

# Master Specification

## Part RD-EL-D3

### Conduit Design for Road Lighting, Traffic Signals and ITS

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**Government of South Australia**  
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and Transport

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# RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS

## 1 General

- a) This Master Specification Part sets out the requirements for the design of conduit and pit infrastructure for road lighting, traffic signals and ITS, including:
  - i) the documentation requirements, as set out in section 2;
  - ii) the design requirements, as set out in section 3;
  - iii) the conduit system requirements, as set out in section 4;
  - iv) the pits requirements, as set out in section 5;
  - v) the network identification requirements, as set out in section 6; and
  - vi) the drawing presentation requirements, as set out in section 7.
- b) This Master Specification Part does not apply to conduit design for HV installations. Where conduit design requires the inclusion of HV cabling, refer to the relevant SAPN specifications for the design of the HV component of the conduit design.
- c) The design of conduit and pit infrastructure for road lighting, traffic signals and ITS must comply with the Reference Documents, including:
  - i) AGRD Part 6B: Roadside Environment;
  - ii) AS 3996 Access covers and grates;
  - iii) AS/NZS 2053 Conduits and fittings for electrical installations;
  - iv) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
  - v) AS/NZS 3008.1 Electrical Installations - Selection of cables;
  - vi) ACMA Telecommunications Cabling Provider Rules 2014;
  - vii) AS/CA S008 Requirements for customer cabling products;
  - viii) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
  - ix) Department Road Design Presentation Standards (available from: [https://dit.sa.gov.au/standards/standards\\_and\\_guidelines](https://dit.sa.gov.au/standards/standards_and_guidelines));
  - x) Department Drawing Legend;
  - xi) Department Standard Drawings;
  - xii) SAPN Service & Installation Rules Manual No. 32;
  - xiii) SAPN Technical Standard TS085 - Trenching and Installation of Underground Conduits and Cables (up to and including 33kV); and
  - xiv) SAPN Technical Standard - TS100 Electrical Design Standard for Underground Distribution Networks (up to and including 33kV).

## 2 Documentation

### 2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include:

- a) a detailed conduit design package constituting:
  - i) a design model showing a 3D representation of the designed location of pits and conduits for the electrical and communications systems; and
  - ii) a report detailing the conduit design development in accordance with the requirements of this Master Specification Part; and
- b) Design Drawings:
  - i) showing the design of the conduit system in accordance with the Department Road Design Presentation Standards, and the requirements of section 7;
  - ii) minimum bending radii of conduits are shown on the drawings in accordance with the requirements of section 4.1a)ii); and
  - iii) pit schedule in accordance with the requirements of section 5.1c).

### 3 Design requirements

In relation to the design of conduit systems for road lighting, traffic signals and ITS, the Contractor must ensure that:

- a) the design of the conduit system:
  - i) optimises the layout of electrical and communications conduits and pits;
  - ii) is compatible with the Principal's existing infrastructure;
  - iii) connects to existing Principal or other conduit systems (e.g. SABRENet, SAPN, Telstra) as required;
  - iv) maximises the ease of installation and maintenance of hardware and cabling;
  - v) accommodates other Utility Services, road furniture, watercourses, drainage infrastructure and landscaping, including meeting the requirements of Third Party Asset owners;
  - vi) accommodates the future provision or expansion of ITS infrastructure;
  - vii) minimises the ingress of water, vermin and contaminants that may affect the performance of cable systems housed within the conduit system; and
  - viii) complies with all other requirements of the Contract Documents, including RD-EL-C3 "Supply and Installation of Conduits and Pits";
- b) the consumer mains/sub-mains service connection cable does not share pits or conduits with other Utility Services;
- c) where the use of shared pits for the consumer mains/sub-mains service connection cable is approved by the Principal as a Design Departure, the consumer mains/sub-mains service connection cable must be:
  - i) fixed to the walls of the shared pit with saddles;
  - ii) labelled as a consumer mains/sub-mains service; and
  - iii) labelled to indicate the source and destination of the consumer mains/sub-mains service connection cable;
- d) the conduit design allows for a minimum of 60% spare cross-sectional capacity remaining in each conduit with the calculated cable sizes installed;
- e) all electrical and communications conduit and pit components, including cable trays and cable ladders, are designed to ensure the physical separation (for diversity and redundancy) of the electrical and communications system cabling in accordance with the segregation requirements set out in:

