Technical Specification

Transport and Main Roads Specifications MRTS253 Traffic Signal Lanterns

July 2017

Queensland Government

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1 Introduction

This Technical Specification defines the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and hand over requirements for traffic signal vehicular and pedestrian lanterns.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS201 *General Equipment Requirements* and other Technical Specification as appropriate.

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

2 Definition of terms

The terms used in this Technical Specification will be as defined in Clause 2 of MRTS201 *General Equipment Requirements*.

Further traffic engineering terms used in this Technical Specification are defined in AS 1348 *Road and Traffic Engineering – Glossary of Terms*. Other terms are as defined in the relevant Australian Standards listed in the Section 3 – 'Reference documents'.

Table 2 – Definitions

Term	Definition
a.c.	Alternating Current
Critical Flicker Fusion Frequency	The threshold frequency at which a flickering light is indistinguishable from a steady, non-flickering light.
ELV	Extra-Low Voltage (Not exceeding 50V a.c. or 120 V ripple-free d.c.) (As defined by AS/NZS 3000)
Flicker Frequency	The frequency of the light output
LED	Light Emitting Diode(s)
LV	Low Voltage (Exceeding extra-low voltage, but not exceeding 1000 V a.c. or 1500 V d.c.) (As defined by AS/NZS 3000)
NATA	National Association of Testing Authorities Australia
Percent Flicker	The ratio of the peak light output levels.
r.m.s.	Root mean square
Stroboscopic Effect	The appearance of multiple, discrete images of moving objects as a result of temporally unstable illumination. The effect may also change the appearance of the objects in their motion.
TMR	Department of Transport and Main Roads
Visible Lighting Flicker	The appearance of a temporal instability in illumination due to flicker

3 Reference documents

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

Table 3 – Referenced documents

Reference	Title
AS 2144	*Traffic Signal Lanterns*
AS 2578	*Traffic Signal Controllers*
AS 2979	*Traffic Signal Mast Arms*
AS/NZS IEC 60998	*Connecting devices for low-voltage circuits for household and similar purposes*
AS/NZS ISO 9000	*Quality Management Systems – Fundamentals and Vocabulary*
IEEE Std 1789-2015	*IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS93	*Traffic Signals*
MRTS201	*General Equipment Requirements*
MUTCD Part 14	Queensland *Manual of Uniform Traffic Control Devices,* Part 14 Traffic Signals
TRUM Volume 1, Part 6	*Traffic and Road Use Management Manual,* Volume 1: Guide to Traffic Management, Part 6 Intersections, Interchanges and Crossings

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant under this Technical Specification are defined in Table 4. There are no Witness Points and Milestones defined.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.2	1. Sample for acceptance		
11	2. NATA testing and commissioning		

4.1 Sample for acceptance

The requirements of MRTS201 apply to this Technical Specification.

Each sample shall be marked with the following information:

a) Supplier's name

b) Supplier's product reference code

c) Date of manufacture

d) Reference to this Technical Specification (MRTS253). **Hold Point 1**

4.2 Design changes during contract

During the contract period for the supply of Traffic Signal Lanterns the Principal shall be notified of any changes proposed to the design or components, as early as practicable before implementation.

Acceptance of the modified equipment shall be subject to the written acceptance of the change or changes by Transport and Main Roads.

Implementation of any modifications proposed shall not be carried out before written approval has been given by Transport and Main Roads.

4.3 Quality documentation

The contractor shall submit information regarding the life and quality of the products offered. All claims in relation to life, reliability, maintainability etc. shall be in accordance with the terms and definitions of AS/NZS ISO 9000 *Quality management systems - Fundamentals and vocabulary*.

The manufacturer shall demonstrate conformance to the Queensland Workplace Health and Safety Act for the manufacturing facility.

5 Statutory compliance

The statutory compliance requirements of MRTS201 apply to this Technical Specification.

The traffic signal lanterns and ancillary equipment shall comply with the relevant requirements of AS 2144 *Traffic signal lanterns*, except where otherwise indicated in this Technical Specification.

Lanterns shall be compatible with existing traffic controllers and controllers manufactured to New South Wales Road & Traffic Authority NSW (RTA) TSC/4 specification. Refer to AS 2578 *Traffic signal controllers*, Part 1, Physical and electrical compatibility, and RMS Equipment Specification No. TSC/4 Control Equipment for Road Traffic Signals.

