal locations such as toilet and kitchen areas: Chrome plate copper piping to AS 1192 service condition 2, bright.
* Externally and steel piping and iron fittings internally: Paint.
* In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.
* Valves: Finish valves to match connected piping.

## SANITARY FIXTURES

* 1. **RESPONSIBILITIES**

### General

General: Provide sanitary fixtures to comply with Water Approval and disable friendly.

## STANDARDS

### General

Design for access and mobility: AS 1428.1 and AS 1428.2.

## TAPWARE

* 1. **RESPONSIBILITIES**

### General

General: Provide tapware comply with Water Approval and disable friendly.

## STANDARDS

### General

Design for access and mobility: AS 1428.1 and AS 1428.2

## PRODUCTS

### Thermostatic mixing valves

Standard: To AS 4032.1.

Requirement: Provide thermostatic mixing valves that automatically control the temperature at the mixed outlet to a presealed temperature and suitable for the number of outlets served by the individual valve.

Controls: Include the following:

* A temperature sensitive automatic control that maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails, or if the normal discharge water temperature is exceeded.
* Hot water flush facility.

Wall box: House the thermostatic mixing valve in a stainless steel recessed wall box with a hinged door and keyed lock.

Field testing: To AS 4032.3.

## WATER HEATERS

* 1. **GENERAL**

### General

General: Provide water heaters, as documented.

## ELECTRIC STORAGE WATER HEATERS

### Description

General: Provide a proprietary automatic electrically heated water heater including connections, controls and necessary fittings.

### Standard

General: To AS/NZS 4692.1.

Energy performance: To AS/NZS 4692.2.

### Tariff

General: Install so that the heating system qualifies for the tariff concession or subsidy offered by the statutory authority.

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## STORMWATER – BUILDINGS

* 1. **GENERAL**

### General

General: Provide stormwater installation, as documented.

## STORMWATER DRAINS

### Location

General: Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or point of connection. Make sure that location of piping will not interfere with

other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

Downpipe connections: Turn up branch pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains.

### Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

### Pipe underlay (bedding)

General: Bed piping on a continuous underlay of bedding material, minimum 75 mm, maximum 150 mm thick after compaction. Grade the underlay evenly to the gradient of the pipeline.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

### Pipe surrounds

General: Place the material in the pipe surround in layers, maximum 200 mm loose thickness, and compact without damaging or displacing the piping.

### Anchor blocks

General: If necessary, to restrain lateral and axial movement of the stormwater pipes, provide reinforced concrete anchor blocks at junctions and changes of grade or direction conforming to AS/NZS 3500.3 clause 7.9.

### Thermal movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow movement. Make sure that movement does not strain branch connections.

## SUBSOIL DRAINS

### General

Requirement: Provide subsoil drains to intercept groundwater seepage and prevent water build-up behind walls and under floors and pavements. Connect subsoil drains to surface drains or to the stormwater drainage system as applicable.

Trench width: Minimum 450 mm.

Trench floor: Grade the trench floor evenly to the gradient of the pipeline. If the trench floor is rock, correct any irregularities with compacted bedding material.

Pipe depth: Provide the following minimum clear depths, measured to the crown of the pipe, below the following elements:

* Formation level of the pavement, kerb or channel: 100 mm.
* Average gradient of the bottom of footings: 100 mm.
* Finished surface of unpaved ground: 450 mm.

### Jointing

General: At junctions of subsoil pipes provide tees, couplings or adaptors to AS 2439.1.

### Pipe underlay (bedding)

General: Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Lay the pipe with one line of perforations at the bottom.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

### Pipe surrounds

General: Place the material in the pipe surround in layers, maximum 200 mm loose thickness, and compact without damaging or displacing the piping.

Depth of overlay:

* To the underside of the bases of overlying structures such as pavements, slabs and channels.
* To within 150 mm of the finished surface of unpaved or landscaped areas.

### Geotextiles

General: Provide polymeric fabric formed from plastic yarn composed of at least 85% by weight propylene, ethylene amide or vinylidene chloride and containing stabilisers or inhibitors which provide resistance to deterioration due to ultraviolet light.

Marking: To AS 3705.

Protection: Provide heavy duty protective covering. Store clear of the ground and out of direct sunlight. During installation, do not expose the filter fabric to sunlight for more than 14 days.

### Filter socks

General: Provide permeable polyester socks, capable of retaining particles 0.25 mm and greater. Securely fit or join the sock at each joint.

## PITS

### Finish to exposed surfaces

General: Provide a smooth, seamless finish, using steel trowelled render or concrete cast in steel forms.

Location: At junctions, changes of gradient and changes of direction of stormwater drains, as documented.

### Metal access covers and grates

Standard: To AS 3996.

Cover levels: Top of cover or grate, including frame:

* In paved areas: Flush with the paving surface.
* In landscaped areas: 25 mm above finished surface.
* Gratings taking surface water runoff: Locate to receive runoff without ponding.

## TESTING

### Pre-completion tests

General: Before backfilling or concealing, carry out the following tests to AS/NZS 3500.3 Section 9:

* Downpipes within buildings: Air or water pressure test.
* Site stormwater drains and main internal drains: Air or water pressure test.
* Rising mains from pumped discharge: Water pressure test . Leaks: If leaks are found, rectify and re-test.

## COMPLETION

### Cleaning

General: Clean and flush the whole installation.

## WASTEWATER

* 1. **GENERAL**

### General

General: Provide sanitary plumbing and drainage, as documented.

## SANITARY PLUMBING

### Location

General: Verify location and invert level of piping before commencing installation. Layout: Arrange piping to conform to the documented layouts as follows:

* Avoid interference with other services and building elements not yet installed or built.
* Follow the most direct route with the least number of changes of direction.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

### Discharge from air handling systems

Trays, sumps and plumbing: To AS/NZS 3666.1.

### Thermal movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow for movement. Make sure that movement does not strain branch connections.

### Vent pipes

Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide vent cowls of the same material as the vent pipe.

### Wet area floors

General: Where drainage connections pass through wet area floors, terminate 4 mm below the substrate surface.

## SANITARY DRAINAGE

### Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

## TESTS

### Pre-completion tests

Requirement: Test to AS/NZS 3500.2 Section 15, before backfilling or concealing. Leaks: If leaks are found, rectify and re-test.

## COMPLETION

### Cleaning

General: On completion clean and flush the whole installation.

## COLD AND HEATED WATER

* 1. **RESPONSIBILITIES**

### General

General: Provide cold water and heated water systems, as documented.

## PRODUCTS

### Backflow prevention devices

Standard: To AS/NZS 2845.1 and AS 2845.2.

### Water tanks

Cold water storage tanks: To ATS 5200.026. Materials: To AS/NZS 3500.1.

Polyethylene water tanks: To AS/NZS 4766.

Temperature: Do not exceed the rated service temperature of the tank material. Flywire: Provide plastic flywire covering to overflow and vent pipes.

### Water meters

Standard: To AS 3565.4.

Installation: To the requirements of the network utility operator.

## PIPING

### Location

Mains connection: Connect the cold water supply system to the Network Utility Operator's main through a stop valve and meter.

Cold water system: Provide the cold water supply system, installed from the meter to the draw-off points or connections to other services.

Heated water system: Provide the heated water system, installed from the cold water connection points to the draw-off points or connections to other services.

### Fittings and accessories

General: Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

Provision for dismantling: Arrange piping by the provision of unions or similar so that valves, taps and other maintainable components can be removed for maintenance without disturbing or cutting adjacent piping.

### Pipes under pressure embedded in concrete

General: Use only copper pipe and the minimum number of joints. Pressure test and rectify leaks before the concrete is poured.

## PIPING INSULATION

### General

Requirement: Insulate all non-chrome plated heated water piping, fittings and valves.

Application: Fit insulation tightly to piping surfaces without gaps. Close butt ends of insulation sections. Minimize number of joints. If the insulation is in half-sections, make only half-circumferential joints at any one place. Seal longitudinal seams in foil laminate and fix insulation at maximum 500 mm centres with polypropylene, zinc-coated steel or aluminium straps.

Unions and other items requiring service: Install the insulation so that it is readily removable.

Fittings: Provide insulation with thermal resistance at least equal to that of the adjacent piping insulation.

## TESTING

### Pre-completion tests

Pressure tests: Before insulation is applied to joints pressure test piping to AS/NZS 3500.1 and AS/NZS 3500.4 as appropriate.

Leaks: If found, rectify and re-test.

Cross connections: Isolate systems individually and check for cross connections. Backflow prevention: To AS/NZS 3500.1.

Tapware: Check for leaks.

### Completion test

General: Provide a full operational test to verify conformance.

## COMPLETION

### Commissioning

Strainers: Remove, clean and replace strainer baskets. Cleaning: To AS/NZS 3500.1 Appendix I.

Disinfection: Disinfect to AS/NZS 3500.1 Appendix J.

Cold water systems: Test and commission to AS/NZS 3500.1 Section 18. Heated water systems: Test and commission to AS/NZS 3500.4 Section 13.

Testable backflow prevention devices: Test and commission to AS 2845.3 by a licensed plumber with backflow device accreditation. Tag and certify to the requirements of the Network Utility Operator.

### Charging

Completion: On completion of installation, commissioning, testing and disinfection, fill the system with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

### Maintenance

Heated water systems: To AS/NZS 3500.4 Section 12 and AS/NZS 3666.2. Maintenance manuals: To AS/NZS 3666.2.

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## RAINWATER STORAGE SYSTEMS

* 1. **RESPONSIBILITIES**

### General

General: Provide rainwater storage systems and ancillaries, as documented.

## STANDARDS

### General

Metal tanks and rainwater goods: To AS/NZS 2179.1.

Design and installation: To the recommendations of SAA HB 230.

## SUBMISSIONS

### Warranties

Manufacturer's warranty: Submit the tank manufacturer's warranty naming the principal as warrantee. Include a copy of the warranty in the operation and maintenance manual.

## RAINWATER TANKS

### General

Requirement: Provide structurally sound and watertight tanks.

Openings: Designed to resist human load bearing forces and to prevent the inappropriate entry of humans, animals, insects surface water, ground water and rubbish.

Accessories: Provide the accessories needed to complete the installation. Include the following:

* Inlet and outlet connections.
* Floating outlet to draw water from the upper part of the tank.
* Tight fitting lids or screens with maximum 1 mm mesh at all openings.
* Flap valves at every opening to the tank.
* Calmed inlet to the tank to prevent stirring sediment.
* Overflow siphon to skim surface contaminants. Accessory materials: Select from:
* Ultraviolet light resistant plastic.
* Corrosion-resistant metal. Do not use copper or copper alloys with metallic coated steel tanks.
* The same material as the tank.

Access opening: Provide a vermin-proof, childproof access opening above the high water level and cover with either a strainer or a lid fixed securely to the tank.

### Warranties

Requirement: Provide a manufacturer’s warranty on the tanks.

### Tanks and accessories for potable water

Standard: If the tank is to contain potable water, conform to AS 2070 with testing of materials to AS/NZS 4020.

## POLYETHYLENE TANKS

### General

Standard: To AS/NZS 4766.

## COATED STEEL TANKS

### Roof

Type: Select from the following:

* + - Conical.
    - Flat and back propped internally with a tightly fitting length of PVC-U downpipe.

### Material

General: Conform to the following:

* + - Top and sides: Metallic-coated steel with polymer film to AS 2070 on the inside and prepainted on the outside.
    - Base: Metallic-coated steel with polymer film to AS 2070 on inside and outside.

## BLADDER TANKS

### General

Type: Proprietary plastic bladder type.

Material: Reinforced polymer conforming to AS 2070, resistant to puncture and microbial attack.

## FIRST FLUSH DIVERTER

### General

Requirement: Provide a first flush diverter. Arrange to drain completely. Sizing: Select for minimum 20 L/100 m2 rainwater catchment area.

Construction: Corrosion-resistant and compatible with the rainwater plumbing and tank. Discharge: Discharge waste water from the first flush diverter either:

* If permitted by the local authority, onto grassed areas away from tank and building footings.
* To the stormwater installation.

## RAINWATER FILTRATION

### Tank inlet

General: Provide an easily cleanable filter to treat rainwater before the entry to the tank. Mesh size: Maximum 1 mm.

### Tank outlet

Filtration and treatment: As documented.

Drinking water filters: To AS/NZS 3497 and the requirements of the statutory authorities having jurisdiction.

## PUMPS

### General

General: Provide pumps as documented.

## INSTALLATION

### General

Requirement: Provide structural support to withstand the mass of the tank when full without deformation or excessive settling.

Connecting piping: Support independently of the tank. Provide a 300 mm long section of reinforced flexible hose to prevent piping exerting a load on the tank.

Overflow: Pipe to discharge away from the tank.

Arrangement: Prevent the entry of sunlight to the interior of the tank.

## ABOVE GROUND TANK INSTALLATION

### General

Restraint: Restrain the tank to prevent movement, when empty, caused by wind and other loads.

Base: Provide a level base with gaps not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.

### Polyethylene tanks

Support: Trim and compact the ground and place a level bed of sand at least 50 mm thick.

### Coated steel tanks

Support: Fully support the tank on a self-draining timber or concrete base. Corrosion protection:

* Prevent contact with dissimilar metals.
* Arrange so that no part of the tank is below ground level and so that adjacent ground surfaces fall away from the tank.
* Do not use sharp objects inside the tank. Remove swarf with a magnet if drilling or cutting.

### Bladder tanks

Support: Locate on level base free from sharp objects. Install with manufacturer's supporting frame. Relief: Provide over-pressurising relief and air vent.

## COMMISSIONING

### General

Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

## MAINTENANCE

### Annual maintenance

Requirement: Provide the annual maintenance to SAA HB 230 Table 10.1 at the following times:

* + - If the defects liability period is less than 12 months: Within one month before the end of the end of the defects liability period.
    - If the defects liability period is 12 months or longer: Annually.

## HYDRANTS

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fire hydrant installations including water supply, piping, valves, hydrant valves, booster valve and suction points, as documented.

## AUTHORISED PRODUCTS

### General

Requirement: Provide equipment listed in the Antifire Register of Fire Protection Equipment.

## FIRE HYDRANT SYSTEMS

### General

System: To AS 2419.1.

## VALVES

### Isolating valves

Below-ground metal seated isolating valves: To AS/NZS 2638.1. Below-ground resilient seated isolating valves: To AS/NZS 2638.2. **Fire hydrant valves**

Standard: To AS 2419.2.

Requirement: Provide fire hydrant valves as follows:

* To the requirements of the local fire brigade.
* Copper alloy construction.
* Matching non-ferrous dust cap and chain. Valve monitors: To AS 4118.1.4.

Valve monitors: To AS 4118.1.4.

## INSTALLATION

### General

System: To AS 2419.1.

Valves: Locate valves to permit satisfactory operation and maintenance.

## COMMISSIONING

### General

System: To AS 2419.1.

Fire hydrant valves: To AS 2419.2.

### Baseline data

Requirement: Provide baseline data to AS 1851.

## HOSE REELS

* 1. **RESPONSIBILITIES**

### General

General: Provide hose reels, as documented.

## STANDARDS

### General

Design, construction and performance: To AS/NZS 1221. Installation: To AS 2441.

## FIRE HOSE REELS

### General

Standard: To AS/NZS 1221. Certification: Required.

Certification provider: An organization accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Type: Swivel hose guide.

## INSTALLATION

### Fire hose reels

Standard: To AS 2441.

Protection from damage: To AS 2441.

## COMMISSIONING

### General

Requirement: Test to verify conformance to AS 2441. Results: Submit commissioning and testing results.

### Baseline data

Requirement: Provide baseline data to AS 1851.

## MAINTENANCE

**Fire hose reels** General: To AS 1851. **Water conservation**

General: Conform to the recommendations of SAA HB 233.

**3.0 WATER HEATERS**

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**4.0 HYDRAULIC PUMPS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide pumps, minimum as per schedule in section 4 –selections.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.

## SUBMISSIONS

### Products

Type tests: Required. Standard: To AS 2417.

Accuracy of measurement: Grade 2 to AS 2417.

Type test records: Submit type test curves for each size and type of pump marked with the duty point prior to pump procurement.

## PRODUCTS

* 1. **COMPONENTS**

### General

General: Provide automatically controlled self-priming end-suction centrifugal pumps. Factory assemble the pump and motor on a common baseplate with mounting pads.

Noise and vibration: Minimize noise and vibration, using anti-vibration mountings and flexible couplings on both sides of the pump

### Control panels

General: Provide control panels to suit the controls. Mount switches, and indicating lights on the door. Mount motor starters, relays and switchgear and terminals on DIN rails inside the cabinet. Run cables in trunking or looms.

Labelling: Label all components. Number both ends of each cable and number terminal strips to match the circuit diagram. Provide a laminated circuit diagram inside the cabinet.

Metalwork: Vandal proof cabinet constructed from metallic zinc coated steel with powder coat finish. Provide a hinged and lockable door with 2 keys.

Protection: Degree of protection IP54 or better.

### Controls – dual pump installations

General: Provide controls to alternate the pumps after each cycle of operation, start the idle pump if the other fails, and activate an audible alarm and a flashing warning light to indicate a failure.

Alarm bells: Mount on an external wall. Provide alarm mute. Meters: Provide an hours-run meter to each motor.

Selector: Provide an auto-off-on selector for each pump.

Warning lights: Provide separate lights to indicate power available, run for each pump, fault for each pump and other faults.

### Float switches

Type: Micro switch. Provide one level switch for each liquid level to be detected.

Construction: Double encapsulated hermetic construction designed for long life submerged. Provide a clamp to permit accurate adjustment of levels.

Cable: Low moisture absorption type.

### Marking

General: Provide a robust label on each pump or pump set showing design flow rate, head, temperature of pumped medium, casing, impeller and shaft materials.

### Motors

Installation: To AS 60034.7.

Motors minimum 0.75 kW: Three phase, flange mounted. Overload protection: Provide each motor with overload protection. Performance:

* Efficiency: Motors documented as high efficiency to AS/NZS 1359.5 Section 3, all other motors to AS/NZS 1359.5 Section 2.
* Power factor at full rated output: Minimum 0.72 for single phase motors, minimum 0.83 for three phase motors.

Selection: Provide motors selected for the maximum number of starts per hour of the installed system and to provide efficient, non-overloading pumping sets.

Power rating: At least the maximum power required by the pump when projecting the system resistance curve to the maximum impeller size for the pump casing size.

Degree of protection: IP54 or better.

Shaft: If the impeller is mounted directly on the motor shaft use grade 416 stainless steel for the shaft.

### Pressure vessels

Standard: To AS 2971.

Type: Diaphragm pressure tanks of fabricated steel construction, epoxy coated on metal surfaces in contact with water. Precharge the tanks with air.

### Valves

Type: Long handle full flow female/female connection isolation valves and brass swing type check valves.

### Marking

General: Provide a robust label on each pump or pump set showing design flow rate, head, temperature of pumped medium, casing, impeller and shaft materials.

### Base frames

The package pump system has a common base frame. The pumps are secured to the base frame by bolts. The control cabinet is secured to the base frame by means of a stand.

## PRESSURE BOOSTER SYSTEM

### Pressure booster system

General: Provide 1 duty and 1 standby pump arrangement. Provide controls to alternate the pumps after each cycle of operation, start the idle pump if the other fails, and activate an audible alarm and a flashing warning light to indicate a failure.

Both pumps should be able to meet the duty flow and pressure for the most disadvantage fixture.

Construction: Factory assemble the units with pumps, pressure vessels, control panel and ancillaries on steel frames mounted on steel baseplates.

Controls: Provide a pressure switch to sense excessively low suction pressure, shut down the pumps and signal an alarm. Provide manual reset.

### Pressure gauges

General: Provide a pressure gauge to indicate the pressure at the inlet and outlet of the system.

## EXECUTION

* 1. **INSTALLATION**

### General

Supply and install all equipment necessary to operate the pumps specified under hydraulic services.

Allow for all control cabinets, mounting brackets, contactors, isolating and control switches, auxiliary switches, alarms, wiring between pump and panel and panel and level controls, connection of power supply into panel, and other associated equipment necessary for safe and effective operation of the pumps as required for the installation and in accordance with statutory requirements.

Contractors are to confirm the hazard zone classification of areas pumps and controls are to be installed and suitability of proposed pump system. Notify Superintendent of any discrepancies requiring determination prior to ordering pump equipment.

Where required, pump control panels shall be wired so that multiple installations can run in parallel when demand is high.

### Standards

Cold water service pumps: Install to AS/NZS 3500.1 Section 13.

### Connections

General: Packaged pump set come complete with steel base frame. Install base frame to concrete plinth with vibration mounts and screws.

### Vibration mounts

General: Provide corrosion-resistant anti-vibration installed under the base frame.

### Fixing

General: Fix package pump sets to the supporting structure. Use expanding shield anchors for concrete.

### Over Pressure Protection

Pumpsets and associated equipment are to be selected for their compatibility with the quality & temperature of water to be pumped and the pressure rating of pipework, valves and equipment installed on the system.

Where the rated pressure of pipes, valves and equipment would be exceeded by a combination of the pump shut off pressure and mains pressure or other head suction condition suitable protection is to be provided to the system to prevent the pressure rating of the system and components attached to the system. As a minimum an over pressure shut down switch is to be provided together with either & pressure sustaining valve or pressure relieve valve downstream of the pumpset. The discharge of water to relieve the pressure must be carried out in a manner that will not cause damage.

Provide a complete specification and drawings of pumps and control equipment prior to installation.

## COMPLETION

### Commissioning

General: Commission to the manufacturers' recommendations. Refer to commissioning plan in section 1.1

### Testing

General:

Arrange for testing of complete pumping units in the presence of Superintendent. Record the performance of tests carried out on pumps and pressure gauges, and submit to Superintendent before applying for Certificate of Practical Completion. Any defect in the pumping plant performance or inefficiency due to any cause whatsoever shall be made good without additional expense. Maintain the pumping units in proper working order during the maintenance period. Provide all calibrated testing instruments and other apparatus necessary for testing after the initial test to prove the technical performance guaranteed for the pump, the pump is to be then tested under working conditions. Pumping plant with a capacity less than the specified quantity against the maximum head due to pipeline characteristics or other cause, may be rejected.

Provide the following tests for each pump and pump set before the date for practical completion:

* Pump operation: Test for correct pump rotation and operation.
* Automatic changeover: Test changeover sequence under all operational combinations.
* Level controls: Operate pumps, measure levels and adjust if necessary.
* Safety controls: Simulate fault for each safety control.
* Alarms: Simulate alarm condition. Verify correct alarm raised.
* Motors: Measure motor current and adjust motor overloads to suit.
* Completion test: Provide a full operational test to verify compliance.

## MAINTENANCE MANUAL

Refer to section 10 for hydraulic services equipment maintenance.

## SELECTIONS

* 1. **SCHEDULES**

**Pump schedule as follows:**

|  |  |
| --- | --- |
| **Property** |  |
| Pump type | Horizontal Multi-stage |
| Make | Grundfos or equal approved |
| Control Panel | CU 323 |
| Liquid being pumped | Water |
| Number of pumps in system | 2 |
| Maximum fluid temperature (°C) | 60 |
| Minimum efficiency at duty point (%) | 55% |
| Impeller material | Stainless Steel |
| Casing material | Stainless Steel |

**Valves schedule as follows:**

|  |  |  |
| --- | --- | --- |
| **Property** |  |  |
| Valve type | Isolation Valves | Check Valves |
| Make | Bugatti or equal approved | Bugatti or equal approved |
| Connection | Female/Female threaded type | Female/Female threaded type |
| Body Type | Nickle plated | Brass swing check |

**Pressure Vessel schedule as follows:**

|  |  |
| --- | --- |
| **Property** |  |
| Vessel type | Diaphragm tank |
| Make | Grundfos or equal approved |
| Maximum Pressure | 1000kPa |
| Precharge Pressure | 400kPa |

**Float Switches schedule as follows:**

|  |  |
| --- | --- |
| **Property** |  |
| Switch protection | IP 68 @20m |
| Make | Matelec or equal approved |
| Liquid Temp. | Min. 0°C Max. 60°C |
| Switching angle | 25° from horizontal |

|  |  |
| --- | --- |
| **Property** |  |
| Cable Material and Size | Neoprene Rubber  6mm diameter / 3 x  7.5 sq.mm |

**5.0 STORMWATER – BUILDINGS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide stormwater installation and fittings as per schedule in Section 4.

Supply and install all necessary pipes, junctions, bends, inspection openings, excavation and sundry equipment to convey stormwater from the various downpipes to discharge points and rainwater tanks.

The location of pipes indicated on the drawings is diagrammatic. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate co-ordination of all services and elements. Co-ordination shall be carried out prior to any setting out, excavation and pipe installation takes place.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Service trenching*.
    - *Hydraulic systems*.
    - *Civil systems*.

## STANDARDS

### Stormwater drainage

Standard: To AS/NZS 3500.3.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Embedment material: Includes bedding, haunch support, side support and overlay material.
    - Pipe surround: Includes pipe overlay, pipe side support, side zone and haunch zone.

## SUBMISSIONS

### Tests

Pre-completion tests: Submit results from pre-completion leak testing. Certification: Submit certificate stating that network is leak free upon completion. **Warranties**

Detention tanks: Submit warranty.

## INSPECTION

### Notice

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

* + - Concealed or underground services prior to being covered.
    - Upon completion.

## PRODUCTS

* 1. **MATERIALS**

### Piping

Requirement: Provide gutters, downpipes and pipes to comply with AS/NZS 3500.3 PVC-U: Provide pipe marked *Best Environmental Practice* (BEP).

### Linear drains and grates

Requirement: Provide perimeter channel drainage effectively sized to discharge deck stormwater with downpipes.

Installation: Conform to manufacturer's recommendations.

### Rainwater outlets

Requirement: Provide proprietary rainwater outlets to roof. Size: 100 mm diameter or as documented.

### Concrete and mortar

Requirement: Provide concrete and mortar conforming to AS/NZS 3500.3 clause 2.9.

### Filter material

General: Provide filter materials consisting of natural clean washed sands and gravels and screened crushed rock conforming to AS/NZS 3500.3 clause 2.13.1.

### Embedment material

Stormwater drains: Conform to AS/NZS 3500.3 clause 6.3.5.1. Subsoil drains: Conform to AS/NZS 3500.3 clause 6.4.2.1.

## GEOTEXTILES

### General

Requirement: Provide polymeric fabric formed from plastic yarn composed of at least 85% by weight propylene, ethylene amide or vinylidene chloride and containing stabilizers or inhibitors which provide resistance to deterioration due to ultraviolet light.

### Subsoil drainage

Filter: Conform to AS/NZS 3500.3 clause 2.13.2.

## PREFABRICATED PITS

### General

Requirement: Provide precast or prefabricated pits in conformance with AS/NZS 3500.3 clauses

2.12.8 and 7.5.

### Metal access covers and grates

Standard: To AS 3996.

## EXECUTION

* 1. **PIPING**

### General

Laying: Lay lengths separately with the barrel bearing evenly on the prepared bedding. Sockets: Lay with sockets pointing upstream.

Cleaning: Clean pipe interior of dirt, debris, mortar and other foreign matter.

Protection: Provide temporary caps over the ends of incomplete sections to prevent the entry of foreign matter.

## TOLERANCES

**Pipeline tolerances table**

|  |  |  |
| --- | --- | --- |
|  | **Permissible angular deviation from alignment** | **Permissible displacement from alignment** |
| Horizontal | 1:300 | 15 mm |
| Vertical | 1:500 | 5 mm |
| Note: These tolerances are conditional on falls to outlets being maintained and no part of a pipeline having less than the documented gradient. | | |

## STORMWATER DRAINS

### Location

General: Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or point of connection. Make sure that location of piping will not interfere with other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.

Downpipe connections: Turn up branch pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains.

### Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

### Identification

General: Lay a detectable strip or plastic tape in the trench after pipe laying, testing and initial backfilling.

### Pipe underlay (bedding)

General: Bed piping on a continuous underlay of bedding material, minimum 75 mm, maximum 150 mm thick after compaction. Grade the underlay evenly to the gradient of the pipeline.

Chases: If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

### Pipe surrounds

General: Place the material in the pipe surround in layers, maximum 200 mm loose thickness, and compact without damaging or displacing the piping.

### Anchor blocks

General: If necessary, to restrain lateral and axial movement of the stormwater pipes, provide reinforced concrete anchor blocks at junctions and changes of grade or direction conforming to AS/NZS 3500.3 clause 7.9.

### Thermal movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow movement. Make sure that movement does not strain branch connections.

### Downpipes

Downpipe termination: Stop downpipe 100 mm above the ground level and discharged into grated pit. Do not connect directly into stormwater pipes.

## PITS

### Installation

General: Prepare foundation, install pit and connect pipes, to manufacturer’s recommendations.

Location: At junctions, changes of gradient and changes of direction of stormwater drains, as documented.

### Metal access covers and grates

Standard: To AS 3996.

Cover levels: Top of cover or grate, including frame:

* In paved areas: Flush with the paving surface.
* In landscaped areas: 25 mm above finished surface.
* Gratings taking surface water runoff: Locate to receive runoff without ponding.

## TESTING

### Pre-completion tests

General: Before backfilling or concealing, carry out the following tests to AS/NZS 3500.3 Section 9:

* + - Downpipes within buildings: Air or water pressure test.
    - Site stormwater drains and main internal drains: Air or water pressure test.
    - Rising mains from pumped discharge: Water pressure test Leaks: If leaks are found, rectify and re-test.

## COMPLETION

### Cleaning

General: Clean and flush the whole installation.

### Commissioning

Testing and commissioning of the stormwater drainage system shall follow the commissioning plan as provided in Section 1.1 and conducted as per AS/NZS 3500.3.

## SELECTIONS

* 1. **STORMWATER**

### Stormwater pipeline schedule:

Approved water mark materials, UPVC pipes and fittings. Gutter schedule:

Eaves gutter: type round gutter

**6.0 WASTEWATER**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide wastewater drainage installation and fittings as per schedule in Section 4.

Supply and install all sewer drainage from soil and wastes and fixtures to discharge to sewer manholes provided around the site. Provide all necessary pipes, junctions, bends, pits, floor wastes, excavation, supports, and backfilling, testing and sundry equipment required for the installation. The location of pipelines indicated on the drawings is diagrammatic. Pipeline positions shall be determined on site in conjunction with all other disciplines to ensure adequate co-ordination of all services and elements. Co-ordination shall be carried out prior to any setting out, excavation and pipe installation taking place.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Service trenching*.
    - *Hydraulic systems*.
    - *Civil systems*.

## STANDARDS

### Authorized products

Standard: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.

### Sanitary plumbing and sanitary drainage

General: To AS/NZS 3500.2.

## SUBMISSIONS

### Certification

General: Submit evidence that proposed tapware is listed in the WaterMark Product Database.

## INSPECTION

### Notice

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

* + - Excavated surfaces.
    - Concealed or underground services.
    - Testing and commissioning of the wastewater drainage shall follow the commissioning plan as provided in Section 1.1 and conducted as per AS/NZS 3500.2.

## PRODUCTS

* 1. **SEWAGE TREATMENT**

### Septic tanks

Standard: To AS/NZS 1546.1. Certification: Required.

Certification provider: An organization accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

## TRAPS AND GULLIES

### General

Traps: Provide waste traps ‘S’ type or ‘P” type for all fixtures to maintain water seal. Location: If possible, conceal traps and wastes in the fabric of the building.

Gullies: Provide gullies for the washroom to be charged by hand basin. Minimum size for the floor waste gullies to be 100 round grate with 100 riser and 100 waste trap.

## EXECUTION

* 1. **SANITARY PLUMBING**

### Location

General: Verify location and invert level of piping before commencing installation. Layout: Arrange piping to conform to the documented layouts as follows:

* + - Avoid interference with other services and building elements not yet installed or built.
    - Follow the most direct route with the least number of changes of direction.

Ducts: If installed in ducts, locate and fix stacks, wastes and pipes independently of other services. Arrange so they are easily accessible and removable throughout their entire length.

### Discharge from air handling systems

Trays, sumps and plumbing: To AS/NZS 3666.1.

### Thermal movement

General: Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints in copper and plastic pipes where pipe flexibility does not allow for movement. Make sure that movement does not strain branch connections.

### Vent pipes

Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide vent cowls of the same material as the vent pipe.

### Wet area floors

General: Where drainage connections pass through wet area floors, terminate 4 mm below the substrate surface.

### Tundish

Install tundish below sink bench level and connect to the sink drainage. Air gap shall be provided for connection of condensate discharge over tundish.

### Air Admittance Valve

Install air admittance valve for each hand basin and sinks to allow for relief of foul air and to maintain fixture water seal.

### Inspection Opening / Clear outs

Install inspection openings in accessible locations so that each section of pipework can be cleaned. Inspection opening sizes shall be in accordance with authorities' requirements. Install bolted testing gates on all stacks at each floor level, at each stack's base and on all relief vents at each alternate floor.

### Overflow Relief Gullies

Install an overflow gully to provide a safe release from the connection point. Gully shall be constructed of 100mm diameter "P" trap and 100mm riser. Top of riser shall incorporate a pop up grate with concrete surround.

### Fixtures and Fittings

Install plumbing fixtures as required under the plumbing fixture schedule. All installation shall be conducted as per code requirements and good workmanship. Final fixture connection shall be via flexible connection to fixtures and angle inlet outlet connection.

## SANITARY DRAINAGE

### Laying

General: Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous, cap open ends to prevent entry of foreign matter.

Piping: As documented in the Provide UPVC pipe for drainage and vents comply to AS/NZS 1260.

### Pipeline identification

General: Lay detectable plastic warning tape, 300 mm above buried piping, for the full length of the piping.

## PIPING

### Finishes

General: Finish exposed piping, including fittings and supports, as follows:

* + - In internal locations such as toilet and kitchen areas: Chrome plate copper piping to AS 1192 service condition 2, bright.
    - Externally, and steel piping and iron fittings internally: Paint.
    - In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

### Supports

General: As documented in the **Pipe support schedule**. **Pipeline tolerances table**

|  |  |  |
| --- | --- | --- |
|  | **Permissible angular deviation from alignment** | **Permissible displacement from alignment** |
| Horizontal | 1:300 | 15 mm |
| Vertical | 1:500 | 5 mm |

### Grease Trap

General: Provide minimum 1000 liters grease trap for the kitchens.

* + - Piping: Provide HDPE pipe and fittings drainage for the grease trap from each kitchen sinks.
    - Install grease trap below ground as per manufacturer’s recommendation.

## TESTS

### Pre-completion tests

Requirement: Test to AS/NZS 3500.2 Section 15, before backfilling or concealing. Leaks: If leaks are found, rectify and re-test.

All products part of the drainage system including pipe and fittings shall be tested and report provided.

Testing and commissioning of the wastewater drainage shall follow the commissioning plan as provided in Section 1.1 and conducted as per AS/NZS 3500.2.

## COMPLETION

### Cleaning

General: On completion clean and flush the whole installation.

All products installed including pipe and fittings in the waste water drainage shall be cleaned and flushed prior to handing over to the client.

## SELECTIONS

* 1. **WASTEWATER**

Approved water mark materials, UPVC pipes and fittings.

Traps schedule as marley (or equal approved) ∅100 stainless steel round grate, ∅100 riser, ∅100 4- way boss junction, ∅100 trap. floor gully to be complete with strainer basket.

Overflow Relief Gullies 100mm diameter "P" trap and 100mm riser. Top of riser shall incorporate a pop up grate with concrete surround.

Grease Trap schedule as Halgan modular grease trap mgt 1000 liters inground class b lid. c/cw inlet, outlet and vent.

Tundish schedule as galvin concrete 100mm conical copper tundish (or equal approved) c/w fittings and 40mm outlet.

**7.0 COLD AND HOT WATER**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide cold water and hot water systems, as documented.

Supply and install a complete cold water and hot water system from the authority's main to all fixtures, fittings and faucets requiring domestic cold water. Include for all pipework, tanks, bends, offsets, brackets, pumps, filters, hot water boiling units, backflow prevention, taps and faucets and sundry equipment required for the installation. Carry out all shoring and backfilling as required.

Negotiate with SWA for the supply of all meters, complete with all valves and fittings required.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.
    - *Fire system*
    - *Service trenching*
    - *Civil systems*

## STANDARDS

### General

Water supply: To AS/NZS 3500.1. Heated water supply: To AS/NZS 3500.4.

Backflow prevention: To AS/NZS 2845.1 and AS 2845.2. Copper pipe: To AS 1432 and AS 4809.

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

### Authorized products

Standard: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.

### Installation of glass wool and rock wool insulation

General: Conform to the ICANZ *Industry code of practice for safe use of glass wool and rock wool insulation*.

Marking: Deliver mineral wool products to site in packaging labelled FBS1 BIO-SOLUBLE INSULATION.

### Labelling

Water efficiency labelling: Provide only products conforming to and labelled to the Water Efficiency Labelling Scheme (WELS).

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Material R-Value: The thermal resistance (m2.K/W) of a component calculated in conformance with AS/NZS 4859.1 clause 2.3.3.8. Material R-Value does not include air space or surface resistances.

## SUBMISSIONS

### Certification

WaterMark certification: Submit evidence that proposed components are listed in the WaterMark Product Database.

### Fire hazard properties

General: Submit evidence of conformance with **MATERIALS**, **Fire hazard properties.**

### Materials

Thermal insulation performance: Submit evidence of conformance to AS/NZS 4859.1.

### Samples

General: Submit samples of accessories identified by proprietary item, including the following:

* Valves.
* Instruments, including gauges and thermostats.

## INSPECTION

### Notice

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

* + - Excavated surfaces.
    - Concealed or underground services.

## PRODUCTS

* 1. **COMPONENTS**

### Pressure control valves

General: Provide reduction valves, pressure limiting valves, or ratio valves, which produce the necessary reduction in pressure.

### Backflow prevention devices

General: Provide RPZD to comply with the Samoa Water Authority Requirements. Standard: To AS/NZS 2845.1 and AS 2845.2.

### Line strainers

Type: Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, corrosion-resistant stainless steel, or monel.

Screen perforations: 0.8 mm maximum.

### Pressure gauges

General: Provide gauges with full scale reading in kPa, a minimum nominal diameter of 63 mm and with a full scale value between 130% and 200% of the working pressure.

Bourdon tube gauges: To AS 1349. Accuracy grade: Industrial.

Installation: Comply with the recommendations of AS 1349 Appendix B. Isolate from pump pulsations and provide with a gauge cock.

### Water tanks

Cold water storage tanks: To ATS 5200.026. Materials: To AS/NZS 3500.1.

Polyethylene water tanks: To AS/NZS 4766.

Temperature: Do not exceed the rated service temperature of the tank material. Flywire: Provide plastic flywire covering to overflow and vent pipes.

### Water meters

Standard: To AS 3565.4.

Installation: To the requirements of the Samoa Water Authority.

## MATERIALS

### Cold Water

Pipes and fittings used in the installation shall be selected from the following and as specified under materials section.

### Domestic Cold Water Main to Meter

* *Copper Tube (CU)*

### Domestic Cold Water System

Main Supply Piping 32mm to 150mm

* Copper Tube (CU)

### Domestic Cold Water System

Branch Supply Piping 15m to 25mm may be any of the following;

* Copper Tube (CU)
* Polybutelyne (PB)
* Cross Linked Polyethylene (XPE) Refer to jointing under materials.

The design documents have been produced and the system sized, based on the use of copper tube with a maximum flow velocity of 1.5 metres per second. If another pipe type is the selected alternative, then flow rates equivalent to the nominated sizes of copper tube shall be maintained at a velocity not exceeding 2.0 metres per second.

Refer to AS3500 for equivalent pipe sizes.

Any proposal to install pipes with reduced internal diameters shall be accompanied by detailed support calculation.

All jointing systems shall comply with relevant clauses under jointing, recommended by the pipe manufacturer and is approved by the Authority.

Installation procedures must comply with Manufacturers recommendations and Authorities requirements.

### Fire hazard properties

Spread-of-flame index: Maximum 9 where tested to AS/NZS 1530.3.

Smoke-developed index: Maximum 8 if spread-of-flame is over 5, when tested to AS/NZS 1530.3. Flammability index of facing materials: Maximum 5 when tested to AS 1530.2.

Materials with reflective foil facing: Test to AS/NZS 1530.3 clause A6.

## INSULATION MATERIALS

### General

Standard: To AS/NZS 4859.1.

