DELIVERING FOR QUEENSLAND

Technical Specification

Transport and Main Roads Specifications
MRTS256 Power Cables

May 2026

Queensland Government

Copyright

Licence

CC BY licence summary statement

Translating and interpreting assistance

The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Contents

1 Introduction 1
2 Definition of terms 1
3 Referenced documents 3
4 Quality system requirements 5
4.1 Hold Points, Witness Points and Milestones 5
5 Materials 5
5.1 Standards 5
5.2 Testing of cables 6
5.2.1 Copper cables 6
5.2.2 Aluminium cables 6
5.3 Electrical rating 6
5.4 Environmental conditions 7
5.5 Reliability 7
6 Physical requirements 7
6.1 Mains connection 7
6.2 Traceable cable markings 7
6.3 Road lighting cable configurations 8
6.4 Traffic signal cable configurations 12
6.5 36 core traffic signal cable 13
6.6 Aerial cables 14
6.7 Cables in tunnels 15
6.7.1 Fire protection 15
6.7.2 Rodent protection 16
6.7.3 Thermoplastic-sheathed (TPS) cable 16
6.7.4 Quality test report 16
6.8 Packaging and storage 16
6.9 Other cables 17
7 Electrical requirements 17
8 Installation of cables 18
8.1 General 18
8.2 Underground cable laying 19
8.2.1 Labelling and marking of cables installed underground 20
8.3 Aerial cable installation 21
8.4 Cable installation for bridges and other concrete structures 22
8.5 Cable installation along cable trays 23

8.6 Termination of cables 23
8.7 Joining cables 23
9 Testing and commissioning of installed cables 24
10 Removal of cables 25
11 Reuse of cable 25
12 Training 25
13 Maintenance 26
14 Handover 26
15 Compliance evaluation form 26

1 Introduction

This Technical Specification covers the Department of Transport and Main Roads requirements for design, manufacture, supply, testing, installation, commissioning, performance, documentation, training and maintenance for electric power cables.

Electrical power cables are cables that carry current between equipment, not internal wiring for the equipment.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRS256 *Power Cables* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

All electrical works shall comply with the requirements of the most current legislation.

Telecommunications cables do not form part of the scope of this document and are described in MRTS234 *Communications Cables*.

Vehicle detector loop feeder cables and loop cables do not form part of the scope of this document and are described in MRTS257 *Feeder Cable and Loop Cable for Vehicle Detector*.

In this version changes were made to Clause 8.2 (3) to include power cables for ITS installations, which was not mentioned in previous versions and to clarify the requirements of cable slack in electrical pits.

2 Definition of terms

The terms defined in MRTS01 *Introduction to Technical Specifications* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definitions

Term	Definition
°C	Degrees Celsius
AC	Alternating Current
Act	*Electrical Safety Act 2002* (Qld) and associated Regulations and Codes of Practice
Administrator	Principal's Representative or Administrator as defined in MRTS01 *Introduction to Technical Specifications*

Term	Definition
AS/NZS	Australian Standard / New Zealand Standard
CSA	Cross Sectional Area
DC	Direct Current
Electrical Works	As defined in the Act
Electricity Entity	As defined in the Act
ELV	Extra low voltage: voltage of 50 V or less AC RMS, or 120 V or less ripple-free DC
HD	Heavy Duty
HDD	Horizontal Directional Drilling
HDPE	High-density polyethylene
Hz	Hertz (cycles per second)
ISO	International Standards Organisation
ITS	Intelligent Transport System
km/h	Kilometres per hour
kV	Kilo-volts
Legislation	*Electricity Act 1994* (Qld) and associated Regulations 2006 as currently amended • *Work Health and Safety Act 2011* (Qld) and regulations and codes of practice as currently amended • *Electrical Safety Act 2002* (Qld) and associated Regulations 2013 and *Codes of Practice 2010* – all as currently amended
Licensed Electrical Contractor	Holder of an Electrical Contractor License under the *Electrical Safety Act 2002* (Qld)
LSZH	Low Smoke Zero Halogen
m	Metre
mm	Millimetre
MRTS	Transport and Main Roads Technical Specification
PVC	Polyvinyl chloride, electrical insulating material coating electrical cables
QA	Quality Assurance
RMS	Root mean square
RPEQ	Registered Professional Engineer of Queensland
TPE	Thermoplastic elastomer

Term	Definition
TPS	Thermoplastic-sheathed (cable)
TRUM	*Traffic and Road Use Management Manual*
V	Volts
VAC	RMS voltage, alternating current
W	Watt
XLPE	Cross-linked polyethylene

3 Referenced documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced Technical Specifications (including those referenced in MRTS201 *General Equipment Requirements*), then the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AS/NZS 1125	*Conductors in insulated electrical cables and flexible cords*
AS/NZS 2276.1	*Cables for traffic signal installations – Part 1: Multicore power cables*
AS/NZS 3000	*Electrical installations (known as the Australian / New Zealand Wiring Rules)*
AS/NZS 3013	*Electrical installations – Classification of the fire and mechanical performance of wiring system elements*
AS/NZS 3560	*Electric cables – Cross-linked polyethylene insulated – Aerial bundled – For working voltages up to and including 0.6/1 (1.2) kV*
AS/NZS 3560.2	*Electric cables - Cross-linked polyethylene insulated - Aerial bundled - For working voltages up to and including 0.6/1 (1.2) kV, Part 2: Copper conductors*
AS/NZS 3808	*Insulating and sheathing materials for electric cables*
AS/NZS 5000.1	*Electric cables – Polymeric insulated, Part 1: For working voltages up to and including 0.6/1 (1.2) kV*
AS/NZS 5000.2	*Electric cables – Polymeric insulated - For working voltages up to and including 450/750 V*
AS/NZS ISO 9000	*Quality management systems – Fundamentals and vocabulary*
AS/NZS ISO 9001	*Quality management systems - Requirements*

