# TCS 038: 2024

## Specification

# Traffic Signal Lanterns

# Supply of

Version: 6.0
Date: 2024

VICTORIA State Government | Department of Transport and Planning

## Foreword

This specification has been developed by Department of Transport and Planning. It is one of a number of technical specifications, and associated standard drawings, which set out the requirements for roadside ITS devices, traffic signal equipment and other electrical equipment and associated devices and control systems.

This specification is intended for use in all relevant works undertaken by or on behalf of DTP.

DTP Standard Drawings, Specifications and Guidelines are available for downloading from the VicRoads website: https://www.vicroads.vic.gov.au/business-and-industry/technical-publications/electrical-and-intelligent-transport-systems

**Specification updates.** DTP specifications and associated standard drawings are subject to periodic review. To keep the specifications up to date, amendments or new editions are issued as necessary. It is therefore important for users of DTP specifications to ensure that they have the latest version and associated amendments.

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## COPYRIGHT

## Revision History

| Version | Revision | Date | Author | Description |
|---|---|---|---|---|
| 2001 | | July | ITS | Updated |
| 2004 | | Feb | ITS | Updated |
| 2010 | | June | RUS | Updated |
| 2015 | A | Jan | ITS | Release of new version |
| 2021 | A | Feb | ITS | New version<br>Updated format, inclusion of ELV, dim-by-wire dimming, and installation |
| 2024 | 6.0 | March | ITS | Updated format to DTP<br>Updated to reflect new AS 2144: 2023 |

# Contents

# SECTION 1 SCOPE AND GENERAL

## 1.1 SCOPE

This document covers the requirements for the supply of traffic signal lanterns for use within the State of Victoria.

## 1.2 GENERAL

1.2.1 All traffic signal lanterns shall comply with the relevant requirements of AS 2144: 2023, Traffic Signal Lanterns.

1.2.2 Where this specification differs from the requirements of AS 2144: 2023, this specification shall take precedence.

1.2.3 The Department of Transport and Planning only installs 200mm lanterns (typically referred to as general purpose lanterns in AS 2144) throughout Victoria.

1.2.4 DTP does not use or install 300mm lanterns (typically referred to as extended range lanterns in AS 2144) on any traffic signal installations.

1.2.5 All traffic signal lanterns, displays and associated hardware shall hold current DTP Type Approval.

1.2.6 For details of lantern mounting brackets, upper mounting assemblies including finial caps, and terminal assemblies for large poles, refer to TCS 001.

## 1.3 DISPLAY TYPES

Display types commonly used in Victoria are described in Table 1.1 below.

| Aspect Type | Colour |
|---|---|
| Vehicle Roundel | Red, Yellow, Green |
| Pedestrian | Green (Walk), Red (Don't Walk) |
| Arrow Symbol | Red, Yellow, Green |
| 'U' Turn Symbol | Red, Yellow, Green |
| Bicycle Symbol | Red, Yellow, Green |
| 'Tee' Symbol | Red, Yellow, White |
| 'E' Symbol | White |
| 'B' Symbol | White |
| Pedestrian countdown timer | Yellow digits |

**Table 1.1 – Common displays used in Victoria**

## 1.4 TYPE APPROVAL

1.4.1 All equipment to be supplied under this specification shall hold current DTP 'Type Approval' certification.

1.4.2 To obtain DTP 'Type Approval' the supplier must submit evidence of compliance in accordance with Appendix F of this specification.

1.4.3 Compliance with this version of this specification and subsequent DTP Approval does not constitute automatic approval against future versions of this specification.

1.4.4 Where it is considered necessary, DTP may withdraw current Type Approval and request that the affected product be re-submitted for evaluation against future versions of this specification.

