Technical Specification

Transport and Main Roads Specifications
MRTS256 Power Cables

November 2020

Queensland Government

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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

Table 2 – Definitions

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

Term	Definition
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* and associated Regulations 2006 as currently amended • *Work Health and Safety Act 2011* and regulations and codes of practice as currently amended • *Electrical Safety Act 2002* 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*
m	Metre
mm	Millimetre
MRSD	Transport and Main Roads Standard Drawing
MRTS	Transport and Main Roads Technical Specification
PVC	Polyvinyl chloride, electrical insulating material coating electrical cables
Rate-1 Lighting	Public lighting supplied, installed, owned and maintained by the electricity entity
Rate-2 Lighting	Public lighting owned and maintained by the electricity entity
Rate-3 Lighting	Public lighting supplied, installed, owned and maintained by Transport and Main Roads
RMS	Root mean square
RPEQ	Registered Professional Engineer of Queensland
TPE	Thermoplastic elastomer
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 1660	*Test methods for electric cables, cords and conductors*
AS/NZS 2276.1	*Cables for traffic signal installations - Multicore power cables*
AS/NZS 3000	*Electrical installations (known as the Australian / New Zealand Wiring Rules)*
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 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*
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*
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 1707	*Road Lighting - Base Plate Mounted Pole Mounted on Bridges Wiring Details*
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, AS/NZS ISO 9001 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 must have current type approval certificates issued by Engineering and Technology Branch.

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.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
8.1	1. Test before connection		
8.2		1. Underground cable laying	
9	2. 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

Cables shall comply with the requirements of AS/NZS 3808, AS/NZS 5000.1 or AS/NZS 5000.2 as applicable.

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

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 not exceeding 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%

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

f) 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.

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.

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 must be traceable back to the manufacturing facility / factory.

6.3 Road lighting cable configurations

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

Larger size cables must comply with AS/NZS 5000.1.

Cable insulation colours must comply with AS/NZS 3000 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 AS/NZS 5000.1 Clause 16 or AS/NZS 5000.2 Clause 9.

All conductors shall comply with Clause 5 of AS/NZS 5000.1 and AS/NZS 5000.2 to be Class 2 stranded annealed copper as per AS/NZS 1125.

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

Table 6.3(c) – Road lighting cable configurations

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.

Table 6.3(d) - Road lighting earth cable insulation details

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 for Transport and Main Roads'.

Traffic signal cables must 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, etc.
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.

No. of cores	Configuration	Insulation	Sheath	Location
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.

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 must 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 must 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.

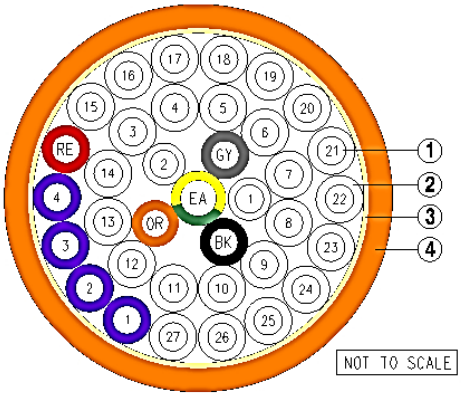
Physical assembly of cores and the requirements for size, numbering and colouring of the cores for the 36-core cable is shown below in Figure 6.5. There are four cores with 1.5 mm² conductors that must be coloured purple and identified with figures and words in white in a similar fashion to those described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

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

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	4 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 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.

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

All power cables installed in tunnels shall comply with the requirements of AS/NZS 1660 *Test methods for electric cables, cords and conductors*, Part 5.2: Fire Tests – 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.

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.

The LSZH cable shall have been tested to and comply with AS/ANZ 1660.5.2, 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 Transport and Main Roads project representative shall be consulted for further direction. The Transport and Main Roads 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.

6.8 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
   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 by the purchaser, 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 supplier at their own expense.

7 Electrical requirements

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

All cables must 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 Tele*communications 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 must 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 carrying out sufficient testing to ensure that materials and installation standards 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 1**

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. 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**

Cable shall be drawn in together to avoid twisting and 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 two or more cables are laid together, they shall not twist or wrap around each other.

Draw ropes shall be replaced in the conduits as and when the cables are drawn in.

Clarifying requirements on slack cable in electrical pits.

The length of the slack cable to be left in a pit after installation is defined as the measurement taken from above ground height of the pit to the end of the cable. That is, for 2 m of slack, there will be 2 m of slack cable above the ground.

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 two metres 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 two metres 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

Cables installed underground shall be labelled at the point of supply and at the point of termination or jointing.

Cables installed underground shall have marking tape laid above the conduit stating what type of cable is installed in the cable, electrical or communications.

8.3 Aerial cable installation

Aerial cables shall not be connected to slip base poles. The placement of the rigid or fixed-base pole should have been adhered 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 to 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 in to 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 of minimum size equal to the cross-sectional area of the supply active shall be installed with the supply cabling. The earth cable shall be connected to the earth point at the pole and at 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 and MRTS94 *Road Lighting*.

The cross-sectional area (CSA) of the earth conductor shall be at least the CSA of the active conductor and not less than 6 mm² (copper).

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:

1. adjacent to the equipment if the equipment is mounted on the cable tray, or
2. 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 for single-phase connections, Standard Drawing 1625 for three-phase connections, and Standard Drawing 1626 for bolting arrangements and 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 sand paper 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 2**

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
- running current.

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.

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.

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.