Superseded

Technical Specification

Transport and Main Roads Specifications MRTS253 Traffic Signal Lanterns

July 2023

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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 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 Clause 3 of this Technical Specification.

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.
D.C.	Direct Current
ELV	Extra-Low Voltage (Not exceeding 50V A.C. or 120 V ripple-free D.C.) (As defined by AS/NZS 3000 – Electrical installations (known as the Australian / New Zealand Wiring Rules)).
Flicker Frequency	The frequency of the light output.
ILAC MRA	International Laboratory Accreditation Cooperation Mutual Recognition Arrangement.
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 – Electrical installations (known as the Australian / New Zealand Wiring Rules).
NATA	National Association of Testing Authorities Australia
Percent Flicker	The ratio of the peak light output levels.
RCM	Regulatory Compliance Mark
RMS	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.
UMA	Upper Mounting Assembly
Visible Lighting Flicker	The appearance of a temporal instability in illumination due to flicker.

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3 Reference documents

The requirements of the referenced documents listed in MRTS201 *General Equipment Requirements* 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 *General Equipment Requirements*), then the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AS 1170.0	*Structural Design Actions – General principles*
AS 1170.2	*Structural Design Actions – Wind Actions*
AS 2144	*Traffic Signal Lanterns*
AS 2339	*Traffic signal posts, mast arms and attachments*
AS/NZS 3000	*Electrical installations (known as the Australian / New Zealand Wiring Rules*
AS/NZS ISO 9000	*Quality Management Systems – Fundamentals and Vocabulary*
IEC 60068-2-52 (ED. 3.0)	*Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)*
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*
MRTS252	*Next Generation Traffic Signal Controllers*
MRTS255	*Traffic Signal Controllers*
MUTCD Part 14	Queensland *Manual of Uniform Traffic Control Devices,* Part 14 *Traffic Signals*
Queensland Workplace Health and Safety Act 2011	*Queensland Workplace Health and Safety Act* 2011 and Workplace Health and Safety Regulation 2011
Traffic Signal Lanterns Evaluation Checklist	A checklist of requirements to assist manufacturers in providing appropriate evidence of compliance with this Technical Specification. Evaluation checklists can be found here: https://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers/Intelligent-transport-systems-and-electrical-approved-products-and-suppliers
QGTM Part 9	*Queensland Guide to Traffic Management,* Part 9: *Transport Control Systems – Strategies and Operations*

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4 Quality system requirements

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

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 Witness Points and Milestones defined.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.4	1. Manufacturing Facility Capability Audit – Australian Manufacturers 2. Manufacturing Facility Capability Audit – Overseas Manufacturers		
4.5	3. Sample for evaluation and acceptance		
11	4. NATA accredited testing and commissioning		

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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* 2011 for the manufacturing facility.

4.4 Manufacturer's requirements

Manufacturers shall demonstrate conformance to this Technical Specification.

For Australian manufacturers, the capability of the manufacturing facility shall be audited by a Transport and Main Roads staff member or independent auditor acceptable to the department. **Hold Point 1**

For overseas manufacturers, the capability of the manufacturing facility shall be audited by an independent auditor acceptable to the department. **Hold Point 2**

The manufacturer shall provide the department with test certificates as required by the Technical Specification.

All products shall be inspected by a qualified departmental representative. The inspection shall be undertaken in Australia at a place suitable to Transport and Main Roads.

Australian manufacturing facilities shall demonstrate conformance to the *Queensland Workplace Health and Safety Act* 2011.

4.5 Samples for evaluation and acceptance

Unless the supplier has a current product approval certificate issued by Transport and Main Roads, traffic signal lanterns shall be submitted to the department for evaluation. Samples submitted for acceptance shall comply with Clause 4.2 of MRTS201 *General Equipment Requirements*.

Hold Point 3

The sample shall be representative of the product which will be supplied in the event of the offer being awarded.

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

e) offer number, and

f) closing date for submission.