Material R-Value of insulation: ≥ Total R-Value in AS/NZS 3500.4 for the type and location of the pipe.

### Polyolefin foam

Type: Closed cell cross-linked polyolefin foam produced using a hydrocarbon blowing agent. Insulation surface facing: Heat-bonded aluminium foil laminate.

### Glass wool and rock wool and polyester

Description: Select from the following:

* Glass wool or rock wool resin-bonded to form tubular sections.
* Polyester in moulded tubular sections.

### Adhesives and sealants

Requirement: Provide adhesives and sealants to manufacturer's recommendations.

## EXECUTION

* 1. **VALVES AND PIPE**

### Location

Mains connection: Connect the cold water supply system to the SWA mains through a stop valve, backflow prevention device and water meter.

Cold water system: Provide the cold water supply system, installed from the meter to the draw-off points or connections to other services as documented in the **drawings**.

### Finishes

General: Finish exposed piping, including fittings, cover plates and supports, as follows:

* Chrome plate copper piping to AS 1192 service condition 2, bright in internal locations such as toilet and kitchen areas:
* Paint external above ground piping, and internal steel piping and iron fittings exposed to view.
* In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces): Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.
* Valves: Finish valves to match connected piping.

### Fittings and accessories

General: Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, pressure and temperature control devices, strainers, gauges and automatic controls and alarms.

Provision for dismantling: Arrange piping by the provision of unions or similar so that valves, taps and other maintainable components can be removed for maintenance without disturbing or cutting adjacent piping.

### Material identification marks

General: Pipes with grade or class identification markings: Install so that the markings are visible for inspection.

### Pipes under pressure embedded in concrete

General: Use only copper pipe and the minimum number of joints. Pressure test and rectify leaks before the concrete is poured.

### Valve spindles

General: If practicable, install valve spindles in a vertical position.

## PIPING INSULATION

### General

Requirement: Insulate all non-chrome plated heated water piping, fittings and valves.

Application: Fit insulation tightly to piping surfaces without gaps. Close butt ends of insulation sections. Minimize number of joints. If the insulation is in half-sections, make only half-circumferential joints at any one place. Seal longitudinal seams in foil laminate and fix insulation at maximum 500 mm centres with polypropylene, zinc-coated steel or aluminium straps.

Unions and other items requiring service: Install the insulation so that it is readily removable.

Fittings: Provide insulation with thermal resistance at least equal to that of the adjacent piping insulation.

### Insulation material

General: Provide insulation material as documented.

### Elastomeric foam insulation

Adhesives: Adhesive fix all longitudinal and butt joints. Adhere to the pipe at end joints, for a distance of 25 mm, to compartmentalize each section. Use only solvent-based adhesive supplied by insulation manufacturer and designed specifically for the material being used.

### Sheathing

General: Provide metal sheathing to all piping insulation:

* In plant rooms.
* Where exposed to weather.
* Where exposed to view.
* Where subject to mechanical damage.
* On valves, pipeline components and pumps in sheathed piping.

Metal sheathing: Cover piping with 0.5 mm thick metallic-coated steel sheet sheathing sprung over the insulation in one piece with laps at least 30 mm wide, and fastened with self-tapping screws or snap head rivets at 150 mm maximum centres. Preform the sheathing to match the shape of the insulated pipe and fittings. Position laps to avoid water penetration. In external locations weatherproof the joints and fixings using non-setting mastic.

Alternative protection for elastomeric foam: Where exposed to sunlight but not exposed to mechanical damage, provide 2 coats of tintable, water-based, rubberised, UV resistant, flexible paint finish to outdoor installations.

### Surface preparation

General: Clean the surfaces to remove scale, rust, grease and dirt and prepare surfaces to suit the insulation. Restore surface coatings, which have been damaged or affected by welding.

### Insulation at pipe supports

General: Provide supports formed to fit around the insulation. Pipes under DN 25: Either:

* Fit supports directly to pipe and form insulation around the support.
* Support as for pipes DN 25 or over. Pipes DN 25 or over: Either:
* Protect the insulation at the support point with metal sheathing extending sufficient distance both sides of the support so the insulation thickness is reduced by less than 10%.
* Replace the insulation at the support point with a shaped timber or cork spacer block. Butt the insulation up to the spacer block and seal with silicone compound. Clad the block and insulation in

0.5 mm metallic-coated steel sheet extending 100 mm both sides of the support.

### Insulation of buried pipes

Insulation material: Elastomeric foam certified by the manufacturer as suitable for use direct buried in- ground.

Sealing: Seal all but joints and longitudinal joints and seams with the insulation manufacturer's recommended adhesive. Seal the insulation to the pipe at both ends and each termination.

Valves and fittings: Insulate and seal as for pipe. Install valves in pits. Protection: Protect the pipe from water penetration. Select from:

* Use of insulation material with integral polymeric coating to protect from mechanical damage, water penetration and the growth of bacteria, mould and mildew.
* Application of high density rubber sheathing supplied by the insulation manufacturer and certified for use underground.

Sleeving: Install the insulated pipe in a PVC-U soil pipe. If the water table may be above the sleeve pipe, seal all joints watertight. If the water table is permanently below the sleeve pipe, provide 10 mm drain holes at 600 mm centres along the bottom centre of the sleeve pipe.

### Insulation of piping to solar water heating systems

Standard: AS/NZS 2712.

Insulation material: Insulate flow and return piping between solar collectors and storage vessels as follows:

* Material temperature rating: Minimum 150°C.
* Protection: Protected against ultra violet light mechanical damage, water penetration and the growth of bacteria, mould and mildew.

Sealing: Seal all but joints and longitudinal joints and seams with the insulation manufacturer's recommended adhesive. Seal the insulation to the pipe at both ends and each termination.

## PITS

### General

General: Install below-ground water meters, stop valves and control valves in concrete access pits with removable pit covers.

### Construction

Internal dimensions: To give 300 mm clear space all around the fittings in the pit. Concrete: Grade N20 to AS 1379, 100 mm thick, reinforced with F82 fabric.

Pit covers: To AS 3996.

### Installation

General: Grade floor to a point on one side and drain to the stormwater drainage system. Carry the pit walls up to 50 mm above finished ground level. Cast in the pit cover frame flush with the top. Trowel the top smooth.

## MARKING

### Notice plate

General: Provide a notice plate containing condensed emergency instructions, legibly printed or engraved on durable material resistant to defacement, at least 3 mm thick or mounted on board at least 3 mm thick, permanently fixed in a convenient position at the control valves.

## VALVE BOXES

### General

General: Provide cast-iron valve boxes with removable covers for access to underground gate valves. Provide cast-iron sluice valve covers for access to sluice valves.

### Installation

General: Set beneath each box a shaft formed of PVC-U pipe to give clear access to the valve wheel or spindle. Set top flush with pavement surface, or 15 mm above unpaved surfaces, and encase in formed concrete box 150 mm thick, with top surface trowelled smooth.

## TESTING

### Pre-completion tests

Pressure tests: Before insulation is applied to joints pressure test piping to AS/NZS 3500.1 and AS/NZS 3500.4 as appropriate.

Leaks: If found, rectify and re-test.

Cross connections: Isolate systems individually and check for cross connections. Backflow prevention: To AS/NZS 3500.1.

Tapware: Check for leaks.

### Completion test

General: Provide a full operational test to verify conformance.

## COMPLETION

### Commissioning

Testing and commissioning of the cold and hot water shall follow the commissioning plan as provided in Section 1.1 and conducted as per AS/NZS 3500.1 and AS/NZS 3500.4.

Strainers: Remove, clean and replace strainer baskets.

Testable backflow prevention devices: Test and commission to AS 2845.3 by a licensed plumber with backflow device accreditation. Tag and certify to the requirements of the SWA.

### Charging

Completion: On completion of installation, commissioning, testing and disinfection, fill the system with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

### Maintenance manuals

Refer to section 10 reference Hydraulic Maintenance.

## MAINTENANCE

### General

Requirement: Conform to the *Hydraulic maintenance* work section.

## SELECTIONS

* 1. **COLD AND HOT WATER**

### Water Meter

∅100 water meter (or equal approved) c/w pulse output for BMS. Installation of water meter as per Samoa Water Authority requirements. Watts (or equal approved) reduced pressure zone device c/w strainer.

### Water Pumps

Refer to Section 2 reference Hydraulic Pumps Schedules.

### Water Filters

1 No. Sbs-d series 20" filter cartridge 20 micron filter pure coarse filter or equal approved. 1 No. Sbs-d series 20" filter cartridge 5 micron filter pure coarse filter or equal approved.

1 No. Davey steriflo uv130-40 uv filter at single phase 240v or equal approved to be c/w control panel and uv lamp

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Supply and install a complete LP gas system from the main cylinders to both kitchens. Include for all

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**9.0 RAINWATER STORAGE SYSTEMS**

## GENERAL

* 1. **CROSS REFERENCES**

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.

## STANDARDS

### General

Stormwater drainage: To AS/NZS 3500.3. Rainwater supply: To AS/NZS 3500.1.

Metal tanks and rainwater goods: To AS/NZS 2179.1.

Design and installation: To the recommendations of SAA HB 230.

### Authorized products

Standard: Listed in the WaterMark Product Database, unless otherwise required by the Network Utility Operator.

Tanks: To ATS 5200.026.

Tank marking: Display the WaterMark symbol and other marking required by ATS 5200.026.

## SUBMISSIONS

### Warranties

Manufacturer's warranty: Submit the tank manufacturer's warranty naming the principal as warrantee. Include a copy of the warranty in the operation and maintenance manual.

## PRODUCTS

* 1. **RAINWATER TANKS**

### General

Requirement: Provide structurally sound and watertight tanks.

Openings: Designed to resist human load bearing forces and to prevent the inappropriate entry of humans, animals, insects surface water, ground water and rubbish.

Accessories: Provide the accessories needed to complete the installation. Include the following:

* Inlet and outlet connections.
* Floating outlet to draw water from the upper part of the tank.
* Tight fitting lids or screens with maximum 1 mm mesh at all openings.
* Flap valves at every opening to the tank.
* Calmed inlet to the tank to prevent stirring sediment.
* Overflow siphon to skim surface contaminants. Accessory materials: Select from:
* Ultraviolet light resistant plastic.
* Corrosion-resistant metal. Do not use copper or copper alloys with metallic coated steel tanks.
* The same material as the tank.

Access opening: Provide a vermin-proof, childproof access opening above the high water level and cover with either a strainer or a lid fixed securely to the tank.

### Warranties

Requirement: Provide a manufacturer’s warranty on the tanks.

### Tanks and accessories for potable water

Standard: If the tank is to contain potable water, conform to AS 2070 with testing of materials to AS/NZS 4020.

### Underground tanks

General: Provide tanks designed for installation underground and to withstand the anticipated loading from above and to prevent the entry of ground and surface water.

Separation from waste treatment installations: To AS/NZS 1547.

### Connections

General: Reinforce the tank wall to resist loads imposed by the connected piping. Outlet size:

* Tanks ≤ 6600 L: 20 mm minimum.
* Tanks > 6600 L: 25 mm minimum.

Overflow: Sized to handle not less than the maximum rate of rainwater inflow.

## POLYETHYLENE TANKS

### General

Standard: To AS/NZS 4766.

## COATED STEEL TANKS

### Roof

Type: Select from the following:

* + - Conical.
    - Flat and back propped internally with a tightly fitting length of PVC-U downpipe.

### Material

General: Conform to the following:

* + - Top and sides: Metallic-coated steel with polymer film to AS 2070 on the inside and prepainted on the outside.
    - Base: Metallic-coated steel with polymer film to AS 2070 on inside and outside.
    - Corrugated steel sheet: To AS 1445.

### Coated steel tanks material table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Minimum base metal thickness (mm)** | | **Steel grade to AS 1397** | **Coating class to AS 1397** | **Profile/Pitch x no. of corrugations** |
| **≤ 3 m diameter or ≤ 17 000 L** | **> 3 m diameter or > 17 000 L** |
| Base | 0.6 | 0.8 | G 300 | Z 275 or  AZ 150 | Flat |
| Walls | 0.6 | 0.8 | G 300 | Z 600 or AZ 200 | 76 x 8 |
| Top | 0.6 | 0.6 | G 300 | Z 275 | Flat |
|  |  |  |  | AZ 150 | Conical |

**Jointing**

General: Conform to the recommendations of the metallic-coated steel manufacturer.

## REINFORCED CONCRETE TANKS

### General

Type: Precast or in situ. Standard: To AS 3735.

Design and certification of construction: By a professional engineer.

## FIRST FLUSH DIVERTER

### General

Requirement: Provide a first flush diverter. Arrange to drain completely. Sizing: Select for minimum 20 L/100 m2 rainwater catchment area.

Construction: Corrosion-resistant and compatible with the rainwater plumbing and tank. Discharge: Discharge waste water from the first flush diverter either:

* If permitted by the local authority, onto grassed areas away from tank and building footings.
* To the stormwater installation.

## RAINWATER FILTRATION

### Tank inlet

General: Provide an easily cleanable filter to treat rainwater before the entry to the tank. Mesh size: Maximum 1 mm.

### Tank outlet

Filtration and treatment: As documented.

Drinking water filters: To AS/NZS 3497 and the requirements of the statutory authorities having jurisdiction.

## EXECUTION

* 1. **INSTALLATION**

### General

Requirement: Provide structural support to withstand the mass of the tank when full without deformation or excessive settling.

Connecting piping: Support independently of the tank. Provide a 300 mm long section of reinforced flexible hose to prevent piping exerting a load on the tank.

Overflow: Pipe to discharge away from the tank.

Arrangement: Prevent the entry of sunlight to the interior of the tank.

### Backflow prevention

Standard: To AS/NZS 3500.1 and the requirements of the Network Utility Operator.

Requirement: Prevent backflow from the rainwater storage system to other potable water supplies.

## ABOVE GROUND TANK INSTALLATION

### General

Restraint: Restrain the tank to prevent movement, when empty, caused by wind and other loads.

Base: Provide a level base with gaps not exceeding 10 mm, free of sharp projections and projecting beyond the edge of the tank at all points.

### Polyethylene tanks

Support: Trim and compact the ground and place a level bed of sand at least 50 mm thick.

### Coated steel tanks

Support: Fully support the tank on a self-draining timber or concrete base. Corrosion protection:

* Prevent contact with dissimilar metals.
* Arrange so that no part of the tank is below ground level and so that adjacent ground surfaces fall away from the tank.
* Do not use sharp objects inside the tank. Remove swarf with a magnet if drilling or cutting.

### Reinforced concrete tanks

Support: Trim and compact the ground.

### Bladder tanks

Support: Locate on level base free from sharp objects. Install with manufacturer's supporting frame. Relief: Provide over-pressurizing relief and air vent.

## UNDERGROUND TANK INSTALLATION

### General

Access: Arrange to permit easy inspection, cleaning and draining.

Sealing: Prevent the entry of groundwater, surface run-off and other contaminants. Prevent entry of stormwater surcharge via the tank overflow.

Access openings: Lockable, 150 to 450 mm diameter. Unless watertight, locate openings 150 mm above finished surface level. Conform to Work health and Safety requirements.

External pressure: Prevent superimposed external pressure exceeding 0.25 m head of water (2.5 kPa) above the manufacturer's maximum recommended fill level.

### Excavation and backfilling

General: Keep excavations free of surface water. After placing the tank, backfill with sand.

### Sand backfilling

Type: Chemically inert sand, free from foreign matter such as salt, organic matter and clay lumps, and graded.

Placing: Place sand backfilling in layers not more than 200 mm thick.

### Ballasting

General: If ballasting is necessary to prevent flotation, fill the tank with water before backfilling and provide a concrete ballast collar.

## MARKING

### General

Labelling: If rainwater is not treated to potable quality, label rainwater piping and outlets to AS/NZS 3500.1.

## COMMISSIONING

### General

Cleaning: Flush the rainwater system. Wash and flush tanks to remove manufacturing and other contaminants.

## MAINTENANCE

### General

Requirement: Conform to the *Hydraulic maintenance* work section.

**10.0 HYDRAULIC ELECTRICAL - MINOR**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide hydraulic electrical installations, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.
    - *Electrical System*

## ELECTRICAL ACCESSORIES

### General

Responsibilities: Provide accessories as documented.

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

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

Default finish: Select from the manufacturers standard range.

## LOW VOLTAGE POWER SYSTEMS

* 1. **GENERAL**

### Standards

Electrical systems: To AS/NZS 3000 and SAA HB 301. Selection of cables: AS/NZS 3008.1.1.

Degrees of protection (IP code): To AS 60529. Electromagnetic compatibility (EMC): To AS/NZS 61000.

Telecommunications systems: To AS/CA S008, AS/CA S009 and AS/NZS 3080.

## PRODUCTS

### Wiring systems

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

### Power cables

Standard: Polymeric cables to AS/NZS 5000.1. Cable: Use multi-stranded copper cable generally. Default insulation: V.75.

Default sheathing: 4V.75. Minimum size:

* Power sub-circuits: 2.5 mm2.
* Sub-mains: 6 mm2.

## EXECUTION

### Power cables

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

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

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

Marking: Identify the origin of all wiring by means of legible indelible marking. Cable 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-U conduit.

## CABLE SUPPORT AND DUCT SYSTEMS

* 1. **GENERAL**

### Standards

Cable trunking systems: To AS/NZS 4296.

Conduits and fittings for electrical installations:

To AS/NZS 2053.3, AS/NZS 61386.1, AS/NZS 61386.21, AS/NZS 61386.22 and AS/NZS 61386.23.

## PRODUCTS

### Non-metallic conduits and fittings

Standards: To AS/NZS 2053.3, AS/NZS 61386.21, AS/NZS 61386.22 or AS/NZS 61386.23.

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

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

### Ducted wiring enclosures

Ducting: Provide purpose-made ducts. Provide rigid supports. Round off sharp edges and provide bushed or proprietary cable entries into metallic ducting.

Accessories: Provide purpose-made accessories and covers to match the duct system. Provide screw- fixed covers or clip-on covers removable only with the use of tools.

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

## EXECUTION

### Unsheathed cables – installation

General: Provide permanently fixed enclosure systems, assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or provide ducts with removable covers.

### Conduit systems – installation

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

Conduits in roof spaces: Locate below roof insulation and sarking. In accessible roof spaces, provide mechanical protection for light-duty conduits.

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

## SWITCHBOARDS

* 1. **GENERAL**

### Standards

Standards: To AS/NZS 3439.3.

## PRODUCTS

### General

Busbars: Incorporate proprietary busbar systems for the interconnection of isolators, circuit breakers and other circuit protection devices.

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

IP rating:

* Weatherproof: IP56 minimum.
* Variable speed drives: IP54.
* Otherwise: IP42 minimum. Separation: Form 1.

Supporting structure: Wall mounted for proprietary switchboards. Floor mounted: Assemblies over 2 m2.

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

## SWITCHBOARD COMPONENTS

* 1. **PRODUCTS**

### General

Rated duty: Uninterrupted in non-ventilated enclosure.

Rated making capacity (peak): Minimum 2.1 x fault level (r.m.s.) at assembly incoming terminals. Utilization category: To AS/NZS IEC 60947.1 clause 4.4.

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

Coordination: Select and adjust protective devices to discriminate under over-current and earth faults.

### Switch-isolator units

Standard: To AS/NZS IEC 60947.1 and AS/NZS 3947.3.

### Moulded case and miniature circuit breakers

Moulded case breakers: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.2. Miniature circuit breakers: To AS/NZS 60898.1 or AS/NZS 3111.

Operation: Independent manual operation including positive ON/OFF indicator. Trip type: Conform to the following:

* Moulded case breakers: Required.

Miniature circuit breakers: Fixed thermal, fixed magnetic. Isolation facility: Required.

Current limiting: Conform to the following:

* Moulded case breakers: Required. Utilization category: Moulded case breakers:
* Final subcircuit category: Category A.
* Mains and submains: Category B.

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

Trip units: Connect interchangeable and integrally fused trip units so that trip units are not live when circuit breaker contacts are open.

### Fuses with enclosed fuse links

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

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

Fuses with fuse-links used as fault current limiters: Coordinate fuse type and rating with the protection switchgear manufacturer’s recommendation where used downstream of the fault current limiters.

Provide labels adjacent to the fuse holder stating FAULT CURRENT LIMITER and fuse size. Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier.

Breaking range and utilization category:

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

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

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

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

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

### Contactors

Standard: To AS/NZS IEC 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic. Poles: 3.

Rated operational current: The greater of:

* Full load current of the load controlled.

- 16 A.

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

### Control devices and switching elements

Standards: To AS/NZS IEC 60947.4.1 and AS/NZS IEC 60947.5.1.

Rotary switches: operated type with switch positions arranged with displacement of 60º.

Off position: Locate at the 12 o’clock position. Test positions must spring return to off position. Control relays standard: To AS/NZS IEC 60947.5.1.

### Indicator lights

Standard: To AS/NZS IEC 60947.5.1.

## EXECUTION

### Marking and labelling

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

## MOTORS AND STARTERS

* 1. **GENERAL**

General: Provide motors selected in conformance with AS 60034.1, the application load characteristics, motor manufacturers’ recommendations and the following:

* + - Motors 0.75 kW and over: Three phase.

### Rating

Standard: To AS 60034.1.

Maximum power rating: The greater of the documented minimum motor size and next preferred standard frame size above the maximum load of the driven equipment.

Duty: Minimum S1.

Class: Continuous running. Speed: Maximum 1500 r/min. **Starting performance**

Designation: Minimum design N to AS 60034.12.

Speed and torque: To suit the driven equipment. Make sure each motor develops torque relative to the starting load of the driven machine such that it runs up to full speed steadily and within a time period compatible with motor winding temperatures, class of insulation and rating of the starting equipment.

### Efficiency

Motors documented as high efficiency: To AS/NZS 1359.5 Table A3 or Table B3. All other motors: To AS/NZS 1359.5 Section 2.

### Environment

Site operating conditions: To AS 60034.1. Electrical operating conditions: To AS 60034.1. **Enclosure**

General: Provide enclosures appropriate to the environment in which the motor operates.

Motor enclosure classification: Minimum IP44 to AS 60529 and AS 60034.5.

### Cooling

Standard: To AS 1359.106. Classification: Minimum IC01.

### Marking

Terminals: To AS 60034.8.

### Mounting

Standard: International mounting (IM) classification to AS 60034.7.

### Noise

Standard: To AS 60034.9.

### Vibration

Standard: To AS 1359.114. Grade: Minimum N (normal).

## STARTERS

### Standard

General: To AS/NZS IEC 60947.1.

Electromechanical motor starters: To AS/NZS IEC 60947.4.1.

### Selection

General: Provide motor starters selected according to the following:

* Electricity distribution network limitations for starting currents and voltage flicker.
* Torque requirements for the motor load.
* Heating effects on the motor.
* Voltage drop during start due to starting currents.
* Time required to accelerate from rest to full speed.
* Number of starts per hour.

### Performance

Rated operational current: At least the full load current of the load controlled. Rated duty: Intermittent class 12.

Utilization category: AC-3.

Mechanical durability: Minimum 3 million cycles to AS/NZS IEC 60947.4.1.

Electric durability: Minimum 1 million operations at AC-3 to AS/NZS IEC 60947.4.1.

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

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

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

### Direct-on-line starters

Type: Direct-switching electromagnetic contactor.

## MOTOR PROTECTION

### General

General: Provide over-current protection with manual reset giving overload protection in each phase of supply as part of the equipment assembly for each motor starter.

Standard: To AS 60034.11.

Contacts: Provide at least one normally-open and one normally-closed set of contacts rated at the starter control circuit voltage and minimum 4 A. Connect contacts to open the starter at the setting temperature.

* Utilization category: AC-11.

Mounting: Ensure relays are not affected by the shock of mechanical contactor operation. Provide sufficient clear space for the disconnection, removal and replacement of heaters, without disconnecting other equipment and wiring.

### Single phase motor protection

General: Provide overload units matching the motor heating curve characteristics.

### 3-phase motor protection

General: Provide thermal overload protection relays for each motor.

Provide the following:

* Triple pole relays with differential trip bar operation for single phase protection, and ambient temperature compensation.
* Thermal overloads connected directly to contactor by means of proprietary links, except where operated separately by current transformers.

Current transformers: Saturating at 10 to 15 times full load current, Class 10P.

**11.0 HYDRAULIC MAINTENANCE**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Maintain the hydraulic systems for the documented maintenance period so that the performance, reliability, service life, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period, in parallel with and including:

* + - Periodic and statutory maintenance, cleaning and replacement of consumables.
    - Emergency repairs.

Maintenance period: As documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.

## INTERPRETATION

### Definitions

General: For the purpose of this work section the following definition applies:

* + - Consumable: Materials or components intended to be replaced within the service life of the associated plant or equipment.
    - Periodic maintenance: Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
    - Repairs: Unplanned/corrective maintenance (reactive).
    - Replacement: Upgrading of a higher value component on regular cycle, including repainting and replacement of air conditioning equipment.

## SUBMISSIONS

### Certification

Annual certification: Inspect and submit certification for all items required to be inspected annually under statutory requirements including, but not limited to, air handling systems required for fire operation, boilers and pressure vessels.

### Records

Maintenance records: Conform to the *General requirements* work section.

Periodic maintenance and performance report: At the frequency documented, submit reports summarising the maintenance performed and the performance of the hydraulic installation in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

* Dates and number of site labour hours for periodic maintenance. Exclude travelling time.
* Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time.
* Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
* List of any motors for which the motor current varied by more than 10% from the current measured during commissioning.
* For each separately metered item, the water or gas use for each month of the reporting period.

## INSPECTION

### Notice

Requirement: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

## PRODUCTS

* 1. **GENERAL**

### Product selection

Proprietary items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance and construction characteristics.

## EXECUTION

* 1. **EMERGENCY REPAIRS**

### General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs. Rectify faults and replace faulty materials and equipment.

Remedial work: Carry out any remedial work, including temporary work, necessary to restore each system to safe and satisfactory operation. Verify each system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary work: Promptly replace temporary work with permanent rectification.

### Contact details

Emergency contract: Provide contact details including after hours and emergency mobile and/or pager details, to permit notification of emergency conditions.

### Response time

Period: Attend site for emergency service within the documented response time.

Response period: Starts at the time of notification to the contactor’s nominated contact point.

## PERIODIC MAINTENANCE

### General

Microbial control maintenance: To AS/NZS 3666.2.

Routine visits: Make routine service visits at the frequency documented. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals.

Notification of defects: When defects in the installation are identified, give notice. Requirement: Provide maintenance work including, but not limited to, the following:

* Carry out the manufacturers' recommended maintenance.
* Attend to reported defects and complaints.
* Check for and repair corrosion.
* Check for and rectify any unsafe conditions.
* Replace faulty or damaged parts and consumable components.
* Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly.
* Identification of pipes, conduits and ducts maintenance: To AS 1345.
* Safety signs maintenance: To AS 1319.

### Backflow prevention devices

Standards: To AS/NZS 3500.1 and AS 2845.3.

### Cleaning

Requirement: At the end of the maintenance period:

* Remove waste and clean all parts of the installation.
* Remove temporary protective coatings, packaging and labels.
* Clean screens and strainer baskets.

### Piped systems

Tasks: Perform the following:

* Check equipment items and record values for operation, calibration, performance compliance, temperature and energy consumption.
* Rectify all water leaks regardless of size. Clean and repair any water damage.
* Check condition of insulation and repair as required.
* Provide service tags recording inspections and tests.

### Cold and heated water

Maintenance of tanks and piping for potable water: To AS/NZS 3500.1 and AS/NZS 3500.4. Ball float valves: Check and adjust for no overflow.

Heated water systems:

* Conform to AS/NZS 3500.4 Section 12.
* Inspection and maintenance: To AS/NZS 3666.2.
* Provide service tags recording inspections and tests.

Leaks: Inspect cold and heated water systems at least annually for the following:

* Leaks, including leaks from cisterns.
* Other defects.
* Safe condition.
* Conformance to the PCA and network utility operator requirements. Leaks and defects: Report if found and rectify.

Strainers: Inspect and clean at least annually.

### Tapware

Requirement: Inspect for leaks and damage. If leaks are found, service O-rings, replace washers and reseat to rectify.

### Hydraulic pumps

Pumps and pump seals: Check and rectify if defective.

Safety and other controls: Check for correct operation and adjust if necessary. Sewage pumps and pits: Perform the following at least six monthly:

* Inspect including seals on lids.
* Clean and test level controls.

### Backflow prevention devices

General: Maintain to AS 2845.3 and AS/NZS 3500.1. Service tags: Record inspections and tests.

### Thermostatic mixing valves

Field testing and maintenance: To AS 4032.3. Service tags: Record inspections and tests.

### Boiling, chilled and filtered water dispensers

Service: Maintain to manufacturer’s recommendations. Provide all consumables including, but not limited to, replacement filter cartridges.

Service tags: Record inspections and tests.

### Water filter cartridges and media

Requirement: Replace at the manufacturer's recommended frequency or sooner if flow is reduced or pressure drop is excessive.

### Fuel gas

Requirement: Maintain fuel gas services so that they are:

* Free from leaks and other defects.
* Efficient and safe.
* In conformance with AS/NZS 5601.1 and network utility operator requirements. Maintenance: Perform the following annually:
* Inspect all gas reticulation including fixings, isolating valves, regulators and safety enclosures.
* Pressure test the whole installation for leaks.
* Provide service tags recording inspections and tests.

### Gas appliances

Service: Conform to AS 3814, including the recommendations of Appendix G. Inspect each appliance for correct operation including flame fail safe valve, thermocouple, thermostat and burners.

### Sanitary plumbing

Requirement: Maintain as follows:

* At least annually: Inspect for leaks, repair and report.
* At other times: Attend and clear blockages within 24 hours of notification. Submit a report on the cause of the blockage.

System performance: Conform to the PCA and network utility operator requirements.

### Trade waste

Requirement: Annually inspect and clean odour vent filters.

### Stormwater

Requirement: Regularly clean and inspection as follows:

* Annually at the end of autumn: Inspect guttering and other rainwater goods. Remove leaves and other potential blockages. Clean leaf screens.
* At other times: Attend and clear blockages within 24 hours of notification.

System performance: Conform to the PCA and network utility operator requirements.

### Rainwater storage systems

Requirement: Provide annual maintenance to SAA HB 230 Table 10.1 at the following times:

* Maintenance period shorter than 12 months: Within a month of the end of the defects liability period.
* Maintenance period 12 months or longer: Annually. Service tags: Record inspections and tests.

### Water conservation

Requirement: Conform to SAA HB 233.

### Automatic controls

Requirement: Perform the following:

* Check operation and safety controls for variable speed drives. Check and record output frequency. Adjust if incorrect. Rectify defects.
* Record readings of thermometers, gauges, meters, current draw of motors and heaters, sample readings, control set points and controlled space conditions.
* Check sensor calibration. Recalibrate if incorrect.
* Check electrical and control systems, including safety limits for temperature, pressure and humidity. Adjust if incorrect. Rectify defects.
* Provide service tags recording inspections and tests.

### Electrical systems

Requirement: Perform the following:

* Check for hot joints, burnt insulation, burn contacts and repair.
* Check electrical connections for tightness. Tighten loose connections.
* Check operation of all electrical components. Rectify defects.
* Check indicating lights and replace defective lamps.
* Check and record motor currents.
* Check overload settings. Adjust if necessary.
* Check and report any changes to controls and wiring.
* Provide service tags recording inspections and tests. Standards:
* Electrical equipment generally: To AS/NZS 3760.
* Switchboards: To AS 2467.
* Repair and overhaul of rotating electrical equipment: To AS 4307.1.

## END OF MAINTENANCE PERIOD SERVICE

### General

Requirement: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

## COMPLETION

### Maintenance records

Service records: Record maintenance undertaken in the schedules in the operation and maintenance manuals.

Maintenance reports: Prepare maintenance reports as documented.

### Restitution after maintenance tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete.

Standard: Equal to the condition of the original installation.

## SELECTIONS

* 1. **MAINTENANCE**

**Maintenance requirements schedule**

|  |  |
| --- | --- |
| **Provision** | **Requirement** |
| Maintenance period | Conform to the *General requirements* work section |
| Call out response time not to exceed | 24 hours |
| Maximum time between programmed service visits | As required |
| Frequency of periodic maintenance and performance reports | As required |

**SECTION D – ELECTRICAL SYSTEMS**

**1.0 ELECTRICAL SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide the electrical services, as documented.

## ELECTRICAL SERVICES SCOPE OF WORK

The work covered by this specification and associated drawings shall be carried out by the Electrical Contractor and consists of the following but not limited to:

The complete fabrication, supply, delivery, off-loading, hoisting into position, installation, termination, testing, commissioning, setting to work, demonstrating, training and maintenance of the following necessary to complete the intent of the project:

* + 1. Design and documentation of the Electrical Services as per the stated design intent in this specification.
    2. The existing Samoa Electric Power Corporation (SEPC) power supply to the buildings via to feed the proposed transformer than to the Main Switchboard.
    3. Electrical Underground HV Site Reticulation includes HV mains cabling, HV cable trenching associated with cable markers, checker plates from Distribution transformer to main switchboard MSB, fittings, supports and associated accessories
    4. Electrical Low Voltage Equipment includes Automatic Transfer Switch, Main switchboard panel, Standby Enclosed Diesel Generator set including Control Panels, Exhaust Flue, attenuation, anti-vibration pads, fittings, supports, generator mains cabling, control cabling, concrete plinth and associated accessories.
    5. UPS power including UPS socket outlets, socket mountings, sub-circuit cabling, and accessories, etc.
    6. Consumer Mains Cabling including authority meter, underground conduits from the Low Voltage Terminals of the transformer to main switchboard, fittings, supports and associated accessories.
    7. A complete Form 3a Main Switchboard and complete Form 2b Distribution Boards including Automatic Transfer Switch, all switchgear, control gear, protective devices, multi-function meters, bus bars, fittings, supports, contactors, timers and associated accessories.
    8. General, Emergency and Exit Lighting including luminaires, fittings, lamps, poles, switches, daylight/photoelectric sensors, controls, sub-circuit cabling, testing facilities and accessories, etc.
    9. General power including socket outlets, socket mountings, sub-circuit cabling, and accessories, etc.
    10. Communication System including power supply adjacent to rack, rack unit, Fibre Tray, Managed POE Ethernet Switches, Patch Panels, rack mountable UPS, data & telecom outlets, backbone and structured cabling, supports and associated accessories
    11. Earthing and Bonding System including pits, rods, clamps, cabling, fittings, supports and associated accessories. Allow for soil resistivity testing on site.
    12. Communications Backbone System including incoming copper and fibre cabling, building Distributor/campus distributor, outlets, supports and associated accessories.
    13. CCTV system including cameras, NVR, monitoring stations, cabling and all other associated accessories.
    14. Vertical passenger machine roomless lift with all associated controls and accessories. Comprise of lift car, landing doors, landing push buttons, illuminated direction of travel and position indicators. Lift machine room less equipment, car and counter weight guide rails and all necessary supports, provisions for stretcher facility, lift pit ladders, screens, well flushing,

warning and statutory notices and all minor and incidental items required for the installation in accordance with this specification and statutory requirements

* + 1. Testing and commissioning of the Electrical services.

Attendance at meetings, contract administration and coordination with the client’s representatives, other trades, utility providers, local authorities, etc.

Any omissions from the above scope do not relieve the contractor of the design

### Electrical Services Associated Works

The following associated works shall be provided under the main contract by the various trades but not limited to, to ensure the successful completion of the Electrical Services installations:

Builders Works as follows but not limited to

1. Forming of penetrations for electrical conduits, and light fixtures and data and communications conduits and provision for penetrations in the walls
2. All required chase in walls and floors.
3. Opening in fixed ceilings, external walls and fire rated compartments.
4. Fire sealing of all penetration passing through a fire rated compartment or structure.
5. Weatherproofing flash roof and wall penetration passing through the external envelope of the building.
6. Concealing of services.
7. Access doors and ceiling access panels to readily access and maintain services
8. Access to ceiling voids, services shaft, partitions and walls to install lighting, power outlets, conduits, ducts, cabling, fittings, supports, etc.
9. Supply and install of lift as per specification.

Civil Services

1. All trenching for conduits for electrical power wiring to electrical equipment, data and communication cabling around site.

Mechanical Services

1. Mechanical Services Switchboard.
2. Cabling from MSSB to all air-conditioning and ventilation equipment.

Hydraulic Services

1. Cabling from the GPOs and isolators to the hydraulics equipment.

Vertical Transportation Services

1. Forming of penetrations for electrical, data and communications cablings and provision for boxing out.
2. Fire sealing of all penetration passing through a fire rated compartment or structure.
3. Power cable connection to E & I panel
4. Telecommunication line connection to the lift controller.
5. Builder to coordinate all services exterior to the lift shaft.

### Electrical Services Control Strategy

The Electrical equipment specified shall be controlled based on their functions and suitability. A brief control strategy for each is described below:

### Main Power Supply and Transformer:

1. Main power supply is taken from Samoa Electric Power Corporation (SEPC) high voltage cabling to the pad mount proposed transformer
2. The transformer is to operate on duty mode. This means should the energized transformer supply power to the site fail to operate, SEPC is to immediately carry out remedial works.

### Standby Generator and Automatic Transfer Switch:

1. The automatic transfer switch consists of a motorized contactor and logic for the automatic control (start, stop and sequencing) of the standby generator in the event of the mains failure via the phase failure relay.
2. When the power authority/utility supply fails to site, the supply of electrical power from the selected standby diesel generator set to the site has to be maintained.
3. The following operational protocols have been observed:
4. The standby diesel generator sets shall supply electrical power to the essential and non – essential load areas, that is, up to 100% of the load demand.
5. The standby diesel generator set will shut after a predetermined cooling down period has elapsed after the PPL power supply has been restored.

### Lighting:

1. Generally the lighting solution selected for the interior areas shall be LED and fluorescent luminaires.
2. Lighting in restrooms is controlled via Multisensory sensors. Timer clock settings to be confirmed on site with time out period from 10 sec to 30 mins.
3. Enclosed single occupant office to have standard push button to turn light manually "on". The ultrasonic sensor should be able to detect small movements.
4. Lighting in service areas will be controlled via daylight sensors. A selector manual and override switch complete with timer to be installed at the face of the main switch board and labelled adequately.

### Emergency Light test facility:

1. Emergency lighting to be tested using test facilities which shall switch on emergency and exit light via a timer set to 120 minutes during normal operations.
2. The emergency lights shall switch back to normal operation after successful completion of 120 minutes.

### Exterior Lighting:

1. Exterior lighting is to be controlled via photocells. Exterior lighting shall switch on from dusk till dawn. Timer “Off” setting shall initially be set at 8 hours and be confirmed by the client. A selector manual and override switch complete with timer to be installed at the face of the main switch board and labelled adequately.

### Telecommunication and Data:

1. Telecommunication underground cables are taken from Blue Sky Samoa and shall be terminated at the Building Distributor located in the IT server room.

### Mechanical/Hydraulics Services Equipment:

1. Dedicated final sub-circuit cabling will be provided from the MSB to the MSSB for the mechanical services equipment. The indoor A/C units and electric hot water units will be drawn from the individual floor distribution boards.
2. Toilets exhaust systems to be interlocked with sensors/light switch and have run-on timers. Run-on timer to have multiple switch connections and time to be adjustable from 10-18 minutes.

### Closed Circuit Television

1. Real time video to be monitored on a 24 hours basis.
2. Backup of 30 days to be allowed for the NVR.

### Access Control and Security

1. Access control to be achieved with magnetic locks and code pads. Security is to include cameras, passive alarm sensors, panic buttons, siren and strobes.
2. Access control for doors to be linked to the FIP during a fire alarm emergency. Security Contractor to provide cable to the FIP for connection.
3. A breach in the security system to activate the building alarms.

### General:

Location: Savaii, Samoa

Building Type: Courthouse / Office Building & Residential

Building Class: Class 5

### Utilities:

Building Power Supply: 3phase 415V/50Hz – As Required 1phase 240V/50Hz – As Required

Available Telecommunications: Optic Fibre and Copper Cables.

