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Rail Corporation New South Wales

Specification for Newtown Traction Substation Section F - Technical Requirements

February 2009

Rev 3



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1. General Requirements

1.1 General

1.1.1 Relevant Standards

All materials used and work performed shall be to the relevant RailCorp and Australian Standards as listed within the following sections of this Specification.

1.2 Cross References

Common Technical Requirements

Conform to associated work sections as follows:

- » Adhesives, sealants and fasteners.
- » Metals and pre-finishes.
- » Timber, finishes and treatment.

Precedence

Requirements of subsequent work sections of the specification override conflicting requirements in this work section.

1.2.1 Referenced Documents

Contractual Relationships

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

Current Editions

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

- » Site copies: 1 each

1.2.2 Interpretation

General

Unless the context otherwise requires, the following definitions apply:

- » Approved: "Approved", "reviewed", "directed", "rejected", "endorsed" and similar expressions mean "approved (reviewed, directed, rejected, endorsed) in writing by the contract administrator".
- » 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".
- » Maintenance period: Synonymous with "Defects liability period".
- » Obtain: "Obtain", "seek" and similar expressions mean "obtain (seek) in writing from the contract administrator".
- » Professional engineer: A person who is listed on the National Professional Engineers Register (NPER) in the relevant discipline at the relevant time.
- » Proprietary: "Proprietary" mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- » Provide: "Provide" and similar expressions mean "supply and install".
- » Registered testing authority:
 - The CSIRO Division of Manufacturing and Infrastructure Technology (CSIRO-MIT); or
 - An authority registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
 - An organisation outside Australia recognised by NATA through a mutual recognition agreement.
- » Required: Means required by the contract documents, the local council or statutory authorities.
- » Samples: Includes samples, prototypes and sample panels.
- » Supply: "Supply", "furnish" and similar expressions mean "supply only".

Abbreviations

APAS: Australian Paint Approval Scheme.

AS: Australian Standard.

BCA: Building Code of Australia.

NATA: National Association of Testing Authorities.

NZS: New Zealand Standard.

SSL: Scientific Services Laboratory.

RTA: Roads and Traffic Authority

Technical

Metallic-coated steel: Includes zinc-coated steel, zinc/iron alloy-coated steel, and aluminium/zinc-coated steel.

Pipe: Includes pipe and tube.

Tests

Pre-completion tests: Tests carried out before completion tests.



- » *Type tests*: Tests carried out on an item identical with a production item, before delivery to the site.
- » *Production tests*: Tests carried out on the purchased equipment, before delivery to the site.
- » *Site tests*: Tests carried out on site.

Completion tests: Acceptance tests and final tests.

- » *Acceptance tests*: Tests carried out on completed installations or systems and, except for final tests, before the date for Completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements.
- » *Final tests*: Acceptance tests carried out before completion of the maintenance period.

1.2.3 Contract Documents

Diagrammatic Layouts

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.

Refer to Electrical Specification for conduit layout requirements.

Levels

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

1.3 Quality

1.3.1 Inspection

Notice

Hold points: If notice of inspection is to be given in respect of parts of the works, do not conceal those parts without approval.

Minimum notice for inspections to be made: 4 hours for on-site inspectors, otherwise 2 working days.

Witness points: If notice of inspection is to be given in respect of parts of the works, advise if and when those parts are to be concealed.

Attendance

Provide attendance.



1.3.2 Tests

Notice

Hold points: If notice of testing is to be given in respect of parts of the works, do not test those parts without approval.

Minium notice for inspections to be made: 4 hours for onsite inspectors, otherwise 2 working days.

Witness points: If notice of testing is required in respect of parts of the works, advise if and when those parts are to be tested.

Testing Authorities

Except for site tests, have tests carried out by authorities accredited by NATA to test in the relevant field, or an organisation outside Australia recognised by NATA through a mutual recognition agreement. Co-operate as required with testing authorities.

Except for site tests, have tests carried out by a Registered testing authority.

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

1.3.3 Submissions

Authorities

Authorities' approvals: If required, submit documents showing approval by the authorities whose requirements apply to the work.

Correspondence: Submit copies of correspondence and notes of meetings with authorities.

Design

General: If part or all of an installation is to be designed by the contractor, submit documents showing the layout and details of the installation.

Variation documents: If it is proposed to change the installation from that shown on the contract documents, or if statutory authorities require changes then submit variation documents showing the proposed changes.

Electronic Submissions

File format: AutoCAD 2004

Transmission medium: C.D.

Errors

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



Identification

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

Materials and Components

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

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

- » Technical specifications and drawings.
- » Performance and rating tables.
- » Recommendations for installation and maintenance.

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.

Notice

Minimum notice: 5 working days for offsite submissions, otherwise 10 working days.

Submission points: If a submission is required for a part of the works, do not commence work on the part until the submission is endorsed that the work may proceed. Co-ordinate related submissions and do not cause delays by making late or inadequate submissions.

Quantity

Bound documents: 3 copies.

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.

Samples: One of each designated item including ancillary items such as fasteners, flashings and seals, and two copies of supporting product data.

Standard contract drawing size: A1

Samples

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

Retention of samples: Keep endorsed samples in good condition on site, until Completion.



Shop Drawings

General: If required, submit dimensioned drawings showing details of the fabrication and installation of services and equipment, including relationship to building structure and other services, cable type and size, and marking details.

As executed drawings: Amend the drawings during the defects liability period to correct errors or omissions and to *show changes made after submission*. Resubmit amended copies.

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

1.4 Execution

1.4.1 Materials and Components

Consistency

For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Corrosion Resistance

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

Table 1-1 Corrosion Resistance Table

Corrosivity Category	Situation	Light Steel Framing, Wall Ties, Connectors and Other Structural Accessories	Steel Cladding, Lining, Trims and Flashings
Low More than 10 km from water subject to breaking surf More than 1 km from salt water not subject to breaking surf	Internal	Refer to Structural Engineering Specifications.	Metallic coated sheet Z275/AZ150
	External	Refer to Structural Engineering Specifications.	Metallic coated sheet Z450/AZ200
	External	Refer to Structural Engineering Specifications.	Metallic coated sheet Z450/AZ200
	External	Refer to Structural Engineering Specifications.	Metallic coated sheet Z200 plus organic coating

Manufacturers' or Suppliers' Recommendations

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



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

Product certification: If products must comply with product certification schemes, provide them in accordance with the certification requirements.

Proprietary Items

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

Alternatives: If alternatives are proposed, submit proposed alternatives and include samples, available technical information, reasons for proposed substitutions and cost. If necessary, provide an English translation. State if provision of proposed alternatives will necessitate alteration to other parts of the works and advise consequent costs.

Sealed Containers

If the manufacturer supplies materials or products closed or sealed containers or packages then bring the materials or products to point of use in the original containers or packages.

1.4.2 Completion

Contractor's Submissions

Within 2 weeks after Practical **Completion**, submit 3 copies of designated documents.

Samples

Remove unincorporated samples on completion.

Warranties

General: Name the principal as warrantee in conformance with the **Warranty schedule**. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

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

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

1.4.3 Record Drawings

General

Submit record drawings. Show the "as installed" locations of plant and equipment. Show off-the-grid dimensions where applicable.



Accuracy

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

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

Drawing Layout

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

Quantity

Provide record drawings in the following quantities and formats:

- » CAD files:
 - File format: .dwg and .pdf
 - Transmission medium: Compact Disk (CD).
 - Number of copies: 3
- » Paper prints:
 - Number of sets: 3
- » Reproducible (plastic):
 - Number of sets: NIL

1.4.4 Operation and Maintenance Manuals

General

General: Submit operation and maintenance manuals for installations.

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

Include the following:

- » Certificates:
 - Copies of manufacturers' warranties.
 - Product certification.
- » Directory: Names, addresses, and telephone and facsimile numbers of contractor, subcontractors and names of responsible parties.
- » Drawings:
 - Record drawings, full size.



- » Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
- » Equipment descriptions:
 - Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
 - Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
- » Maintenance procedures:
 - Detailed recommendations for preventative maintenance frequency and procedures.
 - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
 - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
 - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
- » Operation procedures:
 - Manufacturers' technical literature as appropriate.
- » Table of contents: For each volume. Title to match cover.

Format – Electronic Copies

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

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

Format – Hard Copy

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 and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.
- » *Text*: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.

Quantity

Provide operational maintenance manuals in the following forms and quantities:

- » Electronic copies:
 - File format: .pdf
 - Transmission medium: CD.
 - Number of copies: 3
- » Hardcopy:
 - Number of copies: 3



2. Demolition

2.1 General

Refer to the *General requirements* section.

2.1.1 Standard

Demolition: To AS 2601.

2.1.2 Interpretation

Salvaged for re-use: Demolished materials scheduled for re-use in the works.

Salvaged for disposal: Demolished materials scheduled for re-use elsewhere.

Demolished for re-use: Non-scheduled demolished materials proposed by contractor for re-use in the works.

Demolished for removal: Other demolished materials.

2.2 Quality

2.2.1 Inspection

Witness points

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

- Underground services after demolition work above them.

2.3 Materials and Components

2.3.1 Demolished Materials

Ownership: Ownership of demolished materials is described in the **Demolished materials classes table**.

Re-use: If it is proposed to re-use demolished materials in the works, submit proposals.

Salvage: Recover without damage materials to be salvaged.

Removal: Remove from the site demolished materials, which are the property of the contractor. Do not burn or bury on site.

- Transit: Prevent spillage of demolishing materials in transit.

Demolished materials classes table

Class	Ownership
Demolition for disposal	Contractor



Class	Ownership
» Sections of existing boundary fence to construct sliding gate and log retaining wall.	
» Concrete paths and pits	
» Remove existing trees from area of the new works.	

2.4 Execution

2.4.1 Temporary support

Ground support: Support excavations for demolition of underground structures.

Adjacent structures: Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

- Lateral supports: Provide lateral support at least that given by the structure to be demolished, using shoring.
- Vertical supports: Provide vertical support where necessary using piling or, underpinning or both.

2.4.2 Protection

Dust protection

Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

Security

If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

2.4.3 Explosives

Do not use explosives.

2.5 Hazardous Materials

2.5.1 Hazardous materials

Give notice immediately hazardous materials or conditions are found, including the following:

- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.



- Radiation or radio-active materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

2.6 Completion

2.6.1 Temporary support:

Clear away at completion of demolition.



3. Erosion And Sediment Control

3.1 Scope

This section of the Specification provides for erosion and sediment control measures to be undertaken during construction.

3.2 General

Perimeter control measures shall be placed prior to or in conjunction with the first phase of earthworks. Construction shall be staged so that land disturbance is confined to areas of workable size. This will limit the duration for which disturbed areas are exposed to erosion. Stabilisation measures shall be applied on the disturbed section before the next section is opened up.

Topsoil stockpiles shall be located outside hazard areas such as drainage depressions.

All areas not subject to construction works shall be retained free from disturbance or damage for the duration of the Contract. Should these areas become disturbed or damaged the Contractor shall reinstate them.

3.3 Sediment and Erosion Control Devices

Erosion and sediment control measures shall be implemented and maintained in accordance with the latest revision of the NSW Department of Housing's Managing Urban Stormwater Soils and Construction.

All sediment and erosion control devices shall be maintained in a satisfactory working order throughout the Contract or until such time as the area above has been stabilised and the RailCorp directs that the device be removed.

The Contractor shall inspect the devices after each storm for structural damage or clogging by silt and other debris and make prompt repairs, replace or clean the devices as may be required.

Gravel or other filter materials shall be cleaned and re-stacked or replaced when directed by the RailCorp to maintain effective performance.



4. Earthworks

4.1 General

4.1.1 Cross References

Refer to the following sections:

- » Erosion And Sediment Control
- » Termite Control
- » Pavements (for cut & fill beneath pavements)

4.1.2 Interpretation

Standards

Table 4-1 lists some relevant standards. The list is not exhaustive and where RailCorp standards require a higher level of work standard than that specified in the Australian Standards, then the RailCorp standard shall take preference.

Table 4-1 RailCorp and Australian Standards

Standards No.	Standard Title
TS.3421	General Standard for Formation and Earthworks
TS.3422	Standard for Formation Capping Material
C.1100	Earthworks Construction Procedures
RTS.3432	Track Drainage – Inspection and Maintenance
RTS.3433	Track Drainage – Design and Construction
AP.5181	Care & Protection of Underground Pipes & Cables
G 5000	Management System for Pipe, Electrical, Telephone Crossings Under and Over Railway Property
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1726-1993	Geotechnical Site Investigations
AS 1348-2002	Glossary of Terms – Roads & Traffic Engineering

Definitions

Bad ground: Ground unsuitable for the purposes of the works, including fill liable to subsidence, ground containing cavities, faults or fissures, ground contaminated by harmful substances and ground which is or becomes soft, wet or unstable.

Discrepancy: A difference between contract information about the site and conditions encountered on the site, including but not limited to discrepancies concerning:



- » The nature or quantity of the material to be excavated or placed;
- » Existing site levels; and
- » Services or other obstructions beneath the site surface.

Line of influence: A line extending downward and outward from the bottom edge of a footing, slab or pavement and defining the extent of foundation material having influence on the stability or support of the footings, slab or pavement.

Rock: Monolithic material with a volume greater than 0.5 m³, which cannot be removed without breaking up either by explosives or by rippers or percussion tools.

4.1.3 Site Investigation

Notice

If the following are encountered, give notice immediately and obtain instructions before carrying out any further work in the affected area:

- » Bad ground.
- » Discrepancies.

4.1.4 Existing Services

Marking

Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the ground-works operations including clearing, excavating and trenching.

Excavation

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

4.1.5 Environmental Protection

Erosion control

General: Plan and carry out the work so as to avoid erosion, contamination, and sedimentation of the site, surrounding areas, and drainage systems (refer to Section 3: Erosion And Sediment Control)

4.1.6 Records of Measurement

Excavation and Backfilling

Agreed quantities: If a schedule of rates applies, provisional quantities are specified, or there are variations to the contract levels or dimensions of excavations, do not commence backfilling or place permanent works in the excavation until the following have been agreed and recorded:

- » Depths of excavations related to the datum.



- » Final plan dimensions of excavations.
- » Quantities of excavations in rock.
- » Quantities of fill and topsoil, imports being recorded separately.

Rock

Level and class: If rock is to be measured for payment purposes, whether as extra over excavation of material other than rock or for adjustment of provisional measurements, do not remove the rock until the commencing levels and the classes of rock have been determined.

4.2 Quality

4.2.1 Inspection

Witness points

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

- » Extent of weathered rock following removal of overburden;
- » Extent of rock following removal of weathered rock;
- » Excavation completed to contract levels or founding material.

4.2.2 Tests

Testing authority

Use an independent, NATA approved testing laboratory.

Testing

Compaction (density): Test for compliance.

Retesting: Rework and retest areas that do not achieve the required density until that density is achieved.

Test locations

Fill: Test the areas of fill that is to support non-spanning concrete ground slabs, roads and paved areas.

Test frequency

General: At least one test per 200 m³ or one test per layer per 1000 m², whichever requires the more tests.

Fill: Distribute the testing evenly throughout the fill.

Compaction test results:



4.2.3 Submissions

Tests

Imported fill: Submit certification or test results that establish the compliance of imported fill with the contract.

4.3 Excavating

4.3.1 Excavation

Extent

Site surface: Excavate over the site to give correct levels and profiles as the basis for construction, paving, filling and landscaping. Make allowance for compaction or settlement.

Footings: Excavate for footings and pits to the required sizes and depths. Confirm that bearing capacity is adequate.

Building footings have been designed to bear on Siltstone as specified on the design drawings. Where the footings are founded on material other than that Siltstone, the material shall be removed to Siltstone and replaced with cement stabilised clean sand or lean mix concrete

4.3.2 Explosives

General

Do not use explosives.

4.3.3 Bearing Surfaces

General

Provide even plane bearing surfaces for load bearing elements including footings. Step to accommodate level changes.

4.3.4 Reinstatement Of Excavation

General

Where excavation exceeds the required depth, or deteriorates, reinstate to the correct depth, level and bearing value.

4.3.5 Adjacent Structures

Temporary supports

General: Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works.

Lateral supports: Provide lateral support using shoring.



Vertical supports: Provide vertical support where necessary using piling or underpinning or both.

4.4 Placing And Compaction

4.4.1 Fill

General

Please refer to Section 6: Pavements for details of **FILL** beneath pavement layerworks.

Fill material

General: Inorganic, non-perishable material.

Sulphur content: Do not provide filling with sulphur content exceeding 0.5% within 500 mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means.

Sources

Provide fill imported on to the site from suitable sources unless the fill type can be provided from spoil recovered from the excavations.

Fill types

General fill: Well-graded material, maximum particle size 75 mm, plasticity index < 55%.

Select fill (except under pavements): Granular material complying with the following:

- » Maximum particle size: 75 mm.
- » Proportion passing 0.075 mm sieve: 25% maximum.
- » Plasticity index: >2%, <15%.

Hardcore: Graded hard material capable of being compacted to an even stable surface.

- » Maximum particle size: 120 mm.
- » Proportion exceeding particle size of 50 mm: 75% minimum.

Embankment fill: Graded material for road embankments with maximum particle size determined by location and layer thickness, but in any case not exceeding two-thirds of the compacted layer thickness.

Hand-packed hardcore: Hardcore packed by hand to an even surface before compaction.

Cement Stabilised Sand: 3 to 5% cement, balance clean sand.



4.4.2 Preparation For Filling

General

Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements. Remove loose material, debris and organic matter and compact the ground to achieve the required density.

Benching

If fill is to be placed on a surface that slopes more than 1:4, bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps at least 1 m wide. Re-compact the excavated material as part of the filling.

4.4.3 Placing Fill

General

Layers: Place fill in layers.

Extent: Place and compact fill to the designated dimensions, levels, grades, and cross sections so that the surface is always self-draining.

Placing at structures

General: Place and compact fill in layers simultaneously on both sides of structures, culverts and pipelines to avoid differential loading.

Concrete: Do not place fill against concrete until the concrete has been in place for fourteen days.

Moisture content

Adjustment: Where necessary to achieve the required density or moisture content, adjust the moisture content of the fill before compaction.

Moisture content of compacted material shall be within 2% of OMC at the time of compaction.

Tolerances

Finish the surface to the required level, grade and shape within the following tolerances:

- » Under slabs and load bearing elements: +0, -25 mm.
- » Other ground surfaces: 7 50 mm, provided the area remains free draining and matches adjacent construction where required. Provide smoothness as normally produced by a scraper blade.

4.4.4 Compaction

Density

Compact each layer of fill to the required depth and density specified in Table 4-2.



Table 4-2 Compaction Details

Location	Cohesive soils.	Cohesionless soils.
	Minimum dry density ratio (standard compaction) to AS 1289.5.4.1	Minimum density index to AS 1289.5.6.1
Footings and non spanning slab on ground areas of buildings	98	70
Embankments and paved areas:		
» > 0.3 m below pavement subgrade.	98	70
» < 0.3 m below pavement subgrade.	100	80
All other areas:		
» > 0.3 m below finished surface.	90	62
» < 0.3 m below finished surface.	95	65

4.4.5 Grading

External areas

Grade to give falls away from buildings, minimum 1:100 unless otherwise specified upon the drawings.



5. Termite Control

5.1 General

5.1.1 Standards

Termite barriers: To AS 3660.1.

5.2 Quality

5.2.1 Inspection

Witness points

Give sufficient notice so that inspection may be made of the completed termite barriers.

5.3 Materials And Components

5.3.1 Non-Chemical Barriers

Stainless steel mesh barriers: Proprietary item: Termi-Mesh™.

Graded stone barriers: Proprietary item: Granitgard™.

Combination Termite Shield and membrane:

» Insecticide impregnated geotextile and plastic membrane.

» Proprietary item: Kordon™.

Slab services penetrations: Barrier-type tape membrane to pipe penetrations.

5.3.2 Schedule

Table 5-1 Termite Barrier Schedule

Barrier designation		TB 1
Location		
Slab penetrations		Kordon
Under slabs		Kordon
Building perimeters		Kordon

5.4 Completion

Termite barrier notice: Provide a durable notice permanently fixed in a prominent location to BCA Volume 1 Part B1.3.



Warranty: Minimum written 10 year.

Completion inspection: At the end of the Defects Liability Period, inspect the termite control systems and submit a report on their efficacy and status.



6. Pavements

6.1 General

6.1.1 Cross References

Refer to the following sections:

- » Erosion And Sediment Control
- » Earthworks

6.1.2 Standards

Table 6-1 lists some relevant RTA Standards. The list is not exhaustive and these should be used in conjunction with RailCorp and Australian Standards. Where RailCorp standards require a higher level of work standard than that specified in the RTA or Australian Standards, then the RailCorp standard shall take preference.

Table 6-1 RTA Standards

Standards No.	Standard Title
G40	Clearing & Grubbing
Q2	Quality Management System (Type 2)
R44	Earthworks
R71	Unbound Pavement Course (Normal Duty)
R106	Sprayed Bituminous Surfacing (with cutback bitumen)
R116	Asphalt (Dense Graded & Open Graded)
3051	Unbound and Modified Base and Sub base Materials for Surfaced Road Pavements.
3054	Hydrated Lime
3071	Selected Material for Formation

The latest editions of the above specifications shall be used and these are defined as at the time of calling tenders.

6.1.3 Scope of Work

The work contained in this Specification includes all activities associated with the construction of pavements, including trimming and compaction of sub grade, and placing of flexible pavement structure with AC wearing course, as shown on the drawings and as specified. The Contractor, as part of the construction process of these works, shall also allow for flexible pavement wearing courses to reinstate a strip of



existing pavements adjacent to the new pavements and any existing pavements which become damaged during the course of the Works.

6.1.4 General Description

Pavements shall be constructed to the lines, profiles and cross sections shown and/or approved by the Principal.

6.1.5 Materials Testing

A NATA registered soil laboratory shall carry out all materials and compaction testing.

6.2 Materials

6.2.1 Selected Fill Material

Select fill shall be crushed or ripped sandstone or similar material meeting the requirements of RTA Specification 3071 (Particle Size Distribution Type B) and shall have a 4 day soaked CBR of at least 15% when compacted to 100% standard compaction.

6.2.2 Subbase

The sub base material shall be DGS20 in accordance with the requirements of RTA 3051 Traffic Category type 2(c) (RTA 3051 Clause 3). For the sub base material recycled crushed concrete shall be an acceptable material provided that it is supplied from certified stockpiles. The Contractor shall submit to the Principal, at least seven days prior to the delivery of pavement sub base material, to the site, test results from a laboratory with the appropriate NATA registration of samples showing the materials nominated for use in the works meet the quality requirements specified herein, and the source of the supply of materials. *The following information must be included in the Contractor's Project Quality Plan:*

- » Source and nature of materials.
- » Designated plant for spreading and compaction.

6.2.3 Basecourse

The basecourse material shall consist of well-graded crushed stone from an established hard rock quarry complying with the requirements for DGB20 to RTA Specification 3051 Traffic Category 2(c) material. Recycled materials shall not be used.

The Contractor shall submit to the Principal, at least seven days prior to the delivery of pavement base course material, to the site, test results from a laboratory with the appropriate NATA registration of samples showing the materials nominated for use in the works meet the quality requirements specified herein, and the source of the supply of materials.



The following information must be included in the Contractor's Project Quality Plan:

- » Source and nature of materials.
- » Designated plant for spreading and compaction.

6.3 General Pavement Course Construction

6.3.1 Lateral Extent of Pavement Layers

Pavement courses shall extend to the limit of work as shown on the drawings.

6.3.2 Tolerances

All work shall be undertaken in accordance with the requirements of the relevant RTA clauses.

6.3.3 Joining Existing Pavements

Where the specified pavement is to be overlaid on an existing pavement, the existing pavement shall be broken out or thoroughly scarified so that any fresh pavement material may be bonded to that of the existing pavement.

Where the specified pavement is to be joined to an existing pavement, the existing pavement shall be neatly sawcut and broken out. Successive layers shall be overlapped at least 100mm over the existing material in the adjacent pavement.

The pavement shall be constructed to the levels and profiles specified and/or shown while maintaining a smooth and even transition between the old and new work.

6.3.4 Use of Pavement by Traffic and Plant

No vehicles, including those engaged in the work, shall be permitted to pass over pavement materials until compaction has been completed. Where vehicles are permitted to pass over the course before compaction is completed, care shall be taken to prevent tracking. No vehicles will be permitted to travel over the completed basecourse layers.

6.4 Preparation of Subgrade

The subgrade shall be trimmed smooth, compacted as specified in the Section: 4 Earthworks, and made free from irregular surface changes.

The subgrade surface shall be plus 0, minus 20 mm of the established grade or cross section.

Deviations in the finished surfaces in excess of the limits specified, when tested with a 3 metre straight edge or profile template, as applicable, applied parallel with and/or at right angles to the centreline of the area, shall be corrected by loosening, to a minimum depth of 100 mm adding or removing material, reshaping, adjusting the moisture



content and re-compacting. This testing shall be repeated until the surface conforms to the limits specified.

All excavated subgrade areas (ie NOT those areas previously backfilled within this contract) shall be inspected by a RailCorp-approved geotechnical engineer. Any material that is soft, unstable or deemed unsuitable by the Principal shall be excavated and replaced with select fill in accordance with the requirements of this Specification.

Unsuitable subgrade material such as, silt, mud, roots, organic matter, rubbish, areas of very soft clay or high moisture content and any other deleterious substances shall be identified by the contractor and the Principal advised without delay.

6.5 Pavement Selected Fill Layer

The selected fill material shall be placed and compacted to the lines and grades shown on the drawings to a characteristic relative compaction of at least 102% based on Standard Compaction. The moisture content during compaction shall be within the range of 60% to 90% of the standard optimum moisture content. Compaction shall commence on the low side and progress towards a high point to prevent uncompacted material breaking away. The layer(s) shall be spread and compacted uniformly, which after trimming shall provide the course thickness specified on the Drawings.

Statistical techniques shall be used to control relative compaction. The lot size for compaction testing shall not exceed one layer of 1000m² or one day's placement whichever is lesser. Sampling locations for testing and the calculation of the characteristic value of relative compaction shall be determined in accordance with the methods specified in RTA Specification Q2.

Achievement of the specified compaction constitutes a **HOLD POINT**. The Principal's approval for construction above the granular materials layer is required prior to release of the hold point.

6.6 Pavement Base and Sub base Layers

All work on the base and sub base layers shall be undertaken in accordance with the requirements of RTA Specification R 71 except as follows:

- » Clauses referring to: "Measurement and Payment"; measurement and payment shall be as detailed elsewhere in the Tender Document.

The base and sub base layers shall be placed and compacted to the lines and grades shown on the drawings to a characteristic relative compaction of at least 102% based on Standard Compaction. The moisture content during compaction shall be within the range of 60% to 90% of the standard optimum moisture content.



6.7 Dry Back of Basecourse Layer

At the time of placing the primer seal or asphalt layers, the moisture content of the base layer shall be dried back to not more than 70% of the optimum moisture content for the base material.

6.8 Primer Seal

The contractor shall construct a 7mm primer seal in accordance with RTA R106 except that the clauses referring to: "Measurement and Payment"; shall not apply but shall be those detailed elsewhere in the Tender Document. The contractor shall design the spray seal in accordance with the RTA Spraying Sealing Guide and submission of the design to the Principal shall form a **HOLD POINT**. The Principal's approval for this design is required prior to release of the Hold Point.

6.9 Wearing Course

The work to be carried out under this Specification includes design; production and laying of dense graded asphalt surfacing. The work shall be carried out in accordance with NSW Roads & Traffic Authority (RTA) Specification R116 except as follows:

- » Exclude Clause 7 ("Measurement and Payment"); measurement and payment shall be as detailed elsewhere.

The following requirements apply in Annexure R116/1:

- » Type: AC14 (dense graded, 14mm nominal size)
- » Compacted Thickness: 40 mm
- » Binder: Class 320
- » Minimum PAFV: 44
- » Heavy Duty Application Requirements (Clause 1.1) apply: NO
- » Placement trial required: NO
- » Testing using MATTA & Gyratory compactor: NO
- » Paving in echelon: NO
- » Riding quality to be measured: NO



7. Kerbing

7.1 General

The work to be carried out under this Specification covers the construction of kerbs and gutters.

7.1.1 Standards

Pavements

Concrete In Situ

7.2 Quality

7.2.1 Inspections

Witness Points: Give sufficient notice so that inspection may be made of works areas.

Standards, specifications and test methods are referred to in abbreviated form (eg AS 1234). For convenience, the full titles are given below:

Australian Standards

AS 2876 Concrete Kerbs and Channels (Gutters) - Manually or Machine Placed

7.3 Construction

The batters of cuttings shall not be undercut to allow the construction of kerbs or gutters.

Kerb and gutter shall be constructed in accordance with AS 2876 modified as shown in Table 7-1



Table 7-1- Modifications to the Provisions of AS 2876

AS 2876 Clause Description	Modification
MATERIALS	Concrete properties and delivery, placing, compaction, finishing, curing and protection shall be in accordance with Section 15 - Concrete In Situ .
PROFILES AND DIMENSIONS	Profiles and dimensions shall be as nominated on the Drawings.
PREPARATION OF SUPPORTING LAYERS	Compaction of subgrade, sub base and base layers supporting kerb and gutter shall be to the standard specified for the adjacent pavement.
TOLERANCES	The minimum frequency of testing shall be in accordance with Table 7-2 - Frequency of Testing. On completion of kerb, gutter and adjacent pavement the gutter lip shall not be higher than, nor more than 10 mm lower than, the adjoining pavement surface at any point.
JOINTS	Joints in kerb and gutter adjacent to concrete base pavement shall be as specified in Clause 4 of this Specification. Expansion joints shall be provided in kerbs and gutters alongside flexible pavements at all locations where kerbs and gutters abut structures including drainage pits, retaining walls and bridges. These expansion joints shall be filled with a preformed joint filler complying with RTA 3204.

Unless shown otherwise on the Drawings the Contractor shall provide a steel float finish to gutter inverts and faces of kerbs. Tops of kerbs shall be provided with a broomed finish.

7.4 Kerb and Gutter with Flexible Pavement

Kerb and gutter alongside flexible pavement may be constructed in fixed forms or by extrusion or slip forming.

7.5 Kerb and Gutter with Rigid Pavement

Where kerbs and gutters are adjacent to a concrete base pavement:

- » Gutter placed integrally with the base shall be constructed as specified for the base.
- » Kerb and gutter alongside the base and tied to the base may be placed using fixed forms or by slip forming. The longitudinal joint shall be continuous over the full length without steps or offsets and shall not deviate from a 3 m straight-edge by more than 20 mm after due allowance for planned curvature. The longitudinal joint shall be corrugated and tied as shown on the Drawings and as specified for the base.



- » Kerb and gutter alongside, but not tied to, the base may be constructed in fixed forms or by extrusion or slip forming. The longitudinal joint shall be sealed as shown on the Drawings. The joint need not be corrugated unless shown as corrugated on the Drawings.
- » Kerbs placed on top of a concrete base shall be provided with ties as shown on the Drawings.

Where kerb and gutter is placed after construction of the concrete base:

- » The joint sealing in the base shall be completed prior to the construction of the kerb and gutter to prevent the ingress of mortar into joints in the base; and
- » Where the kerb and gutter is to be placed alongside the base, sealant shall extend down the full vertical face of transverse base joints and any underlying crack that exceeds 1 mm in width.

Where the kerb and /or gutter is to be constructed before the base and the kerb and gutter lip is to be level with the upper surface of the base (but not when the lip is to be above the upper surface of the base to allow for an asphalt wearing course), the radius of the lip of the gutter adjacent to the base shall not exceed 5 mm notwithstanding any larger radius shown on the Drawings.

The same types of transverse contraction, construction and expansion joints as those specified for the concrete base shall be aligned with and continued across the kerb and gutter. No additional joints shall be placed in the kerb and gutter except where shown otherwise on the Drawings. The joints shall be sealed with the same sealant as is used for joints in the base.

Where kerbs are placed on top of the concrete base, each joint in the kerb shall be aligned with the underlying base joint.

Where kerb and gutter is placed alongside the base joints in the kerb and gutter shall intersect at the common longitudinal joint (tolerance 15 mm) and their alignment shall be:

- » In kerb and gutter which is placed integrally with the base, joints shall align with those in the base; otherwise
- » Joints shall be aligned at an angle of $90^{\circ} \pm 5^{\circ}$ to the line of the kerb.

Pay Item R15P1 - Kerbs and Gutters

The unit of measurement shall be the linear metre measured along the length of the kerb or gutter. Separate rates shall be provided for each type of kerb and gutter specified.

The schedule rate shall include excavations, the forming and compaction of foundations, supply and placement of all materials, construction of all joints, and all finishing operations including backfilling and compaction adjacent to the completed kerb or gutter.

The length of drainage pit lintels or inlets shall not be included in the measurement.



Table 7-2 - Frequency of Testing

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
2	Bedding layer -surface irregularities -level	AS 2876/Survey	Every 10 m
2	Finished concrete -horizontal alignment -level -straightness/deviation from vertical curve	AS 2876/Survey	Every 10 m
2	Profile dimensions	AS 2876	Fixed forms: every 10 m Extruded or slip formed: once for each batch of concrete delivered



8. Stormwater Drainage

8.1 Scope

The following Section covers the supply and installation of all stormwater and subsoil drainage complete and as shown on the drawings and specified herein. The Contractor will also be required to maintain Erosion and Sedimentation works in accordance with the: EARTHWORKS AND EXCAVATION Specification.

Refer to the accompanying drawings for the extent and details of the stormwater works.

It is emphasised here that the contractor shall, prior to the commencement of any works on site, expose and prove the existence or otherwise, the size, level and connectability of any existing stormwater conduit to be connected to.

8.1.1 General Description

The stormwater drainage system shall be constructed to the lines, grades and levels and at the locations shown on the accompanying drawings.

Stormwater lines shall consist of manufactured pipe as shown on the accompanying drawings and as specified herein and shall be installed in accordance with this Specification.

Associated pits and structures shall be constructed using cast in-situ concrete pits and precast components together with gratings, lids, covers, lintels and other items as shown and specified in this document and its associated drawings.

Subsoil drainage work shall comprise of the supply and installation of subsoil drainage connected to the stormwater system only where shown and/or specified herein.

8.1.2 Responsibilities

The Contractor shall comply with all relevant Acts, By-Laws and Rules or Regulations of relevant Authorities with respect to all work specified herein, including adopting all appropriate safety measures. The Contractor shall make all applications, obtain all necessary permits and pay all prescribed fees required by such Authorities before commencing work.

8.1.3 Certification

All materials and manufactured components supplied to the work shall be accompanied by a certificate from the supplier stating compliance with the Specification and any relevant Australian Standards, together with any data and performance parameters required to be supplied with these documents.



8.2 Stormwater Drainage Pipes

PVC pipes and fittings as specified in AS 1254, AS/NZS 1260, AS 1273, AS/NZS 1477, and AS/NZS 2179.2(Int) shall, where exposed to direct sunlight, have adequate resistance to UV radiation or protection in accordance with AS2032.

8.3 Excavation

Wherever appearing in the Specification excavation shall mean excavation in all classes of material.

The Contractor shall excavate drainage line trenches to the lines and levels shown on the Drawings, with allowance for bedding. Bottom of trenches shall be compacted to a minimum 98% standard compaction.

Should the Contractor excavate trenches to depths greater than that necessary, the excess excavation shall be backfilled to the correct level with approved material compacted as specified above. This work shall be carried out at the Contractor's expense.

Trenches shall be excavated to a sufficient width such that there is a minimum distance of 100mm between the side of the trench and the outside of the pipe collar. To allow the proper handling, jointing and packing of all types of pipes specified, additional excavation shall be carried out at no additional cost to the Principal, where necessary.

Unless otherwise specified or directed by the RailCorp, trench excavation for bedding on rock shall be a minimum of 200mm below the underside of the pipe. For bedding on earth foundation, the trench shall be excavated over its full width to a level at least 75mm below the underside of the pipe collar before bedding material is placed. All loose material shall be removed from the bottom of trenches prior to the placing of approved granular bedding material.

Subject to any Act of Parliament, Ordinance or Regulation, the Contractor shall satisfy himself as to the necessity of timbering any excavation and shall accept the sole responsibility as to its being required and to its use in the works. The whole cost of supplying, fixing and withdrawing timbering and any timber that the Contractor may deem necessary to leave in the work shall be included in the relevant excavation rate.

The execution of any additional excavation by benching or sloping of the trench walls to offset the necessity of timbering may be approved by the RailCorp on the written request of the Contractor, subject to the Contractor supplying, placing and compacting all additional specified backfill material required to make good the soil excavation in accordance with this Specification, all at no additional cost to the Principal.

The Contractor shall take all precautions against accident, damage to the works or other works and properties and injury or loss arising from any cause whatsoever to persons employed by the Contractor, by the Principal or otherwise.



8.4 Pipe Bedding

The material used for bedding of pipes shall be approved compacted granular material having high permeability and high stability when saturated and free of organic matter.

No bedding material shall be placed until the excavation has been inspected and approved by the RailCorp.

The bed material shall extend over the full width of the trench and shall be compacted by tamping, rolling and/or vibration to a minimum Density Index (DI) of 70.

Field-testing in accordance with AS 1289 shall be required to monitor compaction achieved.

The bed level shall be graded to provide for a uniform fall to the discharging end of the pipeline, with line and level as shown on the drawings.

For pipes with sockets protruding beyond the barrel outside surface, chases shall be dug into the bed and foundation if necessary, in the appropriate positions, so that each pipe is supported along the full length of the barrel and the socket is not subjected to point loading.

Where the trench is excavated in waterlogged ground, a layer of crushed rock, 20 mm to 40 mm size or other materials approved by the RailCorp, shall be laid 300 mm thick below the pipe and shall extend the full width of the trench and half way up the sides of the pipe. Where in the opinion of the RailCorp the crushed rock would not form a suitable foundation for the pipe, a concrete cradle with Type U bedding, may be used instead. The concrete cradle shall be monolithic 20MPa mass concrete of minimum 0.25D below the pipe and surrounding the pipe up to 0.20D, where D is the pipe diameter.

8.5 Pipe Laying

Before pipes are laid all debris and loose material that may have entered the pipe shall be removed and the outside of spigots and inside of sockets thoroughly cleaned of foreign matter.

Where indicated on the Drawings, pipe bends and fittings shall be laid to the details shown on the Drawings and in accordance with the provisions of this Specification.

Pit walls and floors shall be constructed as pipe laying proceeds. Walls shall be brought at least to the level of the pipe obvert during the laying of pipelines unless otherwise directed by the RailCorp.

Provision shall be made for the temporary drainage in the event of rain. The Contractor shall ensure that this temporary drainage does not cause erosion or siltation of pipelines.

8.6 Direct Connections

Where direct pipe connections are shown on the Drawings, both pipes shall be carefully cut or manufactured so that a neat junction is obtained. The inside joints shall



be neatly and tightly finished off with cement mortar as specified hereunder so that the internal shapes of the pipes are maintained.

Bandage joints shall be placed on the outside of the connection so that all exposed external joints are lapped at least 100mm by the bandage.

