

Master Specification

Part RD-EL-C2

Installation of Traffic Signals

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Government of South Australia
Department for Infrastructure
and Transport

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RD-EL-C2 Installation of Traffic Signals

1 General

- a) This Master Specification Part sets out the requirements for the installation of traffic signals, including:
- i) the documentation requirements, as set out in section 2;
 - ii) the electrical installation, testing, approval and product requirements, as set out in section 3;
 - iii) the trench work, conduits, and pits requirements, as set out in section 4;
 - iv) the construction of footings requirements, as set out in section 5;
 - v) the cabling requirements, as set out in section 6;
 - vi) the requirements for the installation of equipment, as set out in section 7;
 - vii) the traffic signal controller requirements, as set out in section 8;
 - viii) the provision for SCATS and CCTV telecommunications requirements, as set out in section 9;
 - ix) the requirements for Bluetooth capture stations, as set out in section 10;
 - x) the detector loop installation requirements, as set out in section 11;
 - xi) the requirements for uninterruptible power supply, as set out in section 12;
 - xii) the warranty requirements, as set out in section 13;
 - xiii) the switch-on requirements, as set out in section 14;
 - xiv) the Witness Point requirements, as set out in section 15; and
 - xv) the verification requirements and record requirements, as set out in section 16.
- b) The installation of traffic signals must comply with the Reference Documents, including:
- i) AS 2144 Traffic signal lanterns;
 - ii) AS 2339 Traffic signal posts, mast arms and attachments;
 - iii) AS/NZS 2276 Cables for traffic signal installations;
 - iv) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - v) AS/NZS 5000 Electrical cables - Polymeric insulated;
 - vi) Department Approved Products List (available from: https://dit.sa.gov.au/contractor_documents/masterspecifications);
 - vii) Department Asset Data Collection Standard (AM-PRC-005);
 - viii) Department Operational Instruction 14.2 Traffic Signal Faces (available from: https://dit.sa.gov.au/standards/standards_and_guidelines);
 - ix)** Department Operational Instruction 3.16 Temporary Signs at Traffic Signals (available from: https://dit.sa.gov.au/standards/standards_and_guidelines);
 - x) Department Standard Drawings (available from: https://dit.sa.gov.au/standards/standards_and_guidelines);
 - xi) RITS Data Collection Template;

- xii) SAPN Service & Installation Rules Manual No. 32; and
- xiii) TSI-SP-069 Control Equipment for Road Traffic Signals, TfNSW.

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) evidence of compliance with section 3c)v);
- b) details of alternative traffic signal products (not forming part of the Department Approved Products List), where relevant;
- c) traffic signal layout drawings and traffic signal conduit layout drawings which have been approved as IFC Design Documentation;
- d) evidence of electrical licensing requirements as required by section 3b);
- e) details of proposed pedestrian detection equipment products as required by section 7.9a);
- f) details of proposed alternative vehicle detection equipment products, as required by section 7.10a);
- g) details of any CCTV equipment and associated mounting arrangements, including supporting brackets details, as required by section 7.11c);
- h) details of Bluetooth capture station products, as required by section 10e);
- i) details of UPS products, as required by section 12d); and
- j) an Inspection and Test Plan which:
 - i) complies with the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable);
 - ii) complies with the requirements of PC-CN1 “Testing and Commissioning”; and
 - iii) includes the information required by section 16.

2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) as-constructed site wiring diagrams and cable connection schedules as required by sections 6.1.1e) and 6.1.1g);
- b) the information required by section 14.1d), including:
 - i) as-constructed traffic signals and traffic signal conduit drawings;
 - ii) electrical certificate of compliance;
 - iii) signal installation information sheet;
 - iv) controller operations sheet; and
 - v) asset data table as specified in the RITS Data Collection Template; and
- c) the verification requirements and records required by section 16.

3 Electrical installation, testing, approvals and products

- a) The Contractor must ensure that all electrical installations for traffic signals:
 - i) are carried out by an electrical worker who is licensed to perform electrical works; and
 - ii) comply with:
 - A. AS/NZS 3000 Electrical installations; and
 - B. SAPN Service & Installation Rules Manual No. 32.
- b) The Contractor must provide evidence of the licence of the electrical workers required in section 3a)i) to the Principal as part of the Construction Documentation, prior to the commencement of any electrical works for traffic signals by the Contractor.
- c) The Contractor must ensure that it:
 - i) obtains all relevant Approvals for traffic signals required by the *Road Traffic Act 1961* (SA) and all applicable Laws;
 - ii) complies with all requirements of PC-SM1 “Traffic and Pedestrian Management” as relevant to the traffic signals, including the development and submission of traffic control device drawings and WTMPs;
 - iii) provides notification to the Principal in relation to traffic signal changes in accordance with the requirements of this Master Specification Part, including section 8.2;
 - iv) only uses traffic signal products that:
 - A. appear on the Department Approved Products List; or
 - B. have been approved as part of the design review process required by PC-EDM1 “Design Management”; or
 - C. have been submitted and approved pursuant to PC-CN3 “Construction Management”; and
 - v) for powered equipment which is fed from the non-metered traffic signal power supply:
 - A. the brand and model number or version of all powered equipment installed must be included in the AEMO National Electricity Market Load Table;
 - B. the equipment must comply with all AEMO requirements, including approved load tables for unmetered connection points; and
 - C. evidence of compliance with this section 3c)v) is submitted as part of the Construction Documentation.

4 Trench work, conduits, and pits

The Contractor must ensure that all trench work, conduits, and pits required for the installation of traffic signals comply with the following:

- a) RD-EW-C2 “Trench Excavation and Backfill”;
- b) RD-EW-C3 “Boring”;
- c) RD-PV-C6 “Reinstatement of Existing Pavements”;
- d) RD-EL-C3 “Supply and Installation of Conduits and Pits”; and
- e) RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”.

