

TCS 038-2015

The Supply of Traffic Signal Lanterns

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Foreword

This specification has been developed by VicRoads. 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 VicRoads.

VicRoads Standard Drawings, Specifications and Guidelines are available for downloading from VicRoads website at the following address
<https://www.vicroads.vic.gov.au/business-and-industry/technical-documents>

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Specification updates. VicRoads 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 VicRoads specifications to ensure that they have the latest version and associated amendments.

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Revision History

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PREFACE

A. CHANGES TO THIS SPECIFICATION

A.1 The main changes to this specification from the previous version are listed below:

- Revised in line with release of AS 2144:2014.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

1.1.1 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 requirements of AS 2144:2014, Traffic Signal Lanterns.

1.2.2 Where this specification differs from the requirements of AS 2144:2014, this specification shall take precedence.

1.2.3 All traffic signal lanterns, displays and associated hardware shall hold current VicRoads Type Approval.

1.3 DISPLAY TYPES

1.3.1 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

Table 1.1 – Common Displays

SECTION 2 RELATED SPECIFICATIONS AND DRAWINGS

2.1 GENERAL

2.1.1 The fabrication and supply of all components shall conform to all relevant Australian Standards.

2.1.2 All installation works shall conform to the relevant VicRoads specifications and related specifications and standards as indicated throughout this document.

2.1.3 The following related Australian Standards are defined:

AS 2144:2014	Traffic Signal Lanterns
AS 2339	Traffic Signal posts and Attachments
AS/NZS 3000	Wiring Rules
AS 60038	Standard voltages

2.1.4 The following related documents are defined:

IES LM-80	Approved Method: Measuring Lumen Maintenance of LED Light Sources
IES TM-21	Projecting Long Term Lumen Maintenance of LED Light Sources

2.1.5 The following related VicRoads specifications and standard drawings are defined:

Standard Section 730	Traffic Signal Installation
TCS 1127	Visor Dimensions

2.2 EXCEPTIONS AND CLARIFICATIONS TO AS 2144:2014

2.2.1 The following changes or clarifications to AS 2144:2014 are summarised in Table 2.1 below.

AS 2144 Clause	Description	Exception / Clarification
3.3.4	Vehicular aspects with a circular display for other technologies	Clause 3.5
3.5.2	Luminance distribution of vehicular aspects that display symbols - Luminance	Clause 3.5
3.7	Luminance distribution of pedestrian and bicycle aspects that display symbols	Clause 3.5
4.1.1	Size and arrangement of aspects	Clause 3.1.1
4.1.2	Mounting facilities	Clause 3.1.3
4.1.3	Access to optical system	Not applicable
4.4	Materials and methods of construction	Clause 3.1
5.2.2	Extra low voltage (ELV) operation	Clause 3.7
5.3.1	Supply conductors	Clause 3.2.5
6.2	Light output states	Clause 3.3
7.5	Visors and louvers	Clause 3.4
7.6	Target boards (for vehicular lanterns)	Clause 3.1.3

Table 2.1 – Changes and Clarifications to AS 2144:2014

SECTION 3 ACRONYMS

3.1 The acronyms use in this document shall be interpreted as follows:

AS	Australian Standard
AS/NZS	Australian / New Zealand Standard
EMC	Electromagnetic Compatibility
ELV	Extra Low Voltage
HPSM	High Power Surface Mount
IESNA	Illuminating Engineering Society of North America
ITS	Intelligent Transport Systems
LED	Light Emitting Diode
LV	Low Voltage
NATA	National Association of Testing Authorities

SECTION 4 REQUIREMENTS

4.1 MECHANICAL AND PHYSICAL REQUIREMENTS

- 4.1.1 Only 200mm lanterns are used in Victoria.
- 4.1.2 Lantern bodies can be plastic or metal.
- 4.1.3 Target boards shall be metal. Plastic target boards will not be accepted.
- 4.1.4 Mounting straps shall comply with section 4.1 of AS 2339. Specifically the lantern straps shall conform to 'size designation 3' of Table 4.1 and be 300mm in length with 260mm 'hole-centres'.

4.2 ELECTRICAL REQUIREMENTS

- 4.2.1 The typical voltages used in Victoria are:
- 240 volt a.c. LV mains supply (standard installation);
 - 42 volt a.c. ELV (for specials installation as defined in individual tender documents); and
 - 12 volt d.c. for solar installations (e.g. flashing yellow roundel and portable signals).
- 4.2.2 The default operating voltage for lanterns shall be deemed to be LV, as defined in AS 2144:2014 Clause 5.2.1, unless otherwise specified in individual tender documents.
- 4.2.3 The maximum wattage of LED aspects shall be 15 watts.
- 4.2.4 Connecting conductors shall be enclosed in a black flexible conduit not less than the length shown in Table 4.1.
- 4.2.5 Connecting conductors shall extend beyond the end of the flexible conduit not less than the length shown in Table 4.1.

Lantern Type	Flexible Conduit Length	Connecting Conductor Length
Pedestrian	3.9m	1.4m
2 Aspect Bicycle	3.9m	1.4m
All Other	2.3m	2.4m

Table 4.1 – Conduit and Conductor Lengths

4.3 DIMMING

4.3.1 Either stepped or linear dimming is acceptable provided it is fully compatible with all VicRoads approved traffic signal controllers.