### General Lighting

As per AS1680.

|  |  |
| --- | --- |
| **TASK AREA** | **MINIMUM ILLUMINANCE ( LUX)** |
| Ground Floor | |
| Court Rooms | 320 |
| Male Toilet | 80 |
| Female Toilet | 80 |
| Offices | 320 |
| Entry | 160 |
| Reception | 160 |
| Administration Office | 320 |
| Staircase | 80 |
| Strong Room | 160 |
| Kitchen and Tea Room | 240 |
| Foyers | 160 |
| Server Room | 320 |
| IT | 320 |
| Mediation Room | 160 |
| Veranda | 160 |
| Judges Chambers | 320 |
| A. Manager | 320 |
| Manager | 320 |

### Electrical Services Reference List

|  |  |
| --- | --- |
|  | Australian National Construction Code Series - 2016 |
|  | National Building Code of Western Samoa |
| AS 1042 | Direct-acting indicating electrical measuring instruments and their accessories. |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AS 1091 | Cabling of Building for Telephone Cables | | | | | | | | |
| AS 1125 | Conductors in insulated electric cables and flexible cords. | | | | | | | | |
| AS 1136 | Low voltage switchgear and control gear - Control circuit devices and switching elements. Part 1 -General requirements.  Part 2 - Additional requirements for pushbuttons and indicator lights.  Part 7 - Additional requirements for control switches with positive opening operation. | | | | | | | | |
| AS 1345 | Identification of the contents of piping, conduits and ducts. | | | | | | | | |
| AS 1477 | Un-plasticized PVC (UPVC) pipes and fittings for pressure applications. | | | | | | | | |
| AS 1675 | Current transformers - measurement and protection. | | | | | | | | |
| AS 1680 | Interior Lighting | | | | | | | | |
| AS 1882 | Earth and bonding clamps. | | | | | | | | |
| AS 1930 | Circuit breakers for distribution circuits (up to and including 1000 V ac. and 1200 V ac.) | | | | | | | | |
| AS 2005 | Low voltage fuses - fuses with enclosed fuse-links. Part 10 -General requirements.  Part 20 - Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Standardization fuses with compact dimensions.  Part 40 - Supplementary requirements for fuse-links for the protection of semi-conductor devices | | | | | | | | |
| AS 2184 | Low voltage switchgear and control gear - moulded case circuit breakers for rated voltage up to and including 600 V ac. and 250 V dc. | | | | | | | | |
| AS 2053 | Non-metallic conduits and fittings. | | | | | | | | |
| AS 2293 | Emergency evacuation lights in buildings. Part 1 - Design and installation.  Part 2 - Inspection and maintenance. | | | | | | | | |
| AS 2768 | Electrical Insulating Materials | | | | | | | | |
| AS/NZS 3000:2007 | Wiring Rules | | | | | | | | |
| AS 3008 | Electrical installations - Selection of cables.  Part 1 - Cables for alternating voltages up to and including 0.6/1 kV. | | | | | | | | |
| AS 3013 | Electrical installations - Wiring systems for specific applications. | | | | | | | | |
| AS 3111 | Miniature Over Current Circuit Breakers | | | | | | | | |
| AS 3112 | Plugs and socket-outlets | | | | | | | | |
| AS 3116 | Elastomer insulated electric cables and flexible cables for working voltages of  0.6/1 kV. | | | | | | | | |
| AS 3131 | Plugs and socket-outlets for use in installation wiring systems. | | | | | | | | |
| AS 3135 | Semi - Enclosed Fuses for A.C Current | | | | | | | | |
| AS 3137 | Approval and test specification - luminaries (lighting fittings) | | | | | | | | |
| AS 3147 | Electric cables - thermoplastic insulated for working voltages up to and including 0.6/1 kV. | | | | | | | | |
| AS 3191 | Electric flexible cords. | | | | | | | | |
| AS 3858 | Low voltage switchgear and control gear - circuit breakers. | | | | | | | | |
| AS/NZS 5000 | PVC Insulated Electric Cables and Flexible Cables for Working Voltages of 0.6/1KV | | | | | | | | |
| AS/NZ ISO 9001 | Model of Servicing. | Quality | Assurance | in | Design, | Development, | Production, | Installation | and |
| AS/NZS 4029.2 | Stationary Batteries – Lead - Acid | | | | | | | | |
| AS 62040.2/ IEC 62040.3. | Uninterrupted Power Supply Systems | | | | | | | | |

**Performance**

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

Performance criteria: Meet the performance criteria, as documented.

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

### Site electricity supply

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

### High voltage supplies

Network distributor’s protection devices: Determine the protection equipment type and protection curves for overload, short circuit and earth fault currents.

Prospective fault current: Determine the high voltage prospective fault current.

High voltage network: To AS/NZS 3000, the network distributor’s requirements and the supply authority Service and Installation rules.

High voltage protection: Provide high voltage short circuit and overload protection for incoming main switches, ring main feeders, spur feeders and incoming supplies to transformers.

High voltage protection devices: Either switch fuse or circuit breaker type devices. Include full discrimination and cascade protection and grade with the network distributor’s incoming supply protection system and the downstream site protection devices.

Protection report: Before ordering the equipment, submit a fault and protection report detailing the location and size of transformers, location and type of protection equipment, cable sizes and type, over-current and earth-fault current curves coordinated with upstream protection devices including the network distributor protection equipment curves and cable I2t curves.

### Low voltage supplies

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

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

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

### Switchboards

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

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

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

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

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

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

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

### Electrical cable systems

Responsibilities: Provide the following cabling systems:

* Power cables: Provide cable systems as documented and to the requirements of the *0921 Low voltage power systems* work section.
* Communications cables: Provide cable systems as documented and to the requirements of Australian Communications and Media Authority (ACMA) and the *0961 Telecommunications cabling* work section.

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

### Lighting

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

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

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

### Alternative power supplies

Responsibilities: Provide alternative power supplies as documented and to the requirements of the following work sections:

* *Power generation – engine driven*.
* *Uninterruptible power supply*.

### Fire safety systems

Responsibilities: Provide fire safety systems as documented and to the requirements of the following work sections:

* *Fire detection and alarms*.
* *Emergency warning and intercommunication.*

### Communications systems

Responsibilities: Provide communication systems as documented and to the requirements of the *0961 Telecommunications cabling* work section.

### Security systems

Responsibilities: Provide security systems as documented and to the requirements of the *0981 Electronic security* work section.

### Lightning protection

Responsibilities: Provide lightning protection as documented and to the requirements of the *0979 Lightning protection work section.*

## DESIGN

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

## PRECEDENCE

### General

Work sections and referenced documents:

* The requirements of other work sections of the specification override conflicting requirements of this work section.
* The requirements of the work sections override conflicting requirements of their referenced documents.
* The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

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

## STANDARDS

### General

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

### Electrical installations

Electrical design guide: To SAA HB 301. Selection of cables: To AS/NZS 3008.1.1. Degrees of protection (IP code): To AS 60529.

Electromagnetic compatibility (EMC): To AS/NZS 61000.

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

Telecommunications systems: To AS/CA S008, AS/CA S009 and AS/NZS 3008.

## CONTRACT DOCUMENTS

### General

Requirement: Conform to the *General requirements* work section.

## SUBMISSIONS

### General

Requirement: Conform to the *General requirements* work section.

### Certification

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

### Operations and maintenance manuals

Requirement: Conform to the *General requirements* work section.

### Technical data

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

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

* Assumptions.
* Calculations.
* Model name, designation and number.
* Capacity of all system elements.
* Country of origin and manufacture.
* Materials used in the construction.
* Size, including required clearances for installation.
* Certification of compliance with the applicable code or standard.
* Technical data schedules corresponding to the equipment schedules in the contract documents. If there is a discrepancy between the two, substantiate the change.
* Manufacturers’ technical literature.
* Type-test reports.
* Single line diagram(s), including fault levels at switchboards, cable size and type.
* Switchboard layouts.

## INSPECTION

### General

Requirement: Conform to the *General requirements* work section.

### Notice

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

## PRODUCTS

* 1. **ELECTRICAL ACCESSORIES**

### General

Responsibilities: Provide accessories as documented and to the requirements of the *0921 Low voltage power systems* work section.

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

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

Default finish: Select from the manufacturers' standard range.

## EXECUTION

* 1. **SWITCHBOARDS**

### General

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

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

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

### Seismic sensitive projects

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

## SUPPORT OF PLANT AND EQUIPMENT

### Support of roof mounted plant and equipment

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

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

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

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

Sloping roofs:

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

### Support of ground level plant and equipment

Ground level:

* If the ground slope is ≥ 15° 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.

## SELECTIONS

* 1. **GENERAL**

### General

Requirement: Conform to the *General requirements* work section.

**2.0 ELECTRICAL DESIGN AND INSTALL**

## ELECTRICAL SYSTEMS

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide the electrical services, as documented. Summary: The electrical services are summarized as follows:

## DESIGN

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

### Electrical system design

General: Design and provide systems, as documented.

Designer qualifications: Use only appropriately experienced and qualified persons to undertake design work. If requested, provide documents verifying the qualification and experience.

Design parameters: As documented.

Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4. Maximum demand: Calculation method to AS/NZS 3000 Appendix C. **Performance**

Supply system: 415 V, 3-phase, 4-wire, 50 Hz, multiple earth neutral (MEN) system.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.

## STANDARDS

### General

Electrical services: To AS/NZS 3000, unless otherwise documented. Electrical design guide: To SAA HB 301.

Selection of cables: To AS/NZS 3008.1.1. Degrees of protection (IP code): To AS 60529.

Electromagnetic compatibility (EMC): To AS/NZS 61000.

Telecommunications systems: To AS/CA S008, AS/CA S009 and AS/NZS 3008.

## CONTRACT DOCUMENTS

### General

Requirement: Conform to the *General requirements* work section.

## SUBMISSIONS

### General

Requirement: Conform to the *General requirements* work section.

### Certification

General: Submit the following:

* Certification of conformance with AS/NZS 3000, for electrical services.
* Certification of conformance with the applicable code or standard.
* Telecommunications cabling: Submit product and installation certification for the installation.

### Samples

Lighting: Submit samples of all luminaires and accessories complete with lamp, control gear and three core flex and plug.

Emergency evacuation lighting: Submit samples of all luminaires and exit signs.

### Shop drawings

Lighting: Submit shop drawings for the following:

* Lighting columns.
* Lighting column mounting bases.
* Non-standard fixing brackets.

Telecommunications cabling: Submit shop drawings showing the following:

* Layouts of equipment racks.
* Cross-connect layout.
* Cabling diagram for complete system.
* Cable management system.

### Technical data

Submissions: Submit design and technical data for the electrical services, all items of plant and equipment.

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

* Assumptions.
* Calculations, including maximum demand 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 conformance to 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.
* Single line diagram(s), including fault levels at switchboards, cable size and type.
* Switchboard layouts.

Lighting: Submit technical data for the following:

* Luminaires.
* Lamps.
* Ballasts.
* Power factor correction equipment.
* Lighting control systems.
* All accessories.

Telecommunications cabling: Submit technical data including the following:

* System design parameters: Performance.
* Voice and/or data transfer rate.
* Cable type and characteristics.
* Segregation requirements for EMI/EMR.
* Maximum length of cables.
* Cross-connect type and characteristics.
* Cross-connect block.
* Patch cords.
* Fibre optic terminations.
* Patch panel module.
* Cable management for racks.
* Rack.
* Fly leads.

Emergency evacuation lighting: Submit technical data for each type of luminaire and exit sign including the following:

* Maximum luminaire spacing for a given mounting height.
* Luminaire classification to AS 2293.3.

### Tests

Lighting efficacy: Confirm the efficacy of the following by a photometric test, carried out for the applicable CCT, from a NATA approved laboratory:

* Light-emitting diode luminaires.
* Light-emitting diode lamp replacement modules.

## INSPECTION

### General

Requirement: Conform to the *0171 General requirements* work section.

### Notice

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

## LOW VOLTAGE POWER SYSTEMS

* 1. **RESPONSIBILITIES**

### General

General: Provide low voltage power systems, as documented.

## PERFORMANCE

### Network supply

General: Liaise with the electricity distributor and provide network connection, as documented. Program: Schedule the works and statutory inspections to suit the construction program.

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

### Distribution system

General: Provide power distribution system elements, as documented.

## SURGE PROTECTION DEVICES (SPD)

### General

Responsibilities: Provide surge protection devices as documented and where required to protect sensitive electrical equipment.

### Surge protection devices (SPD)

General: Where nominated in the document, provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2. Surge Rating: Imax ≥ 20 kA per phase.

Residual Voltage: Up < 600 V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

## SITE ELECTRICITY SUPPLY

### General

Responsibilities: Provide site electricity supplies as documented.

### Consumers mains

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

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

### Alternative power supplies

General: Provide alternative power supplies, as documented.

### Metering

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

Private: Provide private metering, as documented.

## WIRING SYSTEMS

### Selection

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

* + - Underground services.
    - Above-ground services.
    - In-building services. Type: Re-wireable system.

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

Cable support system: To AS/NZS 3000.

## POWER CABLES

### Standards

Polymeric insulated cables: To AS/NZS 5000.1. Aerial cables: To AS 1746.

### Cable

General: Select multi-stranded copper cables. Default insulation: V-75.

Default sheathing: 4V-75.

Minimum size: Conform to the following:

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

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

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

Underground residential distribution (URD) systems: Cables to AS/NZS 4026.

### Colours

Fixed wiring cables: Coloured conductor insulation or at least 150 mm of close fitting coloured sleeving at the termination points of each conductor.

Active conductors in single phase circuits: Red. Active conductors in polyphase circuits:

* A phase: Red.
* B phase: White.
* C phase: Blue. Sheath: White. **Cable installation**

Classifications: To AS/NZS 3013.

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

Stress: Do not use installation methods that exceed the cable’s pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

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

Cable joints: Locate in accessible positions in junction boxes and/or in pits. Individual wiring of extra-low voltage circuits: Tie together at regular intervals. **Tagging**

General: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags

clipped around each cable or trefoil group.

### Marking

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

### Submains and final sub-circuits

Installation: Provide the following:

* Cables with diameter less than 13 mm: Run in conduit, cable ducts or support on cable trays or ladders.
* Cables for lighting systems: Run in conduit, cable ducts, suspend on catenary systems or support on cable trays or ladders.
* Inaccessible concealed spaces: Install cable in PVC-U conduit.
* Roof spaces: Install cable below heat insulation and sarking. If not protected from high ambient roof space temperatures by thermal insulation, derate the cables, to AS/NZS 3008.1.1 Table 27, for an assumed ambient temperature of 55oC.
* Accessible ceiling voids: Support and enclose cables on ceiling surfaces or ceiling suspension systems.
* Plastered or rendered masonry: Install cable in PVC-U conduit.
* Double sided face brick partition: Install cable in PVC-U conduit installed within the brick wall by slotting bricks or using any pathways provided in the brick.
* Walls filled with bulk thermal insulation: Install cables in PVC-U conduit.
* Metal stud framed walls: Install cable using TPS cable allowing rewardability. Bush all knock-outs in steel framing to prevent cable damage. Earth metal stud frames to the electrical earthing system.
* Horizontal cable trays or ladders: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 2000 mm intervals.
* Vertical cable risers: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 1000 mm intervals.
* Plant rooms: Install cable in heavy duty PVC-U conduit or on tray, cable ladder or in duct.

## EARTHING SYSTEMS

### Earthing systems

Protective earthing system with a multiple earth neutral (MEN) connection: To AS/NZS 3000 and as documented.

### Earth electrodes

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

### Bonding

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

### Earth and bonding clamps

General: Provide proprietary earthing and bonding clamps. Standard: To AS 1882.

## ELECTRICAL ACCESSORIES

### General

Selections: Provide accessories, as documented.

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

### Socket outlets

Standards:

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

**Plastic switched socket outlets** Type: Integral switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins at the 6 o’clock position. Mounting configuration: Horizontal.

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

### Weatherproof socket outlets

Type: Integral switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: Grey.

Current rating: 10 A.

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

### Combined RCD switched socket outlets

Type: Integral RCD unit with double switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

RCD trip current: Conform to the following:

* General light and power: 30 mA Type II to AS/NZS 3190.
* Patient treatment areas: 10 mA Type I to AS/NZS 3190 as documented in the project documents. Pin arrangement: Mount outlets with the earth pins, at the 6 o’clock position.

### Multi-switch socket outlets on grid mounted panels

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

Colour: As documented.

Panel finishes: As documented. Current rating: 10 A.

### Plugs – 240 volt

Requirement: Insulated type to AS/NZS 3112 with integral pins.

**240 volt combination switch and permanently connected cord outlet** Type: Three terminal flush mounted switch and flex-lock insert assembly. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

Neon Indicator: Provide neon indicator to match existing.

Flex-lock assembly: Match and securely grip the size and type of flexible cable used. Mounting configuration: Horizontal.

### Permanently connected equipment

General: Provide final subcircuit to permanently connected equipment, as documented. Isolating switch: Locate adjacent to equipment.

Coordination: Coordinate with equipment supplier.

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

### Isolating switches

Standard: To AS/NZS 3133.

**Emergency stop switches** Standard: To AS/NZS 3947.5.5. **3-phase outlets**

Standard: To AS/NZS 3123.

Type: Surface mounted Integral switched socket outlet with flap lid on the outlet. Material: High impact plastic.

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

Current rating: 5 pin, 20 A, 415V a.c.

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

Plug: Provide a matching plug top for each outlet.

### Installation

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

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

Location: Confirm final location of all outlets and equipment on site, before installation. Spacing from adjacent horizontal surface: ≥ 75 mm to the centre of accessory socket. Default mounting heights to centre of accessory plate:

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

Accessories: Flush mounted, 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 ceiling mounted accessories

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

Mounting: Mount appliances independent of ceiling tiles and suspended ceiling suspension system. Fix directly to concrete slab or to roof structure above ceiling.

Connections for fixed equipment: Provide concealed permanent connections.

Fixing: For equipment and appliances heavier than 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, e.g. operating theatre shadowless lights.

## POWER GENERATION – PHOTOVOLTAIC

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide photovoltaic generating system(s) as documented, incorporating the following:

* + - Photovoltaic array.
    - Regulator.
    - Battery system.
    - Inverter.
    - Connection to low voltage power system.

## STANDARDS

### General

Requirement: For the purpose of this work section, the following standards relating to stand- alone systems are also applicable to network connected systems:

* + - Stand-alone power systems: To AS/NZS 4509.1 and AS/NZS 4509.2.
    - Grid connected systems: To AS 4777.1, AS 4777.2 and AS 4777.3.

- IEC 61836.

## PHOTOVOLTAIC MODULE

### General

Selection: To AS/NZS 4509.2, AS/NZS 5033 and as documented.

### Array

Encapsulation: Required. Toughened glass: Required. Protection rating: ≥ IPX6.

Integral bypass diode protection: Required.

### Cells

Type: Polycrystalline. Standard: To IEC 61215. Efficiency: ≥ 12%.

## REGULATOR

### General

Selection: To AS/NZS 4509.2 and as documented. Function: Charge cycle control including:

* + - Low battery voltage disconnect.
    - Pulse width modulation.
    - ≥ 3 step series regulation. Display: LCD display of:
    - Battery voltage.
    - Charge current.
    - Ampere hours in and out.
    - Load current.

Alarms: Visible and audible low and high battery voltage alarms. Transient protection: Required.

## BATTERY SYSTEM

### General

Selection: To meet the documented performance. Blocking diodes: Required.

Service life: ≥ 10 years.

### Standards

General: To AS 2676 and AS 4086.1.

## INVERTER

### General

Selection: To meet the documented performance. Waveform: True Sine wave.

Waveform quality: To AS 4777 series. Voltage regulation: ± 8%.

Harmonic distortion of output current:< 4%. Frequency regulation: ± 1%.

Efficiency: ≥ 90% at 10% load.

Protection: Overload, short circuit and transient required. Automatic no-load shutdown: Required.

Display:

* Output power.
* Grid stability.

### Standards

General: To AS 4777.2 and AS 4777.3.

### Synchronization

Requirement: Self commutation modules which automatically synchronize the inverter supply frequency and phase angle to the low voltage network or other embedded generator system.

## CONTROL SYSTEM

### Control panel

General: Provide photovoltaic system control panels, switchgear and control gear assemblies as documented.

## SWITCHBOARDS – PROPRIETARY

* 1. **RESPONSIBILITIES**

### General

General: Provide proprietary switchboards for the following, as documented:

* + - Main switchboard.
    - Distribution boards.

## STANDARDS

### General

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

## GENERAL

### Enclosure

Default material: Metallic-coated sheet steel.

**Separation** Default: Form 4a. **Metering**

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

electricity distributor.

Private: Provide private metering, as documented.

### Busbars

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

### Spare capacity

Default spare poles: ≥ 20%.

### Surge protection

General: Provide surge protection as documented.

### Earthing

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

### Doors

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

### IP rating

Default rating: IP42 minimum. Weatherproof: IP56 minimum.

### Finishes

Exterior and Interior: To the manufacturer’s standard colour.

### Supporting structure

Assemblies:

* Wall mounted: ≤ 2 m2.
* Floor mounted: > 2 m2.

### Ventilation

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

### Cable entries

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

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

### Cable enclosures

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

### Cable supports

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

## SWITCHBOARD COMPONENTS

* 1. **RESPONSIBILITIES**

### General

Responsibilities: Provide switchboard components as documented.

### Statutory authority’s equipment

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

## PRODUCTS

### Requirements

Selection: To AS/NZS 3000 clause 1.7 and Section 2. Rated duty: Uninterrupted.

Rated making capacity (peak): ≥ 2.1 x fault level (r.m.s.) at assembly incoming terminals. Utilization category: To AS/NZS IEC 60947.1 clause 4.4 and the recommendations of Annex A.

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

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

Enclosure: IP4X minimum.

## OVERLOAD AND FAULT PROTECTION GENERALLY

### General

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

## SWITCH-ISOLATOR AND COMBINATION FUSE-SWITCH UNITS

### General

Standard: To AS 60947.1 and AS/NZS 3947.3.

Operation: Independent manual operation including positive ON/OFF indicator. Shrouding: Effective over range of switch positions.

.

### Load make/load break switch-isolators

Rated making and breaking capacity: As defined in AS/NZS IEC 60947.1 clause 4.3.5 to conform to AS/NZS 3947.3 Table 3 and the manufacturer's recommendations for the prospective fault current conditions.

Rated short-time withstand current: As defined in AS/NZS IEC 60947.1 clause 4.3.5, to conform to the manufacturer’s recommendation for the current conditions.

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

## MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

### General

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

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

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

Operation: Independent manual operation including positive ON/OFF indicator. Trip type: Conform to the following:

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

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

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

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

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

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

## ELECTRICITY DISTRIBUTOR’S SERVICE PROTECTIVE DEVICES

### General

Low voltage service protective devices: To AS/NZS 3000, the electricity distributor’s requirements and the supply authority Service and Installation rules.

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

## RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCBO)

### General

Standard: To AS/NZS 3190.

Integral non-overload protection type: To AS/NZS 61008.1. Integral overload protection type: To AS/NZS 61009.1.

Modular type: To AS/NZS IEC 60947.2.

- Type II.

. Default tripping current: 30 mA.

## CONTACTORS

### General

Standard: To AS/NZS IEC 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic. Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.

- 16 A.

Mechanical durability: 10 million cycles to AS/NZS IEC 60947.4.1.

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

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

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

## LIGHTING

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide lighting and control systems, as documented.

## STANDARDS

### General

Energy efficiency for ballasts and lamps: To AS/NZS 4783.2. **Minimum energy performance standards (MEPS)** General: To AS/NZS 4782.2, AS/NZS 4783.2, AS 4934.2.

Self-ballasted lamps: To AS/NZS 4847.2.

## PROPRIETARY LUMINAIRES

### General

Requirement: Provide proprietary luminaires complete with lamps, luminaire control equipment, lighting control equipment, and accessories as documented. Provide lamps of the same type from the same brand and country of manufacture.

Self-ballasted lamps: To AS/NZS 60968 and AS/NZS 60969.

## LIGHT-EMITTING DIODES (LEDS) LUMINAIRES

### General

Requirement: Provide light emitting diode (LED) luminaires, as documented. Colour: CRI > 80.

CCT: 3000 K.

## CONTROL GEAR ENCLOSURE

### General

Requirement: Provide control gear support enclosure within the body of the luminaire, except where remotely mounted control gear is documented or required by the manufacturer.

Enclosures and control gear mounting assemblies: Provide heat dissipation facilities to dissipate heat from the luminaire.

Controlgear enclosure: Form a barrier against direct contact with live parts of the control gear and the area of the luminaire containing the lamp and lamp support holders.

Separate control gear enclosures: lf separate control gear enclosures external to the luminaire are required, conform to the above requirements.

Fixing: Screw fixed.

## WIRING

### Flexible cords

Recessed luminaires: Provide external flexible cord in conformance with the following:

* + - Length: ≥ 1.5 m.
    - Cross sectional area: 0.75 mm2.
    - Type: 3-core V75 (minimum) PVC/PVC, connected to a 10 A 3-pin moulded plug to AS/NZS 3112 or multi-pin plug, as documented.

## LIGHTING CONTROL

### General

Requirement: Provide the following as documented:

* + - Lighting switches.
    - Dimmers.
    - Automatic control systems.

### Digital control system

General: Provide a proprietary, microprocessor-based system to control lighting under automatic and user interface control, as documented.

## SUPPORTS

### General

Requirement: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material.

### Suspended luminaires

Rods: Steel pipe suspension rods fitted with gimbal joints. Chains: Electroplated welded link chain.

Levelling wire: Stainless steel.

Levelling: Adjust the suspension system length so that the lighting system is level and even. Horizontal tolerance: ± 3 mm between luminaires within the same area.

### Surface mounted luminaires

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Conform to the following:

* Generally: Provide 2 fixings at each end of fluorescent luminaires.
* Luminaires less than 150 mm: A single fixing at each end in conjunction with 1.6 mm backing plates may be used.
* Provide battens and support for the fitting.
* Do not direct fix into plasterboard.

### Recessed luminaries

General: Install recessed luminaries in trimmed openings in the suspended ceiling. Standard: To AS 2946.

## COMPLETION

### General

Requirement: Before the date of practical completion carry out the following:

* + - Verify the operation of all luminaires.
    - Adjust aiming and controls for all luminaires under night time conditions.
    - Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.

## TELECOMMUNICATIONS CABLING

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide a passive telecommunications cabling network system as documented and as follows:

* + - Network connection.
    - Campus distributor.
    - Campus cabling.
    - Building distributor.
    - Backbone cabling.
    - Floor distributors.
    - Consolidation points.
    - Telecommunications outlets.
    - Patching.

### System performance

Application class to AS/NZS 3080 clause 6.3: E.

Balanced system to AS/NZS 3080 clause 7 (data): Category 6. Balanced system to AS/NZS 3080 clause 7 (voice): Category 6. Fibre system class: To AS/NZS 3080 clause 8.

System warranty: 15 years minimum.

### Surge protection devices (SPD)

General: Provide surge protection devices to protect final equipment in racks and cabinets.

## STANDARDS

### General

Authorities: To the requirements of the Australian Communications and Media Authority (ACMA). Cabling products: To AS/CA S008 and AS/NZS 3080.

Installation of cabling: To AS/CA S009, AS/NZS 3080, AS/NZS 3084, SAA HB 252 and AS/NZS ISO/IEC 14763.2.

Installation of small office/home office cabling: To AS/CA S009, AS/NZS ISO/IEC 15018 and AS/NZS ISO/IEC 14763.2.

Cable management and documentation: To AS/NZS 3085.1. Electromagnetic compatibility (EMC): To AS/NZS 3080.

## NETWORK CONNECTION

### External Network

Requirement: Liaise with each external communications carrier and determine the services and site access requirements for the network connection.

## BUILDING ENTRANCE FACILITIES

**Campus distributor (CD)** Standard: To AS/NZS 3080. **Network termination device**

Requirement: Provide network termination device for the termination of external carrier cables and facilities. Provide separate frames for each external communication’s carrier and for copper and optical fibre cables.

Degree of protection for external BD/CDs: To AS 60529.

## DISTRIBUTORS

### General

Requirement: Provide the Building Distributors (BD) and Floor Distributors (FD) for voice and data to AS/NZS 3080 and as documented for the termination of campus and building backbone cable systems and the horizontal cable distribution systems.

Equipment requirements: Provide cable termination racks, patch panels, equipment mounting racks for servers and routers complete with power outlets as documented.

### Copper cable termination distributors

General: Provide Krone termination frames for the termination of copper backbone and horizontal cable services.

Certification: Provide vendor certification (including the warranty period) for the integrated voice/data copper cabling systems.

### Equipment racks

Dimension and type: Conform to the following:

* Equipment racks: 19 inch wide industrial type, or 600 mm or 800 mm wide RUs:

. ≤ 18 RU: Wall mounted, 600 mm depth.

. > 18 RU: Floor mounted, 800 mm or 1000 mm depth.

* Patch panels – Copper CAT 6 cables: 800 mm wide and 800 mm deep.
* Patch panels – Optical fibre cables: 800 mm wide and 800 mm deep. Nominate height of units.
* Server racks: 600 mm wide and 1000 mm deep. Nominate height of units. Access location: Front, sides or rear.

Cable tray: Locate within outer cabinet void.

Doors: Provide transparent safety glass, lockable doors.

Power provision: Minimum 1 socket outlet for every 3 rack units on vertical rail. Cable management: Provide as follows:

* 1 module for every 2 patch panels.
* 1 module for each fibre termination panel.
* Location: Vertically, on both sides of the panel.

Provisions for active equipment: 25% minimum, 1 fixed shelf for every 4RU of active equipment space. Ventilation: Fan assisted.

Earthing: CES earth bar required. Fixing: Conform to the following:

* Floor mounted: Firmly fix to floor, bolt together multiple racks using standard kit accessories.
* Floor/Wall mounted: Firmly fix to floor and wall.

### Cross connect patch panels

General: Provide cross connect patch panels as documented. Terminations: Terminate directly to the modular connector.

Fixed terminations:

* Rear terminals: Connect to 45° IDC punch down type.
* Front terminals: Connect to RJ45 modular connector.

Patch cords: Terminate cord ends with appropriate registered jacks.

### Optical fibre termination panels

Requirement: Provide rack mounted termination frames for the termination of optical fibre backbone and horizontal cable services.

Certification: Provide vendor certification, including the warranty period, for the optical fibre cabling systems.

Break out trays: Provide fibre optic cable break out trays at each group of fibre optic cable terminations.

Loom cables: Neatly loom cables and lay stripped cables into the break out tray.

Secure cables: Make sure that cables are secured by the sheath and that there is no stress on the fibre optic cores.

### Cross connect patch panels (Optical fibre cables)

Requirement: Provide optical fibre cross connect patch panels as documented for both single and multicore optical fibre cables.

### Cable management

Record book: Provide a record book at each cross-connect. Location: Secure log books in each distribution frame records holder.

Identification, labelling, and record documentation: To AS/NZS 3085.1.

## CABLES

### Copper

Standard: To AS/CA S008, AS/CA S009, AS/NZS 3080 and AS/NZS ISO/IEC 14763.2.

Campus and building voice backbone cables: Multicore CAT 3 UTP cable as documented or to suit the voice outlet density at each building or floor distributor, with 30% spare capacity allowance.

Horizontal cabling voice and data: CAT 6 UTP cabling to each floor outlet. Balanced system cables: UTP.

Cable end length: Provide a 5 m cable loop at each end of the cable.

### Fibre

Standard: To IEC 60793-2-10.

Campus and building backbone cables:

* Default multimode type: 6 core multi-mode OM3 50/125 mµ.
* Default single mode type: single core 9/125 mµ.

Length: Provide not less than 1000 mm spare at each end. Component type: SC.

Safe practices: To AS/NZS 2967.

### External

Standard: Water penetration resistance to IEC 60794-1-2.

## TELECOMMUNICATIONS OUTLETS

### General

Outlets: Provide RJ45 8 way modular jacks except where documented otherwise. Provide for up to three modular voice or data outlets on the each faceplate with three spaces for identification inserts.

Pinouts: T568A to AS/NZS 3080.

## FLY LEADS

### General

Type: Stranded. Length: 1200 mm.

Quantity: Provide fly leads to 50% of outlets installed.

## PATCH CORDS

### General

Type: Stranded. Length: 900 mm.

Quantity: 100% of outlets installed. Termination: Registered jacks.

## ENGINEERING SERVICES

### General

Requirement: Provide cabling systems, as documented.

## CABLE INSTALLATION

### Installation

Requirement: To manufacturers' recommendations.

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

### Cable separation

Separation for safety: To AS/CA S009, and by at least 150 mm. Fluorescent luminaires: Maintain a clearance of more than 300 mm. **External cables**

Requirement: To ACIF C524.

## TELECOMMUNICATIONS OUTLET INSTALLATION

### Installation

Mounting: Flush mount.

Style, material and colour of plates: To match adjacent power and switch plates.

Horizontal cabling termination: Terminate Category 6 cabling to the rear of the outlet modular jack with insulation displacement connections forming a gas tight joint. Arrange cable pairs at each jack conforming to AS/NZS 3080 Fig 15.

## EARTHING SYSTEM

### General

Standard: To AS/CA S009, Section 20.

### Communication earth system (CES)

Requirement: Provide a communications earth terminal (CET) adjacent to each electrical switchboard. Connect the CET to the local protective earth (PE) system at the switchboard.

Distributor: Provide an earth bar within each distributor and connect to the local CET.

Interconnections: Verify that there are no interconnections between the lightning protective earthing system and the telecommunications earthing system.

## COMPLETION

### Cable management

General: Before the date for practical completion submit log books for each distribution frame with details of cable terminations and provisions for recording cable, line and jumper information.

Identification and labelling, and record documentation: To AS/NZS 3085.1.

## TELEVISION DISTRIBUTION SYSTEMS

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide a system suitable for the reception and distribution of analogue and digital television, video, radio and sound signals, as documented.

Network connection: Arrange with the network operator(s) for the connection of their network. Comply with the network operators' requirements.

Designer: Network operator’s Approved Design Partner.

Survey: Confirm location and height of Free-to-air (FTA) antenna by on-site measurements.

## SYSTEM DESCRIPTION

### System type

Type: As documented.

### Performance

General: To AS/NZS 1367.

Capacity: Provide the distribution system with the installed capacity to accommodate 30% additional outlets.

### Signal sources

Free-to-air (FTA) antennae system: Provide FTA antennae system terminating at the premises cabling interface.

Network operator: Provide for the connection of the network operator’s system terminating at the premises cabling interface as documented.

Local signal source: Provide television input sockets at the premises cabling head-end for the distribution of in-house television channels on separate channels of the network.

### Service entry

General: Provide service entry facilities to suit signal sources, head end equipment and distribution systems.

Location: As documented.

### Head end equipment

General: Provide head end equipment to suit signal sources, distribution systems and documented performance.

Location: As documented.

### Surge protection devices (SPD)

General: Provide surge protection devices to protect final equipment in racks and cabinets.

### Distribution system

General: Provide a cabling distribution network from the head end equipment to each network distribution tap.

FTA distribution taps: Provide FTA distribution taps.

Network distribution taps: For systems designed for more than one network operator provide individual distribution taps for each network operator. Co-locate the taps with FTA taps in groups to facilitate selected connection or changes to outlet feeders.

Location: Group all equipment as documented.

### Outlets

General: Provide outlets and feeders from distribution tap(s) as documented. Quantity: Provide separate sockets for each source and service.

## STANDARDS

### General

Electromagnetic compatibility: To AS/NZS 1367 Section 3.

Bending radius: Conform to the manufacturer’s recommendations minimum bending radius for the size of cable.

## EMERGENCY EVACUATION LIGHTING

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide single point monitored emergency lighting and exit signs as documented.

## SINGLE-POINT SYSTEM LUMINAIRES

### General

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the local distribution board which disconnects main supply to the luminaires and tests for discharge performance and automatically reverts to normal operating mode after testing.

### Monitored system

Data connection: Provide internal monitoring facilities and provision for the connection of data cabling to a central monitoring computer.

### Batteries

Type: Provide lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously for at least 2 hours during commissioning tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of between 10oC and 40°C and subject to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

## SINGLE POINT SYSTEM

### Power supply

General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

### Data monitoring

General: If a monitoring system is documented, provide a data cable system from each single-point luminaire and connect to the monitoring computer.

## FIRE DETECTION AND ALARMS

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fire detection and alarm systems as documented.

## SYSTEM

### General

System type: Addressable.

Interface: Emergency warning and intercommunications system.

## STANDARDS

### General

Standard: To AS 1670.1, AS 4428.1 and AS 7240.13.

## AUTHORISED PRODUCTS

### General

Equipment: Provide equipment listed in the Active Fire Register of Fire Protection Equipment.

## CONTROL AND INDICATING EQUIPMENT

### Standards

General: To AS 7240.2.

Air-handling fire mode control panels: To AS 4428.7. Alarm investigation facility (AIF): To AS 4428.10.

Alarm signalling equipment: To AS 4428.6. Power supply units: To AS 4428.5.

Fire brigade panel: To AS 4428.3. Routing equipment: To AS 7240.21.

Wire-free alarm zone circuits: To AS 4428.9.

### Fire indicator panels

General: Provide metal cubicle-type enclosures.

### Isolation

Isolating facilities: Provide on fire indicator panels to enable testing without the transmission of alarm signals to the fire brigade.

### Capacity

Spare zones: 50% minimum.

## DETECTORS

### Type

Areas generally: Optical beam smoke detectors.

Hot areas: Fixed temperature integral heat detector/alarm unit type.

### Standards

Smoke alarms: To BCA Spec E2.2a.

Carbon monoxide (CO) fire detectors: To AS 7240.6. Duct sampling units (DSUs): To AS 1603.13.

Heat detectors: To AS 7240.5.

Point type smoke detectors: To AS 7240.7 and AS 1603.2. Integral heat detector/alarm units: To AS 1603.3.

Integral smoke detector/alarm units: To AS 3786. Multi-sensor fire detectors: To AS 7240.15.

Multi-point aspirated smoke detectors: To AS 1603.8. Optical beam smoke detectors: To AS 1603.7.

Remote indicators: To AS 1603.15. Visual warning devices: To AS 1603.11. **Self-indicating detectors**

General: Provide a light emitting diode mounted in a clearly visible position, which illuminates

whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes: Conform to the following:

* Visible detectors: On the outside of the detector or its base.
* Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.
* Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.
* Remote indicators: To AS 1603.15.

### Installation

General: Install detectors so they can be easily inspected and tested in situ, and readily withdrawn from service.

## MAGNETIC DOOR HOLDERS

### General

Standard: To AS 4178.

### Control facilities

Standard: To AS 1670.1 clause 3.19.

Signals: Ancillary control device circuits and connections for automatically controlling and releasing magnetic door holders to operate the relevant doors under fire alarm conditions.

## AIR HANDLING SYSTEMS

### Fire fan control and indication panels (FFCP)

Standard: To AS/NZS 1668.1.

Signals: Provide fire detection and alarm signals for the fire fan control and indication panel (FFCP).

## ELECTRONIC SECURITY AND ACCESS CONTROL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide electronic security and access control systems as follows and as documented.

* + - Remote monitoring system.
    - Access control system.
    - Intruder detection system.
    - Closed circuit television system.
    - Intercom system.

Security classification: As documented.

### Intruder alarm systems

General: To AS/NZS 2201.1.

Alarm transmission system: To AS/NZS 2201.5. Internal detection devices: To AS 2201.3.

Wire free systems: To AS 2201.4.

### CCTV systems

General: To AS 4806.2.

Remote monitored systems: To AS 4806.4.

## SECURITY SYSTEMS

### Alarm system panels or processors

Capacity: Provide separate sectors for each nominated internal zone, and for normally-closed and normally-open perimeter zones.

Sector time delay: Provide adjustable time delay entry/exit for each sector, with adjustment range 0 to 30 s.

Batteries and chargers:

- Sealed battery: Provide a sealed battery and charger system contained within each control panel with capacity as documented.

### Uninterruptible power supply

General: Provide a dedicated uninterruptible power supply and connect to the security systems. Capacity: At least 15 minutes, for the complete system in normal operation.

### Activation

Activation devices: Provide keypads, cards, card readers and other activation devices for access control and intruder alarm systems as documented.

External: Provide weatherproof (IP56) hoods or housings for external units. Default mounting height: 1100 mm from floor level.

### External audible and visual alarms

General: Provide a corrosion-resistant weatherproof metal enclosures containing sirens and blue strobe lights. Fix in locations not readily accessible without a ladder.

