

TCS 032:2021

Specification

'NO RIGHT TURN' and 'NO LEFT TURN' SIGNS

Supply and Installation

Version: 2021

Revision: A



Department
of Transport

Foreword

This specification has been developed by Department of Transport (DoT). 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).

DoT (Roads) 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>

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Specification updates. DoT (Roads) 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 DoT (Roads) specifications to ensure that they have the latest version and associated amendments.

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Revision History

Version	Revision	Date	Author	Description
2001	1	2001	ITS	New Specification
2004	1	January 2004	ITS	Revised Cover New Preface Requirements for Approval Added
2021	A	March 2021	ITS	Updated requirements New Template

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

- 1.1.1 This specification covers the design, manufacture and installation of electronic NO RIGHT TURN (NRT) and NO LEFT TURN (NLT) signs for use within the State of Victoria.
- 1.1.2 Electronic NRT and NLT signs are used where a part time ban on a turn movement is required.
- 1.1.3 The performance and photometric requirements of this specification can also be applied to “NO U-TURN” and “NO ENTRY” signs.

1.2 GENERAL

- 1.2.1 NRT and NLT signs are utilised in conjunction with traffic signals to advise drivers entering an intersection that turning right or left through the intersection is banned.
- 1.2.2 The sign is an alternative to the conventional static version, which consists of a red circle and slash over a black arrow on a white background.
- 1.2.3 Illuminated signs are generally installed where turns through an intersection are banned only at certain times.
- 1.2.4 This specification is based on the use of light emitting diode (LED) technology. Other technologies that comply with the performance requirements of this specification may be considered.
- 1.2.5 All NRT and NLT signs shall be DoT Type Approved as detailed in APPENDIX A.
- 1.2.6 A typical site layout for the NRT sign is shown in Figure 1.1.

