

*Connell Wagner Pty Ltd  
ABN 54 005 139 873  
60 Albert Road  
South Melbourne  
Victoria 3205 Australia*

*Telephone: +61 3 9697 8333  
Facsimile: +61 3 9697 8444  
Email: cwmel@conwag.com  
www.conwag.com*

---

***COLLINS STREET (SPENCER / KING)  
TRAM SUPER STOP -  
ELECTRICAL  
SERVICES SPECIFICATION***

*9 July 2003  
Reference 5020/04/433  
Revision 2*

## Document Control

**Connell Wagner**

Document ID: F:\C&I\502004C\OUT\01-COLLINS-SPENCER\03-08-13\GENERAL ELEC SPEC 02.DOC

Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
1	7 March 2002	Issued for Generic Use	RDM	RDM		
2	27 June 2003	Revised Issue	rdm	RDM	CB	

*A person using Connell Wagner documents or data accepts the risk of:*

- a) *Using the documents or data in electronic form without requesting and checking them for accuracy against the original hard copy version; and*
- b) *Using the documents or data for any purpose not agreed to in writing by Connell Wagner.*

# Table of Contents

<i>Section</i>	<i>Page</i>
<b>1. Scope of Works</b>	<b>2</b>
1.1 General	2
1.2 Scope	2
1.3 Tram Shelter	3
1.4 Real Time Information (RTI) System	4
1.5 Ticket Vending System	4
1.6 Payphones	5
1.7 Timetable	5
1.8 Work By Others	5
1.9 Approvals and Permits	6
1.10 Drawings	6
<b>2. General</b>	<b>7</b>
2.1 Standards	7
2.2 Site Survey	7
2.3 Inground Services	7
2.4 Telstra Services	8
<b>3. Underground Conduits</b>	<b>9</b>
3.1 General	9
3.2 Cables and Conduits in Trenches	9
3.3 Cable Pits	9
3.4 Underground Cable Routes	11
3.5 Boring	11
3.6 Reinstatement	11
3.7 Shop Drawings	11
<b>4. Electrical Services</b>	<b>12</b>
4.1 General	12
4.2 Electrical Supply Characteristics	12
4.3 Radio, Television and Electrical Interference	12
4.4 Earthing	13
4.5 Tariff Metering	13
4.6 Electrical Switchboard Enclosure	13
4.7 Cabling	15
4.8 Shop Drawings	16

# 1. Scope of Works

## 1.1 General

The Yarra Trams network forms a major part of the tram system that has been an important means of public transport and major part of Melbourne's streetscape for many years. The tram network has a strong historical significance and forms an important part of the community's local identity.

Under agreement with the State Government of Victoria, Yarra Trams has a commitment to increase patronage on the Yarra Tram network. Yarra Trams' strategy for achieving its commitment is through improved service levels. The creation of Superstops is one of several commitments aimed at improving the tram service.

Superstops are to be located at route transfer stops, including inter-modal transfers, or stops with particularly high patronage. All superstops will include shelters and Disability Discrimination Act (DDA) compliant platforms to allow direct access for all wheelchair-bound, sight impaired and elderly passengers. Subject to site specific restrictions, these stops will also have some or all of the following public amenities: Shelters with illuminated advertising displays and general lighting, payphones, real time passenger information, ticketing vending machines and illuminated timetable displays. At locations where some of these facilities are not installed with the initial construction, provision shall be made for future installation.

## 1.2 Scope

The Contractor shall carry out the associated Works as indicated on the drawings and generally as itemised below. Yarra Trams may require the works to be completed on one platform prior to the commencement of works on the second platform.

### 1.2.1 Network Connection for Electricity and Communications

The contractor shall liaise with the local electricity supply authority to determine the point of supply to the tram stop.

The Contractor shall install conduits and pits, as shown on the drawings and set out in this specification, to allow for connection of the platforms to the Electricity and Telephone networks. The Contractor shall allow safe access to Electricity and Telephone network personnel to perform whatever works are necessary to finalise the connections.