- i) AS/NZS 3000 Electrical installations; and
- ii) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
- f) the design of the conduit system accommodates the requirement for physical separation within all pits, ITS enclosures, junction boxes and marshalling cabinets;
- g) pit sizes P4 and larger, and also barrier voids, all conduits are designed and installed with permanent bell mouths on conduit ends to assist in cable pulling and to prevent cable damage during installation; and
- h) pits housing equipment which may require regular maintenance (e.g. containing fuses, fibre splices, submersible switchboards) are not placed in any area where access is constrained.

## 4 Conduit

### 4.1 Layout

In relation to the design of the conduit system for road lighting, traffic signals and ITS, the Contractor must ensure that:

- a) the conduit system satisfies the following:
  - i) conduits must be placed in straight lines avoiding unnecessary bends;
  - ii) conduit bends must not exceed the minimum bending radius specified by the conduit supplier and the minimum bending radii are documented on the Design Drawings;
  - iii) conduit bends must not exceed the minimum bending radius specified by the supplier of the electrical or communications cabling which is intended to be installed in the conduit;
  - iv) conduits must generally run either parallel or normal to the carriageway;
  - v) large sweeping bends must be adopted for entry into junction boxes and pile footings;
  - vi) with the exception of road crossings, conduits must not exceed a 90° total change in direction in any run between pits;
  - vii) for road crossing conduits, the conduit may include a 90° bend at each pit to enable the conduit to exit and enter the short sides of each pit;
  - viii) conduits must enter the short side of the pits;
  - ix) conduits installed on bridges and other structures (e.g., culverts, overpasses or underpasses) must:
    - A. be incorporated into the structure and not visible; and
    - B. terminate in pits no smaller than P4, external to the bridge or other structure; and
  - x) where conduits are installed under rail corridors:
    - A. conduits must terminate in pits no smaller than P4 either side; and
    - B. pits must be installed external to the rail boundaries as required by section 5.5d)vii);
- b) where a telecommunications service is required for a particular electrical or communications device, the design includes the installation of a telecommunications conduit directly from the relevant telecommunications service pit (housing the telecommunications service point) to the relevant electrical or communications device;
- c) where an ITS device requires LV, ELV, communications or detector feed in cables, the design includes conduits for those required cables to terminate in a common cable draw-in pit. Segregation requirements must be in accordance with AS 3000 Electrical installations and AS/CA S009 Installation requirements for customer cabling (Wiring Rules); and

- d) the design must provide for separate dedicated conduits for each cable use (e.g., road lighting, traffic signals and ITS cables must be installed in separate conduits).