5 Construction of footings

5.1 General

- a) The requirements of this section 5 apply to the construction of footings for the installation of traffic signals.
- b) The Contractor must ensure that:
 - i) cast-in-place concrete complies with ST-SC-S1 “Normal Class Concrete”;
 - ii) footings are constructed of unreinforced normal class concrete, grade N20; and
 - iii) the top surface of concrete is finished with a wooden float to a smooth even surface.

5.2 Footing construction requirements

The Contractor must ensure that:

- a) all traffic signal post footings are constructed in accordance with Department Standard Drawing S-4515, sheet 2;
- b) with respect to mast arm footings:
 - i) all mast arm footings and reinforcement for traffic signals are constructed in accordance with Department Standard Drawing S-4055, sheet 30; and
 - ii) a **Witness Point** applies at the completion of excavation and prior to the construction of the footing to assess the suitability of the soil to support the footing;
- c) all signal controller footings plus surrounds for traffic signals:
 - i) are of the type shown in the Design Documentation; and
 - ii) are constructed as shown on the following Department Standard Drawings:
 - A. for pavement mounted controller - base details, Department Standard Drawing S-4512, sheet 3; and
 - B. for holding down bolts for traffic signal posts, Department Standard Drawing S-4515, sheet 2; and
- d) the front of the signal controller cabinet is aligned as detailed in the Construction Documentation.

6 Cabling

6.1 Cable installation

6.1.1 General

- a) The requirements of this section 6 apply to cabling installed for traffic signals.
- b) LV/ELV cables must be used for traffic signal multi-core power cables, where both LV and ELV applications are required.
- c) LV cables must be used where LV only applications are required.
- d) All cables must be continuous and without joins except at termination points.
- e) The Contractor must submit an as-constructed site wiring diagram and as-constructed cable connection schedule as part of the Quality Management Records.
- f) The site wiring diagram required in section 6.1.1e) must include details of each traffic signal installed, including:

- i) type of signal pole;
 - ii) cable size and connection schedules;
 - iii) pole, lantern and pedestrian signal groups;
 - iv) detector feeder cables;
 - v) connections to audio tactile units and camera installations as applicable; and
 - vi) junction boxes.
- g) Site wiring diagrams and cable connection schedules must be submitted by the Contractor in accordance with the format shown in the sample in Appendix 1: Site wiring diagram layout (sample only) as part of the Quality Management Records.
- h) The Contractor must ensure that:
- i) the installation of cables is as shown in the site wiring diagrams, cable connection schedules, and the Design Documentation;
 - ii) cables are drawn through signal conduits using draw cords;
 - iii) cables are installed through pits and conduits without causing damage to the cable;
 - iv) strain exceeding cable manufacturers' recommendations is not placed on any individual core, individual cable or group of cables during the drawing in process;
 - v) a draw cord remains in the conduit after the installation of the cable to enable the installation of additional cables in the future as required by RD-EL-C3 "Supply and Installation of Conduits and Pits";
 - vi) a minimum of:
 - A. 10 spare cores are provided in road crossings; and
 - B. 3 spare cores are provided to each signal post top; and
 - vii) spare cable length is provided and located as specified in this section 6.

6.1.2 Signal post and controller cables (LV / ELV)

- a) The minimum length of signal post cable tails (LV / ELV cables) required on installation within pits and at the base of the signal controllers must be as follows:
 - i) one complete loop, as large as can be looped within the relevant pit, for each pit; and
 - ii) 1.8 m for signal controller base.
- b) The Contractor must ensure that, after termination, all spare signal post cable is stored in the base of the pits and signal controller.

6.1.3 Detector feeder cables

- a) The Contractor must ensure that detector feeder cables are drawn around the signal site in separate electrical conduits to LV and ELV cables.
- b) The minimum length of detector feeder cable tails required on installation at the signal controller base and detector pit must be as follows:
 - i) 2 m for signal controller base; and
 - ii) 0.5 m for detector pit.
- c) The Contractor must ensure that, after termination, all spare detector feeder cable is stored in the base of the signal controller and the detector pit.

6.1.4 Consumer mains cable (LV cable)

The Contractor must ensure that:

- a) a consumer mains service cable is installed as shown in the Construction Documentation and in accordance with the SAPN Service & Installation Rules Manual No. 32 in between:
 - i) the SAPN connection point;
 - ii) the Department isolation pit; and
 - iii) the signal controller or UPS base;
- b) where the SAPN connection point cannot be located close to the signal controller and the consumer mains cable is drawn to the signal controller base via intermediate draw-in pits or traffic signals conduits and pits, the consumer mains cable must be:
 - i) drawn in through a separate conduit to all other cables;
 - ii) fixed with insulated saddles to the walls of such underground cable drawing pit; and
 - iii) clearly labelled as "CONSUMER MAINS SERVICE" in each underground cable drawing pit;
- c) the following minimum lengths of consumer mains cable tails are used for installation at the signal controller base and Department isolation pit, and SAPN connection point:
 - i) 0.75 m for signal controller base;
 - ii) 0.75 m each end of the active core only, for a Department isolation pit. The neutral core must be continuous; and
 - iii) 1.5 m for SAPN connection point; and
- d) after termination, all spare consumer mains cable is stored in the base of the signal controller, the Department isolation pit and the SAPN connection point.

6.1.5 Telecommunications cabling

The Contractor must ensure that, where the installation of traffic signals requires a physical connection to a telecommunications Utility Service:

- a) prior to completion of the installation, a telecommunications cable (to be sourced by the Contractor from the relevant telecommunications Utility Service Authority) must be drawn from the telecommunications Utility Service pit shown in the Construction Documentation to the line terminating box on the side of the signal controller housing;
- b) a cable tail of 0.4 m in length is provided at the terminating box;
- c) any excess cable is neatly coiled in the telecommunications Utility Service pit; and
- d) the installation of the telecommunications Utility Service into the traffic signal controller housing is arranged with the relevant telecommunications Utility Service Authority.