## 1.5 ACRONYMS AND DEFINITIONS

The acronyms used in this document shall be interpreted as follows.

| | |
|---|---|
| AC | Alternating Current |
| ACMA | Australian Communications and Media Authority |
| AS | Australian Standard |
| AS/NZS | Australian Standard / New Zealand Standard |
| DC | Direct Current |
| DTP | Department of Transport and Planning |
| ELV | Extra Low Voltage (nominally 42V AC) |
| EMC | Electromagnetic Compatibility |
| HPSM | High power surface mount LED |
| ILAC-MRA | International Laboratory Recognition Arrangement – Mutual Recognition Arrangement |
| IP | Internet Protection |
| ITS | Intelligent Transport Systems |
| LED | Light Emitting Diode |
| LV | Low Voltage (nominally 240V AC) |
| NATA | National Association of Testing Authorities |
| RCM | Regulatory compliance mark |
| TfNSW | Transport for New South Wales |

# SECTION 2 RELATED SPECIFICATIONS AND DRAWINGS

## 2.1 AUSTRALIAN STANDARDS

2.1.1 Subject to the following clauses, the fabrication and supply of all components for traffic signal lanterns shall fully comply with the most recent issue of the Australian Standards listed below, together with any amendments to these standards.

2.1.2 The following related Australian Standards are referenced.

| | |
|---|---|
| AS 2144: 2023 | Traffic Signal Lanterns |
| AS 2339: 2017 | Traffic Signal Posts, Mast Arms and Attachments |
| AS/NZS 3000 | Wiring Rules |
| AS 60038: 2012 | Standard Voltages |
| AS/NZS 61000.6.3 | General Standards – Emission standard for residential, commercial and light industrial environments |

## 2.2 DTP SPECIFICATIONS

2.2.1 The fabrication and supply of all components shall conform to the relevant DTP specifications, and related specifications and standards, as indicated throughout this document.

2.2.2 The following DTP Specifications are referenced.

| | |
|---|---|
| Contract Standard Section 730 | Traffic Signal Installation |
| TCS 001 | Traffic signal MA's, JUMA's, and JUP's and associated hardware |
| TCS 016 | Traffic Signal Controllers |
| TCG 016 | Product Compliance Process for ITS and Electrical Products |

## 2.3 DTP STANDARD DRAWINGS

The following DTP Standard drawings are referenced.

| | |
|---|---|
| TC-1000 | Typical layouts |
| TC-1003 | Typical layouts for pedestrian operated signals |
| TC-1115 | Lantern mounting bracket orientation |
| TC-1116 | Traffic signal mounting arrangement |

| | |
|---|---|
| TC-1119 | Lantern mounting details |
| TC-1127 | Visor dimensions |

## 2.4 EXCEPTIONS AND CLARIFICATIONS TO AS 2144: 2023

Changes or clarifications to AS 2144 are summarised in Table 2.1 below.

| AS 2144 Clause | Description | TCS 038 Exception / Clarification |
|---|---|---|
| Tables 3.4, 3.5 & 3.6 | Distribution for extended range lanterns | Not Applicable |
| 3.8 | Pedestrian countdown timer | 3.1.3 |
| 4.1.1 | Size and arrangement of aspects | Refer Clause 3.2.2 |
| 4.1.2 | Mounting facilities | Refer Clause 3.2.5 |
| 5.2 | Supply Voltage | Refer Clause 3.3.1.2 |
| 5.2.3 | Dual voltage operation | 3.3.2 |
| 5.3.1 | Supply conductors | Clause 3.3.3 |
| 5.5.5 | Dimming | Refer Clause 3.4. |
| 6.2 | Light output states | Refer Clauses 3.4 and 3.4 |
| 6.4 | Progressive failure of LEDS | Refer Clause 3.5. |
| 7.4 | Visors and louvres | Refer to Clause 3.8 |
| 7.5 | Target boards (for vehicular lanterns) | Refer Clause 3.9 |

**TABLE 2.1 – Changes and clarifications to AS 2144**

# SECTION 3 LANTERNS

## 3.1 PHOTOMETRIC PERFORMANCE

### 3.1.1 General

All lanterns supplied for use in Victoria shall comply with the photometric performance requirements of Section 3 of AS 2144, Photometric Performance.