## 4.2 Spare conduits

- a) The Contractor must ensure that the conduit design includes the following spare conduits (as a minimum) installed along the entire length of any traffic signals backbone (main conduit ring):
  - i) 1 spare communications conduit with a minimum diameter of 100 mm; and
  - ii) 1 spare electrical conduit with a minimum diameter of 80 mm.
- b) The Contractor must ensure that the design of conduits includes the following spare conduits (as a minimum) installed along the entire length of any ITS backbone:
  - i) 1 spare communications conduit with a minimum diameter of 100 mm; and
  - ii) 1 spare electrical conduit with a minimum diameter 100 mm.
- c) Where trenches are required for purposes other than ITS backbone cabling (for example, to ITS cabinets located off the ITS backbone or for road lighting which does not use the ITS backbone trench), the Contractor must ensure that:
  - i) the conduit design includes installation of 1 spare communications conduit (with a minimum diameter of 100 mm) in the relevant trench and connected to the ITS backbone conduit system; and
  - ii) the conduit design provides for spare conduits to be terminated in a pit no smaller than pit size P4 at the end of the trench.
- d) The Contractor must ensure that the conduit design for road lighting, traffic signals and ITS satisfies the following requirements with respect to spare conduits to be installed on bridges, overpasses and under rail crossings:
  - i) the design must include 100% capacity over the number of spare conduits specified in the Contract Documents (for example, if 1 spare communications conduit and 2 spare electrical conduits are specified, and the conduits pass under a rail crossing or across a bridge, the number of spare conduits must be 2 communications conduits and 4 electrical conduits at the bridge and rail crossing locations); and
  - ii) the spare conduits installed on bridges and under rail crossings must terminate in pits no smaller than pit size P4 outside the rail boundary or external to any bridge structure.

## 4.3 Separation and size of conduits

### 4.3.1 General

The Contractor must ensure that if trenches for road lighting, traffic signals and ITS are to be shared with other Utility Services, the design stipulates that conduits and other Utility Services must be placed side-by-side (in the horizontal plane) as opposed to overlaying services vertically.

### 4.3.2 Conduit size determination

The Contractor must ensure that conduit size selection for the design is determined by consideration of all of the following criteria:

- a) ability to haul in additional cable infrastructure;
- b) for telecommunications conduit, cable accommodation and technology mix, e.g. twisted pair;
- c) coaxial and optical fibre cables;
- d) costs of conduit laying (direct material and labour costs); and
- d) costs of trenching or horizontal boring.

#### 4.3.3 Electrical power conduit size and colour

The Contractor must ensure that the conduit design for road lighting, traffic signals and ITS satisfies the following requirements with respect to electrical power conduits:

- a) all electrical power conduits must be coloured orange; and
- b) the diameter of the electrical power conduits must not be smaller than:
  - i) 25 mm reinforced flexible conduits for above ground only (e.g., from a pole to a pole mounted cabinet);
  - ii) 25 mm flexible conduits (only for subducting to provide segregation);
  - iii) 80 mm for road lighting conduits;
  - iv) 80 mm for traffic signal electrical conduits;
  - v) 100 mm for electrical conduit for ITS cabinets; and
  - vi) 100 mm for electrical conduit for ITS devices.

#### 4.3.4 Communications conduit size and colour

The Contractor must ensure that the design of conduits for road lighting, traffic signals and ITS satisfies the following requirements in respect to communications conduits:

- a) conduits must be compliant with AS/CA S008 Requirements for customer cabling products;
- b) all communications conduits must be coloured white; and
- c) the diameter of the communications conduits must not be smaller than:
  - i) 25 mm for flexible conduits (only for subducting to provide segregation);
  - ii) 100 mm for ITS conduits not entering pole bases;
  - iii) 50 mm for conduits between pits and pole bases where it is impractical to use 100 mm conduit and a 50 mm conduit meets the requirements for the communications cable; and
  - iv) 50 mm for traffic signal detector conduits.

### 4.4 Underground consumer mains

The Contractor must ensure that the design of conduits for road lighting, traffic signals and ITS provides for underground consumer mains to be installed at a depth and method in accordance with the requirements of:

- a) AS/NZ 3000 Electrical installations;
- b) AS/NZS 3008.1 Electrical Installations - Selection of cables;
- c) the following SAPN technical specifications:
  - i) SAPN Service & Installation Rules and Regulations Manual No. 32;
  - ii) SAPN Technical Standard TS085 - Trenching and Installation of Underground Conduits and Cables (up to and including 33kV); and
  - iii) SAPN Technical Standard - TS100 "Electrical Design Standard for Underground Distribution Networks (up to and including 33kV)";
- d) RD-ITS-C2 "Mains Power Supplies for Roadside Traffic Management Equipment"; and
- e) section 3b) of this Master Specification Part.