4.4 VISORS AND LOUVRES

4.4.1 Visors typically used in Victoria are detailed in VicRoads Standard Drawing TC-1127 and shown in Table 4.2 below.

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 4.2 – Visors

4.4.2 Louvres are not typically used with LED displays.

4.5 CONTROLLER COMPATIBILITY

4.5.1 LED lanterns shall be compatible with the operation of, and allow full functionality with, VicRoads Approved traffic signal controllers.

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

4.6 HPSM LED TECHNOLOGY

4.6.1 Lanterns that use HPSM LED technology shall comply with all relevant requirements of AS 2144:2014.

4.6.2 HPSM LED's shall maintain sufficient lumen maintenance to ensure that at the end of the expected life the minimum photometric performance is maintained.

4.6.3 To ensure that lumen maintenance levels are adequate, HPSM LED's shall be tested to requirements of the following IESNA standards:

- **LM-80** – The standard method and procedure for measuring LED lumen depreciation; and
- **TM-21** – Currently a memorandum which recommends a method to project the lumen maintenance of an LED based on the results of LM-80.

4.6.4 Where LM-80 and TM-21 test results are not available, other means of demonstrating compliance with lumen maintenance requirements may be considered.

4.7 LANTERNS USED WITH ELV

4.7.1 Lanterns operating on 42 volts (ELV) shall be identified with the use of a light blue end cap located on the lower end of the lantern as shown in Figure 4.1.

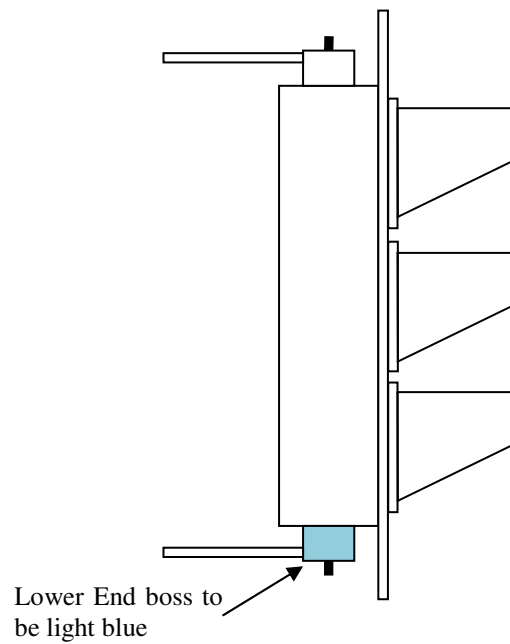


Figure 4.1 – Light blue end boss for lanterns operating on ELV

APPENDIX A

(Normative)

REQUIREMENTS SPECIFIC TO HPSM LED'S

A1 BACKGROUND INFORMATION

Section 3 of AS 2144 sets out the requirements for initial luminous intensity for the various signal colours. Appendix E of AS 2144 details the basis upon which the initial luminous intensity figures were derived. Lumen loss factors applied to initial luminous intensities are intended to ensure that, at the end of anticipated life (i.e. 100,000 hours for red and green and 10,000 hours for yellow), the minimum value of luminous intensity will be achieved. For red and green displays this is 150cd.

AS 2144:2014 does not preclude the use of HPSM LED's. To ensure that HPSM LED's meet minimum luminance intensity values at the required life, predicted lumen loss must be calculated.

A2 DETERMINING LUMEN LOSS OF LED'S

Clause 5.2.2.2 of AS/NZS 2144 requires that LED aspects be designed to provide a life expectancy of 100,000 for red and green and 10,000 hours for yellow. Actually testing LED's for 100,000 hours is not practicable. In order to determine LED life, IESNA together with the LED industry have developed a standard methodology for testing LED's. This methodology has been widely accepted throughout the LED industry. This has resulted in two separate IESNA 'standards' being produced. These are:

- **LM-80** – The standard method and procedure for measuring LED lumen depreciation; and
- **TM-21** – Currently a memorandum which recommends a method to project the lumen maintenance of an LED based on the results of LM-80.

LM-80 requires that:

- a. A number of LED's are tested under controlled conditions;
- b. The tests are conducted at three different ambient temperatures, 55°C, 85°C (LM-80 specified) and a third temperature specified by the manufacturer;
- c. Initial measurements of lumens and chromaticity are taken;
- d. Subsequent measurements of lumens and chromaticity are taken at nominal 1,000 hour intervals;
- e. A minimum of 6 measurements (6,000 hours of operation) must be taken.

The resultant average lumen measurement at 6,000 hours is referred to as the average Lumen Maintenance at 6,000 hours. These results can then be entered into a standard TM-21 table which will then calculate the extrapolated life expectancy when the LED will reach 70% (L70) or 80% (L80) of its initial lumen output. The intent of this is to provide a guide as to the expected life of the LED under test.