Reference	Title
AS/NZS IEC 61034	*Measurement of smoke density of cables burning under defined conditions*
EN 50525-2-21	*Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS91	*Conduits and Pits*
MRTS93	*Traffic Signals*
MRTS94	*Road Lighting*
MRTS201	*General Equipment Requirements*
MRTS210	*Provision of Mains Power*
MRTS226	*Telecommunications Field Cabinets*
MRTS234	*Communications Cables*
MRTS257	*Feeder Cable and Loop Cable for Vehicle Detector*
Standard Drawing 1149	*Traffic Signals / Road Lighting / ITS – Installation of Underground Electrical and Communications Conduit*
Standard Drawing 1327	*Traffic Signals / Road Lighting – Mains Connections*
Standard Drawing 1624	*Road Lighting - Junction Box Single Phase Wiring Details*
Standard Drawing 1625	*Road Lighting - Junction Box Three Phase Wiring Details*
Standard Drawing 1626	*Road Lighting - Junction Box Active, Neutral and Earth Bolting Arrangements*
Standard Drawing 1699	*Parts List*
Standard Drawing 1707	*Road Lighting - Base Plate Mounted Pole Mounted on Bridges Wiring Details*
TN159	*Treatment of non-compliant Underground Wiring Systems (UWS) in Brownfield Installations*
TRUM Volume 4 Part 3	*Traffic and Road Use Management Manual (TRUM) – Volume 4 – ITS and Electrical Technology – Part 3 Electrical Design for Roadside Devices*
TRUM Volume 4 Part 4	*Traffic and Road Use Management Manual (TRUM)* – Volume 4 – *ITS and Electrical Technology – Part 4: Road Lighting Dome Junction Box Assembly*
-	Electricity Regulation, 2006

4 Quality system requirements

The supplier shall provide evidence of the cable manufacturer's quality system which is compliant with AS/NZS ISO 9000 *Quality management systems – Fundamentals and vocabulary*, AS/NZS ISO 9001 *Quality management systems – Requirements* and the requirements of MRTS50 *Specific Quality System Requirements*. The quality system requirements defined in MRTS201 *General Equipment Requirements* shall also apply to this Technical Specification. All cables covered within this Technical Specification shall have current type approval certificates issued by the Department of Transport and Main Roads. **Hold Point 1**

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 4.1.

There are no Milestones defined.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4	1. Cable-type approval		
8.1	2. Test before connection		
8.2		1. Underground cable laying	
9	3. Cable Testing		

5 Materials

5.1 Standards

Materials supplied and installed under this Technical Specification shall meet the requirements of the relevant Standards listed in Table 3 except where varied by this Technical Specification.

5.2 Testing of cables

5.2.1 Copper cables

Copper cables shall comply with the requirements of AS/NZS 3808 *Insulating and sheathing materials for electric cables*, AS/NZS 5000.1 *Electric cables – Polymeric insulated, Part 1: For working voltages up to and including 0.6/1 (1.2) kV* or AS/NZS 5000.2 *Electric cables – Polymeric insulated - For working voltages up to and including 450/750 V* as applicable.

HDPE sheathing material shall comply with AS/NZS 3808, Table 10: Test and criteria for polyolefin sheath.

5.2.2 Aluminium cables

Aluminium cables shall comply with the requirements of AS/NZS 5000.1 or AS/NZS 5000.2, as applicable.

Due to the greater vulnerability of aluminium conductors to water ingress, which can initiate corrosion and other degradation mechanisms, the aluminium cable insulation and sheath shall be manufactured from water resistant compounds in addition to the materials specified in AS/NZS 3808. Water resistant sheath compounds shall include, but are not limited to:

- cross-linked elastomeric compounds
- other compounds demonstrating equivalent water resistance and mechanical performance.

The aluminium cable shall be capable of submersion to a depth of up to 25 m and shall comply with all applicable requirements of AS/NZS 3808.

Cable must also meet the water resistance test described in Annex D and Annex E in EN 50525-2-21 *Electric cables – Low voltage energy cables of rated voltages up to and including 450/750 V*.

5.3 Electrical rating

All electrical components shall be suitable for operation on electricity supply as detailed in the Electricity Regulation 2006. Transient voltage fluctuations outside these limits may occur under some conditions, such as those due to faults, sudden connection or disconnection of large loads or lightning strikes.

5.4 Environmental conditions

Cables installed above ground will be installed outdoors and shall be designed, constructed and supplied so as to perform properly under the following conditions:

a) ambient temperatures from -5°C to 40°C

b) enclosure temperature not exceeding 70°C

c) solar radiation intensity of 1000 W/m² with high ultraviolet content

d) extended periods of humidity in excess of 90%, and

e) an altitude of up to 500 m above sea level.