8.7 Inspection Prior To Backfilling

All drainage lines shall be inspected and approved by the RailCorp after laying and jointing and prior to the placing of any backfilling.

8.8 Backfilling

8.8.1 General

The material shall be placed over the full width of the trench either in layers not exceeding 150mm compacted thickness and compacted by conventional methods or compacted in one operation by saturation and vibration to achieve a minimum Density Index (DI) of 70.

Field-testing in accordance with AS 1289 shall be required in order to monitor compaction achieved.

Upon completion of pipe laying, jointing and backfilling of the drainage line, the whole of the drainage line including junction pits, inlet pits, etc., shall be thoroughly cleaned to the satisfaction of the RailCorp and maintained in that state for the duration of the Contract.

8.8.2 Capping Material

The forming capping material referred to on the Drawing shall conform to the requirements of TS 3422.

8.9 Subsoil Pipes

8.9.1 General

Subsoil drainage pipelines shall be installed where shown on the drawings and also in the base of stormwater drainage line trenches for a distance 3m upstream of all stormwater inlet pits, unless the drainage pipe is slotted.

Subsoil pipes upstream of the pits shall be 100 mm in diameter and laid in the base of the trench on the trench-bedding layer at the same grade as the stormwater pipeline.

Subsoil pipes in the gravel trench drain shall be as per the drawings. This trench shall be backfilled with 20mm nominal gravel. These pipes shall be placed at a minimum of 650 mm below finished surface levels.

Subsoil pipes shall be Type 1, Class 1000, perforated plastic piping conforming to the requirements of AS 2439.1.



Joints, couplings, elbows, tees and end plugs shall conform to the manufacturer's specifications and AS 2439.1 using the manufacturer's appropriate accessory fittings, unless otherwise approved by the RailCorp.

Seamless tubular filter fabric shall conform to the requirements of RTA QA Specification 3553.

All subsoil pipes shall be fitted with a filter sock. The filter sock shall be appropriately tied at the upstream end of the subsoil pipe to preclude the entry of filter material.
Installation

8.9.2 Compaction

Filter material placed in subsoil drains shall be compacted for its full depth to a relative standard compaction of not less than 95%. Tamping around and over the pipe shall be done in such a manner as to avoid damaging or distorting the pipe or disturbing the joints and joint covering.

Reference Standards

The following Standards shall apply to all Civil and Earthworks:

Table 8-1 Standards

Standards No.	Standard Title
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1379	Specification and Supply of Concrete
AS 1646	Elastomeric Seals for Waterworks Purposes
AS 2439	Perforated Plastics Drainage and Effluent Pipe and Fittings
AS 3725	Loads on Buried Concrete Pipes
AS 3996	Metal Access Covers, Road Grates and Frames
AS 3972	Portland and Blended Cement
AS 4058	Precast Concrete Pipes (Pressure and Non-Pressure)
AS 4671	Steel Reinforcing Materials
RTS.3432	Track Drainage – Inspection and Maintenance
RTS.3433	Track Drainage – Design and Construction



9. Sewers

9.1 Scope Of Work

This section of the specification covers the installation of sewer reticulation works associated with the ablution facilities to be provided in the substation building. It is emphasised here that the contractor shall, prior to the commencement of any works on site, expose and prove the existence or otherwise, the size, level and connectability of any existing sewer to be connected to.

9.1.1 Extent of Work

The Specification provides for the provision of new and the adjustment of all existing sewer within the scope of the Works.

9.1.2 Responsibilities

The Contractor shall be responsible for carrying out all the necessary works in accordance with this specification, Sydney Water Corporation (SWC) specifications, the Drawings and the associated contract documents.

The Contractor will be solely responsible for liaison with Sydney Water regarding adjustments to any Sydney Water plant and will be responsible for the payment of all Authorities' fees. Any applications to SWC should commence as early in the contract as possible.

9.1.3 Certification

The Contractor is to ensure, where applicable, all Sydney Water requirements are satisfied. The Contractor shall maintain records of all work carried out with respect to the installation of the sewer connection.

9.2 Standard Specifications

9.2.1 General

Work carried out and testing performed under this Specification shall comply with the requirements of AS/NZS 3500, Sydney Water and any other relevant Authority requirements, to the extent that they are relevant and not overridden by the Specification.

9.3 General Requirements

9.3.1 General

Terms used in this specification shall have the meanings assigned to them as follows:

'Approved' shall mean approved in writing by the Superintendent.



'Or equal approved' shall mean equivalent in performance, quality and price to that specified and approved by the Superintendent.

The term "construction area" in this Part shall be defined as an area to be excavated and backfilled in order to access the existing sewer and construct the new connection.

9.3.2 Liaison with Sydney Water

All costs incurred by Sydney Water with respect to any Sydney Water supervision and site inspections shall be borne by the Contractor.

9.4 Regulations

9.4.1 General

The Contractor shall comply with all relevant Acts, Regulations and By-Laws in respect of all work specified herein, including temporary timbering, strutting, safety barriers and all other safety measures to be adopted. The Contractor shall make all applications, obtain all permits and pay all prescribed fees within the times nominated by the Authorities.

9.5 Materials and Components

9.5.1 Sewer mains

All sewer mains shall be UPVC class SH pipe unless otherwise shown on the Drawings.

9.5.2 Fittings and accessories

All fittings for the sewer mains shall be uPVC class SH, unless noted otherwise, and connected to the sewer main in accordance with the requirements of AS3500 and the Drawings.

All floor traps shall comply with the requirements of AS3500 and the Drawings.

9.6 Environmental Protection

9.6.1 General

Refer to the Earthworks and Excavation Specification.



10. Water

10.1 Scope Of Work

This section of the specification covers the installation of a new cold water supply to the ablution facilities inside the substation building. It is emphasised here that the contractor shall, prior to the commencement of any works on site, expose and prove the existence or otherwise, the size, level and connectability of any existing water main to be connected to.

10.1.1 Extent of Work

The full extent of the works is depicted on the accompanying hydraulics drawings.

10.1.2 Responsibilities

The Contractor shall be responsible for carrying out all the necessary works in accordance with this Specification, to Sydney Water requirements, to the Drawings and to the associated contract documents.

10.1.3 Certification

The Contractor shall maintain 'Work as Executed' details of all concrete encasement and supply such details to the Superintendent throughout the duration of the Works. The start and finish of concrete encasement shall be measured as a chainage from the adjacent property boundaries.

10.2 Standard Specifications

10.2.1 General

Work carried out and testing performed under this Specification shall comply with the requirements of AS/NZS 3500, Sydney Water and any other relevant Authority requirements, to the extent that they are relevant and not overridden by the Specification.

10.3 Quality

10.3.1 Inspection

The Contractor shall give sufficient notice to the Superintendent so that inspection may be made at the following stages:

- » Concealed or underground services installed prior to concealment or backfill.



10.3.2 Samples

Submit samples of accessories not specified as proprietary items, including the following:

- » Valves
- » Means of identification, including adhesive labels and engraved disks or plates
- » Fittings such as cover plates, purpose made sealing covers, valve boxes and couplings.

10.4 General Requirements

10.4.1 General

Terms used in this specification shall have the meanings assigned to them as follows:

'Approved' shall mean approved in writing by the Superintendent.

'Or equal approved' shall mean equivalent in performance, quality and price to that specified and approved by the Superintendent.

The term "construction area" in this Part shall be defined as an area to be excavated and backfilled in order to access existing water supply pipework.

10.5 Regulations

10.5.1 General

The Contractor shall comply with all relevant Acts, Regulations and By-Laws in respect of all work specified herein, including temporary timbering, strutting, safety barriers and all other safety measures to be adopted. The Contractor shall make all applications, obtain all permits and pay all prescribed fees within the times nominated by the Authorities.

10.6 Concrete Works

Refer to the relevant Section on concrete within this Specification.

10.7 Materials and Components

10.7.1 General

Construction of pipelines shall be in accordance with the WSA 02 (2002) "Sewerage Code of Australia Sydney Water Edition" and WSA 03 (2002) "Water Reticulation Code of Australia Sydney Water Edition".



10.7.2 Pipework Supply And Installation

All pressure and non-pressure pipework and associated fittings and structures shall be supplied, installed, tested and commissioned in accordance with the requirements of WS-SPEC available from Standards Australia International Ltd.

Pipework for the water reticulation main shall be class 12 uPVC to AS1477 or K9 ductile iron to WSA PS-200. Smaller diameter plumbing may be constructed in HDPE.

Pipework fittings shall be ductile iron to WSA PS-201. Polyethylene sleeving for corrosion protection of buried ductile iron pipework shall be in accordance with WSA PS-320. Flange gaskets shall be in accordance with WSA PS-312.

The connection to existing Sydney Water pipelines shall be carried out in accordance with the principles shown on the water layout drawings to Sydney Water standards and Sydney Water shall be notified and liaised with for this element of the works and their requirements followed.

10.7.3 Valves

General

Valving and other fittings shall comply with the following requirements.

All ferrous alloy valves shall have protective coatings complying with SWC's Engineering Products Specification 101 – "Protective Coating of Valves and Fittings".

Globe Valves

All globe valves shall be of bronze construction with bronze stems, integral bronze seats and renewable plastic discs. Globe valves up to and including 50 mm nominal bore shall be screwed, larger sizes shall be flanged unless shown otherwise. Materials shall comply with the requirements of AS1628.

Gate Valves

Gate valves up to and including 80 mm nominal bore shall be of bronze construction and shall comply with AS1628 as amended. Gate valves up to and including 50 mm nominal bore shall be screwed, larger sizes shall be flanged.

Gate valves larger than 80 mm shall be of cast iron construction and shall be flanged with outside stem and yoke. The valves shall comply with AS 2638 Part 1 Class 16 requirements and shall have separate facing rings. All fasteners shall be stainless steel.

Reflux Valves

Reflux valves 100 mm diameter and over shall be cast iron body, counter-balanced lever swing gate type with a clear opening at least equal to that of the connecting pipe and shall comply with AS 4794. The disc shall have separate seating rings and shall incorporate a type 316 stainless steel spindle extension on both sides, and a lever and weight on one side and provision for a microswitch or limit switch where necessary. All fasteners shall be stainless steel.



Reflux valves for water piping less than 100 mm diameter shall be bronze body full bore type with freely moving bronze disc, and shall comply with AS1628.

An inspection cover shall be incorporated and provision made for periodic lubrication of the trunnions.

Limit switch housings if fitted shall be of metal with degree of protection IP56D. The switches shall be provided with two sets of changeover contacts rated at 2A at 24V D.C.

Where it is impractical to fit a limit switch on a reflux valve (eg. because of low flow and/or valve too small) the Contractor shall supply and install a suitable flow switch to carry out the duty intended, in addition to the reflux valve.

10.7.4 Backfilling

Backfilling of pipes shall be carried out in accordance with the details of the Sydney Water's standard drawings. Backfill shall be placed uniformly on each side and over the pipe and compacted in such a manner that the pipe is not disturbed or damaged. Backfilling shall not be started until all tests and inspections have been successfully completed.

The Contractor shall ensure that normal drainage is not interfered with after completing the backfill and shall make good any subsidence that occurs in the backfill before the end of the maintenance period and any damage caused by subsidence.

No rubbish or rocks larger than 100mm shall be used in backfill.

Embedment material backfill only shall be placed within 150mm of any pipes when backfilling.

Where no pavements or structures or services are to be constructed over the excavation, the remaining backfill may be the excavated spoil or other material, providing it is not greater than 75mm particle size, not excessively wet or lumpy so as to prevent compaction or that it does not contain excessive organic material. The backfill shall be placed in layers not exceeding 180mm compacted thickness and each layer compacted before placing further backfill.

Where pavements or structures are to be constructed over the trench, the backfill shall be completed with granular material.

Any temporary trench supports shall be removed progressively during backfilling to ensure that:

1. Placing and compaction of pipe embedment and trench fill materials occur below the trench support and against the undisturbed native ground;
2. Removal of the support does not disturb any compacted embedment or trench fill material;
3. No damage or disturbance occurs to the bedding, surround, or any foundation material; and
4. No damage or disturbance occurs to the pipes and fittings laid in the ground.



Degree of Compaction

Backfill material shall be placed and compacted at a moisture content in the range of 97% to 103% of optimum moisture content.

Each layer of backfill shall be compacted to the satisfaction of the Contractor's Design Manager such that the percentages of maximum dry density as defined by the Standard Compaction Test in AS 1289 are not less than the following:

- | | |
|---|------|
| i. Backfilling around and to a height of 300 mm above pipes in non trafficable areas | 90% |
| ii. Backfilling around and to a height of 300 mm above pipes in trafficable areas | 95% |
| iii. Backfilling material above (a) where pavements are to be constructed over the excavation | 98% |
| iv. Backfilling material above (a) where no pavements, structures or services are to be constructed over the excavation | 95% |
| v. Backfilling around and above pipes where Contractor's structures are to be constructed over the trench | 100% |

10.7.5 Field Testing

Pressure pipelines shall be hydrostatically pressure tested after installation in accordance with the methods specified in WSA 03-2002 Water Supply Code of Australia Sydney Water Edition.

Non pressure pipelines and shall be tested by the air pressure methods specified in WSA 02-2002 Sewerage Code of Australia Sydney Water Edition.

The Contractor shall prepare a work method statement for testing indicating test methods, lengths to be tested, isolation of test sections and support arrangements and shall submit this work method statement to the Superintendent at least three weeks prior to commencement of the testing programme. The Contractor shall arrange to test in the presence of the Superintendent and shall give notice of at least two clear working days of any proposed test.

The Contractor shall supply all labour, plant, equipment, instruments, materials and test water and perform any work necessary to undertake the tests and any incidental work.

The pipeline shall be hydrostatically tested to the test pressure as nominated by the Contractor's Design Manager. If a test pressure is not shown, then the line shall be tested to 1.25 times the maximum working pressure of the pipeline.

10.7.6 Thrust And Anchor Blocks

The Contractor shall place concrete thrust and anchor blocks at deflections, bends, tees, and tapers and as required. Thrust blocks shall be cast against undisturbed



ground and shall be Grade N 20 concrete in accordance with AS1379. Loads shall not be applied to the thrust blocks within 7 days of casting.

10.7.7 Valve boxes

Provide cast iron valve boxes with hinged covers for access to underground taps and valves.

Refer to drawings for details.

10.8 Charging

On completion of installation, commissioning, testing and disinfection, fill the system with water and leave the water supply system in full operational condition.



11. Electrical Ducting

11.1 General

11.1.1 Cross References

- » Earthworks
- » Concrete In Situ
- » Service Trenching

11.1.2 Scope of Works

The work involved includes:

- » Laying of new HV, LV and Data ducting
- » Construction of associated draw pits
- » Building light and power services

Table 11-1 RailCorp and Australian Standards

Standards No.	Standard Title
AS 4799-2000	Installation of underground utility services and pipelines within railway boundaries
EP 20 00 04 02 SP	Underground Installation Configurations for High Voltage and 1500 Vdc Cables
EP 20 00 04 05 SP	Cable Pits
EL 0024639	Standard Drawing: Underground Cables. Undertrack Crossing Arrangement
AP.5181	Care & Protection of Underground Pipes & Cables
G 5000	Management System for Pipe, Electrical, Telephone Crossings Under and Over Railway Property

11.1.3 Route of Ductline

The indicative routes are detailed on the Contract Drawings.

The Contractor shall peg on site the ductline route and the location of each pit. The pegged route, marked pit locations and duct/cable depths are to be reviewed by the RailCorp before construction work commences.

11.1.4 Program of Excavation

The work shall be organised to keep the time between the opening of the ground surfaces and the final restoration as short as possible.



The Contractor shall obtain the approval of RailCorp for the lengths of trench to be opened at any one time.

11.1.5 Obstructions

Indicative locations of obstructions, including some existing underground services, have been plotted on the Drawings for information only. Should obstructions be encountered during construction that require diversion so that ductline construction can proceed or which require a variation to the ductline route, the Contractor shall notify the RailCorp and the Contractor shall not proceed with such work without acceptance from the RailCorp of the Contractor's proposed diversion.

11.1.6 Excavation

Refer to the Earthworks and Service Trench Sections.

11.1.7 Ductline Trench Width and Depth

The width and depth ductline shall comply with a minimum dimensions as shown on the Contract Drawings and/or the relevant standards listed in Table 11-1.

Trenches are to be excavated so that ductlines can be laid with 300 mm clearance all round from other obstructions, unless otherwise approved by the RailCorp. Separation between ducts is specified in Section 5.1 of EL 20 00 04 02 SP.

Twenty metres (20m) of fully excavated trench shall be maintained ahead of all incomplete ductlines to allow for deviation if required. The Contractor shall allow for any costs incurred by having to carry out portions of the work at times outside normal hours or to avoid inconvenience near the ductline route.

Unless otherwise noted, all ductlines should be installed at a depth indicated by EP 20 00 04 02 SP Table 3. Undertrack crossings are to be laid in accordance with RailCorp drawing EL 0024639.

11.1.8 Ductlines

New uPVC ducts are to be installed as indicated in EP 20 00 04 02 SP.

The works shall include the supply of all necessary materials, labour and plant.

Generally the ducts shall be laid along the route in the positions and at the depths indicated by the specification and the drawings. The final position and depth of the ducts may be changed on site with the approval of the RailCorp to avoid obstructions. The Contractor shall lay the ducts at such varied positions or depths and shall make no charge for such variation.

The duct ends shall be smooth and cleanly cut with sharp edges removed and all ductlines are to be provided with draw wire.



11.1.9 Ducts

HV and LV ducts and bends shall be orange coloured Class 6 uPVC pipes manufactured in accordance with Australian Standards 1477, Part 1. A socket shall be formed at one end of each pipe and bend.

Data ducts and bends shall be white coloured Class 6 uPVC pipe manufactured in accordance with the relevant Australian Standards.

11.1.10 Inspection of Ducts Prior to Laying

Give notice to inspect all ducts before installation. Ensure that all ducts are free from defects and foreign material, which could damage the cable and otherwise render the duct unsuitable for use, and notify the RailCorp the ducts are ready for his/her inspection.

Seek RailCorp's approval if repairs to unsuitable ducts shall be attempted. Ducts that cannot be repaired to the satisfaction of the RailCorp shall be removed from the work site and replaced at no cost to the Principal.

11.1.11 Jointing of Ducts

All ducts shall be forced well into the socket and solvent welded. The joints shall be water tight and installed in accordance with the manufacturer's instructions.

11.1.12 Temporary Plugging of Ducts

Where the laying of ducts is temporarily discontinued and at the boundary of the current works area and Limits of Contract, the exposed ends of the ducts shall be plugged with approved duct plugs. The plugs shall remain in position until the work is resumed. A drawing of the duct plugs to be used is to be provided by the Contractor for approval by the RailCorp.

11.1.13 Bedding of Ducts

The ductline shall be bedded in accordance with the details in EP 20 00 04 02 SP.

11.1.14 Installation of Duct Pits

Installation of ducts into all pits shall be carried out by this contract. HV duct entry into the HV draw pits will vary according to the size of cable and the entry/exit points shall comply with the requirements of Appendix A of EP 20 00 04 05 SP (Cable Pits).

Where conduits enter pits, the ends are to be fitted with proprietary manufactured UPVC bellmouth set cut off flush with the inside wall, and the entry finished off to the satisfaction of the RailCorp.

11.1.15 Cut Lengths of Duct

The duct installation will, wherever possible, comprise full lengths of duct as manufactured.



It may be necessary to cut a length of ductline where construction takes place from both ends towards the middle. In this case, a length of duct may be cut and inserted into the line to connect together with two ends approaching from opposite directions.

It will be necessary to use slip couplings supplied by the manufacturer for this purpose. The length of pipe to be inserted will be measured and cut to a length no less than 10 mm shorter than the gap to be filled, and the joints made using the slip couplings in accordance with the manufacturer's instructions.

11.2 Duct Plugging

After the ducts have been cleaned and tested to the satisfaction of the RailCorp, the Contractor shall plug each duct with an approved duct plug. The Contractor shall supply a drawing of the duct plugs intended to be used.

11.2.1 Installation of Warning Strip

Polythene film warning strips to indicate the presence of the ductlines are to be laid in the trench at a depth shown in EP 20 00 04 02 SP.

11.2.2 Underground Duct Routes Survey

Accurately record the routes of underground ductlines before backfilling.

11.2.3 Pits

Construction of electrical and communications pits shall be carried out to the specific requirements of the Contract drawings and these Specifications.

Construction of pits should include lids as detailed on the Contract Drawings. Sizes indicated are internal dimensions.

Soil shall be compacted to prevent settlement of the pits and associated cables.

Markers and PVC pipe protection measures shall be positioned in accordance with EP 20 00 04 02 SP requirements.

The Principal cannot guarantee the accuracy of any records of obstruction, or that the excavation site will be free of unrecorded obstructions of any kind.

Any additional excavation required for the construction of the pit to the presence of an obstruction and the surface breaking, planking and temporary reinstatement associated therewith, shall be included in the contract work.

No payment shall be made for inconvenience or additional expense incurred by the Contractor during the construction of a pit due to the presence of any obstructions.

Make provision for drainage from the bottom of cable pits as shown on the Civil drawings.

11.3 Concrete Construction

Refer to the Concrete Section.



11.3.1 Test and Inspections – Quality Assurance

Refer to Preliminary Section.

11.3.2 Testing on Site During Construction

The Contractor shall carry out all testing necessary to provide the correctness of the installation as the work progresses.

Testing of Completed Ductline

The Contractor shall provide all necessary test equipment and operators to carry out the routine tests after completion. Any other tests that the Contractor or the RailCorp may wish to have carried out to prove the fitness of the installation shall also be carried out this time. The Contractor will not be allowed any extension of time for the carrying out of these tasks.

The Contractor shall be entirely responsible for the proper performance of the equipment and material under test.

The Contractor shall rectify any defect revealed by the tests and, at his own expense, shall repeat such testing as often as may be necessary to obtain the results required.

Ductlines must be clear and suitable for use.

11.4 Marking Plates for Underground Cabling

11.4.1 General

The Contractor shall provide Cable Route Markers in accordance with the requirements of Section 6 of EP 20 00 04 02 SP.

11.4.2 Indication of cable entry to a Building

At the point at which an underground cable enters or leaves a building marker plates shall be engraved with an arrow pointing to the direction in which the cable is laid and the words “HV Electric Cable”, “LV Electric Cable” Data Cable” as applicable.

11.4.3 Indication of Directional Changes

At each change of direction two (2) marker plates shall be installed. Each plate shall be engraved with an arrow pointing in the direction in which the cable is laid and the words “HV Electric Cable”, “LV Electric Cable” or “Data Cable” as applicable.



12. Adhesives, Sealants And Fasteners

12.1 General

12.1.1 Cross References

General

Refer to the *General Requirements* work section.

12.2 Execution

12.2.1 Adhesives and Sealants

Standards

Mastic adhesive: To AS 2329.

Non-structural adhesive for timber: To AS 2754.3.

Polymer emulsion adhesive for timber: To AS 2754.2, not inferior to Type 3 if required to be water-resistant.

Sealing compound (polyurethane, polysulphide, acrylic):

» Single component: To ASTM C920.

Sealing compound (silicone):

» Single component: To TT-S-001543B.

12.2.2 Fasteners

General

Masonry anchors: To be proprietary expansion or chemical types.

Plain washers: To AS 1237.1.

» Provide washers to the heads and nuts of bolts, and heads and nuts of coach bolts.

Plugs: To be proprietary purpose-made plastic.

Powder-actuated fasteners: To AS/NZS 1873.4.

Steel nails: To AS 2334.

» Length: At least $2\frac{1}{2}$ x the thickness of the member being secured, and at least 4 x the thickness if the member is plywood or building board <10mm thick.

Unified hexagon bolts, screws and nuts: To AS/NZS 2465.

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

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

Steel products:

» Distance to water: To the mean high water mark.>10km

Corrosivity Category	Situation ¹	Self Drilling Screws to AS 3566: Class	Threaded Fasteners and Anchors: Material or Minimum Local Metallic Coating Thickness (µm)	Power Actuated Fasteners: Material or Minimum Local Metallic Coating Thickness (µm)
Low	Internal	1	Galvanised	Galvanised
More than 10 km from water subject to breaking surf	External	3	galvanize 30	Stainless 316
More than 1 km from salt water not subject to breaking surf				

¹ Situation:

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

Finishes

Galvanizing:

- » Threaded fasteners: To AS 1214.
- » Other fasteners: To AS/NZS 4680.

Mild steel fasteners: Galvanize if:

- » Exposed to weather.
- » Embedded in masonry.
- » In contact with chemically 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.

Performance

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

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 and AS 3566.2.

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.



13. Service Trenching

13.1 General

13.1.1 Cross References

Related section

Refer to the following sections:

- » Earthworks
- » Stormwater Drainage
- » Electrical Ducting

13.2 Quality

13.2.1 Inspection

Witness points

Give sufficient 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.

13.2.2 Tests

Bedding density tests.

Testing authority: Have density tests of pipe bedding carried out by an authority accredited by NATA.

Test methods:

- » Field dry density: AS 1289.5.3.2 or AS 1289.5.3.5.
- » Maximum dry density: AS 1289.5.1.1.
- » Dry density ratio: AS 1289.5.4.1.
- » Density index: AS 1289.5.6.1.

13.3 Service Trenches

13.3.1 Excavating

Excavation

Excavate for underground services, to required lines, levels and grades. Generally make the trenches straight between personnel access ways, inspection points and junctions, with vertical sides and uniform grades.



Trench widths

Keep trench widths to the minimum consistent with the laying and bedding of the relevant service and construction of personnel access ways and pits.

13.3.2 Backfilling

General

Backfill service trenches as soon as possible after the service has been laid and bedded, if possible on the same working day. Place the backfill in layers ≤ 150 mm thick and compact to the density that applies to the location of the trenches to minimise settlement, and so that pipes are buttressed by the trench walls.

Backfill material

General: General fill with no stones greater than 25 mm occurring within 150 mm of the service, or other materials as required for particular services or locations. Well-graded, inorganic, non-perishable material, maximum size 75 mm, plasticity index $\leq 55\%$.

Under roads and paved areas and within 4 m of buildings: Coarse sand, controlled low strength material or fine crushed rock.

In topsoil areas: Complete the backfilling with topsoil for at least the top 50 mm.

In reactive clay: In sites classified M, H or E to AS 2870, provide an impervious material where trenches fall towards footings.

13.3.3 Reinstatement Of Surfaces

General

Reinstate existing surfaces removed or disturbed by trench excavations to match existing and adjacent work.



14. Metals And Pre-Finishes

14.1 General

14.1.1 Cross References

General

Conform to the *General Requirements* section.

14.2 Materials and Components

14.2.1 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

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

Ferrous hollow and open sections by electrogalvanizing: To AS 4750.

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

Metallic-coated sheet: To AS 1397.

» Thickness: 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.

Stainless Steel

Bar: To ASTM A276.

Plate, sheet and strip: To ASTM A240/A 240M.

Welded pipe (round): To AS 1769.

Welded pipe (square): To ASTM A 554.



Steel

Sheet: To AS/NZS 1595.

Structural bars and sections: To AS/NZS 3679.1.

Structural hollow section: To AS 1163.

Steel for Pre-finishes

Cold rolled bar: To AS 1443 "bright".

Cold rolled sheet: To AS/NZS 1595.

» Designation: CA2S-E.

Electric resistance welded pipe: To AS 1450 "bright".

14.3 Execution

14.3.1 General

Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. For butt joints do not rely on the filler metal fillet only.

Filler metal: To AS 1167.1.

Damage

If prefinishes are damaged, including damage caused by unauthorised site cutting or drilling, remove and replace the damaged item.

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, galvanising or electroplating. Ensure 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.

Priming steel surfaces: If site painting is specified to otherwise uncoated mild steel or similar surfaces.

- » Prime after fabrication and before delivery to the works; and
- » After installation, repair damaged priming and complete the coverage to unprimed surfaces.



Repair

If a repair is required to metallic coated sheet or electrogalvanized or inline galvanized steel products, clean the affected area and apply a two-pack organic primer to AS/NZS 3750.9 or APAS-2916.

Welding

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6.

Steel: To AS/NZS 1554.1.

14.3.2 Self Finishing

Mechanical Finishes

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

14.3.3 Anodising

Anodising

Standard: To AS 1231.

Thickness grade:

- » Indoor applications: At least AA10.
- » Outdoor applications: At least AA25.

14.3.4 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.

14.3.5 Powder Coating

Preparation

General: Use chemical pre-treatment. If recommended, provide conversion coatings.

Aluminium: Pretreat as recommended in AS 3715 Appendix G.



Galvanized steel: Clean by immersing in a suitable alkaline or acidic solution, apply a zinc phosphate chemical conversion coating, rinse and degas.

Unprotected steel: Remove rust to the recommendations of AS 1627.4 to grade Sa 2¹/₂ of AS 1627.9. Clean by immersing in trichloroethylene or an alkaline solution, and apply a coat of iron phosphate.

Thermoset Powder Coating

Standards: To AS 3715 or AS/NZS 4506 as appropriate.

External use: APAS-0155/2.

Finish: Full gloss.

Internal use: APAS-0155/1.

14.3.6 Prepainting

Air-Drying Enamel

Application: Spray or brush.

Finish: Full gloss.

Internal use:

- » Primer: Two-pack epoxy primer to APAS-2971.
- » Topcoats: 2 coats to APAS-0015/1.

Equipment Paint System

Description: Brush or spray application using paint as follows:

- » Full gloss enamel finish coats, oil and petrol resistant: APAS-0024/1, two coats.
- » Prime coat to metal surfaces generally: APAS-0032 or APAS-0162/1.
- » Prime coat to zinc-coated steel: APAS-0134.
- » Undercoat: APAS-0029.

High Performance Organic Coatings

Description: Factory applied spray coatings on aluminium products, including polyvinylidene fluoride (PVF₂) coatings.

Standards: To AAMA 2604 and AS 2728.

Prepainted Metal Products

Standard: To AS/NZS 2728.

Product finish: as shown on drawings

Product type: Not lower than the type appropriate to the field of application.

Two-Pack Liquid Coating

Application: Spray.



Finish: Full gloss.

Primer: Two pack epoxy primer to APAS-2971.

Topcoat:

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



15. Concrete In Situ

15.1 General

15.1.1 Cross References

General

Refer to the *General Requirements* worksection.

Related Worksections

Conform to associated worksection as follows:

- » Concrete finishes.
- » Concrete formwork.
- » Concrete reinforcement.
- » Finishes Schedule for colour additive and sealer

15.1.2 Standards

General

Concrete: To AS 1379.

Concrete structures for retaining liquids: To AS 3735.

Materials and construction: To AS 3600.

15.1.3 Interpretation

Definitions

Assessment:

- » Production: An assessment procedure for concrete specified by strength grade, carried out by the supplier and based on the statistical assessment of standard compressive strength tests on concrete, specified by compressive strength and produced by a specific supplying plant.
- » Project: An assessment procedure for concrete specified by strength grade, specified at the customer's option, which provides additional test data for the statistical assessment of concrete supplied to a specific project.

Concrete class:

- » Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise in accordance with AS 1379 clause 1.6.3.
- » Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in accordance with AS 1379 clause 1.6.4.



Batch: A quantity of concrete containing a fixed amount of ingredients produced in a discrete operation.

Early age: Strength requirement at an age less than 28 days.

Joint:

- » Construction: A joint provided to suit construction sequence with reinforcement continuous across the joint.
- » Expansion: An un-reinforced joint with the joint surfaces separated by a compressible filler.

Sample: A portion of the material used in the works, or to take such a sample.

Specimen: A portion of a sample, which is submitted for testing.

Weather:

- » Cold: Surrounding outdoor shade temperature $< 10^{\circ}\text{C}$.
- » Hot: Surrounding outdoor shade temperature $> 32^{\circ}\text{C}$.

15.2 Quality

15.2.1 Inspection

Witness Points

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

- » Commencement of concrete placing.
- » Completed formwork, and reinforcement, cores, conduits and embedments fixed in place.
- » Membrane or film underlay installed on the base.
- » Surfaces or elements to be concealed in the final work before covering.

15.2.2 Concrete Tests

Production Assessment

Dissemination of production information: If concrete is manufactured off site, register the project in accordance with AS 1379 clause 6.4.3.

Control Tests

General: Determine transfer strength and early strength using site cured specimens in conformation with the **Control tests schedule**.

Acceptance criteria:

- » Average strength of all samples must exceed the required value.
- » Strength of any one sample must be at least 0.85 of the required value.



Project Assessment

Standard: To AS 1379.

Drying shrinkage: Test 3 specimens of each type of concrete every 3 months or every 3000 m³ placed concrete. Base assessments on the average of the 3 specimens test results. Conduct 2 sets of tests on trial mixes.

Frequency: Sample, test and assess the concrete for conformance with the **Sampling frequency table** and the **Concrete tests schedule**. For each property test at least two specimens from each sample.

Slump: Test at least one sample from each batch before placing concrete from that batch in the work.

Strength grade/Characteristic compressive strength: Spread the site sampling evenly throughout the pour.

» Specimen size: 200 x 100 mm diameter but, if aggregate size exceeds 20 mm, 300 x 150 mm diameter.

Test authority: Concrete supplier or a Registered testing authority.

Sampling Frequency Table

Number of Batches for Each Type and Grade of Concrete Per Day	Minimum Number of Samples Per Day
1	1
2-5	2
6-10	3
11-20	4
each additional 10	1 additional

Concrete tests schedule

Property	Test method	Test/sampling frequency
Slump	To AS 1012.3.1	One per 25m ³ or part thereof or where directed by the RailCorp for each mix type used in the works or other requirements of this specification
Characteristic compressive strength	To AS 1012.9	One set per 50m ³ or part thereof or where directed by the Site Manager or other requirements of this specification for reinforced concrete



Property	Test method	Test/sampling frequency
Drying shrinkage	To AS 1012.13	One test per six months for each mix where more than 100m ³ supplied during the month (or cumulative since last test).

Test Records

Records and reports: To AS 1012.

15.2.3 Submissions

Design

Loading: Submit calculations to justify the adequacy of the structure to sustain any construction loads and procedures.

General: Submit proposals for mixing, placing, finishing and curing concrete including the following:

Design

Loading: Submit calculations to justify the adequacy of the structure to sustain any construction loads and procedures.

General: Submit proposals for mixing, placing, finishing and curing concrete including the following:

- » Addition of water at the site.
- » Changes to the plastic concrete mix.
- » Curing and protection methods.
- » Curing period for low-pressure steam curing, if proposed.
- » Cutting or displacing reinforcement, or cutting hardened concrete.
- » Handling, placing, compaction and finishing methods and equipment, including pumping.
- » High early strength cement.
- » Sequence and times for concrete pours, and construction joint locations and relocations.
- » Site storage, mixing and transport methods and equipment, if applicable.
- » Target strength, slump and proposed mix for each type and grade of concrete.
- » Temperature control methods.

Sawn joints: Submit proposed methods, timing and sequence of sawing joints.



Materials

General: Submit details of proposed sources of materials and type-test reports to verify conformance with the **Material tests schedule**.

Concrete mixes: Submit details, including proposed admixtures and use, if any, of fly ash or granulated slag.

Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit the following information:

- » Certified test results for water retention to AS 3799 Appendix B.
- » Efficiency index.
- » Evidence of compatibility with concrete, and with applied finishes, if any.
- » Evidence that an acceptable final surface colour will be obtained.
- » Methods of obtaining the required adhesion for toppings and render.

Foamed concrete: Submit details, including aggregate grading and mix proportions.

Ready Mixed Supply

Delivery docket: For each batch, submit a docket listing the following information:

- » For special class performance concrete, specified performance and type of cement binder.
- » For special class prescription concrete, details of mix, additives, and type of cement binder
- » Method of placement and climate conditions during pour.
- » Name of concrete delivery supervisor.
- » Project assessment carried out each day.
- » Serial numbers of identification certificates of each batch.
- » The amount of water, if any, added at the site.
- » The concrete element or part of the works for which the concrete was ordered, and where it was placed.
- » The total amount of water added at the plant and the maximum amount permitted to be added at the site.
- » Colour additive included.

Shop Drawings

Cores, fixings and embedded items: If the locations of items are not shown or are shown diagrammatically, submit shop drawings showing the proposed locations, clearances and cover. Indicate proposed repositioning of reinforcement.



Subcontractors

Submit names and contact details of proposed ready-mixed concrete suppliers, and alternative source of supply in the event of breakdown of ready mixed or site mixed supply.

Tests

Dissemination of production information: Submit copies of the reports.

Material tests: Before supplying concrete submit test certificates based on samples from the most recent production or from stockpiles for the project, for the materials and properties listed in the **Material tests schedule**. Submit additional certificates at the scheduled frequency during the course of the works.

Sampling and testing of specimens: Submit records providing the full history of sampling and testing. Submit test certificates, and retain results in tabular form on site.

15.3 Execution

15.3.1 Polymeric Film Underlay

General

Under internal slabs on ground including integral ground beams and footings, provide a vapour barrier or, in areas prone to rising damp or salt attack, a damp-proofing membrane.

Refer to Section 3 Termite Control.

Standard

Vapour barriers and damp-proofing membranes: To AS 2870.

Installation

Lay over the base, lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces as far as the damp proof course where applicable, and fix at the top by tape sealing. Locate vertical laps only on vertical or inclined surfaces. Patch or seal punctures or tears before pouring concrete.

Base Preparation

According to base type, as follows:

- » Graded stone base: Blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

15.3.2 Concrete Materials

General

Aggregate: Unsegregated and uncontaminated.



Cementitious materials: Dry and uncontaminated.

Bagged Cement

Standard: To AS 3972.

- » Type: GP.
- » Age: Less than 6 months old.

Chemical Admixtures

Contents: Free of chlorides, fluorides and nitrates.

Materials test schedule

Material	Testing program
Cement, fly ash and other cementitious materials	Monthly
Aggregates	Monthly
Curing Compounds	Certificate of uniformity with each batch

15.3.3 Concrete

General

Provide concrete in conformance with:

- » The Concrete performance schedule.
- » The Concrete prescriptive schedule.

Concrete Performance

Drying shrinkage (at 58 days): 700 microstrain.

Placement: Mix must work readily into corners and angles, and around reinforcement, without segregation or excess free water on the surface, producing sound concrete, with minimal plastic settlement and shrinkage cracking.

Elapsed Delivery Time

Elapsed time between the wetting of the mix and the discharge of the mix at the site must be as short as possible, and must not exceed the criteria in the **Elapsed delivery time table**.

Elapsed Delivery Time Table

Concrete Temperature at Time of Discharge (°C)	Maximum Elapsed Time (hours)
10 - 24	2.00
24 - 27	1.50



27 - 30	1.00
30 - 32	0.75

Ready Mixed Supply

Addition of water: Do not add water at the site after starting discharge.

Method: Use the batch production process. Deliver in agitator trucks.

Transport: Mode must prevent segregation, loss of material and contamination, and must not adversely affect placing or compaction.

Site Mixed Supply

Emergencies: Do not mix by hand.

Plant: Mix concrete in a plant located on the construction site.

15.3.4 Cores, Fixings and Embedded Items

Adjoining Elements

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. Where applicable provide for temporary support of the adjoining elements during construction of the concrete.