On or before the delivery of the first sample, the supplier shall provide two hard copies (or electronic copies if agreed by the department) of any hardware manuals if they are not already in possession of the department.

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4.6 Multiple or excessive failures

In addition to the requirements of MRTS201 *General Equipment Requirements*, where the traffic signal lantern fails within the first six-month period, the manufacturer shall replace that signal lantern with a new one at its expense and within one month. Replacing only individual parts can be done at the discretion of the department.

Where a traffic signal lantern has more than two failures in the first three years, the manufacturer shall replace that signal lantern with a new one at its expense and within one month. Replacing only individual parts can be done at the discretion of the department.

4.7 Product life

The mechanical components and housing of the traffic signal lanterns shall be designed for a minimum operational life of 20 years as detailed in AS 2144 *Traffic Signal Lanterns*.

The electrical components of the traffic signal lanterns shall be designed for a minimum operational life of 10 years as detailed in AS 2144.

4.8 Documentation

All updates and modifications to the lantern hardware and manuals over the life of the equipment shall be documented within the manufacturer's quality system. This documentation shall be provided on a periodic basis as specified by the department.

5 Statutory compliance

The statutory compliance requirements of MRTS201 *General Equipment Requirements* apply to this Technical Specification.

RCM shall be indelibly marked in a clearly visible location.

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

Lanterns shall be compatible with existing traffic signal controllers and current traffic signal controllers manufactured to comply with MRTS252 *Next Generation Traffic Signal Controllers or* MRTS255 *Traffic Signal Controllers*.

Contact Statewide Network Operations (Operational Technologies) (ITS_Electrical_Technology@tmr.qld.gov.au) for a full list of traffic signal controllers for which compatibility is required.

For all tests listed in the Traffic Signal Lanterns Evaluation Checklist, an independent certification from a National Association of Testing Authorities Australia (NATA) accredited laboratory shall be provided. The results of these tests shall be presented clearly in test reports and will be considered 'professionally tested' for the purposes of approving the product. Test certificates issued by a laboratory accredited by ILAC Mutual Recognition Agreement (MRA) (ILAC MRA) signatory is acceptable provided that the test is covered by the scope of accreditation of the laboratory. All other testing does not require NATA certification and shall be undertaken by trained professionals using calibrated equipment.

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.

The following clauses require testing at NATA accredited laboratory:

- Clause 6.5 – Weather resistance
- Clause 7.1 – Electrical requirements
- Clause 9.1 – Visible lighting flicker, and
- Clause 11 – Testing and Commissioning

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6 Mechanical and physical requirements

The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* 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 general purpose, extended range, pedestrian and bicycle lantern bodies 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 Clause 3.4.3 Wind Loading of AS 2339 *Traffic signal posts, mast arms and attachments*.

The lantern body, visors, target boards and mounting shall be designed to withstand forces of wind. The wind forces shall not:

- cause any parts to disconnect from the assembly or
- alter the position and orientation.

The design wind speed shall be derived using Tables 3.1 and 4.1 of AS 1170.0 *Structural Design Actions – General principles* and AS 1170.2 *Structural Design Actions – Wind Actions*.

The following parameters shall be used in calculating the design wind speed:

$Height = 6.5$

$Terrain\ Category = 2$

$Region = C$

$Reference\ Probability\ of\ Exceedance\ P_{ref} = 0.01$

$Mechanical\ Design\ Life = N = 20\ years$

$Annual\ Probability\ of\ Exceedance\ P = P_{ref} \times \left(\frac{50}{N}\right) = 2.5\%$

$Average\ recurrence\ interval\ (R) = \frac{1}{P} = 40$

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The design integrity shall be assessed by a structural Registered Professional Engineer of Queensland to demonstrate the ability of the lantern and accessories to withstand the wind speed calculated above. The assessment report shall be submitted to Transport and Main Roads as evidence to approve the product.

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 as detailed in IEC 60068-2-52 (ED. 3.0) *Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)*. A detailed report of the lantern after the salt mist test has been completed shall be supplied with the sample.

