Technical Specification

Transport and Main Roads Specifications MRTS257 Feeder Cable and Loop Cable for Vehicle Detector

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Queensland Government

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1 Introduction

This Technical Specification defines the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance, and handover requirements for vehicle detector loop and feeder cable.

Unless otherwise specified herein, preformed loops shall comply with the requirements of this Technical Specification.

In this version, additional requirement has been included in Clause 8.3, on installation of feeder cable, where the unterminated end of the loop feeder cable shall be able to be lifted out of the pit by a minimum of 300 mm and a maximum of 500 mm.

This Technical Specification defines the Department of Transport and Main Roads requirements for the loop cable suitable for inductive type vehicle detector loops. The loop cable is intended to be installed in slots cut in roadway surfaces, using a suitable sealant to seal the loop cable in the slots.

Also defined in this Technical Specification are the department's requirements for screened, twisted, balanced-twin feeder cable, and multi-pair versions of this cable, intended for the interconnection of vehicle detector equipment and the aforementioned inductive type vehicle detector loops.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRS257 *Feeder Cable and Loop Cable for Vehicle Detector* and other Technical Specifications as appropriate.

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

2 Definition of terms

The terms defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Terminology definitions

Term	Definition
AS/NZS	Australian Standards and New Zealand Standards
CAT	Customer (field) Acceptance Test(s)
CT	Commissioning Tests
FAT	Factory Acceptance Test(s)
IAT	Installation Acceptance Test(s)
Low voltage	Exceeding extra low voltage but not exceeding 1000 V a.c. or 1500 V d.c.
MRTS	Transport and Main Roads Technical Specifications
NATA	National Association of Testing Authorities, Australia
SAT	STREAMS Acceptance Test(s)
STREAMS	Department of Transport and Main Roads Integrated Intelligent Transport System
WHS	Work Health and Safety

3 Referenced documents

The requirements of the referenced documents listed in Table 3 below apply to this Technical Specification.

Where there are inconsistencies between this Technical Specification and the referenced MRTS, the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Document ID	Document name / description
AS/NZS 2276.2	*Cables for traffic signal installations* *Part 2: Feeder cable for vehicle detectors*
AS/NZS 2276.3	*Cables for traffic signal installations* *Part 3: Loop cables for vehicle detectors*
AS/NZS 3000	*Electrical Installations (Wiring Rules)*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS201	*General Equipment Requirements*
MRTS204	*Vehicle Detectors*
Standard Drawing 1424	*Traffic Signals - Detector loops formed insitu in asphalt installation details*
Standard Drawing 1425	*Traffic Signals - Detector loops placement details*
Standard Drawing 1701	*Traffic Signals - Detector loops counting/right turn loops and diode connection details*
Standard Drawing 1702	*Traffic Signals - Detector loops motorways and ramp placement, and installation details*
TRUM Vol 4 Part 5	*Traffic and Road Use Management Manual* - Configuration and Placement of Vehicle Detection Sensors

The title changed in Standard Drawing 1424, due to incorporating new details for detector loop installation. Standard Drawing 1700 and 1704 are withdrawn after being reviewed for currency. Standard Drawing 1703 is withdrawn. Content regarding 'Typical lane setup Lane Red Connections' has been included in Standard Drawing 1425.

4 Quality system requirements

Quality system requirements shall be in accordance with this Technical Specification and the requirements of the contract (including the requirements of MRTS01 *Introduction to Technical Specifications*).

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

4.1 Hold Points, Witness Points and Milestones

The Hold Points and Witness Points 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
8.1	1. Commencement of works		
8.2.1		1. Smooth and clean slot for vehicle detector loop	
8.2.2		2. Jointing of cables	
9.2		3. Testing of individual loops	
9.3		4. Testing of loop cable and feeder cable circuit	
9.4		5. Connection of loop circuit to vehicle detector	

5 Functional requirements

The loop cable is buried in the surface of the asphalt and forms a vehicle detector loop.

The feeder cable connects the detector loop to the vehicle detector unit. The vehicle detector may be a standalone unit or located within a traffic signal controller.