Protection

General: Grease threads. Cover and protect embedded items against damage.

Compatibility: Ensure inserts, fixings and embedded items are compatible with each other, with the reinforcement and with the concrete mix to be used.

Corrosion: Galvanize and chromate passivate inserts, anchor bolts and embedded fixings.

Structural Integrity

Fix cores and embedded items to prevent movement during concrete placing. In locating embedded items, do not cut or displace reinforcement, or cut hardened concrete. Ensure that embedded pipes and conduits do not adversely affect structural integrity.

Tolerances

Maximum deviation from correct positions:

- » Anchor bolt groups for structural steel: To AS 4100.
- » Cores and embedded items generally: 10 mm.
- » Fasteners, including anchor bolts: 3 mm.

Isolation: Isolate fixings so that water cannot track from fixings to reinforcement.



15.3.5 Concrete Working Base

Finish

Membrane support: Wood float finish or equivalent.

Material

N20 concrete. Lay over the base or subgrade and screed to the required level.

Surface Tolerance

5 mm from the correct plane, 5 mm from a 2 m straight edge.

Thickness

Minimum 50 mm.

15.3.6 Placing and Compaction

Compaction

General: Remove air bubbles and fully compact the mix.

Methods: Use immersion and scree vibrators accompanied by hand methods as appropriate.

Vibrators: Do not allow vibrators to come into contact with partially hardened concrete, or reinforcement and items including pipes and conduits embedded in it. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Horizontal Movement

Use suitable conveyors, clean chutes, troughs or pipes. Do not use water to facilitate the movement.

Placing

General: Use placing methods which minimise plastic settlement and shrinkage cracking. Avoid segregation. Avoid loss of materials. Between construction joints, maintain a plastic concrete edge.

Layers: Place concrete in layers ≤ 300 mm thick, such that each succeeding layer is compacted before previous layer has taken initial set.

Placing slabs and pavements: Place concrete uniformly over the width of the slab so that the face is generally vertical and normal to the direction of placing.

Placing Records

Keep on site and make available for inspection a logbook recording each placement of concrete, including the following:

- » Date.
- » Specified grade and source of concrete.
- » Slump measurements.



- » The portion of work.
- » Volume placed.

Rain

Do not expose concrete to rain before it has set, including during mixing, transport or placing.

Sequence of Pours

Minimise shrinkage effect by pouring the sections of the work between construction joints in a sequence such that there will be suitable time delays between adjacent pours.

Vertical Movement

In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed chutes or access hatches in forms. As far as practicable keep chutes vertical and full of concrete during placement, with ends immersed in the placed concrete.

15.3.7 Placing in Cold Weather

General

Concrete: Maintain the temperature of the freshly mixed concrete within the limits shown in the **Cold Weather Placing Table**. "Outdoor" air temperature applies to the air temperature at the time of mixing and to the predicted or likely air temperature at any time during the next 48 hours.

Formwork and reinforcement: Before and during placing maintain temperature at > 5°C.

Admixtures

Do not provide calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Cold Weather Placing Table

Outdoor air temperature	Temperature of concrete	
	Minimum	Maximum
5oC	10oC	32oC
< 5oC	18oC	32oC

Frozen Materials

Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.



Heating

General: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

Maximum temperature of water: 60°C when it is placed in the mixer.

High Early Strength Cement

Provide in severe weather conditions to enable the concrete to develop sufficient strength to permit formwork removal within the specified time. Do not provide as a substitute for the heating of materials or for adequate protection of placed concrete against low temperatures. Do not provide high alumina cement.

15.3.8 Placing in Hot Weather

Handling

Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete as rapidly as possible.

Hot Weather Placing Table

Concrete Element	Temperature Limit
Normal concrete in footings, beams, columns, walls and slabs	35°C
Concrete in large mass concrete sections; or concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness	27°C

Mixing

Surrounding outdoor shade temperature > 38°C: Do not mix concrete.

Placing

Formwork and reinforcement: Before and during placing maintain at ≤ 32°C.

Concrete: When being placed in the forms, the temperature of the concrete must not exceed the criteria in the **Hot Weather Placing Table**.

Temperature Control Methods

Select one or more of the following methods of maintaining the specified temperature of the placed concrete:

- » Cool the concrete using liquid nitrogen injection before placing.
- » Cover the container in which the concrete is transported to the forms.
- » Spray the coarse aggregate using cold water.
- » Use chilled mixing water.



15.3.9 Placing Under Water

General

Condition: Do not place under water if placing in the dry is practicable by pumping or other means of dewatering.

Minimum cement content for the mix: Increase by 25%.

Method

If required, submit proposals.

15.3.10 Curing

General

Curing period: Cure continuously from initial set until the total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10°C, is at least the following:

- » Fully enclosed internal surfaces/Early high-strength cement concrete: 3 days.
- » Other surfaces/Ordinary Portland cement concrete: 7 days.

Protection: Protect fresh concrete, during the curing period, from premature drying and from excessively hot or cold temperatures. Protect fresh concrete from physical and thermal shock, from traffic likely to damage the surface, and from rain. If temperature of surrounding air is > 35°C, protect from wind and sun until the concrete can be covered. Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period. Prevent rapid drying out at the end of the curing period.

Cold Weather Curing

Prevent plastic concrete from freezing, but do not use salt or chemicals. Maintain concrete temperature between 10 - 20°C for curing period.

Curing Compounds

Standard: To AS 3799.

Application: Conform to the **Curing schedule** and provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken at least seven days after application.

Substrates: Do not use wax-based or chlorinated rubber-based curing compounds on surfaces forming substrates to concrete toppings and cement-based render. Do not use PVA compounds.

Hot Weather Curing

Do not use curing compounds. After placement, either:

- » If the temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant.



- » Immediately cover the concrete using an impervious membrane, or hessian kept wet, until curing begins; or
- » Pond or continuously sprinkle with water;

Visually Important Surfaces

Produce uniform colour on adjacent surfaces.

15.3.11 Protection

Loading

Notice: Give notice before loading the concrete structure.

Protection: Protect the concrete from damage due to load overstresses, heavy shocks and excessive vibrations, particularly during the curing period. Do not place construction loads on self-supporting structures which will overstress the structures.

Surface Protection

Protect finished and exposed aggregate concrete surfaces from damage.

15.3.12 Construction Joints

Location

Do not relocate or eliminate construction joints, or make construction joints not shown on the drawings. This includes emergency construction joints made necessary by unforeseen interruptions to the concrete pour.

Finish at Construction Joints

Butt join the surfaces of adjoining pours. In visually important surfaces make the joint straight and true, and free from impermissible blemishes relevant to its surface finish class.

Joint Preparation

Roughen and clean the hardened concrete joint surface, remove loose or soft material, free water, foreign matter and laitance. Dampen the surface just before placing the fresh concrete.

15.3.13 Expansion Joints

Joint Filling

Joint filling: Fill with jointing materials. Finish visible jointing material neatly flush with adjoining surfaces.

Preparation: Before filling, dry and clean the joint surfaces, and prime.

Watertightness: Apply the jointing material so that joints subject to ingress of water are made watertight.



Jointing Materials

Type: Provide jointing materials compatible when used together, and non-staining to concrete in visible locations.

Bond breaking: Provide back-up materials for sealants, including backing rods, which do not adhere to the sealant. They may be faced with a non-adhering material.

Foamed materials (in compressible fillers): Closed-cell or impregnated types which do not absorb water.



16. Concrete Formwork

16.1 General

16.1.1 General

Refer to the *General requirements* section.

16.1.2 Related sections

Refer to the following sections as follows: >

- » Concrete finishes.
- » Concrete in situ.
- » Concrete reinforcement.

16.1.3 Standard

General

Formwork design and construction: To AS 3610.

16.2 Quality

16.2.1 Witness points

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

- » Completed formwork before concrete placing.
- » Evaluation of the finish.
- » Used formwork, after cleaning and before reuse.

16.3 Execution

16.3.1 Materials and Components

- » Form linings and facings
- » To be compatible with finishes applied to concrete.

Lost formwork

Not to contain timber or chlorides and not to impair the structural performance of the concrete members.

Release agents

To be compatible with applied finishes to concrete and the contact surfaces.



Void formers

To be unwaxed cardboard or fibreboard, collapsible on absorption of moisture.

16.3.2 Formwork

General

General: Design and construct formwork so that the concrete, when cast in the forms, will have the required dimensions, shape, profile, location and surface finish. Allow for dimensional changes, deflections and cambers resulting from the application of prestressing forces (if any), applied loads, temperature changes and concrete shrinkage and creep.

Openings: In vertical forms provide form openings or removable panels for inspection and cleaning, at the base of columns, walls and deep beams. For thin walls and columns, provide access hatches for placing concrete.

Cleaning

Before placing concrete, remove free water, dust, debris and stains from the forms and the formed space.

Corners

Work above ground: Chamfer at re-entrant angles, and filled at corners.

» Face of bevel 25mm.

Embedments

Fix embedments through formwork to prevent movement, or loss of slurry or concrete, during concrete placement.

Release agents

Before placing reinforcement, apply a release agent to form linings and facings. Do not coat the reinforcement and construction joints with release agent. Do not allow the release agent to "puddle."

Steel linings

Clean off any rust and apply inhibiting agent prior to re-use.

16.3.3 Dimensional Tolerances

Dimensional tolerances

Plumb of elements 8 m high: >

Position: Construct formwork so that finished concrete is in conformance with the **Position tolerances table** and the **Dimensional tolerances schedule**.



16.3.4 Position tolerances table

Surface finish class to AS 3610	1	2	3	4	5
Maximum deviation from correct position (mm)	10	15	20	25	40

16.3.5 Formed Surface Finish

Visually Important Surfaces

For concrete of surface finish classes 1, 2 or 3, set out the formwork to give a regular arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface. Form 45° bevels, 25 mm on the face on corners and angles.

Formed surfaces schedule

Surface finish class to AS 3610	Concrete element or surface
2	All other surfaces exposed to view, including soffit sides/edges of columns down to and including platform level
4	Surfaces not exposed to view

16.3.6 Stripping and Removal

Formwork removal

Extent: Remove formwork, other than steel reinforcement decking, including formwork in concealed locations.

Timing: Do not disturb forms until concrete is hard enough to withstand it. Do not remove formwork until concrete is strong enough to support loads without unacceptable deflection.

Loading before stripping

Do not erect masonry walls or other permanent loading on the structure while it is still supported by formwork.

Stripping of formwork

General: To AS 3600 where it is more stringent than AS 3610.



17. Concrete Reinforcement

17.1 General

17.1.1 Cross References

General

Refer to the *General requirements* worksection.

Related worksections

Refer to the following worksections:

- » Concrete finishes.
- » Concrete formwork.
- » Concrete in situ.

17.1.2 Standards

General

Steel reinforcing materials: To AS/NZS 4671.

17.2 Quality

17.2.1 Inspection

Witness points

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

- » Cores and embedments fixed in place.
- » Reinforcement fixed in place.

17.3 Execution

17.3.1 Reinforcement

General

Ductility grade: To AS/NZS 4671 Class N.

Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material, which would reduce the bond between the reinforcement and concrete.

Bending

General: To AS 3600.



Fabrication tolerances

Standard: To AS 3600.

Tie wire

General: Annealed iron 1.25 mm diameter (minimum).

External and corrosive applications: Galvanized.

17.3.2 Protective Coated Reinforcement

Damage

If damage occurs to the coating undertake the following action:

- » Epoxy coatings: Conform to the **Epoxy coating** subclause.
- » Galvanized coatings: Replace the damaged reinforcement.

Epoxy coating

General: High building, high solids chemically resistant coating.

Thickness: 200 μm minimum.

Extent

For concrete elements containing protective coated reinforcement, provide the same coating type to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates and ferrules, and protect other embedded metals with a suitable coating.

Galvanising

Standard: To AS/NZS 4680

Sequence: Galvanize after fabrication.

Passivation: Dip in 0.2% sodium dichromate solution.

Preparation: Pickling to AS 1627.5.

Zinc coating (minimum): 700 g/m^2 .

17.3.3 Reinforcement Supports

General

Provide proprietary concrete, metal or plastic supports, adequate to withstand construction and traffic loads, and in the form of chairs, spacers, stools, hangers and ties.

- » If ferrous metal supports extend to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement, provide a protective coating.
- » Supports over membranes



General: Prevent damage to waterproofing the membranes or vapour barriers. Place a metal or plastic plate under each support.

Support spacing

General: Provide supports in adequate numbers and spacing to maintain reinforcement in the correct position.

Standard: To AS 3600.

Minimum spacing:

- » Bars: ≤ 60 diameters.
- » Fabric: ≤ 750 mm.

17.3.4 Fixing Reinforcement

Dowels

Fixing: If a dowel has an unpainted half, embed this in the concrete placed first.

Tolerances:

- » Alignment: 2 mm in 300 mm.
- » Location: $\pm$ half the diameter of the dowel.

Fixing requirements

General: Secure the reinforcement against displacement by tying at intersections with either annealed iron 1.25 mm diameter (minimum) wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.

Beams: Tie ligatures to bars in each corner of each ligature. Fix other longitudinal bars to ligatures at 1 m maximum intervals.

Columns: Secure longitudinal column reinforcement to all ligatures at every intersection.

Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections, and at other points as required.

Tolerances: To AS/NZS 4671 Section 19.

Splicing

General: To AS 3600 Subsection 13.2, for splicing additional to that documented.

Welding

If required, to AS/NZS 1554.3.



18. Structural Steel

18.1 General

18.1.1 Cross References

General

Refer to the *General Requirements* section.

18.1.2 Standard

General

Materials, construction, fabrication and erection: To AS 4100.

18.1.3 Adjoining Elements

General

Provide for the fixing of adjoining building elements to be fixed to or supported on the structural steel.

Quality

18.1.4 Inspection

Witness Points – Off Site

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

- » Materials including welding consumables before fabrication.
- » Testing of welding procedures and welder qualification tests.
- » Commencement of shop fabrication.
- » Commencement of welding.
- » Before placement of root runs of complete penetration butt welds.
- » Completion of fabrication before surface preparation.
- » Surface preparation before shop painting.
- » Completion of protective coating before delivery to site.

Witness Points – On Site

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

- » Steelwork on site before erection.
- » Tensioning of bolts in categories 8.8/TB and 8.8/TF.
- » Steelwork and column bases erected on site, before grouting, encasing, site painting or cladding.



- » Anchor bolts in position before casting in.
- » Commencement of encasing.

18.1.5 Tests

Non Destructive Weld Examination

Standard: To AS/NZS 1554.1.

Radiographic and ultrasonic inspection: Have the examination performed by an independent testing authority.

Repairs: Repair faulty welds revealed by non-destructive examination and repeat the examination.

Non-Destructive Weld Examination (NDE) Table

Type of Weld and Category	Examination Method	Extent (% of total length of weld type)
Fillet welds	Visual inspection	100
Butt welds, GP	Visual inspection	100
Butt welds, SP	Visual inspection	100
	Radiographic or ultrasonic inspection	10

18.1.6 Samples

Special Finishes

General: Submit samples of finished steel listed in the Special finishes schedule.

Minimum sample sizes:

- » Surface finish samples: 0.1 m².
- » Weld samples: 300 mm run of weld.

18.1.7 Submissions

Subcontractors

Submit names and contact details of proposed fabricator and installer.

Shop Drawings

General: Submit shop drawings showing the following information:

- » Relevant details of each assembly, component and connection.
- » Information relative to fabrication, surface treatment, transport and erection.

Particular: Include the following information:



- » Identification.
- » Steel type and grade.
- » Dimensions of items.
- » Required camber, where applicable.
- » Fabrication methods including, where applicable, hot or cold forming and post weld heat treatment.
- » Location, type and size of welds or bolts.
- » Weld categories and bolting categories.
- » Orientation of members.
- » Surface preparation methods and coating system.
- » Procedures necessary for shop and site assembly, and erection.
- » Temporary works such as lifting lugs, support points, temporary cleats and bracing which are required for transport and erection of the structural steelwork.
- » Required fixings for adjoining building elements.

Tests

Steel: Submit evidence that the steel used in the work complies with the cited material standards.

Acceptable evidence: Certified mill test reports, or test certificates issued by the mill.

Alternative: Have the steel tested by an independent testing authority for compliance with the chemical composition and mechanical test requirements of the cited material standard.

Materials and Components

Masonry anchors: If masonry anchors are required or proposed for the support or fixing of structural steel, submit evidence of the anchor capacity to carry the load.

Execution

Splicing: If splicing of structural members is intended, submit proposals.

Welding procedures: Submit details of proposed welding procedures, using the form in Table C2 of AS/NZS 1554.1.

Erection: If members cannot be properly erected, give notice.

Identification marks: Submit details of proposed marking for high strength structural bolted connections in work exposed to view.

Distortions: If a member is distorted during the galvanizing process, submit proposals for straightening.



18.2 Materials and Components

18.2.1 Steel Type and Grade

Standards

Cold-formed sections: To AS/NZS 4600.

Steel Grade Table

Type of Steel	Grade
Universal beams and columns, parallel flange channels, large 300 angles to AS/NZS 3679.1	
Flat, small angles, taper flange beams and columns to AS/NZS 3679.1	250
Welded sections to AS/NZS 3679.2	300
Hot rolled plates, floor plates and slabs to AS/NZS 3678	250
Hollow sections to AS 1163:	
- Circular sections less than 165 mm outside diameter	C250
- Sections other than the above	C350
Cold formed purlins and girts to AS 1397	G450 Z275
Steel rails to AS 1085.1	(one grade only)

18.2.2 Members

Members

General: Uncontaminated.

18.2.3 Bolts

Bolts, Nuts and Washers

General: Hot-dipped galvanized, corrosion-free coated in oil and in serviceable condition.

18.3 Execution

18.3.1 Fabrication

Splicing

General: Provide structural members in single lengths.



Beam Camber

If beam members have a natural camber within the straightness tolerance, fabricate and erect them with the camber up.

Straightening

Do not injure the material when straightening or flattening members.

Site Work

Other than work shown on the shop drawings as site work, do not fabricate or weld structural steel on site.

18.3.2 Bolting

Connection Bolts

For connection bolts not shown on the drawings, provide bolting category 8.8/S.

Bolting Category 8.8/TF

Contact surfaces: Clean, as-rolled and free from applied finishes.

Foundation Bolts

General: Provide each foundation bolt with 2 nuts and 2 oversize washers and provide sufficient thread to permit the levelling nut to be set below the base plate.

Hexagonal bolts: To AS 1111.1.

Hexagonal nuts: Class 5.

Plain washers: To AS 1237.1

Lock Nuts

General: Provide lock nuts for bolts in moving parts or parts subject to vibration and for vertical bolts in tension.

Tensioning of Bolting Categories 8.8/TB and 8.8/TF

Method: Do not use torque control.

Permanent Bolting

Do not bolt until correct alignment and preset or camber have been achieved.

18.3.3 Welding

General

Standard: To AS/NZS 1554.1.

Weld Category

Weld categories not shown on the drawings: Category SP.



Weld Type

Weld type not shown on the drawings: 6 mm continuous fillet weld made using E48XX electrodes or equivalent.

Site Welds

Wherever possible locate site welds in positions for down hand welding. Do not weld until correct alignment and preset or camber have been achieved.

18.3.4 Erection

Temporary Connections

Do not attach cleats except as shown on shop drawings.

Temporary Members

Fix temporary members so as not to weaken or deface permanent steelwork.

Hand Flame Cutting

Do not hand flame cut bolt holes.

Movements

Provide for thermal movements during erection.

Anchor Bolts

For each group of anchor bolts provide a template with setting out lines clearly marked for positioning the bolts when casting in.

Grouting at Supports

Preparation: Before grouting steelwork to be supported by concrete, masonry and the like, set steelwork on packing or wedges.

- » Permanent packing or wedges: Form with solid steel or grout of similar strength to the permanent grout.
- » Temporary packing or wedges: Remove before completion of grouting.

Temperature: Do not grout if the temperature of the base plate or the footing surface exceeds 38°C.

Type: Non-Shrink Class 'A' Cementitious General Purpose Grout

Minimum compressive strength (MPa): 45

Minimum thickness (mm): 20

Maximum thickness (mm): 30

Handling

Do not overstress or deform members or components.



Drifting

Use only to bring members into position. Do not enlarge holes or distort components.

Work Exposed to View

Welds: Grind smooth but do not reduce the weld below its nominal size.

Shearing, flame cutting and chipping: Perform carefully and accurately.

Corners and edges: Grind fair those corners and edges which are sharp, marred, or roughened.

18.4 Finishes

18.4.1 Identification Marks

General

Provide marks or other means for identifying each member, and for the setting out, location, erection and connection of the steelwork and compatible with the finish. If the work includes more than one bolting category, mark high-strength structural bolted connections with a 75 mm wide flash of colour, clear of holes.

18.4.2 Surface Preparation

General

Methods: To AS 1627.

Site connections: After completing the connection, prepare the surface of the connection, adjacent unprimed surfaces and surfaces damaged during erection.

Steel surfaces generally: Remove loose millscale, loose rust, oil, grease, dirt, globules of weld metal, weld slag and other foreign matter. Ensure surfaces are dry.

Abrasive Blast Cleaning

Dry and wet abrasive blast-cleaning: To AS 1627.4.

Marking

On the contact surfaces of friction type joints, confine the use of marking ink to the minimum necessary for marking hole positions.

18.4.3 Protective Coatings

General

Standard: Comply with the recommendations of AS/NZS 2312.

Shop work: Apply the primer coat or protective system to the structural steel before delivery to the site.

Transport and handling: Do not damage the paintwork.



Site work: After erection, repair damage to the shop coating and apply coating omitted at site connections.

Priming

Time delay: Prime the steel surface as soon as possible after surface preparation and before the surface deteriorates, and in any case within 4 hours for shop work and 2 hours for site work. If the surface is contaminated or rust bloomed, repeat surface preparation before priming.

Conditions: Do not prime in adverse ambient conditions.

Concrete encasing: Where members are part concrete encased extend the priming 25 mm into the surface to be encased.

Clearances: Keep priming clear of members and components to be site welded, and surfaces against which, concrete is to be poured (including concrete encasing except as noted above). On completion of site welding, of concrete pouring and of 8.8/TF bolting, prime to give complete coverage of exposed surfaces.

Inaccessible Surfaces

Where surfaces will be in contact or near contact after fabrication or erection, apply the finish and allow it to dry before assembly.

Paint Coatings Schedule

Refer to Structural Engineering drawings.

18.4.4 Galvanising

Structural Sections

Finish: Galvanize after fabrication.

- » Cold worked items: Except for hollow sections, anneal to 650°C before galvanizing
- » Hollow sections: Provide seal plates with breather holes.

Galvanizing Schedule

Refer to Structural Engineering drawings.



19. Light Steel Framing

19.1 General

19.1.1 Cross References

General

Refer to the *General requirements* section.

Refer to the *Structural Engineering Drawings*

19.1.2 Standards

Standards

Design, materials and protection: To AS/NZS 4600.

Design of domestic metal framing: To AS 3623.

19.2 Quality

19.2.1 Inspection

Witness points

Give sufficient notice so that inspection may be made of steel framing erected on site before lining or cladding.

19.2.2 Submissions

Design

Office and amenities areas roof and wall frame member sizes: Submit a schedule of proposed member sizes certified by a suitably qualified structural engineer as meeting stated project requirements. Overall design of roof and wall system to be certified by a qualified structural engineer. Certification shall be submitted in writing.

Shop Drawings

General: Submit shop drawings showing the following information:

- » Relevant details of each assembly, component and connection.
- » Information relative to fabrication, surface treatment, transport and erection.

Particular: Include the following information:

- » Identification.
- » Steel type and grade.
- » Dimensions of items.
- » Location, type and size of welds or bolts.



- » Weld categories and bolting categories.
- » Fixing detail to roof slab.
- » Orientation of members.
- » Surface preparation methods and coating system.
- » Required fixings for adjoining building elements.

Subcontractors

Submit names and contact details of proposed fabricator and installer.

19.3 Execution

19.3.1 Construction Generally

Fabrication

Length: Cut members accurately to length so that they fit firmly against abutting members.

Service holes: Form holes by drilling or punching.

- » Bushes: Provide plastic bushes or grommets to site cut holes.
- » Swarf: Remove swarf and other debris from cold-formed steel framing immediately.

Fastening

Type: Select from

- » self-drilling, self-tapping screws;
- » blind rivets; or
- » proprietary clinching system.

Welding

Type: Use the metal inert gas (MIG) technique or carbon arc welding.

Touch up: Clean the weld and coated areas affected by welding and touch up with zinc rich organic primer to GPC-C-29/16.

Prefabricated frames

Protect frames from damage or distortion during storage, transport and erection.

Bracing

Provide diagonal noggings or tensioned straps to satisfy code requirements.

Metal separation

Install lagging to separate non-ferrous service pipes and accessories from the metal framing.

**Earthing**

Permanent earthing: Required.

Temporary earthing: Provide temporary earthing during erection until the permanent earthing is installed.

CCA treated timber

Do not fix in contact with cold-formed steel framing.



20. Heavy Duty Galvanised Coatings

20.1 General

20.1.1 Cross References

General

Refer to the *General requirements* section.

20.2 Quality

20.2.1 Inspection

Witness point

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

- » Coating integrity, at the galvanising plant.

20.2.2 Tests

Galvanising tests

Coating mass tests: Required.

Coating thickness tests: Required.

Coating uniformity tests: Required.

Frequency of tests-Test once after fabrication and rectify faults. Prior to delivery on site, issue certification from testing authority stating that galvanising is satisfactory.

Sampling plan: In accordance with the recommendations of Appendix B to AS 1214 or Appendix B to AS/NZS 4680, as appropriate.

Testing authority

A NATA Certified testing organisation.

Testing venue

General: Galvanising plant.

20.2.3 Submissions

Holes and lifting lugs

Submit advice on size and locations of holes and lifting lugs to facilitate handling, filling, venting and draining during galvanising.



Problematic design

Submit advice on design and fabrication features of the articles to be galvanised which may lead to difficulties during galvanising.

Removal of deleterious materials

Submit advice on suitability of marking paints, and removal of materials deleterious to galvanising such as grease, oil and paint.

20.3 Execution

20.3.1 General

Care

Dimensional change: Avoid.

Embrittlement: Take due care in processing steel that is susceptible to embrittlement.

Mechanical properties: Avoid mechanical damage. Ensure that mechanical properties of the base metal do not change.

Coating reinstatement

Extent: Significant areas of uncoated surface, and areas damaged by handling at the galvanising plant.

- » Size of area to be repaired: Relevant to the size of the article and the conditions of service.

Method: Wire brush or mechanically buff the surface. Apply zinc-rich primer to 150 µm dry film thickness. Stipple edges of the primed area.

- » Primer: To APAS-0014/1, or APAS-2916.
- » Components in contact with concrete.

General: Chromate passivate.

Chromate passivation process: Dip in 0.15 – 0.2% sodium dichromate solution.

Drilling

Generally fabricate with holes predrilled before galvanising.

Hot-dip galvanized coatings

Ferrous articles: To AS/NZS 4680.

Threaded fasteners: To AS 1214.

Preparation for architectural finishes

Coarse preparation: Remove spikes, and ensure edges are free from lumps and runs.

Light sweep blasting:

- » Abrasive grade (range): 0.2 - 0.5 mm clean ilmenite or garnet.



- » Angle of blasting to surface (degrees): 45
- » Blast pressure (maximum): 280 kPa.
- » Distance of nozzle from surface (range): 300 - 400 mm.
- » Nozzle type: Venturi, diameter 10 - 13 mm.
- » Storage of galvanized articles.

General: Store in dry, well ventilated conditions.

Structural sections

Cold worked items: Except for hollow sections, anneal to 650°C before galvanising.

Hollow sections: Provide seal plates with breather holes.

Surface finish

Coating quality: Continuous, adherent, smooth, evenly textured and uniform, free from defects detrimental to the end use of the finished article, such as lumps, blisters, gritty areas, uncoated spots, acids and black spots, dross and flux.

- » Silicon killed steels: Dull grey is acceptable.

Friction-type bolted connections: Treat contact surfaces to achieve the required slip factor.

Surplus zinc on fastener threads: Remove.

Surface preparation

Abrasive blast cleaning: To AS 1627.4.

- » Grade: Sa 2 to AS 1627.9.

Acid pickling: To AS 1627.5.

- » Acid: Hydrochloric.

Chemical cleaning: To AS 1627.1.

- » Cleaning designation: AD.

Surface contaminants and coatings generally: Chemical clean, then acid pickle.

Surface contaminants and coatings which cannot be removed using chemical cleaning: Abrasive blast clean.

20.4 Erection

Delivery

Transport in dry, well ventilated conditions.

Site coating reinstatement

Extent: Areas damaged by transport, site welding, site flame cutting, site handling, or erection.



- » Size of area to be repaired: Relevant to the size of the article and the conditions of service.

Method: Wire brush or mechanically buff the surface. Apply zinc-rich primer to 150 µm dry film thickness. Stipple edges of the primed area.

- » Paint standard: To APAS-0014/1 or APAS-2916.
- » Surface preparation: To AS 1627.2 and Grade St 2 to AS 1627.9.
- » Site welding.

Grinding of edges: Permitted.

Weld areas: Reinstate coating.



21. Timber Finishes and Treatments

21.1 General

21.1.1 Cross References

General

Refer to the *General Requirements* section.

21.1.2 Interpretation

Definitions

Plywood: To AS/NZS 4491.

"Standard trade common names": To AS/NZS 1148.

Groups of timbers: Terms employed for that purpose in relevant Australian standards.

21.2 Quality

21.2.1 Submissions

Materials

Rainforest species: Do not use.

Pressure preservative treatment: For timber required to be pressure treated, submit a certificate or other satisfactory evidence showing that the timber has been treated.

21.3 Materials

21.3.1 Timber

Durability

General: Provide timbers having natural durability appropriate to the conditions of use, or preservative-treated timber of equivalent durability.

Natural durability class of heartwood: To AS 5604.

Minimum requirements:

Class 1: Timbers in contact with ground.

Class 2: Timbers above ground, not in continuous contact with moisture, well ventilated, protected from moisture but exposed to the weather.

Class 3: Timbers above ground, not in continuous contact with moisture, well ventilated, protected with a finish, and well maintained.



Class 4: Timbers fully protected from moisture, indoors, above ground, and well ventilated.

Durability Schedule

Location or Application	Natural Durability
Fence Posts (Insulating Fence Panel)	Class 1
Vanity unit	Class 4

Lyctus Susceptible Timbers

Do not provide timbers containing Lyctus susceptible sapwood.

Preservative Treatment

Reconstituted wood-based products: To AS/NZS 1604.2.

Hazard classification: To Table A1.

Sawn and round timber: To AS 1604.1.

Hazard classification: To Table D1.

Water-Repellent Treatment

Repellent: To GPC-M-96.

Moisture Content

Tolerance: Make milled and dressed products from timbers seasoned:

To within 3% of the equilibrium moisture content appropriate to the timber and its intended conditions of use;

To 10 - 15% moisture content; and

With no more than 3% difference between any 2 pieces in any one group.

Test: To AS/NZS 1080.1.

Protection: Protect timber and timber products stored on site from moisture and weather. For milled, prefinished, prefabricated and similar elements, which are protected in the final structure, provide temporary weather protection until the permanent covering is in place.

Finished Sizes

General: Provide milled timbers with actual dimensions, which are at least the stated dimensions, except for dimensions qualified by a term such as "nominal" or "out of" to which industry standards for finished sizes apply.

Unseasoned Timber

If unseasoned timber is used, or if variations in moisture are likely, allow for shrinkage, swelling and differential movement.



Surface Finish

Hardwood: To AS 2796.1 Table B1.

Softwood: To AS 4785.1 Table B1.

21.4 Execution

21.4.1 Workmanship

Painting

Edges: Chamfer edges of work to receive paint or similar coatings.

Priming: For woodwork to be painted, prime hidden surfaces before assembly.



22. Concrete Finishes

22.1 General

22.1.1 Cross References

General

Refer to the *General Requirements* section.

22.2 Execution

22.2.1 Tolerances

Flatness

Conform to the **Flatness class table** for the maximum deviation of the finished surface under a straight edge laid in any direction on an area of uniform grade.

Flatness class table

Class	Measurement	Maximum Deviation (mm)
A	3 m straight edge	3
B	3 m straight edge	6
C	600 mm straight edge	6

22.2.2 Surface Modifiers

Seal Stripper

Thoroughly clean the surface before the application of finishes to masonry and cementitious floors. Remove wax (buffable, self-polishing and acrylic paste types), heavy-duty polymer finishes, and clear resin sealer using a seal stripper.

Surface Hardeners

Apply to clean surfaces.

22.2.3 Surface Modifiers

Screeding

Strike off, consolidate and level slab surfaces to finished levels, to tolerance class C.

Finishing Methods

Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.



Machine floated finish: After screeding consolidate the surface using a machine float. Hand float in locations inaccessible to the machine float. Cut and fill to tolerance class B and refloat immediately to a uniform, smooth, granular texture.

Steel trowelled finish: After machine floating, use power trowels to produce a smooth surface relatively free from defects. Then, when the surface has hardened sufficiently, use steel hand trowels to produce the final consolidated finish free of trowel marks and uniform in texture and appearance, to tolerance class A. Where floor coverings are to be installed, remove defects that would show through them.

Smooth surface for sealed internal concrete floors: 3mm maximum deviation of the finished surface over 3000mm in any direction on an area of uniform grade, complying also to flatness grade.

Wood float finish: Produce the final finish using a wood float.

Broom finish: After floating draw a broom or hessian belt across the surface to produce a coarse even-textured slip-resistant transverse-scored surface.

Sponge finish: After machine floating, obtain an even textured sand finish by wiping the surface using a damp sponge.

Integral Colour Finish: A dry shake mix of pure silica sands, cements, iron oxide pigments and special chemical additives, that is broadcast over wet concrete and trowelled in to colour the concrete.

22.2.4 Formed Surfaces

Evaluation of Formed Surfaces

If evaluation of formed surface tolerance or colour is required, complete the evaluation before surface treatment.

Floated Finishes

Sand floated finish: Remove the forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.

Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread, using hessian pads or sponge rubber floats, a slurry consisting of one part cement (including an appropriate percentage of white cement) and one and a half parts sand passing a 1 mm sieve. Remove surplus until a uniform colour and texture are produced. Cure.



22.3 Integral Finishes Schedule – External Bunded Yards and Slabs

Location	Substation	Bunded Yards	Ramp
Tolerance class	A. Refer to drawings for Super-Flat Floor finishes	A	A
Finish	Power trowel and steel float finish. Integral colour additive.	Steel trowel to floor	Steel trowel to kerb Light broom finish to ramp
Surface modifier	NA	NA	NA



23. Brick And Block Construction

23.1 General

23.1.1 Cross References

General

Refer to the *General Requirements* worksection.

23.1.2 Standard

General

Materials, construction and detailing: To AS 3700.

23.1.3 Interpretation

Definitions

Bedding:

- » Face shell: Covering the parts of a hollow unit, which are connected by webs, but not the webs themselves with mortar.
- » Full: Covering the entire plan area of a solid unit with mortar.

Brickwork and blockwork types:

- » Prestressed: Brickwork and blockwork in which some or all cavities or cores are reinforced with stressed tendons.
- » Reinforced: Brickwork and blockwork in which some or all grouted cavities or cores are reinforced with steel reinforcement.
- » Special: Brickwork and blockwork with specified strength values higher than those specified in AS 3700 and which is tested during its construction to verify that those values have been achieved.
- » Standard: Brickwork and blockwork, which is not tested for specified strength values.

Compressive strength:

- » Bricks or blocks: The characteristic unconfined compressive strength when tested in accordance with AS/NZS 4456.4.
- » Brickwork or blockwork: The characteristic unconfined compressive strength determined in accordance with AS 3700.

Face units: Bricks or blocks used in facework, including purpose-made units such as squints, sills and thresholds.

Facework: Brickwork or blockwork in which the form, or form and colour, of the face units and joints is visible in the completed works.



Joint:

- » Bed joint: Joint formed by the mortar on which the bricks and blocks are laid.
- » Control joint: Joint constructed in brickwork or blockwork to control and absorb movements in it.
- » Flush joint: Joint that is finished flush with the surface of the bricks or blocks.
- » Perpend: Joint formed between adjacent bricks or blocks laid in the same course.
- » Raked joint: Joint that is raked out to a specified depth behind the face of the bricks or blocks.
- » Tooled joint: A joint, including flush joint and raked joint, in which the surface is trowelled or ironed to a smooth, dense finish.

Ties:

- » Cavity tie: Tie connecting two leaves of masonry that are separated by a cavity of any width.
- » Head and column tie: Tie connecting masonry to a structural support.
- » Type A tie: Tie not required to have specific seismic design characteristics.
- » Type B tie: Tie required to have specific seismic design characteristics.
- » Veneer tie: Tie connecting a masonry veneer to a frame or wall designed to resist lateral forces.

23.2 Quality

23.2.1 Inspection

Witness Points

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

- » Bottoms of cavities, after cleaning out.
- » Bottoms of core holes, before grouting.
- » Control joints, ready for insertion of joint filler.
- » Damp-proof courses, in position.
- » Flashings, in position.
- » Lintels, in position.

23.2.2 Samples

Brick Or Block Unit Samples

Submit face units of each type illustrating the range of variation available, including colour, texture, surface irregularities, defective arrises, and shape.

- » Number of each type: 6.



23.3 Execution

23.3.1 Materials and Components

Bricks and Blocks

Standard: To AS/NZS 4455.

Minimum age of clay bricks: 7 days.

Corrosion Resistance and Durability

To be as follows and to the **Corrosion Resistance and Durability Table** or provide proprietary products with metallic and / or organic coatings of equivalent corrosion resistance:

- » Built-in products: Below damp-proof course to be stainless steel 316 or engineered polymer.
- » Bricks and blocks: Below damp-proof course, and in external leaves in Corrosivity category High to the Corrosion Resistance and Durability Table, use 'Exposure' category to AS/NZS 4456.10: 1997 Appendix A (Salt attack resistance categories).
- » Mortar: Below damp-proof course use mortar Grade M4 to the Mortar Mixes Table..
- » External: Includes external leaf and air spaces behind single skin brickwork or blockwork walls.
- » Internal: Includes building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.

Corrosion Resistance and Durability Table

Corrosivity Category ¹	Situation ²	Lintels	Wall Ties, Connectors and Other Structural Accessories Above Damp-Proof Course	Minimum Cement Content (Mortar Grade) Above Damp-Proof Course
Low	Internal	Galvanize after fabrication 300 g/m ²	Galvanize after fabrication 330 g/m ² Metallic coated sheet Z275/AZ150 Galvanized wire 300 g/m ² In line galvanized sections with after fabrication coating repair ILG/150	M2



External	Galvanize after fabrication 600 g/m ²	Galvanized wire 470 g/m ² Stainless steel grade 316 or 316L	M3
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Connectors and Accessories

Standard: To AS/NZS 2699.2.

Flashings and Damp-Proof Courses

Standard: To AS/NZS 2904.

Mortar Mixing

Measure volumes using buckets or boxes. Machine mix for at least six minutes.

