

TCS 038 - 2021

Specification

Traffic Signal Lanterns

Supply of

Version: February 2021

Revision: A



Department
of Transport

TCS 038 - 2021

Foreword

This specification has been developed by DoT (Roads). 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 DoT (Roads).

VicRoads 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>

COPYRIGHT

© Department of Transport (VicRoads). All rights reserved.

This document remains the property of DoT (Roads). No part of this document may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of DoT (Roads)

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.

**Intelligent Transport Systems
60 Denmark Street Kew 3101**

ITSimprovementsandstandards@roads.vic.gov.au

Revision History

Version	Revision	Date	Author	Description
2001		July 2001	ITS	Updated
2004		Feb 2004	ITS	Updated
2010		June 2010	RUS	Updated
2015	A	Jan 2015	ITS	Release of new version
2021	A	Feb 2021	ITS	New version Update format, inclusion of ELV, dim by wire dimming and installation.

Contents

SECTION 1	SCOPE AND GENERAL	5
1.1	SCOPE	5
1.2	GENERAL	5
1.3	DISPLAY TYPES	5
1.4	ACRONYMS	6
SECTION 2	RELATED SPECIFICATIONS AND DRAWINGS	7
2.1	AUSTRALIAN STANDARDS	7
2.2	DOT (ROADS) SPECIFICATIONS AND DRAWINGS	7
2.3	ADDITIONAL SPECIFICATIONS AND DRAWINGS	8
2.4	EXCEPTIONS AND CLARIFICATIONS TO AS 2144: 2014	8
SECTION 3	LANTERNS	9
3.1	MECHANICAL AND PHYSICAL REQUIREMENTS	9
3.2	ELECTRICAL REQUIREMENTS	9
3.3	LIGHT SOURCE	10
3.4	DIMMING	10
3.4.1	LV Lanterns	10
3.4.2	ELV Lanterns	10
3.5	CONTROLLER COMPATIBILITY	12
3.6	HPSM LED TECHNOLOGY	12
3.7	PROGRESSIVE FAILURE OF LEDS	12
3.7.1	5mm LED's	12
3.7.2	HPSM LED's	13
3.7.3	Aspect Failure	13
3.8	LANTERNS USED WITH ELV	13
3.9	VISORS AND LOUVRES	14
3.10	TARGET BOARDS	14
3.11	WARRANTY REQUIREMENTS	14
SECTION 4	INSTALLATION	15
4.1	GENERAL INSTALLATION REQUIREMENTS	15
APPENDIX A REQUIREMENTS SPECIFIC TO HPSM LED'S		16
APPENDIX B REQUIREMENTS FOR TYPE APPROVAL		18
APPENDIX C INFORMATION TO BE SUPPLIED WITH ORDER		22

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 requirements of AS 2144, Traffic Signal Lanterns.
- 1.2.2 Where this specification differs from the requirements of AS 2144, this specification shall take precedence.
- 1.2.3 All traffic signal lanterns, displays and associated hardware shall hold current VicRoads Type Approval.
- 1.2.4 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
Tram 'Tee' Symbol	Red, Yellow, White
'E' Symbol	White
'B' Symbol	White

Table 1.1 – Common displays used in Victoria

1.4 ACRONYMS

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

AC	Alternating Current
ACMA	Australian Communications and Media Authority
ANSI	American National Standards Institute
AS	Australian Standard
AS/NZS	Australian Standard / New Zealand Standard
ANSI	American National Standards Institute
DC	Direct Current
DoT (Roads)	Department of Transport (Roads) (formerly VicRoads)
ELV	Extra Low Voltage (nominal 42V AC)
EMC	Electromagnetic Compatibility
HPSM	High Power Surface Mount (LED)
IESNA	Illuminating Engineering Society of North America
IP	Internet Protocol
ITS	Intelligent Transport Systems
LED	Light Emitting Diode
LV	Low Voltage (nominal 240V AC)
NATA	National Association of Testing Authorities

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: 2014	Traffic Signal Lanterns
AS 2339: 2017	Traffic Signal Posts, Mast Arms and Attachments
AS/NZS 3000	Wiring Rules
AS 60038	Standard Voltages
AS/NZS 61000.6.3	General Standards – Emission standard for residential, commercial and light industrial environments

2.2 DOT (ROADS) SPECIFICATIONS AND DRAWINGS

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

2.2.2 All installation works shall conform to the relevant DoT (Roads) specifications and related specifications and standards.