A2.1 Lumen Maintenance of a LED

To test the lumen maintenance of a LED:

- a minimum of 20 units of LED's should be used for each of the temperature settings;
- tests are conducted at 55°C, 85°C and a third temperature specified by the manufacturer;
- the initial measurements of lumens and chromaticity are documented;
- the subsequent measurements of lumens and chromaticity at the nominal 1,000 hour intervals are recorded;
- a minimum of 6 measurements are taken;
- additional measurements beyond 6,000 hours are encouraged; and
- the results are then used to populate a TM-21 table to calculate the average extrapolated life expectancy to 70% of initial luminance.

A copy of the LM-80 test report, including the results of a TM-21 extrapolation to L70 is provided for each of the required temperatures. An example of a summary of results of this testing are shown in Table A1.

Temperature	55°C	85°C	105°C
Number of LED's tested	25	25	25
Measurement Current	350mA	350mA	350mA
Average Lumen Maintenance at 6,000 hours	98.8%	97.5%	97.1%
Average Chromaticity Shift at 6,000 hours	0.0022	0.0022	0.0021
L70 Extrapolation in hours	248,303	151,188	149,247

Table A1: Example summary of test results

Table A1 above shows an example of how a higher LED temperature decreases the lifespan of the LED.

APPENDIX B

(Normative)

REQUIREMENTS FOR TYPE APPROVAL

OF A

TRAFFIC SIGNAL LANTERN

B1 GENERAL

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 complete working sample of the lantern.
- An outline drawing showing the general presentation and overall dimensions of the complete lantern.
- Documentation to demonstrate that the lantern has been manufactured and supplied under an approved quality assurance system.
- Documentation to demonstrate that the lantern conforms to all relevant requirements of AS/NZS 2144:2014 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.

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.

B2 REQUIRED NATA ACCREDITED TESTING

Notwithstanding B1 above, the supplier shall submit test results from a NATA accredited testing organisation to demonstrate compliance with the following specific clauses of AS 2144:2014, where relevant to the particular type of lantern submitted:

- | | | |
|-----|----------------|---|
| (a) | Clause 2.2 | Signal Displays |
| (b) | Clause 3.3 | Intensity Distribution of Vehicular Aspects with a Circular Display |
| (c) | Clause 3.5 | Luminance Distribution of Vehicular Aspects with a Symbolic Display |
| (d) | Clause 3.7 | Luminance Distribution of Pedestrian and Bicycle Aspects |
| (e) | Clause 3.8 | Veiling Reflections |
| (f) | Clause 3.9 | Sun-Phantom |
| (g) | Clause 4.6.2 | Weather Resistance – Required Protection |
| (h) | Clause 4.7 | Operating Temperatures |
| (i) | Clause 5.1.1 | Compliance with AS/NZS 3100 |
| (j) | Clause 5.2.1.4 | Provision for Aspect Monitoring |
| (k) | Clause 5.2.1.7 | Electromagnetic Compatibility |
| (l) | Clause 6.2 | Light Output States |

B3 OTHER REQUIRED INFORMATION

The supplier shall also supply evidence of compliance with the following:

- AS 2144:2002 Clause 5.2.2 Components and Construction;
- Copy of LED manufacturers specification for each LED type used
- maximum LED current (no more than 70% full rated current);
- minimum design life (e.g. 100k hours);
- LM-80 test results;
- TM-21 calculations;

VicRoads may require additional information or testing to be carried out as part of its evaluation of the product.

B4 CONTROLLER COMPATIBILITY

The supplier shall provide VicRoads evidence, such as test reports, that the lanterns are fully compatible with all VicRoads approved traffic signal controllers. Where VicRoads decides to undertake compatibility testing, lanterns shall be supplied to VicRoads (at no cost) for compatibility testing with VicRoads approved traffic signal controllers. The required number of each type of lantern submitted may be as described in Table B1.

Lantern Type	Number Required
3 Aspect roundel vehicle	2
3 Aspect Arrow	2
3 Aspect 'U'	2
2 Aspect Pedestrian	2
3 Aspect Tram Tee	2
2 Aspect Bicycle	2
3 Aspect Bus	2
Emergency Symbol	2

Table B1 – Minimum Number of Lanterns required for Compatibility Testing

The lantern manufacturer/supplier may elect to be present for compatibility testing if desired.

The critical points of compatibility are:

- Correct and accurate detection of 'lamp fail' alarm function for all groups; and
- Last red out function.

B5 ASSESSMENT PROCEDURE

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

- Assessment of construction, workmanship and critical dimensions.
- Preliminary assessment of the lantern under continuous burning at the VicRoads Test Rack for a period of not less than three months.
- Evaluation of the submitted data against the requirements of the specification
- Successful completion of the controller compatibility testing for all approved controller types.
- An on-road trial for a period of not less than three months.

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 C

INFORMATION TO BE SUPPLIED WITH ENQUIRY OR 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 (ie vehicular roundel, vehicular arrow, pedestrian, bicycle, etc. and the number of aspects of each lantern).
- (b) The rated voltage of the electricity supply on which the lantern is to be capable of operating if not 2v0 volt AC mains supply (ie 42 volt AC mains supply or 12 volt DC solar operation).
- (c) Details of any special purpose displays required.