6.8 Surface finishes

Surface finish shall be as per AS 2144 except for the ELV lanterns boss end caps and conduit covers shall be of colour B21 Ultramarine as defined in AS 2700.

7 Electrical requirements

The electrical requirements defined in MRTS201 *General Equipment Requirements* 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 Clause 5 of AS 2144, the lanterns shall be tested by a qualified person using calibrated test equipment to meet the following requirements:

- 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 waveforms shall not exceed 5.0%. Frequencies up to the 40th harmonic of the waveform are to be tested.

7.2 Supply voltage

7.2.1 Low Voltage (LV) lanterns

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

The minimum and maximum power consumption for low voltage lanterns in various states is shown in Table 7.2.1.

Table 7.2.1 – Low voltage lantern power consumption

Control Method	State	Minimum Consumption	Maximum Consumption
Dimmed by Voltage Control	Undimmed	5W	30W for green and red aspects, 35W for yellow aspects
	Dimmed	3W	18W for green and red aspects, 21W for yellow aspects

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7.2.2 Extra Low Voltage (ELV) lanterns

ELV lanterns shall comply with the following supply voltage requirements:

- Lanterns shall turn off when the supply voltage drops below the lower voltage threshold, in the range of between 24V and 26V.
- Lanterns shall only be turned on when the supply voltage reaches a level of 2V above the lower voltage threshold in the range between 26V and 28V.
- Maximum operating voltage of lanterns shall be 50VAC.

The minimum and maximum power consumption for extra low voltage lanterns in various states is shown in Table 7.2.2.

Table 7.2.2 – Extra low voltage lantern power consumption

Control Method	State	Minimum Consumption	Maximum Consumption	
			General Purpose	Extended Range
Dimmed by Control Wire	Undimmed	1W	10W for green and red aspects, 15W for yellow aspects	20W for green and red aspects, 30W for yellow aspects
	Dimmed	0.6W	6W for green and red aspects, 9W for yellow aspects	12W for green and red aspects, 18W for yellow aspects

7.2.3 Dual LV / ELV lanterns

Dual LV and ELV lanterns shall comply with the supply voltage requirements in Clause 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 Clause 5.2.4 of AS 2144.

7.3 Supply conductors

In addition to the requirements of Clause 5.3.1 of AS 2144, all flexible conduits for traffic signal lanterns shall be black. At least 2.5 m of supply conductors shall be provided where terminated into an upper mounting assembly. At least 12 m of supply conductors shall be provided for extended range lanterns on mast-arm outreach poles where the supply conductors are terminated in the junction box rather than the UMA.

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.

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8 Operational requirements

The operational requirements defined in MRTS201 *General Equipment Requirements* 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 as specified in AS 2144. Chromaticity shall conform to AS 2144 across the rated voltage range of the lantern including voltage levels when dimming is active. The change in luminosity from dimming the aspects shall not induce visible flicker.

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

8.1.1 Low voltage lanterns

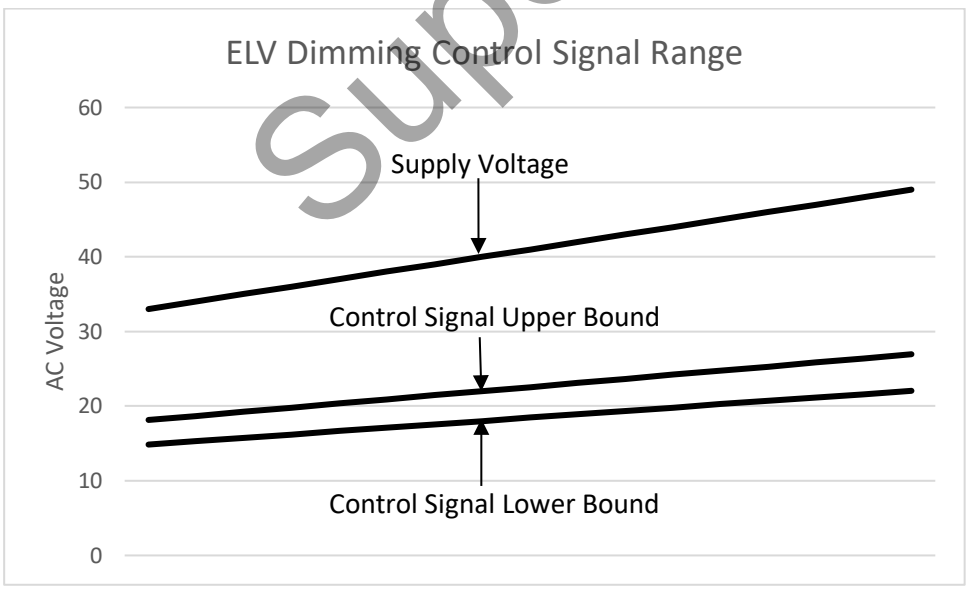
Low voltage lanterns shall be provided with facilities to respond to the supplied voltage from the controller. The voltage range in which dimming shall occur for LV lanterns can be found in Figures 6.1 in AS 2144.