2.2.3 The following DoT (Roads) Specifications are defined:

TCS 001	Traffic Signal MA, JUP and JUMA and associated hardware
TCS 016	Traffic signal controllers

2.2.4 The following DoT (Roads) Contract Standard Section Specifications are referenced:

Standard Section 730	Traffic Signal Installation
Standard Section 732	ITS Devices Installation

2.2.5 The following DoT (Roads) Standard Drawings are defined:

TC-1000	Typical layouts
TC-1003	Typical layouts for pedestrian operated signals
TC-1115	Lantern and mounting bracket orientation
TC-1116	Traffic signal mounting arrangement
TC-1119	Lantern mounting details
TC-1127	Visor Dimensions

2.3 ADDITIONAL SPECIFICATIONS AND DRAWINGS

2.3.1 The fabrication and supply of all components shall conform to the following specifications and drawings as indicated throughout this document.

2.3.2 The following specifications are referenced:

ANSI/IES LM-80: 2015	Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
ANSI/IES TM-21: 2011	Projecting Long Term Lumen Maintenance of LED Light Sources

2.4 EXCEPTIONS AND CLARIFICATIONS TO AS 2144: 2014

The following changes or clarifications to AS 2144: 2014 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	Refer Clause 3.1.1.
3.3.4	Vehicular aspects with a circular display for other technologies	Refer Clause 3.8.
4.1.1	Size and arrangement of aspects	Refer Clause 3.1.1.
4.1.2	Mounting facilities	Refer Clause 3.1.4.
4.1.3	Access to optical system	Not applicable.
4.4	Materials and methods of construction	Refer Clause 3.1.
5.2	Supply Voltage	Refer Clause 3.2.
5.2.2	Extra low voltage (ELV) operation	Refer Clause 3.7.
5.3.1	Supply conductors	Clause 3.2.5.
5.5.5	Dimming	Refer Clause 3.4.
6.2	Light output states	Refer Clause 3.4.
6.4	Progressive failure of LEDS	Refer Clause 3.7.
7.5	Visors and louvres	Refer to Clause 3.9.
7.6	Target boards (for vehicular lanterns)	Refer Clause 3.10.

Table 2.1 – Changes and clarifications to AS 2144:2014

SECTION 3 LANTERNS

3.1 MECHANICAL AND PHYSICAL REQUIREMENTS

- 3.1.1 Only 200mm lanterns are used in Victoria.
- 3.1.2 Lantern bodies can be plastic or metal.
- 3.1.3 Target boards shall be metal. Plastic target boards will not be accepted.
- 3.1.4 Lantern mounting straps shall comply with the general requirements of AS 2144 (Clause 4.1.2) and AS 2339 (Clause 6.3).
- 3.1.5 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).

3.2 ELECTRICAL REQUIREMENTS

- 3.2.1 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).
- 3.2.2 The operating voltage for lanterns shall be specified in individual contract documents.
- 3.2.3 The maximum power consumption of LED aspects shall be 15 watts.
- 3.2.4 The minimum power consumption of LED aspects shall be 5W as specified in AS 2144, Clause 5.5.3.3 for LV operation.

Note: A lower power consumption for ELV aspects may be considered where correct operation with the traffic signal controller can be demonstrated.
- 3.2.5 Connecting conductors shall be enclosed in a black flexible hose not less than the length shown in Table 3.1.
- 3.2.6 Connecting conductors shall extend beyond the end of the flexible hose not less than the length shown in 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 – Conduit and conductor lengths

3.3 LIGHT SOURCE

- 3.3.1 This specification is based on LED technology as the light source.
- 3.3.2 The two LED technologies currently used are 5mm and HPSM.
- 3.3.3 It is envisaged that as 5mm technology becomes more difficult to source the use of HPSM will become the standard arrangement.