### 3.1.2 General purpose and extended range lanterns

3.1.2.1 For the purpose of this specification, reference in AS 2144 to 'general purpose aspects' shall be interpreted as 200mm lanterns.

3.1.2.2 For the purpose of this specification, reference in AS 2144 to 'extended range aspects' shall be interpreted as 300mm lanterns.

## 3.2 MECHANICAL AND PHYSICAL REQUIREMENTS

3.2.1 Lanterns shall comply with the requirements of Section 4 of AS 2144, Mechanical and physical features and properties.

3.2.2 All lanterns shall be 200mm.

3.2.3 Lantern bodies may be plastic or metal.

3.2.4 Lantern mounting straps shall comply with the general requirements of Clause 4.1.2 of AS 2144 and Clause 6.3 of AS 2339.

3.2.5 For all lantern types used in Victoria, the lantern mounting strap shall be 'size designation 4' as detailed in Figure 6.3 of AS 2339 (i.e. 300mm length and 6mm thickness).

## 3.3 ELECTRICAL REQUIREMENTS

### 3.3.1 General

3.3.1.1 Lanterns shall comply with Section 5 of AS 2144, Electrical Requirements.

3.3.1.2 The nominal lamp supply voltages used in Victoria are:

(a) 240 volt AC for low voltage (LV) traffic signal installations.
(b) 42 volt AC for extra low voltage (ELV) traffic signal installations.

(c) 12 volt DC for solar-powered installations (typically solar powered flashing yellow conspicuity devices or portable signals).

3.3.1.3 The operating voltage for lanterns shall be specified in individual contract documents.

### 3.3.2 Dual voltage lanterns

Further to Clause 5.2.3 pf AS 2144, dual voltage lanterns that automatically sense and select the operating voltage, rather than via a manual switch, may be considered.

### 3.3.3 Provision for connection to supply

3.3.3.1 Lanterns shall be provided with conductors encased in a black flexible hose (conduit) as specified in Section 5.3 of AS 2144.

3.3.3.2 The length of the conductors and flexible hose shall be as per Table 3.1.

| Lantern Type | Flexible Hose Length | Connecting Conductor Length beyond end of flexible hose |
|---|---|---|
| Pedestrian | 3.9m | 1.4m |
| 2 Aspect Bicycle | 3.9m | 1.4m |
| Mast Arm outreach | 2.3m | 14m |
| All Other | 2.3m | 2.4m |

**Table 3.1 – Flexible hose and conductor lengths**

### 3.3.4 Dimming

3.3.4.1 Dimming of lanterns shall be as per Section 5.5.5.3 of AS 2144, Dimming methods.

3.3.4.2 The dimming methods used in Victoria shall be as per Table 3.2.

3.3.4.3 Dimming voltages shall be as specified in Clause 3.4.

| Lantern Voltage | Controller Version | Dimming Method |
|---|---|---|
| LV | All | Voltage Control |
| ELV | VC6 | Dedicated input (control wire) |
| ELV | <VC5 | Voltage Control |

**Table 3.2 – Dimming Methods**

## 3.4 OPERATIONAL REQUIREMENTS

### 3.4.1 General

Lanterns shall comply with the light output states specified in Section 6 of AS 2144, Operational Requirements except as specified below.

### 3.4.2 Dimming of LV lanterns

3.4.2.1 LV lanterns shall be dimmed by reduced lamp voltage using either stepped or linear voltage dimming as detailed in Clause 5.5.5.2 of AS 2144.

3.4.2.2 The light output state of the lantern shall generally conform to Table 6.1 of AS 2144.

3.4.2.3 The dimming voltage shall be 80 ±5% of the nominal lamp supply voltage (i.e. 192 volts) in accordance with TSI-SP-069, clause 6.6.3.2.2 for Level 2 dimming.

### 3.4.3 Dimming of ELV lanterns using reduced voltage

3.4.3.1 ELV lanterns shall be dimmed using either dedicated input (control wire) or reduced lamp voltage in accordance with Table 3.2.