6 Operational requirements

6.1 Environmental conditions

The loop and feeder cable shall be capable of continuous, normal operation in the conditions described below:

a) installed directly in sunlight

b) ambient air temperature range between -5°C and 50°C

c) enclosure air temperature between -5°C and 75°C (when fitted into an enclosure)

d) ambient ground temperature not exceeding 40°C

e) a humidity of up to 95% non-condensing

f) Queensland coastal environment with salt deposit densities in the range of 2.0 to 3.0 g/m²

g) varied light intensity due to shadows

h) conditions, both permanent and temporary, that may be unique to the specified location, for example instances of thick smoke and electromagnetic interference, and

i) vibrations reasonably expected in the installed location.

The loop cable and feeder cable performance shall be unaffected by a humidity of 90% combined with an ambient air temperature of 40°C followed by a sudden drop in temperature of up to 10°C.

Loop and feeder cable operation shall cause no adverse effect on the surrounding environment in which it is installed.

7 Mechanical and physical requirements

Additional mechanical and physical requirements for equipment provided under this Technical Specification are given in the clauses below.

7.1 Balanced-twin feeder cable

The twisted balanced-twin feeder cable shall be manufactured to comply with AS/NZS 2276.2 with the following options and requirements.

7.1.1 Options for balanced twin feeder cable

AS/NZS 2276.2 Clause 16: Polyamide Jacket – the jacket is not required.

7.1.2 Additional requirements for balanced twin feeder cable

AS/NZS 2276.2 Clause 11: Water Block Materials – the feeder cables shall be manufactured with fillers used as water block materials.

AS/NZS 2276.2 Clause 17: Marking – an indication of the length of the cable remaining on the drum shall be marked on the cable sheath at intervals of 1 m.

AS/NZS 2276.2 Clause 19: Tests: a type test certificate from a NATA registered authority, or other recognised authority, demonstrating compliance with AS/NZS 2276.2, shall be provided.

7.2 Multi-pair feeder cable

The aim of the multi-pair feeder cable is to reduce the space required for three and four separate twin-feeder cables by combining them into one single cable.

The multi-pair cable shall be manufactured to comply with AS/NZS 2276.2, but shall be in the form of three or four twin-feeder cables laid up with a helical twist and with the following amendments.

7.2.1 Exclusions for multi-pair feeder cable

- AS/NZS 2276.2 Clause 6: Construction
- AS/NZS 2276.2 Clause 15.3: Overall Diameter.

7.2.2 Options for multi-pair feeder cable

- AS/NZS 2276.2 Clause 11: Water Block Materials – the feeder cables shall be manufactured with fillers used as water block materials.
- AS/NZS 2276.2 Clause 12: Binding Tapes – binding tape is not required.
- AS/NZS 2276.2 Clause 13: Inner Sheath – the inner sheath is not required.
- AS/NZS 2276.2 Clause 16: Polyamide Jacket – the jacket is not required.
- AS/NZS 2276.2 Clause 17: Marking – an indication of the length of the cable remaining on the drum shall be marked on the cable sheath at intervals of 1 m.
- AS/NZS 2276.2 Clause 19: Tests – a type test certificate from a NATA registered authority, or other recognised authority, demonstrating compliance with AS/NZS 2276.2, shall be provided.

7.2.3 Additional requirements for multi-pair feeder cable

- An outer sheath shall be applied to the three or the four twin-feeder cables.
- The cable shall have an overall diameter no more than 15 mm and cross sectional area no more than 180 mm².
- The individual twin-feeder cables shall be clearly and durably numbered / labelled to allow identification.

- A schematic diagram similar to Figure 1 of AS/NZS 2276.2 shall be provided outlining the construction of the three-pair or the four-pair feeder cable.

7.3 Loop cable

The loop cable shall be manufactured to comply with AS/NZS 2276.3, with the following options and requirements:

- AS/NZS 2276.3 Clause 7: Conductor shall be tinned annealed copper.
- AS/NZS 2276.3 Clause 8: Insulation - material shall be X-90UV.
- AS/NZS 2276.3 Clause 10: Tests – a type test certificate from a NATA registered authority, or other recognised authority, demonstrating compliance with AS/NZS 2276.3, shall be provided.