Mortar Materials

Additives or admixtures:

- » Air-entraining agents: To AS 1478.1.
- » Methyl-cellulose water thickeners: To be designed for use in brickwork or blockwork.
- » Plasticizers or workability agents: To be designed for use in brickwork or blockwork.

Lime: To AS 1672.1.

Masonry cement: To AS 1316.

Portland cement: To AS 3972.

- » Type: GP.

Proportions: Conform to the **Mortar Mix Table**.

Sand: To be fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.

Water: To be clean and free from any deleterious matter.

White cement: To have iron salts content ≤ 1%.

Mortar Mix Table

Mortar class to AS 3700	Cement, Lime, Sand Ratios			Water Thickener
	Clay	Concrete	Calcium Silicate	
Masonry cement				
	1:0 to 0.5:3	1:0 to 0.5:3	1:0 to 0.5:3	Optional
M3	1:0:4	1:0:4	n/a	No



Mortar class to AS 3700	Cement, Lime, Sand Ratios			Water Thickener
M4	1:0:3	n/a	n/a	No
Portland cement				
M2	1:2:9	n/a	n/a	No
M3	1:1:6	1:1:6	n/a	Optional
	1:0:5	1:0:5	1:0:5	Yes
M4	1:0:5:4.5	1:0.5:4.5	n/a	Optional
	1:0:4	1:0:4	1:0:4	Yes

Protection From Contamination

Protect masonry materials and components from ground moisture and contamination.

Steel Lintels

Angles and flats: To AS/NZS 3679.1.

Cold formed proprietary lintels: To be designed to AS/NZS 4600.

Corrosion protection: To AS/NZS 2699.3.

Galvanizing: Do not cut after galvanizing.

Wall Ties

Standard: To AS/NZS 2699.1.

» Non-seismic areas: Type A.

Strength classification:

» Heavy duty.

» Materials: Stainless Steel Grade 316 or 316L

23.3.2 Brickwork and Blockwork

Bond

External 110mm walls: Stretcher bond

Internal 230mm walls to cubicles: Flemish bond as shown on drawings

All block walls: Stretcher bond



Building-in

Embedded items: Build in wall ties and accessories as the construction proceeds. If it is not practicable to obtain the required embedment wholly in the mortar joint in hollow unit brickwork or blockwork, fill appropriate cores with grout or mortar.

Steel door frames: Fill the backs of jambs and heads solid with mortar as the work proceeds.

Construction at Different Rates or Times

If two or more adjoining sections of masonry, including intersecting walls, are constructed at different rates or times, rake back or tie the intersections between those sections so that monolithic structural action is obtained in the completed work.

Holes and Chases

If not required, do not cut holes and chases.

Joining to Existing

Do not tooth new masonry into existing work.

Joints

Lay solid and cored units on a full bed of mortar. Face-shell bed hollow units. Fill perpend solids. Cut mortar flush.

- » Externally: Tool to give a dense water-shedding ironed finish.
- » Internally: Tooled joint.
- » Thickness: 10 mm.

Joints and Cutting

Set out bricks or blocks with joints of uniform width and minimise cutting of masonry units.

Monolithic Structural Action

General: Provide brick header units, except in stretcher bond facework.

Location:

- » At engagement of diaphragms with the leaves in diaphragm walls.
- » At intersections with supporting walls and buttresses.
- » Between leaves in solid masonry construction.

Rate of Construction

Regulate the rate of construction to eliminate joint deformation, slumping or instability.

Rods

76 mm high units: 7 courses to 600 mm.

90 mm high units: 6 courses to 600 mm.



190 mm high units: 3 courses to 600 mm.

Weather Protection

Keep the top surface of brickwork covered to prevent the entry of rainwater.

23.3.3 Facework

Cleaning

Clean progressively as the work proceeds to remove mortar smears, stains and discolouration. Do not use acid.

Colour Mixing

If the colour of the face units is visible, evenly distribute the colour range of units and prevent colour concentrations and “banding”.

Perforations

If perforations would otherwise be visible, use solid face units.

Perpend

Vertically align perpend in alternative courses.

NOTE: Adjust perpend width to suit dimensions of brick walls as documented where not standard to brick rod.

Sills and Thresholds

Solidly bed sills and thresholds and lay them so that the top surfaces drain away from the building. Set out so that no unit is cut smaller than $\frac{3}{4}$ full width.

Extent

New Switchroom Building

External:	All building walls	Face brick
External:	Bunded Yards	Face block
Internal:	All exposed faces	Face block
	Interior of Toilet and Administration Room	Fair Face block

Existing Section Hut Building

External:	Infill openings	Face brick
Internal:	All exposed faces	Face brick

23.3.4 Damp-Proof Courses

Location

General: Provide damp-proof courses as follows:



- » Cavity walls built off slabs on ground: In the bottom course of the outer leaf, continuous horizontally across the cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 1 course above as shown on drawings.

Installation

Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step. Sandwich damp-proof courses between mortar.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses and waterproof membranes.

23.3.5 Flashings

Location

Provide flashing and weatherings as follows:

- » Floors: Full width of outer leaf immediately above slab continuous across cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 2 courses above. Where the slab supports the outer skin and is not rebated, bed the flashing in a suitable sealant.
- » Under sills: 30 mm into the outer leaf bed joint 1 course below the sill, extending up across the cavity and under the sill.
- » Over lintels to openings in cavity walls: Full width of outer leaf immediately above the lintel, continuous across cavity, turned 30 mm into the inner leaf 2 courses above. Extend at least 50 mm beyond the lintels.
- » At stiles where cavities are closed: Full height flashing extending 75 mm beyond the closure into the cavity, interleaved with the sill and head flashing at each end. Fix to frame stiles.

Installation

General: Sandwich flashings between mortar. Bed flashings, sills and copings in one operation to maximise adhesion.

Pointing: Point up joints around flashings, filling voids.

Weepholes

Location: Provide weepholes to external leaves of cavity walls in the course immediately above flashings, and cavity fill, and at the bottoms of unfilled cavities.

Form: Open perpend.

Maximum spacing: 720 mm or 2 per opening.

23.3.6 Wall Ties

Location

Provide wall ties in conformance with the **Wall tie spacing table** and as follows:



- » To structured engineer's drawings.
- » Opposite vertical lateral supports.

Installation

Embedment: At least 50 mm into mortar and ensure mortar cover is 15 mm minimum to the outside face of the mortar.

Flexible types: If ties or anchors extend across control joints, use ties or anchors which do not impair the effectiveness of the joint.

Water transmission: Install to prevent water passing across the cavity.

Wall Tie Spacing Table

Location requirements	Minimum interval	
	Generally	Around openings and joints
76 mm high bricks		
vertically	7 courses	Alternate 3 and 4 courses
horizontally	2 ½ bricks	Alternate 1 and 1½ bricks
230mm DCCB cubicle walls	Ties at every 3 rd course at junction to concrete block walls	NA

23.3.7 Cavity vents

Install cavity vents where shown on the drawings

- » Type Terra cotta: Perforated, 230 x 160 mm to match existing.

23.3.8 Control of Movement

Aging of Concrete

Minimum age of concrete supports to clay bricks: 28 days.

Control Joints in Brickwork

Refer to locations on drawings

Minimum width of control joint: 10 mm.

Brick Finish

Refer to Finishes Schedule.

Filler Material

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



- » Bond breaking materials: To be non-adhesive to sealant, or faced with a non-adhering material.
- » Foamed materials: To be closed-cell or impregnated, not water-absorbing.

Joint Filling

Installation: Clean the joints thoroughly and insert an easily compressible backing material before sealing.

Sealant depth: Fill the joints with a gun-applied flexible sealant for a depth of at least two-thirds the joint width.

Colour: To match brickwork or blockwork colour.

23.3.9 Bed Joint Reinforcement

Location

Locate as follows:

- » In first 2 bed joints above and below head and sill flashings to openings.
- » In first 2 bed joints above and below openings.
- » In second bed joint below top of wall.
- » In third bed joint above bottom of wall.

Maximum vertical intervals: 500 mm.

Installation

Lap 450 mm at splices. Fold and bend at corners so that the longitudinal wires are continuous. Stop 200 mm short of control joints.

- » In brickwork: Extend 450 mm beyond each side of openings.

Reinforcement

Material: Galvanized welded wire mesh.

Width: Equal to the width of the leaf, less 15 mm cover from each exposed surface of the mortar joint.

23.3.10 Reinforced and Grouted Blockwork

General

Provide reinforcement and/or grouting in conformance with the **Standard Geometry Reinforcement Table**.

Cleaning Core Holes

Provide purpose-made cleanout blocks or machine cut a cleaning hole at the base of each grouted core. Located on the side of the wall, which is to be rendered or otherwise concealed. Cover the hole with formwork and grout the core.



Grouting

Commencement: Do not commence until grout spaces have been cleaned out and the mortar joints have attained sufficient strength to resist blow-outs.

Hight of lift: Limit the height of individual lifts in any pour to ensure that the grout can be thoroughly compacted to fill all voids and ensure bond between grout and masonry. Compact by vibration or by rodding.

Topping up: On the completion of the last lift, top up the grout after 10 min to 30 min, and vibrate or rod to merge with the previous pour.

23.3.11 Steel Lintels

Location

General: Do not cut on site. Keep lintels 6 mm clear of heads of frames. Pack mortar between the angle upstand and supported masonry units. Install the long leg vertical.

Minimum bearing each end:

- » Span $\leq$ 1000 mm: 100 mm.
- » Span $>$ 1000 mm: 150 mm.

Propping: To prevent deflection or excessive rotation, temporarily prop proprietary cold-formed lintels until the masonry reaches it required strength.

- » Minimum propping period: 7 days.

Lintels Schedule

Opening dimensions (mm)	Wall Thickness	Lintel type	Dimensions (mm)		
			D1 ¹	D2 ²	Thickness ³
2050	110mm	Angle	100	100	10
3250	110mm	Angle	150	90	10

¹ D1 is depth of lintel.

² D2 is width of lintel.

³ Thickness applies only to steel T or angle lintels.

23.3.12 Schedule

Brick and Block Construction Schedule

	A: Internal Walls	B: External Substation Walls	C: Link Yard
Characteristic	To AS/NZS4455:	To AS/NZS4455:	To AS/NZS4455:



	A: Internal Walls	B: External Substation Walls	C: Link Yard
unconfined compressive strength	1997	1997	1997
Name or type	<u>New Switchroom</u> Boral Designerblock Almond Smooth Face throughout <u>Existing Building</u> Dry pressed brick to match existing	Austral or Boral Bricks to match existing building for brickwork generally	Boral Designerblock Charcoal Split Face
Mortar	With additive ref. Cl 20.3.1 above	With additive ref. Cl 20.3.1 above	
Cement	Blue Circle White	Blue Circle White	
Colour	Off White for blocks Match existing for brickwork	Cream to match existing building	Grey with black oxide as recommended by manufacturer
Proportions or class	M3	M3	
Sand	White washed river sand.	White washed river sand.	
Bond	Stretcher to 190mm walls. Stretcher to 230mm walls.	Stretcher	Stretcher
Depth	0	10mm	10mm
Shape or profile	Flush	Ironed	Ironed



24. Insulation And Barriers

24.1 General

24.1.1 Cross References

General

Refer to the *General requirements* section.

24.1.2 Standards

Installation of mineral wool insulation

Comply with the AMWU/CFMEU/CEPU/FARIMA Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation.

Marking: Deliver mineral wool products to site in packaging labelled FBS-1 BIO-SOLUBLE INSULATION.

24.1.3 Interpretation

Definitions

Terminology: To AS/NZS 4859.1.

Sarking-type material: Flexible membrane material normally used for waterproofing, vapour proofing or thermal reflectance.

Mineral wool (including glasswool and rockwool): Entangled mat of fibrous non-crystalline material derived from inorganic oxides or minerals, rock, slag or glass, processed at high temperatures from a molten state.

24.2 Quality

24.2.1 Inspection

Witness points

Give sufficient notice so that the sarking, vapour barrier and insulation may be inspected before they are covered up or concealed.

24.3 Materials and Components

24.3.1 Materials and Components

Bulk insulation

Mineral wool blankets and cut pieces: To AS/NZS 4859.1, Section 8.

Polyester: To AS/NZS 4859.1, Section 7



Polyurethane (rigid cellular sheets): To AS 1366.1.

Urea-formaldehyde in situ set foam: To AS 4073.

Wool: To AS/NZS 4859.1, Section 6.

Standards Mark: Required.

Sarking-type material

Standard: To AS/NZS 4200.1.

Standards Mark: Required

Flammability index to AS 1530.2: ≤ 5 .

Spread of flame index to AS/NZS 1530.3: ≤ 5 .

Duty: Medium.

Vapour proofing: Permeance to AS 3999.

Fasteners and supports

Galvanised steel.

Mesh support to roof insulation

Wire netting: To AS 2423.

» Size: 45 mm mesh x 1 mm diameter.

Welded safety mesh: To AS/NZS 4389.

24.4 Execution

24.4.1 Installation

Bulk insulation

Standard: To AS 3999 or AS 4075.

Batts and rigid sheets: Fit tightly between framing members over wire netting support.

Sarking-type material

Standard: To AS/NZS 4200.2.

24.4.2 Roof Insulation

Extent

Location: The whole of the metal deck roof area to the switchroom building.

The whole of the ceiling area to the switchroom building.

Materials

Bulk insulation:



- » Type: Blanket Proprietary product equal to CSR Bradford insulation R 2.0 Anticon.
- » R-value: 2.5
- » Thickness nominal 75mm to roof slab area
- » Thickness nominal 50mm under metal deck roof.

Vapour barrier: Integral with Anticon insulation to roof only.

Installation

Support and fixing: in accordance with manufacturer's published recommendations

Mesh support to roof insulation

Locations: Provide mesh support to

- » blanket type thermal insulation laid over roof framing members as insulation to metal roofing.

Installing wire netting: Lay over the roof framing providing sufficient slack or sag between members to suit the application.

Fixing wire netting: Staple to timber frame, wire to steel frame.

Installing welded safety mesh: To AS 4389.



25. Waterproofing

25.1 General

General

Refer to the *General requirements* section.

25.1.1 Standard

Standard: To BCA Section F 1.7 and AS 3740.

25.2 Quality

25.2.1 Witness Points

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

- » Competed waterproofing system prior to tiling or covering.

25.2.2 Submissions

Certification

On completion of the area to be waterproofed, and prior to tiling, submit written certification from the waterproofing membrane manufacturer stating that the respective part of the Works has been performed to the manufacturer's requirements and specifications to the satisfaction of the manufacturer.

25.3 Materials and Components

25.3.1 Proprietary Waterproofing System

The builder shall be fully responsible for the final design and application of the waterproofing system to the areas identified for waterproofing.

The waterproofing system shall be a proprietary system, including all necessary components. The system shall allow for and include all necessary components of the specified finishes.

The waterproofing system shall be compatible with all substrates and applied finishes.

25.3.2 Membranes

Single layer membranes

Fix and lap sheets with appropriate proprietary adhesive or by heat welding using a gas torch ("torch on"), self finished or finished with a proprietary surfacing.



Seamless membranes

Membranes applied in liquid or gel form and air cured to form a seamless film.

25.4 Execution

25.4.1 Substrates

Substrates for membranes

General: Apply membranes to dry, smooth, firm, continuous surfaces, clean and free from loose or foreign matter. Provide coving or fillets on internal corners. Round or arris external corners and edges.

25.4.2 Wet Areas

Waterproofing

Standard: To AS 3740.

Membrane

Type: Proprietary liquid applied or sheet membrane system which

- » has a current Australian Building Product and Systems Certification Scheme certificate; or
- » has a current technical opinion issued by the Australian Building Systems Appraisal Council stating that the system is suitable for use as a waterproofing system for use in wet areas, shower recess bases and associated floors and wall/floor junctions which are to be tiled.

Extent: tiled floors and walls as indicated on *architectural drawings* and as follows:

- » Floors: Full extent of floors to toilet areas including tiled skirtings.

Installation

General: Install in accordance with manufacturer's specifications and recommendations.

Applicators: Use suitably qualified applicators, approved by the manufacturer of the waterproofing system.

Floor wastes: Turn membrane down onto the floor waste puddle flanges, and adhere.

Curing: Allow membrane to fully cure before tiling.



25.5 Completion

25.5.1 Warranties

Joint Warranty

Submit a warranty from the applicator of the waterproofing system covering materials, components and labour for a period of 7 years.

Any defects due to faulty material or workmanship during the warranty period shall be made good at no charge to the Proprietor.

Manufacturer's Warranty

Submit the waterproofing membrane manufacturer's standard warranties.



26. Roofing & Wall Cladding

26.1 General

26.1.1 Cross References

Refer to : Light Steel Framing, Insulation and Barriers.

General

Refer to the *General Requirements* section, and to building services requirements for roof mounted fans, ventilators and the like.

26.2 Quality

26.2.1 Performance Criteria

Minimum Requirements

Provide a roofing system and associated work which:

- » Remains intact and waterproof under the local or regional ambient climatic conditions;
- » Protects people, property and the environment from the adverse effects of stormwater;
- » Provides adequate means of dealing with vapour pressure, condensation, corrosion and thermal movement;
- » Supports the specified imposed loads and types of roof access without impairment of performance;

Submissions

Provide layout of the roof Safety Anchor system certified to comply with AS/NZS 1891.4 for approval before proceeding with the work.

Ambient Climatic Conditions

Design rainfall intensity (mm/h) to AS/NZS 3500.3: >

Thermal Insulation

Minimum added thermal resistance R2.5

26.2.2 Inspection

Witness Points

Give sufficient notice so that inspection may be made of:

- » Roof supports; and
- » Roof Penetrations and



- » Those parts of the roofing, sarking, vapour barrier, insulation and roof plumbing installation, which will be covered up or concealed.

26.2.3 Tests

Metal Roofing

General tests: Type test the roof sheeting and fastenings to AS 1562.1 for resistance to concentrated load and to wind pressure.

26.3 Materials and Components

26.3.1 Materials and Components

Fasteners

Self-drilling screws: Corrosion resistance Class 3.

Finish: Prefinish exposed fasteners with an oven baked polymer coating to match the roofing material, or provide matching purpose-made plastic caps.

Fastenings to timber battens: Provide fastenings just long enough to penetrate the thickness of the batten without piercing the underside.

Fibre cement

Standard: To AS/NZS 2908.2.

Cladding:: Type A Category 3 (modulus of rupture ≥ 7 megapascals).

Compressed cladding: Type A Category 5 (modulus of rupture ≥ 18 megapascals).

- » Edges: Square.

26.4 Execution

26.4.1 Installation

Protection

General: Keep the roofing and rainwater system free of debris and loose material during construction, and leave them clean and unobstructed on completion. Repair damage to the roofing and rainwater system.

Touch up: If it is necessary to touch up minor damage to prepainted metal roofing, do not over-spray onto undamaged surfaces.

Thermal Movement

Provide for thermal movement in the roof installation and the structure, including movement in joints and fastenings.



26.4.2 Safety Mesh

Standard

General: To AS/NZS 4389.

26.4.3 Sheet Metal Roofing and Wall Cladding

General

Type: Provide a proprietary system of preformed sheet and purpose-made accessories.

Prepainted and organic film/metal laminate products: To AS/NZS 2728.

Product finish: Prefinished

Design and installation: To AS 1562.1.

Material: Zincaluminium

Profile:	Roof:	Match existing profile or Lysaght Spandek
	Wall:	Lysaght Wallclad

Thickness (base metal): 0.42mm

Finish: Colorbond

Colour: Refer to *External Finishes Schedule*.

Fixing: In accordance with manufacturers recommendations, single length sheets to the roof.

Accessories: Provide material with the same finish as roofing sheets.

Ridges and Eaves

Treat ends of sheets as follows:

- » Project sheets 50 mm into gutters.
- » Close off ribs at bottom of sheets using mechanical means or with purpose-made fillers or end caps.
- » Turn pans of sheets up at tops and down into gutters by mechanical means.
- » Provide pre-cut notched eaves flashing and birdproofing where necessary.

Close off ridges with purpose-made ridge fillers of closed cell polyethylene.

Ridge and Barge Capping

Finish off along ridge and verge lines with purpose-made ridge capping or barge rolls.

Pan Type Sheets

Removal: Capable of being de-indexed and removed without damage.



Metal Separation

Prevent direct contact between incompatible metals and aluminium or coated steel, by either:

- » Applying an anti-corrosion, low moisture transmission coating to contact surfaces; or
- » Inserting a separation layer.

26.4.4 Roof Plumbing

General

Standard: To AS/NZS 3500.3.

General: Provide the flashings, cappings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system.

Materials

Metal rainwater goods: To AS/NZS 2179.1.

Jointing Sheetmetal Rainwater Goods

Butt joints: Make joints over a backing strip of the same material.

Soldered joints: Do not solder aluminium or aluminium/zinc coated steel.

Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

Flashings and Cappings

Flashing material: To AS/NZS 2904.

Type: Prefinished metal to match adjacent claddings.

Installation: Flash roof junctions, upstands, abutments and projections through the roof. Preform to required shapes where possible. Notch, scribe, flute or dress down as necessary to follow the profile of adjacent surfaces. Mitre angles and lap joints 150 mm in running lengths. Provide matching expansion joints at 6 m maximum intervals.

Upstands: Flash projections above or through the roof with two part flashings, consisting of a base flashing and a cover flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.

Fixing to pipes: Solder, or seal with neutral cured silicone rubber and either:

- » Secure with a clamping ring; or
- » Provide a proprietary flexible clamping shoe with attached metal surround flashing.

Gutters

General: Prefabricate gutters to the required shape shown on the drawings or equivalent approved proprietary product. Form stop ends, downpipe nozzles, bends



and returns. Dress downpipe into outlets. Provide overflow slots to prevent back-flooding.

Gratings and guards: Provide removable leaf guards to gutters and gutter units.

Leaf guards to gutter outlets: >Wire balloon type.

Expansion Joints: Provide expansion joints for runs in excess of 20m. Locate at centre of Switchroom building.

Switchroom building Match existing profile.

Downpipes

General: Prefabricate downpipes to the required section.

External downpipes to Switchroom building Rectangular to match existing.

Downpipe support: Provide astragals and fixings for downpipes.

26.5 Cladding Types

26.5.1 Fascia

Install fascia full length of switchroom building eaves gutter.

Product type:	Lysaght Novaline
Product finish:	Colorbond prefinished
Colour:	Refer to Refer to <i>External Finishes Schedule..</i>
Fixing:	Screw fix to timber blocking onto eaves purlin as detailed.
Accessories:	Provide in accordance with the recommended product

26.5.2 Roof Access

Install roof access attachments in accordance with AS/NZS 1891.4, AS/NZS1891.2 and the NSW Code of Practice-Safe Work on Roofs and Occupational Health and Safety Regulations 2001. Equipment shall also have been accredited by NATA testing laboratories.

The positions of the anchor points and horizontal ties shown on dwg CV 0388947, is indicative only and the contractor shall install a system complying with the Standards and Codes of Practice.

Scope to include the following:

- » Grade 316 stainless steel anchor points and pendulum eyebolts to the roof areas shown on the drawings;
- » Non-corrosive sign at eye level to indicate the location of the roof access point;
- » 1 No stainless steel permanent ladder safety bracket and stainless steel cable attached to the first eyebolt from the ladder bracket at the positions shown;



- » Stainless steel horizontal ties fixed between the roof anchors;
- » Water seal guarantee;
- » Initial training in the safe use of installed height safety systems for nominated RailCorp personnel or contractors;
- » 10 year warranty on the installation;
- » Fix to metal deck with purpose made plates or channels to suit rib type.

Equipment generally equal to Murphy's Height Safety Pty Ltd or Safety Anchors Pty Ltd.

26.5.3 Completion

Warranties

Submit the roofing materials manufacturer's published product warranties.

Provide certificate of compliance from the installer for the roof access system.



27. Doors And Hatches

27.1 General

27.1.1 Cross References

Refer to Electrical Services for earthing to steel door frames.

General

Refer to the *General requirements* section.

Doors and frames shall conform to the general configurations shown on the drawings, including the Door Details.

27.1.2 Interpretation

Definitions

Door set: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for satisfactory operation.

Door types: To AS 2688.

27.2 Quality

27.2.1 Inspection

Witness points

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

- » Door frames in place before building in to masonry.
- » Door frame earthing/grounding

27.2.2 Samples

General

Confirm the following by sample or catalogue specification:

- » Sections proposed to be used for frames, louvres and slats.
- » Door manufacturer's standard hardware items.



27.3 Products

27.3.1 Frames

Aluminium frames

General: Assembled from aluminium sections, including necessary accessories such as buffers, pile strips, strike plates, fixing ties or brackets and cavity flashing, with suitable provision for fixing nominated hardware.

Steel frames

General: Continuously welded from metallic-coated steel sheet sections, including necessary accessories such as buffers, strike plates, spreaders, mortar guards, switch boxes, fixing ties or brackets, and cavity flashing with suitable provision for fixing hardware and electronic security assemblies, and prefinished with a protective coating.

Finish: Grind the welds smooth, cold galvanize the welded joints and shop prime.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm backplates and lugs. Screw fix the hinges into tapped holes in the back plates.

Base metal thickness:

- General: ≥ 1.1 mm.
- Fire rated doorsets: ≥ 1.4 mm.
- Security doorsets: ≥ 1.6 mm.

Metallic-coated steel sheet: To AS 1397.

- Metallic-coating: Zinc-iron.

27.3.2 Doors

Standards

Materials: To the following:

Decorative laminated sheets: To AS/NZS 2924.1.

- Wet processed fibreboard (including hardboard): To AS/NZS 1859.4.
- Dry processed fibreboard (including medium density fibreboard): To AS/NZS 1859.2.
- Particleboard: To AS/NZS 1859.1.
- Plywood and blockboard for interior use: To AS/NZS 2270.
- Plywood and blockboard for exterior use: To AS/NZS 2271.
- Seasoned cypress pine: To AS 1810.
- Timber – hardwood: To AS 2796.1.



- Timber – softwood: To AS 4785.1.

Certification

General: Brand panels under the authority of a recognised certification program applicable to the product. Locate the brand on faces or edges which will be concealed in the works.

Certification programs:

- Plywood and blockboard: Engineered Wood Products Association of Australia (EWPPAA) Quality Control and Product Certification Scheme.
- Wet processed fibreboard, dry processed fibreboard, particleboard and decorative overlay wood panels: Australian Wood Panels Association AWPA JAS-ANZ Scheme.

General

Doors: Proprietary products manufactured for interior or exterior applications and for the finish required.

Flush doors

General: Of balanced construction.

Cellular core and intermediate rail core flush doors:

- Provide a subframe of 25 mm minimum width timber around openings for louvres and glazing.
- Provide additional material to take hardware, fastenings and grooves.
- Cut outs: If openings are required in flush doors (e.g. for louvres or glazing) make the cut outs not closer than the width of the styles at the edges of the doors.

Solid core: Solid flush doors as follows:

- Flush door with blockboard: Core plate of timber strips laid edge to edge, fully bonded to each other and to facings each side of no less than two sheets of timber veneer.
- Single thickness of moisture resistant general purpose medium density fibreboard.

Smoke doors: Solid core $\geq$ 35 mm thick.

Construction

Adhesives:

- Internal: To AS/NZS 2270.
- External: To AS/NZS 2271.



Door thickness:

- General: 35 mm.
- External doors and doors over 900 mm wide: 40 mm.

Edge strips: Fix to stiles. Minimum thickness 10 mm. Increase overall thickness to > 15 mm to accommodate the full depth of the rebate in rebated doors. Form rebates to suit standard rebated hardware. Bevel square edged doors as necessary to prevent binding between the leaves.

Louvre grilles: Construct by inserting the louvre blades into a louvre frame, and fix the frame into the door.

Double doors

Rebated meeting stiles: Provide rebated meeting stiles or fix equivalent metal 'T' stop to one leaf unless the doors are double acting. Chamfer square edged doors as necessary to prevent binding between the leaves.

Tolerance

Squareness: The difference between the lengths of diagonals of a door: ≤ 3 mm.

Twist: The difference between perpendicular measurements taken from diagonal corners: ≤ 3 mm.

Nominal size (mm):

- Height: + 0, - 2.
- Width: + 0, - 2.

27.3.3 Doorsets

Duct hatches

General: Proprietary products comprising metal-faced doors side hung to steel door frames, inclusive of the necessary hardware and accessories including hinges and lock and lugs or other suitable means for installation.

27.4 Materials

27.4.1 Materials and Components

Flashings and weatherings

Standard: To AS/NZS 2904.



General: Provide flashings and weatherings, which are corrosion resistant, compatible with the other materials in the installation, and coated with a non-staining compound where necessary.

Jointing materials

Provide recommended jointing and pointing materials, which are compatible with each other and with the contact surfaces and non-staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Pile weather strips

Standard: To AAMA 701/702.

Materials: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

Finned type: A pile weather seal with a central polypropylene fin bonded into the centre of the backing rod and raised above the pile level.

Extruded gaskets and seals

Type: Non cellular (solid) elastopressive seals.

Material:

- » Rubber products (neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber): To BS 4255.1.
- » Flexible polyvinyl chloride (PVC): To BS 2571. 100% solids with high consistency, ultra-violet stabilised.

Nylon brush seals

Dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door with double sided PVC foam tape.

27.5 Execution

27.5.1 Construction Generally

Installers

Have proprietary door sets installed by specialist firms.

Frames

General

Frames: Install so that the frames are as follows:

- Plumb, level, straight and true.
- Adequately fixed or anchored to the building structure.



- Will not carry any building loads, including loads caused by structural deflection or shortening.

Aluminium frames

Building in to masonry: Screw galvanized steel brackets twice to jambs and build in.
Fixing to masonry openings: Build in seasoned timber plugs to masonry joints or use proprietary expansion anchors and screw twice through jambs at each fixing.

Frame fixing

Brackets: Metallic-coated steel:

- Width: ≥ 25 mm.
- Thickness: ≥ 1.5 mm.

Depth of fixing for building into masonry:

- Brackets: ≥ 200 mm.
- Expansion anchors: ≥ 50 mm.
- Plugs: ≥ 50 mm.
- Rods: ≥ 60 mm.

Heads of fasteners: Conceal where possible, otherwise sink the head below the surface and fill the sinking flush with a material compatible with the surface finish.

Jamb fixing centres: ≤ 600 mm.

Joints

General: Make accurately fitted joints so that no fasteners, pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Steel frames

Building in to masonry: Attach galvanized steel rods to jambs, build in and grout up.
Fixing to masonry openings: Build in hairpin anchors and install locking bars, or use proprietary expansion anchors and screw twice through jambs at each fixing.
Fixing to stud frame openings: Attach galvanized steel brackets to jambs and screw twice to studs at each fixing.

Prime timber doors on all edges before installation.

Fill all steel door frames with mortar.



Weatherproofing

Flashings and weatherings: Install flashings, weather bars, drips, storm moulds, caulking and pointing to prevent water from penetrating the building between the door frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Finishing

Trim: Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the door frames. Install to make neat and clean junctions between the frame and the adjoining building surfaces.

Specify particular requirements for architraves, backmoulds, pelmets, etc., if different from the general requirement in the text clause,

Installation

Install doors so that the frames

- » Are plumb, level, straight and true within acceptable building tolerances;
- » Are adequately fixed or anchored to the building structure; and
- » Will not carry any building loads, including loads caused by structural deflection or shortening.
- » are grounded/earthed as required.

Joints

Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Operation

Ensure moving parts operate freely and smoothly, without binding or sticking, at correct tensions or operating forces and that they are lubricated where appropriate.

Seals

Provide purpose-made proprietary seals to meet requirements for weather, draught, smoke and acoustic sealing. Provide fixings, rebates, grooves and clearances as necessary for installation and operation of the seals. Allow seals unwound from coils to settle before use.

External double leaf doors shall have rebated meeting stiles.

Trim

General: Install to make neat and clean junctions between the frame and the adjoining building surfaces as shown on drawings



27.6 Components

27.6.1 Timber Doors

Standards

Flush doors and joinery doors: To AS 2688.

Installation: To AS 1909.

Door dimensions

Location/ Door Number	Door Leaf Size (h x w)	Thickness	Type	Frame Type
D01	3500x3010mm brick opening width and block opening height	NA	Roller shutter	Steel guides
D02, D03	2040x870mm leaf size	35mm	Solid core external metal faced	Steel
D04	2040x870mm leaf size	To Code	Solid core external 2-hr fire rated metal faced	Steel
D05, D06	2040x870mm leaf size	35mm	Solid core Undercut D05 25mm	Steel
D07	Door size to match existing opening with additional 110mm brick skin	To Code	Solid core 2-hr fire rated	Steel
D08	New door same size to replace existing.	35mm	Solid core	Existing steel frame

Flush doors

Edge strips: Minimum thickness 10 mm. Increase overall thickness to at least 15 mm to accommodate the full depth of the rebate in rebated doors. Form rebates to suit standard rebated hardware.

Metal clad doors

Flush doors faced both sides with 0.6 mm thick galvanized steel sheet extended over and across hardwood edge strips on all edges and fixed with waterproof adhesive using a press.



Priming

27.7 Fire Resistant Door Sets

27.7.1 Door leaf construction

Fire resistant doorsets: To AS/NZS 1905.1.

Internal materials: Inert mineral materials containing no asbestos products.

Framing: Increase the width of door leaf members or provide additional members to accommodate hardware and grooves so that items of furniture are contained within framing members and do not encroach on the core materials.

Frames: Steel.

Timber facings: Timber face veneers and edge strips.

Location	Rating	Finish
D04 Transformer Yard	2-hr	Metal clad for paint finish
D07 Battery Room	2-hr	Timber for paint finish

27.7.2 Installation

Standard: To AS/NZS 1905.1.



28. Overhead Doors

28.1 General

Roller shutters are to be manually operated with chain and pulley mechanism.

28.1.1 Cross References

General

Refer to the *General requirements* section.

28.1.2 Interpretation

Definition

Cycle: One complete operation from the closed position to fully open and back to closed.

28.2 Quality

28.2.1 Inspection

Witness points

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

- » Tracks and guides installed before doors or shutters are hung

28.2.2 Samples

General

Submit 2 samples of each of the following where applicable:

- » Sections proposed to be used for frames, louvres and slats.
- » Joints made using proposed techniques.
- » Finishes to prepared surfaces.
- » Colour range samples from prefinished production material. When the colour selection has been made, submit 5 sets of samples showing the colour range.
- » Door manufacturer's standard hardware items. including electrical safety switches, contactors and sensors

28.2.3 Submissions

Submit the following information for approval:

- » Name for proposed brand of roller door.
- » Door manufacturer's standard hardware items. including electrical safety switches.



28.2.4 Roller Shutters

Roller shutters

Type: Proprietary system equivalent to B&D Roller-A-Shutter 4/100 industrial slat type comprising 0.42mm tensile steel slats 115mm overall height sliding between vertical guides, raised or lowered by rolling or unrolling around a horizontal drum (barrel) mounted above the opening, inclusive of the manufacturer's standard operating gear, hardware, and accessories necessary for satisfactory performance.

Wind loading

Install so that the shutter, in its closed position, withstands pressure on the surface of at least 550 Pa without impairment of its ability to function under ambient temperature.

Curtain

Continuous curtain: A single metal sheet pressed to a horizontal ribbed profile.

Slatted curtain: A curtain of horizontal interlocking slats, incorporating interlocking hinges extending the full width of the curtain.

Bottom curtain rail: A stiffening member interlocking with the bottom edge or lowest slat of the curtain, extending between the inner faces of the vertical guides, formed or adapted where necessary to follow the contour of a sloping floor or threshold. The rail may also be adapted to house the locking device. Include compressible hollow rubber door seal to underside of bottom rail.

Drum

Springs: Helical torsion springs housed in the drum and arranged to counterbalance the curtain weight without exceeding the safe working stress of the spring material.

Operation

Method of raising and lowering the curtain:

- » Chain manual: By pulling on a chain passing over a sprocket on the drum, with planetary reduction gears.

Manual operation

Install so that the force required to operate the door manually does not exceed 220 N.

28.3 Completion

28.3.1 Warranties

Refer to Warranty Schedule.

28.3.2 Maintenance

Submit manufacturer's published recommendations for service use.



29. Louvre Doors and Windows

29.1 General

29.1.1 Cross References

General

Refer to the *General Requirements* worksection.

29.1.2 Performance

General

Provide windows in conformance with relevant Australian Standards,

29.2 Execution

29.2.1 Materials and Components

Standards

Flashings: To AS/NZS 2904.

29.2.2 Installation

Install windows so that the frames:

- » Are plumb, level, straight and true within acceptable building tolerances;
- » Are adequately fixed or anchored to the building structure; and
- » Will not carry any building loads, including loads caused by structural deflection or shortening.

Flashing and Weatherings

Install flashings, weather bars, drips, storm moulds, caulking and pointing so that water is prevented from penetrating the building between the window frame and the building structure under the prevailing service conditions, including normal structural movement of the building.

Fixing

Fastener spacing (nominal): 600 mm.

Fasteners: Conceal fasteners.

Packing: Pack behind fixing points with durable full width packing.

Limiters: Install arm limiters to outward opening louvre doors fixed to the door frame and head transome on suitable mounting brackets.



Joins

General: Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Sealants: If priming is recommended, prime surfaces in contact with jointing materials.

Installers

Have windows installed by their manufacturer or by a subcontractor recommended by the manufacturer.

Protection

Removal: Remove temporary protection measures from the following:

- » Contact mating surfaces before joining up.
- » Exposed surfaces.

Trim

Provide mouldings, architraves, reveal linings, and other internal trim using materials and finishes matching the window frames. Install to make neat and clean junctions between frames and the adjoining building surfaces.

29.3 Louvre Assemblies

Metal louvres

Provide metal louvre blades mounted in a metal surround frame or subframe, installed as for metal window installations.

Louvre arrangement

Horizontal: Louvres span between frame stiles or mullions.

Frames

Include the necessary sills, jambs, mullions, transoms, internal and external corners, beads, brackets, anchors, straps and accessories.

Louvre Type L1, L2 and L3 shall be equal to CVS Equipment Model MFL 150/3P.

Louvre Designation	Louvre Arrangement	Accessories	Method of operation	Minimum free area (mm ²)	Opening size (mm) h x w
L01	45 deg, two-stage stormproof	Al trims fixed into brick reveals	Fixed	50%	2057x1930mm
L02	45 deg, two-stage stormproof	Al trims fixed into brick reveals	Fixed	50%	3430x1090mm
L03	45 deg, two	Al trims fixed	Fixed	50%	1330x970mm



	stage stormproof	into brick reveals			
L04	45 deg, two stage stormproof	Al trims fixed into brick reveals above door frame	Fixed	50%	1373x970mm to suit existing opening (check on site)
L05	45 deg, two stage stormproof	Al trims fixed into brick reveals	Fixed	50%	868x850mm to suit existing opening (check on site)

Louvre materials schedule

For louvre designation:

>

Component	Material	Finish	Type	Size (mm)
Stiles, mullions	Aluminium	Powdercoat	Capral 400 Series Narrowline	100mm
Accessories	Aluminium	Powdercoat	NA	NA
Frame	Aluminium	Powdercoat	Channel	75mm
Blades	Aluminium	Powdercoat	Stormproof to wall louvres	204mm wide
Louvre doors	Aluminium	Powdercoat	Aluminium box frame	100x50x3mm

29.3.1 Bird-WireScreens

Aluminium framed screens

General: Install woven wire bird mesh to internal face of all louvre windows and doors including exhaust air ducts at face of internal block walls.