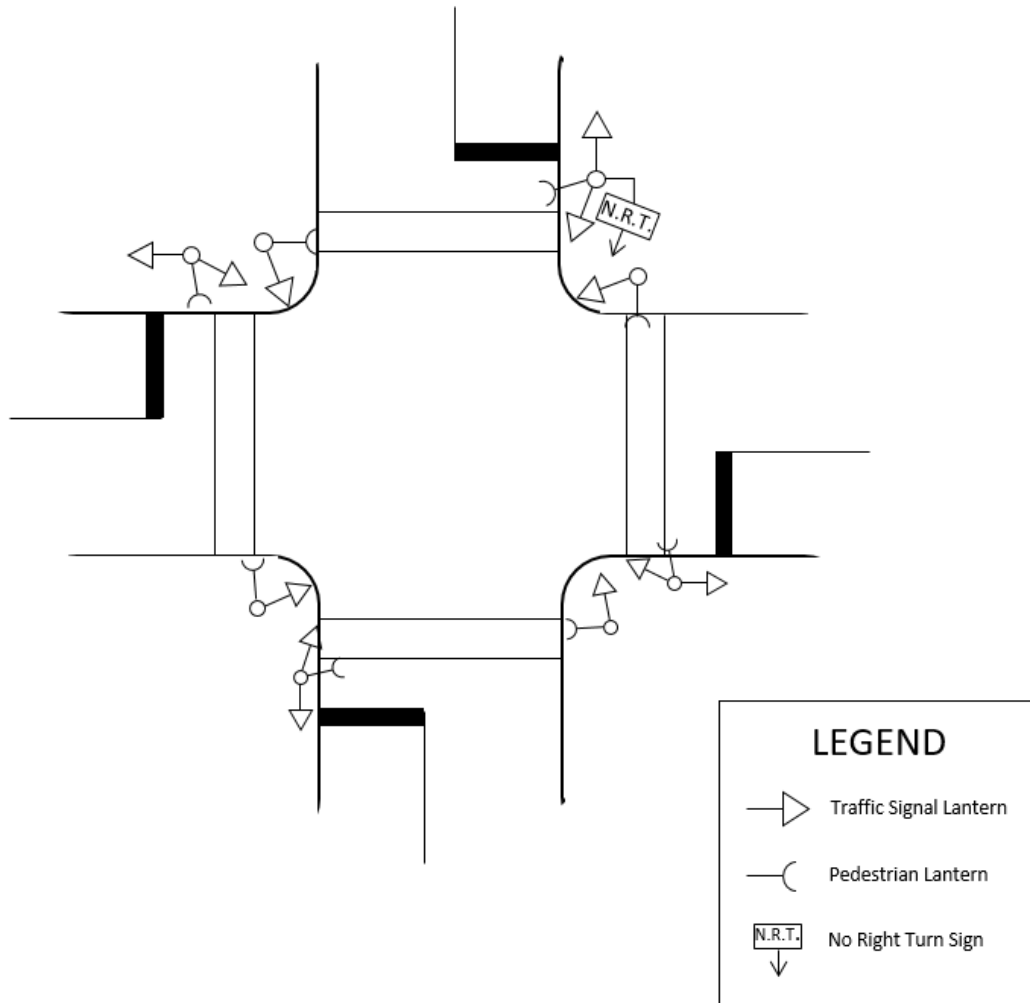


Figure 1.1: Typical Layout of “No Right Turn” Sign

1.3 INTELLECTUAL PROPERTY

1.3.1 In relation to all Intellectual Property used in/or to operate the sign, the manufacturer shall grant to DoT non-exclusive licence to use or provide to DoT authorised contractors any and all software, firmware or programs required to operate and maintain the SRAS systems and components that without the licence, could be breach of the licensors Intellectual Property.

1.3.2 Intellectual Property shall include, but not be limited to, the following:

- Software required to program and configure individual sites.
- Software required to enable maintenance and fault finding of SRAS
- Schematic diagrams.
- Circuit diagrams.
- Wiring diagrams.
- Listings of replaceable components and sub-components.
- Any and all operational and maintenance documentation.

1.3 ACRONYMS

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

ACMA	Australian Communications and Media Authority
AS	Australian Standard
DoT	Department of Transport
ELV	Extra Low Voltage
EMC	Electromagnetic Compatibility
IP	Ingress Protection (degree of protection)
ITS	Intelligent Transport System
LED	Light Emitting Diode
LV	Low Voltage
NLT	No Left Turn
NRT	No Right Turn

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 ESLs 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/NZS 1170.2	Structural design actions – Part 2: Wind actions
AS 1742.2	Manual of uniform traffic control devices, Part 2: Traffic control devices for general use
AS/NZS 1734:1997 (reconfirmed 2020)	Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate.
AS 1743:	Road signs – Specifications
AS 2144	Traffic signal lanterns
AS/NZS 3000	Electrical Requirements
AS/NZS 3100	Approval and test specification - General requirements for electrical equipment
AS 5156	Electronic speed limit signs
AS 60038	Standard voltages
AS 60529	Degrees of protection provided by enclosures (IP code).
AS/NZS 61000.6.1	General Standards – Immunity for residential, commercial and light industrial environments
AS/NZS 61000.6.3	General Standards – Emission standard for residential, commercial and light industrial environments
AS/NZS 61558.1	Safety of transformers, power supplies, reactors and similar products – General requirements and tests
IEC 60068-2-6	Environmental testing – Part 2-6, Vibration (sinusoidal)
IEC 60068-2-30	Environmental testing – Part 2-30, Damp (heat cyclic)

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) Contract Standard Section Specifications are referenced:

Standard Section 730	Traffic signal installation
Standard Section 732	ITS Devices installation
Standard Section 733	Installation of Conduits and Pits

2.2.4 The following DoT (Roads) specifications and guidelines are defined:

TCG 016	Product compliance process for ITS and electrical products
TCG 018	Register of ITS approved products
TCS 038	Traffic signal lanterns

2.2.5 Following related document is referenced:

Victorian Legislation	Road Rules Victoria
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SECTION 3 DISPLAY REQUIREMENTS

3.1 GENERAL

- 3.1.1 The layout for the LED NRT and the LED NLT signs shall comply with the requirements of Rule 91 of Road Rules Victoria and AS-1743:2018, for an R2-6A size sign with an outer radius of 220mm.
- 3.1.2 The display shall consist of a red circle and slash over a white arrow on a black background.

3.2 ARROW AND ANNULUS

The sign's arrow shall consist of three-pixel rows of LEDs while the annulus shall consist of two LED pixel rings with 12.5mm spacing, as shown in Figures 3.1 and 3.2.