8 Installation requirements

8.1 Commencement of works

At least one full working day prior to intending to install the vehicle detector loops, the Contractor shall notify the Principal of the proposed work. The method of notification is as agreed by the Principal.

The Contractor shall not proceed with the works until the Principal has issued acceptance of the proposed works. **Hold Point 1**

8.2 Installation of vehicle detector loops

Vehicle detector loops shall be installed in the locations shown in the department's Standard Drawings with the assistance, where necessary, of Standard Drawings 1424, 1425, 1701 and 1702.

8.2.1 Installation of loop

Vehicle detector loops shall be installed in accordance with the details shown on Standard Drawings 1424 and 1702.

The installation of detector loops details is outlined in Standard Drawing 1424 and 1702.

Any sharp edges in the slot which might damage the detector loop cable during installation shall be smoothed off. The slot shall be cleaned out using dry compressed air. **Witness Point 1**

The detector loop cable shall be installed in the slot in a single continuous length and wound with the number of loops stated in the drawings. Both ends of the cable shall terminate in the jointing pit.

8.2.2 Jointing of cables

The ends of the detector loop cable shall be connected to the detector feed cable in the jointing pit with appropriate ELV rate IP68 enclosure approved by the Principal. **Witness Point 2**

8.3 Installation of feeder cables

The feeder cable is intended to be installed in underground ducting with a cable carrying low voltage, and as such is required to comply with the requirements of AS/NZS 3000. Feeder cable shall be installed between a traffic signal controller or standalone vehicle detector and a vehicle detector loop and be installed without intermediate joints.

Additional requirement on the unterminated end of the loop feeder cable.

The unterminated end of the loop feeder cable shall be able to be lifted out of the pit by a minimum of 300 mm and a maximum of 500 mm.

9 Testing and commissioning

The testing and commissioning requirements as defined in MRTS201 apply to this Technical Specification.

The testing procedures defined in AS/NZS 2276.2 and AS/NZS 2276.3 and in the following clauses apply to this Technical Specification.

The loop shall be tested after installation before the saw cut is sealed with approved slot sealant and the overlay placed on the vehicle detector loop. The circuit shall be tested again when the loop feeder twin is connected to the loop lead-in cable, before the connection is sealed. Preformed loops with overlay do not require slot sealant.

Insulation resistance of the feeder cable and the loop cable shall be recorded, together with the loop circuit inductance and resistance. The resistance and inductance shall be measured at several stages during the installation. These measurements shall be recorded for each individual loop.

Where two or more loops are connected to the one vehicle detector sensor channel, the inductance and the resistance of the loop and feeder cable circuit is to be measured as a total.

The testing of the loops is the same for both quadruple and rectangular loop. All measurements are to be recorded in the Vehicle Detector Loop Settings and Measurements Record in Appendix A.

All works shall meet the requirements of AS/NZS 3000 and the local electricity supply authority.

Typical detector loop and feeder cable characteristics are shown in the following tables.

Table 9(a) – Detector loop characteristics

Configuration	Length	Width range	Number of turns	Resistance range (Ω)	Inductance range (µHenry)
Rectangular	2.0 m	2.0 m	4	0.200 to 0.025	470 to 580
Rectangular	2.0 m	1.8 m to 3.2 m	3	0.10 to 0.30	200 to 340
Rectangular	2.0 m	1.8 m to 3.2 m	4	0.15 to 0.33	440 to 760
Quadruple	2.0 m	1.8 m to 3.2 m	3	0.20 to 0.50	120 to 190
Quadruple	2.0 m	1.8 m to 3.2 m	4	0.25 to 0.50	210 to 320

Table 9(b) – Detector feeder cable characteristics

Length of loop feeder	Increase in resistance (Ω)	Increase in inductance (µHenry)
50 m	0.7	33
100 m	1.4	67
150 m	2.0	100

Length of loop feeder	Increase in resistance (Ω)	Increase in inductance (μHenry)
200 m	2.7	133
250 m	3.4	167
300 m	4.1	200

9.1 Testing of feeder cable

The feeder cable shall be tested after installation and before being connected to the loop and the detector.