6.2 Cable termination

6.2.1 General

In relation to cable termination for the installation of traffic signals, the Contractor must ensure that:

- a) cable cores are terminated in such a manner to ensure that no movement of wires is possible;
- b) all cables are terminated and labelled as detailed in the site wiring diagrams and cable connection schedules required by section 6.1.1;
- c) labels are permanent in nature and stamped or embossed to avoid loss of identification; and
- d) handwritten labels are not used.

6.2.2 Signal posts

In relation to signal posts required for the installation of traffic signals, the Contractor must ensure that:

- a) upper mounting bracket assemblies are terminated as follows:
 - i) the signal post cable must be secured to the terminal plate with cable ties;
 - ii) the cores must be separated into LV and ELV groups;
 - iii) the resulting LV and ELV core forms must be tied and further restricted to prevent movement of the core forms; and
 - iv) all work must be in accordance with Department Standard Drawing S-4517, sheet 1; and
- b) post mounted terminal boxes for traffic signals are terminated as follows:
 - i) cables to mast arms, signal posts, and other locations where an upper mounting bracket assembly cannot be utilised, must be terminated in a post mounted terminal box; and
 - ii) cores must be:
 - A. separated into LV and ELV allocations and terminated in the terminal strip in accordance with the site wiring diagram and cable connection schedules required by section 6.1.1; and
 - B. tied and restrained to prevent movement of the LV and ELV core forms in accordance with Department Standard Drawing S-4518, sheet 2.

6.2.3 Consumer mains

In relation to consumer mains required for the installation of traffic signals, the Contractor must ensure that:

- a) Department isolation pits for the installation of traffic signals are terminated as follows:
 - i) the active core tails must be terminated in a fully waterproof, insulated fuse holder which is suitable for installation in an underground service pit, and can be connected quickly and safely by one person avoiding the need for stripping, compression tooling, or heat shrinking;
 - ii) fuse holding clamps must be placed onto the wall of the Department isolation pit at a point 150 mm below the pit lid, as shown on Department Standard Drawing S-4055, sheet 56; and
 - iii) the main earth stake must:
 - A. be installed in a trench in the ground through the hole provided in the Department isolation pit base; and
 - B. provide a clearance from the pit lid of 150 mm;
- b) active and neutral cores of the consumer mains service cable are terminated at the signal controller or UPS power distribution panel; and
- c) the main earth core terminated complies with the multiple earthed neutral system of earthing in accordance with AS/NZS 3000 Electrical installations.

6.2.4 LV / ELV cables at the signal controller

In relation to LV / ELV cables at the traffic signal controller, the Contractor must ensure that:

- a) cables are located and secured under the cable retaining clamps at the bottom of the traffic signal controller frame;
- b) the outer sheath is stripped back to the top of the retaining clamps;

- c) cable cores are separated into LV and ELV allocations;
- d) each cable is clearly labelled to indicate the number of the post or junction box to which it is connected;
- e) LV and ELV cores:
 - i) are formed and separately tied with cable ties; and
 - ii) run to the relevant terminal strips within the traffic signal controller;
- f) segregation between LV and ELV cable forms is maintained; and
- g) all spare cores are earthed.

6.2.5 Lanterns

In relation to lanterns relevant to the traffic signals, the Contractor must ensure that:

- a) traffic signal vehicle and pedestrian lanterns are terminated to the appropriate terminals as detailed in section 6.2.2;
- b) traffic signal vehicle and pedestrian lanterns are terminated at the terminal strip located on the upper mounting bracket assembly;
- c) where traffic signal vehicle and pedestrian lanterns are mounted on a support other than a signal post with an upper mounting bracket assembly, the lantern cables are terminated in a post terminal box located on the support; and
- d) termination to LV and ELV terminal strips in either the upper mounting bracket assembly or post terminal box is as detailed in the site wiring diagram.

6.2.6 Push button and audio tactile driver unit

In relation to push button and audio tactile driver units relevant to the traffic signals, the Contractor must ensure that:

- a) push button assemblies are terminated to ELV terminals at the terminal strip located on the upper mounting bracket assembly or as detailed in the site wiring diagram;
- b) where push buttons are mounted on a support other than a signal post with an upper mounting bracket assembly, the push button cables are terminated in a post terminal box located on the support; and
- c) the cable harness from the audio tactile amplifier assembly is terminated to the LV and ELV terminal strips on the upper mounting bracket assembly or post mounted termination box as detailed in the site wiring diagram.

6.2.7 Detector feeders

In relation to detector feeders relevant to the traffic signals, the Contractor must ensure that:

- a) detector feeder cable screens are insulated and joined by crimping drain wires into a through crimp connector and extended with an insulated earth core to a terminal earth point; and
- b) detector feeder cables are:
 - i) neatly formed;
 - ii) tied with cable ties; and
 - iii) labelled to identify the loop to which it is connected.

6.2.8 Spare cable cores

The Contractor must ensure that spare cores from signal post cables are:

- a) separated from terminated cores;

- b) tied with cable ties;
- c) connected through crimp connector; and
- d) extended with an insulated earth core to a terminal earth point.

7 Installation of equipment

7.1 General

The Contractor must ensure that:

- a) the installation of traffic signal equipment complies with the requirements of this section 7;
- b) general traffic signal aspects are 200 mm or 300 mm diameter arranged in accordance with the requirements of Department Operational Instruction 14.2 Traffic Signal Faces;
- c) signs labelled "Signals Not Operating" are installed:
 - i) in accordance with Department Operational Instruction 3.16 Temporary Signs at Traffic Signals; and
 - ii) on all signal posts at the same time as the lanterns are installed;
- d) all signs installed in accordance with section 7.1c) remain in place until the signals are commissioned; and
- e) where additional lanterns are to be provided at an existing traffic signal site, the Contractor meets the requirements of RD-EL-D2 "Traffic Signal Design".