### Anti-tamper devices

Anti-tamper devices: Provide anti-tamper devices to control panels, external equipment, control and activating devices, and access control devices.

Function: To register an instantaneous alarm if covers are removed or vital wiring is disconnected.

### External audible and visual alarms

General: Provide a corrosion-resistant weatherproof metal enclosures containing sirens and blue strobe lights. Fix in locations not readily accessible without a ladder.

### Remote monitoring

Monitoring system: Provide a monitoring system in the alarm panel or processor for transmission of alarms and monitoring of the system by parties responsible for attending to alarms.

## ACCESS CONTROL

### Access control processors or panels

Capacity: Provide separate entry/exit control modules for each designated access point.

Users: Program the system to match the number of authorised users with unique access codes. Time zones: At least 4 per day, with provision for weekends and public holidays.

### Door control devices

General: Provide electric strikes, electric locks, drop bolts, or similar devices as documented to suit door construction and hardware.

Monitoring: Provide lock status and door position monitoring of door control devices.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment. Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

### Vehicle control

Vehicle access control: Provide vehicle access control system combining connection to vehicular doors and boom gates, and interconnection to the main access control system.

Exit loop detection: Provide a buried loop detection system adjacent to the exit point to activate boom gates or vehicular doors on approach by a vehicle. Connect so that doors or gates close after a pre- set time.

Interlock: Provide a photo electric beam safety interlock.

Interlock function: To prevent door or gate from closing until the vehicle has cleared the exit point.

Push-buttons and readers: Where practicable, provide direct wall mounting for push-buttons or readers; otherwise provide a robust mounting bollard and extension arm.

Default mounting height: 1000 mm from floor level.

Reed switches: Provide heavy duty reed switches on both sides of vehicle doors to generate a door closed indication at the control panel.

### Intercom

Base station: Provide intercom base station, interconnected with the individual local stations. Include speakers and microphones.

Entry station construction: Wall mounted flush stainless steel panel. Weatherproofing: IP56.

Dial: Digital push-button type.

Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the base station intercom panel.

Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.

Internal station type: Surface mounted, removable handset type.

Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the entry station can communicate with the internal station only when the switch is held down.

Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point.

## VIDEO MONITORING

### CCTV system

General: Provide a closed circuit television system monitoring and recording the areas/spaces as documented.

### CCTV cameras

Selection: Provide cameras selected to provide coverage of designated areas and to enable persons within the field of view to be readily distinguishable on monitors under all ambient night and day lighting conditions.

Motorized cameras: Provide camera drives which provide remote control of camera rotation and tilt, and of lens focal length.

External cameras: Provide corrosion-resistant weatherproof housings for cameras located externally, which allow cameras to perform to manufacturer’s specification.

Fixing: Provide mounting brackets and hardware which rigidly fix cameras, monitors and accessories to buildings or structures.

### CCTV monitors

General: Provide LCD colour monitors compatible with the security system, and provide fixing brackets and hardware for wall-mounted and ceiling-mounted monitors.

### CCTV recording system

General: Provide CCTV recording hardware and software systems which store data from each camera in an industry standard compressed digital format.

Functionality: Provide the following:

* Index according to events.
* Fast search.
* Frame by frame search.
* Frame printing.
* Zoom and pan within a recorded frame.
* Back up daily to off-site storage. Minimum data storage: 30 days.

**CCTV video switching system**

General: Provide switching software which enables each camera to be directed to a specific monitor or

for cameras to be scanned sequentially at predetermined intervals to a specific monitor and which, on receipt of an alarm signal, interrupts the scanning sequence and switches to the relevant security zones.

## EQUIPMENT POWER SUPPLY

### Mains supplies

Permanent power supply: Provide permanent power supply to the following:

* + - Intruder alarm panels and access control panels including sub panels.
    - Electric door strike local panels or control equipment.
    - Intercom stations.
    - CCTV monitors and cameras.

Marking: Label the switchboard circuit breaker from which power for the security systems is obtained as follows:

*SECURITY SYSTEM - Do not switch off*.

### Interconnection to other services

General: Provide functions and equipment to allow the interconnection to other systems. Provide and connect wiring to the designated services.

Lifts: Arrange for installation and connection of lift readers and associated equipment.

## SELECTIONS

* 1. **ACCESSORIES**

**Accessory schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Manufacturer |  |  |  |
| Catalogue product number or reference |  |  |  |
| Description/rating |  |  |  |
| Other/IP rating |  |  |  |
| Special |  |  |  |

## LIGHTING

**Lighting types and illumination levels schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Area description |  |  |  |
| Proposed usage |  |  |  |
| Lighting type |  |  |  |
| Illumination level (Lux) |  |  |  |

**Lighting control schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Manufacturer |  |  |  |
| Catalogue product number or reference |  |  |  |
| Description/rating |  |  |  |
| Special |  |  |  |

## TELECOMMUNICATIONS CABLING

**Building distributor design schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type | Rack mounted | Rack mounted | Rack mounted |
| Location |  |  |  |
| Spare capacity: minimum (%) |  |  |  |
| Space for active equipment (%) |  |  |  |

**Floor distributors design schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type | Rack mounted | Rack mounted | Rack mounted |
| Location |  |  |  |
| Spare capacity: minimum (%) |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Space for active equipment (%) |  |  |  |

**Telecommunications outlets schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Manufacturer |  |  |  |
| Catalogue product number or reference |  |  |  |
| Description/rating |  |  |  |
| Special |  |  |  |

## EMERGENCY EVACUATION LIGHTING

**Emergency lighting schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Manufacturer |  |  |  |
| Catalogue product number or reference |  |  |  |
| Description/rating |  |  |  |
| Special |  |  |  |

**3.0 CABLE SUPPORT AND DUCT SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide cable support, trunking and duct systems, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

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

## SUBMISSIONS

### Certification

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

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

### Operation and maintenance manuals

Requirement: Submit all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Shop drawings

General: Submit shop drawings showing the following:

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

### Technical data

General: Submit technical data for the following:

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

## PRODUCTS

* 1. **GENERAL**

**Storage and handling**

## MARKING

### Identification

General: Deliver materials to the site in the manufacturer’s original sealed containers or packaging, legibly marked to show the following:

* + - Manufacturer’s identification.
    - Product brand name.
    - Product type.
    - Quantity.
    - Product reference code and batch number.
    - Date of manufacture.
    - Material composition and characteristics such as volatility, flash point, light fastness, colour and pattern. Provide technical data sheets if not shown on labels.
    - Handling and installation instructions.
    - Safety data sheets.

## CONDUITS

### General

Standards: To AS/NZS 2053.3, AS/NZS 61386.1, AS/NZS 61386.21, AS/NZS 61386.22 and

AS/NZS 61386.23.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

### Type

General: Rigid.

### Sizes

Requirement: Conform to the following:

* Underground: ≥ 25 mm.
* Telecommunications: ≥ 25 mm.
* Other locations: ≥ 20 mm.

### Fixings

Surface mounted: Double sided fixed. In concrete slabs: Tie to structural steel. **Colour**

Conduits generally: Light orange.

Telecommunications systems conduits: White.

### Galvanized water pipe

Medium or heavy: To AS 1074.

## NON-METALLIC CONDUITS AND FITTINGS

### General

Standards: To AS/NZS 2053.3, AS/NZS 61386.21, AS/NZS 61386.22 or AS/NZS 61386.23.

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

### Flexible conduit

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

### Associated fittings

Type and material: Same as the conduit.

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

### Inspection-type fittings

Requirement: Use only in accessible locations and where exposed to view.

### Joints

Type: Cemented or snap-on joints.

## CABLE DUCT/TRUNKING

### General

Standards: To AS/NZS 4296.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

### Cable duct

Material: Metal.

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

Covers for accessible locations: Screw-fixed or clip-on type removable only with the use of tools. Accessories: Purpose-made to match the duct system.

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

### Proprietary trunking systems

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

Accessories and outlets: Proprietary fasteners and mountings facilities. Covers: Screw-fixed or clip-on type, removable only with the use of tools.

## CABLE SUPPORT SYSTEMS

### General

Standard: To NEMA VE-1. Type tests: To NEMA VE-1.

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

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

Spare capacity: Minimum 50%.

### Support

Power cables: Conform to the following:

* Overhead suspension: Trapeze or centre rail structure.
* Wall supported: Wall bracket with full access from one side of the cable support. Communications cables: Conform to the following:
* Overhead suspension: Single sided.
* Wall supported: Wall bracket with full access from one side of the cable support. Dimensions: To the preferred dimensions nominated in NEMA VE-1.

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

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

## CATENARY SYSTEMS

### General

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

Wire: Stainless steel or coated galvanized cable and couplings.

## CABLE PITS

### General

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

### Proprietary cable pits

Pits ≤ 1200 x 1200 mm: Proprietary concrete or polymer moulded pits.

### In situ construction

Pits > 1200 x 1200 mm: Either:

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

### Pit covers

General: Provide pit covers to suit external loads. Fit flush with the top of the pit. Standard: To AS 3996.

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

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

### Drainage

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

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

## COLUMNS

### General

Columns: Conform to the following for fabricated columns more than 2400 mm high which are designed to support accessories outdoors.

### Standards

Public lighting poles: AS 1798. Concrete structures: AS 3600. Steel structures: To AS 4100.

Structural design of columns: To AS/NZS 4676.

Hot-dipped galvanized (zinc) coatings on ferrous articles: To AS/NZS 4680.

### Design

General: Tapped hot-dipped galvanized steel, aluminium or concrete columns, designed, manufactured and tested by a specialist manufacturer.

Mounting: Conform to the following:

* Steel and aluminium columns: Base plate mounting, suitable for mounting on rag bolt assemblies.
* Concrete columns: Direct mounting in the ground.

Footings: Provide footings and rag bolt assemblies detail designed by a professional engineer and independently certified.

Site specifics: Take into consideration the design wind category and the soil conditions. Dimensions: To AS 1798.

Rag bolt assemblies: Galvanized threaded steel of cross-sectional area designed to support each column taking into account the wind loads expected to act on the column and the luminaires mounted on the column. Set the rag bolt assemblies in the concrete footings. Cut holding bolts within 3 threads above top of base plate top lock nuts.

Base sealing: Seal space under pole base plate with grout.

Maintenance access: Provide pole stirrups secured to either side of the column for access to accessories. Locate the first stirrup greater than or equal to 3 m above ground level.

Electrical connections: For hollow metal or concrete poles provide a recess fitted with a flush mounted lockable or screw fixed cover at the base of the column for access to cable connections and equipment.

Cable support: For connections higher than 3 m, provide a catenary wire cable support system unless cable and anchor methods at the ends of the cable suspension are designed for unsupported cable suspension.

Drainage: Provide adequate drainage at the column base.

## POWER POLES

### Hardwood poles

Requirement: Conform to the requirements of AS/NZS 3000, the local network distributor’s standards and the local Service and Installation Rules.

Selection: Dressed, natural, round poles with all sapwood removed.

Capping: Galvanized steel, domed cap extending 25 mm down the sides. Fix with galvanized steel nails.

Termite and fungus treatment: To 600 mm above ground level.

### Cable support at point of supply

Requirement: Bolts and support service hooks fixed to the pole for the support of overhead insulated- aerial bundled cables as required by the local network distributor and the Service and Installation Rules.

Accessories: Provide the accessories for any additional poles used in the provision of overhead services.

### Steel poles

General: Hot-dipped galvanized round steel poles to conform with the requirements of AS/NZS 3000, the local network distributor’s standards and the local Service and Installation Rules.

Capping: Galvanized steel, domed cap extending 25 mm down the sides. Fix with galvanized steel screws.

Drainage: Provide adequate drainage at the column base.

## CUSTOM DESIGNED POLES/COLUMNS

### General

Requirement: Provide columns designed, manufactured and tested by a specialist manufacturer. Standards: To the local network distributor’s standards and to the local Service and Installation Rules. **Construction**

General: Hot-dip galvanize steel columns and fittings after fabrication. Powder coat or anodize

aluminium columns and fittings after fabrication. Drainage: Provide adequate drainage at the column base. **Bases and footings for custom designed columns**

Requirement: Provide bases to custom designed columns as documented.

Bases: Provide mounting bases for rag bolt assembly fixing to reinforced concrete footings.

Footings: Provide footings and rag bolt assemblies detail designed by a professional engineer and independently certified.

Site specifics: Design for the site wind category and the soil conditions. Dimensions: To AS 1798.

Rag bolt assembly: Cut holding bolts within 3 threads above top of base plate top lock nuts. Base fixing: Galvanized holding down nut with galvanized lock nut above.

Design of footing and rag bolt assemblies: Undertake design by a professional engineer and provide independent certification.

Base sealing: Seal space under pole base plate with grout. Finish: Paint, colour as documented.

### Cable support at point of supply

Requirement: Bolts and support service hooks fixed to the pole for the support of overhead insulated- aerial bundled cables as required by the local network distributor and Service and Installation Rules.

Accessories: Provide bolts, support hooks and any other support accessories for any additional poles used in the provision of overhead services.

Overhead to underground cable facilities: Provide access and cable support for conduit and cable systems connecting the unprotected overhead service cable to the facility underground cable duct system.

Accessory mountings: Provide adjustable mountings, to suit accessories. Include provision for rigidly clamping each item in position, once adjusted correctly.

Maintenance access: Provide pole stirrups secured to either side of the column for access to accessories. Locate the first stirrup greater than or equal to 3 m above ground level.

Electrical connections: For hollow metal or concrete poles if a continuous conduit system is not utilised, provide a recess fitted with a lockable or screw fixed flush mounted cover at the base of the column for access to cable connections and equipment.

Cable support: If cable and anchor methods at the ends of the cable suspension are not designed for unsupported cable suspension, provide a catenary wire cable support system for connections higher than 3 m.

Service connection: Provide pole mounted equipment including weatherproof box and service fuses at the service connection point as required by the network distributor.

## EXECUTION

* 1. **GENERAL**

### Fire isolation

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

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

## UNSHEATHED CABLES – INSTALLATION

### General

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

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

## CONDUIT SYSTEMS – INSTALLATION

### Inspection fittings

Location: Locate in accessible positions.

### Draw cords

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

### Draw-in boxes

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

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

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

### Expansion

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

### Rigid conduits

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

### Routes

Set out: If exposed to view, install conduits in parallel runs with right angle changes of direction. Bends: Install conduits with no more than 2 right angled bends per cable draw-in run.

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

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

### Painting

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

### Conduits in concrete slabs

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

Parallel conduit spacing: ≥ 50 mm apart.

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

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

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

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

### Conduits in hollow-block floors

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

### Conduits in columns

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

Bends: Enter columns with radius sweep bends greater than or equal to 150 mm. Do not use elbows. Chasing: Do not chase columns.

## CABLE SUPPORT SYSTEMS – INSTALLATION

### General

Standard: To NEMA VE-2.

Design: Support cable support systems as follows:

* Horizontal runs:

. Concealed cable support system: At spacing which is less than length of cable support section.

. Visible cable support: Loaded deflection ≤ span/200.

* Vertical runs: To manufacturer’s recommendation, taking into account the weight of cables installed.

### Fixing to building structure

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

### Cable fixing

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

### Inside bend radius

Requirement: At least 12 times the outside diameter of the largest diameter cable carried.

### Cable protection

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

### Clearances

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

From hot water pipes: > 200 mm. From boilers or furnaces: > 500 mm.

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

## CATENARY SYSTEMS – INSTALLATION

### General

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

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

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

## CABLES IN TRENCHES – INSTALLATION

### Sand bed and surround

General: Conform to the *0223 Service trenching* work section.

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

### Sealing ducts and conduits

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

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

## COLUMNS – INSTALLATION

### General

Requirement: Provide columns including in situ reinforced concrete footings as documented in the

### Columns schedule.

Columns set in the ground: Set columns in the ground to AS 1798 requirements and to manufacturers' requirements.

Soil suitability: If the soil is unsuitable, consider alternative pole types and mount in concrete or on rag bolt assemblies set in concrete footings.

## POWER POLES – INSTALLATION

### Standards

General: To the local Service and Installation Rules and to the local network distributor’s standards for the project environment and for the selected aerial arrangement.

### Hardwood poles

Requirement: Set poles directly in the ground.

Planting depth: 1600 mm minimum or as required by AS/NZS 3000, the local network distributor’s standards and the local Service and Installation Rules.

Support: Baulk and stay to suit the design loads.

Cable protection: Protect cables and conduits installed on the exterior of the pole to a height of 2000 mm above and 150 mm below ground using either galvanized water pipe or 3.2 mm thick hot- dipped galvanized channel.

### Steel poles

Requirement: Set round steel poles directly in the ground to AS 1798 requirements and to manufacturers' requirements.

Soil suitability: If the soil is unsuitable, consider alternative pole type and mount in concrete or on rag bolt assemblies set in concrete footings.

### Custom designed poles/columns

General: Install columns as documented, including the provision of in situ reinforced concrete.

## SELECTIONS

* 1. **WIRING ENCLOSURES AND CABLE SUPPORT SYSTEMS**

**Cable trunking schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Size |  |  |  |
| Number of channels |  |  |  |
| Profile and dimensions (mm) |  |  |  |
| Material |  |  |  |
| Colour |  |  |  |
| Finish |  |  |  |

**Cable trays/ladders schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Material |  |  |  |
| Finish |  |  |  |
| Dimensions (mm) |  |  |  |
| Usable width (mm) |  |  |  |
| Usable depth (mm) |  |  |  |
| Minimum thickness (mm) |  |  |  |
| Unit length (mm) |  |  |  |
| Connector type and material |  |  |  |

**Catenary systems schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Maximum number of cables permitted to be supported by a catenary system |  |  |  |
| Lighting circuits |  |  |  |
| Socket outlet circuits |  |  |  |
| Telecommunications cabling |  |  |  |

**Columns schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Height (mm) |  |  |  |
| Sections/dimensions |  |  |  |
| Footing type/dimensions |  |  |  |
| Material |  |  |  |
| Colour/finish |  |  |  |
| Maintenance requirement facilities |  |  |  |

**Power pole schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Height (mm) |  |  |  |
| Sections/dimensions |  |  |  |
| Footing type/dimensions (mm) |  |  |  |
| Material |  |  |  |
| Colour/finish |  |  |  |

**4.0 LOW VOLTAGE POWER SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide low voltage power systems, as documented.

### Design

Fault protection: Automatic disconnection to AS/NZS 3000 clause 2.4. Maximum demand: Calculation method to AS/NZS 3000 Appendix C.

PERFORMANCE

### Network supply

General: Liaise with the electricity distributor and provide network connection, as documented. Program: Schedule the works and statutory inspections to suit the construction program.

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

Supply system: 415 V, 3-phase, 4-wire, 50 Hz, MEN system.

### Embedded generator supplies

General: Provide embedded generator supplies, as documented.

### Distribution system

General: Provide power distribution system elements, as documented.

### Metering

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

Private: Provide private metering, as documented.

### Surge protection devices (SPD)

General: Provide surge protection as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Building management systems*.
    - *Electrical systems*.
    - *Cable support and duct systems*.

## STANDARDS

### General

Electrical design: To SAA HB 301. Electrical equipment: To AS/NZS 3100.

Fire and mechanical performance classification: To AS/NZS 3013. Selection of cables: To AS/NZS 3008.1.1.

Distribution cables: To AS/NZS 4961.

Communications cabling: To AS/NZS ISO/IEC 14763.2.

### Testing

Standard: To AS/NZS 3017.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - RCD: Residual current device.
    - SPD: Surge protection device.

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Embedded generator: Electricity generator connected to the local electrical distribution network.
    - Extra-low voltage: Not exceeding 50 V a.c. or 120 V ripple-free d.c.
    - High voltage: Exceeding low voltage.
    - Low voltage: Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Samples

General: Submit samples of all visible accessories and equipment.

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

### Shop drawings

General: Submit shop drawings of the following:

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

### Technical data

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

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

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

### Tests

Other tests: Submit results as follows:

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

## PRODUCTS

* 1. **SITE ELECTRICITY SUPPLY**

### LV supplies from dedicated substations

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

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

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

### Consumers mains

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

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

### Alternative power supplies

General: Provide alternative power supplies, as documented.

## WIRING SYSTEMS

### General

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

* + - Underground services.
    - Above-ground services.
    - In-building services. Type: Re-wireable system.

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

Cable support system: Conform to the *0911 Cable support and duct systems* work section*.*

## POWER CABLES

### Standards

Polymeric insulated cables: To AS/NZS 5000.1. Aerial cables: To AS 1746.

### Cable

General: Select multi-stranded copper cables. Default insulation: V-75.

Default sheathing: 4V-75.

Minimum size: Conform to the following:

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

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

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

Underground residential distribution (URD) systems: Cables to AS/NZS 4026. Distribution cables: To AS/NZS 4961.

### Colours

Fixed wiring cables: Coloured conductor insulation or at least 150 mm of close fitting coloured sleeving at the termination points of each conductor.

Active conductors in single phase circuits: Red. Active conductors in polyphase circuits:

* A phase: Red.
* B phase: White.
* C phase: Blue. Sheath: White.

## ELECTRICAL ACCESSORIES

### General

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

### Socket outlets

Standards:

* General: To AS/NZS 3112.
* Industrial: To AS/NZS 3123. **Plastic switched socket outlets** Type: Integral switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

Pin arrangement: Mount outlets with the earth pins at the 6 o’clock position. Mounting configuration: Horizontal.

### Weatherproof socket outlets

Type: Integral switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: Grey.

Current rating: 10 A.

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

### Combined RCD switched socket outlets

Type: Integral RCD unit with double switched socket outlet. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

RCD trip current: Conform to the following:

* General light and power: 30 mA Type II to AS/NZS 3190.
* Patient treatment areas: 10 mA Type I to AS/NZS 3190 as documented in the project documents. Pin arrangement: Mount outlets with the earth pins, at the 6 o’clock position.

### Multi-switch socket outlets on grid mounted panels

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

Colour: As documented.

Panel finishes: As documented. Current rating: 10 A.

### Plugs – 240 volt

Requirement: Insulated type to AS/NZS 3112 with integral pins.

**240 volt combination switch and permanently connected cord outlet** Type: Three terminal flush mounted switch and flex-lock insert assembly. Material: High impact plastic.

Size: Standard single gang. Colour: White electrical.

Current rating: 10 A.

Neon Indicator: Provide neon indicator to match existing.

Flex-lock assembly: Match and securely grip the size and type of flexible cable used. Mounting configuration: Horizontal.

### Installation couplers

Standard: to AS/NZS 61535.

### Permanently connected equipment

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

Isolating switch: Locate adjacent to equipment. Coordination: Coordinate with equipment supplier.

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

**Isolating switches** Standard: To AS/NZS 3133. **Emergency stop switches**

Standard: To AS/NZS 3947.5.5.

### 3-phase outlets

Standard: To AS/NZS 3123.

Type: Surface mounted Integral switched socket outlet with flap lid on the outlet. Material: High impact plastic.

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

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

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

Plug: Provide a matching plug top for each outlet.

### Appliances

Connection: Shorten lead to minimum length for plug connections. Isolating Switches: To AS/NZS 3000.

## EXECUTION

* 1. **SITE ELECTRICITY SUPPLY**

### General

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

## EARTHING

### Earthing systems

Protective earthing system with a multiple earth neutral (MEN) connection: To AS/NZS 3000 and as documented.

### Earth electrodes

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

### Bonding

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

### Earth and bonding clamps

General: Provide proprietary earthing and bonding clamps. Standard: To AS 1882.

## POWER CABLES

### Cable installation

Classifications: To AS/NZS 3013.

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

Stress: Do not use installation methods that exceed the cable’s pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures.

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

Cable joints: Locate in accessible positions in junction boxes and/or in pits. Individual wiring of extra-low voltage circuits: Tie together at regular intervals. **Tagging**

General: Identify multicore cables and trefoil groups at each end with stamped non-ferrous tags

clipped around each cable or trefoil group.

### Marking

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

### Submains and final sub-circuits

Installation: Provide the following:

* Cables with diameter less than 13 mm: Run in conduit, cable ducts or support on cable trays or ladders.
* Cables for lighting systems: Run in conduit, cable ducts, suspend on catenary systems or support on cable trays or ladders.
* Inaccessible concealed spaces: Install cable in PVC-U conduit.
* Roof spaces: Install cable below heat insulation and sarking. If not protected from high ambient roof space temperatures by thermal insulation, derate the cables, to AS/NZS 3008.1.1 Table 27, for an assumed ambient temperature of 55oC.
* Accessible ceiling voids: Support and enclose cables on ceiling surfaces or ceiling suspension systems.
* Plastered or rendered masonry: Install cable in PVC-U conduit.
* Double sided face brick partition: Install cable in PVC-U conduit installed within the brick wall by slotting bricks or using any pathways provided in the brick.
* Walls filled with bulk thermal insulation: Install cables in PVC-U conduit.
* Metal stud framed walls: Install cable using TPS cable allowing rewirability. Bush all knock-outs in steel framing to prevent cable damage. Earth metal stud frames to the electrical earthing system.
* Horizontal cable trays or ladders: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 2000 mm intervals.
* Vertical cable risers: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 1000 mm intervals.
* Plant rooms: Install cable in heavy duty PVC-U conduit or on tray, cable ladder or in duct.

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## FIRE-RESISTANT CABLES

### Protection

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

## COPPER CONDUCTOR TERMINATIONS

### General

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

### Within assemblies and equipment

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

Alternative: Run cables in PVC-U cable duct with fitted cover.

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

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

## ACCESSORIES

### Installation

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

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

Location: Confirm final location of all outlets and equipment on site, before installation. Spacing from adjacent horizontal surface: ≥ 75 mm to the centre of accessory socket. Default mounting heights to centre of accessory plate:

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

Accessories: Flush mounted, 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 ceiling mounted accessories

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

Mounting: Mount appliances independent of ceiling tiles and suspended ceiling suspension system. Fix directly to concrete slab or to roof structure above ceiling.

Connections for fixed equipment: Provide concealed permanent connections.

Fixing: For equipment and appliances heavier than 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, e.g. operating theatre shadowless lights.

### Installation couplers

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

## TESTING

### Site tests

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

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

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

### Dummy load tests

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

## SPARE PARTS

### General

Spare parts: As documented.

## SELECTIONS

* 1. **SCHEDULES**

**Network supply connection schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Network distributor |  |  |  |
| Supply system type |  |  |  |
| Contestable works included |  |  |  |
| Contestable works excluded |  |  |  |
| Maximum fault level (kA r.m.s.) |  |  |  |
| Maximum fault level (kA peak) |  |  |  |
| Network distributor protection |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Upstream impedance for earth fault loop |  |  |  |
| Fault current limiting method |  |  |  |

**Embedded generators schedule**

|  |  |
| --- | --- |
| **Property** | **GEN 1** |
| Type |  |
| Energy source |  |
| Function |  |
| Maximum fault level (kA r.m.s.) |  |
| Maximum fault level (kA peak) |  |
| Degree of protection (IP rating) |  |
| Upstream impedance for earth fault loop |  |
| Fault current limiting method |  |
| Network synchronization required |  |

**Distribution cable schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **Consumers mains** | **Submains** | **Final subcircuits** |
| Termination location |  |  |  |
| Termination |  |  |  |
| Conductor material |  |  |  |
| Insulation |  |  |  |
| Sheathing |  |  |  |
| N° of cores |  |  |  |
| Cable type |  |  |  |
| Fire-resistance level (FRL) |  |  |  |
| WS rating |  |  |  |

**Metering schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Electricity Retailer |  |  |  |
| Tariffs |  |  |  |
| Private metering |  |  |  |
| Export metering |  |  |  |

**Design schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Voltage drop in final subcircuits |  |  |  |
| Spare capacity for future use |  |  |  |
| Export metering |  |  |  |
| Neutral sizing | 100% | 100% | 100% |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Harmonic loads |  |  |  |

**Accessory schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Manufacturer |  |  |  |
| Catalogue product number or reference |  |  |  |
| Description/rating |  |  |  |
| Other/IP rating |  |  |  |
| Special |  |  |  |

**Spare parts schedule**

|  |  |
| --- | --- |
| **Spare part** | **Requirement** |
|  |  |
|  |  |
|  |  |

**5.0 POWER GENERATION – ENGINE DRIVEN**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide proprietary packaged stand-by generating set(s), as documented.

### Performance

Requirement: Incorporate the following:

* Engine cooling system.
* Combustion air system.
* Exhaust system.
* Liquid fuel system.
* Acoustic enclosure.
* Control system.
* Connection to low voltage power system.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Liquid fuels*.
    - *Building management systems*.
    - *Fuel gas*.
    - *Electrical systems*.
    - *Low voltage power systems*.
    - *Switchboards – proprietary*.
    - *Switchboards – custom-built*.
    - *Switchboard components*.
* [complete/delete]

## STANDARDS

### General

Requirement: For the purpose of this work section, conformance to the following standards relating to stand-alone systems is also applicable to those systems which are to be connected to the network supply:

* + - Stand-alone power systems: To AS/NZS 4509.1 and AS/NZS 4509.2. Standard: To AS/NZS 3010.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Net continuous rated output (or prime rating): Net continuous electrical output available at alternator terminals, not including the electrical power consumed by the generating set’s dependent and essential auxiliaries.
    - Net short-time rated output (or stand-by rating): Net electrical output available from the generating set for 1 hour in every 12 hours at net continuous rated output, not including electrical power consumed by the generating set’s dependent and essential auxiliaries.
    - Start response time: Total elapsed time from receipt of start signal to final connection to load.

## SUBMISSIONS

### Operation and maintenance manuals

Standard: To AS/NZS 4509.1.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Shop drawings

General: Submit shop drawings indicating the following:

* General arrangement of equipment, generating sets, fuel tanks, exhaust silencers, control panels, batteries, cable tray runs.
* Single line schematic showing the interconnection with the building electrical system.
* Operating sequence in test and emergency modes as well as restoration of normal supply.
* Location and size of fuel tanks.
* Physical size of exhaust silencers including clearances from other system, building and structural elements.
* Physical size of generating set base and clearances for maintenance.
* Location and estimated size of control and distribution boards.
* Location of control and starting batteries.
* Acoustic performance criteria (engine, exhaust, air flow), to determine the level of sound proofing required.
* Maximum mass and overall dimensions of each separable assembly.
* Access clearances for operational maintenance and dismantling.
* Electrical single line diagram, and general arrangement for the complete system.
* Control diagrams.
* Alarms and shutdown annunciator text engraving schedule.
* Details of foundations and anti-vibration mountings.

### Technical data

General: Submit technical data including the following:

* Technical description and specifications of each generating set, including output curves for base load and stand-by conditions, alternator and engine data, automatic voltage regulator, synchronizing and load sharing modules and auxiliaries.
* Type test reports as follows:

. Generating sets.

. Alternators: To AS 60034.1, AS 60034.5 and AS 60034.7.

* Net continuous rated output.
* Net short-time rated output.
* Transient and sub transient reactance of the alternators.
* Voltage regulation grade.
* Generating set efficiency at 50%, 75% and 100% load.
* Calculations for performance of acoustic enclosures and silencers.
* Evidence that the engine type has previously passed cold starting tests at the minimum ambient site temperature.

## INSPECTION

### Notice

Complete tests: Give notice so that factory inspection may be made of each complete generating set and associated systems at the manufacturer’s or supplier’s factory before delivery to the site.

## PRODUCTS

* 1. **GENERAL**

### Multiple generating sets

General: For multiple generating sets operating in parallel, provide generating sets of the same make and type.

### Mounting

General: Mount the engine and alternator units on a common structural steel frame to support the generating set assembly and the engine local control board.

### Vibration suppression and seismic restraints

General: Conform to General requirements work section.

Vertical and horizontal restraint: Support the mounting frame on vibration isolating mountings complete with seismic snubbers or captive type vibration isolation mounts.

### Coupling

General: Directly couple the engine and generator shafts with a self-aligning type coupling, capable of transmitting the engine maximum output torque under operating conditions, including starting and overload.

## ALTERNATORS

### General

Standards: To AS 60034.1, AS 60034.5, AS 60034.7, AS 60034.8, AS 60034.9 and AS 60034.11.

Voltage waveform: Sinusoidal, with total wave form deviation not exceeding 10%. Excitation: Provide self-regulated brushless type exciters.

Overspeed: Withstand a speed of 1.2 times unit rated speed for both alternator and engine.

Alternator underspeed withstand: Normal operation at net continuous rated output at a speed of 0.95 times unit rated speed, without overheating.

Sustained short-circuit withstand: At least 2.5 times full load steady state short-circuit current, for at least 5 s.

Number of poles: 4.

Enclosure classification: IP21, with screened ventilation openings. Cooling method classification: Class IC 01, to AS 1359.106.

Insulation classification: Thermal class 180 (H), to IEC 60085.

### Anti-condensation heaters

General: Provide at least 2 anti-condensation heaters within the winding enclosure.

Rating: Rate heaters to maintain the windings and insulation at least 6°C above ambient temperature when the alternator is at rest and one heater is in service.

Location: Locate a heater at each end of alternator windings in a position which allows heat transfer to the winding insulation by convection, without exceeding maximum allowable insulation temperature.

Do not fix heaters to windings.

Terminations: Connect heaters to separate identified terminals within a separate accessories terminal box which is connected to a permanent supply.

Connection diagram: Provide a connection diagram for the heaters. Locate within the terminal box.

### Winding thermistors

General: Provide thermistors to alternator stator windings. Standard: To AS/NZS IEC 60947.8 and AS 60034.11.

Thermistor type: Positive temperature coefficient. Thermistor temperatures:

* Engine shutdown: 160°C.
* Winding temperature high pre-alarm: 140°C.

### Terminal boxes

Construction: Provide metal terminal boxes sized to allow the neat installation and termination of the current transformers, power and control cables and cable lugs with necessary clearances between live parts and the box, and without placing undue strain on termination points.

Supply cable terminal box: Provide removable lid and side covers.

Terminals: Provide star connected windings. Bring both ends of each winding out to separate terminals. Establish a neutral terminal.

Sealing: Provide neoprene or bonded cork gaskets between terminal boxes and their frames and covers.

Marking: To AS 60034.8.

## ENGINES

### General

General: Provide a permanent test load either using the building load or a permanent resistive test load.

Resistive test load: Provide a separate fan cooled, resistive test load connected to the generating set control panel.

Arrangement: Enclose test load resistors and fan and associated switchgear and controls in 2 segregated enclosures within a common ventilated sheet metal enclosure.

Type: Turbocharged diesel engine.

Sizing: Take into account the nature of loads including auxiliaries, harmonics and transient operation.

Bearings: Provide front and rear main bearings, so that crankshaft alignment is not affected by dismantling of the alternator.

### Governing

General: Provide electronic or mechanically controlled governors connected to the alternator.

Rotational speed: To operate continuously at 1500 r/min from no-load to the maximum rated electrical load.

Filters: Provide filters to prevent interference with the operation of the governor, overspeed or underspeed cut out devices from harmonics or switching spikes generated by the load.

Governing accuracy: Class M3, to AS 4594.

Governor adjustments: Provide adjustment settings for the following:

* Speed droop.
* Stability.
* Maximum speed.
* Acceleration rate.
* Load gain.

## DIESEL FUEL STORAGE

### General

General: Conform to the *Liquid fuels* work section.

## CONTROLS

### General

General: Provide automatic and manual modes to start and shut down generating sets in the selected sequence and, if operating in parallel, share the load to optimize their rated kW and kVAR capacities. **Manual sequence control**

General: Provide controls to manually, start, synchronize and shut-down each generating set. Include emergency stop, synchroscope, meters, selector switches, check synchronizer and status indicating lights.

### Automatic start control

General: Provide for the following:

* When a start signal is received, generating sets start automatically, come on-line and, if appropriate synchronize before connecting to the load.
* Connection of alternators for sequential control of load sharing/shedding.
* Shutdown of alternate machines.

### Automatic engine shutdown

General: Provide for generating sets to run to suit the load demand until receipt of the mains restored signal is received. At this point the automatic sequenced engine shutdown signal must be activated after an adjustable time delay of 0 to 30 min.

### Engine shutdown

General: Provide a shutdown control system which disconnects the alternators, and shuts down engines upon the occurrence of fault conditions, so that:

* Engines cannot be restarted before safety devices have been manually reset and system alarm sensors have returned to the normal state.
* The overspeed shutdown acts directly to disconnect the fuel supply independent of the governor.
* The shutdown control system may be reset by the operation of one reset switch, after safety devices have been manually reset.

### Emergency and fault shutdown

General: Provide for the following conditions to register as audible and visible alarms and to cause each generating set main circuit breaker to open immediately and each generating set to immediately shutdown:

* Emergency stop push-button: Pressed.
* Generating set: Over voltage.
* Generating set protection: Activated.
* Generating set: Over current.
* Engine: Overspeed.
* Engine oil pressure: Low.
* Jacket water temperature: High.

### Automatic synchronizing

General: Provide synchronizing modules which automatically synchronize each incoming alternator supply frequency and phase angle to the live busbars.

### Emergency stop push-buttons

Generating sets < 2 m long: Provide one push-button per generating set.

Other generating sets: Provide 2 push-buttons per generating set. Locate one on each side or locate one of the push-buttons in the engine local control board.

Type: 40 mm diameter red, palm operated type mounted in a metal wall box fixed to a free standing U channel pedestal. Wire to disconnect the generator and immediately shut down the engine when the controls are in the automatic or manual mode.

## CONTROL PANELS

### General

Requirement: Provide control panels, switchgear and control gear assemblies to the *0942 Switchboards – custom-built*, *0943 Switchboard components* work sections and as documented.

Equipment: Accommodate equipment operating in parallel and stabilize load sharing between each generating set at all load steps. Include reverse power interlock.

### Engine local control board

General: For each generating set, provide the following:

* Key operated local engine start/stop control.
* Controls for auto/off/manual/load test.
* Emergency manual shutdown.
* Analogue indicating meters with minimum 1% accuracy: Speed indicator, kW meter, frequency meter, ammeter, voltmeter, kVAR meter, power factor meter, and hours run meter.
* Indicator showing generating set under local control.
* Oil pressure indicator.
* Coolant temperature indicator.
* Undervoltage protection: Adjustable down to 90% rated voltage with time delay 0 to 10 s.
* Under frequency protection with two stages:

. First stage: Adjustable 47 to 50 Hz with time delay 0 to 10 s.

. Second stage: Adjustable down to 40 Hz and with instantaneous trip.

* Automatic voltage regulator consisting of the following:

. Switch to select manual or automatic voltage control.

. Solid-state type automatic voltage regulator.

* Under and overvoltage sensing.
* Power transducers.
* Over and underspeed sensors.

Alternator output control: For overload and fault protection provide the following:

* Type: Circuit breaker.
* Rating: To protect the alternator. Alternator voltage control:
* Manual control adjustment.
* Automatic voltage regulator:
* Voltage adjustment.
* Set point adjustment.

## BATTERIES AND CHARGERS

### General

Requirement: Provide separate batteries and charger systems for the following:

* + - Engine start.
    - Control and alarm functions.

### Standards

Engine start batteries: To AS 4029.1, AS/NZS 4029.2 or AS 4029.3. Battery chargers: To AS 4044.

Control and alarm batteries: To AS 3731.1, AS 3731.2, AS/NZS 4029.2 or AS 4029.3.

### Starting batteries

Location: Locate in proprietary battery holders attached to the generating set, or on purpose-built stands next to the set and constructed of timber or other corrosion resistant material. Isolate batteries from vibration.

Covers: Provide a high-impact resistant transparent cover for each battery.

Capacity: Sufficient to crank the engine for 3 successive attempted starts, repeated at 5 min intervals. Isolator: Provide a lockable isolator to prevent accidental starting.

### Starting batteries chargers

General: Select the charger to suit the batteries supplied.

Mains power: Connect chargers to the mains power. Make sure that power is maintained to the charger under all supply conditions.

Alarm outputs: Provide the following local audible and visual alarms together with facilities for extending them via a common alarm output to a remote location:

* + - Mains off.
    - Over voltage.
    - Over current.
    - Low battery voltage.
    - Insufficient charge rate.

### Control and alarm batteries

Location: Segregate battery and charger equipment from generator control equipment.

Capacity: Sufficient to supply full generating set control, monitoring and alarm functions for a period of 48 hours, and then operate circuit breaker and transfer devices for 10 consecutive open-trip-close cycles with mains supply off and at minimum ambient temperature.

### Chargers – control and alarm batteries

General: Select the charger to suit the batteries supplied.