Cables installed underground shall be designed, constructed, supplied and installed so as to perform properly under the following conditions:

a) ambient air temperature not exceeding 40°C

b) ambient ground temperature not exceeding 25°C

c) an altitude of up to 500 m above sea level

d) extended periods of humidity in excess of 90%, and

e) installed directly in PVC conduit at a depth of no less than 600 mm and up to 1200 mm, with cable ends rising up concrete or timber poles and exposed to direct sunlight.

For aerial cables, the nominated minimum wind speed, normal to the cable, is defined to be 0.5 m/s.

5.5 Reliability

The design service life of cables shall be 25 years under the specified system and environmental conditions.

6 Physical requirements

6.1 Mains connection

Requirements for the connection of switchboards to the overhead mains supply shall be as shown on Standard Drawing 1327 *Traffic Signals / Road Lighting – Mains Connections*.

6.2 Traceable cable markings

Cable batch numbers and manufacture factory codes shall be printed on the outer sheath of all cables including on drum labelling.

Batch numbers shall be traceable back to the manufacturing facility / factory.

6.3 Road lighting cable configurations

Cables up to and including 6 mm² shall comply with AS/NZS 5000.2.

Larger size cables shall comply with AS/NZS 5000.1.

Cable insulation colours shall comply with AS/NZS 3000 *Wiring Rules* and are listed in Table 6.3(a) and Table 6.3(b).

Table 6.3(a) – Road lighting cable insulation colour details – single phase

Conductor type	Core colour	Alternative core colour
A Phase	Red	Brown
Neutral	Black	Light Blue
Earth	Green / yellow	

Table 6.3(b) – Road lighting cable insulation colour details – three phase

Conductor type	Core colour
A Phase	Red
B Phase	White
C Phase	Dark blue **
Neutral	Black
Earth	Green / yellow

Note: **Pale blue or light blue shall not be used for any active conductor.

The cable shall be durably marked every 1 m to comply with Clause 16 of AS/NZS 5000.1 or Clause 9 of AS/NZS 5000.2. The mark shall be printed on both insulation and sheath layers with the format specified as below:

- Insulation – “Month/Year – Dept. TMR QLD – Batch No. – Scrap approval required”
- Sheath – “Model Number, Batch No., Supplier Name, Month/Year, Cable Type, No. of cores, Conductor diameter, Conductor material, Insulation material, Sheath material, Voltage rating, Relevant Australia standard, Temperature rating, Single/Multi Cire [colour], Manufacturer ID – Dept. TMR QLD – Scrap approval required”

Copper conductors shall comply with Clause 5 of AS/NZS 5000.1 and AS/NZS 5000.2. Copper conductor to be Class 2 stranded annealed copper as per AS/NZS 1125 *Conductors in insulated electrical cables and flexible cords*.

Aluminium conductors shall comply with Clause 5 of AS/NZS 5000.1 and AS/NZS 5000.2. Aluminium conductor to be Class 5 stranded aluminium as per AS/NZS 1125. Centre filler and non-hygroscopic tape may be applied.

Insulation and sheathing materials shall comply with AS/NZS 3808 as follows.

Table 6.3(c) – Road lighting cable configurations - copper

Configuration	Phase	Insulation type and minimum rating	Sheath	Typical application
2 core x 2.5 mm² Flat	Single	PVC V-90 or 5V-75	PVC 5V-90 or 5V-75	Cable between pole switch-disconnector and luminaire.
2 core x 4 mm² Flat	Single	PVC V-90 or 5V-75	PVC 5V-90 or 5V-75	General use cable between re-openable joint and pole switch-disconnector.
2 core x 4 mm²	Single	XLPE or X-90	GP-75-TPE	Minimum size cable for all applications.
2 core x 16 mm² Flat / Round	Single	XLPE or X-90	PVC 5V-90 or 5V-75	General use cable, point of supply to switchboard, switchboard to pit, pit to pit.
2 core x 16 mm² Flat / Round	Single	XLPE or X-90	HDPE	Cable for continually wet and vermin-infested areas between re-openable joint and pole switch-disconnector.
2 core x 25 mm² Flat / Round	Single	XLPE or X-90	PVC 5V-90 or 5V-75	Special cable for long runs, point of supply to switchboard, switchboard to pit, pit to pit.
2 core x 25 mm² Flat / Round	Single	XLPE or X-90	HDPE	Cable for continually wet and vermin-infested areas, point of supply to switchboard, switchboard to pit, pit to pit.
4 core x 16 mm²	Three	XLPE or X-90	PVC 5V-90 or 5V-75	General use cable, point of supply to switchboard, switchboard to pit, pit to pit.

Configuration	Phase	Insulation type and minimum rating	Sheath	Typical application
4 core x 16 mm²	Three	XLPE or X-90	HDPE	Special cable for long runs, for continually wet and vermin-infested areas, point of supply to switchboard, switchboard to pit, pit to pit.
4 core x 25 mm²	Three	XLPE or X-90	PVC 5V-90 or 5V-75	Special cable for long runs, point of supply to switchboard, switchboard to pit, pit to pit.
4 core x 25 mm²	Three	XLPE or X-90	HDPE	Cable for continually wet and vermin-infested areas, point of supply to switchboard, switchboard to pit, pit to pit.
4 core x 35 mm²	Three	XLPE or X-90	PVC 5V-90 or 5V-75	Special cable for long runs, point of supply to switchboard, switchboard to pit, pit to pit.
4 core x 35 mm²	Three	XLPE or X-90	HDPE	Cable for continually wet and vermin-infested areas, point of supply to switchboard, switchboard to pit, pit to pit.