## 5 Pits

### 5.1 General

The Contractor must ensure that the design of conduits for road lighting, traffic signals and ITS satisfies the following requirements with respect to pits:

- a) pits and lids must provide sufficient strength to support a wheel loading of at least one tonne without any visible damage, including to the underside of the pit lid;
- b) road lighting, traffic signals and ITS must not share pits (this does not apply to the use of combination road lighting and traffic signal poles at intersections, where road lighting power is fed through the intersection's backbone from a non-essential distribution board in the traffic signal controller extension housing);
- c) a pit schedule is submitted with the Design Drawings including the following pit attributes as a minimum:
  - i) unique identification;
  - ii) chainage;
  - iii) description;
  - iv) owner;
  - v) usage type;
  - vi) size;
  - vii) set out locations in GPS coordinates; and
  - viii) lid security level as defined in section 5.3a);
- d) all pits must be designed such that they fit within the space provided giving due consideration to adjacent Utility Services;
- e) subject to section 5.1f), a 1.2 m clear working width must be provided around all pits;
- f) if a group of pits are installed together and are sharing a common concrete apron, a minimum 100 mm separation must be provided between each of the pits within the apron (in which case the requirement of a 1.2 m clear working width, as per section 5.1e), then applies to the apron around the group of pits). Note also that where other assets such as cabinets, electronic sign footings etc are located adjacent to the pit location and also require a concrete apron, they may all share a single common concrete apron;
- g) all pits must be designed in accordance with Department Standard Drawing S-4055, sheets 66-70; and
- h) where pits are located adjacent to unkerbed roads, the pits must be located such that they are not subject to being driven over by vehicle traffic which may pull off the road to park. Where this is not achievable, pits are to be trafficable.

### 5.2 Isolation pits

The Contractor must ensure that all isolation pits forming part of the conduit design for road lighting, traffic signals and ITS are:

- a) designed in accordance with Department Standard Drawing S-4055, sheet 56;
- b) placed between the SAPN connection point and the relevant Department switchboard, cabinet or equipment; and
- c) placed at least 5 m from the relevant Department switchboard, cabinet or equipment.

### 5.3 Pit lids

In relation to the conduit design for road lighting, traffic signals and ITS, the Contractor must ensure that the selection of pit lids in the design satisfies the following requirements:

- a) for the purposes of this Master Specification Part, where a pit lid is to be:
  - i) lockable - the pit lid must be secured with a padlock and may also be fitted with restricted security bolts;
  - ii) secured - the pit lid must be secured with restricted access tri-notch security bolts (for clarification, provision of these bolts and the matching keyed tool is controlled by the Principal); and
  - iii) unsecured - no securing mechanism is required for the pit lid;
- b) unless otherwise specified in the Contract Documents:
  - i) road lighting pits must be secured, with the exception of pits at the base of light poles which must be unsecured;
  - ii) all traffic signal and ITS power and communications pits must be, at a minimum, secured;
  - iii) pits housing critical power or communications infrastructure in exposed or unrestricted access locations (these locations will be identified by the Principal as a part of the design review process, or in the Contract Documents) must be lockable; and
  - iv) isolation pits must be secured;
- c) secure metal pit lids must be used on unkerbed roads;
- d) fibre access pits must be at least P7 size and lockable; and
- e) all pits with cable sizes greater than 25 mm<sup>2</sup> with a cable length greater than 30 m must be lockable.