7.2 Signal posts

For all traffic signal posts (including road lighting combination poles that form part of the traffic signal design), the Contractor must ensure that:

- a) the type of post installed is as shown in the Design Documentation;
- b) posts are as shown on the Department Standard Drawings, including:
 - i) Department Standard Drawing S-4537, sheet 6; and
 - ii) Department Standard Drawing S-4055, sheets 42, 48 and 49;
- c) the following are treated with a rust inhibiting lubricant prior to erection of the post:
 - i) the threaded lower end of the traffic signal post;
 - ii) the threaded collar on the prefabricated post base plate; and
 - iii) the holding down bolts in the base foundation;
- d) the traffic signal post base plate is firmly bolted down to the concrete foundation;
- e) non-corrosive metal packing shims are used to ensure that the traffic signal post is vertical;
- f) the traffic signal post is tightened down to the base plate;
- g) where mechanical means are used to tighten the traffic signal post into the base plate, the galvanized outer surface of the traffic signal post is not damaged; and
- h) push button assemblies (including push button mounting heights and arrows) are located correctly to match the alignment requirements for push buttons.

7.3 Vehicle signal lanterns

For all vehicle signal lanterns, the Contractor must ensure that:

- a) all vehicle signal lanterns are attached to the traffic signal post by upper and lower mounting bracket assemblies using appropriate galvanised mounting straps;
- b) where vehicle signal lanterns are to be attached to other supports (e.g. Stobie poles), brackets are provided by the Contractor;
- c) the vehicle lantern assembly, including visors and backing boards, is positioned 300 mm clear of the kerb line and sited (aimed) as detailed on Department Standard Drawing S-4538, sheets 1 and 2;
- d) 3-aspect vehicle signal lanterns are installed so that the centre of the red lens is 4.0 m above the footpath or median surface unless otherwise specified in the traffic signal design drawings;
- e) adjacent aspects are mounted so that doors giving access to internal vehicle signal lantern aspects open away from each other;
- f) vehicle and arrow signal aspects are arranged so the same-coloured signal aspect is horizontally aligned and located in a 6-aspect lantern configuration;
- g) right arrows are on the right of the corresponding vehicle aspect;
- h) left arrows are on the left of the corresponding vehicle aspect; and
- i) where the signal face comprises less than 3 aspects, the vacant positions in the 3 aspect lantern body are blanked out.

7.4 Pedestrian signal lanterns

For all pedestrian signal lanterns, the Contractor must ensure that:

- a) pedestrian signal lanterns are attached to the traffic signal posts using appropriate galvanized mounting straps and 2 lower mounting brackets;
- b) the pedestrian signal lantern assembly including visors is positioned 300 mm clear of the kerb line and aimed so that pedestrians have a clear view of the signal from the opposite side of the carriageway; and
- c) the pedestrian signal lantern is installed with the centre of the walk lens 3 m above the foot pavement or median surface.

7.5 Mounting of vehicle and pedestrian lanterns

The Contractor must ensure that all vehicle and pedestrian lanterns are secured to their respective lower mounting brackets with a locking mechanism in accordance with AS 2339 Traffic signal posts, mast arms and attachments.

7.6 Push button mounting assemblies - pedestrian and cyclist

For all pedestrian and cyclist push button assemblies, the Contractor must ensure that:

- a) push button assemblies are attached to signal posts indicated on the traffic signal drawings;
- b) where push button assemblies are attached to other supports, mounting brackets are used as shown on Department Standard Drawing S-4516, sheet 2;
- c) where the push button assembly is mounted on a support other than a signal post, it is terminated directly to the nearest ELV termination strip as detailed in the site wiring diagram and cable connection schedule as required by section 6.1.1;
- d) the cable connecting the push button assembly to the post mounted termination box is placed into a PVC sheathed flexible metal conduit (anaconda product type or similar) in accordance with section 7.12; and
- e) the flexible conduit required in section 7.6d) is:
 - i) attached to the push button by means of a flexible metal conduit terminator; and

- ii) securely attached to the support to prevent any movement of the conduit.

7.7 Pedestrian push buttons

For all pedestrian push buttons, the Contractor must ensure that:

- a) pedestrian push buttons include arrow legends in the audio tactile display;
- b) pedestrian push buttons driving different audio tactile signals are located on separate posts, with only one audio-tactile pushbutton installed per post;
- c) the pedestrian push button assembly is positioned such that:
 - i) the face of the device is parallel with the direction of cross walk; and
 - ii) the arrow points in the direction of crosswalk in accordance with Department Standard Drawing S-4074, sheet 7;
- d) pedestrian push button assemblies are located 1,015 mm above the walking surface or standing place used by pedestrians when operating the button, measured to the cable entry hole of the push button assembly;
- e) the height of the push button is measured to the cable entry hole as described on Department Standard Drawing S-4537, sheet 6;
- f) all pedestrian push buttons are audio tactile;
- g) the audio tactile push button assemblies are installed in accordance with the Construction Documentation;
- h) audio tactile signal arrows are positioned horizontally and point to the far side of the road in the direction that the pedestrian is expected to walk;
- i) the audio tactile driver is mounted on the same support nominated for the audio tactile push button assembly it controls;
- j) if the audio tactile driver cannot be mounted as required by section 7.7i), it must be mounted on the closest suitable signal support; and
- k) the brackets supplied as part of the housing are used to mount the audio tactile driver at a height of 4 m above the footpath or median surface.

7.8 Cyclist push buttons

For all cyclist push buttons, the Contractor must ensure that:

- a) cyclist push buttons are not audio tactile and include a cycle symbol in the assembly above the button;
- b) cyclist push buttons are orientated with the face of the device parallel to the direction of traffic, pointing generally towards a cyclist stopped at the stop line;
- c) cyclist push buttons are located 1,015 mm above the adjacent road surface measured to the cable entry hole of the push button assembly;
- d) cyclist push buttons are located on the same post as the primary traffic signal face;
- e) the cyclist push buttons must have push button faces positioned parallel to the kerb and adjacent to the road carriageway within reach of a cyclist stopped at the stop line (and stopped in the bike lane, where it exists); and
- f) where the cyclist push button is co-located on the same post as a pedestrian push button, the cyclist push button is positioned at the same level as the height of the pedestrian push button.