Alarm outputs: Provide the following local audible and visual alarms together with facilities for extending them via a common alarm output to a remote location:

* + - Mains off.
    - Over voltage.
    - Over current.
    - Low battery voltage.
    - Insufficient charge rate.

## STARTING

### Electric starting

General: Provide starter motors, batteries and chargers, and associated control equipment to automatically start each engine.

Wiring: Wire starter motors so that starter motor solenoid contacts are on the active side and field windings are at earth potential when the motor is de-energized. Provide an interlock, connected directly to the engine, to prevent the starter motor operating when the engine is running.

Starting interlock: Provide a starting lock out system which prevents further starting attempts after 3 successive unsuccessful attempts.

## ACOUSTIC ENCLOSURES

### General

General: Provide weatherproof acoustic enclosures to surround generating sets, including inlet and outlet sound attenuators.

### Sound pressure level limit

General: 85 dB (A) at 12 locations 1 m from the enclosure exterior surface, at 1.5 m above floor or roof levels, measured with the generating set operating at constant maximum rated full load output, with doors closed and service penetrations sealed.

### Dimensions

General: Size enclosures to accommodate diesel engine inlet and outlet attenuators and permit an unobstructed walkway at least 600 mm wide between the generating set and internal face of the enclosure.

### Doors

General: Provide doors of same material as the enclosure. Provide door stays to each door.

### Ventilation

General: Provide ventilation to the enclosure so that:

* With generating sets running at full rated output the enclosure temperature rise does not exceed 10°C.
* Hazardous concentrations of toxic or explosive fumes and gases are prevented.

## MARKING

### Rating plates

Temperature-rise limits: If temperature-rise limits are achieved by de-rating an oversized generator, state the de-rated value.

Alternator mass: State alternator mass.

### Thermistor detector identification and warning plates

Thermistors: Provide details of thermistor type classification and reference temperature. Warning: Provide a warning engraved in 4 mm high lettering as follows:

* WARNING – Do not apply more than 2.5 V across the protection thermistor devices.

Anti-condensation heater identification and warning: Locate next to heater terminals. State the number, voltage and power rating of the heaters, and the following separate warning engraved in red letters on a white background:

* WARNING – Anti-condensation heater. Circuit is live when the set is off.

### Auxiliary wiring

Ferrules: Provide to wiring ends identifying each conductor.

### Engine direction of rotation

General: If driving shafts or associated rotating parts are accessible, clearly and permanently mark the direction of rotation on an adjacent fixed surface.

Rotation identification: Provide a label within the supply cable terminal box identifying the relationship between the direction of rotation and the marking of terminals.

### Charger enclosure markings

General: Provide enclosure with the following:

* Manufacturer’s rating plates.
* Markings to AS 4044.

Plate material: Stainless steel.

## EXECUTION

* 1. **GENERAL**

### Plinths

General: Provide reinforced concrete plinths for floor mounted equipment, sized to suit equipment footprints.

### Resilient mounts

General: Provide at least 6 resilient mounting blocks between the frame and the plinth.

### Drip trays

General: Provide removable drip trays under those parts of the assembly where fuel or lubricant leakage may occur. Provide overflow outlet pipes taken to a point where a receptacle can be fitted under the pipe outlet.

Capacity: At least 1.5 times the oil capacity of the engine sump. Material: 1.6 mm galvanized steel with brazed joints and rolled edges.

## PERMANENT TEST LOAD

### General

General: Provide a permanent, fan cooled, resistive test load connected to the generating set control panel.

Arrangement: Enclose test load resistors and fan and associated switchgear and controls in 2 segregated enclosures within a common ventilated sheet metal enclosure.

Degree of protection:

* Indoor locations: IP41.
* Outdoor locations: IP55.

Rating: At least 50% rated output of combined generating sets.

Resistor bank: 415 V, 3 phase, delta connected, stainless steel finned, sheathed element type. Interconnect resistors with nickel plated copper links supported on stand-off insulators. Arrange resistor banks to suit switched load steps.

Resistor bank switching: Switched in at least 3 equal load steps, from the generating set control panel. Internal wiring:

* Connection to elements: 150°C silicone rubber insulation.
* General internal wiring: V-90HT insulation.

Circuit breakers: Provide a main circuit breaker to connect the alternator supply and individual circuit breakers for each resistor group.

Protection: Provide a thermal overload relay for fan motor protection. Provide safety interlocks to disconnect the load if ventilation air flow is restricted or resistor temperature limits are exceeded.

Fan run-on: 5 min after load disconnection.

Remote monitoring: Provide outputs for remote monitoring of the following:

* Load step indication.
* Fan run-on.
* Common alarm for fan motor overload, air flow restriction, and safety interlock operation.

## ENGINE COOLING

### General

Requirement: Provide a cooling system consisting of radiators, fans and pumps. Cooling air ductwork: Connect the cooling air outlet to generator room cooling air outlet.

## ENGINE AIR INTAKE

### General

Filters: Provide dry type air intake filters of sufficient capacity to permit continuous engine operation for 200 hours before filter servicing becomes necessary. Provide filter manometers.

Ductwork: To AS 4254.2.

Fans: Provide a fan selected for the installed system air pressure drop. Include power absorbed by the fan under site operating conditions when calculating generator output.

## EXHAUST SYSTEM

### General

Requirement: Provide exhaust piping from the engine complete with silencers, piping, ductwork, supports and expansion devices.

### Exhaust piping

Material: Type 321 Stainless steel.

Diameter: Match engine exhaust manifold connection.

Connections: Provide flanged connections to silencers and pipe interconnections. Vibration isolation: Provide a stainless steel flexible connection to the engine.

### Weatherproofing

General: Provide weatherproof flashing, sleeves and acoustic seals where the exhaust system penetrates the roof or external walls.

### Exhaust drainage

General: Grade the exhaust line away from the engine to drainage pockets, or connect to a suitable drainage outlet.

### Exhaust pipe insulation

General: Insulate the full length of exhausts within buildings.

Insulation Material: Mineral wool, suitable for temperatures up to 260°C. Maximum thermal conductivity: 0.036 W/m.K at 20°C.

Minimum thickness: 50 mm.

Application: Wrap insulation around exhaust pipes. Hold in place with 12 mm x 0.55 mm zinc-coated steel straps at 600 mm maximum centres.

Sheathing: Sheath insulation as follows:

* Sheathing not exposed to weather: 0.55 mm metallic-coated steel sheet.
* Sheathing exposed to weather: 0.55 mm metallic-coated steel sheet or 0.8 mm (minimum) aluminium sheet.
* Joints: Lap joints in sheathing at least 30 mm and rivet or screw at 150 mm maximum centres.
* Edges: Neatly cut around nozzles and cone down to flanges.
* Terminations: At terminations, return edges of sheathing to protect edges of insulation.

## DIESEL FUEL SYSTEM

### General

Requirement: Comply with the *0754 Liquid fuels* work section.

### Fuel connections

Fuel piping and associated auxiliary equipment: To AS 1940.

### Stop valves

General: Provide stop valves on the inlet to, and outlets from, the daily service tank.

## COMPLETION

### Completion tests

General: For each generating set carry out the following:

* + - Check tightness of connections and securing devices.
    - Verify correctness of operation of protection devices and systems including sensor settings. Simulate actual conditions as far as possible, in order to test responses to faults imposed.
    - Before to connecting the generator to mains supply or project loads, verify that the correct electricity supply phase sequence is provided at switchboards and control panels, and that circuit protective devices are correctly sized and adjusted.
    - Functional checks to AS 4594.1 Table 7, List C, items C1 to C5 inclusive.
    - Cold start with the engine having been at rest for the previous 24 hours, timed from receipt of mains failure signal to acceptance of full rated load in 3 load steps to within the limits of output voltage and frequency.
    - Continuous operational trial consisting of:

. 4 hours at 100% rated power.

. 1 hour at 110% rated power.

. 30 min at 75% rated power.

. 30 min at 50% rated power.

* + - Record fuel consumption for each step of the continuous trial.
    - Sample engine oil from engine sump before and after tests. Perform laboratory analysis and submit a report on each oil sample.
    - Continuous operational trial: During the trial, measure the following at maximum intervals of 30 minutes:

. Generator kW and kVAR output.

. Generator output voltage.

. Generator output current.

. Generator output frequency.

. Power factor.

. Oil pressure and water temperature.

. Electrical power requirements of continuously running electric motor driven ancillaries.

. Each battery charger current and voltage readings.

. Noise level.

Synchronization and load sharing tests: For generating sets running in parallel perform tests to verify automatic synchronization and load sharing including the following:

* + - Sequence start and shutdown of each generating set.
    - Parallel operation of generating sets.
    - Synchronizing of generating sets.
    - Equal load sharing of kW and kVAR over 5 equal load steps.
    - Neutral switching sequence and operation, where provided.
    - Operation of controls, switchgear and auxiliaries.

### Temporary test loads

General: Provide test loads including power and control wiring, ancillary equipment and test instruments to achieve the kW, kVAR and necessary load steps.

### Reports

General: Submit reports from manufacturers or suppliers verifying the performance of safety and control functions of each system.

## MAINTENANCE

### General

Call out: Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults and replace faulty materials and equipment.

## SELECTIONS

* 1. **SCHEDULES**

**Performance schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Net continuous rated output (kVA) |  |  |  |
| Overload kVA output |  |  |  |
| Overload time duration |  |  |  |
| Rated voltage (V) |  |  |  |
| Number of phases |  |  |  |
| Neutral connection |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Earthing |  |  |  |
| Frequency (Hz) |  |  |  |
| Duty-type to AS 60034.1 |  |  |  |
| Voltage regulation grade to AS 60034.1 |  |  |  |
| Compensation |  |  |  |
| Machine location |  |  |  |
| Altitude (m) |  |  |  |
| Available cooling water temperature (C) |  |  |  |
| Degree of protection (IP rating) |  |  |  |
| Other relevant site conditions |  |  |  |

## DIESEL FUEL STORAGE TANKS

**Fuel storage tank schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Day storage capacity (hours at net continuous rated kVA) |  |  |  |
| Bulk storage capacity (hours at net continuous rated kVA) |  |  |  |

## SYSTEM CONTROL PANEL

**System control panel schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Neutral switching |  |  |  |
| Automatic starting: Sensing voltage range |  |  |  |
| Automatic starting: Set point adjustment |  |  |  |
| Indicating devices: General size |  |  |  |
| Indicating devices: Types |  |  |  |

**6.0 POWER GENERATION – PHOTOVOLTAIC**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide photovoltaic generating system(s) as documented.

### Performance

Requirement: Incorporate the following:

* Photovoltaic array.
* Regulator.
* Battery system.
* Inverter.
* Connection to low voltage power system.

### Design

Irradiation data: Australian Bureau of Meteorology.

### System provider

Requirement: An installer with the Clean Energy Council accreditation.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Building management systems*.
    - *Electrical systems*.
    - *Cable support and duct systems*.
    - *Low voltage power systems*.
    - *Switchboards – proprietary*.
    - *Switchboards – custom-built*.
    - *Switchboard components*.
    - *Lightning protection*.

## STANDARDS

### General

Requirement: For the purpose of this work section, the following standards relating to stand- alone systems are also applicable to network connected systems:

* + - Stand-alone power systems: To AS/NZS 4509.1 and AS/NZS 4509.2.
    - Grid connected systems: To AS 4777.1, AS 4777.2 and AS 4777.3.

- IEC 61836.

## INTERPRETATION

### Definitions

General: For the purpose of this work section the definitions given in AS/NZS 4509.2 apply.

## SUBMISSIONS

### Operation and maintenance manuals

Standard: To AS/NZS 4509.1

Requirement: Submit all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Rebate application

General: Submit complete timely application documentation for a grant under the appropriate Rebate Program.

### Shop drawings

General: Submit shop drawings, to a scale that best describes the detail, showing the following:

* General arrangement of equipment.
* Single line schematic showing the interconnection with the building electrical system.
* Access clearances for operational maintenance and dismantling.
* Electrical single line diagram and general arrangement for the complete system.
* Control diagrams.
* Support details.

### Technical data

General: Submit technical data including the following:

* Technical description and specifications of each component.
* Calculations and assumptions for all selections and systems.
* Type test reports.

### Tests

General: Before the date of practical completion submit test reports from manufacturers or suppliers verifying the performance of safety and control functions of each system.

## PRODUCTS

* 1. **SYSTEM SELECTION**

### General

Selection: To meet the system requirements, as documented. Marking: To AS/NZS 5033.

## PHOTOVOLTAIC MODULE

### General

Selection: To AS/NZS 4509.2, AS/NZS 5033 and as documented.

### Array

Encapsulation: Required. Toughened glass: Required. Protection rating: ≥ IPX6.

Integral bypass diode protection: Required.

### Cells

Type: Polycrystalline. Standard: To IEC 61215. Efficiency: ≥ 12%.

## REGULATOR

### General

Selection: To AS/NZS 4509.2 and as documented. Function: Charge cycle control including:

* + - Low battery voltage disconnect.
    - Pulse width modulation.
    - ≥ 3 step series regulation. Display: LCD display of:
    - Battery voltage.
    - Charge current.
    - Ampere hours in and out.
    - Load current.

Alarms: Visible and audible low and high battery voltage alarms. Transient protection: Required.

## BATTERY SYSTEM

### General

Selection: To meet the documented performance.

Blocking diodes: Required. Service life: ≥ 10 years.

### Standards

General: To AS 2676 and AS 4086.1.

## INVERTER

### General

Selection: To meet the documented performance. Waveform: True Sine wave.

Waveform quality: To AS 4777 series. Voltage regulation: ± 8%.

Harmonic distortion of output current:< 4%. Frequency regulation: ± 1%.

Efficiency: ≥ 90% at 10% load.

Protection: Overload, short circuit and transient required. Automatic no-load shutdown: Required.

Display:

* Output power.
* Grid stability.

### Standards

General: To AS 4777.2 and AS 4777.3.

### Synchronization

Requirement: Self commutation modules which automatically synchronize the inverter supply frequency and phase angle to the low voltage network or other embedded generator system.

## CONTROL SYSTEM

### Control panel

General: Provide photovoltaic system control panels, switchgear and control gear assemblies to the

*Switchboards – custom-built* and *0943 Switchboard components* work sections and as documented.

PV switch disconnectors: Non polarity sensitive switch disconnectors to AS/NZS 5033 clause 4.3 for both circuit breakers and disconnect devices used to isolate PV panels.

## EXECUTION

* 1. **INSTALLATION**

### General

Standard: To AS/NZS 5033. **Photovoltaic array** Location: As documented.

Orientation: Fixed to AS/NZS 4509.2.

Tilt: Fixed to AS/NZS 4509.2 and AS/NZS 4509.1. Wind loading: To AS/NZS 1170.2.

PV Array Disconnectors: Cable connections to the disconnector to manufacturer's requirements. Lightning protection: Connect to photovoltaic array support system.

### Regulator

Location: As documented. **Battery system** Standard: To AS 4086.2. Location: As documented.

Enclosure: To AS/NZS 4509.2.

Support: Mount in proprietary battery holders or on purpose-built stands constructed of timber or other corrosion resistant material.

### Inverter

Location: As documented.

Standard: To AS 4777.1.

### Low voltage connection

General: Connect to low voltage power system as documented. Surge diversion: Required.

### Earthing

Standard: To AS/NZS 5033.

### Support

Roof mounted plant and equipment: Supports as documented. Ground level mounted plant and equipment: Support as documented.

## COMPLETION

### Completion tests

General: To AS/NZS 4509.1 and AS/NZS 5033.

### Warranties

General: Provide manufacturers and installers warranties as documented.

## MAINTENANCE

### General

Stand-alone power systems: Maintain the system to AS/NZS 4509.1 during the defects liability period.

Grid connected systems: Maintain the system to AS/NZS 5033 Appendix H during the defects liability period.

Call out: Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults and replace faulty materials and equipment.

## SELECTIONS

* 1. **PERFORMANCE**

**System performance schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Design daily energy consumption: Summer |  |  |  |
| Design daily energy consumption: Autumn |  |  |  |
| Design daily energy consumption: Winter |  |  |  |
| Design daily energy consumption: Spring |  |  |  |
| Oversupply coefficient |  |  |  |
| Connected load maximum demand |  |  |  |
| Connected load power factor |  |  |  |
| Surge demand |  |  |  |
| Provision for future load growth (%) |  |  |  |
| Rated output voltage (V) | 230/400 | 230/400 | 230/400 |
| Frequency (Hz) | 50 | 50 | 50 |
| Number of phases | 1 | 1 | 1 |
| Load harmonic characteristics |  |  |  |
| Neutral connection |  |  |  |
| Earthing |  |  |  |
| Autonomy days |  |  |  |
| Array location/mounting/support |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Regulator location/housing/IP rating |  |  |  |
| Battery location/housing |  |  |  |
| Battery discharge depth (max) |  |  |  |
| Inverter location/housing/IP rating |  |  |  |
| Warranties: Crystalline modules (years) | 20 | 20 | 20 |

**7.0 UNINTERRUPTIBLE POWER SUPPLY**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide uninterruptible power supplies, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Building management systems*.
    - *Electrical systems*.
    - *Switchboards – proprietary*.
    - *Switchboards – custom-built*.
    - *Switchboard components*.

## STANDARD

### General

Requirement: To AS 62040.2 and AS IEC 62040.3. Electronic compatibility (EMC) requirements: To AS 62040.2.

Classification of uninterruptible power supply (UPS): Unrestricted sales distribution (Class A-UPS). Converters: To AS 60146.2.

Inverters: To AS/NZS 5603.

Batteries: To AS/NZS 4029.2 or AS 4029.3.

Batteries installation: To AS 2676 series and AS 3011 series.

### Authorities

EMC: Comply with the requirements of the Australian Communications and Media Authority.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - EMC: Electromagnetic compatibility.

### Definitions

General: For the purposes of this work section the following apply:

* + - Uninterruptible power supply (UPS): Battery operated static inverter system with automatic controls to provide electrical power in the event of an interruption to the primary power supply.

## SUBMISSIONS

### Design

Standard: Submit technical data to AS IEC 62040.3.

Calculations: Submit calculated input power factor and harmonic content.

### Operation and maintenance manuals

Standard: To AS/NZS 4509.1.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Shop drawings

General: Include the following:

* The UPS system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations, and necessary clearances.
* Functional block diagram.
* The general arrangement of the remote manual by-pass switch/cabinet and indication/alarm panel with details of installation requirements.
* Type and rating of equipment items.
* Battery layout and associated details.

## PRODUCTS

* 1. **SYSTEM**

### Performance

Environment: Provide systems suitable for operation under the documented special service conditions. Module type: Single module.

Mode: Single. Redundancy: n+1.

Operation: On-line double conversion. Transfer switch: Electronic automatic. By-pass supply: Prime.

Automatic bypass: An automatic, no break, integral static by-pass switch with automatic reset to transfer the load automatically to the by-pass supply when the UPS output characteristics are outside the designated limits.

Maintenance by-pass: A manual by-pass switch to transfer the load to the by-pass supply, by-passing the UPS and static by-pass switch.

Interrupters: Individual. Isolation switches: Required. Battery charger: Integral.

### Protection

Discrimination: Provide main circuit breakers, both input and output within the UPS to fully discriminate with upstream and downstream protection.

Components: Provide component protection to minimise damage and downtime in the event of component failure.

Output: Provide protection against output overload and short circuit to ensure output short circuits will not damage the UPS.

Safety interlocks: Provide interlocks to prevent accidental damage to the UPS during maintenance and normal operation.

## RECTIFIER

### General

Performance: To meet system requirements.

## BATTERY CHARGER

### General

Performance: To meet system requirements.

## BATTERY

### Performance

General: Conform to the **Battery schedule**, as documented. Type: Sealed lead acid, recombination type.

Service life: ≥ 10 years.

## INVERTER

### General

Performance: To meet system requirements. Testing: To AS/NZS 5603.

Classification: Class A to AS/NZS 5603. Submissions: To AS/NZS 5603 Appendix B.

## MONITORING AND CONTROL

### Local functions

Local control facilities:

* + - Incoming mains isolation.
    - If batteries are not contained within the UPS enclosure: Battery supply isolation.
    - Manual bypass, to isolate the UPS and maintain power to connected equipment. Local monitoring facilities:
    - Incoming mains: On, off, trip.
    - Battery supply: On, off, trip.
    - Overtemperature shut down: Activated.
    - System automatic bypass: Activated. Local audible and visual alarms:
    - Overload shutdown.
    - High temperature warning.
    - Overtemperature shutdown.
    - Battery contactor open.
    - Low battery.
    - d.c. overvoltage.
    - Input power failed.
    - Output overvoltage.
    - Output undervoltage.
    - Static switch on manual.
    - Load on bypass.
    - UPS free running.

## COMPLETION TESTS

### General

Standard: To AS IEC 62040.3.

### Test loads

General: Supply reactive test loads including power, control wiring and ancillary equipment.

Function: To achieve the kW, kVAr and load steps necessary to demonstrate and verify the designated steady state and transient frequency and voltage responses and waveform deviation tests. **Functional unit tests**

Rectifier: Factory tests to AS IEC 62040.3 and AS 60146.1.1. Inverter: Factory tests to AS IEC 62040.3 and AS 60146.2.

Switch: Factory tests to AS IEC 62040.3 and AS 60146.1.1. Monitoring and control: Factory tests to AS IEC 62040.3.

Battery:

* Factory tests to AS IEC 62040.3 clause 6.6.4, including rated stored and restored energy time tests and battery ripple current measurement.
* Capacity test to **AS 4029**. **Complete UPS**

On-site tests: Provide routine and optional tests as documented in the **On-site tests schedule**.

EMC: To AS 62040.2.

Power line condition: Test input power factor and harmonic content on completed installation.

## EXECUTION

* 1. **COMPLETION**

### Spares

General: Supply spare parts necessary to maintain the mean time to repair. Storage: Package and label spare parts for long-term storage within the UPS room.

### Completion tests

General: Test run the UPS system continuously connected to the test load, for at least 48 hours. Record line and load voltage, current frequency and temperature measurements.

### On-site tests

General: As documented.

## MAINTENANCE

* 1. **GENERAL**

Requirement: Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

## SELECTIONS

* 1. **UNINTERRUPTIBLE POWER SUPPLY**

**Special service conditions schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| **Environmental** |  |  |  |
| Damaging fumes |  |  |  |
| Moisture |  |  |  |
| Dust |  |  |  |
| Steam |  |  |  |
| Explosive dust or gas |  |  |  |
| Salt air |  |  |  |
| Weather/water |  |  |  |
| Temperatures (°C) |  |  |  |
| Water quality |  |  |  |
| Electromagnetic fields |  |  |  |
| Excessive radio-active levels |  |  |  |
| Fungus, insects, vermin etc. |  |  |  |
| Limited ventilation |  |  |  |
| Heat sources |  |  |  |
| Battery service conditions |  |  |  |
| **Mechanical** |  |  |  |
| Vibration, earthquakes |  |  |  |
| Transportation/storage conditions |  |  |  |
| Space, weight limitations |  |  |  |

**Inputs schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| **Primary supply** |  |  |  |
| Supply impedance |  |  |  |
| Supply configuration |  |  |  |
| Supply voltage/variations |  |  |  |
| Supply frequency/variations |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Superimposed high frequency voltages |  |  |  |
| Existing voltage harmonics at the point of common coupling |  |  |  |
| Transient voltages/noise |  |  |  |
| Protective device characteristics |  |  |  |
| All-pole isolation requirements |  |  |  |
| **Standby supply** |  |  |  |
| Full characteristics |  |  |  |
| Control functions |  |  |  |

**Load schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Continuous apparent power |  |  |  |
| Power factor |  |  |  |
| Phases |  |  |  |
| Inrush currents |  |  |  |
| Load balance |  |  |  |
| Non-linearity/harmonics |  |  |  |
| Duty |  |  |  |
| Load profile/start-up |  |  |  |
| Circuit protection/control |  |  |  |

**Output schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Rated output power |  |  |  |
| Rated power factor |  |  |  |
| Number of phases |  |  |  |
| Nominal output voltage |  |  |  |
| Steady state and transient tolerance bands |  |  |  |
| Nominal output frequency and tolerance band |  |  |  |
| Synchronization requirements |  |  |  |
| Harmonic requirements |  |  |  |
| Modulation requirements |  |  |  |
| Voltage control range |  |  |  |
| Phase angle tolerance |  |  |  |
| Unbalanced load capability |  |  |  |
| Protection coordination requirements – Load |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Protection coordination requirements – Supply |  |  |  |

**Battery schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Nominal voltage |  |  |  |
| Capacity (ampere hour) |  |  |  |
| Rated stored energy time |  |  |  |
| Rated restored energy time |  |  |  |
| Additional d.c. loads |  |  |  |
| Enclosure details |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Control |  |  |  |
| Monitoring |  |  |  |
| Alarms |  |  |  |
| Shutdown management |  |  |  |
| Protocol | SNMP | SNMP | SNMP |
| Communications |  |  |  |
| Graphical user interface |  |  |  |

**On-site tests schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Interconnection cable check | Required | Required | Required |
| Light load test |  |  |  |
| UPS auxiliary devices test |  |  |  |
| Synchronisation test |  |  |  |
| a.c. input failure test |  |  |  |
| a.c. input return test |  |  |  |
| Simulation of parallel redundant UPS fault |  |  |  |
| Transfer test |  |  |  |
| Full load test |  |  |  |
| UPS efficiency test |  |  |  |
| Electromagnetic compatibility test |  |  |  |
| Harmonic distortion of input current test |  |  |  |
| Residual earth current test |  |  |  |
| Standby generator compatibility test |  |  |  |

**8.0 SWITCHBOARDS – PROPRIETARY**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide proprietary switchboards, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

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

## STANDARDS

### General

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

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

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

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Products

Data for proprietary assemblies: Submit the following:

* Makes, types and model numbers of items of equipment.
* Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data
* Overall dimensions.
* Fault level.
* IP rating.
* Rated current of components.
* Number of poles and spare capacity.
* Mounting details.
* Door swings.
* Paint colours and finishes.
* Access details.
* Schedule of labels.

### Tests

General: To AS/NZS 3439.1.

Type tests: Submit results, as follows:

* Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory test data.
* Testing facility: Accredited by a NATA registered testing authority. Routine tests: Submit results, as follows:
* Assemblies: Electrical and mechanical routine function tests at the factory using externally connected simulated circuits and equipment.
* Dielectric testing: 2.5 kV r.m.s. for 15 s.

## INSPECTION

### Notice

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

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

## PRODUCTS

* 1. **GENERAL**

### Enclosure

Default material: Metallic-coated sheet steel.

**Separation** Default: Form 3a. **Metering**

Requirement: To the *Low voltage power systems* work section.

### Busbars

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

### Spare capacity

Default spare poles: ≥ 20%.

### Surge protection

General: Provide surge protection as documented.

### Earthing

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

### Doors

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

### IP rating

Default rating: IP42 minimum. Weatherproof: IP56 minimum. **Finishes**

External and interior: Orange X15 or the manufacturer’s standard colour.

* Installed in cupboards, switchrooms and plant rooms: Orange X15 or the manufacturer’s standard powder coated finish.
* Installed elsewhere: Orange X15, the manufacturer’s standard power coated finish or to the documented non-standard powder coated colour.

### Supporting structure

Assemblies:

* Wall mounted: ≤ 2 m2.
* Floor mounted: > 2 m2.

### Ventilation

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

## EXECUTION

* 1. **GENERAL**

### Fixing

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

### Cable entries

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

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

### Cable enclosures

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

### Cable supports

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

## MAINTENANCE

### General

Standard: To AS 2467.

## SELECTIONS

* 1. **PROPRIETARY SWITCHBOARDS**

**Proprietary switchboard schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Special service condition |  |  |  |
| Enclosure material |  |  |  |
| Enclosure colour |  |  |  |
| Bus bar rated current (minimum) |  |  |  |
| Rated short-circuit current (minimum) |  |  |  |
| Form of separation (minimum) |  |  |  |
| Limiting overall dimensions (width, height, depth) (mm) |  |  |  |
| Main isolator rated current (minimum) |  |  |  |
| Provision for future circuits |  |  |  |
| Minimum number of poles (excluding main isolator) |  |  |  |
| Surge protection |  |  |  |
| Metering |  |  |  |
| Provision for control equipment |  |  |  |

**9.0 SWITCHBOARDS – CUSTOM-BUILT**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide switchboards, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

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

## STANDARD

### General

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

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

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

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Custom-built assemblies: Low voltage switchgear and control gear assemblies manufactured to order and incorporating either purpose-built or proprietary components or purpose-built or proprietary busbar assemblies.
    - Fault current limiters: Circuit opening devices designed or selected to limit the instantaneous fault current.
    - Incoming busbars: Busbars connecting incoming terminals to line side terminals of main switches.
    - Main circuit supply busbars: Busbars connecting incoming functional unit terminals, or incoming busbars where no main switches are included, to outgoing functional unit terminals or outgoing functional unit tee-offs.
    - Rated currents: Rated currents are continuous uninterrupted current ratings within the assembly environment under in-service operating conditions.
    - Rated short-circuit currents: Maximum prospective symmetrical root mean square (r.m.s.) current values at rated operational voltage, at each assembly incoming supply terminal.
    - Tee-off busbars: Busbars connecting main busbars to incoming terminals of outgoing functional units.

## SUBMISSIONS

### Calculations

General: Submit detailed certified calculations verifying design characteristics. Standard: To AS 3865 and AS 60890.

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Routine tests

Standard: To AS/NZS 3439.1. General: Submit reports.

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

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

### Shop drawings

General: Submit shop drawings showing:

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

### Technical data

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

### Tests

Standard: To AS/NZS 3439.1.

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

Alterations to TTAs: Submit records of alterations made to assemblies since the tests. Testing facility: Accredited by a NATA registered testing authority.

## INSPECTION

### Notice

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

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

## PRODUCTS

* 1. **CUSTOM-BUILT SWITCHBOARD CONSTRUCTION**

### General

Requirement: Provide custom-built switchboards as documented.

### Switchboard manufacturer

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

### Separation

Default: Form 3a for Main Switch Board and 2b for Distribution board .

### Metering

General: Conform to the *Low voltage power systems* work section.

### Spare capacity

Default spare poles: Minimum 20%.

### Surge protection

General: Provide surge protection as documented.

### Earthing

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

### IP rating

Default rating: IP42 minimum. Weatherproof: IP56 minimum. **Supporting structure** Assemblies:

* Wall mounted: Maximum 2 m2.
* Floor mounted: Greater than 2 m2.

### Ventilation

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

### Layout

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

Connection: Front connected.

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

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

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

### Segregation

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

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

Material: Metallic-coated sheet steel to AS 1397. Material thickness:

* Diagonal dimension:

. < 900 mm: Minimum 1.6 mm.

. ≥ 900 mm: Minimum 2.0 mm.

Coating class:

* Indoor assemblies: Z200.
* Outdoor assemblies: Z450.

### Insect proofing

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

### Equipment mounting panels

General: To support the weight of mounted equipment.

Metallic panels: Construct from metal greater than or equal to 3 mm thick with heavy metal angle supports or plates bolted or welded to enclosure sides.

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

Non-metallic boards: To IEC 60893-1.

### Equipment fixing

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

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

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

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

### Earth continuity

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

### Construction

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

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

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

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

## CABLE ENTRIES

### General

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

### Cover and gland plates

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

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

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

## DOORS AND COVERS

### General

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

### Door layout

Maximum width: 900 mm. Minimum swing: At least 90°.

Door stays: Provide stays to outdoor assembly doors.

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

### Door construction

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

Hinges: Provide the following:

* Generally: Corrosion-resistant pintle hinges or integrally constructed hinges to support doors.
* For removable doors: Staggered pin lengths to achieve progressive engagement as doors are fitted.
* For doors higher than 1000 mm: 3 hinges.
* For non lift-off doors: Restraining devices and opposed hinges. Door hardware: Provide the following:
* Corrosion resistant lever-type handles, operating a latching system with latching bar and guides strong enough to withstand explosive force resulting from fault conditions within the assembly.
* Dual, edge mounted, corrosion resistant T handles with provision for key locking cylinder.
* Captive, corrosion resistant knurled thumb screws as an alternative to handles. Locking: Incorporate cylinder locks in the latching system. Key alike, 2 keys per assembly.

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

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

### Covers

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

Fixing: Fix to frames with at least 4 fixings, using corrosion-resistant acorn nuts with serrated washers. Rest cover edges on the cubicle body or on mullions. Do not provide interlocked covers.

Handles: Provide corrosion-resistant D type handles.

### Escutcheons

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

### Escutcheon plates

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

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

## FACTORY FINISHES

### General

Standard: To AS 2700.

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

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

### Factory finish colours

Mounting structure (brackets): To match enclosure. Enclosure - indoor:

* Indoor assemblies: Orange X15.
* Assembly interior: Orange X15 Enclosure - Outdoor. Enclosure - outdoor:
* Outdoor assemblies: Avocado green G34.
* Assembly interior: White.

Escutcheons - removable equipment panels:

* Internal assemblies: Orange X15.
* External assemblies: Off white Y35.

Doors: To match enclosure. Plinths: Black.

## BUSBARS

### General

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

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

### Custom-built busbar construction

Material: Hard-drawn high-conductivity electrolytic tough pitched copper alloy bars, designation 110. Temperature rise limits - active and neutral conductors:

* Maximum rated current temperature rise limits: 65 ± 1.5°C by type test or calculation to AS 3768 or AS 60890.
* Maximum short-circuit withstand current temperature rise limits: 160°C by calculation to AS 3865.

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

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

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

### Proprietary busbars

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

### Phase sequence

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

### Colour coding

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

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

MEN link: Green-yellow and black. Protective earth busbar: Green-yellow.

Restrictions: Do not provide adhesive type colour bands.

### Current carrying capacity

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

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

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

### Tee-off busbars current rating

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

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

### MEN links

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

Amend to suit the supply authority or project specific requirements.

### Fault current limiters

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

### Busbar links

General: For current transformers, provide removable busbar links less than or equal to 450 mm long.

### Cable connection flags

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

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

### Future extensions

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

### Jointing

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

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

### Custom-built busbar insulation

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

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

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

Damaged insulation: Repair damaged insulation before energizing.

## NEUTRAL LINKS AND EARTH BARS

### Terminals

General: Provide terminals for future circuits.

### Links

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

Assembly capacity ≤ 36 poles: Provide links and bars at the point of entry of incoming supply cables. Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral links and earth bars. Labels: Provide labels for neutral and earth terminals.

Cables > 10 mm2: Provide bolts or studs.

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

## INTERNAL WIRING

### Wiring

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

### Cable interconnections

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

* ≥ 1.5 mm2 internal cables, with minimum V75 insulation rating with stranded copper conductors rated to AS/NZS 3008.1.1. Provide cables with current ratings suitable for the internal assembly ambient air temperature and for temperature rise limits of equipment within the assembly.
* Run cables clear of busbars and metal edges.
* Provide cables capable of withstanding maximum thermal and magnetic stresses associated with relevant fault level and duration.
* Run cables neatly. Provide slotted trunking sized for future cables or tie at 150 mm maximum intervals with ties strong enough to withstand magnetic stresses created at the specified fault current. Do not provide adhesive supports.
* Provide for installation of wiring for future equipment without removal of existing equipment.
* Identify power and control cables at both ends with neat fitting ring type ferrules agreeing with record circuit diagrams. Mark to AS/NZS 4383 series.
* Terminate control cables and motor control circuits in tunnel terminals or, if necessary, provide suitable palm type lugs and correct crimp tool.
* For equipment mounted on hinged doors run cables on the hinge side to avoid restricting the door opening. Bundle cables with spiral wrap PVC and secure to door.
* If recommended by device manufacturers, provide shielded wiring.

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

### Cables > 6 mm²

Terminations:

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

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

* Spacing at enclosure: ≤ 200 mm from a termination.
* Spacing generally: ≤ 400 mm.
* Strength: Capable of withstanding forces exerted during fault conditions.

Single core cables rated ≥ 300 A: Do not provide ferrous type metal cable saddles.

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

### Control and indication circuits

General: Provide conductors sized to suit the current carrying capacity of the particular circuit. Minimum size: 1 mm2 with 32/0.2 stranding.

### Cable colours

General: Colour code wiring as follows:

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

## TERMINATIONS

### Submains, light and power circuits

General: Connect direct to the control equipment terminals.

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

## EXECUTION

* 1. **ASSEMBLY INSTALLATION**

### Fixing

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

## ASSEMBLY ENTRIES

### Cable entries

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

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

### Cable enclosures

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

### Cable supports

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

## MARKING AND LABELLING

### General

Switchboard assembly: Label in conformance with AS/NZS 3439.1 including the following:

* + - Size and type of all incoming and outgoing mains and submains.
    - Emergency operating procedures.

## MAINTENANCE

### General

Standard: To AS 2467.

Requirement: Carry out the following:

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

## SELECTIONS

* 1. **CUSTOM-BUILT SWITCHBOARDS**

**Custom-built switchboard schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Fault level |  |  |  |
| Special service conditions |  |  |  |
| Form of separation |  |  |  |
| Separated compartments of the assembly |  |  |  |
| Limiting overall dimensions (width, height, depth) (mm) |  |  |  |
| Busbar insulation |  |  |  |
| Future bus bar extension |  |  |  |
| Provision for future circuits |  |  |  |
| Surge protection |  |  |  |
| Connection |  |  |  |
| Supporting structure |  |  |  |
| Degree of protection (IP rating) |  |  |  |
| Enclosure category |  |  |  |
| Bus bar rated current (minimum) |  |  |  |
| Rated short-circuit current (minimum) |  |  |  |
| Main isolator rated current (minimum) |  |  |  |
| Metering |  |  |  |
| Provision for control equipment |  |  |  |
| Dimensions (maximum) (mm) |  |  |  |

**10.0 SWITCHBOARD COMPONENTS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide switchboard components, as documented.

## DESIGN

### Statutory authority’s equipment

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

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Switchboards – proprietary*.
    - *Switchboards – custom-built*.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

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

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Submit all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Technical data

General: Submit technical data for all components.

## PRODUCTS

* 1. **REQUIREMENTS**

### General

Selection: Conform to AS/NZS 3000 clause 1.7 and Section 2. Rated duty: Uninterrupted.

Rated making capacity (peak): ≥ 2.1 x fault level (r.m.s.) at assembly incoming terminals. Utilization category: To AS/NZS IEC 60947.1 clause 4.4 and the recommendations of Annex A.

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

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

Enclosure: IP4X minimum.

## SWITCH-ISOLATOR

### General

Standard: To AS/NZS IEC 60947.1 and AS/NZS 3947.3. Poles: 3.

Operation: Independent manual operation including positive ON/OFF indicator. Shrouding: Effective over range of switch positions.

### Load make/load break switch-isolators

Rated making and breaking capacity: As defined in AS/NZS IEC 60947.1 clause 4.3.5 to conform to AS/NZS 3947.3 Table 3 and the manufacturer's recommendations for the prospective fault current conditions.

Rated short-time withstand current: As defined in AS/NZS IEC 60947.1 clause 4.3.5, to conform to the manufacturer’s recommendation for the current conditions.

## OVERLOAD AND FAULT PROTECTION GENERALLY

### General

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

## AUTO-TRANSFER SWITCHES

### General

Standard: To AS/NZS IEC 60947.1 and AS/NZS 3947.6.1.

Type: 3 pole automatic type with supervisory circuits which initiate and restore the changeover transfer operation.

Load side connections: Segregate from incoming side. Classification: To AS/NZS 3947.6.1 clause 3:

* Contactors: PC.
* Circuits: CB.

Utilization category: To AS/NZS 3947.6.1 clause 4.4.

Interlocks: Provide electrical and mechanical interlocks. If circuit breaker is used, provide for isolation of each circuit breaker.

## MOULDED CASE AND MINIATURE CIRCUIT BREAKERS

### General

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

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

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

Operation: Independent manual operation including positive ON/OFF indicator. Trip type: Conform to the following:

* Moulded case breakers: Adjustable thermal, fixed magnetic.
* Miniature circuit breakers: Fixed thermal and fixed magnetic. Isolation facility: Required.

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

Utilization category: Moulded case breakers:

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

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

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

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

## ELECTRICITY DISTRIBUTOR’S SERVICE PROTECTIVE DEVICES

### General

Low voltage service protective devices: To AS/NZS 3000, the electricity distributor’s requirements and the supply authority Service and Installation rules.