Mesh: Fix 12.5x12.5x0.8mm gal weldmesh birdwire to the inside face of the louvres or to the blockwork openings.

Pop rivet mesh to louvre blades at 600 centres with washer clamps.

Flatten mesh before fixing to avoid deflection of the louvre blades.



30. Glazing

30.1 General

30.1.1 Cross References

General

Refer to the *General Requirements* section.

30.1.2 Design

Glass Type and Thickness

Standard: To AS 1288, where no glass type or thickness is given. For values to be used for permissible stress design, multiply the ultimate limit state design wind pressure derived from AS/NZS 1170.2 by 0.67.

30.1.3 Standard

Standard

Materials and installation: To AS 1288.

Cut-to-size quality: To AS/NZS 4667.

Laminated and toughened glass process: To AS/NZS 4667.

30.1.4 Interpretation

General

Twin ground plate: Plate glass ground simultaneously on both faces so that uniform glass thickness and parallel faces are maintained within close limits.

Terminology for work on glass: To AS/NZS 4668.

30.2 Materials and Components

30.2.1 Glass

Glass Types

Classification and description: To BS 952:1.

Glass and Glazing Materials

Glass and glazing materials generally: Free from defects, which detract from appearance or interfere with performance under normal conditions of use.



Glazing plastics: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

Float Glass Quality

Glazing Select Quality q3 to ASTM C 1036.

Safety Glasses

Standard: To AS/NZS 2208.

Standards Mark: Required.

Processed Glasses Schedule

Generic Term	Glass Type (base glass) and Other Properties	Location(s)
Mirrors:	Clear float, silvering quality	All mirrors

30.2.2 Glazing Materials

General

Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacing strips, spacing tapes, spacers, setting blocks and compression wedges): Appropriate for the conditions of application and the required performance.

Jointing Materials

Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

30.2.3 Mirrors

Reflective Surface

Type: Silver layer deposited on the glass or glazing plastic.

Protective coatings: Electrolytic copper coating at least 5 m thick, and 2 coats of mirror backing and edge sealing paint having a total dry film thickness of at least 50 m.

Location and size: Refer *architectural drawings*.



30.3 Execution

30.3.1 Glass Processing

General

Processing: Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access holes and speaking holes. Process exposed glass edges to a finish not inferior to ground arrised.

30.3.2 Fixing Mirrors

Frame Fixing

General: Proprietary aluminium frames to mirror perimeter, corners mitred. Bed glass edges in a continuous resilient gasket. Attach the frame to the substrate with concealed screw fixings. Seal the frame to the substrate with paintable sealant, which will not react with the mirror coating. Do not allow the sealant to contact the mirror back.

Finish: Natural anodised

30.4 Completion

30.4.1 Cleaning

Replace damaged glass and leave the work clean, polished, free from defects, and in good condition.



31. Door Hardware

31.1 General

31.1.1 Cross References

General

Refer to the *General requirements* section.

Refer to the Door Hardware Schedule (Appendix 2)

31.2 Execution

31.2.1 Materials and Components

Handling

Before supply, verify on site, the correct handling of hardware items.

Operation

Ensure working parts are accurately fitted to smooth close bearings, without binding or sticking free from rattle or excessive play, lubricated where appropriate.

31.2.2 Hinges

Butt Hinge Sizes

Conform to **Hinge table A** in which length (l) is the dimension along the knuckles, not including hinge tips, if any, and width (w) is the dimension across both hinge leaves when opened flat.

Steel internal and stainless steel external , butt hinges for timber doors in steel frames:
To **Hinge table A**.

Hinge Materials

Doors fitted with closers: Provide low friction bearing hinges.

Brass hinges: For brass hinges used for door leaves exceeding 30 kg or door leaves controlled by door closers, provide bronze or stainless steel washers to each knuckle joint.

Hinge Pins

Exterior or security doors opening out: Provide fixed pin hinges or security hinges.



Hinge Table A

Nominal hinge size l x w x t (mm)	Door leaves not exceeding any of the following:		
	Mass (kg)	Width (mm)	Thickness (mm)
85 x 60 x 1.6	20	820	35
100 x 75 x 1.6	30	920	40
100 x 75 x 2.5	50	920	50

Number of Hinges

Other door leaves: Provide 3 hinges for leaves between 2040 mm and 2340 mm high, and 4 for door leaves between 2340 mm and 3050 mm high. Provide at least 3 hinges for door leaves controlled by door closers.

Small door leaves: Door leaves not exceeding any of the following may have 2 hinges each:

2040 mm high.

820 mm wide.

30 kg mass.

Wide Throw

If necessary, provide wide throw hinges to achieve the required door swings in the presence of obstacles such as nibs, deep reveals and architraves.

31.2.3 Locks and Latches

Furniture

Provide lock and latch furniture suitable for use with the lock or latch to which it is installed with the corresponding level of performance.

Mechanical Locksets

» Standard: To AS 4145.2.

Mortar Guards

For steel door frame installations provide mortar guards designed to enable the full extension of the lock tongue or similar devices and the correct operation of the locking mechanism.

Padlocks for External Gates and Condenser Enclosure

Standard: To AS 4145.4.

Performance: Lockwood 2334 Series, steel shackle

» Corrosion resistance: Corrosion Resistance Rating 4



» Security: Rating 5-7

Strike Plates

Use strike plates provided with the locks or latches. Do not provide "universal" strike plates.

31.2.4 Door Controllers

Performance

Door controllers specified generically: Provide door controllers, including door closers, floor or head spring pivots and automatic door operators, which are suitable for the door type, size, weight and swings required and the operating conditions, including wind pressure.

31.2.5 Keying

Contractor's Keys

Master key systems: Do not use any key under a master key system.

Delivery of Keys

Master keys: Arrange for the manufacturer or supplier to delivery direct to the principal.

Number of keys:

Group Keying

Existing system: Allow to master key the building on completion to the existing RailCorp system.

Stamping: Stamp keys and lock cylinders to show the key codes and/or door number as schedule.

Identification

Supply each key with a purpose-made plastic or stamped metal label legibly marked to identify the key, attached to the key by a metal ring.

Key Material

Level locks: Malleable cat iron or mild steel.

Pin tumbler locks: Nickel alloy, not brass.

31.2.6 Installation

Door Hardware

Mounting heights: Mount locks and latches so that the centreline of the lever spindle is 1000 mm above finished floor.

Proprietary doorsets: Provide the standard hardware.



Door Stops

Fixing: Fix on the floor, skirting or wall, as appropriate, to prevent the door or door furniture striking the wall or other surface.

Fasteners

Materials: Provide materials compatible with the item being fixed, matching where exposed, and of sufficient strength, size and quality to perform their function.

- » Concealed fixings: Provide a corrosion resistant finish to concealed fixings.
- » Exposed fixings: Match exposed fixings to the material being fixed.

Security: Locate exposed fixings to lock furniture on the inside faces of external doors and on the inside faces of internal doors to lockable rooms.

Support: Provide appropriate back support (for example lock stiles, blocking, wall noggings and backing plates) for hardware fixings.

Type: Sleeved compressible rubber tube type with separate base fixing.

Install to Door D04, D05 and D06.

Hinges

Metal frames: Fix hinges using metal thread screws.

Timber doorsets: Install butt hinges in housings equal in depth to the thickness of the hinge leaf (except for hinges designed for mounting without housing), and fix with countersunk screws.

Install extended butt hinges to D07 to enable leaves to swing at 180 deg.

31.3 Completion

31.3.1 Product Warranties

Automatic door operators: Submit a warranty (or interlocking warranties) from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of Completion.

Hardware: Submit the warranties offered by the manufacturer for the hardware items used in the works.

31.3.2 Adjustment

Leave the hardware properly adjusted with working parts in working order, and clean, undamaged, properly adjusted, and lubricated where appropriate.

Automatic door operators: Maintain and adjust the system throughout the defects liability period.



31.3.3 Keys

Contractor's keys: Immediately before Completion, replace cylinders to which the contractor has had key access during construction with new cylinders which exclude the contractor's keys.

Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver to the contract administrator at Completion.

31.3.4 Hardware Code Schedule

Door Controllers Schedule

Hardware Item	Door Types	Hardware Code
Proprietary name or generic term		
- Closer	D02, D03, D08	Lockwood 414
- Closer	D04	Two-hour rated.
- Closer	D07	Two-hour rated.

Door seals schedule

Hardware Item	Door Types	Hardware Code
Proprietary name or generic term		
Door Seals	External Doors D02, D03, D04	Raven surface RP38 RP28 Threshold plate Clear Anodised.
Door Seals	External Doors D04	Raven surface RP99Si for fire door application RP28 Threshold plate Clear Anodised

Locks and Latch Schedule

Hardware Item	Door Types	Hardware Code
Proprietary name or generic term	Roller Shutter D01	Slide bolt and padlock
Proprietary name or generic term	Combination Passage Latch D05, D06, D08	Lockwood 3574 Privacy latch to D05
Proprietary name or generic term	Panic Exit Device and Combination Passage Latch D07	Lockwood 9000 Series Lockwood single point horizontal 9000LA Series on the internal face and



Hardware Item	Door Types	Hardware Code
		Lockwood 3574 Passage Latch on external face, for 2-hr rated door.
Proprietary name or generic term	Panic Exit Device D02, D03	Lockwood 9000NL Series single point horizontal push bar with external 15SIL pull plate and Lockwood 8219 circular cylinder for Yale masterkey on external face.
Proprietary name or generic term	Panic Exit Device D04	Lockwood 9300EOSIL Series two point vertical push bar with external pull plate and Lockwood 8219 circular cylinder for Yale master key.

Latch and Plate schedule

Hardware Item	Door Types	Hardware Code
Proprietary name or generic term		
Lever Handles	Timber doors	Lockwood Artefact Series SS Type 96 handles and 21201NA backing plates
Gate Latch	Pipe framed gates G02, G04	Approved trip type catch for self latching and for padlocking.
Chain locking	Pipe Framed double entrance gates G01	8mm thick chain welded to one leaf capable of fixing with 10mm padbolt.
Security Gates	Steel framed	Refer to Section 40



32. Lining

32.1 Materials and Components

32.2 Quality

Witness Points

Give sufficient notice so that inspection may be made of substrate or framing before installation of linings.

32.3 Materials and Components

Plasterboard

Standard: To AS/NZS 2588.

Location: > Ceilings to Administration Room and Toilet

Grade: > Standard

Thickness (mm): > 10mm

Particleboard flooring

Standard: To AS/NZS 1859.1.

Grade: Class 1 flooring.

Fixing

On visible flooring, sink the heads of fixings below the surface and fill the sinking flush with a material tinted to match the flooring and compatible with the surface finish.

Adhesives

Contact adhesives: To AS 2131.

For plasterboard: To AS 2753.

For wallboards: Mastic adhesive.

32.4 Execution

Substrates or Framing

Before fixing linings check and, if necessary, adjust the alignment of substrates or framing.

Battens

Fix at each crossing with structural framing members, or direct to solid walls or ceilings. Provide wall plugs in solid backgrounds. Do not provide explosive powered fastenings.



Ceiling Linings

Do not install until at least 14 days after the timber roof structure is fully loaded.

Accessories and Trim

Provide accessories and trim necessary to complete the installation.

Adhesives

General: Provide adhesives of types appropriate to their purpose, and apply them so that they transmit the loads imposed, without causing discolouration of finished surfaces.

Plasterboard Supports

General: Install timber battens or proprietary cold-formed galvanized steel furring channels

- » where framing member spacing exceeds the recommended spacing; and
- » where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or substrate.

Transverse walls: Locate noggings

- » at least 150 mm from the horizontal joint; or
- » ensure that noggings do not protrude beyond the face of studs.

32.4.1 Installation

Gypsum plasterboard: To AS/NZS 2589.1.

- » Level of finish: >

Fibre reinforced gypsum plaster: To AS/NZS 2589.2.

Framed construction: Screw or nail or combine with adhesive.

Metal stud frames: Screw using galvanized self tapping screws, or retain using proprietary clamping straps and cover trims.

Masonry construction: Fix using adhesive direct to masonry, but do not fix direct to masonry as a substrate for tiled finish.

To furring channels: Fix using screw or screw and adhesive.

32.4.2 Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.

Butt joints: Make joints over framing members or otherwise provide back blocking.

External corner joints: Make joints over zinc-coated steel corner beads.

Dry joints: Provide square edged sheet and finish with a UPVC joining section.



Control joints: Install purpose-made zinc-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural movement joints.

Wet areas: Install additional supports, flashings, trim and sealants as required.

Joints in tiled areas: Do not apply a topping coat after bedding perforated paper tape in bedding compound.



33. Suspended Ceilings

31.1 Cross references

31.1.1 General

General: Conform to the *General requirements* worksection.

31.2 Standards

31.2.1 General

Suspended ceilings: To AS/NZS 2785.

31.3 Inspection

31.3.1 Notice

Inspection: Give notice so that inspection may be made:

- » Of the suspension system before the installation of lining.
- » Of the completed ceiling before site painting.

31.4 Submissions

31.4.1 Samples

General: Submit samples as follows:

- » Suspension system: Sections proposed for the suspension system, including wall angles and trim.
- » Accessories including hatches and wall trims.

33.5 Type tests

General: Submit type-test reports to verify conformance with the Suspended ceilings performance schedule and as follows:

- » Fire hazard properties:
 - Spread of flame index: To AS/NZS 1530.3.
- » Fire resistance level: To AS 1530.4.

33.6 Products

31.6.1 Suspension System

Proprietary System

General: Provide in conformance with the Proprietary suspended system schedule.



33.6.2 Plasterboard

Standard: To AS/NZS 2588.

Fire resistant: Formulated for additional resistance to fire exposure.

33.6.3 Adhesives

For plasterboard: To AS 2753.

33.6.4 Sealants

Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.

31.7 Cornice

31.7.1 Timber Cornice

Fixing: Plug and screw 42x19mm timber cornice to black walls in the Toilet.

31.7.2 Fire Rated Cornices

Type: Install wall angle support to suspended ceiling. Insert Fire Mastic sealant to the first sheet for full perimeter of wall and Rondo P50 shadow line stopping bead to the second sheet.

Location: Switchroom and Battery Rooms.

33.8 Execution

31.8.1 Suspension System

Failure: Provide a ceiling system such that failure of any one suspension point does not cause a progressive failure of the ceiling.

Height adjustment: Provide height adjustment by means of a length adjustment device at each suspension point, permitting length variation of at least 50 mm.

Grid members: If required, notch grid members at the junction with the perimeter trim to ensure the panels lie flat on the perimeter trim.

Restriction: Do not attach the suspension system to the lip of purlins.

33.8.2 Services

Support: Space the support members as required by the loads on the system and the type of ceiling, and allow for the installation of services and accessories, including ductwork, light fittings and diffusers. Provide additional back support or suspension members for the fixing of such items to ensure that distortion, overloading or excessive vertical deflection is prevented. Do not fix suspension members to services (e.g.



ductwork) unless the service has been designed to accept the ceiling load. In locations where services obstruct the ceiling supports, provide bridging and suspension on each side of the services. Do not support services terminals on ceiling tiles or panels.

33.8.3 Stability

General: Install the ceilings level; and fix so that under normal conditions there is no looseness or rattling of ceiling components.

33.8.4 Bracing

General: Provide bracing to prevent lateral movement and to resist the imposed horizontal seismic force.

33.8.5 Fasteners

General: Install fasteners so that they are not visible in the finished ceiling. Do not use screw fasteners in materials supporting hangers less than 3 mm thick.

33.8.6 Movement joints

Abutments: Install the ceiling to allow for differential movement at abutting surfaces.

Alignment: Install the ceiling with control joints at positions shown on the drawings.

Install Rondo P35 control joint with set finish.

31.9 Plasterboard lining

31.9.1 Installation

Gypsum plasterboard: To AS/NZS 2589.1.

Fibre reinforced gypsum plaster: To AS/NZS 2589.2.

Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.

31.9.2 Multiple Sheet Layers

Application: Fire rated and acoustic rated walls.

Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Install ceilings generally in accordance with current CSR Installation Guides.

31.9.3 Joints

Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.



Butt joints: Make joints over framing members or otherwise provide back blocking.
External corner joints: Make joints over metallic-coated steel corner beads.
Control joints: Install purpose-made metallic-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural movement joints.
Wet areas: Install additional supports, flashings, trim and sealants as required.

31.10 Fibre Cement Lining

31.10.1 Installation

General: Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.
Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.
Wet areas: To AS 3740.

31.10.2 Multiple Sheet Layers

Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

31.10.3 Joints

Dry joints: Provide square edged sheet and finish with a UPVC joining section.
Control joints: Provide purpose-made metallic-coated control joint beads at ≤ 7.2 m centres in walls and ceilings and to coincide with structural movement joints.
Wet areas: Provide additional supports, flashings, trim and sealants as required.

31.11.5 Trim

General: Provide trim such as beads, mouldings and stops to make neat junctions between lining components, finishes and adjacent surfaces.

31.11 Warranty

Provide warranty certificate for the ceiling fire rated access panels.



34. Tiling

34.1 General

34.1.1 Cross References

General

Refer to the *General Requirements* section.

34.1.2 Standard

General

Installation: To AS 3958.1.

34.1.3 Interpretation

Definitions

Substrate: The building element to which the tiles are to be bedded.

Underlay: An intermediate layer (e.g. render, screed or sheeting) applied to the substrate to provide a suitable surface for tile bedding.

Separation layer: A membrane laid on the substrate beneath the bedded finish to prevent the two elements from adhering to each other.

34.2 Quality

34.2.1 Inspection

Witness Points

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

- » Waterproofed substrate immediately before screeding or tiling.

34.2.2 Submissions

Tiling System

Tiling is to be executed as an integral system, incorporating all necessary components including, but not limited to, waterproofing, adhesives, underlay, trays, tapes, grouts and tiles. The system is to be installed by an Applicator approved by the manufacturer of the waterproofing system and to be warranted by the manufacturer and the Applicator.

Execution

Grouting: Submit proposals for grouting methods and materials.



Margins: If it appears that minor variations in joint widths or overall dimensions will avoid cut tiles, submit a proposal.

34.3 Materials and Components

34.3.1 Tiles and Accessories

Ceramic Tiles

Standard: To AS 4662.

Slip resistance testing and classification: To AS 4586.

Accessories

Provide tile accessories, which match the composition, colour and finish of the surrounding tiles.

34.3.2 Adhesives

General

Standard: To AS 2358 or AS 4992.1 (Int).

PVA (polyvinyl acetate) based adhesives: Do not provide in wet areas or externally.

Type

Generally: Provide adhesives compatible with the materials and surfaces to be adhered.

34.3.3 Grout

Type

Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.

- » For joints < 3 mm: 1:2 cement: sand.
- » For joints ≥ 3 mm: 1:3 cement: sand.

Pigments

Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.



34.4 Execution

34.4.1 Substrates

Drying and Shrinkage

Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:

- » Concrete slabs: 42 days.
- » Toppings on slabs and rendering on blockwork: A further 21 days.

34.4.2 Preparation

Suitably prepare substrates to receive the bedded finish, including the following:

- » Remove deleterious and loose material and leave the surface dust-free and clean.

34.4.3 Tiling Generally

Sequence

Fix wall tiles before floor tiles.

Cutting and Laying

Cutting: Cut tiles neatly to fit around fixtures and fittings, and at margins where necessary. Drill holes without damaging tile faces.

Laying: Return tiles into sills, reveals and openings. Butt up to returns, frames, fittings, and other finishes. Strike and point up beds where exposed. Remove tile spacers before grouting.

Variations

If necessary, distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

Protection

Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

34.4.4 Setting Out

General

Joint widths: Set out tiles to give uniform joint widths within the following limits:

- » Internal ceramic tiling: 1.5 - 3 mm.
- » Vitrified floor tiling: 3 - 5 mm.



Joint alignment: Set out tiling with joints accurately aligned in both directions and wall tiling joints level and plumb, to a tolerance of 4 mm in 2 m from the design alignment.

Margins: Provide whole or purpose made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

Fixtures: If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures, which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.

34.4.5 Falls and Levels

General

General: Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.

- » Fall, general:
 - 1:100 minimum.
- » Fall, in shower areas:
 - 1:60 minimum.

Flatness: Maximum deviation of the finished surface under a 2 m straight edge laid in any direction on an area of uniform grade:

- 3 mm.

Change of finish: Maintain finished floor level across changes of floor finish including carpet.

34.4.6 Bedding

Preparation of Tiles

Adhesive bedding: Fix tiles dry; do not soak.

Bedding

Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

Thin Adhesive Beds

General: Provide only if the substrate deviation is less than 3 mm when tested with a 2 m straight edge. Cover the entire tile back with adhesive when the tile is bedded.

Thickness: 1.5 - 3 mm.



Thick Adhesive Beds

General: Provide on substrates with deviations up to 6 mm when tested with a 2 m straight edge, and with tiles having deep keys or frogs.

Nominal thickness: 6 mm.

34.4.7 Grouted and Caulked Joints

Grouted Joints

General: Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.

Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

Edges of tiles: Grout exposed edge joints.

Epoxy grouted joints: Ensure that tile edge surfaces are free of extraneous matter such as cement films or wax, before grouting.

Caulked Joints

General: Provide caulked joints filled with sealant and finished flush with the tile surface as follows:

- » Where tiling is cut around sanitary fixtures.
- » Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- » At junctions with elements such as window and door frames and built-in cupboards.
- » At internal corners.

Width: 6 mm.

Depth: Right through to the substrate.

34.4.8 Joint Accessories

Floor Finish Dividers

General: Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.

Type: Angle

Material: Aluminium



34.5 Completion

34.5.1 Warranties

Provide a joint warranty from suppliers and Applicators of all tiling and waterproofing systems stating that all materials and components, supplied and installed must remain in good condition, secure against faulty workmanship and/or defective materials for 7 years.

34.5.2 Cleaning

Clean tiled surfaces using an appropriate tile cleaning agent, and polish.

34.6 Tiling Schedule

Location:			
Toilet			
Tile type:	Floor Tiles	Wall Tile	Skirting Tile
Proprietary Item	Refer <i>Internal finishes schedule</i>	Refer <i>Internal finishes schedule</i>	Refer <i>Internal finishes schedule</i>
Slip resistance grade	R11	N/A	R11 (same as floor tile)
Bedding:			
- Type	Adhesive	Adhesive	Adhesive
- Thickness (mm)	To manufacturer's specifications	To manufacturer's specifications	To manufacturer's specifications
Grout Colour	Grey	White	Grey



35. Painting

35.1 General

35.1.1 Cross References

General

Refer to the *General requirements* section.

35.1.2 Standards

General

Painting: Comply with the recommendations of those parts of AS/NZS2311 and AS/NZS 2312 which are referenced in this section.

35.1.3 Interpretation

Definitions

Standard: To AS/NZS 2310.

35.2 Quality

35.2.1 Submissions

Materials

Proprietary materials: If the brand of paint has not been specified, submit the proposed brand of paint and paint line, at least 3 weeks before the paint is required.

35.3 Materials

35.3.1 Materials and Components

Paints

GPC specifications: Provide paints and other materials which are scheduled in the Australian Paint Approvals Scheme "List of Approved Products" as complying with cited GPC specifications.

Quality: Provide premium quality lines.

Combinations

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



Delivery

Deliver paints to the site in the manufacturer's labelled and unopened containers. Ensure containers of materials specified by a GPC specification code are labelled accordingly.

Tinting

General: Provide only products, which are colour tinted by the manufacturer or supplier.

Tinting by contractor: Add tinters or stainers only if this is without detriment to the durability or aesthetic performance of the product.

Putty

General: Water based timber filler.

Toxic ingredients

Comply with the requirements of Appendix P "Uniform Paint Standard" to the Standard for the Uniform Scheduling of Drugs and Poisons.

35.3.2 Colour Selection

Methods

From manufacturer's chart: From the standard colour chart of the nominated manufacturer.

From AS 2700: From the Australian standard colour range specified in AS 2700.

From samples:

- » For paint systems: By requiring the paint to be mixed or tinted to match samples provided. Consult the paint manufacturer to ensure that the colours selected are of satisfactory durability and opacity, and will comply with requirements in the specified number of coats.

35.4 Execution

35.4.1 Painting

Standards

General: To AS/NZS 2311 Sections 3, 6 and 7.

Protection of steelwork: To AS/NZS 2312 Sections 4, 8 and 10.

Order of Work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings, floor sanding and laying flooring materials.



Protection

Fixtures: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the installation.

Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

"Wet Paint" Warning

Place notices conspicuously and do not remove them until paint is dry.

Restoration

Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up damaged decorative paintwork or misses only with the paint batch used in the original application.

Substrate Preparation

General: Prepare substrates to receive the painting systems.

Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

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

Drying

Use a moisture meter to demonstrate that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

Paint Application

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

Priming Before Fixing

Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

- » Bottoms of external doors.
- » Associated trims and glazing beads.

Repair of Galvanizing

General: For galvanized surfaces, which have been subsequently welded, prime the affected area.

Primer: To GPC-C-29/16, two pack.



Services

If exposed to view, paint new services and equipment including in plant rooms, except chromium, anodised aluminium, GRP, UPVC, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces. Repaint proprietary items only if damaged.

35.4.2 Paint Systems

Paint system Description

Final coat: If a paint or clear finish system is referred to only by its final coat (for example by the manufacturer's brand name, or the generic name) provide in addition to the final coat, the appropriate stains, primers, sealers and undercoats, suitable for the substrate and compatible with the finish coat and each other.

No system description given: If a surface is to be painted but no system is nominated select the system from AS/NZS 2311 clause 5.1, using System 1 where a choice is offered.

Number of Coats

Unless specified as one coat or two coat systems, each paint system consists of at least 3 coats. Provide additional coats if necessary to

- » prepare porous or reactive substrates with prime or seal coats consistent with the manufacturer's recommendations;
- » achieve the total film thickness or texture; or
- » achieve a satisfactory opacity.

Paint Systems Schedules

General: These schedules specify, for each of the paint systems listed in the **Painting Schedules**, and for each substrate to which those systems are applied in the project,

- » the number and order of coats; and
- » the paint type for each coat.

Codes: Codes are GPC Specification codes.

Flat latex: Interior

Substrate	1st Coat	2nd Coat	3rd Coat
Concrete	S-17/2	L-26/6	L-26/6
Cement render	S-17/2	L-26/6	L-26/6
Fibre cement	S-17/2	L-26/6	L-26/6
Masonry	S-17/2	L-26/6	L-26/6
Organic or inorganic zinc primed metal	S-17/1	L-26/6	L-26/6
Timber	P-18/3	L-26/6	L-26/6



Substrate	1st Coat	2nd Coat	3rd Coat
UPVC	U-16/1	L-26/6	L-26/6

Flat or low gloss latex: Exterior

Substrate	1st Coat	2nd Coat	3rd Coat
Concrete	L-26/3	L-26/3	
Fibre cement	L-26/3	L-26/3	
Masonry	L-26/3	L-26/3	
Oil-based air-drying primed metal	L-26/3	L-26/3	
Organic or inorganic zinc primed metal	L-26/3	L-26/3	
Timber	P-18/3	L-26/3	L-26/3
UPVC	L-26/3	L-26/3	

Full gloss, solvent-borne: Interior

Substrate	1st Coat	2nd Coat	3rd Coat
Iron & steel	P-32	E-15/4	E-15/4
Metallic-coated steel	P-13/4	E-15/4	E-15/4
Timber	U-16/1	E-15/4	E-15/4

Full gloss, solvent-borne: Exterior

Substrate	1st Coat	2nd Coat	3rd Coat
Iron & steel	P-32	E-15/3	E-15/3
Metallic-coated steel	P-13/4	E-15/3	E-15/3
Organic or inorganic zinc primed metal	P-13/4	E-15/3	E-15/3
Timber	P-18/1	U-16/1	E-15/3

35.4.3 Anti-Graffiti Paint

The external faces of the concrete block walls to the Transformer yards and the external brick walls of the building shall be treated with an anti-graffiti finish immediately after the blockwork has cured.

The finish shall be equivalent to Wattyl Paracryl IFC Antigraffiti Clear.

Application shall be in accordance with the manufacturer's recommendation



35.4.4 Clear Sealer

Apply one coat of approved clear acrylic sealer to internal brick and block walls to provide a dust proof finish to the walls.

35.5 Completion

35.5.1 Warranties

Refer to Warranties Schedule.

35.6 Painting Layout and locations

Refer architectural drawings and Finishes Schedules.



36. Metal Fixtures

36.1 General

36.1.1 Cross References

General

Refer to the *General requirements* section.

36.1.2 Submissions

Design

Calculations: Submit calculations and other data demonstrating detailed compliance with performance criteria.

36.2 Materials

36.2.1 Materials and Components

Metals

Performance: Provide metals suited to their required function, finish and method of fabrication, in sections of strength and stiffness adequate for their purpose.

Copper alloys (brass, bronze, etc.)

Composition and designations: To AS 2738.

Rivets

Blind rivets where available in the required metal.

Masonry anchors

Proprietary types comprising screws or bolts in self-expanding sockets.

Masonry plugs

Screws in purpose-made resilient plastic sockets.

36.3 Execution

36.3.1 Construction Generally

Aluminium structures

Standard: To AS/NZS 1664.1 or AS/NZS 1664.2.



Metals

Performance: Provide metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.

Incompatible metals: Separate using concealed layers of suitable materials in appropriate thicknesses.

Fasteners

Performance: Provide fasteners so that they do not cause galvanic corrosion.

Materials: Provide fasteners in materials of mechanical strength and corrosion resistance at least equal to that of the lowest resistant metal joined.

To copper and copper alloys: Provide copper or copper-alloy fixing devices only.

To aluminium and aluminium alloys: Provide aluminium alloy or non-magnetic stainless steel fixing devices only.

To stainless steel: Provide appropriate stainless steel materials only.

Fabrication

Workshop: Fabricate and pre-assemble items in the workshop wherever practicable.

Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges without excessive radiusing.

Tube bends: Form bends in tube without visibly deforming the cross section.

Colour finished work: Match colours of sheets, extrusions and heads of fasteners.

Thermal movement: Accommodate thermal movement in joints and fastenings.

Fabrication Tolerances

Structural work generally: 2 mm.

Joints

General: Fit joints to an accuracy appropriate to the class of work. Finish visible joints made by welding, brazing or soldering using grinding, buffing or other methods appropriate to the class of work, before further treatment.

Self-finished metals: Free of surface colour variations, after jointing.

Joints: Fit accurately to a fine hairline.

36.3.2 Welding and Brazing

General

Quality: Provide finished welds, which are free of surface and internal cracks, slag inclusion, and porosity.

Site welds: Do not weld on site.



Butt weld quality level: Not inferior to the appropriate level recommended in AS 1665 Appendix A.

Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not use butt joints relying on the filler metal fillet only.

Filler metal: >

36.4 Pipe Railings

Standard

Materials, design and construction: Comply with the recommendations of AS 1657.

Fabrication

Method: Welding.

Joints: Produce smooth unbroken surfaces at joints. Scribe the joints between posts and rails. Make end-to-end joints over an internal sleeve.

Bends: Make changes of direction in rails by evenly curved pipe bends.

Free ends: Seal the free ends of pipes with fabricated or purpose made end caps.

Refer to Structural drawings for extent and design of the handrail a

Fixing to Structure

Provide fabricated predrilled or purpose made brackets or post bases, and attach the pipework to the retaining wall capping beam with galvanised masonry fixings. ,

Galvanizing

If possible, complete fabrication before galvanizing; otherwise apply a zinc-rich primer to affected joint surfaces.

Galvanise external handrail only.

36.5 Corner Guards

Fabricate corner guards from 100x75x6mm steel plate at position shown on drawings.

Galvanise finish on completion and masonry anchor fix with 12mm gal bolts at maximum 450mm centres.

Dimension as shown on the drawings.

Paint finish as shown on External Finishes Schedule.

36.6 Flue Support Brackets

Fabricate and install flue support brackets as detailed on the drawings.

Construct from 6mm plate steel with full length fillet weld connections.



Galvanise the bracket assembly on completion after forming connection holes.

Masonry anchor fix through wall cladding to blockwork as detailed. Ensure blockwork is reinforced and core filled at the bracket fixing locations.

36.7 Air Conditioner Condenser Brackets

Supply and install 2 No gal steel brackets masonry anchor fixed to brickwork to support the condenser unit.

Liaise with mechanical contractor for weight of the condenser to select suitable brackets.

36.8 Security Grilles

General

Type: Proprietary metal security grille screen fixed to the building structure with tamper resistant fastenings.

Installation of Security Grilles

Standard: To AS/NZS 4605.

Type: Grilles shall comprise 20mm gal square steel bars in with 40x6mm gal steel frame and transome members equally spaced at approximately 1050mm centres as shown on drawings.

Gal masonry anchor fix grilles into external brick reveals at 600mm centres.

Paint finish as per External Finishes Schedule.

NOTE:

- » Security bars are not required to Battery Rm louvre L04.
- » Install top and bottom transome members only to L05 and L03.
- » Install top, bottom and centre transome members only to L01.

36.9 AC Condenser Security Enclosure

General

Type: Galvanised steel security enclosure fixed to the building structure with masonry anchors.

Installation of Enclosure

Type: Enclosure shall comprise 20 mm gal steel bars welded to 40x6 mm gal steel flats as detailed for masonry fixing to brickwork.

Provide lift off front grille attached to the enclosure frame by locating lugs at the top cross frame member and at the bottom by 2 No welded staples at each corner and gal pins with padlocks.



Construct front grille with minimal tolerance to lift off to ensure top lugs and bottom pins retains the grille flush within the frame.

Fix the enclosure to the external brick wall with gal 16mm masonry anchors at 4 locations each side as drawn.

Touch-up galvanised finish as required on completion.



37. Timber Fixtures

37.1 General

37.1.1 Cross References

General

Refer to the *General requirements* section.

37.2 Quality

37.2.1 Materials

Plywood

Interior use generally: To AS/NZS 2270.

Interior use, exposed to moisture: To AS/NZS 2271.

Particleboard

Standard: To AS/NZS 1859.1 (Int).

Melamine overlaid particleboard: Particleboard overlaid on both sides with low pressure melamine.

Dry-processed Fibreboard

Standard general purpose medium density fibreboard: Medium density fibreboard (STD MDF) overlaid on both sides with low pressure melamine.

Decorative Overlays

Standard: To AS/NZS 1859.3.

High-pressure Decorative Laminate Sheets

Standard: To AS/NZS 2924.1.

Thickness (minimum):

- » For horizontal surfaces fixed to a continuous background: 1.2 mm.
- » For vertical surfaces fixed to a continuous background: 0.8 mm.
- » For post formed laminate fixed to a continuous background: 0.8 mm.
- » For vertical surfaces fixed intermittently (e.g. to studs): 3.0 mm.
- » For edge strips: 0.4 mm.

Steel Sheet

Surface finish:

- » For painting: B (bright) or M (matt).



Stainless Steel

Grade: S30400

Finish: Surface finish 4 (general purpose polished).

37.3 Execution

37.3.1 Construction Generally

General

Accuracy: Build components square and install plumb.

Joints: Provide materials in single lengths whenever possible. If joints are necessary make them over supports.

Framing: Frame and trim where necessary for openings, including those required by other trades.

Accessories and trim: Provide accessories and trim necessary to complete the installation.

Adhesives

General: Provide adhesives to transmit the loads imposed and to ensure the rigidity of the assembly, without causing discolouration of finished surfaces.

Decorative laminated sheets: Contact adhesive to AS 2131.

Finishing

Junctions with structure: Scribe benchtops, splashbacks, ends of cupboards, kickboards and returns to follow the line of structure.

Joints: Scribe internal and mitre external joints.

Matching: For surfaces which are to have clear or tinted finish, arrange adjacent pieces to match the grain and colour.

37.4 Components

37.4.1 Vanity

Material:

- » Wet Areas: High moisture resistant medium density fibreboard. Finish: High-pressure decorative laminated sheet.

Thickness: 33 mm.

Colour: Refer *Finishes Schedule*.

Edges:

- » Shaped nosings: Extend laminate over shaped nosings.



» Straight edges: Laminex 2mm thick ABS edge strip to match benchtop or worktop.

Undersides: Laminate undersides of benchtops.

Installation: Scribe to walls. Fix to timber battens on back and side walls.

37.5 Completion

37.5.1 Cleaning

Progressively clean up the Works. On completion remove all off-cuts and unused material and clean the Works.



38. Miscellaneous Furniture & Fixtures

38.1 General

38.1.1 Cross References

General

Refer to the *General Requirements* section.

38.2 Quality

38.2.1 Inspection

38.2.2 Tests

Fire Hazard Limits

If a spread of flame index or smoke developed index is required for a furniture item, type test to AS/NZS 1530.3.

38.2.3 Submissions

Subcontractors

Submit names and contact details of proposed suppliers and installers.

Installation

Submit the manufacturer's standard drawings and details showing methods of construction, assembly and fixing, with dimensions and tolerances.

38.3 Materials and Workmanship

38.3.1 Hazardous Materials

Fire Hazard

General: Do not provide materials which, when subject to fire conditions, will emit excessive smoke or dangerous fumes.

38.3.2 Materials

Steel Tube

Surface:

» For painted work: Semi-bright.



Steel Sheet

Surface finish:

- » For electroplating: P (plating quality).
- » For painting: B (bright) or M (matt).

Stainless Steel

Grade S30400

Finish: Surface finish 4 (general purpose polished).

Flexible Cellular Polyurethane

Standard: To AS 2281.

Applications: Generally as recommended in AS 2281 Appendix A.

38.3.3 Fire Extinguishers

Supply and install 6A:80B(E) 7.5 Kg powder fire extinguishers to AS 2444 including signs and wall brackets in positions as indicated.

Extinguishers in the Transformer Yards shall be installed in a proprietary weatherproof, enclosure, plug and screwed to the wall.

38.4 Miscellaneous Fixtures Schedule

Description	Product	Colour/Finish	Product Code	Location
Paper Towel Dispensers	Bradley Econo-Roll	Stainless Steel satin finish	258	Toilet
Toilet Roll Holder	Bradley single roll dispenser	Stainless Steel	5054	Toilet
Bin	Bradley (wall mounted)	Stainless Steel satin finish	356	Toilet
Coat Hooks	Lockwood bumper & coat hook (2)	Chrome	L432SC	Toilet door
Utility Shelf	Bradley	Stainless Steel	9953	Toilet wall, adjacent to tap



39. Landscape Works

39.1 General

39.1.1 Cross References

Refer to the *General requirements* section.

General

Related sections

Refer to the following sections: >

39.2 Scope

Replace vegetation to earth batters where existing has been removed for construction the works.

39.3 Standards

Soils

General: To AS 4419.

Interpretation

Definitions

Site topsoil: Soil excavated from the site, which has the following characteristics:

- » Contains organic matter.
- » Supports plant life.
- » Free from unwanted matter.