### 5.4 Pit sizes

- a) In relation to the conduit design for road lighting, traffic signals and ITS, the Contractor must:
  - i) adopt the generally accepted industry standard of P classification for pit sizes (i.e., P2, P4, P5) in accordance with Department Standard Drawing S-4055, sheets 66 to 70; and
  - ii) select pit sizes:
    - A. based on the intended use of the pit, including the number and size of conduits entering and exiting the pit; and
    - B. such that the cables can be housed within the pit to be installed and operated according to the manufacturer's specifications, including accommodating minimum bending radiuses.
- b) Subject to section 5.4c), the Contractor must use nominal pit sizes in accordance with Table RD-EL-D3 5-1.
- c) If the number of conduits, or the number or size of cables preclude the use of the nominated pit size as per Table RD-EL-D3 5-1, the Contractor must implement a larger pit that meets the requirements of this Master Specification Part.
- d) For P4 and smaller pits, the total number of conduit penetrations must not exceed 4.

Table RD-EL-D3 5-1 Nominal pit sizes

Pit size <sup>(1)(2)</sup>	Nominal pit use <sup>(3)</sup>					
	Power distribution Electrical	Road lighting Electrical	Traffic signal Electrical	Traffic signal Communication	ITS Electrical	ITS Communication
<b>P2</b>	a) Earth stake pit; b) isolation pit; and c) termination pit beneath type A switchboard.	a) Slip base and energy-absorbing pole base pits; and b) direct connects.	Not to be used	Vehicle detector end of run termination pit up to 4 loops	Not to be used	Vehicle detector end of run termination pit up to 4 loops (more than 4 loops, use a P4 pit).
<b>P4</b>	Termination pit beneath large switchboard	a) Draw-in pits; b) road crossing pits; c) combination traffic signals and road lighting pole base pits; and d) mast arm pole base pits.	a) Combination traffic signals and road lighting pole base pits; and b) termination pit beneath traffic signal controller.	a) Traffic signal communication pit; and b) vehicle detector end of run termination pit for more than 4 loops.	Intermediate pull-in pits on single device routes or spur distribution (off-alignment)	a) Intermediate pit for loop detector screen cables; b) detector road crossing; c) vehicle detector end of run termination pit for more than 4 loops; d) local device cables distribution (including ITS field cabinet to camera or sign or similar); and e) draw-in pits for backbone network (provided that minimum bending radius is not compromised during hauling).
<b>P6</b>	Local submains and final sub-circuit distribution	Not to be used	Not to be used	Not to be used	Local submains and final sub-circuit distribution	Use where the design requires a larger pit than P4 to accommodate all conduits or cables.
<b>P7</b>	Submains and final sub-circuit distribution	Not to be used	Not to be used	Not to be used	Any common service trench (CST) requirements	a) Any common service trench (CST) pits required for storing spare fibre loops or fibre access points; b) backbone network; and c) any road crossing pits

<b>P8</b>	Submains and final sub-circuit distribution	Not to be used	Not to be used	Not to be used	Any common service trench (CST) requirements	a) Where P7 does not provide sufficient space; b) any common service trench (CST) pits required for storing spare fibre loops or fibre access points; c) backbone network; and d) any road crossing pits.
<b>S</b>	Not to be used	Not to be used	a) Draw-in pits; and b) road crossing pits.	Not to be used	Not to be used	Building entry pit.
<b>D</b>	Not to be used	Not to be used	Traffic signal backbone (typically at corners and in front of controller)	Not to be used	Not to be used	Building entry pit where the design requires a larger pit to accommodate all conduits or cables.

**Table notes:**

(1) The total number of conduit penetrations must not exceed 4 conduits for P4 pits or smaller.

(2) P1, P3, P5 pits must not be used.

(3) In all cases the nominal pit used is the minimum size. Where the design requires larger pits to accommodate all cables and conduits, larger pits must be selected and specified in the design.