Where the specification calls for compliance with a test in an Australian Standard, an independent certification, from a NATA recognised laboratory shall be provided to verify that the component complies with the relevant standard.

For the body of the lantern and the optical system, a label stating compliance with AS 2144 shall be fixed adjacent to or on the component.

6 Mechanical and physical requirements

The mechanical and physical requirements defined in MRTS201 apply to this Technical Specification. Additional mechanical and physical requirements for equipment provided under this Technical Specification are given in the clauses below.

6.1 Fasteners

All fasteners shall be made from hot-dipped galvanised steel or grade 316 stainless steel.

6.2 Mounting straps

All lanterns shall be supplied with a complete set of straps for mounting. Lengths of straps are defined in AS 2144.

A spring washer of suitable size shall be supplied with the mounting strap. This is in addition to the two full hexagon nuts and flat washer as specified in AS 2144. Nuts supplied shall have a width across flats of 18 mm.

6.3 Body construction

The 200 mm, 300 mm, pedestrian lantern bodies and bicycle lanterns shall be Aluminium. Where non-metallic items are used in other parts of the lantern including the housing, they shall be UV stabilised.

The mounting facilities and electrical connections shall permit ready replacement of lamp aspect and transformers in the field, without the necessity to remove the lantern from its normal position.

6.4 Galling prevention

Lubrication shall be applied to all exposed bolt threads and studs unless the bolt or stud is used for earthing. The lubricant used shall be Stearin Wax or Relton Stick Wax. The bolt thread or stud shall be treated prior to the nut being installed on the bolt.

6.5 Weather resistance

Weather resistance shall be as defined in Clause 4.6 of AS 2144.

6.6 Wind loading

The wind loading for a completed lantern assembly with attached target board and visors shall meet the weather conditions expected in Queensland including the cyclonic tropical areas of North Queensland. Assuming a rigid mast arm or post, the defined wind loading shall be based on the design of the lantern body, target board, visors, and all mounting arrangements supplied with the lantern (i.e. brackets, straps nuts, bolts, studs, etc.). Refer to Section 2.2.3 Wind Loading of AS 2979 *Traffic signal mast arms*.

6.7 Environmental tests

In addition to Clause 4.8 of AS 2144, all lanterns submitted by the offeror shall pass a salt mist test specified in Table 6.7 below. A detailed report of the lantern after the salt mist test has been completed shall be supplied with the sample.

Table 6.7 – Environmental tests - Salt mist

Test	Stages	Condition
Salt mist, cyclic (sodium chloride solution) AS 60068.2.52 – 2003 Test Kb	Preconditioning	None
	Severity	1
	Initial Measurements	Visual inspection, operational test
	Recovery	None
	Final Measurements	Visual inspection, operational test

7 Electrical requirements

The electrical requirements defined in MRTS201 apply to this Technical Specification. Additional electrical requirements for equipment provided under this Technical Specification are given below.

7.1 General

In addition to the requirements of Section 5 of AS 2144, the lanterns shall be tested by a qualified person using calibrated test equipment to meet the following requirements:

- The minimum power consumption of an aspect shall not be below 5W. Where control wire dimming is used the minimum power consumption shall not be below 1W.
- The maximum power consumption of an aspect shall not exceed 30W.

- Power filtering shall be provided on the LED driver to minimise harmonics and noise, to ensure an essentially sinusoidal input waveform (where a.c. lanterns are used).
- Total Harmonic Distortion for the current and voltage waveforms shall not exceed 5.0%.

7.2 Supply voltage

7.2.1 Low Voltage (LV) lanterns

LV lanterns shall comply with the supply voltage requirements in Section 5.1.1 of AS 2144.

7.2.2 Extra Low Voltage (ELV) lanterns

ELV lanterns shall comply with the supply voltage requirements in Section 5.2.2 of AS 2144.

7.2.3 Dual LV/ELV lanterns

Dual LV and ELV lanterns shall comply with the supply voltage requirements in Section 5.2.3 of AS 2144.

7.2.4 Direct Current (DC) lanterns

DC lanterns shall only be used in conjunction with Portable Traffic Signals. DC lanterns shall comply with the supply voltage requirements in Section 5.2.4 of AS 2144.

7.3 Supply conductors

In addition to the requirements of clause 5.3.1 of AS 2144. All traffic signal lanterns shall be provided with at least 2 metres of 16 mm-diameter black flexible conduit, and at least 2.5 metres of supply conductors.