Unwanted matter (in topsoil):

- » Stones over 25 mm diameter.
- » Clay lumps.
- » Weeds and tree roots.
- » Sticks and rubbish.
- » Material toxic to plants.

Imported topsoil:

- » Fine: Clay loam, fine sandy loam, sandy clay loam, silty loam, loam.
- » Medium: Sandy loam, fine sandy loam.
- » Coarse: Sand, loamy sand.

Topsoil mixture: Topsoil and compost or other additives, thoroughly mixed before placing.



39.4 Quality

Inspection

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

- » Subgrades cultivated or prepared for placing topsoil.
- » Plant material delivered to site
- » Plants placed and ready for backfilling
- » Completion of planting bed work.

39.5 Weed eradication

Herbicide: Eradicate weeds using environmentally acceptable methods, such as a non-residual glyphosate herbicide in any of its registered formulae, at the recommended maximum rate.

Manual: Regularly remove, by hand, rubbish and weed growth throughout grassed, planted and mulched areas. Remove weed growth from an area 750 mm diameter around the base of the trees in grassed areas. Continue eradication throughout the course of the works and during the planting establishment period.

39.6 Subsoil

Ripping

General: Rip parallel to the final contours wherever possible. Do not rip when the subsoil is wet or plastic.

Ripping depths: Rip the subsoil to the following typical depths:

- » Compacted subsoil: 300 mm.
- » Heavily compacted clay subsoil: 450 mm.

Cultivation

Minimum depth: 100 mm for turfed areas and 150mm for planting beds.

- » Grassed areas (seeded, turf, strip turf, stolonized):
- » Hydroseeded or hydromulched areas:

Services and roots: Do not disturb services or tree roots; if necessary cultivate these areas by hand.

Cultivation: Thoroughly mix in materials required to be incorporated into the subsoil. Cultivate manually within 300 mm of paths or structures. Remove stones exceeding 25 mm, clods of earth exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during cultivation. Trim the surface to design levels after cultivation.



39.7 Additives

General: Apply additives after ripping or cultivation and incorporate into the upper 100 mm layer of the subsoil.

Gypsum: Incorporate at the rate of 0.25 kg/m².

39.8 Topsoil

Source

General: Import topsoil for turfed areas and planting beds. .

Placing topsoil

General: Spread the topsoil on the prepared subsoil and grade evenly, making the necessary allowances to permit the following:

Finishing: Feather edges into adjoining undisturbed ground.

Consolidation

Compact lightly and uniformly in layers. Avoid differential subsidence and excess compaction and produce a finished topsoil surface, which has the following characteristics:

- » Finished to design levels.
- » Smooth and free from stones or lumps of soil.
- » Graded to drain freely, without ponding, to catchment points.
- » Graded evenly into adjoining ground surfaces.

Topsoil Types

Turfed Areas: Medium to coarse imported topsoil

Planting Beds: Topsoil mixture equal to that supplied by Australian Native Landscapes for native species.

Top dressing: Coarse topsoil

Topsoil particle size table (% passing by mass)

AS sieve aperture	Soil textures		
	Fine	Medium	Coarse
2.36	100	100	100
1.18	90 - 100	95 - 100	95 - 100
0.60	75 - 100	75 - 100	70 - 90
0.30	57 - 90	55 - 85	30 - 46
0.15	45 - 70	38 - 55	10 - 22



0.075	35 - 55	25 - 35	5 - 10
0.002		2 - 15	2 - 8

Topsoil Depths

Planting Beds: 300mm

Surplus Topsoil

General: Spread surplus topsoil on designated areas on site, if any; otherwise, dispose off site.

39.9 Fertiliser

Provide proprietary fertilisers, delivered to the site in sealed bags marked to show manufacturer or vendor, weight, fertiliser type, N:P:K ratio, recommended uses and application rates.

Fertiliser Schedule

Location	N:P:K Ratio	Application Rate
Planting Beds	63:18:28	As recommended by manufacturer

39.10 Plants

Plants

General: Provide plants with the following characteristics:

- » Large healthy root systems, with no evidence of root curl, restriction or damage.
- » Vigorous, well established, free from disease and pests, of good form consistent with the species or variety.
- » Hardened off, not soft or forced, and suitable for planting in the natural climatic conditions prevailing at the site.

Replacement: Replace damaged or failed plants with plants of the same type and size.

Plant Schedule

Plant Key	Plant Species	Number Required	Plant size (mm)
			Container size
Cl	Callistemon linearis	13	5l
Cr	Correa reflexa	9	5l
Ds	Dillwynia sieberi	10	5l
El	Epacris longiflora	9	5l
Hs	Hakea sericea	8	5l



Hd	Hibbertia diffusa	11	200 pot
Pr	Pittosporum revolutum	8	25l

Storage

Deliver plant material to the site on a day to day basis, and plant immediately after delivery.

Planting Conditions

Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend excavation when the soil is wet, or during frost periods.

Watering

Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress.

Placing

Remove the plant from the container with minimum disturbance to the root ball, ensure that the root ball is moist and place it in its final position, in the centre of the hole and plumb, and with the top soil level of the plant root ball level with the finished surface of the surrounding soil.

Fertilising

Pellets: In planting beds and individual plantings, place fertiliser pellets around the plants at the time of planting.

Application rate: As recommended by the manufacturer

Backfilling

Backfill with topsoil mixture. Lightly tamp and water to eliminate air pockets. Ensure that topsoil is not placed over the top of the root ball, so that the plant stem remains the same height above ground as it was in the container.

39.11 Mulching

Mulch

General: Provide mulch, which is free of deleterious and extraneous matter such as soil, weeds and sticks.

Standard: To AS 4454.

Mulch material: Pine bark nuggets from *Pinus radiata* spp (Mini Nuggets)

Placing Mulch

General: Place mulch to the required depth, clear of plant stems, and rake to an even surface flush with the surrounding finished levels. Spread and roll mulch so that after



settling, or after rolling, it is smooth and evenly graded between design surface levels sloped towards the base of plant stems in plantation beds, and not closer to the stem than 50 mm in the case of gravel mulches.

In mass planted areas: Place after the preparation of the planting bed but before planting and other work.

Application: Place mulch clear of plant stems, and rake to an even surface flush with the surrounding finished levels.

Depths: Spread organic mulch to a depth of 75 mm, and gravel mulch to a depth of 50 mm.

Application: 75mm to all planting beds, but reduce depth around plant stems to nil.

39.12 Stakes and Ties

Stakes

Material: Hardwood, straight, free from knots or twists, pointed at one end.

Installation: Drive stakes into the ground for at least a third of their length, avoiding damage to the root system.

Stake sizes:

- » For plants ≥ 2.5 m high: Three 50 x 50 x 2400 mm stakes per plant.
- » For plants 1 - 2.5 m high: Two 50 x 50 x 1800 mm stakes per plant.
- » For plants < 1 m high: One 38 x 38 x 1200 mm stake per plant.

Ties

General: Provide ties fixed securely to the stakes, one tie at half the height of the main stem, others as necessary to stabilise the plant.

Tie types:

- » For plants ≥ 2.5 m high: Two strands of 2.5 mm galvanized wire neatly twisted together, passed through reinforced rubber or plastic hose, and installed around stake and stem in a figure of eight pattern.
- » For plants < 2.5 m high: 50 mm hessian webbing stapled to the stake.

39.13 Completion

Planting Establishment

Period

Commencement: The planting establishment period commences at the date of practical completion.

Required period: >12 weeks

**Recurrent Works**

Throughout the planting establishment period, carry out maintenance work including, watering, mowing, weeding, rubbish removal, fertilising, pest and disease control, reseeding, returfing, staking and tying, replanting, cultivating, pruning, hedge clipping, aerating, reinstatement of mulch, renovating, top dressing, and keeping the site neat and tidy.

Replacements

Continue to replace failed, damaged or stolen plants.

39.14 Completion**Product Warranty**

Submit the supplier's written statement certifying that plants are true to the required species and type, and are free from diseases, pests and weeds.

Cleaning

Stakes and ties: Remove those no longer required at the end of the planting establishment period.

Temporary fences: Remove temporary protective fences at the end of the planting establishment period.



40. Fences And Gates

40.1 General

40.1.1 Cross References

General

Refer to the *General Requirements* section.

40.2 Quality

40.2.1 Inspection

Witness Points

Give sufficient notice so that inspection may be made of set out before placing posts.

40.3 Materials and Components

Wire

Chainwire, cable wire, tie wire and barbed wire: To AS 2423.

Chainwire shall be 3.15mm base thickness and 4.15mm coated thickness

Coating: zinc/aluminium alloy coating W02Z with black PVC finish.

Posts, Rails and Braces

Shall be galvanised finish, minimum W10Z/HG

40.4 Execution

4.4.1 Construction Generally

Setout

Set out the fence line and mark the positions of posts, gates and bracing panels.

Clearing

Except for trees or shrubs to be retained, clear vegetation within 1 metre of the fence alignment. Grub out the stumps and roots of removed trees or shrubs and trim the grass to ground level, but do not remove the topsoil except where a new surface treatment is indicated on the drawings.

Note that trees on the Council footpath are to remain except where trees interfere with installation of the fence post footings or are within 500mm of the of the fence.



Excavation

Excavate postholes so that they have vertical sides and a firm base. Remove surplus material from site.

Line and Level

Erect posts vertically. Set heights to follow the contours of natural ground on the footpath side.

Concrete Footings/Fixings

In ground: Place mass concrete around posts as shown on the drawings and finish with a weathered top falling 25 mm from the post to ground level. Footing size in accordance with AS 1725, using 300dia x 1000mm at corner posts and gates and 250dia x 600mm for intermediate fence posts.

On slabs: Provide welded and drilled post flanges and fix with 3 masonry anchors per post (Type-B to AS 1725).

At concrete retaining walls, install fence posts to inside face of wall with proprietary galvanised clamp plates, minimum 2 fixings per post.

Allow for backstays in accordance with AS 1725 to provide additional support to fence posts with similar concrete footing preparation and base plates as for the posts.

40.4.2 Gates

Hardware

Provide the following:

- » Drop bolt and ferrule to each leaf of double gates.
- » Concrete pads for drop bolts at the open and closed positions.
- » Latch to one leaf of double gates.
- » Provision for locking by padlock on external side of gate
- » For clip type hinges, provide collar welded to the gate frame to provide a bearing surface for top and bottom hinges (G02, G04). For double gates (G05) install gudgeon pins to the bottom hinge only.

40.5 Fence Types

Chainwire Barriers

Standard

General: To AS 1725.

Fence Dimensions

Maximum post spacing:

Type-A Corridor Fence: 3000 mm.



Type-B Security Fence: 2400 mm

Type-C Insulating Fence 3000 mm

40.5.1 Type-A Corridor Fence

Component Sizes

Intermediate posts: 48.3 mm diameter OD, 2.6 mm wall thickness with steel caps.

End, corner and gateposts: 88.9 mm diameter OD, 4.0 mm wall thickness.

Chainwire: 3.15 mm diameter wire woven to form uniform mesh.

- » Selvedges: Knuckled.
- » Mesh generally: 50 mm.
- » Tie wire: 2 mm diameter.

Post and rail barriers:

- » Rails and gooseneck stay: 42.4 mm OD, 2.6 mm wall thickness. Rails shall be provided at top and bottom of all fences for 2400mm fabric height. Clearance from bottom rail to finished ground surface shall be 80mm
- » Cable wires:
 - Two strands: 3.15 mm diameter wire.
 - One strand: 4 mm helicoil wire.

Security barriers:

- » Chainwire selvedges: Twisted and barbed.

Installation

Posts: Do not splice members except in posts when splice is embedded at least 150 mm into concrete. Fit tightly fitting steel caps to posts, except where fixed to overhead structure.

Chainwire: Lace chainwire to end and gate posts. Tie chainwire twice around members at 250 mm maximum intervals. Twist ends twice and cut off neatly.

Cable wire: Tension cable wire(s) to support chainwire after at least 24 hour curing of concrete footings.

1. Concrete Footing Installation.

- » Footing size:
 - Intermediate and end posts: 250 mm diameter x 600 mm depth.
 - Corner posts and gate: 300 mm diameter x 1000 mm depth.

Post and rail barriers:

- » Rails: Connect rail(s) to posts using bolted split pipe fittings and purpose-made caps and brackets with rail apertures.



- » Continuous rail type fences: Join the rails together in long lengths using purpose-made sleeves or socketed connections, and pass them through the apertures of caps and brackets on intermediate posts.

2. Wall fixing: Fix fence posts to inside face of concrete retaining wall using proprietary clamping system equal to Downee RMD with 2 No clamps per post. Posts shall extend minimum 450mm below the top of the retaining wall with top clamp 100mm below the wall and the bottom clamp 50mm up from the bottom of the post.

Gates

Construct gates generally in accordance with Appendix-E of AS 1725.

All joints fully welded with minimum 6mm for fillet welds,

Touch up welds with 2 coat zinc rich paint to surfaces damaged by welding.

Height of gate to match height of fence (G05) or 2100mm (G02, G04).

Gate to be covered with chain link fabric as for the fence and laced with 2mm lacing wire to the outer frame and tied to each internal member.

Gate Type-D (G02, G04)

Frame tubes: 33.7 mm OD, 2.6 mm wall thickness.

Intermediates frame: 26.9 mm OD, 2.3 mm wall thickness.

Double Gates Type-E (G05)

Frame tubes: 42.4 mm OD, 2.6 mm wall thickness.

Intermediates frame: 33.7 mm OD, 2.6 mm wall thickness.

Include 3 rows of barbed wire. Gate generally to match existing double gates.

Locking

Install the following locking systems to gates

Gate Type-E (G02, G04)

Install trip type cam latch for slam closing. Latch to enable padlocking with up to 10mm dia padlock.

Gates Type-D (G05)

Install 8mm galvanised chain welded to gate frame and length suited for padlocking (by the Principal) with 10mm dia padlock.

Provide DN25 medium x 150mm long keepers set in 2 No 200x200x300mm deep concrete footings for the open position and brass ferrule set in the concrete dish drain adjacent to the grating for the closed position.

40.5.2 Existing Fences

Existing fences are to be retained including making good at junction with new Corridor or Insulating fences.



Existing barbed wire topping shall be re-tensioned where the wire is sound and capable of re-tensioning or replaced with new barbed topping where wires have deteriorated.

40.5.3 Insulating Fence

Refer to drawings for construction details of timber post insulating fence, Type-C.

40.5.4 Type-B Security Fence

Component Sizes

All fence and gate posts: 100 UC pre-drilled with vertical slotted holes at spacings recommended by the fence manufacturer for fixing the mesh. Weld 100x50x5mm angle cleats with slotted holes to columns for fixing top and bottom rails as detailed.

Block wall posts: 40x40mmx5mm.

Top and bottom rails: 65x50x6mm angle rails shall be installed at the top and bottom of the fence. Clearance from underside of the bottom rail to finished top surface of the concrete bund shall be maximum 50mm. Pre-drill with holes at spacings recommended by the fence manufacturer for fixing the mesh.

Mesh: 4mm diameter horizontal and 4mm vertical wire size equal to Gryffin 358 Securifor with vertical rods external.

Topping: Top of mesh fence and block walls shall be finished with nominal 550mm dia (installed) stainless steel concertina short barbed tape.

Finish: All post and rail members including posts in block walls, shall be galvanised. Fence weldmesh panels shall be powdercoat with panels site measured and cut prior to powdercoating. Any on site cut panels (or other fence members) should be kept to a minimum and shall receive cold gal touch up and additional pre-paint treatment prior to hand painting to match the powdercoat.

Transparent Barrier: 10mm clear polycarbonate flat sheet. Size to cover the full face of each exit gate including fixing onto the top and side of the lock mounting plate. Provide similar panel 1000mm wide x nominal 2400mm high located on fence panels adjacent to the lock side of the gate except where noted.

Installation

Fence Posts: Shall be cast into the bund wall with minimum 600mm embedment.

Install additional reinforcement in the bund wall around the post as detailed.

Rails: Install 65x50x5mm angle top and bottom rails bolted to posts cleats as detailed. Fix rails to cleats with 2 No M12 galvanised bolts and washers.

Mesh: Fix mesh to posts and top and bottom rails at centres recommended by the mesh manufacturer or 300mm vertically and 250mm horizontally. Vertical mesh shall be on the external face with the 75mm aperture in the horizontal direction. Fixings shall be M8 stainless steel with C-washers and stainless steel shear nuts. Mesh shall



be fixed to the inside face of the UC flanges. Adjust the position of the rails on the cleats to align the mesh fixing (and/or mesh/acrylic) on the rail with the inside face of the of the post flanges so the mesh remains in the same plane across each bay.

Block Wall Posts: Cast posts into the top of wall as detailed with 300mm minimum embedment. Posts shall be 500mm high. Notch capping block around posts and point with non-shrink grout.

Transparent Barrier: Fix barrier over the gate and fence panel adjacent as detailed. Fix underneath the security mesh using common screw fixing for both materials.

Barbed Tape: Fix barbed tape in accordance with the following:

Top Rails: Proprietary HD U-Clip screwed to the top of the rail and wrap coil around extended UC fence posts.

Block Walls: Proprietary 25x70mm V-mesh strip, plug and screw to capping block and wrap around 40 EA posts.

Gates

Type-F Security Gates G01, G03

Frames: 75x50x5mm welded steel angle perimeter frame with 2 No back-to-back 50x50x5mm (T-section) angles for the mid rail. Pre-drill slotted holes for mesh fixing prior to powdercoating. Gaps at gate frame to gate post and head rail shall not exceed 5mm. The lock stile shall have a 50x5mm flat welded full height to the frame to cover the jamb gap. Weld 2 No 4 mm thick plates to the mid rail for fixing and protecting the lock and fixing the edge of the weldmesh/acrylic sheet.

Hinges: 3 No 100mm galvanised butt hinges with 4 fixings per hinge of thickness suitable to support the weight of the gate. Hinges shall be bolt fixed to the gate frame and gate posts with 8mm stainless steel c/sunk screws. Hinges shall be designed to prevent removal of the gate in the closed position.

Finish: Gate shall be galvanised to frame members and powdercoat to the mesh panels as for the fence in black including same treatment to make good for on-site cutting.

Lock: Locks shall have escape function internal with external cylinder equal to Lockwood 002, Deadlatch Lever to suit the Yale master key system used by RailCorp.

Installation: Install mesh and polycarbonate as for fence construction generally, ie to the inner face of the angle frame using slotted fixing holes to align the mesh. Bottom of gate frame shall align with the fence bottom rail.

Install 20x20mm latch keeper angle to post frame as detailed.

40.6 Mesh Infill Wall

Install chain wire wall to perimeter of the ceiling slab above the Administration Room, Toilet and Battery Room as shown on the drawings, including access gate to each ceiling space.



Fix at base to timber plates as detailed and at top into suspended ceiling structure.

Construct generally in 42.4 OD gal pipes and gate from 33.7 OD pipe. Install proprietary gate latch suitable for padlocking with 6mm dia shaft.

40.7 Fence Schedule

Type of Barrier	Type-A Perimeter Fence incl replacement Boundary Fence	Type-B Security Fence to Transformer Yards	Type-C Insulating Fence Panel
Description			
Height from finished ground to top rail (fabric plus bottom 80mm rail clearance)	1880mm		Height to match existing boundary fence adjacent
Height from finished bund to top rail incl 50mm bottom rail clearance)		2450mm	
Height from top of block wall to top of angle post		600mm	
Post and rail barriers:			
» Number of rails	2 (top and bottom)	2 (top and bottom)	2 (top and bottom)
Security barriers:			
» 3 rows barbed wire	450mm high		NA
» Short barbed tape		550mm dia	

40.8 Chainwire and Security Gate Schedule

Type of Barrier	Opening Size		
	Type- D Single Corridor Fence Gates	Type-E Double Security Gates to Transformer Yards	Type F Security Gates
Height from finished ground to head rail (allow 80mm clearance to gate bottom rail)	2100mm G02, G04		
		To match	



Type of Barrier	Opening Size		
	Type- D Single Corridor Fence Gates	Type-E Double Security Gates to Transformer Yards	Type F Security Gates
Height from finished driveway crossing to gate top rail (allow 80mm clearance to gate bottom rail)		adjoining fence mesh panel height plus 450mm for 3 rows barbed wire G05	
Height from top of bund to underside of head rail (allow 50mm clearance from <u>top</u> of bund)			2385mm
Post and rail barriers:			
» Number of rails	3 (top, centre and bottom)	3 (top, centre and bottom)	Top and bottom
Width	950mm G02, G04	4000mm G05	1000mm nominal opening width
Locking	Trip type cam latch	Chain, keeper blocks and ferrule as specified	Lockwood 002 on mounting plate

40.8 Bollards

Steel Tube Bollards

Type: Bollards fabricated from heavy steel tube, to minimum nominal size DN 100, to AS 1074. Seal free ends with fabricated end caps, spot welded and ground smooth.

Finish: Galvanize after fabrication.

Footings: Encase in a concrete footing at least 600 mm deep x 250 mm diameter.

On slabs: Weld on a 10 mm thick baseplate drilled for 4 bolts, and bolt to masonry anchors.

Filling: Fill the tube with 15 MPa concrete.



41. Finishes Schedule

External

Location	Finish	Colour	Comment
Roof and Ventilators			
Sheeting	Colorbond	Match existing	Incl awning roof
Barge & Ridge Cappings	Colorbond	Match existing	
Flashings, trims	Colorbond	Match existing	
Gutters and Fascia	Colorbond	Match existing	
Metal wall cladding	Colorbond	Dune	
Downpipes Generally	Colorbond	Match existing	
Ventilation shaft turbine and fixing strap	Powdercoat	Dulux Duralloy "Woodland Grey" 84220	Colorbond equivalent
Ventilator brackets	Paint	Colour to match Woodland Grey	
Windows & Doors			
Aluminium louvre panels	Powdercoat	Dulux Duralloy "Arrowhead" 50258	



Location	Finish	Colour	Comment
Steel Corner Guards at roller shutters	Paint	Dulux Black with 45 deg yellow stripes	Black and yellow stripes 100mm wide
Air Conditioner frame	Gal finish	NA	
Roller Shutter	Colorbond	Woodland Grey	
Timber Doors and Frames	Paint	Dulux "Brood" P12B7	Match powdercoat to louvres
Security Bars	Paint	Black	
Walls			
Switchroom Building	Face brick Anti-graffiti paint	Match existing Clear	
Link Yard	Face Block Anti-graffiti paint	Refer Brickwork Section Clear	
Floors			
Bunded Transformer Yards	Resin Sealer	Clear finish	
Fences			
Metal fences	Galvanised frames	NA	



Location	Finish	Colour	Comment
	Powdercoat to security mesh panels	Black	
Timber fence (insulating fence)	Treated pine	Clear finish	Approved external grade clear finish treatment

Internal

Item	Finish	Colour	Comments
Floors			
Switchroom building and new DCCB cubicle	Paving paint	Equal to Berger Aquatread	Match existing building
Floor Tile	Tile	Johnsons Kerastar 150 x 150 "Priamus", Gripfoot surface	
Battery Room	Acid Resisting Paint	Equal to Wattyl Multiguard, 3-coat system, with sand for non-slip finish between coats 2 and 3. Standard Grey finish.	
Skirtings			
Skirting Tile (Toilet only)	Tile	Johnsons Kerastar "Priamus" coved skirting tile	



Walls & Partitions

Brickwork (cubicle walls)	Face brick	Match existing
	Dust sealer	Clear
Blockwork	Face block	As per Brickwork Schedule
	Dust sealer	Clear
Toilet wall tiles	Tile	Johnsons Waringa 150 x 150 "Ultra White"
FC duct cover to DCCB cubicles	Paint	Dulux "Grey Pail" PG1 A1

Doors and Frames

Admin Room. Toilet and Battery room, inside face of external doors	Paint	Dulux "Brood" P12B7
Plywood panels to DCCB cubicle fronts	Paint	Dulux "Grey Pail" PG1 A1

Ceiling

All ceilings	Paint	Dulux "Vivid White" PW1 H
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Joinery Finishes Schedule

Item	Finish	Colour	Comments
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Joinery

Toilet vanity laminate	Flint Finish	"Ocean Shimmer"	
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Fascia board to Administration and Toilet rooms	Paint	White	
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42. Mechanical Works

42.1 Scope of Contract

42.1.1 Scope

The work covered in this specification consists of the site survey, finalisation of installation details, co-ordination, installation documentation, supply, delivery, installation, lifting, testing, commissioning, installation certification, warranty and maintenance for the provision of new mechanical systems and associated electrical and controls as indicated in this specification and the drawings to serve the Newtown Traction Substation located in Newtown NSW.

The scope of the project includes:-

- » Natural ventilation to the equipment rooms.
- » Air conditioning to the administration room.
- » Mechanical ventilation to the toilet.

42.1.2 Description of Work

The equipment rooms are to be naturally ventilated utilising wind driven turbines. The turbines are to be connected to high-level exhaust grilles, mounted on external ductwork in the new building and roof mounted in the existing building. Make up air will be introduced to the rooms via weatherproof louvres in the external walls.

A split system air conditioning unit is to be installed to serve the administration room. The indoor fan coil unit will be wall mounted within the room and the outdoor condensing unit will be wall mounted externally.

An exhaust fan will be mounted in an external wall to ventilate the toilet. Make up air shall be via the undercut door.

42.1.3 Extent of Work

The extent of work to be performed shall comprise but not be limited to:

- » Submission of detailed shop drawings for the complete installation for review prior to commencement of work.
- » Submission of details of equipment for review prior to ordering.
- » Detailed drawings showing locations and sizes of penetrations, plinths, drain points, and any other item required to be provided by other trades.
- » Co-ordination of work with other trades and existing structure.
- » 1 of factory assembled air-cooled reverse cycle split system air conditioning unit comprising a wall mounted indoor fan coil unit and a wall mounted outdoor condensing unit complete with interconnecting refrigerant piping, wiring and controls as scheduled.



- » Refrigeration piping shall be insulated to manufacturer's requirements and where exposed to weather shall be protected by sheet metal cladding. The sheet metal cladding shall be painted to match colour of the associated wall.
- » Condensate drain pipework to be run to waste. Pipework to be copper.
- » 12 of factory assembled wind activated turbine ventilators with powder coat finish as scheduled.
- » Supply and install aluminium circular ductwork for exhaust air systems complete with mesh exhaust grilles as shown on the drawing. Ductwork to be painted to match powder coat finish of ventilators.
- » 1 of wall mounted toilet exhaust fan as scheduled.
- » Labelling of equipment with permanent labels.
- » All minor items and incidental work required for proper completion of the works.
- » All inspection fees necessary for the completion and certification of the works.
- » As installed drawings and operating and maintenance manual.
- » Co-ordination of work with client including programming of the works.
- » Attendance at meetings as requested by the client.
- » Attendance at witness and hand over tests.
- » Commissioning and testing of installation.
- » Certification of installation.
- » Twelve (12) months warranty maintenance and defects rectification.

42.1.4 Work By Other Trades

The following work, associated with this trade will be carried out by other trades:

Work by Building Trade

- » Provision of weatherproof air intake louvres having 55% free area complete with birdmesh. The total area of louvres shall be minimum 19m².
- » Provision of penetrations.
- » Provision of weatherproof flashing of all external penetrations.
- » Provision of support brackets for wall mounted outdoor condensing unit, ventilators and ductwork, subject to advice from the mechanical contractor on the type and adequacy of the proposed supports.
- » Undercut the toilet door.
- » Provision of opening in battery room to enable room to be naturally ventilated to AS2676.1.

Work by Electrical Trade

- » Provision of a 15 amp 240 volt 1 phase electrical supply for air conditioning unit terminating with a weatherproof isolation switch adjacent to the external unit.



- » Provision and termination of 240 volt 1 phase electrical supply to the toilet exhaust fan from lighting circuit. Fan to operate through light switch.

42.1.5 Submissions

Shop Drawings

The Contractor shall produce or obtain, and submit for review, comprehensive installation and shop drawings, with notes and/or specifications (hereinafter called shop drawings) for such parts of the works as are necessary or specified in the Contract, or as set out below.

The shop drawings shall be submitted following detailed co-ordination with other trades.

Such drawings shall be submitted to allow sufficient time for examination, production and supply so as not to delay progress of the works. The drawings shall be examined and returned to the Contractor with acceptance or otherwise of the work shown for use on or in connection with the Contract. Where amendments to such drawings are required, the amendments shall be made and re-submitted promptly, without variation.

The Contractor shall not stockpile, manufacture, assemble or supply anything affected by such drawings until he has obtained acceptance for the drawings, which shall not be unreasonably delayed.

Examination of the drawings shall not diminish the Contractor's responsibility for ensuring that they are in agreement with the Contract documents and correct as to all relevant information.

Shop drawings shall take account of site dimensions, actual dimensions and access requirements for installation and servicing of the particular brands and models of equipment supplied, and shall co-ordinate with the building structure, finishes and other services in accordance with the design details and general arrangements shown on the design drawings and shall comply with Statutory Authorities.

The Contractor shall prepare shop drawings from the latest available information.

The drawings shall include, but not limited to the following:

- » Ductwork layouts at scale not less than 1:50 showing positions and sizes of all ducts, dampers and registers. Drawings shall also include extent, type and thickness of insulating materials and provide details of clearances for co-ordination with other trades.
- » Layout drawings showing the position and size of all penetrations required through the structure both horizontally and vertically in all masonry components (walls, slabs, beams, roof etc) and the positions and size of all sleeves.
- » Layout drawings showing all other necessary builders work including plinths, outside air louvres, access panels penetrations and other appropriate provisions.
- » Fixing and support method for attaching ventilation flues to the block walls or roof brackets. The mechanical contractor shall be responsible for advising the size,



dimensions and type of mounting brackets required on the building structure for fixing the ventilation shafts.

- » Wiring diagram for all mechanical equipment and control circuits.

Operating and Maintenance Manual

Prior to Completion and acceptance of the work, the contractor shall provide two (2) hard copies and one (1) electronic copy in Microsoft Word doc format of a complete Operating and Maintenance Manual, which shall contain the following information:

- » As-built drawings of equipment;
- » Equipment list including make, model, capacities and duties;
- » Balance and test reports;
- » Design conditions and general description of equipment and systems;
- » Normal operating procedures;
- » Manufacturer's trouble-shooting suggestions for equipment and literature
- » Equipment selection data eg fan operating point;
- » Inspection and maintenance procedures and schedule;

The manual shall be neatly prepared and bound in a vinyl hard-back folder (preferred colour white) with stamped lettering on the front.

As Installed Drawings

Prior to Completion, the Contractor shall provide two (2) complete sets of "As Installed" drawings at A1 size and electronic copy in AutoCad 2004 format. These drawings shall include all changes and variations made during the execution of the work and shall be included in the Operating and Maintenance Instructions.

The drawings shall include the following information:

- » Layout drawings showing actual duct positions,

All drawings shall have a graphic scale as well as a designated scale.

42.1.6 Obvious Minor Work

Provide all minor work(s) and provide minor parts, which are necessary for the successful completion of the work(s) without extra charge or delay.

42.1.7 Rules and Regulations

All work performed shall be complete with all necessary equipment for its satisfactory operation, control and maintenance under all normal conditions of service and shall comply in all respects with the latest issue and/or revision of applicable Australian Standards or Code of Practice at the time of tender as referred to in this Specification:

- » The Local Government Authority.
- » Building Code of Australia including the latest revisions.



- » The Standards Association of Australia.
- » The Australian Refrigeration and Air Conditioning Code of Good Practice HB 40.
- » Any other Statutory Authority having jurisdiction over this installation.

Work not covered by the requirements of Statutory Authorities or this Specification shall comply with the appropriate publication of the Standards Association of Australia and/or relevant publications of the British Standards Institution will be held to apply.

On completion of the installation the Contractor shall arrange and bear the costs for each authority having jurisdiction to inspect and check the contract works and to obtain compliance certificates from such authority to effect that the equipment, machinery and installation comply with the authority's requirement and Building Code of Australia. The Contractor shall advise the RailCorp of the date that the inspection is to take place, to enable the RailCorp or his representative to be present.

42.2 Details of Equipment

42.2.1 General

This Section of the Specification covers the basic minimum requirements in respect of type, materials, workmanship and installation of the major items of mechanical plant and equipment to be provided for the satisfactory operation of the various systems as intended.

The Subcontractor shall offer plant and equipment which they consider to be most suitable for the application and the arrangements shown on the drawings. Notwithstanding this, the plant and equipment offered shall comply in every respect with the requirements of the Design Criteria as nominated and all capacities and other performance requirements covered in the schedules and drawings and elsewhere in the Specification.

The Subcontractor shall ensure that all plant and equipment offered and accepted for installation shall operate satisfactorily within the standard ranges of capacities and speeds guaranteed by the manufacturers and that the manufacturers and/or suppliers have received, during the tender period, complete information pursuant to their offers and are fully cognisant of the work involved and the requirements of this Specification in so far as these relate to the plant and/or equipment offered.

All sizes shown are indicative only and shall be rechecked when producing the shop drawings to ensure all sizes can be accommodated.

42.2.2 Split System Air Cooled Air Conditioning Unit

Supply and install factory assembled performance guaranteed reverse cycle split system air conditioning units where shown on the drawings, as scheduled and to the following requirements: -



Indoor Fan Coil Section

Type	Wall mounted type comprising internally insulated cabinet containing supply fan, fan drive motor, evaporator coil, filter and drip tray.
Casing	Casings shall be constructed of minimum 1.5mm thick galvabond panels suitably internally insulated with 15mm faced insulation.
Fan	Centrifugal, forward or backward curved with adjustable speed direct drive. Fan statically and dynamically balanced.
Coil	Copper tubes, aluminium fins. Four row, fin spacing 1.74 mm.
Installation	Mount unit on wall. Fit condensate drain trap to unit and run to waste.
Controls	A matching factory produced control panel complete with temperature display and adjustment and unit operation controls shall be mounted on the wall adjacent to the fan coil unit.
Labelling	Clearly visible and robust manufacturer's nameplate permanently fitted showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw etc.

Outdoor Condensing Section

Type	Air-cooled type with weatherproof housing containing hermetic compressor, condenser coil, condenser fan and motor and factory wired power and control panel.
Casing	Casings shall be constructed of minimum 1.5mm thick galvabond prime coated and finished in heavy-duty powder coat.
Coil	Copper tubes, aluminium fins with mechanically bonded corrosion resistant coating. Two row, fin spacing 1.74 mm.
Fan	Direct driven propeller type.
Refrigeration:	Refrigerant R 22 or other approved refrigerant. Hermetic compressors vibration isolated within cabinet. Refrigerant circuits to include compressor service valves, filter drier, sight glass, crankcase heater and HP/LP controls.



Electrical	Fully wired electrical panel including all operating and safety controls.
Installation	Mount units on prefabricated galvanised wall bracket with rubber pad vibration isolators.
Labelling	Clearly visible and robust manufacturer's nameplate permanently fitted showing the manufacturer's name, type and/or model number, serial number, and all essential operating data such as speed, capacity, voltage, current draw etc.
Ambient Conditions	38 deg C.
Approved Manufacturers	Daikin or approved equal.

42.2.3 Wind Activated Turbine Ventilators

The wind activated turbine ventilators shall be manufactured from aluminium with vertical turbine vane and shall be free running on ball bearings or self-lubricating bearings. Ventilators shall conform to AS 2428.1 for dynamic wind load and rain penetration testing.

Bases shall be suitable for duct mounting.

Ventilators Construction shall be:

Turbine & throat	Aluminium 5005 H34
Shaft	Aluminium 2011 T3
Dome & skirt	Aluminium 1200 H0
Brackets	Aluminium 6060 T591
Finish	Powder coated

- » Ventilators shall be Hurricane type as manufactured by Edmonds or approved equal.

42.2.4 Fan

Supply and install wall fan where shown on the drawings, as scheduled and to the following requirements: -

Type:	Propeller fan with weather and impact resistant plastic housing
Shutters:	Electrically operated automatic shutters
Motor:	Motor designed for continuous operation with thermal overload protection



Electrical: Single phase 240V

Installation: Mount fan with galvanised steel wall tube built into wall.

Fans shall be Stylvent type as manufactured by Fantech or approved equal.

42.3 Ductwork

42.3.1 General

All ductwork systems shall be manufactured from marine grade aluminium complete with transitions, bends, tees, supports, dampers, off-sets, flexible connections take-offs and similar fittings necessary for the balancing and full operation of the distribution system. Manufacture and install all ductwork in accordance with the latest editions of AS 4254. All duct sizes are shown with clear internal dimensions of the air passage.

42.3.2 Materials

Low pressure sheet metal ductwork shall be fabricated from marine grade sheet to AS 1734. The thicknesses of the sheet metal shall fully comply with SMACNA Standard to the relevant pressure class or AS 4254 not less than 3.0 mm thick.

42.3.3 Circular Sheet Metal Ductwork

All circular sheet metal ductwork for low and medium pressure application shall be fabricated from full size aluminium sheet specifically manufactured for roll forming. In all cases, long runs of duct up to 2400 mm in length shall be fabricated from continuous sheets unless broken by transitions, bends etc. Patched ductwork fabricated from small pieces shall not be used.

In general all circular ductwork shall comply with SMACNA except that proprietary spiral lock seam type duct may be used, with proprietary duct fittings such as reducers, bends and tee-pieces and provided that the proprietary system employs the duct sizes indicated on the accompanying drawings. In particular, preference will be given to the use of pressed metal bends in lieu of lobster back bends.

All longitudinal seams in shop fabricated rolled ductwork shall be of the grooved (AMCE) lock seam type. All site joints shall be of either the spigotted or flanged type.

All joints in circular ducting exposed to the weather or carrying air borne steam noxious and moisture (eg. Kitchen exhaust, evaporative cooling system, laboratory fumes, toilet exhausts etc) shall be sealed with a synthetic rubber sealing compound similar to 3M EC800 or approved equivalent applied to the metal surfaces prior to making the joints.

All circular sheet metal ductwork for medium pressure applications shall be fabricated as per the preceding clauses except where the following requirements supervene.

All shop joints and duct fittings and in particular lobster back bends and all circumferential joints, should preferably be fully welded and all surfaces damaged by welding shall be made good.



All shop and “on-site” joints which have not been fully welded shall be sealed with a synthetic rubber sealing compound similar to 3M EC800 or approved equivalent.

Exposed circular ductwork shall be fitted with proprietary joint fittings and care taken to disguise the joint visually. Exposed jointing shall be subject to the approval of the RailCorp.

42.3.4 Sealing and Flashing

All ducts protruding through walls and exposed to view shall be provided with neat aluminium sealing frames fixed to ducts and to walls as appropriate.

Where ducts protrude through external walls they shall be double flashed with fully welded or soldered joints and rendered completely weatherproof to the approval of the RailCorp.

42.4 Refrigerant Pipework

42.4.1 Pipe Materials & Fittings

The successful tenderer shall be responsible for piping design and sizing in accordance with the equipment manufacturer’s recommendations.

Supply refrigerant piping in full standard lengths or with ends sealed or capped prior to and during installation.

Use copper piping manufactured from phosphorous deoxidised non-arsenical copper to AS 1572-122a and complying with AS 1432, AS 1571, AS 1572 and AS B160 as appropriate.

42.4.2 Testing

Advice shall be given not less than 48 hours in advance for all tests so that a representative may be present.