3.4 DIMMING

Dimming of lantern displays shall be achieved by one of the methods detailed below.

3.4.1 LV Lanterns

- 3.4.1.1 LV lanterns shall be dimmed by reduced lamp voltage using either stepped or linear voltage dimming as detailed in AS 2144, Clause 5.5.
- 3.4.1.2 The dimming voltage shall be $80 \pm 5\%$ 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.

3.4.2 ELV Lanterns

The dimming method for ELV lanterns shall be achieved by one of the following methods.

3.4.2.1 *Dimming by reduced lamp voltage.*

- 3.4.2.1.1 This method of dimming will typically be applied to existing installed dual voltage lanterns (when the site is converted to ELV)
- 3.4.2.1.2 The dimming voltage shall be $80 \pm 5\%$ 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.



3.4.2.2 Dimming by control signal

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

3.4.2.2.2 Dimming by control signal (also referred to as ‘dim by wire’ dimming) shall be achieved by reducing the dimming control signal voltage to $50 \pm 10\%$ of nominal lamp voltage as detailed in TSI-SP-069 Clause 6.6.3.2.3.

3.4.2.2.3 The dim control wire shall be violet in colour in accordance with Clause 5.3.1 of AS2144.

3.4.2.2.4 The dim by wire input to the signal aspects shall be as detailed in Table 3.2 below.

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

Table 3.2 – Dim by wire control wire input

3.4.2.2.4 A typical arrangement for dim by wire is shown in Figure 3.1 below.

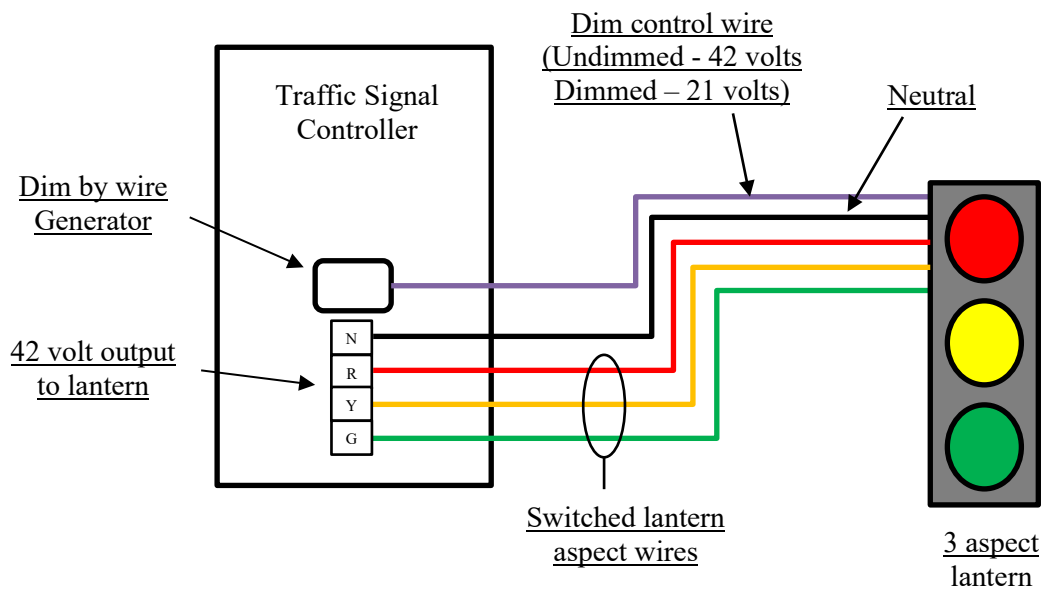


Figure 3.1 – Dim by wire wiring arrangement

3.5 CONTROLLER COMPATIBILITY

- 3.5.1 LED lanterns shall be compatible with the operation of, and allow full functionality with, VicRoads Type Approved traffic signal controllers.
- 3.5.2 All lanterns shall be required to be subjected to traffic signal controller compatibility testing.
- 3.5.3 Unless otherwise agreed, the lantern supplier will be required to arrange compatibility testing with each approved controller supplier.
- 3.5.4 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, DoT may arrange and/or facilitate the testing.