Table 6.3(d) – Road lighting cable configurations – aluminium

Configuration	Phase	Insulation / minimum rating	Sheath	Typical application
2 core x 16 mm² Flat / Round	Single	XLPE, X-90 or X-HF-90 with water resistant compounds	PVC 5V-90 with water resistant compounds	General use cable, point of supply to switchboard, switchboard to pit, pit to pit in either dry or wet conditions
2 core x 25 mm² Flat / Round	Single	XLPE, X-90 or X-HF-90 with water resistant compounds	PVC 5V-90 with water resistant compounds	General use cable, point of supply to switchboard, switchboard to pit, pit to pit in either dry or wet conditions
4 core x 16 mm²	Three	XLPE, X-90 or X-HF-90 with water resistant compounds	PVC 5V-90 with water resistant compounds	General use cable, point of supply to switchboard, switchboard to pit, pit to pit in either dry or wet conditions
4 core x 25 mm²	Three	XLPE, X-90 or X-HF-90 with water resistant compounds	PVC 5V-90 with water resistant compounds	General use cable, point of supply to switchboard, switchboard to pit, pit to pit in either dry or wet conditions
4 core x 35 mm²	Three	XLPE, X-90 or X-HF-90 with water resistant compounds	PVC 5V-90 with water resistant compounds	General use cable, point of supply to switchboard, switchboard to pit, pit to pit in either dry or wet conditions

Table 6.3(e) - Road lighting earth cable insulation details – copper only

Configuration	Phase	Insulation / minimum rating	Typical application
1 core x 6 mm²	Earth	PVC V-75 or V90 (Green and yellow)	Earth cable between re-openable joint and pole earthing point. Minimum earth cable for underpasses.
1 core x 16 mm²	Earth	PVC V-75 or V90 (Green and yellow)	Earth cable on bridge – match active size.
1 core x 25 mm²	Earth	PVC V-75 or V90 (Green and yellow)	Earth cable on bridge – match active size.

6.4 Traffic signal cable configurations

All traffic signal controller cables are to be marked in black every 1 m with the words 'Manufactured to AS/NZS 2276.1 *Cables for traffic signal installations – Part 1: Multicore power cables* for Transport and Main Roads'.

Traffic signal cables shall comply with one of the following configurations.

Table 6.4 – Traffic signal cable configurations

No. of cores	Configuration	Insulation	Sheath	Location
6 Core	4 x 1.5 mm² Active 1 x 1.5 mm² Earth 1 x 1.5 mm² Neutral	PVC	PVC	Pedestrian push-buttons, wig-wags, and so on.
19 Core	16 x 1.5 mm² Active 1 x 2.5 mm² Earth 1 x 2.5 mm² Neutral 1 x 2.5 mm² ELV Return	PVC	PVC	End-of-run cable, mast arm / upper mounting assembly to final equipment.
36 Core	33 x 1.5 mm² Active 1 x 6 mm² Earth 1 x 4 mm² Neutral 1 x 2.5 mm² ELV Return	PVC	PVC	General use cable, controller to traffic signal pole, pole to pole. Preferred cable due to larger centre cores.

No. of cores	Configuration	Insulation	Sheath	Location
36 Core	*33 x 1.5 mm² Active *1 x 6 mm² Earth *1 x 6 mm² Neutral *1 x 2.5 mm² ELV Return * Tinned conductor	PVC with water resistant compounds	PVC with water resistant compounds	For semi / permanently submerged, waterlogged or damped areas for use with controller to traffic signal pole, pole to pole. Preferred cable due to larger centre cores.

Requirements for the 36 core cable are set out in the next clause.

Requirements for 6 core cable are the same as 13 core cable in AS/NZS 2276.1, with the exception of the number of cores and the overall outer diameter.

Core numbering is required.

Other cables shall comply with AS/NZS 2276.1, with the exception of its Clause 14 as a nylon jacket is not required.

For all cable sizes below, test certificates shall be provided to show compliance with AS/NZS 2276.1.

6.5 36 core traffic signal cable

Conductors for the 36 core cable shall be flexible (Class 5) annealed copper complying with the requirements of AS/NZS 1125.

For 36 core cable, additional test certificates are required to show compliance to AS/NZS 1125.

Physical assembly of cores and the requirements for size, numbering and colouring of the cores for the 36 core cable is shown below in Figure 6.5. There are 4 cores with 1.5 mm² conductors that shall be coloured purple and identified with figures and words in white in a similar fashion to those described in Clause 9(b) of AS/NZS 2276.1.

Printed markings on the purple cores shall be printed in either black or white, as necessary, to provide the greatest visual contrast for ease of identification.