Upon completion of erection, pressure test the refrigeration circuit except for the pressure gauges, controls and compressors, which may be valved off, with dry inert gas.

Where leaks are detected they shall be marked and repaired after the pressure in the system has been released. Brazed joints which leak shall be opened and remade, and shall not be repaired by the addition of silver brazing alloy to the joint. After all leaks have been repaired the system shall be re-tested with the test pressures maintained for a period of not less than 24 hours. No measurable drop in pressure should be detected.

After the satisfactory completion of the pressure tests the system shall be evacuated. A high-vacuum pump shall be connected to both the high and low pressure sides of the refrigeration system with all valves open and all controls connected. The vacuum shall be measured with calibrated gauges of the Macleod or the electronic type of approved manufacture.



The vacuum pump shall operate on the system until the pressure has been reduced to less than 200 microns (0.2 mm) Hg absolute and as low as the pump will bring it, and then allowed to operate at this minimum pressure for a period of six (6) hours. The pumps shall then be stopped and the system shall be isolated and allowed to stand for six (6) hours. If the pressure rises during this period the leaks shall be found and rectified and evacuation repeated.

On completion of the evacuation the system shall be charged with the correct quantity of refrigerant and oil.

42.5 Air Grilles

42.5.1 Exhaust Grilles

Exhaust grilles shall be natural aluminium wire mesh type complete with flange frame.

Grilles shall be free from distortion, bends, surface defects, irregular joints, exposed fastenings and operation vibration and mounted with secure and concealed fixings.

Pressure drop: ≤ 5 Pa at the documented airflow.

42.6 Controls

42.6.1 General

This section of the specification covers the controls work associated with the mechanical services equipment detailed elsewhere in the specification.

The entire electrical and controls installation shall be in accordance with the current regulations, the requirements of the local Supply Authority and with the relevant SAA Codes, in particular AS 3000.

Supply and install the complete electrical and controls installation as required for satisfactory operation, control, maintenance and safety of mechanical services equipment, under all conditions of service and suitable for the working environment.

In summary, the works to be supplied and installed shall include the following:

- » Electrical wiring of all new mechanical equipment.
- » Manual and automatic controls for all new mechanical systems.

42.6.2 Control Function

Administration Room Air Conditioning Unit

- » Start/stop operation shall be manual and temperature control shall be automatic from a wall-mounted factory assembled proprietary remote controller located in the administration room.
- » Cooling mode shall be activated when room temperature exceeds 23°C to maintain room temperature of 24°C (adjustable).



- » Heating mode shall be activated when room temperature is below 19°C to maintain room temperature of 20°C (adjustable).

Toilet Exhaust Air Fan

- » Exhaust air fan shall be operated from the light switch and runs whenever the lights are turned on (This work is to be undertaken by the Electrical Services Contractor).

42.7 Mechanical Commissioning

42.7.1 General

This work shall include the adjustment of all variables to meet the specified requirements, the setting of motor overloads, safeties, controls etc. to protect the plant from unsafe operation. In particular, the following work shall be undertaken:

- » Check and correct, if necessary, initial charges of lubricant and refrigerant.
- » Calibration and adjustment of safety devices, overloads and other controls.
- » The correct direction of operation of motors.

42.7.2 Refrigerant Systems

Refrigeration piping systems shall be pressure and vacuum tested as described in the Refrigeration Piping section of this specification.

Record HP and LP cut-out settings.

Suction and condensing pressures and the operation of expansion devices shall be checked and proven to approval.

Record all motor amperages and overload settings.

42.8 Mechanical Maintenance

42.8.1 Maintenance Period

During the Defects Liability period, be responsible for maintaining the installed equipment in a correct operating condition. Replace any equipment or parts found to be faulty or not achieving the specified conditions. Maintain the systems during this period.

42.8.2 Operational Maintenance

Allow for maintenance of all mechanical services plant as following the manufacturers maintenance procedures for the duration of the Defects Liability period.



42.8.3 Maintenance Report

Each monthly report shall contain a description of the findings of the service any remedial action and comments on any anticipated further remedial action that may be necessary.

42.9 Schedules of Equipment

42.9.1 Air Conditioning Unit

Reference No.	AC1
Area Served	Administration Room
System Form	Reverse cycle split system
Total Cooling /Heating (KWr)	2.5/3.3
Ambient Temp. (°C)	38
Operating Current (Amps)	5
Electrical Supply	240/1/50

42.9.2 Wind Activated Turbine Ventilators

Reference No.	TV1 to TV5
Area Served	New Equipment Room
Mounting	Duct mounted
Air Flow Rate @ Wind Speed of 6 km/h (L/s)	1233
Throat size (mm)	799

Reference No.	TV6 to TV11
Area Served	Existing Equipment Room
Mounting	Roof mounted
Air Flow Rate @ Wind Speed of 6 km/h (L/s)	540
Throat size (mm)	511

42.9.3 Exhaust Fan

Reference No.	EAF1
Area Served	Toilet
Fan Type	Axial



Mounting	Wall mounted
Air Flow Rate (L/s)	40
Static Pressure (Pa)	60
Speed (rps)	21
Motor (Kw)	0.1
Electrical Supply	240/1/50



43. Electrical Works

43.1 Scope of Work

This Contract covers the design, manufacture, supply, delivery to site, installation, testing, commissioning, and warranty of the Electrical Services pertaining to the Newtown Traction Substation Building Services as specified herein including the drawings forming part of this Contract. This specification must be read in conjunction with the Drawings to fully understand all aspects of the scope of work

The Scope of Work shall include but not be limited to the following:

- » Supply and installation of submains from the DC rectifier control cubicle via a 600/415V auxiliary transformer to the 415V AC Auxiliary Distribution Board including all terminations;
- » Supply and installation of 415V Auxiliary Distribution Switchboards including all switchgear and controlgear;
- » Supply and installation of 120V DC Distribution Switchboards including all switchgear and controlgear;
- » Supply and installation of all internal and external luminaires. Provide suitable support frames and brackets for light fittings as necessary to complete the installation;
- » Supply and installation of light switches, contactors and lighting control equipment (PE cell) for internal and external luminaires;
- » Supply and installation single line diagram, distribution board general arrangement drawing in separate wall mounted holder adjacent to 415V auxiliary switchboard;
- » Supply, installation and termination of submains cables to air conditioning unit, hot water system, toilet exhaust fan and all other equipment as further documented;
- » Supply and installation complete earthing system, including continuous earthing of cable trays and other metal cable supports, equipment cabinets and racks, electrical equipment and switchboard;
- » Supply and installation of all submains and sub-circuit wiring including all termination and connection for all such cables. Confirm all loads and final locations with the RailCorp prior to installing new submains;
- » Supply and install cable identification markers and underground cable route markers;
- » Supply and installation of underground conduits and pits including all excavation and backfilling;
- » Supply and installation of cable tray including support brackets. Provide additional structural support frames and brackets where necessary.
- » Supply and installation of self-contained emergency escape luminaires and EXIT signs;



- » Supply and installation of lighting control and discharge test control for emergency escape luminaires in accordance with AS2293.1;
- » Supply and installation of socket outlets and power isolators including all terminations;
- » Supply and installation of an AS1670 fire detection and alarm system including alarm output to SCADA RTU for remote monitoring;
- » Supply and installation of wall and mounting boxes for socket outlets, isolators and switches. Provide fire rated and acoustic mounting boxes between fire rated walls where required;
- » Supply and installation of lighting and power final sub-circuit cabling and associated cabling infrastructure and fixings;
- » Supply and installation of all necessary support frames for all panels and switchboards;
- » Provision of penetrations and coordinate major structural penetrations with RailCorp.
- » Supply and install permanent labels on the 415V auxiliary distribution board The labelling system to be employed shall be issued to the RailCorp for review and approval prior to the manufacture of labels;
- » Supply and installation of permanent labelling of each socket outlet and isolator denoting circuit number and rating. The labelling system to be employed shall be issued to the RailCorp for review and approval prior to the manufacturer of labels;
- » Submission of workshop drawings for review and approval by the RailCorp;
- » Submission of all test documentation for review and approval by the RailCorp;
- » Testing and commissioning of the entire installation including provision of all test apparatus;
- » Provision of Form 15 Annual Fire Statement Certificate for the essential services installed under this Contract;
- » Supply of operation and maintenance manuals and as built drawings in AutoCAD release 2004 for review and approval by the RailCorp;
- » Maintenance service during the Defects Liability Period

Final location and mounting height of all new and relocated socket outlets shall be confirmed with the RailCorp prior to the installation of outlets.

43.2 Work by Other Trades

43.2.1 Work by Builder

- a) Patching and making good to conduits chases and penetrations in walls.
- b) Patching and making good to chases around switch and outlet boxes, etc.
- c) Any floor, roof, wall or ceiling penetrations, with trimming.



- d) Access panels for ceiling access in normally inaccessible building spaces.
- e) All cuttings, patching, framing-up, furring-in and making good etc. associated with the building structure for the passage of cables, cable trays and conduits etc. The Electrical Contractor shall supply detailed drawings and marking out to and as required by the builder. The Electrical Contractor shall verify the above prior to submitting tender price in order for the builder to make provision when submitting its tender price. Any item not detailed to the builder shall be at the cost of the Electrical Contractor.
- f) All penetrations in masonry or block work structure for the penetration of cable trays and ducts. The Electrical Contractor shall provide all information, setting out, supervision and sleeves as required by the Builder.
- g) Provide a survey of all existing underground services to and on the site. Builder shall coordinate all excavation on site to avoid possibility of interference with existing underground services.

It is the responsibility of the Electrical Contractor to provide information to the Builder in sufficient time for his works. Works associated with Electrical Contractor to be completed so as not to delay the overall programme.

Any additional costs incurred due to the provision of inadequate, incorrect or out-of-sequence information shall be recoverable from the Electrical Contractor.

43.2.2 Work by Mechanical Services Trade

- a) Provision of all mechanical equipment. Termination of submains cables to the Mechanical equipment shall be by the Electrical Services Contractor. The Mechanical Services Contractor shall isolate for cable testing by the Electrical Services Contractor.
- b) Provision of mechanical loads to the Electrical Services Contractor for coordination. No submains to be installed until loads have been confirmed by mechanical services contractor.

43.2.3 Work by Hydraulic Services Trade

- a) Provision of all hydraulics equipment. Termination of submains cables to the hydraulics equipment shall be by the Electrical Services Contractor. The Hydraulic Services Contractor shall isolate for cable testing by the Electrical Services Contractor.
- b) Provision of hydraulic equipment electrical loads to the Electrical Services Contractor for coordination. No submains to be installed until loads have been confirmed by mechanical services contractor.



43.3 General Requirements

43.3.1 Rules, Regulations and Codes

All works performed under this Contract shall comply with the requirements of Supply Authority, WorkCover Authority, State Pollution Control Commission, Australian Communication Authority (ACA) and other authorities having jurisdiction over the work. The Electrical Contractor shall be responsible for arranging inspections and obtaining approval from such authorities for the entire installation.

All works performed and equipment supplied under this Contract shall conform in design, material, construction, workmanship and performance to the latest edition of the appropriate Australian Standards or, if there is no Australian Standard applicable, with the current relevant International Electrotechnical Commission (IEC), British Standards or other relevant codes.

The following list indicates those standards most relevant to this Contract. It must be noted that standards related to Component parts that are not listed below are to be complied with:

AS/NZS CISPR 11	Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement
AS/NZS CISPR 14.1	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus - Emission
AS/NZS 1020	The control of undesirable static electricity
AS 1345	Identification of the contents of piping, conduits and ducts.
AS 1675	Current transformers - Measurement and protection.
AS 1680.1	Interior Lighting: General principles and recommendations.
AS 1680.2.1	Interior Lighting: Circulation spaces and other general areas.
AS 1680.2.2	Interior Lighting: Office and screen-based tasks.
AS 1692	Tanks for flammable and combustible liquids.
AS/NZS 1768 (Int)	Lightning protection
AS 1930	Circuit breakers for distribution circuits (up to and including 1000V a.c. and 1200V d.c.).
AS 2184	Low voltage switchgear and control gear – Moulded-case circuit breakers for rated voltages up to and including 600V a.c. and 250V d.c.
AS 2201	Parts 1 and 3. Intruder Alarm Systems.



AS/NZS 2293	Emergency evacuation lighting for buildings – System design, installation and operation
AS/NZS 2430	Classification of hazardous areas series standards
AS 2467	Maintenance of electrical switchgear.
AS 2700	Colour standards for general purposes.
AS/NZS 3000	Electrical installations (known as the Australian/ New Zealand Wiring Rules)
AS/NZS 3008.1.1	Electrical installations – Selections of cables – Cables for alternating voltages up to and including 0.6/1kV – Typical Australian installation conditions
AS/NZS 3013	Electrical installations – Classification of the fire and mechanical performance of wiring systems
AS/NZS 3017	Electrical Installations – Testing and inspection guidelines
AS/NZS 3080	Telecommunications installations – Generic cabling for commercial premises (ISO/IEC 11801:2002, MOD)
AS 3111	Approval and test specification – Miniature over current circuit-breakers
AS 3190	Approval and test specification – Residual current devices (current operated earth-leakage devices)
AS/NZS 3191	Electric flexible cords
AS/NZS 3439.1	Low-voltage switchgear and controlgear assemblies – Type-tested and partially type-tested assemblies
AS/NZS 3947:2001	Low Voltage Switchgear and Control Gear.
AS 4070	Recommended practices for protection of low voltage electrical installations and equipment in MEN systems from Transient voltages
AS 4398.1:1996	Insulators
AS 4594.0-1999	Internal combustion engines - Performance.
AS/NZS 4534:1998	
AS/NZS 4680:1999	Hot dipped Galvanised Coatings on Ferrous Articles
AS/NZS 4792:1999	
AS/NZS 4782.1:2004	Tubular Fluorescent Lamps for General Lighting Service



AS/NZS 5000.1:2003	Elastometer Insulated Electric Cables and Flexible Cables for Working Voltages of 0.6/1kV
AS/NZS 5000.1:2003	Electric cables – Polymeric insulated – For working voltages up to and including 0.6/1 (1.2) kV
AS/NZS 60079	Electrical apparatus for explosive gas atmospheres series standards
AS/NZS 60269.1	Low voltage fuses – General Requirements
AS 60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS 60923:1998 AS/NZS 60922:1998	Ballast for High Pressure Mercury Vapour and Low Pressure Sodium Vapour Discharge Lamps
AS 60947.1	Low voltage switchgear and control gear – General Rules
AS 60947.4.1	Low voltage switchgear and control gear – Contactors and motor starters – Electromechanical contactors and motor starters
AS 60947.4.2	Low-voltage switchgear and control gear – Contactors and motor-starters – A.C. semiconductor motor controllers and starters
AS 60947.5.1	Low voltage switchgear and control gear – Control circuit devices and switching elements – Electromechanical control circuit devices
AS/NZS 61000	Electromagnetic Compatibility (EMC) series standards
AS/NZS 61241	Electrical apparatus for use in the presence of combustible duct series standards
ASC 151	Busways (enclosed busbar-wiring system).
IEC 60255	Electrical relays series standards

43.3.2 Abbreviations

The following abbreviations are used in this specification and on the Tender drawings:

AS	Australian Standard.
AS/NZS	Australian/New Zealand Standard.
BS	British Standard.



Approved	shall mean approved by the RailCorp or the RailCorp's representative.
Directed	shall mean directed by the RailCorp or the RailCorp's representative.
Indicated	shall mean as specified in the related tender documents.
DB	Distribution board.
IE	Integral Energy (supply authority)
HDHC	Hard drawn high conductivity (copper).
MDB	Main distribution board.
MIMS	Mineral insulated metal sheathed cable (copper).
PABX	Private automatic branch/exchange (telephone).
PVC	Polyvinylchloride.
PVC-SWA-PVC	PVC insulated steel wire armoured and PVC served (cable).
SAA	Standards Association of Australia.
Supply Authority	The authority which supplies electricity to the locality of the particular project to which the Contract documents apply.
Switchboard	Main switchboard, main distribution board, switchboard, distribution board, control board, control panel or similar enclosure.
TPI	Thermoplastic insulated (cable).
TPS	Thermoplastic insulated and sheathed (cable).
Wiring Rules	The current edition of the SAA Wiring Rules AS/NZS 3000.
XLPE	Cross-linked polyethylene cable.

43.3.3 Certification

The Contractor shall certify that all essential services covered by this specification are designed and installed in accordance with the relevant Australian Standard as required by Local Government (Approvals) Regulation. All certification shall be submitted to the RailCorp for witnessing prior to Completion.



43.3.4 Temporary Power Supply

The Electrical Contractor shall undertake liaison with the Supply Authority to ensure a temporary three phase power supply is provided on site for works under this contract.

43.3.5 Location of Equipment

The Electrical Contractor shall coordinate the final location of all outlets and other items of equipment with the other trades. The exact locations shall be determined in conjunction with the RailCorp and via the shop drawing submission and approval process. The RailCorp prior to commencement of the associated installation works must approve the position of each outlet.

All service outlets shall be of the same mounting height, aligned vertical and horizontal, and level with other outlets adjacent unless otherwise noted. When more than one outlet is installed adjacent in a group these outlets shall be evenly spaced apart.

43.3.6 Cutting and Making Good

The Electrical Contractor shall do all minor cutting, drilling, etc necessary for the installation of the work.

The Electrical Contractor shall cooperate with the Builder to the fullest extent possible to minimise the cutting, drilling, etc, of finished work. Structural members shall not be cut or drilled without prior consent from the RailCorp.

All firewalls penetrated by the Electrical Contractor shall be sealed with fire rated compound. Any outlet to be installed in a fire rated wall shall not affect the rating of that wall.

43.3.7 Installation to be Easily Maintained

Notwithstanding any approvals given during the progress of the work all equipment and materials shall be installed in such a way that they are easily maintained and cleaned when the installation and the building are completed. This shall apply in particular to all periodically maintained items such as lamps, fuses, but shall also apply to all materials and equipment in the installation.

Any equipment designed or installed in a manner which is difficult to maintain, will be rejected.

43.3.8 Shop Drawings

The Contractor shall prepare fully dimensional and detailed working drawings for all switchgear, control panels, distribution boards and riser arrangements, cable trays and cable ladders, and to cover all aspects of the works. These drawings shall also include the complete set of design drawings. All drawings in AutoCAD 2004 format.

Submit shop drawings to the RailCorp via the Contractor for approval prior to manufacture and/or commencing any purchases or work.



Site work shall only be carried out based on "Approved Shop Drawings" a copy of which shall be held on site by the Electrical Contractor. All access panels and required penetrations in the building structure shall be marked on drawings for provision by the Contractor. Drawings shall be adequate to illustrate all installation requirements and shall include details of all equipment proposed to be supplied. The scale of the drawings shall be not less than 1 to 100 for plans and 1 to 20 for details.

As soon as shop drawings, requiring Authority approval, are completed and approved, the Electrical Contractor shall prepare the necessary forms and submit these drawings to the Authority for approval.

Shop drawings are required for the following items:

- » Switchboards layout drawings showing the arrangement of equipment within the switchboard.
- » Single line diagrams.
- » Typical termination arrangement(s) for incoming supply outgoing wiring.
- » Distribution board general arrangement drawings.
- » Detailed layout drawings showing the arrangement of equipment, provisions for the termination of all-incoming cables, etc, complete with all necessary dimensions.
- » Co-ordinate layouts of all conduits, cable trays, cable ladders, duct, light fittings, socket outlets etc, including all penetrations through walls, beams, slabs and underground.
- » Final details of circuiting including modified single line diagrams.
- » Schematic diagrams of lighting control systems, emergency lighting, workshop drawings for all associated equipment panels and engraving details.
- » Any other drawings as required by the RailCorp.
- » Symbols shall be in accordance with AS 1102.

Immediately on completion of the installation (or the particular section of the installation) the Electrical Contractor shall supply the RailCorp drawings giving full information on actual installed circuitry and equipment location.

Equipment listings shall be prepared for all electrical components, the number required, ratings, make, model, catalogue number, etc.

To achieve up-to-date drawings, the Electrical Contractor shall progressively update his copies of drawings, or prepare sketches immediately any change occurs.

The "As-Built" drawings shall clearly show:

- a) All information to be accurate with all modifications shown as at post commissioning.
- b) Positions of distribution boards, control stations, light fittings, power outlets, etc.
- c) Dimensioned routes and sizes of cable trays and ladders.



43.3.9 Maintenance Manuals

At Completion, the Contractor shall supply 4 copies each of the Installation, Operating and Maintenance Instructions Manual. Provide separate manuals for electrical and fire systems.

The bound manuals shall incorporate all changes and amendments. Only relevant data to be used in manual, no typical information will be acceptable.

The manual shall be bound in three or four post loose-leaf system and shall be adjustable to permit secure and compact binding. Each binder cover shall be stamped with labelling approved by the RailCorp. A sample binder with appropriate labelling shall be submitted to the RailCorp for approval with the unbound draft copies. All data and drawings listed shall be photo-reduced or enlarged to conform to the binder. Fold-out drawings shall be 297 mm x 420 mm or 297 mm x 630 mm and shall be so arranged that when unfolded they may be viewed in full on the right hand side of the manual.

All information in the manuals shall be clearly set out, indexed and numbered card dividers shall be inserted between sections.

The format of the manuals shall be in legible English and set out in separate sections in accordance with the following details:

- » Title with name of project, contract number, name of Contractor's, Contractor's and supplier etc.
- » Comprehensive index.

Section 1 - General Description

Section 1 shall include introduction with a brief overall description of the installation and equipment, including design references.

List of Contractors.

List of Suppliers.

List of Service Contacts.

Note this is a non-technical section only.

Section 2 - Detailed Description of Installation and Equipment

Section 2 shall include a full system description, component data, trouble shooting, spare parts, maintenance procedure schedule and reference drawings and document list.

Section 2 shall be divided up into the following subsections as a minimum:

- 2.1 Switchboards and Controlgear.
- 2.3 Earthing System
- 2.4 Luminaires and Switches.
- 2.5 Socket Outlets and isolators.



2.6 Cables and Cable Support System.

2.7 Other Miscellaneous Services (if applicable).

Each subsection shall include a full system description of installation, list and component data (brochures), where relevant- trouble shooting information on fault finding and recommended action, maintenance operations, recommendations for adjustments and routine maintenance procedures and reference drawings. Information shall be relevant to the installation.

Section 3 - Test Certificates and Commissioning Reports

Section 3 shall include all set out the procedure for all tests, a list of tests carried out, contain signed test reports and certifications.

Section 4 - Guarantees and Warranties

Section 4 shall include all guarantees and warranties on all equipment supplied. Also a signed statement of the Contractor's guarantee.

Section 5 - As-Built Drawings

Section 5 shall include drawings produced by the Contractor for approval, Shop drawings, final marked-up As-Built drawings and other relevant drawings not submitted for approval.

43.3.10 Testing and Commissioning

It is the intent of this Specification to ensure that all workmanship, all materials employed, all required equipment and the manner and method of all installation conform to the accepted construction and engineering practices, and that each piece of equipment is in satisfactory condition, to successfully perform its functional operation.

Supply necessary meters, instruments, temporary wiring and labour to perform all required tests and adjustments of equipment and wiring installed and connected under this Contract, including electrical equipment furnished by others to determine proper polarity, phasing, freedom from earths and short operation of equipment meters, relays, etc.

In general the Contractor shall:

- Check designation of all circuit labels at distribution boards.
- Check all fittings and power outlets for correct polarity.
- Check earth continuity of all fittings and power outlets.

The Contractor shall carry out the tests indicated on all electrical equipment and supply all necessary test equipment. Where the Australian Standard calls for a test to be carried out to certify the correct operation of the system, these tests must be conducted by the Contractor.

A written report of the test results shall be handed to the RailCorp within 48 hours of their completion. These shall include standard test forms from relevant Australian Standards.



All test to be carried out by qualified personnel, includes areas where specialised training is necessary. Generally the manufacturer/ supplier shall commission specialised system.

The following tests shall be performed:

Earthing

- » Measure the earth resistance of the main earthing conductor.
- » Check the earth continuity to all equipment.
- » Check the earth continuity to metallic sheathed cables.

Cabling

- » Measure the insulation resistance between cores and between all cores and earth using a 1000-volt megger. Resistance values of less than 10 mega ohms for 415-volt cables per cable run will not be accepted. Care shall be taken during these tests to ensure that no equipment likely to be damaged by the test voltages is connected to the cables.
- » On power cabling check and test correct phase rotation with numbers and colours.

Extra Low Voltage Cables

- » Test each pair in each cable for continuity, correct sequence, reversed pairs, transpositions and split pairs.
- » Measure insulation resistance of each pair in the outer layer of cable and of one pair to earth.
- » Additional tests required by Australian Communication Authority.

Lighting and Power Outlets

- » Check all fittings and power outlets for correct polarity.
- » Check the correct operation of all switching circuits.
- » Check the power factor for all light fittings.
- » Demonstrate that all lights operate for a period of 1½ hours or longer.
- » Additional tests required in accordance with AS 2293.

415 Volt switchgear and control gear

- » With cable tails disconnected, check the insulation resistance between phases and between phases to earth using a 500-volt megger. Insulation resistance readings of less than 10 mega ohms will not be accepted.
- » Test correct operation of all circuit protection and all control circuits.
- » Injection tests of all protection and metering equipment.
- » Functional test of all components.
- » Check power factor reading that the reading is 0.9 or better.
- » Additional tests required by the Supply Authority.



Electrical Interference

Additional tests required in accordance with AS/NZS CISPR 14.1 and AS/NZS 61000.3.2.

43.4 Power Supplies and Switchboard Requirements

43.4.1 General

All switchboard and controlgear components of the same function shall be of the same type or model and from the same manufacturer, especially circuit protection components in switchboards and control panels.

The ambient temperature shall be 40°C.

43.4.2 415V AC Supply System and Auxiliary Distribution Switchboard

General

The Contractor shall provide a 415/240 V AC auxiliary power supply system. Equipment and works shall include but not be limited to the following:

- » 415V AC composite changeover board and distribution board
- » All cabling from the sources of supply to the AC changeover board and from the AC changeover board to local distribution board and field loads.
- » Preferred Supply: Supply from DC rectifier control cubicle via a 600/415V auxiliary transformer.

The Preferred and Standby supplies shall supply a 415V supply busbar via a changeover switch or interlocked contactors.

Auxiliary Distribution Boards

The 415V AC auxiliary switchboard will provide power for:

- » Transformer auxiliary and OLTC equipment.
- » Battery charger.
- » Air-conditioners.
- » Circuit breaker heaters.
- » Floodlighting.
- » General light and small power requirements.
- » Cubicle lights.
- » All other auxiliary loads not mentioned above.

The switchboard shall meet the following requirements:

Description		Specification
Applicable Standard		AS 3439



Rated Voltage	V	415
Fault current withstand	kA	To suit 415V supply transformers
Degree of protection to AS 1939		IP52
Degree of segregation		Form 1
Provision for future growth		100%
Timed break before make		Automatic changeover

The interlocking and changeover scheme shall be installed so that the local service supply (Preferred Supply) cannot be paralleled with the local distribution system supply (Standby Supply).

An automated changeover scheme shall be provided such that:

- » If the Preferred Supply is lost and the Standby Supply is present, the switchboard is transferred break-before-make to the Standby Supply.
- » If the Preferred Supply is then restored, the switchboard is transferred, break-before-make, back to the Preferred Supply.

The status of the 415V supply to the local distribution board shall be monitored and signaled to SCADA.

The distribution board shall have sufficient capacity to supply the substation loads as well as have 20% spare capacity in the number of poles within the distribution board.

The AC Supply system shall be designed to maximize the physical and electrical segregation between alternate sources of supply.

43.4.3 120V DC Supply System and Distribution Board

General

The Contractor shall provide a secure and reliable DC supply system at 125V DC nominal voltage but referred to as 120V DC system. This voltage level is the most common voltage used for RailCorp substation equipment and provides the least problems where the battery voltage is required to operate at large distances from the battery bank.

The DC supply system will provide power for:

33kV Circuit breaker protection and tripping circuits.

DCCB feeder circuit breaker circuits.

- » 33kV/600V Transformer control circuits.
- » Rectifier control circuits.
- » Frame leakage equipment supplies.
- » Panel indication supplies.



- » PLC based equipment.
- » Communications equipment.
- » Building emergency lighting.

The 120V DC systems shall be unearthed.

The 120V DC systems shall be sized and rated to supply 200% of the loads required for the works.

Provision shall be made on the DC distribution board for:

- » Additional circuits required by future extensions.

The 120V DC subsystem shall be sized and rated to supply all connected and future standing loads and three open/close operations of a 33 kV circuit breaker within an ten - hour period, without the voltage falling below 90% of the nominal voltage at loads in the field, in the absence of the AC charger supply.

The design of all DC cabling and wiring to field devices shall be such as to ensure that operational voltage drops in the cables do not put at risk the reliable operation of the field devices.

Battery Bank

The battery banks shall be of the vented/valve regulated lead-acid batteries or nickel-cadmium type with a ten-year design life and shall comply with the requirements of AS 4029.1 and AS 4029.3 or any other Australian Standard applicable.

The battery bank shall be mounted in a tiered stand, interconnected, filled, charged and tested, all strictly in accordance with the manufacturer's instructions. A battery fuse or high speed circuit breaker shall be provided, selected and sized to suit the short circuit current of the battery bank.

The battery bank is to be installed in a separate ventilated room in accordance with the requirements of AS 2676.2 and AS 3011.2. The battery chargers shall be installed outside the battery room.

Battery Charger

The battery charger shall be designed for float charging to its connected battery bank.

The battery charger shall be of the constant voltage current limited type with characteristics selected as necessary to suit the battery characteristics and ensure optimum life under float charging conditions.

RMS AC ripple in the charger output voltage shall not exceed 1% of the average voltage under any load condition.

Under normal conditions the battery charger output voltage is set at 127V DC but can be adjusted by +/- 5V DC.

The maximum output conditions are dependent on the type of charger and are either 10A or 20A at 140V DC. The output voltage is maintained within +/- 1V DC for variation in load from zero to maximum amperes, up to 140V DC.



Float voltage settings shall be in accordance with the battery manufacturer's recommendations.

The battery charger output voltage is not temperature compensated and is boost charged with the load connected.

The battery charger shall be fitted with a load DC ammeter, a battery charge ammeter, a charger isolation switch and shall incorporate battery and charger and charger condition monitoring features.

Alarm outputs shall include:

- » AC failure
- » Charger fault
- » Low/high DC voltage
- » Earth fault.

120V DC Distribution Boards

120V DC distribution boards shall be designed in accordance with the principles indicated in the sample drawing provided. 120V DC distribution board shall be equipped with double fusing on each outgoing circuits.

The board shall meet the following requirements:

Description		Specification
Applicable Standard		AS 3439
Rated Voltage	V	120V
Fault current withstand	kA	10kA for 1 second
Degree of protection to AS 1939		IP52
Degree of segregation		Form 1
Provision for future growth		100%

43.5 Switchboard Technical Requirements

43.5.1 Switchboard Manufacturer

The Switchboard manufacturer shall be the applicant and holder of successful and acceptable test reports called for in the Specification.

43.5.2 Type Tests – Proof of Performance

All switchboards shall be PARTIALLY TYPE TESTED ASSEMBLIES as defined by AS3439.1.



The Contractor shall supply to the RailCorp prior to final switchboard manufacture clearly marked up drawings of each type of switchboard design that has been assembled from relevant type tested assemblies.

Each drawing shall bear cross-reference to the relevant Type Test Certificate and Report.

43.5.3 Construction Details

All distribution boards and other switchgear panels shall be constructed in accordance with the Form of segregation specified elsewhere in the specification in accordance with AS 3439.1.

Switchboard panels shall be constructed from minimum 2 mm thick zinc annealed steel with adequate angle iron bracing to ensure that the housing is suitably stiffened. The maximum depth for light and power distribution boards shall be 260 mm. Boards and panels shall be mounted so that the top of the boards is between 2000 mm and 1500 mm above the finished floor level (AFFL). All control gear and switchgear components shall be at least 300 mm AFFL.

The board and panels shall be custom manufactured to suit the space provided with all new components installed. The ease of final sub circuit installation in the board shall be considered and the appropriate space allowed including space for 25% future cables.

The distribution boards and panels shall be fully welded corrosion resistant construction and totally enclosed sheet metal type arranged for front connection.

The distribution boards and panels shall be fitted with hinged front doors. All doors shall be fitted with lift-off hinges and gaskets to provide a continuous seal against a smooth surface. All doors to be master key lockable with a heavy-duty key type lock. Two (2) master keys shall be provided. The doors shall have 3 point locking. The boards and panels located in sealed electrical cupboards do not require doors.

The degree of protection shall be as noted on the drawings, unless stated otherwise.

The distribution boards and panels shall have large wide cable zones and removable top and bottom gland plates.

Escutcheon plates cut to expose circuit breaker toggles shall be fitted over all circuit breakers. The escutcheon plates shall be separately hinged, lift off type fitted with chromed lifting handles and guide pins.

A typed circuit schedule heavy gauge card, covered with perspex, shall be securely fixed to the inside door of each distribution board. The circuit schedule shall have columns to indicate the following:

- (i) Circuit Number
- (ii) Rating of Circuit Breaker
- (iii) Size of Cable
- (iv) Description of Circuit



(v) Location of Circuit

The switchboards shall be designed and constructed to withstand a nominal fault of 10kA for 1 second. Install fault current limiters when the calculated fault level is higher or use higher rated circuit breakers. "Gaskets used for dust and weatherproofing shall be of an approved non-flammable material such as soft neoprene with a smooth surface finish. Estafoam or similar type gaskets are not acceptable.

Provide 25% spare space on each distribution board and with a minimum 3 spare 20A circuit breakers on each board.

Door handles and hinges shall be heavily chrome plated and shall be of a design, which allows the gasket seal to compress as the door is closed.

All nuts, bolts, washers and spring washers, if any, used in the assembly of components and cubicles shall be of adequate size for the duty required and shall be zinc plated.

Paint preparation, finish and colour of the enclosure shall be N42 Light Grey in accordance with AS 2700. Escutcheons and equipment tray shall be Gloss White.

43.5.4 Infra-Red Scanning

During the commissioning stage of the project all busbars, switchgear, connections and any other equipment within each switchboard shall be checked with an infra-red scanner and the temperatures recorded. All temperatures shall be recorded in degrees Celsius on an appropriate diagram of the switchboard. The scanner used shall be of the digital read-out type and must be approved by the RailCorp before commencement of scanning activities.

This procedure shall be carried 6 months into the defects liability period and 1 week prior to completion of this project.

All scanning shall be carried out in the presence of, and under the supervision of the RailCorp.

Any sections of the switchboard which produce abnormal temperature readings shall be disassembled, checked and reassembled as a part of this contract and at no variation in price.

43.5.5 Balance of Load and Phasing

The Electrical Contractor shall balance the electrical load between the individual phases of supply as far as possible and in any case to +/- 5% differential under full load conditions.

The Electrical Contractor shall ensure that the correct phase sequence is maintained on all Main Switchboards, busbars, submains, distribution boards and final sub-circuits throughout the entire installation.

Phase sequence (rotation) to be red, white, blue (clockwise).



43.5.6 Busbars

Busbars shall be sized in accordance with Appendix C of AS 3439.1 with regards to withstanding thermal stresses due to fault currents. Busbars shall be rated:

- a) To match the maximum frame rating of the respective circuit breaker and not according to the rating of the trip units specified.
- b) To cater for the maximum operating temperature of the connected equipment.

The sizing of cross-section of conductors inside each switchboard shall be the responsibility of the Electrical Contractor, who shall guarantee their ratings.

Individual neutral submain busbars, where required to provide segregation or connections, shall be fully rated based on the associated rating of the frame size of the circuit breaker, and not based on the trip unit ratings.

43.5.7 Cabling

The submain and sub-circuit wiring shall leave the distribution board generally via min.600 mm cable tray(s) which shall distribute the wiring to the overhead cable tray system. The submain and sub-circuit wiring to the distribution board shall be neatly bundled and laced to a cable tray. Removable gland plates shall also be provided at the top and bottom of each distribution board to facilitate cable and conduits 'take off' from the boards.

43.5.8 Circuit Breakers

Miniature moulded case circuit breakers shall be of the din rail type, suitable for the specified fault ratings and each shall be flush mounted behind an escutcheon. Space, complete with busbar facilities, shall be provided for future circuit breakers, as shown on the drawings. Circuit breakers shall be of the thermal magnetic type and shall fully comply with AS 3111 or AS 2184 as appropriate. Circuit breakers shall have pole-breaking capacity in the range of 10A to 100A in the same frame group.

Cutouts in the escutcheon for operating toggles shall be cut evenly and in a neat and tidy manner, presenting a pleasing overall appearance.

Circuit breakers shall be of an approved compact type with a moulded enclosing case designed for front connection of conductors and suitable for mounting on panels incorporated in a sheet metal enclosure.

The following features are to be incorporated:

- » Arc interrupting device
- » Toggle action quick make and break
- » Operate in any position
- » Inverse time limit characteristics
- » Trip-free handle
- » Visual indication when in tripped position



- » Contact to be non-welding
- » Mechanism to be non-temperable
- » Uniformity of style and construction in all sizes.
- » Thermal-magnetic tripping mechanism.

For miniature circuit breakers (i.e. up to 10,000 amps rupturing capacity), toggle tripping to the “off” position is acceptable in lieu of “Visual indication when in tripped position”.

Earth leakage circuit breakers shall be in accordance with AS 3000 and 30mA tripping sensitivity. These shall protect all common and cleaning outlets.

43.5.9 Control Wiring

All internal auxiliary wiring shall be carried out using a minimum 1.5 mm² PVC 660 Volt grade flame resisting cable conforming to ASC 147Ap.

Wiring to outgoing circuits shall be terminated on rail mounting terminal blocks arranged for easy termination and fixing of all outgoing cabling. Four spare terminals shall be fitted in each section. All terminals shall be located at the top of the section.

Each end of each conductor shall be fitted with Critchley type Z or similar approved markers having black symbols in upper case upon white.

All conductors shall be terminated using pre-insulated compression type lugs which are compatible to the terminating device.

The lugs shall be crimped by the end of the correct tool. Wherever stranded conductors cannot be fitted with lugs, all strands shall be tinned solid before connection.

Conductors shall run from terminal without intermediate joints.

43.5.10 Fuse Fittings and Fuse Links

All fuse fittings and fuse links shall be shrouded type fitted with HRC fuse links of a suitable rating.

The fuse links shall be Class Q1 category complying with the requirements of AS 60269.1.

43.5.11 Control Gear

Each switchboard that has emergency lighting and exit sign circuit(s) shall be wired with a manual test facility, incorporating a self-resetting timer (open for test).

Where external lighting is connected to the distribution board, provide a lighting control circuit with automatic and manual operation. Automatic operation is controlled by both a programmable time switch(s) and photoelectric cell. The manual operation is controlled by a bypass circuit.



43.5.12 Contactors

Contactors shall be of current ratings and voltages shown on the drawings and shall be in accordance with AS 60947.4.1 uninterrupted duty, Category AC3 air break.