3.6 HPSM LED TECHNOLOGY

- 3.6.1 Lanterns that use HPSM LED technology shall comply with all relevant requirements of AS 2144.
- 3.6.2 HPSM LED's shall maintain sufficient lumen maintenance to ensure that at the end of the expected life, the minimum photometric performance is maintained.
- 3.6.3 To ensure that lumen maintenance levels are adequate, HPSM LED's shall be tested to requirements of the following IESNA standards:
 - (a) LM-80 – The standard method and procedure for measuring LED lumen depreciation; and
 - (b) TM-21 – Currently a memorandum which recommends a method to project the lumen maintenance of an LED based on the results of LM-80.
- 3.6.4 Where LM-80 and TM-21 test results are not available, other means of demonstrating compliance with lumen maintenance requirements may be considered.

3.7 PROGRESSIVE FAILURE OF LEDS

3.7.1 5mm LED's

- 3.7.1.1 For 5mm LED's, the failure of LED's shall comply with AS 2144, Clause 6.4.
- 3.7.1.2 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.

3.7.2 HPSM LED's

- 3.7.2.1 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.
- 3.7.2.2 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.
- 3.7.2.3 Where the failure of one or more HPSM LED's reduces the luminance intensity below minimum requirements, or where designed to do so, the aspect shall shut down.

3.7.3 Aspect Failure

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

3.8 LANTERNS USED WITH ELV

- 3.8.1 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 3.2.
- 3.8.2 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.

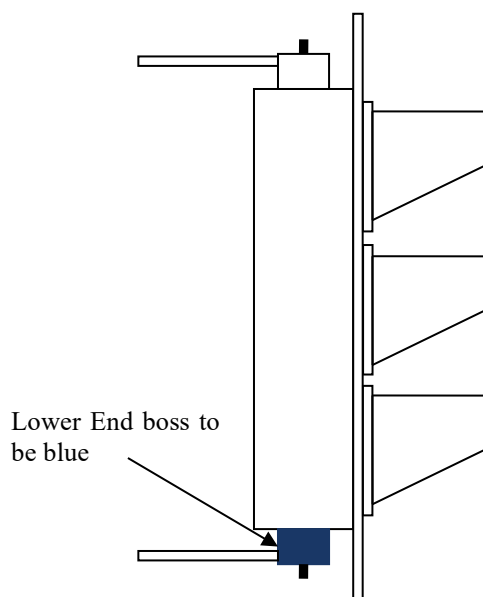


FIGURE 3.2 – Blue end boss for lanterns operating on ELV

Note: For ELV installations the finial cap shall also be coloured in accordance with Clause 3.8.2. For further detail, refer to TCS 001.

3.9 VISORS AND LOUVRES

3.9.1 Visors shall generally comply with the requirements of AS 2144, Clause 7.5.

3.9.2 Visors typically used in Victoria are detailed in VicRoads Standard Drawing TC-1127 and shown in Table 3.3.

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 3.3 – Visors

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

3.10 TARGET BOARDS

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

3.10.2 Target boards shall be metal.

3.10.3 Plastic target boards shall not be used.

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

3.11 WARRANTY REQUIREMENTS

3.11.1 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 E of AS 2144).

3.11.2 All lanterns, including displays, must be designed for a minimum of 10 years life.

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

3.11.4 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.

SECTION 4 INSTALLATION

4.1 GENERAL INSTALLATION REQUIREMENTS

- 4.1.1 Traffic signal lanterns and all associated hardware shall be installed in accordance with the requirements of Standard Contract Section 730 and individual contract documents.
- 4.1.2 Lantern mounting brackets as specified in TCS 001 shall be used for mounting lanterns on Type 2 pedestals.
- 4.1.3 Upper mounting assemblies shall be as specified in TCS 001.
- 4.1.4 Lanterns shall be connected to the traffic signal cable via an approved terminal assembly as specified in TCS 001.