7.9 Alternative forms of pedestrian detection

- a) Where the traffic signals design includes pedestrian detection either to determine the presence of pedestrians or the clearance of pedestrians, the Contractor must include details of the proposed detection equipment products as part of the Construction Documentation.
- b) If approved for use by the Principal, the Contractor must ensure that the pedestrian detection equipment referred to in section 7.9a) is installed in accordance with the manufacturer's specifications, including with respect to setup, location and orientation.

7.10 Alternative forms of vehicle detection

- a) Where the traffic signals design includes an alternate form of vehicle detection, the Contractor must include details of the proposed detection equipment products as part of the Construction Documentation.
- b) If approved for use by the Principal, the Contractor must ensure that the vehicle detection equipment referred to in 7.10a) is installed in accordance with the manufacturer's specifications, including with respect to setup, location and orientation.

7.11 CCTV camera installation

Where CCTV equipment is required to be installed at intersections, the Contractor must ensure that:

- a) the roadside CCTV control equipment is housed in an extension housing attached to the top of the traffic signal controller cabinet;
- b) the CCTV equipment and its mounting arrangement, including the detail of supporting brackets, complies with the Department Standard Drawings;
- c) if the approved design includes an alternative mounting arrangement other than those specified in 7.11b), details for CCTV mounting arrangements are clearly shown in the relevant Construction Documentation;
- d) cabling inside poles is supported so that it does not bear its own weight;
- e) cabling is segregated from traffic signals or road lighting cabling (which may be achieved by subducting or flexible communications conduit);
- f) a spare ethernet cable is installed and tested from the extension housing to each CCTV camera; and
- g) if a UPS is fitted at the signalised site, the CCTV equipment is to be powered from the UPS.

7.12 Flexible conduits to equipment

The Contractor must ensure that:

- a) flexible black PVC conduits from the upper mounting bracket assembly or termination box to lanterns and audio tactile drivers are tied together and securely fixed using UV rated cable ties to the signal post or other support to prevent excessive movement;
- b) flexible conduits are free from distortion and are positioned away from strap brackets and other supports likely to cause mechanical damage in the event of the equipment being hit by a vehicle; and
- c) flexible conduits extend 50 mm inside the final assembly cap.

8 Traffic signal controller

8.1 General

In relation to the traffic signal controller, the Contractor must ensure that:

- a) traffic signal controller installation complies with the requirements of this section 8;

- b) traffic signal controllers are installed as shown in the Construction Documentation;
- c) the traffic signal controller has sufficient capability in terms of the number of signal groups and detectors that can be terminated in the traffic signal controller cabinet;
- d) there are at least 2 spare signal groups and detectors for future expansion;
- e) when electronic signs are fed off from a traffic signal controller which is more than 12 signal groups, a separate fuse is installed in the traffic signal controller cabinet for the signs;
- f) the fuse type, fuse rating and holder type required by section 8.1e) must be supplied in accordance with TSI-SP-069 Control Equipment for Road Traffic Signals, TfNSW;
- g) door alarms for traffic signal controller cabinets:
 - i) are extended to the:
 - A. extension housing (if fitted); and
 - B. UPS cabinet doors, where a separate UPS is installed; and
 - ii) can be remotely monitored by the Traffic Management Centre via SCATS; and
- h) the opening of traffic signal controller cabinet, extension housing, or UPS cabinet door results in an alarm being generated at the Traffic Management Centre via SCATS which identifies the relevant cabinet location and the door status (i.e. open or closed).

8.2 Traffic signal controller programming

In relation to traffic signal controller programming, the Contractor must:

- a) provide the Principal with the programmable controller personality module and any associated documentation, including the Traffic Signals Operational Performance Report and approved traffic signal drawings in accordance with RD-EL-D2 "Traffic Signal Design";
- b) once the information required by section 8.2a) has been provided to the Principal, formally request that the Principal undertake programming of the personalities provided in section 8.2a); and
- c) make an allowance of 8 weeks from date of the Contractor's formal request under section 8.2b) for the Principal to undertake and deliver the programmed controller personality module to the Contractor.

9 Provision of telecommunications for SCATS and CCTV

9.1 SCATS and CCTV communication

The Contractor must ensure that the provision of telecommunications connections for SCATS and CCTV is in accordance with:

- a) RD-EL-D2 "Traffic Signal Design";
- b) the Design Documentation; and
- c) this section 9.

9.2 New traffic signal sites

In relation to new traffic signal sites, the Contractor must:

- a) ensure that traffic signal controllers are fitted with all hardware necessary for SCATS connection, Bluetooth connection and CCTV communications (where CCTV is also specified in the Design Documentation); and
- b) provide all related elements of the communications connections, including:
 - i) SCATS compatible modem hardware;

- ii) 4G / 5G / GPS antenna;
- iii) telecommunications - 4G / 5G / ethernet (WAN) (as applicable);
- iv) direct access to the TrafficNet via fibre optic connection; and
- v) traffic site specific parameters.

9.3 SCATS compatible modem or network hardware

- a) The Contractor must:
 - i) procure all SCATS compatible modem and network devices required for the installation of traffic signals;
 - ii) deliver the equipment specified in section 9.3a)i) to the Principal for configuration and ordering telecommunications service connection; and
 - iii) allow the Principal 8 weeks for configuration, ordering of telecommunications service connection and the return of programmed equipment.
- b) The Contractor must make provision in its works program for all allowances required in this section 9.3.