### 1.2.2 Electrical distribution switchboard

The Contractor shall provide an IP56 (minimum) enclosure with two distribution boards (Yarra Trams and JC Decaux), 2 sets of metering facilities (Yarra Trams and JC Decaux) and RCD main switches installed inside. The Contractor shall supply and install the electrical distribution system as indicated on the drawings and to the requirements as set out in this specification. The design and construction of the distribution switchboard shall be arranged by the Contractor and be to the satisfaction of the Superintendent.

Supply and install a single phase isolation transformer as indicated on the schematic diagram, to the load side of the main switch and mount in a weather resistant enclosure adjacent the switchboard enclosure.

### 1.2.3 Underground conduits

The Contractor shall provide underground conduits complete with cable draw pits and draw wires for electrical power and communication reticulation as indicated on the drawings and to the requirements as set out in this specification.

Where conduits are provided for the future installation of furniture items, draw wires shall be provided to extend not less than 500 mm from the end of the conduit and secured to prevent wire retracting back into the conduit. Additionally 1 power and 1 communication spare conduits shall be provided to each platform.

#### **1.2.4 Power and communication interfaces**

The Contractor shall allow safe access to others for final connection and cabling interfaces to all platform equipment including but not necessary limited to shelters/advertising panels, passive and interactive real time information displays, Ticket vending system, Timetable displays and the like. The Contractor shall supply and install appropriate sub main cables for platform equipment as detailed in the following clauses.

### **1.3 Tram Shelter**

#### **1.3.1 General**

The connection of shelter electric supply is to be coordinated by the Contractor. Shelters normally consist of fluorescent lighting for advertising panels and ELV Dichroic downlights. Supply and installation of the Tram shelters shall be by:

#### **J.C. DeCaux Australia**

Michael Strike – Installation Manager

Mobile: 0417 440 325

J.C. DeCaux will have a Registered Electrical Contractor (REC). The REC has overall responsibility for the electrical work associated with the shelter and will be required to liaise with the Contractor's REC. The Contractor's REC must co-operate with and keep J.C. DeCaux's REC informed at all times of any potential issue with respect to the completion of the electrical work as a whole. It is the Contractor's responsibility to ensure that the construction of the Works does not compromise J.C. DeCaux's electrical Works. In any such instance the Contractor will be directed to rectify the matter at his own cost.

#### **1.3.2 Electrical Conduit**

Refer to the Underground Conduit section of this Specification for conduit requirements.

The layout of the underground conduits shown on drawing is indicative only and the Contractor shall coordinate and liaise on site with J.C. DeCaux to determine the final routing and requirements.

#### **1.3.3 Electrical Cabling**

The Contractor shall supply and install power cabling between the shelters and the switchboard. J.C. DeCaux's REC shall terminate cabling at the shelter.

Provide a single phase 16A circuit breaker at the J.C. DeCaux distribution board for each shelter to be installed.

## **1.4 Real Time Information (RTI) System**

### **1.4.1 General**

The connection of shelter electric supply is to be coordinated by the Contractor. Supply and installation of the RTI equipment shall be by:

#### **Pixeltech Design**

Michael Krivitsky  
Ph: 03 9529 8777

John Johnston  
Ph: 0402 066 884

### **1.4.2 Conduit**

Refer to the Underground Conduit section of this Specification for conduit requirements.

The layout of the underground conduits shown on drawing is indicative only and the Contractor shall coordinate and liaise on site with Pixeltech to determine the final routing and requirements.

Conduit for future tram detection circuits shall pass under the tram-side tramstop kerb and terminate between the face of the kerb and the tram rail, within 50mm of the face of the kerb. Provide a small VicRoads style detector pit at the end of the conduit, for future connection to tram detection loops.

### **1.4.3 Electrical and Communications Cabling**

The contractor shall supply and install electrical cabling between the distribution switchboard and the RTI equipment.