No Right Turn Sign Layout

Figure 3.1 - Typical sign layout for NRT



No Left Turn Sign Layout

Figure 3.2 - Typical Sign Layout for NLT

3.3 NO U-TURN AND NO ENTRY SIGNS

- 3.3.1 No ‘U-Turn’ signs shall adopt the same layout as the NRT and NLT signs with a ‘U’ replacing the arrow in accordance with Road Rules Victoria and AS-1743:2018.
- 3.3.2 ‘NO ENTRY’ signs shall adopt the same annulus as the NRT and NLT signs without the slash. The arrow shall be replaced with the words NO ENTRY and a white horizontal line in accordance with Road Rules Victoria and AS-1743:2018.

3.4 OPTICAL REQUIREMENTS

- 3.4.1 The display shall conform to the relevant requirements of AS 5156.
- 3.4.2 Specifically, signs shall comply with the requirements of AS 5156 as detailed in Table 3.1.

AS 5156 Clause	Description
5.1.1.2	Luminance output
5.1.1.4	Pixel Service life
5.1.1.5	Maintainability
5.1.2.1	Pixel interspersion
5.1.2.2	Annulus (this shall apply to the annulus and slash)
5.1.8	Display flicker
5.2.1	Luminance and luminance ratio
5.2.2	Luminance matching of colours
5.2.3	Luminance intensity uniformity
5.2.4	Colours

Table 3.1 – Optical requirements from AS 5156

3.5 DIMMING REQUIREMENTS

- 3.5.1 Signs dimming shall comply with the requirements of Clause 3.4 of TCS 038 for traffic signal lantern dimming.
- 3.5.2 TCS 038 requires dimming as shown in Table 3.2.

TCS 038 Clause	Description
LV Dimming	Signs operating from LV shall be dimmed by reduced lamp voltage.
ELV	Signs operating on ELV shall be dimmed by reduced lamp voltage or ‘dim-by-wire’ as specified.

Table 3.2 – Dimming requirements from TCS 038

- 3.5.3 For signs that operate with ‘dim-by-wire’, the dim control wire shall be violet in colour in accordance with Clause 5.3.1 of AS2144.

SECTION 4 OPERATIONAL AND MONITORING REQUIREMENTS

4.1 GENERAL

- 4.1.1 The signs shall be activated via direct cable switching from a core of an adjacent traffic signal controller.
- 4.1.2 The signs dimming shall be controlled by traffic signal controllers as specified in Clause 3.3.
- 4.1.3 The sign shall be designed to only flash the inner ring of the annulus when operating.
- 4.1.4 During the **fully on period** during the flash cycle all pixels shall be activate, including all annulus rings as shown in Figure 4.1.
- 4.1.5 During the **partial off period** during the flash cycle, only inner ring of the annuls shall flash, while the white arrow and the slash shall always be ON, as shown in Figure 4.2.
- 4.1.6 Once activated, the signs shall partially flash at a rate of 55 to 65 (desirably 60) flashes per minute with sign showing full display 40% to 60% (desirably 50%), in accordance with AS 1742.14 Clause 2.3.3.



Figure 4.1 - Sign fully ON during flash cycle



Figure 4.2 - Sign partially off during flash cycle

- 4.1.7 No 'U-Turn' signs shall flash the inner ring of the annulus as detailed above for the NRT and NLT signs.
- 4.1.8 NO ENTRY signs shall flash the inner ring of the annulus as detailed above for the NRT and NLT signs. The test and horizontal bar shall not flash.

4.2 MONITORING

- 4.2.1 The sign shall be capable of being monitored (i.e. create alarm when failed) by the traffic signal controller or other specified means.
- 4.2.2 The sign shall provide a "No Voltage" dry contact output that closes when the sign is in failed state.
- 4.2.3 A failed state shall be any of the following conditions:
 - (a) The sign is blank due to LED failures.
 - (b) Power failure to the sign.
 - (c) Any other state that would cause the sign not to operate correctly.
- 4.2.4 The output shall typically connect to either an external detector input or special purpose input in the controller.
- 4.2.5 The requirements of the controller input will depend on the how the controller is programmed, as specified in individual tender documents.