3.4.3.2 Dimming by reduced lamp voltage shall be achieved by reducing the lamp voltage as detailed in Table 6.2 of AS 2144.

3.4.3.3 The nominal dimmed voltage applied to lanterns is 32 volts.

3.4.3.4 Dimming by dedicated input (control wire) shall be achieved by reducing the dedicated input (control wire) voltage by 50%. voltage shall be 80 ±5% of the nominal lamp supply voltage (i.e. 32 volts) in accordance with TSI-SP-069, clause 6.6.3.2.2 for Level 2 dimming.

### 3.4.4 Dimming of ELV lanterns using dedicated input (control wire)

3.4.4.1 Dimming by dedicated input (control wire) shall be achieved by reducing the dedicated input (control wire) voltage to 50% of the nominal lamp voltage as detailed in Clause 6.6.3.2.3 of TSI-SP-069.

3.4.4.2 This method of dimming will typically be applied to new installations where a VC6 version traffic signal controller is being installed.

3.4.4.3 The operation of the dedicated input (control wire) shall be as detailed in Table 3.3.

| Lantern Output | Dim control wire voltage |
|---|---|
| Undimmed | 42V a.c.<br>(nominal lamp supply voltage) |
| Dimmed | 21V a.c. |
| Dimming disabled | 0V a.c. |

**Table 3.3 – Dim by wire control wire input**

## 3.5 PROGRESSIVE FAILURE OF LEDS

### 3.5.1 5mm LED's

3.5.1.1 For 5mm LED's, the failure of LED's shall comply with AS 2144, Clause 6.4.

3.5.1.2 Failure of a single LED shall not cause more than two other LEDs in the aspect to cease operation unless the failure meets the condition of shut down.

### 3.5.2 HPSM LED's

3.5.2.1 For HPSM LED aspects, the failure of one LED need not cause the aspect to shut down provided the luminance intensity of the display still meets minimum requirements.

3.5.2.2 Where the failure of a single LED increases the current of the remaining LED(s) to maintain luminance intensity, the increased current shall not reduce the life if the display.

3.5.2.3 Where the failure of one or more HPSM LEDs reduces the luminance intensity below minimum requirements, or where designed to do so, the aspect shall shut down.

### 3.5.3 Aspect Failure

An aspect shall be deemed to have failed when the number of failed individual LEDs has become sufficient to shut the aspect down.

## 3.6 CONTROLLER COMPATIBILITY

3.6.1 LED lanterns shall be compatible with the operation of, and allow full functionality with, DTP Type Approved traffic signal controllers.

3.6.2 All lanterns shall be required to be subjected to traffic signal controller compatibility testing.

3.6.3 Unless otherwise agreed, the lantern supplier will be required to arrange compatibility testing with each approved controller supplier.

3.6.4 A detailed report showing all findings and detailing the methodology used shall be provided. The report shall be endorsed by the lantern supplier and the controller supplier.

**Note:** Due to the potential commercial issues involved between competitive suppliers, if requested by either party, DTP may arrange and/or facilitate the testing.

## 3.7 LANTERNS USED WITH ELV

3.7.1 Lanterns operating on 42 volts (ELV) shall be identified with the use of a blue end cap located on the lower end of the lantern as shown in Figure 3.1.

3.7.2 The blue shall be Resene, Into the Blue B35-060-269 (RGB 25, 55, 102. LAB 23.33, 6.74, -30.92. CMYK 75, 46, 0, 60), or similar.