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

## RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCBO)

### General

Standard: To AS/NZS 3190.

Integral non-overload protection type: To AS/NZS 61008.1. Integral overload protection type: To AS/NZS 61009.1.

Modular type: To AS/NZS IEC 60947.2.

- Type II.

. Default tripping current: 30 mA.

## AIR CIRCUIT BREAKERS

### General

Standard: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.2.

Type: Open construction, withdrawable 3 pole, front connected. Utilization category: Category B.

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

Opening operation: Provide independent manually operated release for opening.

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

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

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

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

Mechanical Interlock: Provide cable or bar interlocks.

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

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

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

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

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

### Withdrawable type

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

* Connected.
* Test/isolated.
* Disconnected.

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

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

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

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

## SURGE PROTECTION DEVICES (SPD)

### General

Standard: To IEC 61643-11 and IEC 61643-12.

Installation: To AS/NZS 3000 Appendix F.

### Primary protection

General: Provide shunt connected metal oxide varistor based SPDs between each phase and neutral at assembly incoming supply terminals, on the load side of incoming functional units.

### Type I SPD

Surge Rating: Imax ≥ 150 kA per phase to neutral.

Surge Rating: Imax ≥ 100 kA neutral to earth if remote from the MEN earthing system. Residual Voltage: Up < 800 V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life visible from the switchboard front panel.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 63A HRC fuse.

### Type II SPD

Surge Rating: Imax ≥ 100 kA per phase to neutral.

Surge Rating: Imax ≥ 100 kA neutral to earth if remote from the MEN earthing system. Nominal discharge current: 40 kA (8/20µs).

Residual Voltage: Up < 800 V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life visible from the switchboard front panel.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 63A HRC fuse.

### Secondary protection

General: Provide shunt connected metal oxide varistor based SPDs between each phase and neutral and a gas discharge tube between neutral and earth at assembly incoming supply terminals, on the load side of incoming functional units and upstream of RCD devices.

### Type III SPD

Surge Rating: Imax ≥ 50 kA per phase to neutral. Surge Rating: Imax ≥ 20 kA neutral to earth.

Residual Voltage: Up < 800 V @ 3 kA.

Visual indicator: Provide visual indication of SPD status and life.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker or 32A HRC fuse. Connecting lead lengths should not exceed 300 mm.

### Combined primary and secondary surge reduction filter protection

General: Provide series connected surge reduction filter comprising metal oxide varistor or triggered spark gap based primary SPDs, a low pass LC filter and secondary metal oxide varistor based SPDs.

Surge Rating: Imax ≥ 100 kA per phase to neutral primary protection.

Surge Rating: Imax ≥ 100 kA neutral to earth if remote from the MEN earthing system. Residual Voltage: Up < 600 V @ 20 kA.

Visual indicator: Provide visual indication of SPD status and life.

Alarm contacts: Provide one set of normally closed dry contacts indicating status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

### Protection of final subcircuits

General: Provide series connected surge filter comprising metal oxide varistor based primary SPDs, a low pass LC filter and secondary metal oxide varistor based SPDs.

Type: ERICO TDF 20A240V surge reduction filters TD technologies. Operating voltage: Un = 220 – 240V at 50 Hz.

Maximum discharge current: Imax = 20 kA (8/20 µs) phase to neutral and 10 kA neutral to earth. Voltage protection level: Up < 600 V at 3 kA and < 700 V at 500 A.

Visual indicator: Provide visual indication of SPD status. Maximum continuous operating voltage: Uc = 340 V a.c.

Enclosure and installation: House SPD in electrical switchboard or panel. Enclosure mounting: Din rail mounted.

## CURRENT TRANSFORMERS (METERING)

### Standard

Measurement current transformers: To AS 60044.1.

### Test links

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

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

### Test studs

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

### Accuracy classification

Energy measurements: Class 0.5. Indicating instruments: Class 3.

### Ratings

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

Rated primary current: At least equal to the current rating of the functional unit. Secondary windings: Rated at 5 A, burden of 0.4 Ω (10 VA) with star point earthed. **Type**

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

wound-primary type with mounting feet.

### Installation

General: Install transformers to permit easy removal.

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

## INSTRUMENTS AND METERS

### Electricity meters (Watthour meters)

Standards:

* + - Socket mounting system: To AS 1284.4.
    - Electronic: To AS 62053.21. Electricity meters: Class 0.5.

3-phase metering: Polyphase meters suitable for balanced 3 phase, 4 wire loads. 1 or 2 phase metering: Single phase meters.

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

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

Covers: Seal main covers.

## ELECTRICAL INDICATING MEASURING METERS

### General

Standard: To the IEC 60051 series. Accuracy: Conform to the following:

* + - Indicating Instruments and accessories: ≤ Class 1.5.
    - Thermal maximum demand indicators: Class 3.
    - Power factor meters, phase angle meters and synchroscopes: 2 electrical degrees maximum error.
    - Transducers: Class 0.5. Mounting: Flush mount. Meter size:
    - Minimum: 96 mm square bezel type.
    - If located on Form 3 and Form 4 motor starter enclosures: 76 mm square bezel type.

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

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

Accessories: Mount next to associated instruments, inside cabinets.

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

**Ammeters and voltmeters** Standard: To IEC 60051-2. Ammeters: Conform to the following:

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

Voltmeters: Conform to the following:

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

### Maximum demand indicators

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

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

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

### Wattmeters and varmeters

Standard: To IEC 60051-3.

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

### Frequency meters

Standard: To IEC 60051-4.

Type: Either an analogue type, or vibrating reed type with 7 reeds. Analogue type: Graduated in 0.1 Hz increments.

Scales:

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

### Phase angle meters

Standard: To IEC 60051-5.

General: Provide for 3 phase, 4 wire balanced loads. Scales: 0.5 leading to 0.5 lagging.

### Hours-run meters

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

## CONTACTORS

### General

Standard: To AS/NZS IEC 60947.4.1.

Type: Enclosed, block type, air break, electro-magnetic. Poles: 3.

Rated operational current: The greater of:

- Full load current of the load controlled.

- 16 A.

Mechanical durability: 10 million cycles to AS/NZS IEC 60947.4.1.

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

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

Auxiliary contacts: Provide auxiliary contacts with at least one normally-open and one normally-closed separate contacts with rating of 6 A at 240 V a.c., utilization category: AC-1.

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

## CONTROL DEVICES AND SWITCHING ELEMENTS

### Standards

General: To AS/NZS IEC 60947.1 and AS/NZS IEC 60947.5.1.

Switching elements:

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

### Rotary switches

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

Off position: Locate at the 12 o’clock position. Test positions must spring return to off position. Rated operational current: At least 6 A at 230 V a.c.

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

### Time switches

Type: 7 day fully programmable with holiday override function. Daylight saving switch: Required.

Mains failure operation: 100 hour minimum operating capacity. Contact rating: ≥ 16 A at 240 V a.c. resistive load.

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

Dial: Digital with hour and minute display. Override switch (manual): Required.

### Control relays

Standard: To AS/NZS IEC 60947.5.1. Operation: Suitable for continuous operation.

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

General: Provide heavy duty fixed mounted type 3 relays. Type: Modular block.

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

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

Plug-in types: If required provide the following:

* Receptacle bases with captive clips which can be operated without using tools.
* Changeover type contacts to allow either normally-open or one normally-closed configuration.

### Control relay selection table

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

**Time delay relays**

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

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

### Synchronous relays

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

### Phase failure relays

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

* Detect less than 85% of normal voltage.
* Detect single phase failure.
* Detect reverse phase sequence after an appropriate time delay.
* Automatic reset on detection of normal power supply.

Sensing circuit: To reject induced voltage spikes and disturbances with frequencies other than 50 Hz. Back-up protection: Provide high rupturing capacity fuses to each phase.

### Push-buttons

Type: Oil-tight, minimum 22 mm diameter, or 22 x 22 mm. Rated operational current: At least 4 A at 240 V a.c.

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

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

## SEMICONDUCTOR CONTROLLERS AND CONTACTORS

### General

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

Standard: To AS/NZS 3947.4.3.

## CONTROL AND PROTECTIVE SWITCHING DEVICES OR EQUIPMENT

### General

Standard: AS/NZS IEC 60947.6.2.

## CONTROLLER DEVICE INTERFACES

### General

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

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

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

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

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

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

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

## INDICATOR LIGHTS

### Standard

General: To AS/NZS IEC 60947.5.1.

### LED indicators

Requirement for light units: Integrated LEDs. Voltage range: 12 V a.c. and 12 V d.c. to 30 V d.c. Body type: Plastic.

Rating: IP66. Lens type: Plastic.

Terminals: Screw fixing.

## INDICATING COUNTERS

### General

General: Provide the following:

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

## ALARM ANNUNCIATORS

### General

General: Provide the following:

* + - Labelled annunciator illuminated windows, to indicate status and alarm conditions.
    - Lamp test acknowledge-mute and reset individual push-buttons.
    - Audible alarm and associated logic circuitry.

### Mode of operation

General: Provide the following functions:

* + - Fault conditions: To initiate flashing of appropriate annunciator lamps and sounding of audible alarms.
    - Operation of acknowledge and mute buttons: To silence audible alarms and change annunciator lamps to the steady state on condition.
    - Window: To extinguish only when fault condition has been cleared and alarm reset push-button has been activated.
    - Subsequent alarms on other inputs: To reactivate the audible alarm and flash the appropriate annunciator lamp.
    - Resetting: After correction of the fault condition, provide on-site choice of either automatic resetting or manual resetting at the annunciator panel.

### Type

General: Extra-low voltage, solid state, flush mounted, window type.

### Lamps

General: Provide annunciators with 2 extra-low voltage lamps per window.

Rated voltage of lamps: 105% of the annunciator system voltage.

Replacing: Changeable from front of panel without affecting condition of annunciator. Vibration: Provide lamps which do not disconnect due to vibration.

### Extra-low voltage power supply

General: Provide an extra-low voltage power supply for the alarm annunciator.

### Windows

Nominal size: 15 x 35 mm.

Engraving: Filled in black.

* + - Background colours: White for status monitoring, red for alarms and shutdown functions.

## AUDIBLE ALARM DEVICES

### Sound level

General: Not less than the greater of the following:

* + - 65 dB(A) at 1 m.
    - 15 dB(A) above ambient sound levels at any location in designated areas.

## EXTRA-LOW VOLTAGE TRANSFORMERS

### General

General: Provide the following:

* + - Centre tap on secondary winding.
    - Primary and secondary windings wired out on opposite sides of transformer case.
    - Primary and secondary windings separated by means of an earthed screen wired out to an insulated terminal.
    - Transformer rating greater than or equal to 125% of maximum output load, taking account of degree of ventilation and ambient temperature within assembly, and supplied load.

## BATTERIES AND CHARGERS

### General

General: Provide a battery and charger system for circuit breaker tripping, closing and automatic changeover switch operation. Locate within the switchroom or switchboard assembly.

### Standards

General: To AS/NZS IEC 60947.5.1.

Valve regulated sealed lead-acid batteries: To AS/NZS 4029.2. Vented nickel-cadmium batteries: To AS 3731.1.

Chargers: To AS 4044 Type 2.

### Circuit breaker operation

General: Provide a d.c. supply for circuit breaker operation from battery system and charger.

### Performance

General: Capable of 10 consecutive air-circuit breaker or moulded case circuit breaker operations for the designated quantity of circuit breakers. Each operation consists of open-close of main contacts for

0.5 s duration, with 1 s intervals between operations, and minimum discharge current of 4 A, with batteries in 50% discharge condition. Maintain a minimum terminal voltage of 80% of rated voltage at the completion of the 10 operations.

System voltage: 110 V d.c.

### Battery chargers

Type: Free standing, floor mounted, ventilated cabinet type with separate charger and battery subsections.

Degree of protection: IP42.

Tapping: Provide tappings on the transformer to permit adjustment over a range of 95% to 105% of secondary winding voltage on open circuit.

Circuitry: Solid state, micro-processor type, constant voltage, fully automatic, incorporating a smoothing network to give an output wave form at least as smooth as that of a 3-phase bridge system, and automatic boost and float charge functions to ensure maximum battery life and rated performance. Provide facilities for manual boost and test.

Maximum design transient: 70% of the component manufacturer’s peak inverse ratings.

Instruments, controls and indicators: Group for ease of operation. Provide analogue or digital instruments for the following:

* Charger output current.
* System voltage.
* Load current.

a.c. input protection: Miniature circuit breakers. Protect outgoing tripping supply with a 2 pole d.c. miniature circuit breaker.

Alarm indication: Provide alarm indication to monitor the following:

* a.c. supply.
* Boost charge on.
* Charge fail.
* Low battery voltage.
* High battery voltage.
* Low electrolyte for vented cells.
* Earth fault, secondary side. **Safety signs and labels** Standard: To AS 2676.1.

Safety signs: Provide cautionary, regulatory and emergency safety signs to charger enclosure and switchroom.

## ANTI-CONDENSATION HEATERS

### General

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

Type: Black heat type with surface temperature less than or equal to 50°C, mechanically protected and thermostatically controlled.

## SPARES CABINET

### General

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

Location: Either of the following:

* Incorporated into assembly enclosure.
* Wall mounted in main switchroom. Finish: To match switchboard assembly.

## EXECUTION

* 1. **MARKING AND LABELLING**

### General

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

**Labels on assembly exteriors** Manufacturer’s name: Required. Assemblies: Label with essential markings.

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

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

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

### Labels on assembly interiors

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

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

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

### Danger, warning and caution notices

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

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

Externally controlled equipment: To prevent accidental contact with live parts, provide warning notices for equipment on assemblies not isolated by main switch or local main switch.

Stand-by power: Provide warning notices stating that assemblies may be energized from the stand-by supply at any time.

Anti-condensation heaters: To prevent accidental switching off, provide caution notices for anti- condensation heaters.

Insulation and shrouding: For insulation or shrouding requiring removal during normal assembly maintenance, provide danger notices with appropriate wording for replacement of insulation shrouding before re-energizing assemblies.

Positioning: Locate notices so that they can be readily seen, next to or, if impracticable, on busbar chamber covers of functional units and behind the front cover of functional units. Provide circuit identification labels in the cabling chamber of each functional unit, located next to external terminations.

### Schedule cards

General: For general light and power distribution assemblies, provide schedule cards of minimum size 200 x 150 mm, with typewritten text showing the following as-installed information:

* Submain designation, rating and short-circuit protective device.
* Light and power circuit numbers and current ratings, cable sizes and type and areas supplied.
* Mounting: Mount schedule cards in a holder fixed to the inside of the assembly or cupboard door, next to the distribution circuit switches. Protect with hard plastic transparent covers.

### Single-line diagrams

Main switchboards and distribution switchboard assemblies: Provide single-line diagrams. Format: Non-fading print, at least A3 size, showing the system as installed.

Mounting: Enclose in a non-reflective frame and wall mount close to assembly.

### Marking cables

General: Identify the origin and cable size of wiring with legible indelible marking.

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

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

## MAINTENANCE

### General

Standard: To AS 2467.

**11.0 POWER FACTOR CORRECTION**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide power factor correction, as documented. Type: Microprocessor controlled.

Function: To maintain the system power factor in the documented range and to provide harmonic filtering under all load conditions.

Components: Size and select as follows:

* Limit the increase in incoming supply voltage total harmonic distortion to less than 2.5%.
* Limit the total harmonic distortion to less than 4%.
* Prevent interference with Supply Authority frequency injection systems

Harmonics: Reduce parallel supply impedance resonance using a series connected reactors tuned to limit the total harmonic current within the capacitors to less than 5% of their nominal rating.

Service life of all components: > 10 years.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Low voltage power systems*.
    - *Switchboards – custom-built*.
    - *Switchboard components*.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - PFC: Power factor correction equipment.

## STANDARDS

### General

Electronic compatibility (EMC) requirements: To AS/NZS 61000.

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Shop drawings

Shop drawings: Provide the following:

* The system general arrangement and layout with details of connections, circuit breakers, cable sizes, overall dimensions, weight, location of access doors, cable terminating locations and necessary clearances.
* Control schematics. A description of operation with all control schematics.
* Functional block diagram.
* Heat generated by the PFC.
* Type and rating of all equipment items.

### Technical data

General: Submit the following:

* EMC technical data to AS/NZS 61000.
* Design calculations for the sizing of all capacitors and reactors. Submit the capacitor unit test report before factory inspection.

### Tests

Capacitor test report: Submit the capacitor unit test report before factory inspection.

## INSPECTION

### Notice

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

* + - Equipment is ready for inspection before despatch from factory.

## PRODUCTS

* 1. **CAPACITORS**

### General

Standard: To IEC 60831-1 and IEC 60831-2.

Type: Vacuum oil impregnated metallized polypropylene (MPP). Automatic overpressure disconnection: Required.

Capacitance tolerance: -5% to +10%.

Construction: Cylindrical with single capacitor unit per can.

Dielectric rating: ≥ 500 V r.m.s. at 50 Hz selected to accommodate the series reactor voltage. Discharge resistance: Required.

Loss: < 0.5W/kVAR (low loss type).

Removal: Arranged to permit removal of faulty module while the remaining capacitors continue to function normally.

Surface temperature: Rated to achieve < 60°C. Terminals: Tunnel or post type.

### Pre-completion tests

General: Carry out capacitance and d.c. dielectric tests.

## CONTACTORS

### General

Standard: To AS/NZS IEC 60947.4.1. Type: Step-switching.

Utilization category: for capacitor switching AC-6b.

Rating: For capacitor switching duty at ≥ 1.5 times the capacitor step full load current.

## CONTROLLER

### General

General: Provide a site-programmable, microprocessor, step controller, incorporating non-volatile programme and data memory. Include the following:

* + - Automatic cycling of use of capacitor steps: Required.
    - Automatic isolation in the event of capacitor over temperature or over current: Required.
    - Data interface for remote monitoring and data download: RS232.
    - Local alarms for:

. Over temperature.

. Over voltage.

. Reactive power exceeding adjustable programmed levels.

* + - Local digital display and remote monitoring of:

. Power factor.

. Incoming supply load (amps, kW and kVAR).

. Number of steps in use.

. Percent harmonic current.

. Harmonic currents.

. Stored data for greater than or equal to 1 week in date/time format.

* + - Manual-off-auto selection: Required.
    - Remote alarm output contact for remote group alarm facility: Required.
    - Supply from an alternative source: Provide terminals and logic to disable all capacitor steps.
    - Time delay after restoration of power supply: ≥ 60 s before switching in the first stage.
    - Time delay between stages: Switching adjustable to be from 1 to 300 s.

Software: Provide 3 copies of proprietary software for remote monitoring and alarms.

## CURRENT TRANSFORMER INTERFACE

### General

General: Provide interface to a 5 A secondary, 10 V.A, class 1, PFC current sensing transformer installed in the relevant switchboard.

## INDUCTORS

### General

Carrying capacity: ≥ 1.5 times the rated capacitor current at 50 Hz without saturating at 40°C ambient. Cores: Insulated, laminated, high permeability silicon iron.

Flux density at rated current: < 0.85 tesla. Inductance tolerance: ± 5% at rated current. Losses: Very low loss design.

Mounting hardware: Non-ferrous. Q factor: > 10.

Separate inductors for each capacitor step: Required.

Windings: High purity copper with Class F temperature rated insulation.

## EXECUTION

* 1. **INSTALLATION**

### General

General: Connect the PFC to the power system as documented.

### Power system

Protection: Provide protective devices to grade and discriminate with upstream devices. Individually protect each kVAR step.

### Capacitors

Insulation: Insulate all live parts.

Layout: Arrange capacitors for easy removal and replacement.

Mount capacitors in separate cubicle compartment, segregated from inductors, fuses and switchgear. Ventilation: Separate capacitors by at least 25 mm of air space.

### Inductors

General: Mount inductors in separate cubicle compartment, segregated from capacitors, fuses and switchgear.

### Harmonic Resonance

General: Vary the kVAR output and capacitor switching combinations to avoid resonant frequency generation in the system.

### Cubicle

Construction: To the *Switchboards – custom-built* work section. Colour: Match main switchboard.

Cooling fans: Muffin type axial fans.

Temperature rise: Ventilate the PFC cabinet so internal temperature rise is less than 5°C above ambient in each cabinet compartment.

## COMPLETION

### Warranties

Warranty: Provide 24 month warranty with six monthly service.

## MAINTENANCE

### General

Standard: To AS 2467.

## SELECTIONS

* 1. **PERFORMANCE**

**Performance schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Power factor range: Minimum | 0.95 |  |  |
| Power factor range: Maximum | 1.0 |  |  |
| KVAR steps: Step size (kVAR) | < 50 |  |  |
| KVAR steps: Number | ≥ 5 |  |  |
| Maximum design load (kW) |  |  |  |
| Uncorrected power factor (PF) |  |  |  |
| Expected harmonic: First (amps) |  |  |  |
| Expected harmonic: Third (amps) |  |  |  |
| Expected harmonic: Fifth (amps) |  |  |  |
| Expected harmonic: Seventh (amps) |  |  |  |
| Expected harmonic: Ninth (amps) |  |  |  |
| Acoustic noise limits |  |  |  |

**12.0 LIGHTING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide lighting and control systems, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Building management systems*.
    - *Electrical systems*.
    - *Cable support and duct systems*.
    - *Low voltage power systems*.
    - *Switchboard components*.

## STANDARDS

### General

Air-handling luminaires: To AS/NZS 60598.2.19. EMC compliance: To AS/NZS CISPR 15.

Energy efficiency for ballasts and lamps: To AS/NZS 4783.2. Fixed general purpose luminaires: To AS/NZS 60598.2.1.

Floodlights: To AS/NZS 60598.2.5. Harmonic limits: AS/NZS 61000.3.2.

Luminaires, general requirements and tests: To AS/NZS 60598.1. Luminaires: To AS/NZS 60598.1.

Luminaires for swimming pools: To AS/NZS 60598.2.18.

Luminaires for use in clinical areas of hospitals and health care buildings: ToAS/NZS 60598.2.25. Luminaires with built-in transformers for filament lamps: To AS/NZS 60598.2.6.

Portable general purpose luminaires: To AS/NZS 60598.2.4. Recessed luminaires: To AS/NZS 60598.2.2.

Road lighting luminaires: To AS/NZS 1158.6. Radio interference limits: To AS/NZS CISPR 15.

### Minimum energy performance standards (MEPS)

General: To AS/NZS 4782.2, AS/NZS 4783.2, AS 4934.2.

Self-ballasted lamps: To AS/NZS 4847.2.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - CCT: Correlated colour temperature.
    - CFL: Compact fluorescent lamps.
    - CRI: Colour rendering index.
    - DALI: Digital addressable lighting interface.
    - EEI: Energy efficiency index.
    - ELV: Extra low voltage.
    - EMC: Electromagnetic compatibility.
    - HID: High intensity discharge.
    - ILCOS: International lamp coding system.
    - LED: Light-emitting diode.
    - PIR: Passive infra-red.
    - PLC: Programmable logic controllers.
    - RCD: Residual current device.
    - UPS: Uninterruptable power supply.

### Definitions

General: For the purposes of this work section the definitions given below apply.

* + - Control system: A lighting control system comprising a combination of some or all of the following:

. Automatic sensing and control components.

. Timers.

. Manual overrides.

. Dimming systems.

. Motion detection sensors (Occupancy sensors).

. Computer interface for programming.

* + - Incandescent lamp: Lamps as covered in AS 4934.2 including both tungsten filament and tungsten halogen types.
    - Proprietary luminaires: Luminaires available as a catalogue item.

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Samples

General: Submit samples of all luminaires and accessories complete with lamp, control gear and three core flex and plug.

### Shop drawings

General: Submit shop drawings for the following:

* Lighting columns.
* Lighting column mounting bases.
* Non proprietary luminaires.
* Non standard fixing brackets.

### Technical data

General: Submit technical data of the following:

* Luminaires.
* Lamps.
* Ballasts.
* Power factor correction equipment.
* Lighting control systems.
* All accessories.

### Tests

Lighting efficacy: Confirm the efficacy of the following by a photometric test, carried out for the applicable CCT, from a NATA approved laboratory:

* Light-emitting diode luminaires.
* Light-emitting diode lamp replacement modules.

## PRODUCTS

* 1. **PROPRIETARY LUMINAIRES**

### General

Requirement: Provide proprietary luminaires complete with lamps, luminaire control equipment, lighting control equipment, and accessories as documented. Provide lamps of the same type from the same brand and country of manufacture.

Self-ballasted lamps: To AS/NZS 60968 and AS/NZS 60969.

### Proprietary equipment

General: The requirements of this work section for lamps, ballasts and luminaire control equipment over-ride the specifications inherent in the selection of a particular make and model of luminaire.

## TUNGSTEN HALOGEN LAMPS

### Standards

Tungsten halogen: To AS 2325, IEC 60357, AS/NZS 60432.2 and AS/NZS 60432.3.

### Types

Tungsten halogen lamps enclosed behind glass: Single and doubled ended types for domestic and general use, rated up to 250 V.

Tungsten halogen lamps not enclosed behind glass: Provide low pressure, low UV emission type. Low voltage dichroic lamps: Provide dichroic lamps with integral reflectors.

## ELV VOLTAGE TRANSFORMERS OR ELV SWITCH POWER SUPPLIES

### General

Requirement: Provide separate ELV transformers for each ELV lamp. Standard: To AS/NZS 4879.1, AS/NZS 4879.2 and AS/NZS 61558.1.

## DISCHARGE LAMPS (HID)

### Standards

High pressure mercury vapour: To IEC 60188. High pressure sodium vapour: To IEC 60662. Low pressure sodium vapour: To IEC 60192. Metal halide lamps: To IEC 61167.

Lamp control gear for HID lamps: To AS/NZS 61347 and AS/NZS 60923.

### Discharge lamp ballasts

General: Provide ballasts for lighting systems selected for compatibility with the lamp and control method.

High-pressure mercury vapour, low-pressure sodium vapour, high-pressure sodium vapour and metal halide type: Conform to AS/NZS 61347 and AS/NZS 60923.

Metal halide type:

* ≤ 150 W: Reactors or electronic control gear.
* > 150 W indoor: To the lamp manufacturer’s recommendation.
* > 150 W outdoor: To the lamp manufacturer’s recommendation.

Igniters: If documented, provide igniters which cut out when lamp ignites and after pre-determined time period if lamp fails to ignite.

Instant restrike igniters: If required, provide instant restrike igniters for instant restart of suitable HID lamps to the manufacturer’s requirements.

### HID power factor correction

General: Provide power factor correction on all luminaires to a minimum power factor of 0.9 lagging.

### Capacitors

Standard: To AS/NZS 61048 and AS/NZS 61049.

### Integral fuses

General: Provide integral fuses for reactive high intensity discharge (HID) lamp ballasts.

## LIGHT-EMITTING DIODES (LEDS) LUMINAIRES

### General

Requirement: Provide light emitting diode (LED) luminaires, as documented.

### Light-emitting diode luminaires

General: Light-emitting diode luminaires include integral LEDs, reflectors, lenses, heatsinks and drivers.

Performance: Provide LED luminous efficacy of the LED luminaire at normal operating temperature in its normal position and enclosure of > 60 lumens per watt.

Life of the LED in the complete luminaire: L70 to IES LM-80-2008, unless documented.

Colour: CRI > 80. CCT: 3000K.

### Light-emitting diode lamp replacement modules

Performance: Conform to the following:

* Reflector lamps: Provide luminous efficacy of the LED replacement modules at operating temperature in normal position and enclosure of > 40 lumens per watt where the quoted beam angle is the angle between the points of 50% of maximum luminous intensity.
* Linear fluorescent lamps: Provide luminous efficacy of replacement modules of > 80 lumens per watt.

## CONTROL GEAR ENCLOSURE

### General

Requirement: Provide control gear support enclosure within the body of the luminaire, except where remotely mounted control gear is documented or required by the manufacturer.

Enclosures and control gear mounting assemblies: Provide heat dissipation facilities to dissipate heat from the luminaire.

Controlgear enclosure: Form a barrier against direct contact with live parts of the control gear and the area of the luminaire containing the lamp and lamp support holders.

Separate control gear enclosures: lf separate control gear enclosures external to the luminaire are required, conform to the above requirements.

Fixing: Screw fixed.

## WIRING

### External flexible cords

Recessed luminaires: Provide flexible cord in conformance with the following:

* + - Length: ≥ 1.5 m.
    - Cross sectional area: 0.75 mm2.
    - Type: 3-core V75 (minimum) PVC/PVC, connected to a 10 A 3-pin moulded plug to AS/NZS 3112 or multi-pin plug, as documented.

Other fittings: Provide external flexible cord in conformance with the following:

* + - Cross sectional area: ≥ 1 mm2.

## LIGHTING CONTROL

### General

Requirement: Provide the following as documented:

* + - Lighting switches.
    - Dimmers.
    - Automatic control systems.

### Manual controls

General: Provide manual control of luminaires into groups, zones and to individual devices, as documented.

## ACCESSORIES

### General

Manufacturer: If of a similar finish, provide electrical accessories from the same manufacturer throughout the project and for interchangeability of subcomponents such as switch modules in wall plates.

### Lighting outlets

Pin arrangement: Conform to the following:

* Standard: 3 flat pin with looping terminal.
* Luminaires with integral emergency light or special switching: If required, a 4 or 5 pin plug or a second lighting outlet plug of alternative pin configuration to differential the functions or supply.

### Lighting switches

General: Provide light switches as documented. Standard: To AS/NZS 3133.

Minimum: 10 A, 230 V a.c.

### Key switches

General: Provide key switches as documented.

### Run-on timer switches

General: Provide run-on timer switches as documented. Delay: Adjustable to 20 minutes.

### Dimmer switches

General: Provide integral dimmer/switch units as documented.

### Proximity switches

General: Provide proximity switches as documented. Standard: To AS/NZS IEC 60947.5.2.

### Daylight switches

General: Provide integral photo electric switch units as documented.

Performance: Adjustable between 50 and 1000 lux in internal applications and 2 to 100 lux in external applications

Time delay: > 2 minutes. Illumination differential: > 50 lux. **Motion detector switches**

General: Provide motion detection sensors which cover designated areas as documented.

Timer: Incorporate ON timers adjustable between 1 and 5 minutes minimum and 30 minutes and 2 hours maximum.

Control function: Provide manual/OFF/automatic control switch. If manual switches are used in association with motion sensors, wire the switch so that it can turn the lights OFF but not override the motion switch to turn the lights ON.

Standard: To AS 2201.3. Type: Passive infra-red (PIR). **Manual time delay switches**

General: Provide manual time delay relay switches as documented.

Type: Electronic.

Duration: Adjustable between 5 minutes and 15 minutes.

Indicator light: Required. Activated when artificial illumination is OFF.

## EXECUTION

* 1. **SUPPORTS**

### General

Requirement: Install luminaires on proprietary supports by means of battens, trims, noggings, roses and packing material.

### Suspended luminaires

Rods: Steel pipe suspension rods fitted with gimbal joints. Chains: Electroplated welded link chain.

Levelling wire: Stainless steel.

Levelling: Adjust the suspension system length so that the lighting system is level and even. Horizontal tolerance: ± 3 mm between luminaires within the same area.

### Surface mounted luminaires

General: Fit packing pieces to level luminaires and prevent distortion of luminaire bodies. Provide packing strips to align end to end luminaires.

Fixing: Conform to the following:

* Generally: Provide 2 fixings at each end of fluorescent luminaires.
* Luminaires less than 150 mm: A single fixing at each end in conjunction with 1.6 mm backing plates may be used.
* Provide battens and support for the fitting.
* Do not direct fix into plasterboard.

### Recessed luminaries

General: Install recessed luminaries in trimmed openings in the suspended ceiling. Standard: To AS 2946.

## WIRING CONNECTION

### Recessed luminaires

General: Connect recessed luminaires to a plug socket outlet.

### Lighting tracks

General: For low voltage transformers located remotely from the track, size the cable between the transformer and the track to give a voltage drop of less than 5% between the transformer and the track at the rated current of the transformer.

## ACCESSORIES

### Installation

General: Install accessories and conceal cabling to the *0921 Low voltage power systems* work section.

## COMPLETION

### General

Requirement: Before the date of practical completion carry out the following:

* + - Verify the operation of all luminaires.
    - Adjust aiming and controls for all luminaires under night time conditions.
    - Replace lamps which have been in service for a period greater than 50% of the lamp life as published by the lamp manufacturer.

## SELECTIONS

* 1. **LIGHTING SCHEDULES**

**Luminaire schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Proprietary name or type |  |  |  |
| Catalogue reference |  |  |  |
| Lamp type |  |  |  |
| Colour temperature |  |  |  |
| Ballast type |  |  |  |

**Luminaire refurbishment schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Refurbishment requirement |  |  |  |
| Test and verification |  |  |  |

**Lighting accessory schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Accessory type |  |  |  |
| Manufacturer |  |  |  |
| Catalogue reference |  |  |  |

**Manual lighting control schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Input control device |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Luminaire control |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| group/zone/device |  |  |  |
| Control function |  |  |  |
| Parameters |  |  |  |

**Digital lighting control schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Input control device |  |  |  |
| Luminaire control group/zone/device |  |  |  |
| Control function |  |  |  |
| Parameters |  |  |  |

**Controller interface schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Interfaced control system |  |  |  |
| Control function |  |  |  |
| Parameters |  |  |  |

**13.0 TELECOMMUNICATIONS CABLING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide a passive telecommunications cabling network system, as documented.

## PERFORMANCE

### General

Application class: To AS/NZS 3080 clause 6.3 Class E.

Balanced system: To AS/NZS 3080 clause 7 (data/voice) Category 6. Fibre system class: To AS/NZS 3080 clause 8.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Cable support and duct systems*.
    - *Low voltage power systems*.
    - *Electronic security*.

## STANDARDS

### General

Authorities: To the requirements of the Australian Communications and Media Authority (ACMA). Cabling products: To AS/CA S008 and AS/NZS 3080.

Installation of cabling: To AS/CA S009, AS/NZS 3080, AS/NZS 3084, SAA HB 252 and AS/NZS ISO/IEC 14763.2.

Installation of small office/home office cabling: To AS/CA S009, AS/NZS ISO/IEC 15018 and AS/NZS ISO/IEC 14763.2.

Cable management and documentation: To AS/NZS 3085.1. Electromagnetic compatibility (EMC): To AS/NZS 3080.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - CES: Communication earth systems.
    - EMI: Electromagnetic interference.
    - EMR: Electromagnetic radiation.
    - IDC: Insulation displacement connection.
    - RU: Rack unit.
    - TRC: Telecommunications reference conductor.
    - UTP: Unscreened twisted pair.

## SUBMISSIONS

### Certification

Requirement: Submit certification for product and installation.

Copper cable termination distributors: Provide vendor certification (including the warranty period) for the integrated voice/data copper cabling systems.

Optical fibre termination panels: Provide vendor certification, including the warranty period, for the optical fibre cabling systems.

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Samples

Product data and samples: Submit for the telecommunications outlet.

### Shop drawings

Requirement: Submit the following:

* Layouts of equipment racks.
* Cross-connect layout.
* Cabling diagram for complete system.
* Cable management system.

### Technical data

Requirement: Submit technical data including the following:

* System design parameters: Performance.
* Voice and/or data transfer rate.
* Cable type and characteristics.
* Segregation requirements for EMI/EMR.
* Maximum length of cables.
* Cross-connect type and characteristics.
* Cross-connect block.
* Patch cords.
* Fibre optic terminations.
* Patch panel module.
* Cable management for racks.
* Rack.
* Fly leads.

### Warranties

Requirement: Submit the following:

## PRODUCTS

* 1. **NETWORK CONNECTION**

### External Network

Requirement: Liaise with each external communications carrier and determine the services and site access requirements for the network connection.

## BUILDING ENTRANCE FACILITIES

### Campus distributor (CD)

Standard: To AS/NZS 3080.

### External communications’ carrier network termination device

Requirement: Provide network termination device for the termination of external carrier cables and facilities. Provide separate frames as required for each external communications’ carrier and for copper and optical fibre cables.

## DISTRIBUTORS

### General

Requirement: Provide the Building Distributors (BD) and Floor Distributors (FD) for voice and data to AS/NZS 3080 and as documented for the termination of campus and building backbone cable systems and the horizontal cable distribution systems.

Equipment requirements: Provide cable termination racks, patch panels, equipment mounting racks for servers and routers complete with power outlets as documented.

### Copper cable termination distributors

Requirement: Provide insulation displacement termination frames for the termination of copper backbone and horizontal cable services.

### Equipment racks

Dimension and type: Conform to the following:

* Equipment racks: 19 inch wide industrial type, or 600 mm or 800 mm wide RUs:

. ≤ 18 RU: Wall mounted, 600 mm depth.

. > 18 RU: Floor mounted, 800 mm or 1000 mm depth.

* Patch panels – Copper CAT 6 cables: 800 mm wide and 800 mm deep.
* Patch panels – Optical fibre cables: 800 mm wide and 800 mm deep. Nominate height of units.
* Server racks: 600 mm wide and 1000 mm deep. Nominate height of units. Access location: Front, sides or rear.

Cable tray: Locate within outer cabinet void.

Doors: Provide transparent safety glass, lockable doors.

Power provision: Minimum 1 socket outlet for every 3 rack units on vertical rail. Cable management: Provide as follows:

* 1 module for every 2 patch panels.
* 1 module for each fibre termination panel.
* Location: Vertically, on both sides of the panel.

Provisions for active equipment: 25% minimum, 1 fixed shelf for every 4RU of active equipment space. Ventilation: Fan assisted.

Earthing: CES earth bar required. Fixing: Conform to the following:

* Floor mounted: Firmly fix to floor, bolt together multiple racks using standard kit accessories.
* Floor/Wall mounted: Firmly fix to floor and wall. **Cross connect patch panels (Copper cables)** General: Provide the following:
* Copper cross connect patch panels as documented.
* Separate patch panels for voice and data services and clearly label the service. Size: Provide the following:
* 24 jack modular standard patch panel racks of sufficient quantity to accommodate the horizontal cabling requirements for voice and data equipment circuits.
* 20% spare capacity.

Jacks: Provide 8 position, 8 conductor, non-keyed modular jacks with centre locking latch to AS 3080. Patch cable support: Provide an integral patch cable support system with each patch panel.

Terminations: Terminate directly to the modular connector. Fixed terminations:

* Rear terminals: Connect to 45° IDC punch down type.
* Front terminals: Connect to RJ45 modular connector.

Patch cords: Terminate cord ends with appropriate registered jacks.

### Optical fibre termination panels

Requirement: Provide rack mounted termination frames for the termination of optical fibre backbone and horizontal cable services.

Certification: Provide vendor certification, including the warranty period, for the optical fibre cabling systems.

Break out trays: Provide fibre optic cable break out trays at each group of fibre optic cable terminations.

Loom cables: Neatly loom cables and lay stripped cables into the break out tray.

Secure cables: Make sure that cables are secured by the sheath and that there is no stress on the fibre optic cores.

### Cross connect patch panels (Optical fibre cables)

Requirement: Provide optical fibre cross connect patch panels as documented for both single and multicore optical fibre cables.

### Cable management

Record book: Provide a record book at each cross-connect. Location: Secure log books in each distribution frame records holder.

Identification, labelling, and record documentation: To AS/NZS 3085.1.

## CABLES

### Copper

Standard: To AS/CA S008, AS/CA S009, AS/NZS 3080 and AS/NZS ISO/IEC 14763.2.

Campus and building voice backbone cables: Multicore CAT 3 UTP cable as documented or to suit the voice outlet density at each building or floor distributor, with 30% spare capacity allowance.

Horizontal cabling voice and data: CAT 6 UTP cabling to each floor outlet. Balanced system cables: UTP.

Cable end length: Provide a 5 m cable loop at each end of the cable.

### Optical fibre

Standard: To IEC 60793-2-10.

Campus and building backbone cables:

* Default multimode type: 6 core multi-mode OM3 50/125 mµ.
* Default single mode type: single core 9/125 mµ.

Length: Provide not less than 1000 mm spare at each end. Component type: SC.

Safe practices: To AS/NZS 2967.

### External

Standard: Water penetration resistance to IEC 60794-1-2.

## SURGE PROTECTION DEVICES (SPD)

### General

Requirement: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets, as documented.

Standard: To AS 4262.1 and AS 4262.2.