SECTION 5 MECHANICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 The enclosure shall be constructed from marine grade sheet aluminium alloy 5251 H32 to AS/NZS 1734.
- 5.1.2 The enclosure and ancillary equipment shall be free from sharp corners, edges and protrusions which may cause injury to personnel or damage to components during installation and/or maintenance operations.
- 5.1.3 The enclosure shall be suitably reinforced and/or braced to facilitate the erection and continued operation of the unit in the intended application.
- 5.1.4 All external metal sections of the completed housing shall be polyester powder coated (or similar approved method). Such treatment shall ensure that deterioration due to atmospheric and/or local environmental conditions has no detrimental effect on the structural integrity or visual appearance (including colour fading) of the finished housing for a period not less than ten years.
- 5.1.5 The colour of the front face of the signs shall be matt black.
- 5.1.6 The rear of the sign enclosure may be matt grey.
- 5.1.7 A suitable venting and air circulation system shall be included in accordance with the recommendations of the individual component manufacturers. Air circulation shall include the means to keep dust and dirt from the internal areas of the sign enclosure. The use of air filters that require frequent servicing will not be accepted.
- 5.1.8 A suitable moisture inhibitor shall be provided.
- 5.1.9 The interior layout of the housing shall be such as to provide clear and ready access to all electrical and communication components for inspection, maintenance and replacement purposes.
- 5.1.10 All electrical and communications cabling, circuit boards and equipment inside the sign shall be appropriately separated or electrically isolated.

5.2 DOORS

- 5.2.1 Signs shall incorporate a front opening door.
- 5.2.2 The door shall be hinged on the left and lockable on the right (when viewed from the front).
- 5.2.3 The door shall be used to provide access to all internal components of the sign for both installation and maintenance purposes.
- 5.2.4 Where fitted, a visor shall be no deeper than 220mm on the top and 45mm on the bottom.

5.3 LOCKS

- 5.3.1 Each door shall be securely closed using two locks. The locks shall be “Southco”, key lockable, Link Lock™, Rotary Action Latches (Code 801). All locks shall be keyed alike and shall ensure that the door is securely fastened.
- 5.3.2 Alternative rotary action latches may be considered, provided they use the same key as detailed in 5.3.1 above.

5.4 FRONT VIEWING WINDOW

- 5.4.1 Where a viewing window is provided, it shall comply with the requirements of AS5156, Clause 3.1(a).
- 5.4.2 The size of window area shall be such that, when installed, the sides and bottom edges of the display face shall be fully visible at viewing angles of 45° and 30° respectively to the 0°-0° axis of the display face.
- 5.4.3 Where a viewing window is not provided, it shall comply with the requirements of AS5156, Clause 3.1(b).

5.5 DIMENSIONS

The dimensions of the housing shall be the minimum required to house the intended display and shall not exceed 520mm (h) x 520mm (w) x 120mm (d).

5.6 MOUNTING

- 5.6.1 The housing shall be provided with all facilities to enable mounting of the finished sign using one of the methods detailed in Table 5.1.

Method Name	Description
Top/Bottom Mounting	Two (2) 40 mm x 300 mm x 5 mm standard traffic signal lantern mounting straps affixed to the top and bottom of the housing. The mounting arrangement shall be such as to enable the aiming and locking of the sign in the horizontal plane $\pm 45^\circ$ in increments of not less than 7.5° and $+ 0^\circ$ and -15° in the vertical plane.
Rear Mounting	Using two full width lengths of mounting channel (unistrut® or similar) horizontally affixed to the rear of the housing.

Table 5.1 – Mounting arrangements of the signs

- 5.6.2 The method of mounting shall be detailed in individual tender documents.
- 5.6.3 Alternative methods of mounting may be considered upon submission.

SECTION 6 ELECTRICAL REQUIREMENTS

6.1 GENERAL

- 6.1.1 All electrical works shall comply with relevant requirements of AS/NZS 3000.
- 6.1.2 Transformers used within the sign and/or sign control system shall comply with the appropriate parts of AS/NZS 61558.1.
- 6.1.3 All equipment shall be internally protected against damage resulting from:
- lightning strikes at or near the sign.
 - electrical transients on power cabling.
 - electrical transients on communications wiring.
 - radio frequency interference.
 - static electrical discharge.

6.2 MAINS POWER

The mains supply voltage shall be deemed to be 230 Vac +10%, -6% in accordance with AS 60038, Section 2. The system and or sub-elements of the system shall be capable of operating satisfactorily from the same within $\pm 15\%$.