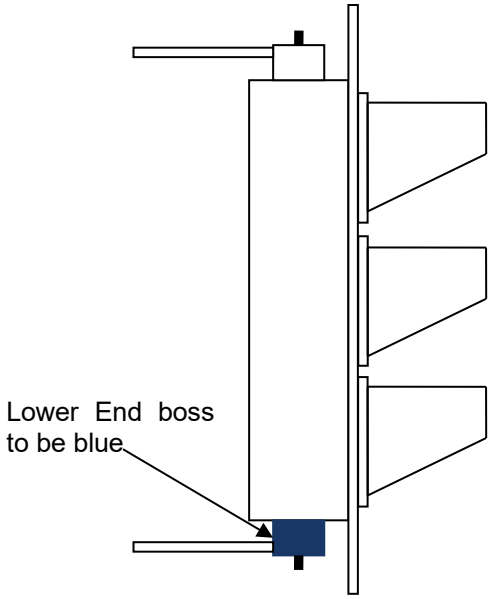


**FIGURE 3.1 – Blue end boss for lanterns operating on ELV**

## 3.8 VISORS AND LOUVRES

3.8.1 Visors shall generally comply with the requirements of AS 2144, Clause 7.4.

3.8.2 Visors typically used in Victoria are detailed in VicRoads Standard Drawing TC-1127 and shown in Table 3.4.

| Lantern Location | Visor Type | Visor Length | Cutaway |
|---|---|---|---|
| Primary | 1 | 200mm | Open |
| Overhead | 1 | 200mm | Open |
| Tertiary / Secondary | 3 | 200mm | Closed |
| Pedestrian | 4 | 200mm | None |
| Bicycle | 4 | 200mm | None |

**TABLE 3.4 – Visors**

3.8.3 Louvres are not typically used with 5mm LED displays.

## 3.9 TARGET BOARDS

3.9.1 Target boards shall comply with the requirements of AS 2144, Clause 7.5.

3.9.2 Target boards shall be metal.

3.9.3 Plastic target boards will not be accepted for use in Victoria.

3.9.4 Four aspect, single column target boards (see AS 2144, Figure 7.13) are not used in Victoria.

## 3.10 WARRANTY REQUIREMENTS

3.10.1 The initial luminous intensity requirements detailed in AS 2144 are based on the display meeting the minimum luminous intensity requirements after 10 years of 'in field' service (see Appendix C of AS 2144).

3.10.2 All lanterns, including the displays, shall be covered by a minimum 5 year *return to the manufacturer* replacement warranty.

3.10.3 Any display that 'shuts down' due to LED failure, within the 5 year warranty period, shall be returned to the manufacturer for a replacement display at no cost.

# APPENDIX A - REQUIREMENTS FOR TYPE APPROVAL

(Normative)

## A1. GENERAL

A1.1 To enable assessment for the purpose of granting Type Approval, the supplier is to submit a formal request for Type Approval, for each lantern type submitted, accompanied by the following:

(a) A complete working sample of the lantern.
(b) An outline drawing showing the general presentation and overall dimensions of the complete lantern.
(c) Documentation to demonstrate that the lantern has been manufactured and supplied under an approved quality assurance system.
(d) Documentation to demonstrate that the lantern conforms to all relevant requirements of AS/NZS 2144 and this specification. This may be by means of submitting test results, from approved and appropriately qualified independent testing organisations, and providing the manufacturer's assurance that the product complies with each paragraph of the standard/specification.

A1.2 The supplier may also submit evidence of Type Approval of the same product by another Australian State Road Authority, together with details of volume and period of usage by other jurisdictions.

## A2. REQUIRED NATA ACCREDITED TESTING

The supplier shall submit certified test reports from a NATA accredited (or equivalent ILAC-MRA certified) testing organisation to demonstrate compliance with the items detailed in Table A1.

| AS 2144 Clause | Requirement |
|---|---|
| 2.1 & 2.2 | Signal colours |
| 3.3 | Luminance intensity distribution of vehicular aspects with a circular display. |
| 3.5 | Luminance distribution of vehicular aspects that display symbols. |
| 3.7 | Luminance distribution of pedestrian and bicycle aspects that display symbols. |
| 3.8 | Pedestrian countdown timer Colour and luminance intensity |
| 3.9 | Veiling reflection |
| 3.10 | Sun phantom |
| 3.11 | Flicker test |