10 Bluetooth capture stations

- a) The Contractor must provide, install, test and commission Bluetooth capture stations:
 - i) within all new or upgraded traffic signal controller cabinets including intersections and pedestrian crossings, in accordance with the requirements of this section 10; and
 - ii) if specified at other locations in the Contract Documents, in accordance with the requirements of this section 10.
- b) The Contractor must ensure that Bluetooth capture stations:
 - i) comprise an industrial DIN-mount programmable communications platform capable of Bluetooth (classic and low energy) and Wi-Fi MAC address capture from passing vehicles, which must be connected into a port at the nearest network (TrafficNet) access point (Layer 2 switch). If a Layer 2 switch is not installed in the traffic signal controller, the Bluetooth capture station must be connected to the traffic signal controller linking control module (LCM);
 - ii) include an external antenna configured to provide full intersection coverage; and
 - iii) are compatible with the AddInsight traffic intelligence system, including beacon and broadcast functionality.
- c) The installation of the antenna required in section 10b)ii) must not compromise the ingress protection (IP) rating of the traffic signal controller housing.
- d) Bluetooth capture station hardware must be compatible with:
 - i) classic Bluetooth (v2.1);
 - ii) Bluetooth low energy (v4.x); and
 - iii) Wi-Fi (2.4GHz and 5GHz) technology.
- e) The Contractor must provide Bluetooth capture station product details as part of the Construction Documentation.

11 Detector loop installation

11.1 General

In relation to detector loops installed for traffic signals, the Contractor must ensure that:

- a) detector loops are installed as specified on the Department Standard Drawings, including Department Standard Drawing S-4500, sheets 1 and 2;
- b) detector loops located at the intersection stop bar are the quadrupole type;
- c) detector loops other than those specified in section 11.1b) are the passage type;
- d) detector loop cables are polypropylene insulated;
- e) a slot is cut to the pattern shown, and of the dimensions detailed, on Department Standard Drawing S-4500, sheets 1 and 2, to suit the individual detector loop requirements;
- f) where cuts intersect, the cut strictly adheres to the cut depth detailed on Department Standard Drawing S-4500, sheet 1, to prevent any variation in level between cuts;
- g) all cuts are straight;
- h) overrun of cuts are to the minimum to maintain the 50 mm depth where cuts intersect;
- i) cutting residue is removed from the vicinity of the detector loop slots and within the detector loop slots, prior to the installation of detector loop cable, in a controlled manner that will not disperse the cutting residue into the surface drainage system;
- j) the detector loop cable is laid in the slot, in accordance with the diagrams shown in Department Standard Drawing S-4500, sheets 1 and 2;
- k) no damage is caused to the detector loop cable;
- l) where detector loop cable enters the detector pit, individual detector loop cables are twisted together to ensure there are no secondary loops formed in the detector pit;
- m) detector loop cables entering the detector pit are cut to a length of 0.5 m;
- n) the detector loop cable is securely held in the slot in accordance with Department Standard Drawing S-4500, sheet 1, and the slot sealed with a sealant which is compatible with both the detector loop cable insulation and the road surface material;
- o) all sealant is applied in accordance with the manufacturer's instructions;
- p) detector loop cables are connected to relevant detector feeder cables by soldering;
- q) the exposed screen drain wire is cut off level with the outer sheath and left unconnected;
- r) the resulting connection from section 11.1q) is encapsulated in a waterproof medium to prevent corrosion of the electrical joint;
- s) the encapsulation required by section 11.1r) includes the outer insulating sheath of the detector feeder cable; and
- t) all detector loops can be identified in the detector pit by means of labelling (in accordance with section 6.2.1) on the feeder cable.

11.2 Road surface condition

In relation to detector loops installed for traffic signals, the Contractor must ensure that:

- a) the road surface is in a condition that enables it to support the installation of loop detection, including feeder cable that is to be cut into the surface; and
- b) there are no instances of repair patching, rutting, cracking, spray seals or road subsidence within 2 m of all sides of the detector loops.

11.3 Testing and acceptance

The Contractor must verify the integrity of detector loops immediately following installation of the loop cable and again on connection of the detector loop feeder cables to the traffic signal controller, in accordance with the requirements of section 14.

12 Uninterruptible power supply

In relation to UPS for traffic signals, the Contractor must ensure that:

- a) the provision of UPS is in accordance with RD-EL-D2 “Traffic Signal Design”;
- b) the spacing between the UPS and the signal controller base is in accordance with Department Standard Drawing S-4055, sheet 73;
- c) the UPS is capable of providing back up power for normal operation of the traffic signals and any attached CCTV equipment for a minimum period of 4 hours (note that this requirement does not extend to road lighting);
- d) UPS equipment product details are submitted as part of the relevant Construction Documentation; and
- e) “Danger, Dual Supply” stickers (refer to Appendix 2: UPS warning label sticker template, 110 mm (width) and 80 mm (height) for an example) are installed at the following locations to provide sufficient warning:
 - i) exterior of UPS and traffic signal controller cabinets, near upper key lock; and
 - ii) interior of traffic signal controller cabinet, below the traffic signal controller switchboard.

13 Warranty

The Contractor must ensure that warranty provisions for the installation of traffic signals comply with the requirements of:

- a) the Contract Documents; and
- b) RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”.

14 Switch-on

14.1 General

- a) All testing and commissioning procedures and documentation must comply with the requirements of:
 - i) PC-CN1 “Testing and Commissioning”; and
 - ii) PC-CN2 “Asset Handover”.
- b) Prior to the switching on of any traffic signals the Contractor must:
 - i) allow in the pre-switch-on program at least 2 days testing with the Principal;
 - ii) liaise with the Principal to arrange a suitable date for switch-on following completion of electrical and functional testing;
 - iii) audit the Site against drawings and provide the record in accordance with:
 - A. the requirements of the Department Asset Data Collection Standard (AM-PRC-005); and
 - B. the format specified in the RITS Data Collection Template;