Provide a single phase 16A circuit breaker at the Yarra Trams distribution board for each RTI ground unit and RTI overhead unit to be installed.

The contractor shall liaise with VicTrack for provision and installation of the Telstra lines to the RTI equipment. The contractor shall coordinate with Victrack and Telstra for installation of the Telstra lines. Contact at VicTrack shall be:

Jenny Dytiapco  
Ph: 0407 918 844

Communications interface cabling between the RTI equipment shall be completed by Pixeltech.

## **1.5 Ticket Vending System**

### **1.5.1 General**

Ticket Vending machines may not be installed under this Contract, however the contractor shall supply and install conduits for the future installation of Ticket machines and Ticket Services Cabinet as detailed on the drawings.

### **1.5.2 Conduit**

Refer to the Underground Conduit section of this Specification for conduit requirements.

### ***1.5.3 Electrical and Communications Cabling***

Provide a single phase 40A circuit breaker at the Yarra Trams distribution board for the Services cabinet.

## **1.6 Payphones**

### ***1.6.1 Supply and Installation***

Payphones may not be installed under this Contract, however the contractor shall supply and install conduits as shown on the drawings for their future installation.

### ***1.6.2 Conduit***

Refer to the Underground Conduit section of this Specification for conduit requirements.

### ***1.6.3 Electrical and Communications Cabling***

Provide a single phase 16A circuit breaker at the Yarra Trams distribution board for each payphone to be installed.

## **1.7 Timetable**

### ***1.7.1 General***

Supply and Installation of the Timetable equipment shall be by:

#### **Diadem**

James Ogilvie – Installation Manager

Ph: 0417 704 669

### ***1.7.2 Conduit***

Refer to the Underground Conduit section of this Specification for conduit requirements.

The layout of the underground conduits shown on drawing is indicative only and the Contractor shall coordinate and liaise on site with Diadem to determine the final routing and requirements.

### ***1.7.3 Electrical Cabling***

The contractor shall supply and install electrical cabling between the distribution switchboard and the timetable units.

Provide a single phase 16A circuit breaker at the Yarra Trams distribution board to serve two timetable units for each platform.

## **1.8 Work By Others**

Works by others include:

- (a) Builder
  - Construction of the tram platform and coordination of the installation. Set out of equipment and formwork for pits.
  - Provide an indication of conduit termination by placing a diagonally cut tile over the location where the conduits turn up to ground level.

- (b) Electrical Distribution Company  
Supply and installation and connection of consumer's mains cabling from the Distribution Company's Network to the new supply authority Point of Attachment (POA). (The Contractor is to supply conduits, trenching and conduit installation to the supply authority POA and consumers mains cabling from the POA to the distribution switchboard).
- (c) Tram Shelters  
Supply and installation of tram shelters. (Contractor to supply and install conduits and cabling as specified).
- (d) Real Time Information System  
Supply and installation of Real Time Information ground unit and associated cabling (Contractor to supply and install cabling and conduits as specified).
- (e) Timetable  
Supply and installation of timetable (Contractor to supply and install conduits and cabling as specified).

### **1.9 Approvals and Permits**

The following approvals shall be obtained by the contractor:

- Approval to connect to the Telstra network and associated Works
- Approval to connect to the electricity grid and associated Works

Note that any alterations to the design intentions reflected in this Specification and on the Drawings made by the Contractor may require additional or revised approvals. These shall be obtained by the Contractor at his expense.

### **1.10 Drawings**

Refer to the site drawings for indicative layouts of equipment and conduit requirements:



## 2. General

### 2.1 Standards

All work shall be performed in accordance with the Contract and the requirements of current Australian Standards and Codes including those listed below. In the event of any conflict, the requirements of the Contract shall apply:

AS1470 Health and safety at work - principles and practices  
AS3000 Wiring Rules  
AS3080 Telecommunications Installations

### 2.2 Site Survey

The Contractor shall engage an experienced and qualified surveyor to set out the Works in strict conformity with the Specification and Drawings. This surveyor shall possess the experience and qualifications which would be acceptable to the Institution of Surveyors, Australia as satisfying the requirements for Corporate or Associate Membership or alternatively, possess the experience and qualifications which would be acceptable for Membership to the Institution of Engineering and Mining Surveyors, Australia.