6.3 OPERATING VOLTAGE

- 6.3.1 The operating voltage shall be specified in individual tender documents. Signs shall be designed to operate from either:
- 240 Volts ac for LV sites; or
 - 42 Volts ac for ELV sites.
- 6.3.2 The signs shall include an internal a circuit breaker of not more than 2 amps to protect the sign and enable isolation of incoming power.
- 6.3.3 The circuit breaker shall be clearly and indelibly marked.

6.4 EMC COMPLIANCE

- 6.4.1 All signs covered by this specification shall comply with:
- AS/NZS 61000.6.1 for immunity; and
 - AS/NZS 61000.6.3 for emissions.

- 6.4.2 Signs shall also comply with the relevant requirements of the ACMA and shall be labelled with a RCM label as shown in Figure 6.1



Figure 6.1 - RCM Compliance Label

6.5 CONNECTION TO SUPPLY

- 6.5.1 The sign shall be supplied with connecting cables 2.5 metres in length.
6.5.2 The connecting wires shall be as specified in Table 6.1.

Cable	Colour
Active	Red
Neutral	Black
Dim control wire (were required)	Violet
Earth	Green/yellow as required by AS/NZS 3000

Table 6.1 – Connecting cable colours

- 6.5.3 The connecting wires shall be enclosed in black flexible conduit 2.0 metres in length (both lengths being measured from the point of entry to the housing).
6.5.4 The flexible conduit shall be 16 mm in diameter.
6.5.5 The cable and hose shall enter the rear panel of the housing through a suitably sealed "goose neck" arrangement.

SECTION 7 ENVIRONMENTAL REQUIREMENTS

7.1 TEMPERATURE AND HUMIDITY

- 7.1.1 The sign and associated equipment shall be designed to operate under any combination of the following conditions:
- Ambient air temperatures within the range -15°C to 55°C; and
 - 95% humidity.
- 7.1.2 The above shall be tested in accordance with IEC 60068-2-30.
- 7.1.3 Consideration shall be given to protection against the effects of high humidity, including condensation following a drop in ambient temperature.

7.2 ENCLOSURE PROTECTION

The complete sign enclosure shall meet the enclosure protection requirements for IP55 in accordance with AS 60529.

7.3 VIBRATION

- 7.3.1 The sign shall be subject to vibration tests in accordance with IEC 60068-2-6 (sinusoidal vibration).
- 7.3.2 The sign shall be subjected to vibration tests in accordance with the requirements of AS 60068.2.6 for sinusoidal vibration as specified in Table 7.1.

AS 60068.2.6 Clause	Detail	Parameters
	Test Sign	Powered and operating
	Test Type	Sinusoidal sweep
5.1	Frequency range	5 Hz to 55 Hz
5.2	Vibration amplitude	0.75mm
5.2	Cross-over frequency	Approximately 8.2 Hz
5.2	Acceleration amplitude	2 m/s ² - 0.2gn

Table 7.1 – Vibration test requirements

7.4 WIND LOADING

- 7.4.1 The facilities provided for supporting and stabilizing/anchoring the sign shall ensure that, when installed for normal operation, the sign will maintain its intended orientation and position when subjected to the wind-loading conditions applicable to the region in which the sign is intended to be used, in accordance with AS/NZS 1170.2.
- 7.4.2 The minimum wind-loading conditions applicable shall be those for Region A, Terrain Category 2 in accordance with AS/NZS 1170.2.

SECTION 8 MARKINGS AND DOCUMENTATION

8.1 MARKINGS

8.1.1 Each sign shall be legibly and durably marked, preferably on an interior surface of the housing, with the following information:

- a) The name, trade name or trademark of the manufacturer.
- b) The equipment code or model number.
- c) Date of manufacture.
- d) Batch code, serial number, or other marking to provide traceability under the manufacturer's quality management system.
- e) RCM certification (as applicable).
- f) Rated supply voltage, power and/or current.

8.2 DOCUMENTATION

The manufacturer shall provide the following documentation:

- a) Technical and operation manual.
- b) Field manual.
- c) Fault finding and diagnostic guide Recommended maintenance requirements.
- d) List of all recommended spare components to enable fault and maintenance repairs.