- iv) ensure that the SCATS co-ordination plans have been installed by the Principal and confirmed as operational by the Principal; and
 - v) in addition to the site acceptance testing required by section 14.2, ensure that the lantern alignments have been reviewed prior to switch-on.
- c) The Contractor must supply and install asset identification using yellow reflective type asset labels with black print and clear gloss laminate as required by RD-ITS-C1 "Installation and Integration of ITS Equipment" which must:
- i) for the traffic signal controller cabinet, be 300 mm height and 250 mm width (noting that while the prefix "ITS" is used for ITS cabinets, the prefix "TS", "PC" and "SC" is used for traffic signal controllers, pedestrian crossing controllers and school crossing controllers respectively); and
 - ii) for the pole number sticker, be in accordance with the Design Drawings and:
 - A. 85 mm height and 47 mm width for single digit; or
 - B. 85 mm height and 100 mm width for double digit; and
 - iii) for UPS cabinets:
 - A. be of the same dimension as the pole number stickers and be of the format "UPS XXX" (where (XXX is the allocated UPS number);
 - B. may be either yellow reflective type or non-reflective black text on white background; and
 - C. attached to the inside of the UPS cabinet door in a location which does not occlude any other attached stickers or cabinet information.
- d) The Contractor must provide the following as part of the Quality Management Records:
- i) as-constructed traffic signal layout and conduit drawings;
 - ii) connection schedule;
 - iii) electrical certificate of compliance;
 - iv) signal installation information sheet;
 - v) controller operations sheet, and
 - vi) asset data table as specified in the RITS Data Collection Template.
- e) The documentation required by section 14.1d)i) must be compliant with the following Department Road Design Presentation Standards:
- i) DP011 Traffic Signals; and
 - ii) DP012 Traffic Signal Conduit.
- f) A copy of the documents required by section 14.1d)) must be included by the Contractor inside the cabinet door pocket within a sealable folder.

14.2 Site acceptance test

- a) At switch-on, the Contractor must undertake Site Acceptance Testing of all traffic signals equipment in accordance with the relevant SAT Plan.
- b) The SAT Plan relating to traffic signal Site Acceptance Testing must include the following tests:
 - i) each traffic signal post, pedestal and the attached equipment must:
 - A. operate correctly;
 - B. be erected in accordance with this Master Specification Part; and
 - C. be properly aimed at the appropriate traffic;

- ii) lantern aspects must not be easily seen by traffic on the wrong approach;
 - iii) the traffic signal controller must respond to the demands from each vehicle, pedestrian, cyclist and any other detector; and
 - iv) the traffic signal controller must communicate correctly with the Principal's SCATS network.
- c) Where an internal or external UPS is installed, the Contractor must:
- i) ensure that all commissioning tests specified by the UPS manufacturer have been completed; and
 - ii) where the UPS manufacturer commissioning testing does not include the following, ensure that the following tests and checks are completed:
 - A. battery terminals are undamaged and torqued to the specified torque;
 - B. corrosion protection is applied to all battery terminals;
 - C. battery and battery cabling internal resistance is within specification; and
 - D. confirmation that the UPS is capable of supporting the attached load for a minimum of 4 hours.
- d) The Contractor must ensure that the traffic signal installation does not allow any unsafe situation.
- e) The Contractor must ensure that after the traffic signals have been switched on:
- i) operation has been correctly transferred to SCATS; and
 - ii) all temporary traffic control devices and associated equipment are removed from the Site.
- f) The switching on and site acceptance testing required by this section 14.2 constitutes a **Witness Point**.
- g) The results of the Site Acceptance Testing must be recorded in a site acceptance test schedule, which forms part of the verification records.

15 Witness Points

Table RD-EL-C2 15-1 details the review period or notification period, and type (documentation or construction quality) for each Witness Point referenced in this Master Specification Part.

Table RD-EL-C2 15-1 Witness Points

Section reference	Witness Point	Documentation or construction quality	Review period or notification period
5.2b)ii)	Inspection after completion of excavation of mast arm footing and prior to the construction of the footing to assess the suitability of the soil to support the footing	Construction quality	24 hours notification
14.2f)	Switch-on and site acceptance tests	Construction quality	3 days notification

16 Verification requirements and records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table RD-EL-C2 16-1 have been complied with.

Table RD-EL-C2 16-1 Verification requirements

Subject	Property	Procedure	Frequency	Acceptable limits
Detector loop integrity	Detector loop continuity	Measure with continuity tester	Each detector loop	Full continuity
Detector loop integrity	Insulation resistance	Measure the insulation resistance between the detector loop circuit conductors and a good earth point with the 2 conductor ends comprising the detector loop circuit connected together	Each detector loop	The insulation resistance between the detector loop circuit conductors and a good earth point must be 10 Megohms or greater measured at a test voltage of 500 V DC applied for at least a minute
Detector loop integrity	Inductance of detector loop circuit	Measure with no vehicles over or traversing the detector loop and with no other adjacent detector loop circuit energised	Each detector loop	Measured inductance must be not more than 20% from the theoretical value for the size and detector loop turns installed
Site acceptance test schedule	Correct site operation	As required by section 14.2	At switch-on	As required by section 14.2

17 Appendix 1: Site wiring diagram layout (sample only)

LOCATION: GRAND JUNCTION ROAD / PROSPECT ROAD													
TS160			PSC 'C'									Date: 06/11/2007	
Main cable size			63	J. BOX 1		J. BOX 2		J. BOX 3			J. BOX 4		
Pole cable size				19	19	19	19	19	19	19	19	19	19
Pole Numbers				10	1	2	3	4	5	6	7	8	9
Group	Cont	Function											
SG1	A3	Green	1					1				1	
	A4	Amber	2					2				2	
	A5	Red	3					3				3	
SG2	A6	Green	4					4				4	
	A7	Amber	5					5				5	
	A8	Red	6					6				6	
SG3	A9	Green	7										
	A10	Amber	8										
	A11	Red	9										
SG4	A12	Green	10										
	A13	Amber	11										
	A14	Red	12										
SG5	B3	Green	13	1			1	7				7	
	B4	Amber	14	2			2	8				8	
	B5	Red	15	3			3	9				9	
SG6	B6	Green	16					10				10	
	B7	Amber	17					11				11	
	B8	Red	18					12				12	
SG7	B9	Green	19										
	B10	Amber	20										
	B11	Red	21										
SG8	B12	Green	22			1				1	1		
	B13	Amber	23			2				2	2		
	B24	Red	24			3				3	3		
SG9	C3	Green	25										
	C4	Amber	26										
	C5	Red	27										
SG10	C6	Green	28										
	C7	Amber	29										
	C8	Red	30										
SG11	C9	Green	31		1	4					4		
	C10	Amber	32		2	5					5		
	C11	Red	33		3	6					6		
SG12	C12	Green	34										
	C13	Amber	35										
	C14	Red	36										