APPENDIX A REQUIREMENTS SPECIFIC TO HPSM LED'S

(Informative)

A1. BACKGROUND INFORMATION

- A1.1 AS 2144, Section 3 sets out the requirements for initial luminous intensity for the various signal colours.
- A1.2 AS 2144, Appendix E details the basis upon which the initial luminous intensity figures were derived.
- A1.3 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.
- A1.4 AS 2144 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

- A2.1 AS/NZS 2144, Clause 5.6.2 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:
- (a) LM-80 – The standard method and procedure for measuring LED lumen depreciation; and
 - (b) TM-21 – Currently a memorandum which recommends a method to project the lumen maintenance of an LED based on the results of LM-80.
- A2.2 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.
- A2.3 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.

A2.4 Lumen Maintenance of a LED

A2.4.1 To test the lumen maintenance of a LED:

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

A2.4.2 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

A2.4.3 Table A1 above shows an example of how a higher LED temperature decreases the lifespan of the LED.

APPENDIX B REQUIREMENTS FOR TYPE APPROVAL

(Normative)

B1. GENERAL

B1.1 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.

B1.2 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.

B2. REQUIRED NATA ACCREDITED TESTING

B2.1 Notwithstanding B1 above, the supplier shall submit test results from a NATA accredited testing organisation (or equivalent accredited and recognised test facility) to demonstrate compliance with the following specific clauses of AS 2144, where relevant to the particular type of lantern submitted:

Clause	Requirement	Evidence
2.1 & 2.2	Signal colours	Test report
3.3	Luminance intensity distribution of vehicular aspects with a circular display.	Test report
3.3.4	Vehicular aspects for other technologies	Test report as required
3.5	Luminance distribution of vehicular aspects that display symbols.	Test report
3.7	Luminance distribution of pedestrian and bicycle aspects that display symbols.	Test report
3.8	Veiling reflection	Test report
3.9	Sun phantom	Test report
4.3	Sealing of optical system	Test report
4.6.2	Weather resistance required protection	Test report
4.7	Operating temperatures	Test report

4.8	Environmental Tests as detailed in Table 4.1 Dry heat Change of temperature Damp heat Simulated solar radiation	Test reports
5.1	Compliance with AS/NZS 3100	Test report
5.5.6.1	EMC Immunity	Test report
5.5.6.2	EMC Emissions AS61000.6.3	Test report
6.2	Light output states	Test report

B3. OTHER REQUIRED INFORMATION

B3.1 The supplier shall also supply evidence of compliance with the following:

Reference	Clause	Requirement	Evidence
AS 2144	4.2	Mass of lantern	Report
	4.4 (b) (ii)	Impact test	Test report
	5.5.3.1	Current wave form	Test report (typically provided with optical test report)
	5.5.3.2	Power factor	Test report
	5.5.5.3	Minimum power consumption	Test report
	5.5.4	Shut down mode	Test report
	5.5.5	Dimming	Test report (typically provided with optical test report)
	5.5.1	Derating	Evidence of design
	5.5.2	Drive current	Test report/measured current/evidence of design
	6.3	Signal switching response times	Test report (typically provided with optical test report)
	6.4	Progressive failure of LED's	Test report
TCS 038	6.5	Dimming of aspects	Test report (typically provided with optical test report)
	3.4.2.2	Dim by wire	Design detail and test report

B3.2 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.

B3.3 DoT (Roads) may require additional information or testing to be carried out as part of its evaluation of the product.

B4. CONTROLLER COMPATIBILITY

B4.1 The lantern supplier shall provide DoT (Roads) evidence, such as test reports, that the lanterns are fully compatible with all DoT (Roads) approved traffic signal controllers. The lantern supplier shall arrange with each of the suppliers of DoT approved traffic signal controllers to undertake compatibility testing.

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

The required number of each type of lantern submitted shall 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

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.

B4.2 The critical points of compatibility are:

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

B5. ASSESSMENT PROCEDURE

B5.1 The assessment procedure for a traffic signal lantern may include the following:

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

B5.2 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 C 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.