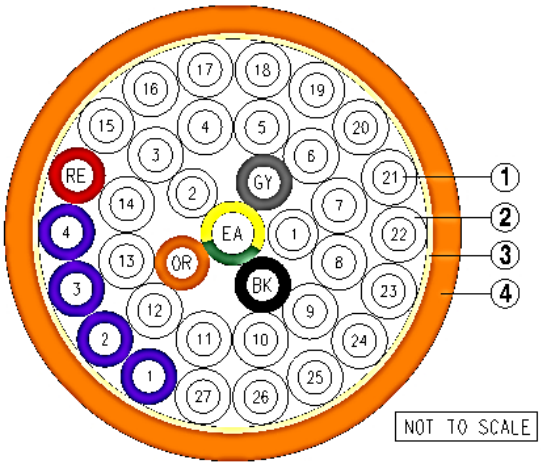
For 36 core traffic signal cables installed in continually wet environments, the cable shall be provided with water resistant insulation and a water resistant sheath manufactured from a cross-linked elastomeric compound or other approved materials demonstrating equivalent water resistance performance. The cable shall comply with the water resistance test requirements specified in Annex D and Annex E of EN 50520-2-21.

The cable construction shall also maintain adequate mechanical flexibility to accommodate installation slack and bending within pits without compromising sheath integrity or conductor / insulation performance.

Table 6.5 – 36 core control cable details

Core numbering	Conductor size	Core colour	Purpose
1-27	1.5 mm²	White, black number printed	230V AC Lamp Actives
P1-P4	1.5 mm²	Purple, black or white number printed	32V AC Pedestrian Push-Button
1	1.5 mm²	Red	Field Active
1	1.5 mm²	Orange	Dimming Control
1	2.5 mm²	Grey	32V AC Detector Common
1	6 mm²	Black	Neutral
1	6 mm²	Green / yellow (Earth)	Earth

Figure 6.5 – 36 core cable



VOLTAGE RATING		0.6/1kV
SHEATH COLOUR		Orange
CORE COLOURS		(See attached table)
④	Sheath	.
③	Overall Tape	.
②	Insulation	.
①	Conductor	.
ITEM	DESCRIPTION	MATERIAL
TRAFFIC SIGNAL CABLE		

6.6 Aerial cables

Aerial cables shall be stranded compacted circular aluminium cable which complies with the requirements of Clause 2.1 of AS/NZS 3560.2 *Electric cables - Cross-linked polyethylene insulated - Aerial bundled - For working voltages up to and including 0.6/1 (1.2) kV, Part 2: Copper conductors* for Aerial Copper Conductors or hard drawn copper cable which complies with the requirements of Clause 2 of AS/NZS 1125.

The insulation shall be X-90UV grade cross-linked polyethylene (XLPE) and shall be in accordance with the requirements of Clause 2.3 of AS/NZS 3560 *Electric cables – Cross-linked polyethylene insulated – Aerial bundled – For working voltages up to and including 0.6/1 (1.2) kV*.

Cable sheath insulation shall be black. The pigmentation shall be chosen to afford maximum long-term stability under ultraviolet radiation and shall include a minimum content of 2% by weight of carbon black evenly distributed throughout the insulation which shall not be detrimental to the insulation levels.

Individual cores of the cable shall be identified by longitudinal continuous raised ribs as specified in Clause 2.4.2 of AS/NZS 3560.

In addition, active cores shall be numbered in Arabic numerals by printing along the core, the numeral matching the number of ribs on the core. The marking shall be legible and durable and shall not degrade the insulation level.

The marking of cable lengths and intervals shall be in accordance with Clause 2.5 of AS/NZS 3560.

The cable shall be tested in accordance with Clause 3 of AS/NZS 3560, except that, in Test 3.d of Table 3.1, the criteria for compliance shall be 'no slip greater than 3 mm as measured from a mark scribed on the conductor at the load application end of the insulation'.

6.7 Cables in tunnels

6.7.1 Fire protection

All power cables installed in tunnels shall comply with the requirements of AS/NZS IEC 61034 – *Measurement of smoke density of cables burning under defined conditions*

All new cables installed within new tunnels shall be specified to be of the Low Smoke Zero Halogen (LSZH) type outer jacket to minimise smoke toxicity in the event of a tunnel fire.

For existing tunnels, all new cables shall be of the LSZH type outer jacket.

All new cables shall have a 2-hour fire rating (WS5X or WS5XW) as specified in Section 3 of AS/NZS 3013 *Electrical installations – Classification of the fire and mechanical performance of wiring system elements*.

The LSZH cable shall have been tested to and comply with IEC 61034.2, with particular reference to smoke emission characteristics of the cable.

Should a project be unable to comply with the LSZH requirement for cabling in tunnels, the Principal shall be consulted for further direction. The department's project representative shall base any consideration on the following:

a) the project shall seek formal advice from a suitably qualified and experienced fire engineer (RPEQ), detailing the effect of the specified amount of non-LSZH cable installed on any such fire event in the relevant tunnel, and

b) that the Transport and Main Roads project shall conduct a risk assessment which among other relevant whole of life considerations, takes input from formal advice received from the fire engineer, as well as takes into account the maintenance standard practice of installing LSZH cables in tunnels.

6.7.2 Rodent protection

A non-metallic armoured construction cable shall be specified on a project-specific basis where rodent protection is an identified risk mitigation strategy within the tunnels.

6.7.3 Thermoplastic-sheathed (TPS) cable

Thermoplastic-sheathed (TPS) cables shall not be used for any underground applications in tunnels.