The drain conductors for all detector feeder cables are to be connected to earth in the detector sensor cabinet.

Earth continuity for the drain conductor shall not exceed 1.4Ω/100 m. Core insulation resistance between the two cores and between earth and either core shall exceed 1MΩ. Cables that fail any of these tests shall be removed and new cables shall be installed.

9.2 Testing of individual loops

For loops fabricated on-site, all measurements shall be recorded when the loop cable has been laid in the saw cut and the retaining wedges are in place. This is to ensure the loop cable does not move in the saw cut. If practicable the lead-in cable, from the loop, shall be placed in its saw cut. Any lead-in cable not placed in a saw cut shall be twisted to have a minimum of one full turn every 10 cm (10 turns per metre), before any measurements are taken.

For loops pre-fabricated, all measurements shall be recorded when the loop cable has been laid in place and secured, to ensure the loop cable does not move. The lead in cable, from the loop should be twisted to have a minimum of one full turn every 10 cm, before any measurements are taken.

The loop internal resistance and inductance shall then be measured.

Record the measurements for all loops in the Vehicle Detector Loop Settings and Measurements Record in Appendix A and any measurements which are not less than the guidelines set out in Table 9(a) shall be highlighted and specifically brought to the Principal's attention before the close of business on the next working day. **Witness Point 3**

9.3 Testing of loop cable and feeder cable circuit

The inductance and resistance shall be measured again after the loop is connected to the loop feeder cable and before the connection joint is sealed. The results of these measurements should be the sum of the previous measurement for the loop and the increased resistance and inductance of the loop feeder cable. Record the measurements for all loop circuits on the Vehicle Detector Loop Settings and Measurements Record in Appendix A. **Witness Point 4**

Any measurements which are not within 15% of the calculated values shall be highlighted and specifically brought to the Principal's attention before the close of business on the next working day.

Where two or more loops are connected to the one vehicle detector sensor channel, the inductance and the resistance of the combined loops and the feeder cable circuit is to be measured as a total.

For loops connected in series, the formulae for calculations are:

$R_t = R^1 + R^2$ Resistance in Ohms (Ω)

$L_t = L^1 + L^2$ Inductance in micro Henry (µH)

For loops connected in parallel, the formulae are:

$$R_t = \frac{R_1 \times R_2}{R_1 + R_2}$$

Resistance in Ohms (Ω)

$$L_t = \frac{L_1 \times L_2}{L_1 + L_2}$$

Inductance in micro Henry (µH)

9.4 Connection of loop circuit to vehicle detector

The loop is connected to the vehicle detector and the operation checked. Vehicle Detector Loop Settings and Measurements Record in Appendix A is to be completed.

Where the vehicle detector provides additional information on the loop circuit, such as either Quality (Q) Factor of the loop or Loop Energy Requirement (LER), the information type and reading shall be recorded in the column headed “Q”.

For vehicle detection “Q” factor for a loop shall be in the range shown for the associated frequency range.

Q = 5 to 50 for Frequency < 60kHz

Q = 3 to 50 for Frequency ≥ 60kHz.

For vehicle classification or identification, the “Q” factor for a loop shall be in the range from 15 to 50.

A copy of this record is to be kept in the cabinet housing the vehicle detectors and a copy shall be provided to the Principal with any vehicle detector which does not operate as per manufacturer’s standard being highlighted and specifically brought to the Principal’s attention. **Witness Point 5**

10 Documentation

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

11 Training

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

12 Maintenance

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Availability of spare parts shall be maintained for at least seven years following the last purchase date of the equipment.

13 Handover

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

Appendix A – Form M4300

Vehicle Detector Loop Settings and Measurements Record

Location	Detector manufacturer's name	Date of loop installation

Site identification number	Detector model	Date data collected

Loop number	Loop			Loop and feeder cable		Detector data					
	Insulation resistance (MΩ)	Resistance (Ω)	Inductance (µH)	Resistance (Ω)	Inductance (µH)	Sensor & channel numbers	Sensitivity setting	Frequency (kHz)	Mode PAsage/ Presence	Resistance (Ω)	Q or Manufacturer information
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
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