SECTION 9 INSTALLATION

9.1 GENERAL

- 9.1.1 Installation of signs shall only be carried out by an appropriately DoT (Roads) pre-qualified contractor.
- 9.1.2 Installation on traffic signal sites shall be carried out in accordance with Standard Section 730.
- 9.1.3 Installation of pits and conduits shall be carried out in accordance with Standard Section 733.
- 9.1.4 The signs are installed to face traffic approaching the stop line of the signalised intersection.
- 9.1.5 The signs shall be mounted above 'low mount' secondary vehicle lanterns and immediately below 'high mount' secondary vehicle lanterns for the nominated approach for which the right turn is to be banned.
- 9.1.6 The signs should not obscure any portion of any vehicle or pedestrian display on the mounting pedestal or on adjacent pedestals.

Note: In some cases the re-mounting of the vehicle or pedestrian lanterns on extended mounting straps may be required.

- 9.1.7 Care should be taken to ensure that the minimum clearances, from the bottom of any lanterns to ground level, are maintained at all times.
- 9.1.8 No portion of the signs, or mounting facilities, is to be less than 2.2 m above ground level.
- 9.1.9 Compatible traffic signal crank-arm or riser unit may be used to raise the signs to a clear viewing position if necessary.
- 9.1.10 A minimum lateral clearance of 500 mm between the back of kerb and the nearest portion of the sign (including visor) shall be maintained at all times.
- 9.1.11 The signs shall be aimed such that the active displays are clearly visible to approaching traffic at the stop line of the relevant turn lanes.
- 9.1.12 The exact position of each sign on the pedestal shall be indicated in individual tender documents and shall be agreed to on site by the superintendent.

APPENDIX A REQUIREMENTS FOR TYPE APPROVAL

(Normative)

A1 GENERAL

- A1.1 The signs covered by this specification, for use on DoT projects are required to hold current DoT Type Approval.
- A1.2 The Product Compliance evaluation process shall be carried out in accordance with DoT Guideline TCG 016.
- A1.3 To enable assessment for the purpose of granting Type Approval, the manufacturer/supplier is to submit a formal request for Type Approval, for each sign type submitted, accompanied by the following:
- A complete working sample of the sign.
 - An outline drawing showing the general presentation and overall dimensions of the complete sign.
 - Documentation to demonstrate that the sign has been manufactured and supplied under an approved quality assurance system.
 - Documentation to demonstrate that the sign conforms to all relevant requirements of AS/NZS 2144:2014 and this DoT Specification. This may be by means of submitting test results from approved and appropriately qualified independent testing organisations, or providing the manufacturer's assurance that the product complies with each paragraph of the specification, as appropriate.

A2 REQUIRED NATA ACCREDITED TESTING

The supplier shall submit test results from a NATA accredited (or equivalent) testing organisation to demonstrate compliance with the requirements detailed in Table A1.

Clause	Requirement
3.2	Optical requirements <ul style="list-style-type: none"> • Luminance and luminance ratio • Luminance matching of colours • Luminance intensity uniformity • Colours
3.3	Dimming
6.4	EMC
7.1	Temperature and humidity
7.2	IP Rating
7.3	Vibration

Table A1 – Required test reports

A3 OTHER REQUIRED INFORMATION

- A3.1 Confirmation that the manufacturer is on the DoT Register for the Pre-qualification for Supply of On-Road Electronic Devices (SOED).
- A3.2 Copy of LED manufacturer's specification for each LED type used.

A4 ASSESSMENT PROCEDURE

- A4.1 The assessment procedure for the signs may include, but not limited to, the following:
 - a) Assessment of construction, workmanship and critical dimensions.
 - b) Evaluation of the submitted data against the requirements of the specification.
- A4.2 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 sign.
- A4.3 DoT may require a trial installation of the sign to be undertaken.

A5 TYPE APPROVAL

- A5.1 The decision to grant a Certificate of Type Approval is at the sole discretion of DoT.
- A5.2 DoT may require additional information or testing to be carried out as part of its evaluation of the product.
- A5.3 If the product is approved, a Certificate of Type Approval will be provided to the supplier. Until such time as this Certificate is issued, the product is not to be used for DoT works.
- A5.4 The manufacturer shall advise DoT in writing of any changes in hardware or firmware in relation to the Type Approved product, DoT reserves the right to review and approve/reject the design changes at DoT discretion.