**TABLE A1 – NATA accredited test reports**

| AS 2144 Clause | Requirement |
|---|---|
| 4.3 | Sealing of optical system |
| 4.6.2 | Weather resistance required protection |
| 4.7 | Operating temperatures |
| 4.8 | Environmental Tests as detailed in Table 4.1<br>• Dry heat<br>• Change of temperature<br>• Damp heat cyclic<br>• Salt mist, cyclic<br>• Sinusoidal vibration<br>• Simulated solar radiation |
| 5.1 | Conformance with AS/NZS 3100 |
| 5.2.3 | Dual voltage operation |
| 5.5.2 | Off voltage |
| 5.5.3.1 | Current wave form |
| 5.5.3.2 | Power factor |
| 5.5.3.3 | Power consumption |
| 5.5.4 | Shut down mode |
| 5.5.5 | Dimming |
| 5.5.7 | EMC |
| 6.2 | Light output states |
| 6.3 | Switching response times |
| 6.4 | Progressive failure of LED's |
| 6.5 | Dimming of aspects |

**TABLE A2 – NATA accredited test reports ….continued**

## A3. OTHER REQUIRED INFORMATION

A3.1 The supplier shall also supply evidence of compliance with the clauses of AS2144 as detailed in Table A2.

| Clause | Requirement |
|---|---|
| 4.2 | Mass of lantern |
| 4.4(a) | Lantern body design life of 20 years |
| 4.4(b) | Electrical component design life of 10 years |
| 4.4 (ii) | Impact test |
| 5.6.1 | Derating |

**TABLE A2 – Other test reports**

A3.2 Other information to be provided.

(a) Copy of LED manufacturers specification for each LED type used.
(b) Minimum design life (e.g. 100k hours).
(c) LM-80 test results.
(d) TM-21 calculations.

A3.3 DoT (Roads) may require additional information or testing to be carried out as part of its evaluation of the product.

## A4. CONTROLLER COMPATIBILITY

A4.1 The lantern supplier shall provide DTP evidence, such as test reports, that the lanterns are fully compatible with all DTP approved traffic signal controllers. The lantern supplier shall arrange with each of the suppliers of DTP approved traffic signal controllers to undertake compatibility testing.

Upon request from either Supplier, a representative from DTP will be present for all compatibility testing.

The required number of each type of lantern submitted shall be as described in Table A3.

| Lantern Type | Number Required |
|---|---|
| 3 Aspect roundel (vehicle) | 2 |
| 3 Aspect Arrow | 2 |
| 2 Aspect Pedestrian | 2 |

**TABLE A3 – Minimum number of lanterns required for compatibility testing**

**Note:** For HPSM symbolic vehicle aspects that use the same light source arrangement with a different mask, testing of a single type of symbolic vehicle display will be sufficient.

A4.2 The critical points of compatibility are:

(a) Correct and accurate detection of ‘lamp fail’ alarm function for all groups.
(b) Last red out function.
(c) Where applicable, correct ‘dim-by-wire’ operation.

## A5. ASSESSMENT PROCEDURE

A5.1 The assessment procedure for a traffic signal lantern may include the following:

(a) Assessment of construction, workmanship and critical dimensions.
(b) Evaluation of the submitted data against the requirements of AS 2144 and this specification.
(c) Evaluation of report from successful controller compatibility testing.
(d) An on-road trial for a period of not less than three months.

A5.2 Where some of these procedures have been completed prior to formal submission, the results will be considered in the evaluation, provided there is no relevant change in the design of the lantern. The supplier is to state whether tests carried out prior to formal submission were carried out on an identical sample of the lantern.

# APPENDIX B INFORMATION TO BE SUPPLIED WITH ORDER

(Informative)

The following information, as appropriate, should be provided with an enquiry or order for traffic signal lanterns conforming to the requirements of this specification:

(a) The type of lantern display (i.e. vehicular roundel, vehicular arrow, pedestrian, bicycle, etc. and the number of aspects of each lantern).
(b) The lantern operating voltage (i.e. LV, ELV or 12V DC).
(c) For ELV lanterns, whether the dim function is standard voltage amplitude dimming or dim-by-wire.
(d) For ELV, how many ‘blue’ finial caps are required.
(e) Details of any special purpose displays required.