The Works are set out to Australian Mapping Grid (AMG) and Australian Height Datum (AHD).

### 2.3 Inground Services

The Contractor shall conduct a Melbourne One Call Survey (MOCS) or similar survey of all underground assets and services prior to commencing work on the site. The Contractor has a "Duty of Care" with respect to all services. For underground services the Contractor shall conduct a careful 'proving excavation' around all services in accordance with the service Authority's or Company's requirements prior to major work to ensure the safety of personnel and to maintain the integrity of the existing underground assets and services.

The Contractor shall inform the Superintendent as soon as he becomes aware of the possible need to encase, alter or relocate services. The Contractor shall advise the Superintendent and the responsible Authority or Company of the details and proposed actions. The Contractor shall be responsible for the costs to obtain the necessary approvals, or permits from the responsible Authority or Company.

The time of any such additional advice shall be the Contractor's responsibility and the Contractor is to organise his work program accordingly. The Contractor shall have no claim against the Principal for any loss or delay associated with work on or around any services.

The Contractor shall be responsible for any damage, which in the opinion of the Superintendent and the Municipal Authority, has been caused to stormwater drains; other street furniture; council and private property; or utility services by any work or operations under the Contractor's control.

Where any damage is caused to work under the Contract by any fault that may develop in any stormwater drain or other utility service, the Contractor shall make arrangements with the appropriate Authority, Council or Company for any repairs to the service which may be necessary. The Contractor shall also make good the damage to the Works. The Contractor shall have no claim against the Principal for any loss or delay due to such damage.

## 2.4 Telstra Services

The Contractor shall arrange to have all managers or supervisors attend the Telstra Cable Awareness Presentation prior to commencing Works in the vicinity of Telstra infrastructure. This free 45 minute presentation can be arranged by contacting either:

Terry Prentice Team Leader Telstra Network Integrity Group Mobile: 0419 331 810	Con Andronis Manager Telstra Network Integrity Group Mobile: 0417 302 674
--	--

## 3. Underground Conduits

### 3.1 General

Underground conduits are to comply with AS 3000 for electrical conduits and TS009 for communications conduits and all other relevant Australian Standards and to the requirements of the Electricity Distribution Company, Telstra and other relevant local authorities.

### 3.2 Cables and Conduits in Trenches

#### 3.2.1 Sand bed and surround

Provide clean sand under and around cables and conduits installed underground. Clear the bottom of the trench of all rocks, stones and other hard and sharp materials. Fill the trench to a depth of 50mm with a layer of selected filling prior to cable placement.

#### 3.2.2 Sealing ducts and conduits

Seal buried entries to ducts and conduits using waterproof seals. Seal spare ducts and conduits immediately after installation. Seal other ducts and conduits after cable installation. Seal the joints of all conduits or pipes enclosing PVC/PVC and XLPE/PVC wiring with approved PVC jointing compound.

#### 3.2.3 Draw wires

Arrange so that cables may be drawn out of the duct or conduit in the event of any cable failure. Install 4 mm<sup>2</sup> polypropylene draw string or 2.5 mm<sup>2</sup> galvanised steel wire in conduits for future installation of cable.

Water proofing: Provide puddle flanges around conduits where they pass into cable pits. Install bell mouth accessory on end of conduit located within wall of pits and flush with inside surface of pits on conduits > 100mm dia.

#### 3.2.4 Pipe ducts and conduits

Electrical buried in ground conduits: Orange heavy duty UPVC conduit.

Communications buried in ground conduits: White UPVC conduit.