Surge Rating: Imax not less than 20 kA per phase. Residual Voltage: Up less than 600 V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

## TELECOMMUNICATIONS OUTLETS

### General

Outlets: Provide RJ45 8 way modular jacks, mounted on 6-way faceplate. Provide for up to three modular voice or data outlets on the each faceplate with three spaces for identification inserts.

Colour: Electric white or as documented. Standard: To AS/CA S008.

Pinouts: T568A to AS/NZS 3080.

Modular socket outlets: Provide an 8-position conductor, no keyed RJ 45 compatible modular jack with centre locking latch in conformance with AS/NZS 3080.

## FLY LEADS

### General

Type: Stranded. Length: 1200 mm.

Quantity: Provide fly leads to 50% of outlets installed.

## PATCH CORDS

### General

Type: Stranded.

Length: 900 mm.

Quantity: 100% of outlets installed with 10% additional spare patch cords. Termination: Registered jacks.

## ENGINEERING SERVICES

### General

Requirement: Provide cabling systems, as documented.

## TESTS

### General

Production tests: Complete as follows:

* + - Balanced cabling systems: To AS/NZS IEC 61935.1.
    - Patch cords: To AS/NZS IEC 61935.2.
    - Solder less connections: To AS/NZS 3080 Annexure C.
    - Free and fixed connections: To AS/NZS 3080 Annexure C.
    - Other connecting hardware: To AS/NZS 3080 Annexure C.

## EXECUTION

* 1. **GENERAL**

### Installation

Standard: To AS/NZS 3080, AS/NZS 3084, AS/CA S009 and AS/NZS ISO/IEC 14763.2.

Precedence: The space requirements as documented take precedence over the specific space requirements of AS/NZS 3084.

## CABLES

### Installation

Requirement: To manufacturers' recommendations.

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

### Cable separation

Separation for safety: To AS/CA S009, and by at least 150 mm. Fluorescent luminaires: Maintain a clearance of more than 300 mm. **External cables**

Requirement: To ACIF C524.

## TELECOMMUNICATIONS OUTLETS

### Installation

Mounting: Flush mount.

Flushplate layout: Provide 6-way standard flushplate capable of accepting the installation of three individual modular sockets along the top horizontal axis and three identification inserts on the bottom horizontal axis. Unused socket positions to be filled with blank inserts. Arrange the modular sockets with the locking latch in the bottom position, i.e. pins at the top.

Horizontal cabling termination: Terminate Category 6 cabling to the rear of the outlet modular jack with insulation displacement connections forming a gas tight joint. Arrange cable pairs at each jack conforming to AS/NZS 3080 Fig 15.

## EARTHING SYSTEM

### General

Standard: To AS/CA S009, Section 20.

### Communication earth system (CES)

Requirement: Provide a communications earth terminal (CET) adjacent to each electrical switchboard. Connect the CET to the local protective earth (PE) system at the switchboard.

Distributor: Provide an earth bar within each distributor and connect to the local CET.

Interconnections: Verify that there are no interconnections between the lightning protective earthing system and the telecommunications earthing system.

## LABELS

### General

Telecommunications facilities: To AS/NZS ISO/IEC 14763.2. Cross connects and outlets: To AS/NZS 3080.

Cables: Label with the origin and destination of the cable.

Outlets: Label with the origin of the cross-connect, the workstation or outlet number and the port designation.

**Label type table**

|  |  |  |
| --- | --- | --- |
| **Component** | **Label scheme** | **Type** |
| Cables | Origin and destination | Self-adhesive, wrap on |
| Cross-connects | Port number | Proprietary |
| Patch cords | Type of service | Colour code |

## TESTING

### General

General: Carry out 100% channel tests.

### Site tests

Standard: To AS/NZS 3080 Annexure B. Include the following:

- Basic Link and Channel transmission tests including the following:

. Wire map.

. Length.

. Attenuation.

. NEXT.

. ACR.

. Propagation delay.

. Delay skew.

. Power sum NEXT.

. Power sum ACR.

. ELFEXT.

. Power sum ELFEXT.

. Return loss.

- Optical fibre cable: Carry out Basic link transmission tests including the following:

. Length.

. Attenuation.

## COMPLETION

### Cable management

General: Before the date for practical completion submit log books for each distribution frame with details of cable terminations and provisions for recording cable, line and jumper information.

## SELECTIONS

* 1. **SYSTEM DESCRIPTION**

**Network termination schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Carrier |  |  |  |
| Network termination device requirements |  |  |  |
| Lead-in cable capacity |  |  |  |

**Building distributor schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Size |  |  |  |
| Capacity – incoming ports |  |  |  |
| Capacity – outgoing ports |  |  |  |
| Capacity – internal ports |  |  |  |
| Spare capacity – minimum (%) |  |  |  |
| Space for active equipment | RU | RU | RU |

**Backbone cabling schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Origin |  |  |  |
| Termination |  |  |  |
| Type |  |  |  |
| Size |  |  |  |

**Floor distributors schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Size |  |  |  |
| Capacity – incoming ports |  |  |  |
| Capacity – outgoing ports |  |  |  |
| Capacity – internal ports |  |  |  |
| Spare capacity – minimum (%) |  |  |  |
| Space for active equipment | RU | RU | RU |

**Consolidation points schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Manufacturer/model |  |  |  |
| Location/mounting |  |  |  |

**Telecommunications outlets schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Type |  |  |  |
| Manufacturer/model |  |  |  |
| Location/mounting |  |  |  |

**Patching schedule**

|  |  |  |
| --- | --- | --- |
| **From** | **To** | **Requirement** |
| Data telecommunications outlet connector at distributor patch panel |  |  |

|  |  |  |
| --- | --- | --- |
| **From** | **To** | **Requirement** |
| Voice telecommunications outlet connector at distributor patch panel |  |  |

Sound Systems

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide a sound system, as documented.

### Performance

System performance: As documented. System functionality requirements:

* Public address.
* Hall sound reinforcement.
* Hearing aid induction loop.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

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

# STANDARDS General

Equipment design and manufacture: To AS 4428.4.

System design, installation and commissioning: To AS 1670.4. Communication systems for the hearing impaired: To AS 1428.5. Hearing aid induction loop system: To AS/NZS 60118.4.

## INTERPRETATION

### Abbreviations

General: For the purposes of this work section the following abbreviations apply:

* + - LED: Light emitting diode.
    - PA: Public address.
    - PAC: Public address control unit.
    - RU: Rack unit.
    - UHF: Ultra high frequency.
    - VU: Volume unit.

## SUBMISSIONS

### Calculations

Amplifiers: Submit calculations of capacity and loads.

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Samples

General: Submit samples of the following:

* Speakers.

### Shop drawings

General: Submit shop drawings showing the following:

* Cabling diagrams.
* Control diagrams.
* Equipment layout.
* Speaker’s layouts.
* Control panel layout.

### Technical data

General: Submit product data for all components.

### Test results

General: Submit test results of the following:

* Speech intelligibility.
* Sound pressure levels.

## PRODUCTS

* 1. **CONTROL UNITS**

### General

Input controls: Provide separate volume controls for each input channel.

Output controls: Provide master control and separate volume controls for each output channel. Remote controls: Provide terminals on the rear panel for remote master volume adjustment.

Tone controls: Provide tone controls with 10 dB cut or boost at 100 Hz and 10 dB cut or boost at 10 kHz.

Displays: Provide VU meter display on the front panel for each output channel.

## LOUDSPEAKERS

### General

Requirement: Provide loudspeakers, as documented. Provide additional loudspeakers as necessary to achieve the documented system performance.

Frequency response: 50 Hz to 15 kHz (-3 dB).

## INDUCTION LOOPS

### General

Standard: To AS/NZS 60118.4.

Location: Embedded in floor of documented spaces.

Loop amplifier: Provide loop amplifier connected to sound system amplifier for selected inputs as documented.

## ACCESSORIES

### Socket outlets

General: Provide socket outlets, as documented.

### Local volume controls

General: Provide local manual volume controls, as documented.

## EXECUTION

* 1. **INSTALLATION**

### Head end equipment

General: Mount amplifiers and control units in location, as documented.

### Loudspeakers

Mounting: Securely fix to building elements. Default wall mounting height: 2300 mm.

External speakers: Confirm mounting position on site to achieve sound coverage with minimum cross- boundary interference.

## TESTING

### General

Speech intelligibility: To AS 60849 Annex A.

Sound pressure level: C-weighted measurements for all areas.

## COMMISSIONING

### Loudspeakers

Performance levels: Adjust to achieve required level as documented.

## TRAINING

### General

Personnel training: Required.

## SELECTIONS

* 1. **DESIGN SCHEDULES**

**PA system performance schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Speech intelligibility |  |  |  |
| System type |  |  |  |

**PA system functions schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Inputs |  |  |  |
| Manual functions |  |  |  |
| Automatic functions |  |  |  |
| Zones |  |  |  |
| PAC |  |  |  |
| Expansion |  |  |  |
| Outputs |  |  |  |

**Hall sound system functions schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Performance |  |  |  |
| Inputs |  |  |  |
| HACP |  |  |  |
| Expansion |  |  |  |
| Outputs |  |  |  |

**Floor loop functions schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Floor loop locations |  |  |  |
| Floor loop inputs |  |  |  |

**14.0 EMERGENCY EVACUATION LIGHTING**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide single point monitored emergency lighting and exit signs, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Low voltage power systems*.
    - *Lighting*.

## STANDARDS

### General

System design, installation and operation: AS 2293.1. Inspection and maintenance: To AS/NZS 2293.2.

Emergency escape luminaires and exit signs: To AS 2293.3.

## SUBMISSIONS

### Operation and maintenance manual

Standard: To AS 2293.1, Section 8.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Samples

General: Submit samples of all luminaires and exit signs.

### Shop drawings

General: For each custom-built luminaire and exit sign, submit the following:

* Construction details.
* Overall dimensions.
* Wiring arrangement.

### Technical data

General: Submit technical data for each type of luminaire and exit sign including the following:

* Maximum luminaire spacing for a given mounting height.
* Luminaire classification to AS 2293.3.

### Tests

General: Submit type test data.

## PRODUCTS

* 1. **SINGLE-POINT SYSTEM LUMINAIRES**

### General

Visual indicator lights: Provide a red indicator, readily visible when the luminaire is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each luminaire to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the local distribution board which disconnects main supply to the luminaires and tests for discharge performance and automatically reverts to normal operating mode after testing.

### Monitored system

Data connection: Provide internal monitoring facilities and provision for the connection of data cabling to a central monitoring computer.

### Batteries

Type: Provide lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously for at least 2 hours during commissioning tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of between 10oC and 40°C and subject to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

**Charger design**

## MONITORING SYSTEM

### Proprietary systems

General: Provide proprietary systems with full compatibility between the monitoring system, operating software and the luminaries selected.

Testing facilities: Provide automatic and manual testing facilities for testing lamp condition and for battery discharge testing.

Remote monitoring: As documented.

## EXECUTION

* 1. **SINGLE POINT SYSTEM**

### Power supply

General: Provide an unswitched active supply to each luminaire and exit sign, originating from the test switch control panel.

### Data monitoring

General: If a monitoring system is documented, provide a data cable system from each single-point luminaire and connect to the monitoring computer.

### Test switch

General: Provide a timed test switch at each distribution board.

Function: To energise emergency lights and exit signs and then to automatically reset controls after a maximum of 2 hours.

## MARKING AND LABELLING

### Labelling

General: Label each luminaire with a unique identifying number. Provide a label which is permanently fixed, indelible and readable at a distance of 1 m.

Emergency evacuation lighting schedule: Record the number and luminaire location in an emergency evacuation lighting schedule included in the operation and maintenance manual.

## TESTS

### General

Requirement: Carry out tests, including out-of-hours tests, to demonstrate the emergency and evacuation system’s performance. Include the following:

* + - Test components for correct function and operation.
    - Demonstrate illumination performance on site, to at least the level stated in the manufacturer’s recommendations for performance for that device.
    - Test operation of battery discharge test and control test switch functions, including discharge and restoration.
    - Demonstrate system functions under mains fail condition.
    - Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

### Mains supply

General: Before commissioning, make sure mains supply has been continuously connected for at least 24 hours.

## SELECTIONS

* 1. **EMERGENCY EVACUATION LIGHTING**

**Exit signs schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Description |  |  |  |
| Illumination |  |  |  |
| Mode |  |  |  |
| Colour: Lettering/Background |  |  |  |
| Monitoring system |  |  |  |

**Single point emergency luminaires schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Description |  |  |  |
| Classification |  |  |  |
| Mode |  |  |  |
| Lamp type |  |  |  |
| Monitoring system |  |  |  |
| Protection |  |  |  |

**Monitoring system requirements schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Description |  |  |  |
| Classification |  |  |  |
| Mode |  |  |  |
| Lamp type |  |  |  |
| Monitoring system |  |  |  |
| Protection |  |  |  |

**15.0 ELECTRONIC SECURITY**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide electronic security systems as documented and as follows:

* + - Remote monitoring system.
    - Access control system.
    - Intruder detection system.
    - Closed circuit television system.
    - Intercom system.

Security classification: As documented. System communications: As documented. **System provider**

Electronic security system provider: A licensed security organization only.

### Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2. Surge Rating: Imax ≥ 20 kA per phase.

Residual Voltage: Up < 600 V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Cable support and duct systems*.
    - *Low voltage power systems*.
    - *Uninterruptible power supply*.
    - *Telecommunications cabling*.

## STANDARDS

### Intruder alarm systems

General: To AS/NZS 2201.1.

Alarm transmission system: To AS/NZS 2201.5. Internal detection devices: To AS 2201.3.

Wire free systems: To AS 2201.4.

### CCTV systems

General: To AS 4806.2.

Remote monitored systems: To AS 4806.4.

## SUBMISSIONS

### Operation and maintenance manuals

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the equipment and systems installed.

### Records

General: Submit records to AS/NZS 2201.1.

Licence: Submit copy.

### Samples

General: Submit samples of the following:

* Door contacts and reed switches.
* Key or card readers.
* Electric door strikes and door release devices.
* Duress alarm switches.

### Shop drawings

General: Before commencing work submit shop drawings showing the following:

* Schematic diagram of all systems.
* Panel layouts and dimensions.
* Power supply requirements.
* Wiring access necessary for door frames.
* Cut out dimensions.
* Fixing provisions for cameras and monitors.

### Technical data

General: Submit data showing dimensions and space requirements for the following:

* Door contacts and reed switches.
* Detection devices.
* Activation devices.
* Electric door strikes and door release devices.
* Television monitors, cameras and associated equipment.
* Intercom stations.
* Vehicle control systems.
* Duress alarm switches.

## PRODUCTS

* 1. **SECURITY SYSTEMS**

### Alarm system panels or processors

Capacity: Provide separate sectors for each nominated internal zone, and for normally-closed and normally-open perimeter zones.

Sector time delay: Provide adjustable time delay entry/exit for each sector, with adjustment range 0 to 30 s.

Batteries and chargers:

- Sealed battery: Provide a sealed battery and charger system contained within each control panel with capacity as documented.

### Uninterruptible power supply

General: Provide a dedicated uninterruptible power supply and connect to the security systems. Capacity: At least 15 minutes, for the complete system in normal operation.

### Activation

Activation devices: Provide keypads, cards, card readers and other activation devices for access control and intruder alarm systems as documented.

External: Provide weatherproof (IP56) hoods or housings for external units. Default mounting height: 1100 mm from floor level.

### External audible and visual alarms

General: Provide a corrosion-resistant weatherproof metal enclosures containing sirens and blue strobe lights. Fix in locations not readily accessible without a ladder.

### Anti-tamper devices

Anti-tamper devices: Provide anti-tamper devices to control panels, external equipment, control and activating devices, and access control devices.

Function: To register an instantaneous alarm if covers are removed or vital wiring is disconnected.

### Alarm circuit supervision

Alarm circuit supervision: At each detection device, provide alarm circuit supervision by means of an end-of-line device connected via a separate circuit within the cable.

Function: To register an instantaneous alarm if cable characteristics change, such as when cut or short circuited.

### Event logging

Printer: Provide for event logging from the alarm and access control panel at a local security monitoring system.

Function: To generate a report showing, as a minimum, the date, time and category of alarm initiations and access control entries.

### Remote monitoring

Duration: Provide remote monitoring for the duration of the defects liability period.

Monitoring system: Provide a monitoring system in the alarm panel or processor for transmission of alarms and monitoring of the system by parties responsible for attending to alarms.

## ACCESS CONTROL

### Access control processors or panels

Capacity: Provide separate entry/exit control modules for each designated access point.

Users: Program the system to match the number of authorized users with unique access codes. Time zones: At least 4 per day, with provision for weekends and public holidays.

### Door control devices

General: Provide electric strikes, electric locks, drop bolts, or similar devices as documented to suit door construction and hardware.

Monitoring: Provide lock status and door position monitoring of door control devices.

Fail-safe: Connect door control devices in a fail-safe mode to permit egress in the event of power failure.

Authorised products: Provide equipment listed in the ActivFire Register of Fire Protection Equipment. Glass doors: Provide tumbler, drop bolts or magnetic holders.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

### Vehicle control

Vehicle access control: Provide vehicle access control system combining connection to vehicular doors and boom gates, and interconnection to the main access control system.

Exit loop detection: Provide a buried loop detection system adjacent to the exit point to activate boom gates or vehicular doors on approach by a vehicle. Connect so that doors or gates close after a pre- set time.

Interlock: Provide a photo electric beam safety interlock.

Interlock function: To prevent door or gate from closing until the vehicle has cleared the exit point.

Push-buttons and readers: Where practicable, provide direct wall mounting for push-buttons or readers; otherwise provide a robust mounting bollard and extension arm.

Default mounting height: 1000 mm from floor level.

Reed switches: Provide heavy duty reed switches on both sides of vehicle doors to generate a door closed indication at the control panel.

### Intercom

Base station: Provide intercom base station, interconnected with the individual local stations. Include speakers and microphones.

Entry station construction: Wall mounted flush stainless steel panel. Weatherproofing: IP56.

Dial: Digital push-button type.

Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the base station intercom panel.

Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.

Internal station type: Surface mounted, removable handset type.

Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the entry station can communicate with the internal station only when the switch is held down.

Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point.

## VIDEO MONITORING

### CCTV system

General: Provide a closed circuit television system monitoring and recording the areas/spaces as documented.

### CCTV cameras

Selection: Provide cameras selected to provide coverage of designated areas and to enable persons within the field of view to be readily distinguishable on monitors under all ambient night and day lighting conditions.

Motorized cameras: Provide camera drives which provide remote control of camera rotation and tilt, and of lens focal length.

External cameras: Provide corrosion-resistant weatherproof housings for cameras located externally, which allow cameras to perform to manufacturer’s specification.

Fixing: Provide mounting brackets and hardware which rigidly fix cameras, monitors and accessories to buildings or structures.

### CCTV monitors

General: Provide LCD colour monitors compatible with the security system, and provide fixing brackets and hardware for wall-mounted and ceiling-mounted monitors.

### CCTV recording system

General: Provide CCTV recording hardware and software systems which store data from each camera in an industry standard compressed digital format.

Functionality: Provide the following:

* Index according to events.
* Fast search.
* Frame by frame search.
* Frame printing.
* Zoom and pan within a recorded frame.
* Back up daily to off-site storage. Minimum data storage: 30 days. **CCTV video switching system**

General: Provide switching software which enables each camera to be directed to a specific monitor or

for cameras to be scanned sequentially at predetermined intervals to a specific monitor and which, on receipt of an alarm signal, interrupts the scanning sequence and switches to the relevant security zones.

## EXECUTION

* 1. **GENERAL**

### Mains supplies

Permanent power supply: Provide permanent power supply to the following:

* + - Intruder alarm panels and access control panels including sub panels.
    - Electric door strike local panels or control equipment.
    - Intercom stations.
    - CCTV monitors and cameras.

Marking: Label the switchboard circuit breaker from which power for the security systems is obtained as follows:

*SECURITY SYSTEM - Do not switch off*.

### CCTV cameras

Positioning and adjustment: Position and aim cameras to provide optimum coverage and to minimise the effect of shadows or direct light sources.

### Interconnection to other services

General: Provide functions and equipment to allow the interconnection to other systems. Provide and connect wiring to the designated services.

Lifts: Arrange for installation and connection of lift readers and associated equipment.

### Completion tests

General: Carry out tests, including out-of-hours tests, to demonstrate the security system’s performance. Include the following:

* + - Test components for correct function and operation.
    - Demonstrate that devices perform on site, to at least the level stated in the manufacturer’s performance specification for that device.
    - Test the operation of alarm sectors and panel functions, including open and short circuit tests.
    - Demonstrate that the system functions under mains fail condition.
    - Demonstrate operation of the battery and charger including a full discharge/recharge over the designated time.

## MAINTENANCE

### General

Standard: To AS/NZS 2201.1.

Breakdown call outs: Attend on site within 24 hours of notification. Rectify faults, and replace faulty materials and equipment.

Frequency of routine visits: ≤ 3 monthly. Maintenance period performance monitoring:

* Monitor: Access control system.
* Investigate: Causes of alarms.
* Alarm Report: < 2 days after alarm. False alarms:
* Notification of false alarms: On the first working day after a false alarm, submit notification of the circumstances surrounding the false alarm and action necessary to prevent similar occurrences.
* Alterations due to false alarms: Carry out alterations necessary to eliminate false alarms due to the following:

. Technical faults, selection, siting or aiming of devices.

. Environmental conditions evident at the time of installation.

## SELECTIONS

* 1. **SYSTEM DESCRIPTION**

**System description schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Security classification |  |  |  |
| System communications |  |  |  |

## SECURITY MONITORING SYSTEMS

**Security monitoring systems schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Monitoring system |  |  |  |
| Communication method |  |  |  |
| Base station location/identification |  |  |  |
| Alarm response time |  |  |  |
| Alarm system |  |  |  |
| External audible and visual |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| alarms |  |  |  |
| Central monitoring facility |  |  |  |
| Location |  |  |  |
| Computer specification |  |  |  |
| Event logging printer |  |  |  |
| Uninterruptible power supply capacity (hours) |  |  |  |
| Backup medium and capacity |  |  |  |
| Interconnected systems |  |  |  |

## ACCESS CONTROL SYSTEM

**Access control system schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| System type |  |  |  |
| Activation method |  |  |  |
| De-activation method |  |  |  |
| Other entry method |  |  |  |
| Equipment mounting and enclosure |  |  |  |
| Number of users to have unique codes |  |  |  |
| Number of programmable time zones for automatic access |  |  |  |
| Number of programmable access zones for automatic access |  |  |  |
| Entry points |  |  |  |
| Door control devices |  |  |  |
| Internal access zones |  |  |  |
| Delayed access zones |  |  |  |
| Intercom function |  |  |  |
| Remote operation function |  |  |  |
| Vehicle control points |  |  |  |
| Spare capacity |  |  |  |
| Number of users |  |  |  |
| Alarm zones |  |  |  |
| Power supply |  |  |  |
| Communication system |  |  |  |

## DURESS ALARM

**Duress alarm schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| System type |  |  |  |
| Alarm button type – wall mounted |  |  |  |
| Alarm button type – desk/furniture mounted |  |  |  |
| Alarm response |  |  |  |

## CCTV MONITORING SYSTEM

**CCTV system schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| System type |  |  |  |
| Communications system |  |  |  |

**Camera schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Camera(s) fixed – location and type |  |  |  |
| Camera(s) pan/tilt/zoom – location and type |  |  |  |
| Camera(s) dome – location and type |  |  |  |
| Lens types and mounts |  |  |  |
| Scanning system |  |  |  |
| Resolution |  |  |  |
| Signal to noise ratio |  |  |  |
| Minimum illumination for useable video |  |  |  |

**Monitor schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location and type |  |  |  |
| Resolution |  |  |  |
| Colour system |  |  |  |
| Video input |  |  |  |

**Recording system schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Type |  |  |  |
| Recording rate |  |  |  |
| Recording modes |  |  |  |
| Resolution |  |  |  |
| Colour system |  |  |  |
| Video/audio input |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Video/audio output |  |  |  |
| Back up site location |  |  |  |
| Back up site interconnection method |  |  |  |

**16.0 BUILDING IT COMPONENTS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide IT components and systems, as documented.

**Special service conditions**

## PRECEDENCE

### General

Work sections and referenced documents:

* + - The requirements of other work sections of the specification override conflicting requirements of this work section.
    - The requirements of this work section overrides conflicting requirements of its referenced documents.
    - The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.

## STANDARDS

### General

Communications facilities: To AS/NZS ISO/IEC 14763.2.

## INTERPRETATION

### Definitions

General: For the purposes of this work section the following definitions apply:

* + - Local area networks (LAN): A telecommunication network that interconnects computers and telecommunications equipment in a limited area such as an office, a building or a series of buildings on a campus site.
    - Wide area network (WANs): A telecommunication network that interconnects computers and telecommunications equipment over a broad geographical area i.e. any network that links across multiple client sites, metropolitan, regional, or national boundaries.

## SUBMISSIONS

### Technical data

Requirement: Submit technical data for all components including the following:

* + - Hardware and software manufacturer’s technical literature.

## PRODUCTS

* 1. **ACTIVE COMPUTER HARDWARE**

### Computer hardware

General: Provide the computer hardware required for the operation and management of the building IT systems and as documented in the **Computer hardware schedule**.

### Network hub/switch

Type: Managed Gigabit ethernet Layer 2. Interface: Web.

RS232 port: Required.

Quality of service: Implementation required to IEEE 802.1Q. Power over ethernet: Required.

VLAN: IEEE 802.19.1.

Security: IEEE 802.1X RADIUS protocol.

Mounting: Rack mounting.

### Network router

Type: Gigabit ethernet.

Functions: Static IP, dynamic IP, integrated DHCP, PPPoE, and device name support. Mounting: Rack mounting.

### Wireless access point

Compatibility: ISO/IEC 8802-11 and IEEE 802.11. LAN port: 100 Mbps.

Modes: Wireless access point, point-to-point bridge, point-to-multi-point wireless bridge, wireless client and wireless repeater.

Power over ethernet: Required.

### ADSL modem

Graphical User Interface (GUI): Required to permit modification of settings to connect to Internet Service Provider (ISP).

Functions: Static IP, Dynamic IP, PPPoE/PPPoA and Bridge connections.

### Coaxial cable modem

Graphical User Interface (GUI): Required to permit modification of settings to connect to Internet Service Provider (ISP).

Functions: Static IP, Dynamic IP, PPPoE/PPPoA and Bridge connections.

### Backup/archive facilities

Type: Tape.

Mounting: Rack mounting.

### Printers

General: As documented in the **Printers schedule**. **Voice telecommunication equipment**

General: As documented in the **Voice telecommunications schedule**.

### WAN interfaces

General: Provide WAN interface equipment for the operation and management of the WAN site and Building IT system interface as documented in the **Computer hardware schedule**.

## SOFTWARE

### General

Requirement: Provide the software required for the operation and management of the building IT systems and equipment including the following:

* + - All passwords, access codes and other means used to limit or control access to, or modification (including extension) of, the software.
    - All software and manuals necessary to modify or extend the software.
    - Back-up copies of software in electronic format.
    - Installation of all software updates issued before the end of the defects liability period.

Compatibility: Provide software systems that are planned to have upgrades backward compatible, so that each upgrade does not require user input or changes to base data or to the site specific installation.

Licence: Provide fully licensed versions of all software and licenses for all users defined in the documents.

OSI model: Provide software that operates on the open system interconnection (OSI) model.

### System software

General: Provide system software as documented in the **System software schedule**. **Application software**

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

systems and equipment including the following:

* + - Absolute right and all necessary facilities for the principal to modify extend or reduce any or all functions, hardware and software that form part of the system.
    - Full listings of all software supplied which has been developed, modified or adapted to meet the requirements of this project.

Function: Provide software that delivers accurate and reliable results.

Modular construction: Provide software constructed in modules to assist maintenance and to reduce the delays in execution.

### Pre-delivery tests

General: Verify that the software has been assembled and tested for operational performance before installation on site.

High level interface test: If a high level interface to other systems is required, test and verify software performance with the documented systems before installation on site.

## EXECUTION

* 1. **INSTALLATION**

### Network integration

General: Integrate the equipment into the network operating system.

### Software integration

General: Integrate the software into the system and applications software.

## COMPLETION

### Completion tests

Requirement: Verify the functional and operational performance of the software before the date of practical completion.

Disaster recovery: Verify that the software recovers from disaster events without loss of data and without loss of reliability.

Reliability: Verify that the software system provides reliable reporting and results through alternative measurement methods.

## SELECTIONS

* 1. **PRODUCTS**

**Computer hardware schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Requirement** | **A** | **B** | **C** |
| Type |  |  |  |
| Processor (minimum speed GHz) |  |  |  |
| RAM (GB minimum) |  |  |  |
| Hard disc (GB minimum) |  |  |  |
| Optical drive |  |  |  |
| Keyboard |  |  |  |
| Pointing device |  |  |  |
| Screen: Type |  |  |  |
| Screens: Size (minimum diagonal inches) |  |  |  |
| Screens: Resolution (pixels minimum) |  |  |  |
| Dial-up modem |  |  |  |

**Printers schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Requirement** | **A** | **B** | **C** |
| Type |  |  |  |
| Colour |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Requirement** | **A** | **B** | **C** |
| Resolution (dots/inch) |  |  |  |
| Paper size |  |  |  |
| Speed (pages/minute) |  |  |  |

**Voice telecommunications equipment schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **A** | **B** | **C** |
| PABX equipment |  |  |  |
| Voice over the Ethernet (VoE) systems |  |  |  |
| Telephone handsets |  |  |  |

**System software schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **A** | **B** | **C** |
| Operating system |  |  |  |
| Management application suite |  |  |  |

**17.0 ELECTRICAL MAINTENANCE**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Maintain the electrical systems for the documented maintenance period so that the performance, reliability, service life, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period, in parallel with and including:

* + - Periodic and statutory maintenance, cleaning and replacement of consumables.
    - Emergency repairs.

Maintenance period: As documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.

## STANDARD

### General

Electrical services: To AS/NZS 3000.

### Maintenance required

Minimum level: To the operations and maintenance manual and the manufacturer’s recommendations.

## INTERPRETATION

### Definitions

General: For the purpose of this work section the following definition applies:

* + - Consumable: Materials or components intended to be replaced within the service life of the associated plant or equipment.
    - Periodic maintenance: Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
    - Repairs: Unplanned/corrective maintenance (reactive).
    - Replacement: Upgrading of a higher value component on regular cycle, including repainting and replacement of air conditioning equipment.

## SUBMISSIONS

### Certification

Annual certification: Inspect and submit certification for all items required to be inspected annually under statutory requirements including, but not limited to, fire detection and alarms, emergency evacuation lighting and early warning and intercommunication systems (EWIS).

### Records

Maintenance records: Conform to the *General requirements* work section.

Periodic maintenance and performance report: At the frequency documented, submit reports summarizing the maintenance performed and the performance of the electrical services in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

* Dates and number of site labour hours for periodic maintenance. Exclude travelling time.
* Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time.
* Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
* Peak load and load profile for electrical power consumed, where metering equipment allows. Where no appropriate metering equipment exists, provide copies of electricity accounts from the electricity service provider.
* Results of recommissioning if scheduled for the period.

## INSPECTION

### Notice

Requirement: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

## PRODUCTS

* 1. **GENERAL**

### Product selection

Proprietary items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance, energy profile and construction characteristics.

Light fittings and ballasts: If fluorescent tubes or ballasts change due to obsolescence, provide changes so that the performance of the system is equal to or better than the existing, e.g. equal or lower energy consumption or changing to electronic ballasts that improves lamp life.

## EXECUTION

* 1. **EMERGENCY REPAIRS**

### General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs. Rectify faults and replace faulty materials and equipment.

Remedial work: Carry out any remedial work, including temporary work, necessary to restore the system to safe and satisfactory operation. Verify the system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary work: Promptly replace temporary work with permanent rectification.

### Contact details

General: Provide contact details including mobile phone numbers for normal working hours and emergency call outs.

### Response time

Period: Attend site for emergency service within the documented response time.

Response period: Starts at the time of notification to the contactor’s nominated contact point.

## PERIODIC MAINTENANCE

### General

Routine visits: Make routine service visits at the frequency documented. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals.

Notification of defects: When defects in the installation are identified, give notice. Requirement: Provide maintenance work including, but not limited to, the following:

* Attend to reported defects and complaints.
* Check for and repair corrosion.
* Check for and rectify any unsafe conditions.
* Replace faulty or damaged parts and consumable components.
* Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly.
* Safety signs maintenance: To AS 1319.

### Cleaning

Requirement: At the end of the maintenance period:

* Remove waste and clean all parts of the installation.
* Remove temporary protective coatings, packaging and labels.
* Clean interior of switchboards, switchgear, contactors and other electrical contacts to remove dust and foreign matter.

Lighting fittings: Clean the interior of luminaires, including diffusers and louvres, annually for non-air conditioned buildings and every three years for air conditioned buildings. For large air conditioned buildings, schedule areas of the building where a third of the fittings are cleaned each year.

### Electrical systems

Requirement: Perform the following:

* Check for hot joints, burnt insulation and burnt contacts.
* Check electrical connections for tightness.
* Check operation of all electrical components and systems.
* Check indicating lights and replace defective lamps.
* Check overload settings.
* Check and report any changes to controls and wiring.
* Provide maintenance in conformance with manufacturer's recommended maintenance program.

### Standards

Electrical equipment generally: To AS/NZS 3760. Switchboards: To AS 2467.

### Power generator - photovoltaic

Stand-alone power systems: Maintain the system to AS/NZS 4509.1 during the defects liability period.

Grid connected systems: Maintain the system to AS/NZS 5033 Appendix C during the defects liability period.

### Power generator – diesel

Call out: Respond to call outs for breakdowns or other faults requiring corrective maintenance. Attend on site within 24 hours of notification. Rectify faults and replace faulty materials and equipment.

### Switchboards

Standard: To AS 2467.

General: Carry out the following:

* Check for hot joints and burnt insulation. Carry out a thermal scan of joints and cable terminations by use of an infrared temperature detector or cameras and repair any joints showing high temperatures.
* Rectify faults, make adjustments and replace consumable and faulty materials and equipment within 24 hours of notification.
* Monthly inspections and maintenance work to maintain the assembly, including battery systems.

### Emergency evacuation lighting

Requirement: To AS/NZS 2293.2.

Interval: Carry out the 6-monthly procedures before practical completion and again before the end of the maintenance period.

### Fire detection and alarms

Operational and maintenance manual: To AS 4428.4. Maintenance and records: To AS 1851.

Routine service process and procedures: To AS 1851 clause 6.2. Baseline data: Provide baseline data to AS 1851.

### System provider

Electronic security system provider: A licensed security organization only.

## END OF MAINTENANCE PERIOD SERVICE

### General

Requirement: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

## COMPLETION

### Maintenance records

Service records: Record maintenance undertaken in the schedules in the operation and maintenance manuals.

Maintenance reports: Prepare maintenance reports as documented.

### Restitution after maintenance tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete.

Standard: Equal to the condition of the original installation.

## SELECTIONS

* 1. **MAINTENANCE**

**Maintenance requirements schedule**

|  |  |
| --- | --- |
| . **Provision** | . **Requirement** |
| . Maintenance period | . Conform to the *General requirements*  Work section |
| . Call out response time not to exceed | . |
| . Maximum time between programmed service visits | . |
| . Frequency of periodic maintenance and performance reports | . |

**SECTION E – FIRE SYSTEMS**

**1.0 FIRE SYSTEMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

General: Provide the fire protection services, as documented. Summary: The fire protection services are summarised as follows:

## FIRE SERVICES SCOPE OF WORKS

The work covered by this specification and associated drawings shall be carried out by the Fire Services Sub-Contractor and consists of the following but not limited to;

The complete fabrication, supply, delivery, off-loading, hoisting into position, installation, testing, commissioning, setting to work, demonstrating, training and maintenance of the following necessary to complete the intent of the project:

### Wet Fire Protection System

* + 1. Fire hydrant booster inlets, external fire hydrants, internal fire hydrants, pipework’s, valves, fittings, support and all other associated accessories.
    2. 36m swing arm fire hose reels, cabinets, pipework, valves, fittings, support and all other associated accessories.
    3. Fire extinguishers complete with cabinets, fittings, supports and all other associated accessories.
    4. Fire blankets complete with supports and all other associated accessories.
    5. All wet fire protection system installation shall have necessary sign / labelling as per required standards.

### Dry Fire Protection Services

1. Automatic Fire Detection System including all cables, Addressable Fire Indication Panel (FIP), detectors, manual call points, circuit cabling, fittings, supports and all associated accessories. FIP and RP cabinets shall be single or double swing door type with locks approved to National Fire Authority standards.
2. Fire fan control panel including cabling, conduits, isolators, protective devices, controls and associated accessories.
3. Cable management including conduits, ducts, cable tray, catenary wire, support, fitting, and accessories, etc.
4. All dry fire protection system installation shall have necessary sign / labelling as per required standards.

Attendance at meetings, contract administration and coordination with the client’s representatives, other trades, utility providers, local authorities, etc.

Any omission from the above scope does not relieve the contractor of the design intent.

## FIRE SERVICES DESIGN CONDITION

### General

Building Type: Class 5

|  |  |
| --- | --- |
| **Fire Hose Reel**  Nominal hose diameter: | 19 mm |
| Pressure required at the outlet (minimum): | 220 kPa |
| Required flow rates (minimum): | 0.33 L/s |
| Minimum supply pipe diameter: | 25 mm |
| Hose length: | 36 m |
| Hose stream: | 4 m |
| Number of fixtures operating simultaneously: | 2 |
| **Fire Hydrant**  Pressure required at the outlet (minimum): | 700 kPa |
| Required flow rates (minimum): | 5 L/s |
| Hose length (internal): | 30m |
| Hose length (external): | 60m |
| Hose stream: | 10 m |
| Number of fixtures operating simultaneously: | 2 |

### Fire Services Design Condition (Dry Fire Protection)

Automatic Smoke Detection and Alarm:

Maximum distances between smoke detectors: 10.0m Maximum distances from walls or partitions for smoke detectors: 5.0m Maximum distances between heat detectors: 7.0m Maximum distances from walls or partitions for heat detectors: 3.5m

Output of sounders: 65Bb – 105dB

## FIRE SERVICES ASSOCIATED WORKS BY OTHERS

The following associated works shall be provided under the main contractor by the various trades but not limited to, to ensure the successful completion of the Fire services installation;

Builders Works as follows but not limited to

1. Forming of penetrations for pipework
2. All required chase in walls and floors
3. Fire sealing of all penetration passing through a fire rated compartment or structure
4. Weatherproofing/flash roof and wall penetration passing through the external envelope of the building
5. Concealing of services
6. Access to ceiling voids (access panels), services shaft, partition and block walls

Hydraulics Services

1. Connection from water mains and tap off for booster supply.

## FIRE PROTECTION SERVICES REFERENCE DOCUMENTS

|  |  |
| --- | --- |
|  | Australian National Construction Code Series - 2016 |
|  | National Building Code of Samoa - 1992 |
| AS/NZS 3500.1:2003 | Plumbing and Drainage – Water Services |
| AS 2441-2005 | Installation of fire hose reels |
| AS 2419-2005 | Fire hydrant installations |
| AS 2444-2001 | Portable fire extinguishers and fire blankets – Selection and location |
| NZS 4510-2008 | Fire hydrant systems for buildings |
| AS1670.1-2015 | Fire detection, warning, control and intercom systems—System design, installation and commissioning - Part 1 Fire |
| AS1670.3-2004 | Fire detection, warning, control and intercom systems—System design, installation and commissioning - Part 3: Fire alarm monitoring |
| AS1670.4-2015 | Fire detection, warning, control and intercom systems—System design, installation and commissioning - Part 4: Emergency warning and intercom systems |
| NZS 4512-2010 | Fire Detection and Alarm System in Building |

* 1. **DESIGN**

### Design for durability and maintainability

Design for durability: Develop the design so the systems achieve the documented performance, reliability, service life, energy efficiency and safety requirements, and are easily maintainable.

Access for maintenance: Develop the design so the systems conform to **ACCESS FOR MAINTENANCE** in the *General requirements* work section.