TPS cables may be used at other locations, such as building areas, in tunnels. However, the Contractor shall obtain pre-approval from the Principal prior to installation.

6.7.4 Quality test report

All new cables installed within tunnels shall be type-approved by the Department of Transport and Main Roads or listed in the Standard Drawing 1699 *Parts List*. Otherwise, the Contractor shall provide quality test reports for approval by the Principal.

6.8 Packaging and storage

Both ends of each length of cable shall be sealed to prevent the ingress of water.

All cables shall be supplied as rolled onto drums (or reels).

a) Marking: The reels (or drums) shall be marked with the following information:

   i. the name or registered trade name or mark of the manufacturer

   ii. the words and letters 'Type of cable and voltage rating'

   iii. length of cable in metres

   iv. the words describing the insulating material (if appropriate)

v. the total weight of the cable and drum shall be marked on both ends of each drum, and

vi. the total length of the cable and a summary of the electrical properties shall be marked on both ends of each drum.

b) Packaging length: Unless otherwise specified, the reel shall contain 1000 m of cable.

c) Barrel diameter: The barrel diameter shall be not less than 170 mm for PVC sheathed cable and 300 mm for PVC sheathed / polyamide jacketed cable.

d) The cable drums shall have a diameter of no greater than 600 mm.

e) The cable drum ends shall be made strong enough around the axle hole to support the cable weight and to enable the full cable drum to be transported while being supported on an axle.

f) The cable shall be firmly wound onto the cable drum and suitably anchored so as to prevent any looseness developing or any damage occurring during transport and storage.

Cable shall be stored in a safe, dry location protected from weather and direct sunlight. Cables shall not be stored on the ground.

Any cable damaged during transit or stacking shall be replaced by the Contractor or Supplier, at their own expense.

6.9 Other cables

Where cables not defined within this section are required for ITS, traffic signal, or road lighting applications, the contractor should source such cables from the departments approved suppliers and shall obtain approval from the Principal prior to their installation.

7 Electrical requirements

The electrical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

All cables shall be suitable for operation on a 240 VAC ± 6%, 50 Hz ± 0.1 Hz system.

Voltage fluctuations outside these limits may occur under some conditions, such as those due to faults or due to sudden disconnection of large electrical loads or due to lightning strikes.

8 Installation of cables

8.1 General

The installation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Cables shall be the type shown in the design drawing. Further requirements for detector loops and local termination within poles, outreach arms and mast arms, where not specified below, shall conform to the requirements of MRTS93 *Traffic Signals* and/or MRTS94 *Road Lighting* and/or MRTS226 *Telecommunications Field Cabinets*.

Ends of cable not immediately terminated shall be sealed to prevent the ingress of water.

Cable shall be stored in a safe dry location until required. Cable shall not be stored directly on the ground.

The work covered by this Technical Specification shall comply with requirements of the Act, subordinate legislation and AS/NZS 3000.

The Contractor shall engage a Licensed Electrical Contractor to perform the duties and functions of 'electrical works' as defined in the legislation.

The Contractor shall be responsible for ensuring that materials and installation standards comply with the requirements of this Technical Specification.

Where the cable sheathing is TPS or other PVC, the Contractor shall ensure that these are not installed in direct contact with polystyrene or polyurethane materials as they have detrimental effects on the insulation.

> This change is included to guard against leaching of the migratory plasticiser in TPS / PVC cables which may occur should the cable come in contact with materials such as polystyrene and polyurethane. These materials make the TPS / PVC insulation to become hard, brittle and prone to cracking thus losing its insulating property.

Where it is not possible to prevent contact with polystyrene, polyurethane or other harmful materials, all TPS / PVC cables used shall be of the non-migratory plasticiser type.

The Contractor shall test the cables before connection to the mains as required by the Act in the presence of the Administrator. **Hold Point 2**

8.2 Underground cable laying

Underground electrical power cable is to be installed in Heavy Duty (HD) electrical conduit consistent with MRTS91 *Conduits and Pits* and Standard Drawing 1149 *Traffic Signals / Road Lighting / ITS – Installation of Underground Electrical and Communications Conduit*. The conduit may be HD rigid or HD flexible (smooth bore). The smooth bore HD flexible may only be used for cable installed by Horizontal Directional Drilling (HDD) methods.

Each run of cable between terminals shall be formed without intermediate joints. Joints in cables shall only occur in electrical pits consistent with MRTS91 *Conduits and Pits*.

Witness Point 1

Runs of cable between terminals shall be drawn in together to avoid twisting without damage, using approved cable lubricant as required. To minimise twisting, the Contractor shall use a 'sock and swivel' to haul cables through conduit.

Cables shall lie loose in the conduits free of any kinks. Where 2 or more cables are laid together, they shall not twist or wrap around each other. For the guide to maximum number of cables installed in conduits, refer to Appendix C in AS/NZS 3000.

The following clause has been modified to clarify requirements on installation of new draw ropes, to guard against draw ropes wrapping around the cable making it difficult for the draw ropes to be reused.

Draw ropes shall be replaced in the conduits after the cables are installed.

Clarifying requirements on slack cable in electrical pits.

The slack cable length to be provided within a pit after installation shall be defined as the distance measured from the finished above-ground height of the pit to the end of the cable. For example, where a slack requirement of 2 m is specified, the installation shall ensure that 2 m of cable is available to extend above ground level.