Minimum Cover:      Electrical Conduit under roadway min. 600mm cover  
                              Electrical Conduit under concrete pavement min 300mm cover  
                              Communication Conduit under roadway min 600mm cover  
                              Communication Conduit under concrete pavement min 300mm cover

Bedding: 50 mm thick, compacted fill and extending the full width of the trench.

Layout: Avoid sharp bends and locate drawing in points above ground.

Cleaning: Swab clean before installing any cables.

### 3.3 Cable Pits

#### 3.3.1 General

Sizes: Minimum 300 x 300mm. Allow for turning of cables at above the minimum acceptable bending radius.

Location: As shown on the drawings. Tolerance shall be within 10mm of the specified point horizontally.

Cable support: Use galvanised iron brackets to separate layers of cables in the pit.

Slack cables: Leave sufficient length of slack cables in pits to cater for future alteration.

Allow for concrete haunching around multiple conduits to prevent pit collapse where multiple conduit entry points are required.

### **3.3.2 Proprietary cable pits**

For pits = 1.2 x 1.2 m, provide proprietary concrete or polymer moulded pits.

### **3.3.3 In situ construction**

Select from the following:

- Proprietary cable pits.
- Construct walls and bottoms from rendered brickwork or 75 mm thick reinforced concrete. Incorporate a waterproofing agent in the render or concrete. Minimum wall thickness as follows:
  - 100 mm for double boxed reinforced pit
  - 125 mm for double boxed un-reinforced pit
  - 150 mm for single boxed un-reinforced pit

### **3.3.4 Pit covers**

General: Provide pit covers to suit expected loads of pedestrian or vehicular traffic in the location in which it is installed fitted flush with the top of the pit or lid surround.

Where possible, pit covers shall be ACO light duty recessed solid bottom "Lock and Seal" galvanised mild steel access cover and frame with locking bolts as required. Infill of pit lids shall match surrounding pavement layout. Where pavers are used cut paving units to fit into access lid with joints aligning with adjacent paving units. Coordinate with the paving contractor for lay out of pits and paving. Pit lids shall sit flush with the surrounding pavement.

Provide engraved brass plaques set into the infill material of the access cover to indicate function of pit. Labels shall be engraved "Electricity" for electrical pits and "Communications" for communication pits.

Standard: To AS 3996.

Maximum weight: 40 kg for any section of the cover (non-trafficable, >5000kg for trafficable).

Lifting handles: Provide a lifting handle for each size of cover section.

### **3.3.5 Drainage**

General: Provide drainage from the bottom of cable pits, to a subsoil drainage pipe wrapped around the base of the pit and surrounded by crushed rock.

Drainage Pipe: Minimum size F75mm x 1000 mm long. The entire pipe shall sit below the base level of the pit.

### **3.4 Underground Cable Routes**

#### **3.4.1 General**

Provide all changes in grade or direction in easy stages, and bends with a radius of not less than fifteen times the conduits overall diameter.

#### **3.4.2 Survey**

Accurately record the routes of underground cables before backfilling. Accurately plot conduit routes, pits, junction boxes, etc., and note levels of ducts at the following points:

- Changes in direction.
- Entry and exit from structures and pits.
- Changes in depth.

#### **3.4.3 Marker tape**

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

#### **3.4.4 Conduit Location**

Where conduits terminate for future equipment, liaise with the builder to provide a section of paving which has been cut diagonally and laid over the conduits to serve as a marker of their location.

### **3.5 Boring**

If under road boring is required in lieu of trenches, engage a suitably qualified person to do the work.

Ensure a tight fit to the service pipes. If voids are encountered, fill by pressure grouting.

### **3.6 Reinstatement**

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

Reinstate paving and roads to match adjacent work, paved surfaces and assets disturbed or removed during excavation of trenching.

Reinstate concrete surfaces to the original level. If necessary, provide steel reinforcement keyed to the adjacent concrete and laid to prevent the reinstated concrete from subsiding and cracking.