8.1.2 Extra low voltage lanterns

Extra low voltage lanterns shall be provided with an input terminal to interface with a dimming control wire. The control signal for dimming will be the presence of a voltage at 50% of the supply voltage. The upper and lower bounds for the control signal depend on supply voltage and are shown in Figure 8.1.1.

The input terminal shall present a load of not more than 2mA at rated supply voltage and shall be able to withstand up to 280VAC without damage.

Figure 8.1.2 – Extra low voltage lantern dimming control signal range



The control signal voltage range for both LV and ELV power can be found using the following equation:

$$Control\ Signal\ Range = \frac{Vs}{2} \pm \left(\frac{Vs}{2} \times 0.1\right)$$

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Where Vs is the supply voltage.

The transition between dimmed and undimmed states shall be completed in less than 4 seconds and should preferably be gradual over a period of 2 – 4 seconds.

8.2 Progressive failure of LEDs

In the case of aspects utilising high-current, super-bright LEDs, Clause 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 failed LED(s) does not create dark spots, as read in Clause 3.2 of AS 2144 that could be misinterpreted as a symbol.

8.3 Pedestrian Countdown Timer (PCT) display

The combined red "Don't Walk and 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.

The PCT timer module shall commence recording once the steady green “Walk” symbol deactivates. It 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, which is the PCT's countdown period.

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

During each subsequent operation of the clearance period, the PCT shall continue to record the clearance time. If the clearance period for any given cycle differs from what was established previously, the time recorded is rounded to the nearest integer and becomes the new countdown period.

If the recorded pedestrian clearance period differs from the countdown period, one of the following behaviours shall apply:

- If the pedestrian clearance period is shorter than the countdown period, once the pedestrian clearance period has elapsed, the PCT display is aborted and the steady “Don’t Walk” symbol will be displayed, or
- If the pedestrian clearance period is longer than the countdown period, once the countdown period has elapsed, the flashing “Don’t Walk” symbol will be displayed. This symbol will flash once per second until the pedestrian countdown period has elapsed and then the steady “Don’t Walk” symbol will be displayed.

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The PCT display is considered faulty if at least four of the seven segments for each of the symbolic displays are faulty. In the event of a fault condition while the PCT display is active, it shall abort the countdown sequence within one second. 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” display has failed. It shall display a lamp fault when the steady red “Don’t Walk” display has failed.

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

Use of PCT displays at crossings is determined in QGTM Part 9: *Transport Control Systems – Strategies and Operations*, Section 6.

Refer to Queensland MUTCD Part 14 *Traffic Signals* and QGTM Part 9: *Transport Control Systems – Strategies and Operations*, Section 6 for further operational requirements.

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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, and
- Flicker percentage shall be less than *flicker frequency x 0.08*.

Recommendations from IEEE Std 1789-2015 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 Technical 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.