For multicore traffic cable, a minimum of 3 m of slack cable at the end of a cable connecting to a traffic signal controller shall be coiled in the pit adjacent to the controller, and a minimum of 6 m of slack cable at the end of each cable connecting to the adjacent signal post, joint-use pole or mast arm column shall be coiled in the pit adjacent to the field termination. A minimum of 2 m of slack cable shall be coiled in each intermediate pit.

For traffic signal power cable other than multicore cable, a minimum of 2 m of slack cable for each end of each cable shall be coiled in the intermediate pit. Where the cable just passes through the pit and is not joined or terminated, then 2 m of cable shall be looped in each pit through which each cable passes.

For other power cables terminating at consumers mains, sub-mains and final sub-circuits, a minimum of 2 m of slack cable at each end of each cable shall be coiled in the terminating and cable joining pits. Where the cable just passes through the pit and is not joined or terminated, then 2 m of slack cable shall be looped in each pit through which the cable passes.

The Contractor shall replace, at its expense, any cable damaged during installation.

8.2.1 Labelling and marking of cables installed underground

When an AS/NZS 3000 Part 1 Solution is adopted and cables from different installations are installed within a conduit, the cables must be clearly and permanently labelled at the following locations: the point of supply, connecting pits, and the point of termination. The labels should include the following information:

- installation owner (for example, Transport and Main Roads, Queensland Police Service and Telco Services)
- installation function (for example, CCTV, traffic signals, road lighting, Camera Detected Offence Program (CDOP), or small cell installations), and
- installation ID (terminal point ID such as intersection M-number or pole number).

> Installations with shared conduits are typically noted as departing from Part 2 of AS/NZS 3000 if the mutual detrimental effects between services are not able to be prevented using the methods prescribed in Clause 3.9.8 of AS/NZS 3000.
>
> In this case, the installation is subject to compliance with a Part 1 Solution, and the instructions above applied as a minimum.

Cables installed underground in single function conduits and complying with Part 2 of AS/NZS 3000 may be labelled at the point of supply and at the point of termination or jointing.

Whilst a new cable installation in single function conduits may be considered an AS 3000 Part 2 Solution, it is recommended that it is still labelled to facilitate future provision for other services to added which would make the installation a Part 1 Solution.

All cables shall be labelled with suitably sized Helagrip markers, or equivalent, with the following requirements:

- labels shall be securely affixed directly to the cable and clearly describe the service provided
- labels shall remain legible for the entire expected service life of the cables, and
- labels shall not be enclosed within sleeves or similar coverings, as the accumulation of dirt, dust, moisture, and other contaminants over time can compromise the readability of the label.

Under-depth cables installed underground shall have marking tape laid above the conduit stating what type of cable is installed in the conduit, electrical or communications as prescribed in TN159 *Treatment of non-compliant Underground Wiring Systems (UWS) in Brownfield Installations*.

Metallic labels shall not be used in electrical cabling, to avoid the possibility of electrical conductivity that may induce unsafe touch potential.

Where the cable sheathing is TPS or other PVC, labels made of polystyrene or polyurethane are not permitted.

8.3 Aerial cable installation

Aerial cables shall not be connected to slip base poles.

Where aerial cables are connected to rigid or fixed-base pole, the placement of the rigid or fixed-base pole shall adhere to the department's guidelines on hazard free clear zone.

For aerial cables, the nominated minimum wind speed, normal to the cable is defined to be at least 66 m/s (greater than 237.6 km/hr) or whatever is the largest recorded wind gust for that area.

Where the initial point of supply for an aerial-fed road lighting pole is located on an electricity entity pole, then that entity shall be contacted in writing detailing the extent of lighting supplied from that point in accordance with MRTS210 *Provision of Mains Power*.

No work shall be carried out on an electricity entity pole without the prior permission from that entity.

Any aerial feed from an electricity entity pole shall also comply with MRTS210 *Provision of Mains Power* and Standard Drawing 1327.

The aerial cable shall be fitted with strain clamps of the appropriate size at both ends which shall be attached to the eyebolts on each pole.

Where 6 mm², twisted 2 core, XLPE, copper aerial cable is used to supply power to a road lighting pole, it may be wired directly into the terminal block of the luminaire terminal panel.

Where 25 mm², bundled 2 core, XLPE, aluminium aerial cable is used to supply power to a road lighting pole, the active and neutral conductors shall each be fixed to an insulating piercing connector, 6-35 mm² or 4-35 mm², external to pole. A 6 mm², twisted 2 core, XLPE, copper cable shall then run from the connectors to the terminal block of the luminaire terminal panel.

When a series of road lighting poles are to be supplied with power in turn by aerial cable, the cable type shall be 25 mm², bundled 2 core, XLPE, aluminium. The active and neutral conductors shall each pass through an insulation piercing connector, 25-95 mm² or 6-35 mm², at each pole. A 6 mm², twisted 2 core, XLPE, copper cable shall then be run from the connectors to the terminal block of the luminaire terminal panel. Where a continuous 25 mm² cable is likely to wear against the pole, it shall be protected by spiral wrap insulation.

8.4 Cable installation for bridges and other concrete structures

A separate earth conductor, with a cross-sectional area at least equal to that of the supply active and not less than 6 mm² (copper), shall be installed with the supply cabling. This earth conductor shall be connected to the earth point at the pole and to the earth point at the point of the circuit supply.