7.4 Terminals for connection of supply conductors

Terminals for the connection of the supply conductors shall be in accordance with the requirements of Clause 5.3.2 of AS 2144. In addition each connector shall be double insulated to ensure that exposed conductors that are attached to the connectors are not accessible.

8 Operational requirements

The operational requirements defined in MRTS201 apply to this Technical Specification. Additional electrical requirements for equipment provided under this Technical Specification are given below.

8.1 Monitoring and dimming

Lanterns shall have stepped dimming characteristic and shall be provided with facilities to respond to changes to the supplied voltage from the controller for lamp dimming purposes.

The lantern shall have sufficient current load, under normal and dimmed output, to facilitate lamp monitoring by any controller.

Chromaticity shall conform to AS 2144 across the rated voltage range of the lantern including voltage levels when dimming is active.

All lanterns shall conform to the step dimming requirements specified in AS 2144. The change in luminosity from dimming the aspects shall not induce visible flicker

8.2 Progressive failure of LEDs

In the case of aspects utilising high-current, super-bright LEDs, Section 6.4 of AS 2144, Progressive Failure of LEDs, will be met and the lantern manufacturer shall demonstrate compliance with the following conditions:

- After the failure of one or more LEDs the aspect is producing no less than 80% of the luminous intensity that it would with all LEDs illuminated.
- That the loss of said LED(s) does not create dark spots, as read in Section 3.2 of AS 2144 that could be misinterpreted as a symbol.

8.3 Pedestrian Countdown Timer (PCT) display

The PCT display shall, upon initial power up:

- Display the flashing red “Don’t Walk” symbol during the first full pedestrian clearance period; and
- Record the duration of the pedestrian clearance period.

Recording shall commence once the steady green “Walk” symbol deactivates. The PCT timer module shall record the duration of the pedestrian clearance period while the red “Don’t Walk” symbol is flashing. Each flash shall correspond to a pulse in seconds received from the Traffic Signal Controller.

The recording shall cease when the steady “Don’t Walk” signal group has been active for at least 655 milliseconds. The recorded pedestrian clearance period shall then be rounded down to an integer in seconds.

Once the pedestrian clearance period has been established, the display shall count down from a value equal to the recorded clearance period with the yellow (chromaticity of yellow as per AS 2144) numeric display instead of the “Don’t Walk” symbol. The numerical value will decrement by one, every second, using the internal timer until the display reaches one (“1”). After a further second, the PCT display will complete the countdown by displaying the steady “Don’t Walk” symbol and not display a zero (“0”).

Although the pedestrian clearance period has been established, the PCT display shall continue to monitor the clearance period even during a count. The PCT display shall abort the count and immediately display the steady “Don’t Walk” symbol:

- when the current count is shorter than what was previously established by at least 1 second – for example, if the current clearance period has been reduced by 1 second, the steady “Don’t Walk” symbol will be displayed after the countdown shows “2”; or
- if the current count is longer than what was established previously by at least 1 second – for example, if the current clearance period has been increased by 2 seconds, upon reaching “1” on the countdown, the PCT display will then flash twice and the steady “Don’t Walk” symbol will be displayed after the two flashes

The timer module will now be updated with the new timing and the countdown will be adjusted to reflect the new clearance period in the next cycle.

In the event of a fault condition while the PCT display is active, it will also abort the countdown sequence within a one-second period. The PCT display shall then revert back to the flashing “Don’t Walk” signal. The PCT display shall no longer be activated for all subsequent pedestrian clearance

periods until it is reset by power cycling the PCT display. If the countdown display has sufficient failures which has affected legibility of the numerals, the PCT display shall also cease its countdown sequence.

The PCT display shall not trigger a lamp fault even if it has detected that the flashing red “Don’t Walk” aspect has failed. It will, however, display a lamp fault when the steady red “Don’t Walk” display is not working.

The countdown timer display within the PCT display shall also have its own connection to the power source. It should not be powered through a parallel connection from the red standing man display.

PCT displays should only be used at crossings as determined in TRUM Volume 1 Part 6, Section 8.2.3-2.

Refer to MUTCD Part 14 and TRUM Volume 1 Part 6, Section 8.2.3-2 for further operational requirements.

9 Optical system components and ancillary devices

9.1 Visible lighting flicker

Lighting flicker requirements have been introduced to reduce driver distress, stroboscopic effects and to minimise any potential health risks associated with lighting flicker.