### **3.7 Shop Drawings**

Submit shop drawings of each of the proposed pits showing:

- Pit type, size and dimensions.
- Manufacturer's details.
- Maximum cover loading.
- Pit function marking details.
- Orientation of pit lid with paving setout.

## 4. Electrical Services

### 4.1 General

#### 4.1.1 Electricity Supply

The electricity incoming supply shall be provided by the Electrical Distribution Company and interfaced with the tram super stop electrical distribution switchboard as indicated on the drawing.

All fees associated with the installation of the incoming supply will be paid by the Contractor.

Liase with the Electrical Distribution Company to determine the exact position of this connection.

The installation shall be in accordance with the Victorian Service and Installation Rules and the Electricity Safety (Network Assets) Regulations 1999.

#### 4.1.2 Communications

Liase with Telstra Network Design to confirm the preferred location to arrange connection of the Telstra service and Telstra project number for the works. The contact person is:

##### **Telstra Network Design**

Trevor Pittock  
Ph: 9634 1023  
Fax: 9639 9004

Liase with VicTrack to provide sufficient notice (minimum 20 working days) for installation of the service cables. The contact person is:

##### **Victrack**

Jenny Dytiapco  
Ph: 9619 8844  
Fax: 9619 4565

Forward all correspondence to Victrack including the Telstra Project number for the works.

### 4.2 Electrical Supply Characteristics

The electrical supply characteristics will generally be as follows:

- 63A, 240 volt, single phase, two wire, 50Hz.
- The maximum prospective fault level at the distribution switchboard to be confirmed by the Electrical Distribution Company.
- The system of earthing shall be in accordance with recommended practice by Yarra Trams.

### 4.3 Radio, Television and Electrical Interference

Design and provide all electrical equipment such that it will not cause interference with radio, television or other equipment in the tram stop.

Radio and television interference levels shall be within the limits as set out in AS 1044.

Electrical disturbance shall within the limits as set out in AS 2279.

#### **4.4 Earthing**

All steel reinforcing shall be provided with an electrical earth by means of suitable tie wire distribution and connections into the earthing system. The Contractor shall ensure that all reinforcing is electrically continuous and suitable lugs are provided at regular intervals for this purpose. Coordinate with the reinforcing contractor to ensure reinforcing is adequately tied into the earthing system.

Provide an earthing system in accordance with AS 3000: 2000 and in compliance with the requirements of the Electrical Distribution Company, Office of the Chief Electrical Inspector and Yarra Trams.

Connect the main earthing conductor to an earthing electrode installed to the requirements of Electrical Distribution Company. Provide the earthing electrode in one piece, comprising a solid steel core bonded to an outer casing of electrolytic copper of minimum length 2000mm and minimum diameter 16mm.

Provide a bonding conductor to connect the earth bar from the distribution pillar to any extraneous conductive parts to form an equipotential zone. Size the main earthing and bonding conductors as required by AS 3000: 2000. Minimum size of earthing and bonding conductor to be 35mm<sup>2</sup>.

Extraneous conductive parts include fence bollards or any other unearthed built-in metal object on the platforms. Bond to the concrete reinforcement bars at regular intervals along the platform via connections provided.

Supply and install separate earthing systems for the communication system in accordance with the requirements of Austel and Telstra.

Connect the main earth conductor to the negative DC rail of the Tram system in accordance with Yarra Trams requirements. Provide a diode or spark gap device rated for the appropriate fault current at the site in series between the main earth conductor and the negative DC rail. Refer to drawing for typical arrangement.

Locations of the earthing connections, conductors and rods are to be indicated clearly on the contractor's As-Installed drawings.

#### **4.5 Tariff Metering**

Provision shall be made for two off meter facilities in the switchboard enclosure. Provide separate metering for J.C. DeCaux Tram Shelters and Yarra Trams platform equipment.