At the point of circuit supply, the earth shall also be connected to the neutral. The neutral conductor shall not be connected to earth at any pole on the bridge.

For road lighting that will require an earth wire from the last light pole on the feed side, before the bridge, up until the last light pole on the bridge as per Standard Drawing 1707 *Road Lighting - Base Plate Mounted Pole Mounted on Bridges Wiring Details* and MRTS94 *Road Lighting*.

This clause shall also apply to electrical loads installed on concrete structures.

8.5 Cable installation along cable trays

Power distribution on cable trays is usually associated with an electrical load installed on a concrete structure. Hence, a separate earth conductor equal in CSA to the active conductor shall be laid from the nearest correctly earthed power feed or junction to the metal support or casing around the electrical load. The earth cable shall be bonded from the relevant switchboard.

Final sub-circuits shall have a 2 m coil of cable at either:

a) adjacent to the equipment if the equipment is mounted on the cable tray, or

b) on the cable tray adjacent to the tee off point of the sub-circuit.

8.6 Termination of cables

Terminal connections shall be as shown in the design documentation certified by an electrical RPEQ.

Cable in road lighting outreach arms shall be terminated to the road lighting termination panel in the pole and to the luminaire when installed.

For traffic signal installations, all unused cores in multicore cables shall be terminated at spare terminals at traffic signal posts, joint use poles and mast arms.

8.7 Joining cables

Joints in cables shall only occur in electrical pits consistent with MRTS91 *Conduits and Pits*.

Electrical power cable joints shall be carried out within a re-openable joint. Refer to Standard Drawing 1624 *Road Lighting – Junction Box Single Phase Wiring Details* for single-phase connections, Standard Drawing 1625 *Road Lighting – Junction Three Phase Wiring Details* for three-phase connections, Standard Drawing 1626 *Road Lighting – Junction Box Active, Neutral and Earth Bolting Arrangements* for bolting arrangements and *Traffic and Road Use Management Manual* (TRUM) Volume 4 Part 4 for bell joint assembly manual.

Electrical power cable shall be terminated neatly with the conductors stripped for the minimum length necessary to correctly join the conductors.

The spigot of the junction box and the cable shall be roughened and de-burred of sharp edges.

The cable entry to the joint shall be sealed against moisture ingress.

The spigot shall be roughened using sandpaper or equivalent method to obtain a key in the surface prior to the installation of the heat-shrink sleeve.

The surface of the spigot and cable shall be inspected for cleanliness and cleaned, if necessary, before installation of the heat-shrink sleeve.

Heat-shrink sleeves shall be applied with the arrow pointing towards the junction box base.

Unused entry ports in junction boxes shall be sealed with Transport and Main Roads approved mastic if the entry port knockouts have been damaged or removed.

The ends of cable which are not immediately jointed or terminated shall be sealed to prevent the ingress of water.

9 Testing and commissioning of installed cables

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

The Contractor shall be responsible for carrying out sufficient testing to ensure that materials and installation standards used comply with the requirements of this Technical Specification.

The Contractor shall test the cables before connection to the mains as required by the Act in the presence of the Administrator. **Hold Point 3**

The Contractor shall energise each circuit in turn to verify each load is connected to the specified circuit and phase.

Tests shall include the mandatory tests detailed in AS/NZS 3000. Minimum tests to be conducted are for:

- supply impedance
- earth fault loop impedance
- voltage drop
- insulation resistance
- phase-to-phase impedance for each phase
- starting current, and
- running current.

In addition to copies of the Contractor's completed test sheets as part of its Quality Assurance (QA) procedures, the Contractor shall also provide a completed Certificate of Test and Compliance, a Record of Inspection and Tests, and accurate As Constructed drawings.

10 Removal of cables

Where shown in the drawing, or where such cable is no longer required for lighting and power, existing underground or aerial cable shall be removed. The Contractor shall remove any remaining cable safely, removing fuses and circuits from conduits wherever appropriate. The Contractor shall record the date each of the circuits is removed.

Where a cable has become hard and brittle due to contact with materials such as polystyrene and polyurethane, the cable shall be removed. However, if the cable is in good condition, the harmful materials shall be removed immediately.

Cable not required for reuse shall be disposed of by the Contractor.

> Transport and Main Roads wants to ensure cables which are no longer required are removed from installations.

11 Reuse of cable

Following its removal, existing underground or aerial cable may be reused only if it is first inspected and tested and is shown to comply with the requirements of this Technical Specification.

Any existing joints and tags shall be removed.

Where traffic signals and road lighting cable is reused, it shall be installed in accordance with the requirements of this Technical Specification.

Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

In addition to copies of the Contractor's completed test sheets as part of its QA procedures, the Contractor shall also provide:

- a completed Certificate of Test and Compliance
- a Record of Inspection and Tests, and
- accurate As Constructed drawings.

12 Training

The training requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

All work involving the handling of cables shall be carried out by trained and qualified staff.

13 Maintenance

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

All maintenance on installed cable systems shall be done by a Licensed Electrical Contractor.

14 Handover

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

15 Compliance evaluation form

The compliance evaluation form for this Technical Specification is published on the Intelligent transport systems and electrical Approved products and suppliers webpage.