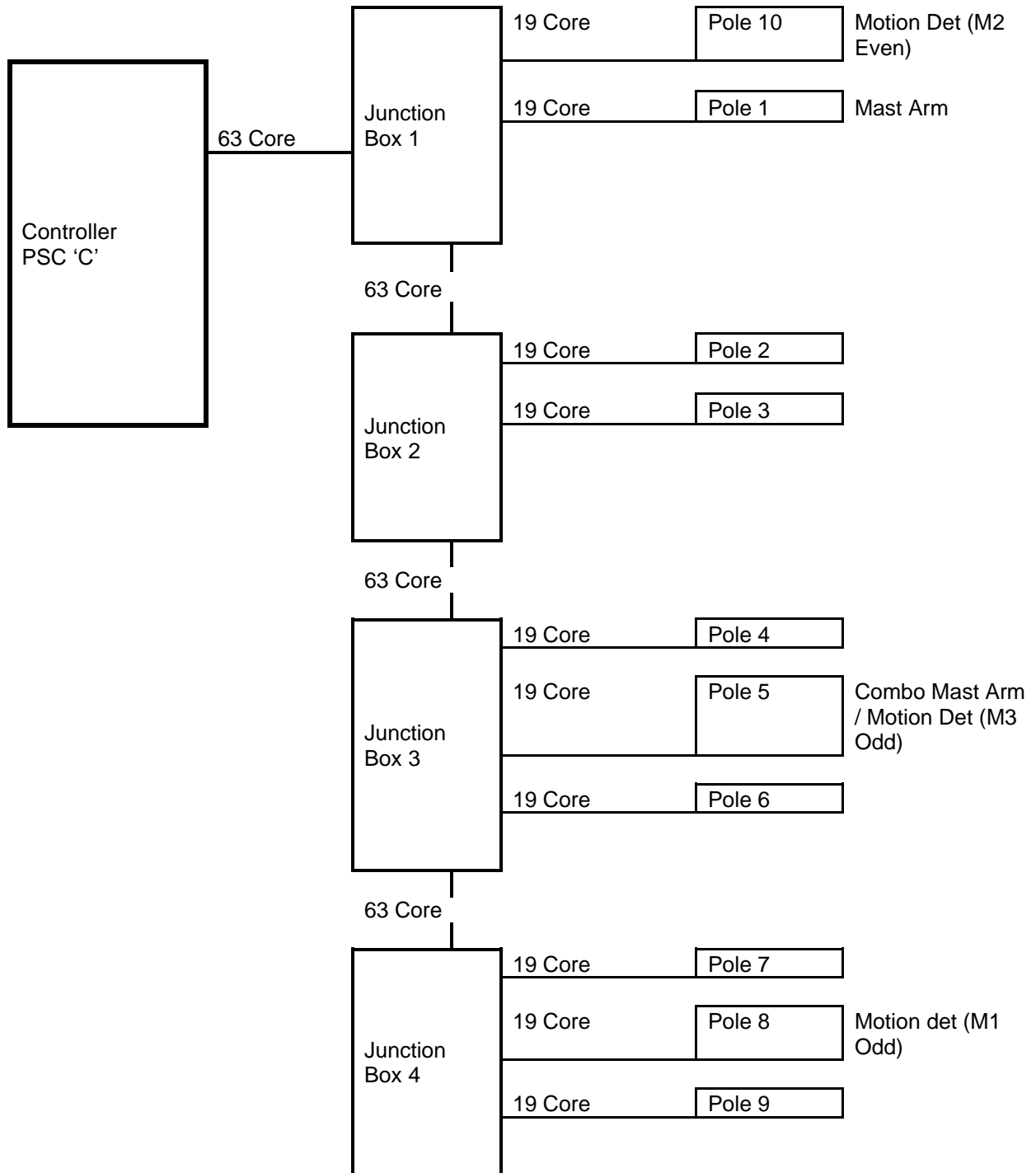
LOCATION: GRAND JUNCTION ROAD / PROSPECT ROAD													
TS160			PSC 'C'									Date: 06/11/2007	
	Main cable size		63	J. BOX 1		J. BOX 2		J. BOX 3			J. BOX 4		
	Pole cable size			19	19	19	19	19	19	19	19	19	19
	Pole Numbers			10	1	2	3	4	5	6	7	8	9
Group	Cont	Function	37										
P1	D12	Walk	38							4	7		
	D14	Don't Walk								5	8		
		WAIT											
	F28	Push Button	56							15	15		
P2	D9	Walk	39		4	7							
	D11	Don't Walk	40		5	8							
	F1-2	WAIT											
	F27	Push Button	57		15	15							
P3	D6	Walk	41				4		4				
	D8	Don't Walk	42				5		5				
	F1-3	WAIT							15				
	F26	Push Button	58				15						
P4	D3	Walk	43	4								4	
	D5	Don't Walk	44	5								5	
	F1-4	WAIT											
	F25	Push Button	59	15								15	
	E3	PB Return	60	16	16	16	16		16	16	16	16	
	A2	230VActv	GREY										→
	A1	Neutral	BLACK										→
	=	Earth	GREEN/YELL OW										→
		Spare	45	6	6	9	6	13	6	6	9	6	13
			↓	↓	↓	↓	↓	14	↓	↓	↓	↓	14
			↓	↓	↓	↓	↓	15	↓	↓	↓	↓	15
			55	14	14	14	14	16	14	14	14	14	16

Example Cable Connection Schedule (sample only)

LOCATION: GRAND JUNCTION ROAD / PROSPECT ROAD

TS160

Date: 06/11/2007



- 18 Appendix 2: UPS warning label sticker template, 110 mm (width) and 80 mm (height)