All traffic signal lanterns shall comply with the following lighting flicker requirements:

- Flicker frequency shall be greater than twice the a.c. line frequency.
- Flicker frequency shall be greater than the critical flicker fusion frequency.
- Flicker percentage shall be less than *flicker frequency x 0.08*.

Documentation from a NATA recognised laboratory shall be provided to verify that the lantern complies with the visible lighting flicker requirements defined above.

Recommendations from IEEE Std 1789 have been adopted to place limits on flicker from LED lanterns.

9.2 Veiling reflections

To reduce the effect of veiling reflections, LED lantern aspects shall be covered with appropriate coloured lenses.

The external surface of the lenses shall be either convex or slightly declining.

9.3 Light source

The sources of supply for the specified LED shall be stated.

LED aspects shall be provided with each lantern supplied as per order. LED aspects shall also be supplied as a spare part.

9.4 Lantern types

For vehicular traffic signal lanterns, this specification calls for the supply of both general purpose and extended range lanterns.

General purpose vehicular lanterns shall have a nominal aspect size of 200 mm.

Extended range vehicular lanterns shall have a nominal aspect size of 300 mm.

9.5 Symbolic displays

All shapes of symbolic displays as shown in AS 2144 shall be provided and included in the list of spare parts.

For the PCT display, the combined yellow countdown timer and flashing red “Don’t Walk” display shall be a direct replacement to the existing Don’t Walk display. Retrofitting the PCT display into the existing pedestrian lantern assembly shall not require any additional modifications.

The PCT display shall have two seven-segment displays comprising one row of 5 mm yellow (chromaticity of yellow as per AS 2144) LEDs to illuminate each segment and display the number as required. The display shall be capable of the following:

Figure 9.5(a) – Dimensions of digits (non-italic)

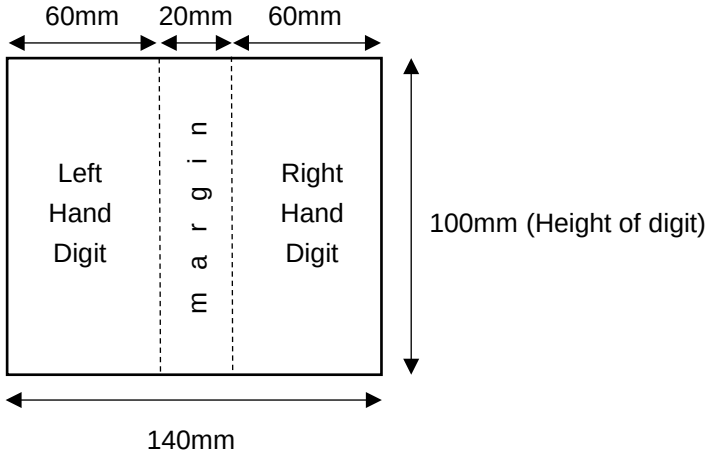
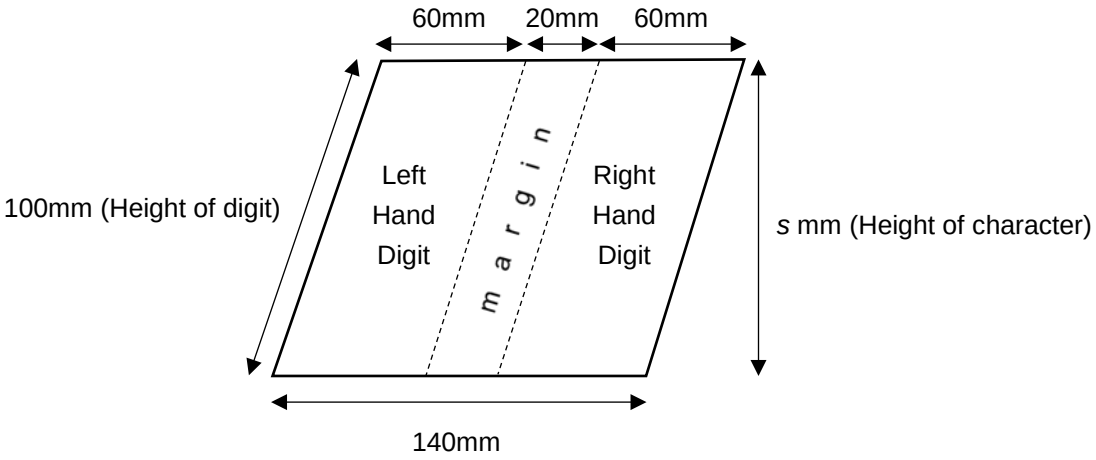