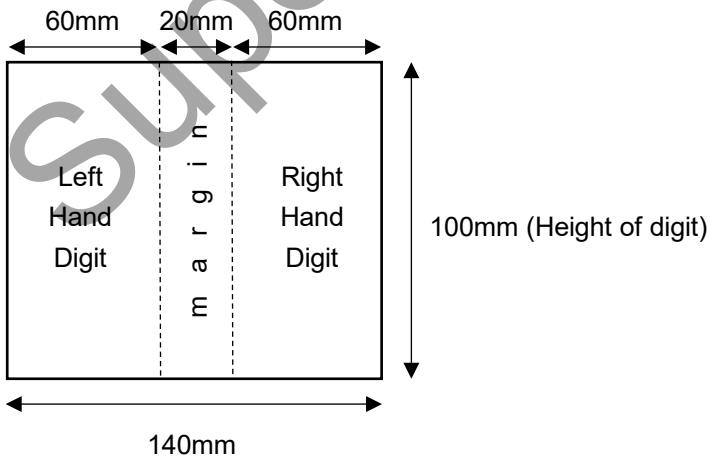
9.5 Symbolic displays

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.

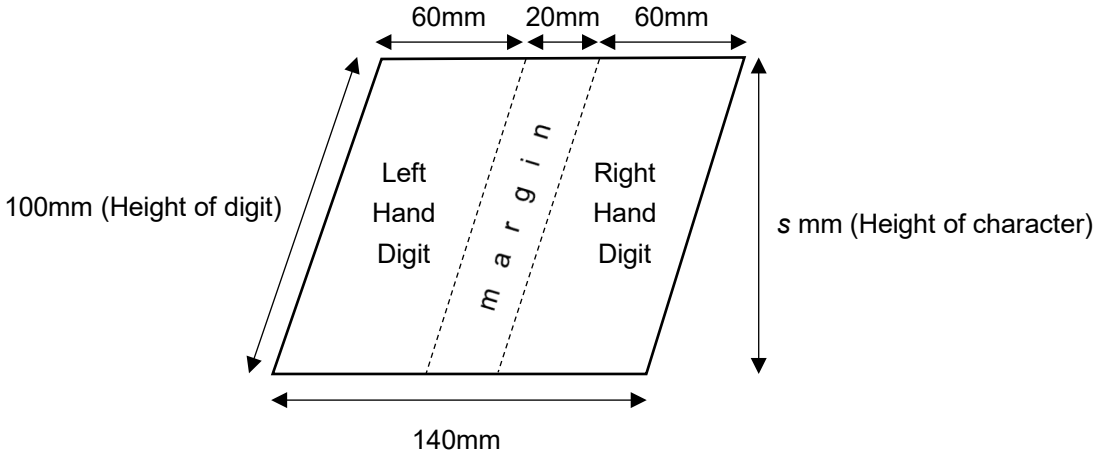
The PCT display shall have two seven-segment displays comprising one row of 5 mm yellow (chromaticity of yellow as per AS 2144) LEDs to illuminate each segment and display the number as required. The display shall be capable of the following:

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



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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.

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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. Fasteners provided are to be spring clips or alternative as approved by Transport and Main Roads.

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 shall be provided with nuts / bolts and associated holes.

10 Installation requirements

The installation requirements defined in MRTS201 *General Equipment Requirements* and MRTS93 *Traffic Signals* apply to this Technical Specification.

11 Testing and Commissioning

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

All lantern data sheets and complete sets of certified results as defined in the Traffic Signal Lanterns Evaluation Checklist shall be provided. These tests are to be performed by an independent testing laboratory, accredited by NATA.

These test results shall demonstrate that the performance characteristics of the unit meet or exceed the standards defined in AS 2144.

Where measured electrical values are required in the test templates, oscillograms for the first second of operation after switching on shall be provided. Oscillograms shall clearly show the values of peak in-rush current, running current, and waveform. **Hold Point 4**

12 Warranty provisions

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

13 Documentation

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

Superseded

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 Technical Specification

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

14 Training

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

15 Maintenance

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

Superseded

Superseded