Allow for all charges and Works associated with the provision of the energy metering facilities in conjunction with the Electricity Retailer.

Allow the meter to be installed in the electrical distribution pillar and make all necessary arrangements with the Electricity Retailer for the installation of metering equipment.

#### **4.6 Electrical Switchboard Enclosure**

##### **4.6.1 General**

Supply and install the distribution switchboard enclosure on the platform as indicated on the drawings and as further specified herein.

The location of the switchboard enclosure shown on the drawing is indicative only. Verify the exact location and actual dimensions required and ensure that all equipment provided will fit the spatial constraint of the tram stop.

Provide a surface mounted double 10A General Purpose Outlet mounted inside the switchboard enclosure and connect to the Yarra Trams distribution board.

#### **4.6.2 Switchboard Enclosure**

The switchboard enclosure shall be:

- Front access
- Bottom cable entry
- Stainless Steel weather and vandal resistant construction to IP56 minimum
- Sized to suit 2 sets of single phase metering, metering links, 2 off distribution switchboards, diodes and switchgear

The construction of the enclosure shall have the following minimum requirements:

- Locking to doors shall be supplied with zinc plated 110mm pad bolts or chrome brass flush locks keyed to CL001.
- Locking system used shall be a Victorian Power Industry lock able to be accessed by The supply authority and Telstra. Provide two sets of keys and hand to the superintendent. Keys to be labelled "Tram Stop ### Electrical Cabinet". Confirm final labelling details with the superintendent.
- Electrical backing panel to switchboard and metering facilities.

#### **4.6.3 Electrical Distribution Switchboards**

Provide two off distribution boards for Yarra Trams platform equipment and J.C. DeCaux Tram Shelters.

Supply and install a minimum 12 pole single phase load centre for Yarra Trams with 80A isolator and RCD main switch and 2 off spare 16A earth leakage circuit breakers.

Supply and install a minimum 9 pole single phase load centre for J.C. DeCaux with 63A isolator and RCD main switch and 2 off spare 16A earth leakage circuit breakers.

Confirm final switchboard requirements with Yarra Trams prior to installation.

Construct distribution boards in accordance with Form 2 of AS 3439.1 suitable for mounting inside the switchboard enclosure. Provide a separate section to each distribution board and to house relays and contactors of the DIN rail mounting type, as required.

Provide labels fixed to escutcheon panels adjacent circuit breakers and internal equipment indicating the relevant section and component.

Provide circuit schedule of minimum size 200 x 150 mm, with typewritten text showing switchboard identification/location, consumers mains size, main switch rating, submain size, type, designation, short-circuit protective device, circuit numbers and current ratings.



Mount schedule cards in a holder fixed to the inside of the door, next to the distribution circuit switches. Protect with a hard plastic transparent cover.

### **Circuit Breakers**

Fault capacity  $\geq 10\text{kA}$ : To AS 3947.2, *Circuit Breakers*.

Fault capacity  $<10\text{kA}$ , current rating  $<100\text{ A}$ : Miniature overcurrent circuit breakers to AS 2184 *Moulded-case circuit-breakers for rated voltages up to and including 600V a.c. 250 V d.c.* or for BCA Class 1a single dwellings or Class 2 sole-occupancy units only, AS/NZS 4898, *Circuit breakers for overcurrent protection for household and similar installations*.

Mount circuit breakers so that the "ON/OFF" and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of all circuit breakers in the same plane.

For miniature overcurrent circuit breakers provide clip tray assemblies capable of accepting single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for unused portions.

### **Neutral and Earth Links**

Provide terminals for future circuits.

Assembly capacity  $>36$  poles: Provide neutral and earth links at the top and bottom of the circuit breaker section.

Assembly capacity  $\leq 36$  poles: Provide links at the point of entry of incoming supply cables.

Mounting: Mount neutral links on an insulated base.

Control circuits: Provide separate neutral and earth links.