## 5.5 Pit locations

In relation to the conduit design for road lighting, traffic signals and ITS, the Contractor must ensure that the design of the pits satisfies the following requirements:

- a) subject to section 5.5b), pits must not be located where it is likely that they will be driven over;
- b) pits and pit lids located in any area which may be subject to being driven over (including carriageways, verges, hard shoulders or service bays/maintenance areas) must be designed to meet the appropriate load classification as described in AS 3996 Access covers and grates;
- c) pits must be located:
  - i) at all junctions and sharp changes in direction of conduits;
  - ii) with the long dimension oriented with the main conduit alignment, typically parallel to the road;
  - iii) at the splice point between transverse and longitudinal connections of conduits;
  - iv) not less than 1 m from the kerb (or kerb line for unkerbed roads) and not less than 3 m back from the intersection of property lines at street corners or from their projection at truncated corners; and
  - v) a minimum distance of 3 m from driveways and property entries which are considered as an exclusion zone;
- d) pits must not be located:
  - i) at vehicle crossovers or at places where congestion of services and future maintenance activities by other Utility Service Authorities could affect the security of the Principal's plant or assets;
  - ii) in flat painted islands or medians;
  - iii) within restricted zones of low voltage electricity distribution pedestals, pads, domes, Stobie poles or service pits;
  - iv) in the exclusion zone described in section 5.5c)v);
  - v) in pedestrian ramps;
  - vi) in bicycle or pedestrian paths unless unavoidable, and if so, the pit lid must be provided with a suitable permanent non-slip treatment which retains its effectiveness in all environmental conditions; and
  - vii) within rail boundaries;
- e) for 80 mm conduits, a maximum spacing of 70 m between pits must not be exceeded;
- f) for 100 mm conduits housing:
  - i) electrical and communications cables, a maximum spacing of 100 m between pits must not be exceeded; and
  - ii) fibre optic cables only, a maximum spacing of 200 m between pits must not be exceeded; and
- g) intermediate cable position markers must be used as required by RD-EL-C3 "Supply and Installation of Conduits and Pits".

## 5.6 Earth stake

- a) Where a Stobie pole mounted switchboard is used as part of the design of conduits for road lighting, traffic signals and ITS, the Contractor must ensure that an earth stake pit is located no closer than 4 m from the SAPN LV or HV earthing system or pole. If this is not possible, approval must be gained from SAPN to locate the earth stake closer than 4 m.

- b) Where an SAPN approval is required as detailed in section 5.6a), the approval must be submitted as a part of the Design Documentation.

## 6 Network identification

In relation to the conduit design for road lighting, traffic signals and ITS, the Contractor must ensure that the following requirements are satisfied:

- a) pits and conduits must be clearly labelled on the Design Drawings required by section 2.1b) to show the following (in accordance with the Department Standard Drawings and Department Drawing Legend):
- i) pit use and size (e.g. L2 = Lighting pit, size P2, IT4 = ITS pit, size P4);
  - ii) the security of the pit lid (unsecured (no label required), secured, or lockable (in accordance with labels on Department Drawing Legend); and
  - iii) pit lid type (e.g. concrete, metal, composite); and
- b) conduits must be clearly labelled on the Design Drawings including:
- i) conduit number;
  - ii) conduit size; and
  - iii) appropriate labelling in accordance with Table RD-EL-D3 6-1.

**Table RD-EL-D3 6-1 Conduit label**

Conduit allocation	Label
Traffic signals power	TS
Road lighting power	RL
ITS power	ITS
ITS communication	COMMS
Telecommunications service	T
Electrical service	ES

## 7 Drawing presentation

In relation to the conduit design for road lighting, traffic signals and ITS, the Contractor must ensure that all Design Drawings required by section 2.1b) comply with the following requirements:

- a) for road lighting conduit design, the Contractor must ensure that it complies with the requirements of RD-EL-D1 "Design of Road Lighting" and the requirements of Department Road Design Presentation Standard DP013 Road Lighting;
- b) for traffic signal conduit design, the Contractor must ensure that it complies with the requirements of Department Road Design Presentation Standard DP012 Traffic Signal Conduit; and
- c) for ITS conduit design, the Contractor must ensure that it complies with the requirements of Department Road Design Presentation Standard DP018 Intelligent Transport Systems (ITS).