## PRECEDENCE

### General

Work sections and referenced documents:

* The requirements of other work sections of the specification override conflicting requirements of this work section.
* The requirements of the work sections override conflicting requirements of their referenced documents.
* The requirements of the referenced documents are minimum requirements.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* *General requirements*.
* *Hydraulics system*
* *Electrical system*

## INTERPRETATION

### Definitions

General: For the purposes of this work section the definitions given in the *General requirements*

Work section apply.

## STANDARDS

### General

Microbial control: To AS/NZS 3666.1, AS/NZS 3666.2 and the recommendations of SAA/SNZ HB 32. Sanitary plumbing and drainage: To AS/NZS 3500.2.

Water supply: To AS/NZS 3500.1.

## CONTRACT DOCUMENTS

### General

Requirement: Conform to the *General requirements* work section.

## SUBMISSIONS

### General

Requirement: Conform to the *General requirements* work section.

### Certification

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

### Electrical loading

Electrical loading: Submit for all equipment before completion of the main switchboard shop drawings.

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.

### 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.

### Operation and maintenance manuals

Requirement: Conform to the *General requirements* work section.

### Shop drawings

Standard: To AS 1100.101, AS 1100.201, AS 1100.301, AS 1100.401 and AS/NZS 1100.501 as

applicable.

Requirement: Submit detail drawings at minimum 1:100 scale, showing the following:

* Pipework and equipment layout and sections showing the work to be installed on 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.

. Site and floor set out points.

. Tank stands and supporting structures.

### Products

Equipment: Documented pump heads are based on provisional equipment selections and estimated pressure drops. 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: 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 conformance to 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.

## INSPECTION

### Notice

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

* Excavated surfaces.
* Concealed or underground services.

## EXECUTION

* 1. **WORK ON EXISTING SYSTEMS**

### Demolition

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

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

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

### Existing systems

Condition of existing systems:

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

## INSTALLATION

### Accessories

General: Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.

Isolating valves: In addition to valves required to meet statutory requirements, provide valves so that isolation of parts of the system for safe isolation of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

### Connections to Network Utility Operator mains

General: Excavate to locate and expose the connection points and connect to the Network Utility Operator mains. On completion, backfill and compact the excavation and reinstate surfaces and elements which have been disturbed such as roads, pavements, kerbs, footpaths and nature strips.

## SUPPORT OF PLANT AND EQUIPMENT

### Support of roof mounted plant and equipment

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

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

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

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

Sloping roofs:

* Roof slope 10° or over: Adopt the roof material manufacturer’s documented installation procedures, or seek the advice of a professional engineer.
* Roof slope less than 10°: Provide appropriate continuous supporting members, compatible with the roof material, laid parallel to the span of the roof sheeting. Extend the continuous support members in both directions to the first purlin or joist that is over 1 m from the face of the plant or equipment it supports.

### Support of ground level plant and equipment

Ground level:

* If the ground slope is 15° or over, 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.

**2.0 HYDRANTS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fire hydrant installations including water supply, piping, valves, hydrant valves, booster valve and suction points, as documented.

### Design

Standard: To AS 2419.1.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.

## STANDARDS

### General

Standard: To AS 2419.1.

## SUBMISSIONS

### Products

Product listing: Submit documentation to verify product listing in the ActivFire Register of Fire Protection Equipment for the respective item.

### Samples

General: Submit samples of accessories not documented as proprietary items, including the following:

* Fire brigade booster valve.
* Fire hydrant valve.
* Vandal resistant canister enclosures.

## INSPECTION

### Notice

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

* + - Connection branch to Network Utility Operator water main.
    - Pipes installed in trenches including all thrust blocks.
    - Fire brigade booster valve installed and ready for operational test.

## PRODUCTS

* 1. **AUTHORISED PRODUCTS**

### General

Requirement: Provide equipment listed in the Antifire Register of Fire Protection Equipment.

## PIPING

### General

Piping material: As documented.

## VALVES

### Isolating valves

Below-ground metal seated isolating valves: To AS/NZS 2638.1. Below-ground resilient seated isolating valves: To AS/NZS 2638.2. **Fire hydrant valves**

Standard: To AS 2419.2.

Requirement: Provide fire hydrant valves as follows:

* To the requirements of the local fire brigade.
* Copper alloy construction.
* Matching non-ferrous dust cap and chain. Valve monitors: To AS 4118.1.4.

## FIRE BRIGADE BOOSTER CONNECTION

### General

Standard: To AS 2419.3.

Type: Provide a proprietary booster fitting with a cast bronze body, DN 65 inlets suitable for quick connect couplings, back pressure valves, pressure gauge, drain valve and main stop valve.

Requirement: Backflow prevention. Number of booster valves: As documented. Signage and block plan: To AS 2419.1.

## EXECUTION

* 1. **INSTALLATION**

### General

System: To AS 2419.1.

Valves: Locate valves to permit satisfactory operation and maintenance.

## COMMISSIONING

### General

System: To AS 2419.1.

### Baseline data

Requirement: Provide baseline data to AS 1851.

## MAINTENANCE

### General

Requirement: Conform to the *Hydraulic maintenance* work section.

1. **SELECTIONS**
   1. **HYDRANTS**

**3.0 HOSE REELS**

1. **GENERAL**
   1. **RESPONSIBILITIES**

### General

Requirement: Provide hose reels, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Hydraulic systems*.

## STANDARDS

### General

Design, construction and performance: To AS/NZS 1221. Installation: To AS 2441.

## SUBMISSIONS

### Products

Product listing: Submit evidence of listing in the Antifire Register of Fire Protection Equipment.

## INSPECTION

### Notice

Inspection: Give notice so that inspection may be made of the mains supply.

## PRODUCTS

* 1. **AUTHORISED PRODUCTS**

### General

Requirement: Provide equipment listed in the Antifire Register of Fire Protection Equipment.

## FIRE HOSE REELS

### General

Standard: To AS/NZS 1221. Certification: Required.

Certification provider: An organization accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Type: Swivel hose guide. **Pumpset systems** General: To AS 2941.

## EXECUTION

* 1. **INSTALLATION**

### Fire hose reels

Standard: To AS 2441.

Protection from damage: To AS 2441.

## COMMISSIONING

### General

Requirement: Test to verify conformance to AS 2441. Results: Submit commissioning and testing results. **Baseline data**

Requirement: Provide baseline data to AS 1851.

## MAINTENANCE

### General

Requirement: Conform to the *Hydraulic maintenance* work section.

1. **SELECTIONS**
   1. **HOSE REELS**

**4.0 FIRE EXTINGUISHERS AND BLANKETS**

1. **GENERAL**
   1. **RESPONSIBILITIES**

### General

Requirement: Provide fire extinguishers and fire blankets, as documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.

## AUTHORISED PRODUCTS

### General

General: Provide equipment listed in the Antifire Register of Fire Protection Equipment.

## PRODUCTS

* 1. **EXTINGUISHERS**

### Standards

General: Provide portable fire extinguishers and location signs as follows:

* + - General requirements: AS/NZS 1841.1.
    - Water: AS/NZS 1841.2.
    - Wet chemical: AS/NZS 1841.3.
    - Foam: AS/NZS 1841.4.
    - Powder: AS/NZS 1841.5.
    - Carbon dioxide: AS/NZS 1841.6.
    - Non-rechargeable: To AS/NZS 1841.8. Selection and location: To AS 2444 Certification: Required.

Certification provider: An organization accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

**Fire extinguishers schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **FE1** | **FE2** | **FE3** |
| Location |  |  |  |
| Number |  |  |  |
| Unit type |  |  |  |
| Classification and rating |  |  |  |
| Nozzle type |  |  |  |
| Maximum force to operate lever (N) |  |  |  |
| Maximum force to frangible seal (N) |  |  |  |
| Cabinet: Type |  |  |  |
| Cabinet: Security |  |  |  |
| Waterproof cover |  |  |  |

## BLANKETS

### Fire blankets

General: To AS/NZS 3504.

Certification: Required.

Certification provider: An organisation accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ).

Selection and location: To AS 2444.

**Fire blankets schedule**

|  |  |  |
| --- | --- | --- |
| **Location** | **Number** | **Size** |
|  |  |  |
|  |  |  |
|  |  |  |

## EXECUTION

* 1. **COMPLETION**

### Maintenance

Fire extinguishers: To AS 1851. Fire blankets: To AS 1851.

**5.0 FIRE DETECTION AND ALARMS**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Provide fire detection and alarm systems, as documented.

## SYSTEM

### General

System type: Addressable.

Interface: Emergency warning and intercommunications system.

### Surge protection devices (SPD)

General: Provide all mode metal oxide varistor based series connected SPD to protect final equipment in racks and cabinets.

Standard: To AS 4262.1 and AS 4262.2. Surge Rating: Imax ≥ 20 kA per phase.

Residual Voltage: Up < 600V.

Visual indicator: Provide visual indication of SPD status.

Enclosure and installation: House SPD in a metal enclosure and protected with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Electrical systems*.
    - *Cable support and duct systems*.
    - *Low voltage power systems*.
    - *Emergency warning and intercommunication*.

## STANDARDS

### General

Standard: To AS 1670.1, AS 4428.1 and AS 7240.13.

## SUBMISSIONS

### Operation and maintenance manual

Standard: To AS 4428.4, Section 3.

Requirement: Provide all operational and maintenance documentation necessary to operate and maintain the systems installed.

### Samples

Requirement: Submit for the following:

* Detectors.
* Manual call points.
* Alarm bells.
* Magnetic door holders.

### Shop drawings

General: Submit showing the following:

* Fire detector layout.
* Dimensions and details of control and indicating equipment.
* Location.
* Circuit identification.
* Labelling details.

### Technical data

Product data: Submit for the following:

* Fire indicating panel.
* Detectors.
* Manual call points.
* Alarm bells.
* Magnetic door holders.

## PRODUCTS

* 1. **AUTHORISED PRODUCTS**

### General

Equipment: Provide equipment listed in the ActivFire Register of Fire Protection Equipment.

## CONTROL AND INDICATING EQUIPMENT

### Standards

General: To AS 7240.2.

Air-handling fire mode control panels: To AS 4428.7. Alarm investigation facility (AIF): To AS 4428.10.

Alarm signalling equipment: To AS 4428.6. Power supply units: To AS 4428.5.

Fire brigade panel: To AS 4428.3. Routing equipment: To AS 7240.21.

Wire-free alarm zone circuits: To AS 4428.9.

### Fire indicator panels

General: Provide metal cubicle-type enclosures.

### Isolation

Isolating facilities: Provide on fire indicator panels to enable testing without the transmission of alarm signals to the fire brigade.

### Capacity

Spare zones: 50% minimum.

## DETECTORS

### Type

Areas generally: Optical beam smoke detectors.

Hot areas: Fixed temperature integral heat detector/alarm unit type.

### Standards

Smoke alarms: To BCA Spec E2.2a.

Carbon monoxide (CO) fire detectors: To AS 7240.6. Duct sampling units (DSUs): To AS 1603.13.

Heat detectors: To AS 7240.5.

Point type smoke detectors: To AS 7240.7 and AS 1603.2. Integral heat detector/alarm units: To AS 1603.3.

Integral smoke detector/alarm units: To AS 3786. Multi-sensor fire detectors: To AS 7240.15.

Multi-point aspirated smoke detectors: To AS 1603.8. Optical beam smoke detectors: To AS 1603.7.

Remote indicators: To AS 1603.15. Visual warning devices: To AS 1603.11. **Self-indicating detectors**

General: Provide a light emitting diode mounted in a clearly visible position, which illuminates

whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes: Conform to the following:

* Visible detectors: On the outside of the detector or its base.
* Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.
* Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.
* Remote indicators: To AS 1603.15.

## MANUAL CALL POINTS

### General

Standard: To AS 1603.5 and AS 7240.11.

## EXTERNAL ALARM INDICATION

### Standards

Bell circuits: To AS 4428.1. Strobe lights: To AS 1603.11. **Power supply**

To the strobe light and ≤ 2 others: From the fire indicator panel battery power supply.

To additional strobe lights: From the mains supply. Provide appropriate interface relays, operated by the fire indicator panel.

## MAGNETIC DOOR HOLDERS

### General

Standard: To AS 4178.

### Control facilities

Standard: To AS 1670.1 clause 3.19.

Signals: Ancillary control device circuits and connections for automatically controlling and releasing magnetic door holders to operate the relevant doors under fire alarm conditions.

## WARNING SYSTEM

### General

Occupant warning system: To AS 1670.1 Section 3.22.

## POWER SUPPLY

### General

Surge protection: Ensure that normal operation is maintained and that voltage surges in the power source do not damage the control and indicating equipment.

Sealed batteries: Cycle the batteries before practical completion so that greater than or equal to 100% of nominal capacity is available at practical completion.

## EXECUTION

* 1. **FIRE ALARM MONITORING**

### General

Standard: To AS 7240.21.

Connection: Connect the installation to a monitoring service provider. Connect using telecommunications fixed wire carrier lines.

Cable rating: Minimum rating WS51W to AS/NZS 3013 for wiring between the alarm signal equipment and the telecommunication carriage service provider’s point of connection.

## DETECTORS

### Installation

General: Install detectors so they can be easily inspected and tested in situ, and readily withdrawn from service.

Integral smoke detector/alarm units: To AS 1670.6.

## INSTALLATION WIRING

### General

To AS 1670.1 Section 3.24.

## TESTING

### General

Tests: Carry out tests, including out-of-hours tests, to demonstrate the automatic fire detection and alarm system’s performance to AS 1670.1 Section 7 and the compliance Sections of the relevant parts of the AS 1603 series. Include the following:

* + - Test components for correct function and operation.
    - Demonstrate detection and alarm performance on site, to at least the level stated in the manufacturer’s performance specification for that device.
    - Test alarm zone identification.
    - Demonstrate air sampling system operation for 14 days with data logger to verify stability of detectors and devices.
    - Demonstrate addressable device operation for 14 days with data logger to verify stability of detectors and devices.
    - Test interface to interconnected systems.
    - Demonstrate correct shutdown sequences during fire mode.
    - In situ testers: To AS 1603.16.

## MAINTENANCE

### Baseline data

Requirement: Provide baseline data to AS 1851, clause 1.8.

## SELECTIONS

* 1. **SYSTEM DESCRIPTION**

**Interconnection to other systems schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| System |  |  |  |
| Interface |  |  |  |

## FIRE DETECTION AND ALARMS

**Base station monitoring system schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Communications cabling |  |  |  |
| Line rental to be paid by |  |  |  |

**Control and indicating equipment schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Enclosure |  |  |  |
| Mounting |  |  |  |
| Doors |  |  |  |
| Finish |  |  |  |
| Master alarm facility |  |  |  |
| Alarm zone facility |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Isolation method |  |  |  |
| Ancillary control facilities |  |  |  |

**Fire fan control panel schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Location |  |  |  |
| Provided by |  |  |  |
| Interconnection by |  |  |  |

**Power supply schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Surge protection |  |  |  |
| Other |  |  |  |

**Fire detection – components schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **A** | **B** | **C** |
| Description |  |  |  |
| Type |  |  |  |
| Mode |  |  |  |
| Addressable |  |  |  |

**6.0 FIRE MAINTENANCE**

## GENERAL

* 1. **RESPONSIBILITIES**

### General

Requirement: Maintain the fire systems for the documented maintenance period so that the performance, reliability, service life, energy efficiency and safety of the system is equal to or better than that at the beginning of the maintenance period, in parallel with and including:

* + - Periodic and statutory maintenance, cleaning and replacement of consumables.
    - Emergency repairs.

Maintenance period: As documented.

## CROSS REFERENCES

### General

Requirement: Conform to the following work section(s):

* + - *General requirements*.
    - *Fire Systems*

## INTERPRETATION

### Definitions

General: For the purpose of this work section the following definition applies:

* + - Consumable: Materials or components intended to be replaced within the service life of the associated plant or equipment.
    - Periodic maintenance: Planned routine maintenance of plant and equipment (proactive), including fire safety measures and statutory requirements.
    - Repairs: Unplanned/corrective maintenance (reactive).
    - Replacement: Upgrading of a higher value component on regular cycle, including repainting and replacement of air conditioning equipment.

## SUBMISSIONS

### Certification

Annual certification: Inspect and submit certification for all items required to be inspected annually under statutory requirements including, but not limited to, fire detection and alarm system, early warning and intercommunication system (EWIS), fire hydrant system and fire hose reel system.

### Records

Maintenance records: Conform to the *General requirements* work section.

Periodic maintenance and performance report: At the frequency documented, submit reports summarizing the maintenance performed and the performance of the hydraulic installation in the preceding period. Set out the report in a form that permits comparison with previous reports. Include the following as minimum requirements:

* Dates and number of site labour hours for periodic maintenance. Exclude travelling time.
* Dates, number of site labour hours and nature of work for emergency repairs. Exclude travelling time.
* Dates and number of site labour hours for defects liability rectification if within the defects liability period. Exclude travelling time.
* List of any motors for which the motor current varied by more than 10% from the current measured during commissioning.
* Results of recommissioning if scheduled for the period.

## INSPECTION

### Notice

Requirement: Give notice so that an inspection may be held simultaneously with the final programmed maintenance visit.

## PRODUCTS

* 1. **GENERAL**

### Product selection

Proprietary items: Select products, as consumables or replacement items, of the same make, model and type as those being replaced.

Substitutions: Where the existing product is no longer available, provide products with at least the same performance and construction characteristics.

## EXECUTION

* 1. **EMERGENCY REPAIRS**

### General

Requirement: Respond to call outs for breakdowns or other faults requiring emergency repairs. Rectify faults and replace faulty materials and equipment.

Remedial work: Carry out any remedial work, including temporary work, necessary to restore each system to safe and satisfactory operation. Verify each system is operating correctly before leaving the site. Do not leave the plant in an unsafe condition.

Temporary work: Promptly replace temporary work with permanent rectification.

### Contact details

Emergency contract: Provide contact details including after hours and emergency mobile and/or pager details, to permit notification of emergency conditions.

### Response time

Period: Attend site for emergency service within the documented response time.

Response period: Starts at the time of notification to the contactor’s nominated contact point.

## PERIODIC MAINTENANCE

### General

Microbial control maintenance: To AS/NZS 3666.2.

Routine visits: Make routine service visits at the frequency documented. Service items of equipment in conformance with the maintenance schedules in the operation and maintenance manuals.

Notification of defects: When defects in the installation are identified, give notice. Requirement: Provide maintenance work including, but not limited to, the following:

* Carry out the manufacturers' recommended maintenance.
* Attend to reported defects and complaints.
* Check for and repair corrosion.
* Check for and rectify any unsafe conditions.
* Replace faulty or damaged parts and consumable components.
* Check anti-vibration supports, brackets and clamps, holding down bolts and flexible connections, for deterioration and for freedom of movement of assembly.
* Identification of pipes, conduits and ducts maintenance: To AS 1345.
* Safety signs maintenance: To AS 1319.

### Cleaning

Requirement: At the end of the maintenance period:

* Remove waste and clean all parts of the installation.
* Remove temporary protective coatings, packaging and labels.
* Clean screens and strainer baskets.

### Piped systems

Tasks: Perform the following:

* Check equipment items and record values for operation, calibration, performance compliance, temperature and energy consumption.
* Rectify all water leaks regardless of size. Clean and repair any water damage.
* Check condition of insulation and repair as required.
* Provide service tags recording inspections and tests.

### Fire pumps

Pumps and pump seals: Check and rectify if defective.

Safety and other controls: Check for correct operation and adjust if necessary. Sewage pumps and pits: Perform the following at least six monthly:

* Inspect including seals on lids.
* Clean and test level controls.

### Backflow prevention devices

General: Maintain to AS 2845.3 and AS/NZS 3500.1. Service tags: Record inspections and tests.

### Hydrants and hose reels

Hydrants: To AS 1851. Hose reels: To AS 1851.

Pumpset systems: To AS 1851.

### Sprinklers

Standard: To AS 1851.

Maintenance: Provide regular maintenance to AS 1851. Carry out yearly routine service during the end of the maintenance period service.

Records: Submit log books.

### Water conservation

Requirement: Conform to SAA HB 233.

### Fire detection and alarms

Operational and maintenance manual: To AS 4428.4. Maintenance and records: To AS 1851.

Routine service process and procedures: To AS 1851 clause 6.2. Baseline data: Provide baseline data to AS 1851.

### Electrical systems

Requirement: Perform the following:

* Check for hot joints, burnt insulation, burn contacts and repair.
* Check electrical connections for tightness. Tighten loose connections.
* Check operation of all electrical components. Rectify defects.
* Check indicating lights and replace defective lamps.
* Check and record motor currents.
* Check overload settings. Adjust if necessary.
* Check and report any changes to controls and wiring.
* Provide service tags recording inspections and tests. Standards:
* Electrical equipment generally: To AS/NZS 3760.
* Switchboards: To AS 2467.
* Repair and overhaul of rotating electrical equipment: To AS 4307.1.

## END OF MAINTENANCE PERIOD SERVICE

### General

Requirement: Within a month of the end of the maintenance period, undertake all work scheduled to be carried out on an annual basis.

## COMPLETION

### Maintenance records

Service records: Record maintenance undertaken in the schedules in the operation and maintenance manuals.

Maintenance reports: Prepare maintenance reports as documented.

### Restitution after maintenance tasks

Requirement: Restore removed, damaged, contaminated or soiled services and building elements when the maintenance task is complete.

Standard: Equal to the condition of the original installation.

## 1 SUMMARY OF TENDER & SCHEDULE OF TECHNICAL INFORMATION MECHANICAL SERVICES TENDER SUMMARY

**APPENDIX A**

The Tenderer shall submit the following Tender price breakdown forms completed and signed. It is mandatory that Tenderers submit this cost breakdown at the time of tender. Failure to submit this cost breakdown constitutes non-conformance of Tender.

|  |  |  |
| --- | --- | --- |
| **ITEM** | **Description** | **COST (WST)** |
| 1.0 | Preliminaries (Mobilization on Site) |  |
| 2.0 | Design and documentation of mechanical services air conditioning and ventilation for the project as per the stated design intent in this specification. |  |
| 3.0 | Supply and installation of VRF & split air conditioning units including wall mounted units, ceiling cassette units, in-ceiling ducted fan coil units, condenser units, and thermostats, hard wired control panels, condensate pumps for wall mounts and all associated accessories. |  |
| 4.0 | Supply and installation of duty/standby split air conditioning units for the MSB & Server room’s c/w condenser units, auto-change over controller, hard wired control panel, condensate pumps for wall mounts and all associated accessories. |  |
| 5.0 | Supply and installation of refrigerant piping for the overall air conditioning system c/w insulation, control valves and all associated accessories. |  |
| 6.0 | Supply and installation of condensate piping for the overall air conditioning system c/w insulation and all associated accessories. |  |
| 7.0 | Supply and installation of fresh air fans including inline fans, roof mounted fans, VSDs, interlocking to AC units, vibration mounting kits and all associated accessories. |  |
| 8.0 | Complete washroom exhaust air ventilation system including in-line duct mounted fans c/w speed controllers, run on timers set to 2mins, interlocking  to light switches of toilets, cladding and all associated accessories. |  |
| 9.0 | Complete kitchen extract & make-up air ventilation system including fans,  stainless steel hoods, proprietary rangehoods, stainless steel ductwork, fan control panels, warning signs and all associated accessories. |  |
| 10.0 | All air distribution ductwork including externally & internally insulated rigid ductwork, un-insulated fresh air and extract air ventilation ductwork,  insulated transfer air ductwork, duct mounted access panels and all associated accessories. |  |
| 11.0 | All insulated flexible ductwork for air conditioning, un-insulated flexible ductwork for fresh air extract air ventilation system and associated accessories. |  |
| 12.0 | All air distribution system accessories including extract air grilles, supply air diffusers, transfer air grilles, door grilles, weatherproof louvers c/w security grilles and vermin mesh, registers, cowls, filters c/w plenum and all associated accessories. |  |
| 13.0 | Supply and installation of fire dampers, fire damper mounting kits, fire collars for pipework penetrations and all associated accessories. |  |
| 14.0 | Supply and installation of volume control dampers, spigots, plenum boxes, cushion heads, acoustic wraps, vibration mounts, seismic restraints and all associated accessories for the air conditioning and ventilation system. |  |
| 15.0 | Supply and installation of the complete Form 2B MSSB together with MCCBs, switches and connection to submain cables provided with all associated accessories. |  |
| 16.0 | Supply and installation of power cabling from MSSB to all mechanical equipment isolators and GPOs including the isolators and GPOs right up till |  |

|  |  |  |
| --- | --- | --- |
|  | all mechanical equipment with cables trays and associated accessories. (Each equipment to have their own isolator or GPO for maintenance purposes in close proximity) |  |
| 17.0 | Supply and installation of all associated controls cabling including cable trays for all mechanical equipment interlocking and operation as per design intent and mechanical drawings. |  |
| 18.0 | Provide a warning sign for kitchen exhaust air fan to be left operation if already running or to be manually stated ruing fire mode in absence of an FIP. Sign to read as follows: “WARNING: VENTILATION SYSTEM SHALL NOT BE TURNED OFF DURING FIRE”. |  |
| 19.0 | All secondary steel, supports, brackets, cladding, etc. |  |
| 20.0 | Height access and lifting and positioning of equipment as required |  |
| 21.0 | Tools, plant and equipment as required |  |
| 22.0 | Testing and commissioning |  |
| 23.0 | Insurance, fees and charges |  |
| 24.0 | Shop drawings, Health and Safety File, Test and Commissioning Reports, Operation and Maintenance Manuals and As Built Drawings etc. |  |
| 25.0 | 12 months monthly services and maintenance |  |
| 26.0 | Builders Works Allowance |  |
| 27.0 | Any items not listed above (please specify) |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  | **TOTAL PROJECT COST (VEP)** |  |
| 28.0 | Contingency Sums (10% of Total Project Cost) |  |
|  |  |  |
|  | **GRANDE TOTAL PROJECT COST (VEP)** |  |

**Tenderer**.......................................................................................................................................

**Name**.............................................................................................................................................

**Signed**...........................................................................................................................................

**Dated**.............................................................................................................................................

**Witness**.........................................................................................................................................

## MECHANICAL SERVICES - SCHEDULE OF TECHNICAL INFORMATION

Fully completed copies of this schedule shall be lodged by tenderers with their tender. Where alternative offers are also submitted, tenderers shall lodge one fully completed copy of this schedule for each alternative.

The tenderer shall set out the details herein required for the equipment offered and in so far as they are not inconsistent with the specification, they shall form part of the description of the plant to be supplied and the work to be carried out.

The mention of any manufacturer’s or contractor’s name in this schedule shall not relieve the contractor of his obligation to supply plant strictly in accordance with the specification and capable of meeting the specified testing and performance requirements.

## SUB CONTRACTORS

The tenderer shall list below names of sub-contractors they propose to employ on any part of the installation to complete the given scope of works.

* 1. Electrical for Mechanical Services ………………………………………………………………
  2. Hydraulics for Mechanical Services. ……………………………………………………………
  3. Builders Works…………………………………………………………………………………….
  4. Controls Specialist……………………………………………………………………………….
  5. Other(s)…………………………………………………………………………………………….

## AIR CONDITIONING UNITS

Wall Mounted Units

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: ……………………………………. Ceiling Cassette Coil Units

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: ……………………………………. Ducted Fan Coil Units

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: ……………………………………. Control Panels

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: …………………………………….

|  |  |
| --- | --- |
| **3. FANS** |  |
| Inline Duct Mounted Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| Roof Mounted Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| Kitchen Exhaust Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |

## DIFFUSERS, GRILLES, LOUVERS

|  |  |
| --- | --- |
| (a) **Diffusers** |  |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| (b) **Return Grilles** |  |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type:  (c) **Extract Grilles** | ……………………………………. |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| (d) **Door Grilles** |  |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |

### Transfer Grilles

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: …………………………………….

* 1. **Weather Proof Louvers**

|  |  |
| --- | --- |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| **5. INSULATION** |  |
| Refrigerant Pipework Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| Condensate Pipework Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| Ductwork Insulation Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| **6. RIGID DUCTWORK** |  |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |
| **7. FLEXIBLE DUCTWORK** |  |
| Manufacturer: | ……………………………………. |
| Make/model: | ……………………………………. |
| Type: | ……………………………………. |

## FIRE DAMPERS

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: …………………………………….

## ROOF COWLS

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: …………………………………….

## MECHANICAL SERVICES DISTRIBUTION BOARD

Manufacturer: …………………………………….

Make/model: …………………………………….

Type: …………………………………….

Form: …………………………………….

**Tenderer**.......................................................................................................................................

**Name**.............................................................................................................................................

**Signed**...........................................................................................................................................

**Dated**.............................................................................................................................................

**Witness**.........................................................................................................................................

## HYDRAULIC SERVICES TENDER SUMMARY

The Tenderer shall submit the following Tender price breakdown forms completed and signed. It is mandatory that Tenderers submit this cost breakdown at the time of tender. Failure to submit this cost breakdown constitutes non-conformance of Tender.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **ITEM** | **Description** | | | | **COST (WST)** |
| 1.0 | Preliminaries (Site Mobilization) | | | |  |
| 2.0 | Supply and Installation of cold water system, connection to existing water mains, water meters, backflow prevention devices, water tanks, pipework, valves, fittings, plumbing fixtures connection, supports and all other associated works. | | | |  |
| 3.0 | Supply and Installation of water booster system, water filtration system, pipework, valves, fittings, plumbing fixtures connection, supports and all other associated works. | | | |  |
| 4.0 | Supply and Installation of water booster pump enclosure, lockable ventilated doors, lights, floor drains, supports and all other associated works. | | | |  |
| 5.0 | Supply and Installation of solar/electric hot water system, roof mounted supports, electric heating element, storage cylinders, pipework, hot water boiling unit, valves, fittings, plumbing fixtures connection, supports and all other associated works. | | | |  |
| 6.0 | Supply and Installation of sewer system, pipework, grease trap, vents, pipework, fittings, plumbing fixtures connections, supports and all other associated works. | | | |  |
| 7.0 | Supply and Installation of roof stormwater system, pipework, eaves gutters, downpipes, deck channel drains, pipework, fittings, supports and all other associated works. | | | |  |
|  |  |  | |  |  |
| l |  | |
|  | | | |
| 9.0 | All secondary steel, supports, brackets, etc. | | | |  |
| 10.0 | Height access and lifting and positioning of equipment as required | | | |  |
| 11.0 | Tools, plant and equipment as required | | | |  |
| 12.0 | Testing and Commissioning | | | |  |
| 13.0 | Insurance, fees and charges | | | |  |
| 14.0 | Shop drawings, Health and Safety File, Test and Commissioning Reports, Operation and Maintenance Manuals and As Built Drawings etc | | | |  |
| 15.0 | Warranty and preventative maintenance during defects liability period of 12 months from the date of practical completion | | | |  |
| 16.0 | Contingency Sums | | | |  |
| 17.0 | Any items not listed above (please specify) | | | |  |
|  | **TOTAL LUMP SUM TENDER PRICE (EXCLUDING GST/VAT)** | | | |  |

**Tenderer:** .......................................................................................................................................

**Name:** .............................................................................................................................................

**Signed:** .............................................................................................................................................

**Dated:** ...............................................................................................................................................

**Witness:** ..........................................................................................................................................

## SCHEDULE OF TECHNICAL INFORMATION

Fully completed copies of this schedule shall be lodged by tenderers with their tender. Where alternative offers are also submitted, tenderers shall lodge one fully completed copy of this schedule for each alternative.

The tenderer shall set out the details herein required for the equipment offered and in so far as they are not inconsistent with the specification, they shall form part of the description of the plant to be supplied and the work to be carried out.

The mention of any manufacturer’s or contractor’s name in this schedule shall not relieve the contractor of his obligation to supply plant strictly in accordance with the specification and capable of meeting the specified testing and performance requirements.

### Sub-Contractors

The Tenderer shall list below names of the sub-contractors they propose to employ of any part of the installation to complete the given scope of works.

* + 1. Electrical for hydraulic services………………………………………………………………
    2. Builders Work…………………………………………………………………………………..
    3. Equipment Specialist(s)……………………………………………………………………….
    4. Other(s)………………………………………………………………………………………….

### Water booster pump

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### UV Filter and Water filters

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Electric Hot Water System

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Cold and Hot Water pipework

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Drainage and pipework

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Floor Gully

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Grease Trap

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

**Tenderer:** .......................................................................................................................................

**Name:** .............................................................................................................................................

**Signed:** .............................................................................................................................................

**Dated:** ...............................................................................................................................................

**Witness:** ...........................................................................................................................................

## ELECTRICAL SERVICES TENDER SUMMARY

### APPENDIX A - Tender Summary

The Tenderer shall submit the following Tender price breakdown forms completed and signed. It is mandatory that Tenderers submit this cost breakdown at the time of tender. Failure to submit this cost breakdown constitutes non-conformance of Tender.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ITEM** | **Description** | | | | | **COST (WST)** |
| 1. | Preliminaries | | | | |  |
| 2. | Supply and install Generators and ATS, Cables. Switchgears Sub mains cabling to ATS , protective devices and all other associated works | | | | |  |
| 3. | Supply and install HDPVC conduits and cable markers in cable trench for HV cabling and all other associated works. | | | | |  |
| 4. | Supply and install complete Main Distribution board, Distribution Board and metering panel including enclosure, main switch, chassis, switchgear, protective device, cabling, accessories, and all other associated works. | | | | |  |
| 5. | Supply and install all consumer mains and sub-mains cabling to respective distribution board and all other associated works. | | | | |  |
| 6. | Supply and install complete indoor lighting system including cabling and all other associated works. | | | | |  |
| 7. | Supply and install complete outdoor lighting system including photoelectric sensor, cabling and all other associated works. | | | | |  |
| 8. | Supply and install complete emergency and exit lighting system including cabling, testing facilities, associated accessories and all other associated works. | | | | |  |
| 9. | Supply and install complete General Power outlets including cabling and all other associated works. | | | | |  |
| 10. | Supply and install complete grid connected photovoltaic system including solar panels, inverters, controllers, surge protection, cabling and all the other associated works | | | | |  |
| 11. | Supply and install complete Telecom voice and data outlets, including rack unit cabling, building distributor/campus distributor, fittings, supports and all associated accessories. | | | | |  |
| . |  |  | |  | |  |
|  | | |  |
|  |  | | |
| 13. | Supply and install lighting protection system, including cabling, fittings, supports and associated accessories and all other associated works. | | | | |  |
| 14. | Supply and install complete cable management system including conduits, catenaries, fittings, supports, associated accessories and all other associated works. | | | | |  |
| 15. | Supply and install CCTV system including cabling, fittings, supports, and associated accessories and all other associated works. | | | | |  |
| 16. | Supply and install complete UPS , UPS outlets with coloured coded | | | | |  |
| 17. | Supply and install complete building earthing system including all specialized equipment and protected areas and all other associated works. | | | | |  |

|  |  |  |
| --- | --- | --- |
| 18. | Tools, plant and equipment as required |  |
| 19. | Provide Spares |  |
| 20. | Testing and Commissioning |  |
| 21. | Shop drawings, Test and Commissioning Reports, Operation and Maintenance Manuals and As Built Drawings etc |  |
| 22. | Warranty and preventative maintenance during defects liability period of 12 months from the date of practical completion |  |
| 23. | Contingency Sums |  |
| 24. | Any items not listed above (please specify) |  |
|  | **TOTAL LUMP SUM TENDER PRICE (EXCLUDING GST/VAT)** |  |

## SCHEDULE OF TECHNICAL INFORMATION

Fully completed copies of this schedule shall be lodged by tenderers with their tender. Where alternative offers are also submitted, tenderers shall lodge one fully completed copy of this schedule for each alternative.

The tenderer shall set out the details herein required for the equipment offered and in so far as they are not inconsistent with the specification, they shall form part of the description of the plant to be supplied and the work to be carried out.

The mention of any manufacturer’s or contractor’s name in this schedule shall not relieve the contractor of his obligation to supply plant strictly in accordance with the specification and capable of meeting the specified testing and performance requirements.

### Sub-Contractors

The Tenderer shall list below names of the sub-contractors they propose to employ of any part of the installation to complete the given scope of works.

* + 1. Builders Work…………………………………………………………………………………..
    2. Equipment Specialist(s)……………………………………………………………………….

### Stand By Generator

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Main Distribution Board

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Distribution boards

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Meter Panel

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Switchgear

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Light Fittings

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Switches

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Power Outlets

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Data and Telecom Outlets

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Cables

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Cable Support System

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Building Distributor/Campus Distributor

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Rack Unit

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Photoelectric Sensor

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

## CCTV

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

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.

**Tenderer**........................................................................................................................................

**Name**.............................................................................................................................................

**Signed**...........................................................................................................................................

**Dated**.............................................................................................................................................

**Witness**.........................................................................................................................................

## FIRE SERVICES TENDER SUMMARY

The Tenderer shall submit the following Tender price breakdown forms completed and signed. It is mandatory that Tenderers submit this cost breakdown at the time of tender. Failure to submit this cost breakdown constitutes non-conformance of Tender.

|  |  |  |
| --- | --- | --- |
| **ITEM** | **Description** | **COST (WST)** |
| 1.0 | Preliminaries (Site Mobilization) |  |
| 2.0 | Supply and Installation of fire water storage, concrete plinth for tanks, pipework, valves, manhole access, access ladders, signage and all other associated works. |  |
| 3.0 | Supply and Installation of fire hose reel, cabinet hose reel, pipework, valves, signage and all other associated works. |  |
| 3.0 | Fire brigade booster assembly and all other associated works. |  |
| 4.0 | Supply and Installation of fire hydrant system, landing valves, pipework, valves, signage and all other associated works. |  |
| 6.0 | Portable fire extinguishers and fire blankets and all other associated works. |  |
| 7.0 | Fire alarm and detection system and all other associated works. |  |
| 8.0 | Fire Indicating Panel (FIP) and all other associated works. |  |
| 9.0 | Provide all necessary signage |  |
| 10.0 | All secondary steel, supports, brackets, etc. |  |
| 11.0 | Height access and lifting and positioning of equipment as required |  |
| 12.0 | Tools, plant and equipment as required |  |
| 13.0 | Testing and Commissioning |  |

|  |  |  |
| --- | --- | --- |
| 14.0 | Insurance, fees and charges |  |
| 15.0 | Shop drawings, Health and Safety File, Test and Commissioning Reports, Operation and Maintenance Manuals and As Built Drawings etc |  |
| 16.0 | Warranty and preventative maintenance during defects liability period of 12 months from the date of practical completion |  |
| 17.0 | Contingency Sums |  |
| 18.0 | Any items not listed above (please specify) |  |
|  | **TOTAL LUMP SUM TENDER PRICE (EXCLUDING GST/VAT)** |  |

**Tenderer:** .......................................................................................................................................

**Name:** .............................................................................................................................................

**Signed:** .............................................................................................................................................

**Dated:** ...............................................................................................................................................

**Witness:** ...........................................................................................................................................

## SCHEDULE OF TECHNICAL INFORMATION

Fully completed copies of this schedule shall be lodged by tenderers with their tender. Where alternative offers are also submitted, tenderers shall lodge one fully completed copy of this schedule for each alternative.

The tenderer shall set out the details herein required for the equipment offered and in so far as they are not inconsistent with the specification, they shall form part of the description of the plant to be supplied and the work to be carried out.

The mention of any manufacturer’s or contractor’s name in this schedule shall not relieve the contractor of his obligation to supply plant strictly in accordance with the specification and capable of meeting the specified testing and performance requirements.

### Sub-Contractors

The Tenderer shall list below names of the sub-contractors they propose to employ of any part of the installation to complete the given scope of works.

1. Builders Work…………………………………………………………………………………..
2. Equipment Specialist(s)……………………………………………………………………….
3. Other(s)………………………………………………………………………………………….

### Fire Hydrant Landing Valves (External)

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Hydrant Landing Valves (Internal)

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Hose Reel

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Hose Reel Cabinet

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Extinguisher

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Extinguisher Cabinet

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Blanket

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Detectors

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Sounder

Manufacturer …………………………………………………………………………………. Make/Model…………………………………………………………………………………… Type…………………………………………………………………………………………….

### Fire Indicating Panel

Manufacturer …………………………………………………………………………………. Make/ Model ………………………………………………………………………………….. Type…………………………………………………………………………………………….

**Tenderer:** .......................................................................................................................................

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**Signed:** .............................................................................................................................................

**Dated:** ...............................................................................................................................................

**Witness:** ...........................................................................................................................................