Auxiliary contacts shall be fitted to each contactor to provide specified control and indication functions.

43.5.13 Terminals

Terminal strips and test links shall be rated not less than 440V AC and shall feature individual terminal blocks fixed to a common clip-in rail mounting and held captive by individual retaining springs.

43.6 Wiring and Cable Support Systems

43.6.1 Generally

The Contractor shall supply, install and terminate all consumers' mains and submains. Size all unsized submains in accordance with AS/NZS 3000 and AS 3008 with a 25% spare capacity. Allow for derating as required.

Submains cabling shall be reticulated from the main switchboard by means of buried conduits externally and cable trays when run in the building.

The Electrical Contractor shall supply and install all submains complete with all accessories necessary for their proper installation, mechanical protection, support, termination, etc.

Each submain shall be provided with labels in form of a clearly displayed stamped metal tag indicating the number and size of the cables.

Every surface run and accessible submain shall be identified by means of a stamped metal tag secured by a metal band not less than 6mm wide, positioned one per floor on vertical runs and once every 8 metres on horizontal runs. Tags to be provided at each end to allow ease of identification at termination points.

All submains shall be complete with an earthing conductor as required.

All submains shall be terminated at both ends.

A maximum voltage drop of 2.5% should be allowed for on all submains.

Single core submain cables shall be laid in trefoil spaced from surface and multicore submain cables shall be laid spaced from surface. All cables shall be spaced apart to avoid de-rating. If derating occurs, cable size shall be re-evaluated by this Contractor, cable size to be determined in accordance with the requirements of the latest AS 3008.

43.6.2 Underground Services

After excavation, clear trenches of sharp projections. Provide clean sharp sand around cables and conduits installed underground.



Seal the buried entries to ducts and conduits with a pliable non-sealing waterproof compound. Seal spare ducts or conduits immediately after installation with a temporary cap, and seal the others after the cable installation.

Provide draw pits where shown on the drawings. The sizes shown refer to the inside dimensions. Walls and bottom shall be rendered brickwork, 75mm thick concrete, moulded fibre cement, or plastic. Incorporate an additive to render or concrete to prevent the ingress of water.

Moulded fibre cement pit; minimum size 650 x 350 x 900 mm deep unless otherwise specified. Mould the word "ELECTRIC" into a lid for use on any pit containing power cables.

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

Allow for radius for cables changing direction.

Provide a schedule of proposed pit sizes and types, including calculations showing allowance for cable bending radius.

Accurately survey the routes of underground cables and conduits/ducts prior to backfilling and provide a survey plan, endorsed by a registered surveyor, which identifies the cable locations in relation to permanent site features and other existing underground services.

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

43.6.3 Fixings to Walls, Etc

All fixings of equipment to walls, floors, ceilings etc shall be by one of the following means:

- a) For all load-bearing fixings into masonry or concrete, by means of approved expanding metal fixings.
- b) Comprise tapered wood screws for fixing to timber.
- c) Comprise drilled and bolted connections or proprietary clamps for steel members.
- d) Be electro-galvanised finish for all bolts, nuts, washers and screws.
- e) Be located at the neutral axis for bolted connections to structural members.
- f) PVC fixings are acceptable for non-load bearing walls i.e. for socket outlets mounting.

The following fixings are NOT acceptable:

- a) Fixings made using explosive powered tools.
- b) Fixings made in the mortar joint of masonry work or block work.
- c) Wood plugs shall not be used.



d) Self-tapping screws into sheet metal.

e) Nails.

Steel structural members shall not be cut, drilled, welded or in any way altered without specific approval from the RailCorp. Clamp type fittings to steel building structures shall be used for pipe supports wherever practicable.

The cutting of holes in any structural or support components using oxy equipment is specifically prohibited.

43.6.4 PVC/PVC and PVC Insulated Cables

Unless specified otherwise, all cables not inferior to 75 °C PVC insulated, PVC sheathed, 0.6/1 kV grade, stranded copper conductors manufactured to AS/NZS 5000.1 and AS/NZS 3191. PVC insulated cables shall not be used in areas where temperatures are likely to exceed 60 °C.

In the case of bolt, stud or screw terminals, cables shall be terminated in machine-cripped proprietary cable lugs, selected to match the particular size of conductor in each case, bolted to switchgear or busbar terminals without distortion or twisting of cables. Copper conductors shall be terminated with copper terminal lugs. Where aluminium cables are specified they shall be terminated with Simel or equal aluminium/copper bimetallic lugs with a proprietary jointing compound. All lugs hydraulically compressed, insulated, multiple crimp long shank type unless otherwise specified. All terminals and cable lugs approved by the cable manufacturer and fitted using proprietary tools which cannot be removed until the correct pressure and crimp depth is obtained in accordance with the cable lug manufacturer's recommendation.

Cables shall be supported independently of the terminal connections, those of 40 mm² section or more fitted with proprietary cable glands of correct size and secured firmly to the switchboard enclosure structure. The whole installation shall be arranged for neatness, reliability and easy access together with sufficient loop for the use of a "hook on" ammeter.

Special care shall be taken in arranging cables in cable trenches and/or a cable support systems, to minimise crossovers.

Single core submains shall be arranged in trefoil formation. Where parallel conductors are used on each phase, the cables shall be grouped in three-phase formation not single-phase formation.

Cables colour coded red, white, blue for phases, black for neutral and green/ yellow for earth at all terminal connections by PVC sleeving or other approved method and labelled with their circuit number at entry into the switchboard cubicle or enclosure and at the junctions of cable ducts or conduits with those of other cables where the cable function is not obvious.

Flexible cables shall have cores identified in accordance with the requirements of AS/NZS 3191 - ELECTRIC FLEXIBLE CORDS.



Each submain shall be provided with a stamped metal tag at its origin. The tag shall indicate the submain's cable size and number of cables.

All submain shall be identified using stamped metal tags firmly secured by a metal band 6 mm wide. The tags shall be located at every 10 metres of horizontal run and vertically at every floor.

Cables for individual three phase circuits shall be cable-tied together at intervals not exceeding 5 metres. The same applies for control cables, with a maximum of 10 cables in any one grouping.

Single core cables shall enter equipment through individual holes in non-ferrous metal gland plates.

43.6.5 Cable Jointing

Cable joints will not be permitted, unless approved or where the length of the cable exceeds the maximum manufactured cable length, in which case cables shall be joined using the manufacturer's recommended procedure and equipment. Locations of cable joints shall be approved, and the location of any joints clearly marked on a reticulation drawing.

Lugs shall be insulated up to the actual mating surfaces either through using pre-insulated type lugs or through sleeving or taping in PVC - correct phase colours - after the connection has been made.

43.6.6 Final Sub-Circuits - General

The Contractor shall install all final sub-circuits in a neat and tidy arrangement, running cables in straight lines and be on cable supports.

Lighting circuits shall be minimum 2.5 mm² with PVC insulation (V75) and power circuits 2.5 mm² minimum (V75).

Cables shall be 75 °C PVC insulated, PVC sheathed, not less than 0.6 kV grade, stranded copper. Where installed entirely in conduit or cable troughing, cables need not be sheathed.

Wiring looped between fittings and accessories via continuous trunking, conduit or duct shall be without through joints.

Active conductors in three phase final sub-circuits colour coded red, white, blue and black for neutral at the ends by PVC sleeving or other approved method, and earth conductors with green and yellow sleeving.

All circuits connected and distributed between phases at each switchboard so that, at full connected load, the unbalance does not exceed $\pm 10\%$ of the connected load. Final sub-circuits for lighting, general power and other groups of similar services independently balanced between phases.



All cabling including junction and terminal boxes, conduit should be installed such that future re-wiring or modifications can be done easily. In general allowing space around cables on tray and only running one cable or one-circuit cables per conduit.

All cables shall be run concealed i.e., inside wall cavity, floor slab conduits, in false ceiling, service poles and skirting duct. Cables shall run in surface mounted cable support system (cable tray, metal duct, conduits and lighting track/ trunking system) at ceiling void or underside of roof only. Workshop lighting cables may run in the channel of the roof purlins.

Cables, cable enclosures and supports shall be located so that they do not obstruct doorways, passages, windows or any other space required for access through the building or to equipment.

Concealed cables in areas with in ceiling voids or underside of roof shall not be supported off or allowed to lie across light fitting, air conditioning ducts, sprinkler pipes, the ceiling lining and shall not be run along the bottom of the furring channels; they shall be supported minimum of 100 mm above the top surface of the ceiling lining.

Cables shall be laid parallel in trays and crossovers shall be avoided as far as possible. Where different services are run on tray, a metal barrier must be provided to segregate these services. A minimum of 150 mm must be maintained between low voltage power cables and extra low voltage system cables. Data and telecommunication cables to be run on separate cable trays.

43.6.7 Cable Terminations for Submains and Sub-Circuits

All cable terminations shall be made using suitably sized copper lugs or ferrules crimped using proprietary lugs and on approved ratchet-crimping tool.

All submain cables shall be terminated using crimped lugs. Soldered or bolted lugs shall not be permitted.

43.6.8 Cable Trays

(a) Type

Cable trays shall be manufactured from perforated sheet steel, with return edges at each side, and finished in galvanised mild steel, or equivalent and paint as per specification.

(b) Fittings

All fittings and accessories shall be of the same manufacture. Where tees, crosses etc. occur, only fittings recommended by one manufacturer shall be used. All joints shall be connected as recommended by the manufacturer and shall at all points be equal in strength to the original section.

(c) Installation

Trays shall be installed square with plant lines, with a minimum number of sets and bends, and fully supported over the entire width at intervals not exceeding 1 m. The



maximum deflection occurring between supports shall not exceed 6 mm with the tray fully loaded with cables.

Trays shall not be continuously mounted direct on a flat surface. Sufficient room shall always be allowed for air circulation around and throughout the tray, and in any case shall not be less than 25 mm clear of such surfaces.

Air circulation around cables shall be a prime factor in determining the location of cable trays.

In locations where dirt and other foreign materials are likely to be present in sufficient quantities to foul the tray, then the tray shall be installed in a vertical plane, and supported on suitable brackets clear of fixed surfaces. Cables shall be cable-tied at intervals not exceeding 300 mm or closer as required to prevent sagging.

Trays shall not be cut or deformed to form cable exit points. Cables shall leave the tray at an end, or over the side, and the end or edge of the tray shall be suitably formed or protected to prevent damage to the cables.

(d) Covers

Cable tray covers shall be installed to all vertical and horizontal runs that occur:

- » Below ceiling within the building
- » Areas outside the building.

Covers are not necessary to cable trays in the ceiling cavity unless mechanical protection is necessary.

Covers shall be of the same manufacture, matching the tray, and fabricated from non-perforated sheet steel.

43.6.9 Cable Ducting

Cable ducting shall be constructed from minimum 1.6 mm thick mild steel or extruded aluminium. PVC shall be allowed on minor installation work if approved by the RailCorp.

The duct shall be flat, true and free from scale, rust, dents and blemishes. The duct shall be electro-galvanised.

Cable ducting shall be installed in horizontal or vertically true and straight runs with a minimum number of sets and bends and shall be provided with covers fixed by blunted screws. Matched pre-fabricated fittings shall be used.

Where exposed ducting is installed, this ducting and support brackets shall be powder coated white or as directed by the RailCorp. All vertically run cable must be concealed or installed in cable duct.



43.6.10 Conduit Installation

All galvanised steel and PVC conduits and fittings shall comply with AS/NZS 2053 "Conduits and fittings for electrical installations". The conduits and fittings shall be welded screwed hot-dip galvanised.

Conduits run underground shall be HD-uPVC orange in colour.

Conduits shall be no smaller than 25 mm in diameter.

Unless otherwise indicated, conduits shall be concealed by wall chases, built into brickwork, run in wall cavities, false ceilings and in concrete slabs. Galvanised conduits shall be installed within the workshop area.

All conduits shall be self draining to the low points of the installation. Condensation shall be prevented from entering terminal boxes and isolators.

Conduits shall be fixed at intervals not exceeding 900 mm and shall follow the building and structure lines parallel to building members, walls, doors, etc and shall be run on the square wherever possible. They shall be protected from mechanical damage where necessary and shall incorporate expansion joints at intervals as recommended by the manufacturer. All conduits and fittings shall be completely erected before the cables are drawn in. All elbows and tees shall be of the inspection type. Adequate pull in boxes shall be provided to ensure that cabling can be drawn in without recourse to dismantling any sections of the runs.

Only approved saddles shall be used. PVC conduit clips and PVC half saddles are prohibited from use.

Conduits cast in concrete slabs shall be located in the centre of the slab between the top and bottom layers of reinforcing.

Connections between fixed conduit and electric motors, and other similar equipment shall be made by short runs of flexible steel, PVC covered conduit of sufficient length to allow full adjustment of the device.

Galvanised draw wires shall be left in all conduits which are spare or have capacity available.

Conduits to drop from cable tray to switches and outlets in general.

Where rendered walls occur conduits to be chased into walls.

Where single brick double face walls occur, conduits to power outlets to be accommodated by "cheese cutting" brickwork.

Screwed steel conduit shall be used in all areas such as plant rooms where the conduit is susceptible to damage.

No more than two power circuits shall be enclosed in one conduit. Light and power circuits shall be run in different conduits.

All conduits terminating in a surface box, switch or other item of plant shall be securely jointed with a locknut and bush. When two or more conduits terminate together, they shall be parallel and shall be cut to equal lengths. Conduit 25 mm and under shall be



fixed at not more than 150 mm and Conduit 32 mm and over shall be fixed at not more than 300 mm from such a termination.

Oval conduit shall not be used.

Conduits shall be kept clear of other pipes and shall be at least 75 mm clear of gas pipes, and pipes containing hot fluids. Conduit shall not run above and parallel to pipes which become hot when in service.

43.6.11 Flexible Conduits and Fittings

Preferred Flexible conduit shall be installed for all final connections to motors, to control equipment and where conduits are subject to change due to vibration.

Rigid conduit to control equipment shall be run to a junction box adjacent to the item of equipment, and thence in flexible conduit to the equipment. Where subject to damage, steel flexible conduits shall be installed. Flexible conduit connections shall be not less than 250 mm or more than 750 mm in length. Where isolating switches are required they may take the place of junction boxes.

43.7 General Power Requirements

43.7.1 Socket Outlets

The Contactor shall supply and install all socket outlets with associated wiring from the designated switchboards.

Wiring to outlets shall be as follows:

- a) Switchroom area TPS and PVC/PVC cables on cable trays, conduits, within wall and ceiling cavities where possible, surface mounted within conduits on walls.
- b) Exterior Outlets TPS cables in underground conduit and surface mounted within conduits on exterior walls.

Fitting and accessories shall be of approved manufacture and rating and shall be selected to meet the requirements of the location and functions. All socket outlets shall be the earth pin located at 6 o'clock position and shall be polarised as in the wiring rules. Socket outlets unless otherwise specified, shall have a 10 amp capacity rating.

The types of socket outlets shall be flush plate of impact resistant plastic, suitably reinforced.

All socket outlets shall be of the Clipsal IP66 industrial make with the exception of the office and amenities areas, which shall be Clipsal C2000 series.

Socket outlets in common areas where provided, unless otherwise noted, shall be mounted at a height of:

- a) 300 mm above floor level
- b) 100 mm above benches



- c) Or as noted on Electrical and Architectural drawings (Architectural drawings take precedence).

43.7.2 Other Socket Outlets

Three-phase socket outlets shall be provided with a five round pin arrangement with the earth pin at the 6 o'clock position, the neutral pin in the centre, and the red, white and blue phases in a clockwise sequence when viewed from the front of the socket.

For single-phase combination switch socket outlets provide a three-pin arrangement with the earth pin located socket power outlets shall be of impact-resistant plastic coloured grey, with flap lid on the socket, screw ring, IP66 rated and with surround mounting plate.

Nominated equipment socket outlets shall be fitted with matching IP 66 plug tops with a screw ring.

43.7.3 Isolating Switches

An isolating switch shall be installed adjacent to each appliance permanently connected and shall be located within 2 metres of the appliance and at a height approximately 1.1 metres above floor unless within cupboard or otherwise indicated, directed or apparent from the location of the power unit. All isolation switches shall be easily accessible and shall be of the industrial Clipsal make..

Provide all isolating switches in accordance with AS/NZS 3000.

Isolating switches shall be of approved type and rating, complying with AS 3133 rating selected to meet the requirements of the location and function. A sample of the type of isolating switch to be used shall be submitted for approval prior to installation.

Isolating switches, except where otherwise indicated, shall be of the impact resistant all insulated moulded type.

Suspended isolators shall not rely on cable as support, provide a secure chrome chain attached to suitable ceiling supports.

43.7.4 Appliances and Equipment

All appliances, computers and equipment will be supported and physically installed by others, unless specified otherwise.

Where items of equipment are connected via a plug, the Contractor shall allow for the supply and connection of a suitable plug top and flexible cord on equipment.

For permanent connections, provide an isolating switch adjacent to the appliance or equipment.

All permanent connected equipment shall be wired through an isolating switch and wiring enclosed in flexible conduit between the switch and equipment. Sufficient cable shall be provided to allow un-fixed equipment to be moved for cleaning purposes.



43.8 General Lighting Requirements

43.8.1 Luminaires

The Electrical Contractor shall supply and install all new luminaires as noted on the drawings. All fittings shall be procured from a reputable supplier and manufactured in accordance with AS 3137 - Luminaires and SAA Approval and Test Specifications AS 3100.

Luminaires shall be installed in a professional manner and shall be complete with new lamps as specified and all new accessories required for the fittings proper functioning.

All luminaires shall be complete with facility for earthing. All luminaire accessories such as fuses, ballasts, capacitors etc. shall be positioned so that they are readily accessible.

Only 1.5 mm² minimum glass or similar heat insulated cable shall be used for final connection to light fittings over 200 watts and other fittings such as dichroic lamps.

The Electrical Contractor shall submit samples of all luminaires in one complete display for approval before ordering.

Photometric data, copies of Statutory Approvals and Supply Authority letters shall be supplied to the RailCorp if requested during the Contract period.

The metal work of luminaires exposed to dust; water or weather shall be protected against corrosion.

All light fittings shall be fitted with capacitors to give a power factor of 0.9 lagging minimum. Capacitors shall comply with AS 2644 and be connected in shunt across the AC supply.

All light fittings shall incorporate electronic high frequency ballast where specified and low loss ballasts for all others.

Where luminaires are mounted on a fire rated ceiling, the integrity of the ceiling shall be maintained.

Where a building member does not exist in the position required, supply and install a suitable fixing.

All installed fittings shall have a removable clear plastic covers to protect fitting from dust and scratching during construction. Remove cover at Completion.

43.8.2 Installation of Luminaires

All screws, battens, roses, noggins, trims, packing, etc necessary for the proper fixing of luminaires, shall be provided by this Contractor as part of the works, whether individually specified or not. Packing pieces of approved material shall be fitted where required to level the luminaires and to prevent distortion.

Where painted surfaces are damaged, the Electrical Contractor shall make them good. Such repairs shall be of the same standard as the original paintwork.



Fittings shall be installed subject to the agreement of the Builder and the approval of the RailCorp.

Generally, fluorescent luminaires shall be securely fixed to structural members of the ceilings or walls, or fixed by hangers, brackets or the like which are themselves securely fixed to building members.

Where a building member does not exist in the position required, supply and install a suitable fixing. Noggins provided in timber frame ceilings or walls shall not be less than 75 mm x 50 mm Oregon; metal sections provided in suspended ceilings shall not be smaller than the main framing of the suspended ceiling.

The minimum size of fixings for luminaires, hangers or brackets for various surfaces shall be as follows:

Fixing to timber - cadmium plated RH TEK screws not less than 3.2 mm x 25 mm long.

Fixing to concrete - approved screw expanding bolts 6 mm dia. x 40 mm long.

Fixing to hollow blocks - at deep cast junction boxes with 4.5 mm dia. metal screws at the centre of the luminaires, with approved expanding fixings at each end.

43.8.3 Fluorescent Luminaires

Luminaires shall be supported by minimum of two fixings at each end.

End to end luminaires shall be correctly aligned using packing strips where necessary.

Luminaires shall not be supported or suspended from plastic boxes or fittings.

Luminaires shall not be erected on sprayed acoustic ceilings until at least 1 week after the spraying of the ceilings has been completed.

43.8.4 Battery Room Luminaires

Fluorescent luminaires to be installed in the battery room to have a hazardous area rating of IP66.

43.8.5 High Frequency Ballasts

Provide high frequency ballasts to all fluorescent luminaires.

High frequency ballasts shall comply to the Australian Minimum Energy Performance Standards (MEPS).

The ballast shall consist of a switched mode power supply providing current to the lamps at a discharge frequency of approximately 25-40kHz.

RFI filter: Limit the radiation of RFI to the requirements of AS1044 by the use of a RFI filter.

Harmonic Interference: Limit the harmonic interference to the mains to meet AS3134 by the use of a harmonic filter.



Functions: Automatic shutdown on lamp fail or lamp removal. Cathode preheating on tube striking.

Input Voltage range: 210 to 260 Volts A.C.

Watts Loss: Less than 4.5W per 36W lamp and 2.6W per 18W lamp

Reliability: Mean time between failures (MTBF) $\geq$ 35,000 Hours

Configuration: Provide one ballast for up to two 36W fluorescent tubes and three 18W fluorescent tubes

43.8.6 Light Switches

The light switch flush plate or panel shall be mounted at a height of 1300 mm to centre line. Switches shall be of the Clipsal C2000 series in the Office and Amenities rooms. In all other areas (plantroom and exterior areas) switches shall be of the heavy-duty industrial Clipsal series.

All rooms shall have local manual control, unless otherwise noted.

The light switch mechanism shall have a minimum 20 amp rating, quick make and break type except in small rooms with less than 4 fittings, where 15 Amp rating to be used. The light switch mechanism shall be suitable for fluorescent and discharge lamp switching. Double pole light switches where required shall be capable of switching the active load through both poles. All light switches located outside the room the switch services shall have a red neon indicator.

Switches on different phases shall be separated by a fixed partition in a wall box. Switches shall be installed on the lock side of doors. Flush mounted wall switches shall be located vertically in a vertical wall box.

43.8.7 Fluorescent Lampholders

Lampholders shall be suitably rated and made of unbreakable plastic of medium bi pin locking type. Terminals shall be spring-loaded. Fixing of the lampholder to the metal work via snap in lugs. Lampholders shall be specifically designed for 26mm lamps.

43.8.8 Internal Wiring

Internal wiring shall be stranded and the insulation not less than 105 degrees Celsius. Wiring shall be installed in a neat workmanlike manner, without stress, securely fixed into position such that contact with the ballast is not possible. An earth terminal shall be provided adjacent top the connector block and be installed in effective contact with the body of the fitting.

43.8.9 Lamps

Fluorescent lamps shall use bi pin connection, switch start, 26 mm diameter, triphosphor with a colour temperature of 3000K and a colour rendering of 84 or greater as noted. All fluorescent lamps, PL or PLC lamps shall be equal to Philips or Osram and have a 3000K-colour temperature, unless otherwise noted.



All low voltage type halogen lamps for down lights shall be dichroic seal beam type lamps.

43.8.10 External Lighting

All outdoor luminaires are to have an IP66 rating and to be vandal proof.

43.8.11 Emergency And Exit Signs

General

The emergency lights and exit sign light fittings shall be complete with self-contained battery/inverter units, dual rate charger and shall comply with AS 2293 Parts 1 and 2. Electronic components to be rated for 105 °C operation. NiCd batteries with a minimum 7 year life to be provided.

All emergency and exit fittings to be appropriately traffolyte labelled and a logbook provided to the RailCorp.

All emergency and exit lights shall be wired from the local 415/240V AC Auxiliary distribution board with an emergency lighting testing circuit and test switch at the board as shown on drawings.

Two 6-month inspections and tests on the emergency lights and exit signs to be carried out during the warranty period. All fault controlgear and lamps to be replaced during this period.

Where the lamps utilised in the normal lighting luminaires are of a type, which will not restrike immediately after restoration of supply, provide a time delay to maintain the operation of the emergency lighting for period necessary to allow the normal lighting lamps to restrike.

Operation

All emergency luminaires and EXIT signs shall be switched on with the normal lighting.

43.8.12 Mixed Circuits

Mixed circuits of light and power will NOT be permitted

43.9 Fire Detection and Alarm System

43.9.1 General

The fire detection and alarm installation shall be carried out in accordance with AS 1668, AS 1670, AS4428, Building Code of Australia (BCA) and with the requirements of the Fire and Accident Underwriter's Association. The Electrical Contractor shall engage an approved fire detection and alarm system installer.



43.9.2 Fire Indicator Panel

The fire indicator panel (FIP) shall be an intelligent, analogue addressable fire alarm control panel with non-proprietary programming tools complete with accessories, LCD screen, buzzers, battery chargers, batteries, etc and shall be installed in the location as shown on the drawing.

The panel shall comply with the relevant requirements of AS 4428 'Fire detection, warning, control and intercom systems' and in particular Part 1: Control and Indicating Equipment'.

Alarm Signalling Equipment (ASE) shall be provided to enable a remote monitoring and control station to receive fire alarm signals and transfer the signals to the RailCorp SCADA. The monitoring service providers' equipment shall be compatible with the requirements of AS4428.6.

Suppression circuits shall be fitted to give immunity to the panel from external transients of up to 5 kV peak.

The colour finish of the panel shall be approved by the RailCorp prior to manufacture.

A Certificate of Compliance with Australian Standards from a recognised testing laboratory shall be supplied.

43.9.3 In-built Building Occupant Warning System

A Building Occupant Warning System shall be incorporated into the fire indicator panel. The FIP shall have the facility to display alarm, fault and isolate status. The Contractor shall make an allowance in its Tender for the full design of the occupant warning system in accordance with Clause 3.22 of AS 1670.1-2004.

43.9.4 Detectors - General

All detectors shall be of the addressable type.

An indicating light shall be built in each detector to show that the detector has operated.

If a detector incorporates electrical contacts, these contacts shall operate with a wiping action and shall be adequately protected from dust, insects or other foreign matter that may hinder the operation of the detector.

Detectors having raised an alarm shall reset on return to normal conditions.

Each detector shall be surface-mounted on a round recessed junction box. The detector shall incorporate white circular flushplates to cover the edges of the junction box.

A Certificate of Compliance with Australian Standards from a recognised testing laboratory shall be supplied.



43.9.5 Smoke Detectors

Smoke detectors shall be an approved photo-optical type as shown on drawing. In all cases, detectors shall comply with the requirements of AS 1603.2 'Automatic Fire Detection and Alarm Systems Part 2 Point Type Smoke Detectors'. The sensitivity levels shall comply with the requirements of the Insurance Council of Australia and the RailCorp.

Every smoke detector shall be permanently marked with its sensitivity level.

43.9.6 Heat Detectors

Heat detectors shall be of an approved temperature compensating type. In all cases detectors shall comply with the requirements of AS 1603.1 'Automatic Fire Detection and Alarm Systems Part 1 Heat Detectors'. Detector shall be effective in operation both in the case of slow and rapid rates of temperature rise. The temperature limits of operation shall comply with the requirements of the Insurance Council of Australia and the RailCorp. Generally, Type A thermal detectors shall be used throughout unless otherwise indicated.

Every thermal detector shall be permanently marked with the maximum temperature to which it can be raised before it operates an alarm when tested with a temperature rise at the rate of 2°C per minute.

43.9.7 Manual Call Point

A manual call point or Break Glass pushbutton conforming to AS 1603.5 shall be located at the FIP.

43.9.8 External Alarm Indication

An approved weather proof visual warning device consisting of a red strobe light incorporating the word "FIRE" marked on or adjacent to the strobe in lettering not less than 25mm in height on a contrasting background shall be supplied and installed approximately where shown on the drawing as per Clause 3.8 of AS1670.1. The red strobe light shall comply with AS1603.11.

Wiring to the strobe light shall be carried out using 25 mm diameter conduit. Failure of this circuit shall not interfere with or affect the transmission of a fire alarm signal. The strobe light shall be protected by an appropriately rated fuse.

43.9.9 Wiring

The Contractor shall supply and install the cables for the complete fire detection and alarm system, including sounders, and wiring to fire sprinkler equipment required under this specification to be monitored.

All fire alarm wiring shall be segregated from other wiring installations and be distinct from all other wiring systems in accordance with AS3000.

All fire alarm wiring shall be stranded copper and have a minimum cross-sectional area of 0.75mm².



All fire alarm wiring shall have a red outer sheath. Each conductor shall be permanently colour marked throughout its length to ensure easy identification at each termination.

Telephone type cable shall not be permitted.

The Contractor shall supply and install RADOX or FIRETUF type cable for the dedicated power supplies, fire alarm wiring. All wiring shall be concealed within ceiling voids where practicable. Wiring shall be secured at a maximum of 1-meter centres within all ceiling voids.

Where ceiling voids do not exist, the Contractor shall supply and install cable tray to secure the fire alarm cables to, or secure the fire alarm cables directly to the building fabric in a neat and workmanlike manner.

Where the Contractor has chosen to install cable tray, this shall be of medium duty galvanised type secured on U channel and drop rods. The cable tray shall be run in an unobtrusive manner in locations that do not affect the operation of equipment within the building, typically around the perimeter of rooms.

Where the Contractor has chosen to install fire alarm cables on the building surface within areas that do not have ceiling voids, then fire alarm cables shall be secured at a maximum of 300mm centres and routed around the perimeter of rooms in such a manner as not to impact on the operation of the building or its equipment.

Fire alarm cables shall be routed together in common cable runs wherever possible.

The Contractor shall advise the Principal of the intended cable routes prior to installation to ensure that the suggested routes do not impact on future requirements for the building.

The wiring system shall be in compliance with AS1670.1– Appendix B.

Wire free alarm zone circuits shall not be acceptable.

43.9.10 Installation of Detectors

When positioning detectors, attention shall be given to the effect of air currents that could render detector either ineffective or prone to false alarms.

Detectors shall not be mounted within 500 mm of light fittings. Detectors shall be installed and located to facilitate access for maintenance.

Where detectors are installed in damp locations, special provision shall be made to ensure that operation will not be effected by the occurrence of false alarms due to water or steam entering the detectors.

Spacing of detectors shall be in accordance with AS 1670 and the Building Code of Australia.

The location of detectors is shown typically on the drawings. The Contractor shall be responsible for correctly locating all detectors in accordance with AS 1670.



The cost of relocating incorrectly installed detectors shall be at the Contractor's expense.

The Contractor shall ensure that a competent representative, conversant with AS 1670 is in attendance during installation.

No more than thirty detectors shall be connected to any AZF.

43.9.11 'As Installed' Diagrams

The Contractor shall supply two copies of 'As Installed' drawings enclosed in a rigid plastic wallet and place the drawings inside the FIP at the completion of the installation and prior to commencement of commissioning tests. This is in addition to the requirement for the general 'As-Installed' drawings.

Fire Brigade Test Instructions shall also be included where applicable.

The drawings shall be durable ink prints and shall contain fully scaled plans of locations and types of detectors, external cabling and all specified fire equipment. The detectors shall be numbered as to their alarm group number as well as a separate number of each detector in the group eg. 8.09 (ninth detector in alarm group 8).

The Contractor shall provide two copies of a maintenance manual with detailed drawings of the Fire Indicator Board and Fire Alarm Panel, fire detector layouts for the complete installation and external pipe locations. The manual shall set out the procedure to be followed for all tests as outlined in the Fire Alarm Code AS 1670.

The drawings shall be 'As-Installed' drawings showing final detector locations, final circuit groups, end of line resistors and circuit diagrams of the board, panel and external equipment.

43.9.12 Commissioning

The Contractor shall provide a completed Commissioning Test Report in accordance with Appendix D of AS 1670.

The Contractor shall provide a completed Installer's Statement in accordance with Appendix B of AS 1670.

43.9.13 Log Book

The Contractor shall supply and install in the FIP prior to the commissioning tests a hardbound logbook. All test results shall be recorded in the logbook. The logbook shall contain a minimum of 100 off 150 mm x 100 mm pages.

43.9.14 Installer's Statement for Fire Alarm System

The Contractor shall supply to the RailCorp at the time of commissioning a signed copy of the statement included with this Specification.



43.9.15 Maintenance Inspection and Tests

The Contractor shall service and maintain at its own expense the whole of the alarm system for a period of twelve calendar months, the commencement of which is to coincide with the date Completion and occupation of the building by the Principal.

The Contractor shall, during this period, carry out all tests excluding daily tests, required by the Insurance Council of Australia, the Australian Standard AS 1670 and Local Government (Orders) Regulation 1993. However, it shall be the Contractor's responsibility to supervise the carrying of daily tests during the first week after completion and take over of the system by the Proprietor.

During this time, the Contractor shall instruct two representatives from the Principal in the procedure for undertaking of such daily tests as necessary.

43.10 Preferred Supplier

ITEM	PREFERRED SUPPLIER OR EQUIVALENT
415/240V MCCB Auto Transfer Switch & 240/415V DB's	Schneider components (standard drawing EL0269646)
Common Equipment Panel:	Alstom / United
Delta I panel (if req):	Alstom / United
Aux Transformer:	Coast Electric / ABW
Isolating Transformer:	Coast Electric / ABW
Battery:	120V lead acid 250Ah Hoppecke supplied by HCB Standby Technology
Battery Charger:	50A CPS National
REC:	Alstom / United
1500V 3 position substation switch:	Edward Keller changed name to DKSH
DCCB Frames:	Eaton
RTU + Cubicle:	TBA
120V DB's	Alstom red spot fuses / fittings



44. Hydraulic Services

44.1 Scope of Work

44.1.1 General

Refer to the *General requirements* worksection.

44.1.2 Sanitary plumbing and sanitary drainage

General: To AS/NZS 3500.2.2.

Local authority requirements: >

44.2 Quality

44.2.1 Inspection

Witness points

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

- » Excavated surfaces.
- » Concealed or underground services.

44.2.2 Submissions

Shop drawings

Submit drawings and schedules showing the layout and details of the system, including

- » location, type, grade and finish of piping, fittings and pipe supports; and
- » location, type and other relevant details of sanitary ware.

44.3 Materials And Components

44.3.1 Authorised Products Standard

To SAA MP52, unless otherwise required by the statutory authority.

44.3.2 Sanitary Fixtures

General

Provide the accessories necessary for correct installation.



44.3.3 Sanitary fixtures schedule

Location	Fixture	Description	Colour
Toilet	WC pan and cistern	Fowler: Regent Mk II	White
	Basin	Fowler: Florida 550	White
	Taps	Dorf: Ezy Clean basin Set with standard washer fittings and Planet taps	Chrome
	Cistern valve	Dorf: Ezy Clean Cistern Stop	Chrome
	Wall Tap	Dorf: Eay Clean Bib Standard	Chrome
	Eye Wash unit	Enware	EE330

44.4 Execution

44.4.1 Sanitary Plumbing

General: If there are chemically corrosive effluent wastes, provide compatible traps and waste connections, and drain to a treatment pit.

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.

Sanitary plumbing piping schedule

Location	Pipe material	Nominal size	Grade	Jointing method
Above ground	uPVC	40-150	DWV	Solvent Welded

Traps

Type: >Fixtures wastes

Material: >uPVC

Dimensions (mm): >40-50mm

44.4.2 Sanitary Drainage

Pipeline identification

Lay detectable plastic warning tape, 300 mm above buried piping, for the full length of the piping.



Traps and gullies schedule

Trap or gully type	Size (mm)	Cover type
Sink traps	50	PVC waste
Basin traps	40	PVC waste
Floor wastes - Bathrooms	100	Stainless Steel Coverplate

44.4.3 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.

45. Oil/Water Separator Tank

45.1 General

An oil/water separator is required to serve the oil-filled transformers and switch gear on the site. These transformers and switch gear are contained within a bunded yard, where any oil leak is contained and allowed to flow via a 150mm uPVC drain pipe into a storage tank sized to cope with the volume of oil within one transformer and one switch box. As the storage tank is likely to also contain water, it has been designed as an oil/water separator, however, unlike conventional separators on a stormwater line, this tank will not be required to cope with water flows greater than 0.25l/s

45.1.1 Cross References

- » Stormwater
- » Service Trenching
- » Concrete

45.1.2 Applicable Standards

Table 45-1- Standards

Standards No.	Standard Title
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1379	Specification and Supply of Concrete
AS 1646	Elastomeric Seals for Waterworks Purposes
AS 2439	Perforated Plastics Drainage and Effluent Pipe and Fittings
AS 3725	Loads on Buried Concrete Pipes
AS 3996	Metal Access Covers, Road Grates and Frames
AS 3972	Portland and Blended Cement
AS 4058	Precast Concrete Pipes (Pressure and Non-Pressure)
AS 4671	Steel Reinforcing Materials
RTS.3432	Track Drainage – Inspection and Maintenance
RTS.3433	Track Drainage – Design and Construction

45.1.3 Scope of Works

The work involved includes the construction of a buried oil/water separation tank beneath the paved yard alongside the bunded transformer yard. The paved surface



over the completed tank is required to be trafficable, requiring consideration of the tank structure and material as well as the pavement layerworks above the tank.

45.1.4 General Description

The tank will be required to accommodate 8600 litres of transformer oil in the event of catastrophic failure. The transformers will be located in a bunded yard that will drain into the tank via a 150mm diameter uPVC drainage pipe. There is no storm catchment draining into the bunded yard and the only water likely to enter the tank is rainwater falling directly into the bunded yard; this can be assumed to be less than 0.25 litres per second. The tank should have an effective storage volume of 8600 litres + 20% (10,300 litres) and it is envisaged that this tank will be emptied immediately after a leakage incident.

The tank will drain into the nearest accessible storm drain.

45.1.5 Materials

The tank will be fabricated from precast concrete elements by an approved supplier (Humes or similar) in accordance with the contract drawings.

45.1.6 Installation

The tank shall be installed in accordance with the manufacturers specifications.



Appendix A

Annexures



Annexures to Specification Section F

- » *Review of Environmental Factors* (May 2006)

GHD Reference: <G:\Projects\21\14606\WP\119745.pdf>

- » *Geotechnical Report* (July 2006)

GHD Reference: <G:\Projects\21\14606\Geotech\1881.pdf>

- » *Earthing Design Report*

GHD Reference: <G:\Projects\21\14606\WP\121443.pdf>

- » *Service Searches* (April 2006)

GHD Reference: <G:\Projects\21\14606\Document Transfer\Incoming\2006.06.20 Service Searches>

Title	Source	Drawing	Revision or Date
Newtown Main South Line 3.625 to 3.712 km Services Search DSS Survey	QASCO/RailCorp	CV0376723 (Sheet 1 of 3)	B
Newtown Main South Line 3.625 to 3.712 km Services Search DSS Survey	QASCO/RailCorp	CV0376724 (Sheet 2 of 3)	C
Newtown Main South Line 3.625 to 3.712 km Services Search DSS Survey	QASCO/RailCorp	CV0376725 (Sheet 3 of 3)	C
DSS Plan Interpretation and User Responsibilities	RailCorp	Written document	23 Feb 2006



GHD Pty Ltd ABN 39 008 488 373

10 Bond Street Sydney NSW 2000-

T: 2 9239 7100 F: 2 9239 7199 E: sydmal@ghd.com.au

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