Figure 9.5(b) – Dimensions of digits (italics)



- Height of the digits shall be approximately (100 ± 10)mm as depicted in Figure 9.5(a).
- Width of a digit shall be approximately (60 ± 10)mm as depicted in Figure 9.5(b).
- Height of the digits shall be approximately (100 ± 10)mm as depicted in Figure 9.5(b) and the height of the characters (denoted as s mm) shall be at least 50% of the nominal roundel diameter
- Width of a digit shall remain as (60 ± 10)mm as depicted in Figure 9.5(b)
- Figure 9.5(a) and Figure 9.5(b) are dimensions appropriate for use on a general purpose pedestrian lantern with a nominal roundel diameter of 200 mm
- Display digits between 1 and 99 inclusive which would represent the time in seconds remaining within the pedestrian clearance period
- Single digits shall not precede with a zero – for example, the countdown timer shall display “5” instead of “05”
- Single digits shall only be displayed on the right hand digit – for example, the countdown timer shall display “X5” where “X” is blank (no LEDs lit) when the countdown timer reaches “5”
- No overlay of two consecutive digits simultaneously
- Only activate all necessary LEDs required to display a digit simultaneously
- Transition between each digit without any perceptible flashing or blanking out of the display
- Provision of a margin, equivalent to 20 mm, is to be used as the spacing between the two digits
- Have sufficient light intensity across the display such that the digits are clear, legible and not distracting to pedestrians meeting visual acuity requirements for driver licensing
- Be capable of being “dimmed” at times of low ambient light

9.6 Visors

Visors for vehicular signal lanterns shall be ordered and supplied separately to lanterns.

Visors for pedestrian lanterns and bicycle lanterns shall be supplied with the lanterns.

If fasteners are required for connection of the visor to the lantern, they shall be supplied with each visor, and secured to prevent loss prior to installation.

9.7 Target boards

Target boards used with lanterns are subject to the following requirements:

- Traffic signal vehicular lanterns shall be supplied with target boards.
- All target boards shall have a white border of dimensions specified in Clause 7.6 of AS 2144.
- Target boards shall be made of aluminium.
- Each target board shall be supplied with all nuts, bolts, etc. necessary for assembly.
- The design of the target boards shall be such that combinations of two columns of one- two- and three-aspect lanterns can be accommodated.

If blanking panels are required, they should be provided with nuts/bolts and associated holes.

10 Installation requirements

The installation requirements defined in MRTS201 and MRTS93 apply to this Technical Specification.

11 Testing and Commissioning

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

All lantern data sheets and complete sets of certified results from an independent testing laboratory, registered by the National Association of Testing Authorities, Australia (NATA) shall be provided.

These test results shall demonstrate that the performance characteristics of the unit meet or exceed the standards defined in AS 2144 *Traffic signal lanterns*. The *Photometric and Colorimetric Measurements - Test Templates for LED Lanterns* shall be completed by the NATA certified laboratory to record the test results for the LED lanterns offered.

Where Measured Electrical Values are required in the Test Templates, provide oscillograms clearly showing the values of peak in-rush current, running current, and waveform during the first second after switch-on. **Hold Point 2**

12 Warranty provisions

The warranty requirements defined in MRTS201 apply to this Technical Specification.

13 Documentation

The documentation requirements defined in MRTS201 apply to this Technical Specification. All information provided shall be written in plain English.

13.1 Additional information to be supplied

In addition to the information requested elsewhere in this Technical Specification, the following information shall also be provided with the offer:

a) Dimensioned outline drawings of all equipment offered.

b) Where a special tool or component is required for assembly, installation or maintenance it shall be clearly stated and detailed by the manufacturer.

13.2 Exceptions to the Specification

The covering letter shall include all details of the equipment offered that do not comply with the relevant clauses of this specification, and any standards referenced by this Technical Specification.

14 Training

The training requirements defined in MRTS201 apply to this Technical Specification.

15 Maintenance

The maintenance requirements defined in MRTS201 apply to this Technical Specification.

15.1 Spare Components

Availability of spare parts shall be maintained for at least eight years following the last purchase date of lanterns.

16 Handover

The handover requirements defined in MRTS201 apply to this Technical Specification.