Labels: Provide labels for neutral and earth terminals.

### **Residual Current Devices**

Standard: To AS 3190 Approval and test specification – residual current devices (current-operated earth leakage devices)

General: Where shown incorporate earth leakage in circuit breaker protection operation.

Mounting: Comply with Moulded case and miniature circuit breakers, in the Circuit breakers subsection.

Residual current classification: Type II.

Maximum tripping current: 30 mA.

## **4.7 Cabling**

### **4.7.1 Conductor material**

Provide cables with high conductivity multi-stranded copper cable, except for fire resisting cables. Do not provide aluminium cables.

#### 4.7.2 Standards

- Building wires and double insulated PVC/PVC cables: To AS 3147 *Electric cables – thermoplastic insulated – for working voltages up to and including 0.6/1kV.*
- Double insulated XLPE/PVC cables: To AS 3198 *Electric cables – XLPE insulated – for working voltages up to and including 0.6/1kV.*
- Flexible cords: To AS 3191 *Electric flexible cords.*
- Control and protection cables: To AS 2373:1 *Electric cables for control and protection circuits – multi-core control cables.*
- AS 2373:2 *Electric cables for control and protection circuits – twisted pair control cables.*

#### 4.7.3 Cable sizes

Consumers mains: 16mm<sup>2</sup> minimum.

Sub-mains: 2.5mm<sup>2</sup> minimum or as indicated on the drawing.

Sub-circuit cables: Increase size where necessary for reasons of voltage drop or de-rating to AS 3008.1 and AS 3000.

- Lighting sub-circuits: 2.5 mm<sup>2</sup>
- General purpose power sub-circuits: 2.5 mm<sup>2</sup>
- Control circuits including alarms, etc: 1.5 mm<sup>2</sup>
- Flexible cords: 30/0.25 mm<sup>2</sup>

#### 4.7.4 Unsheathed Installation

Provide permanently fixed conduit enclosures assembled before installing wiring. Provide draw wires to pull in conductor groups from outlet to outlet, or use ducts with removable covers.

#### 4.7.5 Terminations

##### **Copper Conductors**

Other than for small accessory and luminaire terminals, terminate copper conductors to equipment, with compression-type lugs of the correct size for the conductor. Compress using the correct tool or use soldering.

##### **Within assemblies and equipment**

General: Loop and tie together conductors from within the same cable or conduit from the terminal block to the point of cable sheath or conduit termination. Neatly bend each conductor to enter directly into the terminal tunnel or terminal stud section, allowing sufficient slack for easy disconnection and reconnection.

Identification ferrules: Provide durable numbered ferrules fitted to each core, and permanently marked with numbers, letters or both to suit the connection diagrams.

Spare cores: Identify spare cores and terminate into spare terminals, if available. Otherwise, neatly insulate and neatly bind the spare cores to the terminated cores.

## 4.8 Shop Drawings

Submit shop drawings of the distribution pillar showing:

- Types, model numbers and ratings of assemblies.

- Component details, functional units and transient protection.
- Detailed dimensions.
- Shipping sections, general arrangement, plan view, front elevations and cross-section of each compartment.
- Projections from the assembly that may affect clearances or inadvertent operation, such as handles, knobs, arcing-fault venting flaps and withdrawable components.
- Fault level and rated short circuit capacity characteristics.
- IP rating.
- Fixing details for floor or wall mounting.
- Front and back equipment connections and top and bottom cable entries.
- Door swings.
- External and internal paint colours and paint systems.
- Quantity, brand name, type and rating of control and protection equipment.
- Construction and plinth details, ventilation openings, internal arcing-fault venting and gland plate details.
- Terminal block layouts and control circuit identification.
- Single line power and circuit diagrams.
- Details of mains and submain routes within assemblies.
- Busbar arrangements, links and supports, spacing between busbar phases, and spacing between assemblies, the enclosure and other equipment and clearances to earthed metals.
- Labels and engraving schedules