TCS 037: 2024

Specification

Electronic Speed Limit Signs

Supply and Installation

Version: **11.0**
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.

Intelligent Transport Systems
110 Maroondah Hwy Ringwood Vic 3134

ITS_Improvements_and_Standards@roads.vic.gov.au

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Revision History

Version	Revision	Date	Author	Description
2001	1	April	ITS	New specification
2001	2,3 & 4		ITS	Not released
2001	5	September	ITS	Amendment
2003	6	June	ITS	Amendment
2004	7	January	ITS	Amendment
2014	A	December	SJS	• Incorporate AS 5156, AS 4509.2, AS 4086.1 & AS 4086.2 • Incorporate Tyco ESLS Management System
2019	A	January	SJS	• Amendment to existing specification • Incorporate Network Monitoring and Control System • Incorporate Side Road Activated Speed (SRAS) system
2021	A	May	ITS	• Updated to reflect changes and content order of AS 5156:2020 • Confirmed NMS as host control system • Updated to DoT template • Expanded installation section
2024	11.0	March	ITS	• Update to DTP template • Updated mounting arrangements • Updated in-rush current requirement • Default voltage LV • Include maximum battery weight • Remove requirement for new installations to be NMS2 • Changes to Installation • Minor changes to Type Approval

Contents

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

1.1.1 This specification covers the design, manufacture, installation, and operation of ESLS intended for use as school speed zone, strip shopping centre zone and SRAS treatments.

1.1.2 This specification is not intended to cover the requirements of ESLS used as part of LUMS. The requirements for LUMS are outside the scope of this specification.

1.1.3 This specification is based on the use of LED's as the light-emitting elements. Other technologies that meet the performance requirements of this specification may be considered.

1.2 GENERAL

1.2.1 ESLS are used to display a legally enforceable speed limit to be adopted at different times though-out the day. Any reference to "sign" within this document shall be taken to mean "Electronic Speed Limit Sign".

1.2.2 Only DTP 'type approved' ESLS shall be used for any DTP project. See Appendix D for details of type approval.

1.2.3 Individual tender documents shall detail the types of signs required for a specific project.

1.2.4 The sign display shall be made up of point light sources, arranged in accordance with this specification to comprise a clear and enforceable speed limit sign.

1.2.5 This specification shall be read in conjunction with AS 5156.

1.2.6 Signs are to be designed and constructed to conform to AS 5156, except where modified to meet the requirements stated in this document. Details of the exceptions and clarifications from AS 5156 are given in Section 2.4.

1.3 INTELLECTUAL PROPERTY

1.3.1 In relation to all Intellectual Property used in/or to operate the system, the manufacturer shall grant to DTP non-exclusive licence to use or provide to DTP authorised contractors any and all software, firmware or programs required to operate and maintain the ESLS and components that without the licence, could be in 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 signs.
- Software required to enable maintenance and fault finding of signs.
- Schematic diagrams.
- Circuit diagrams.
- Wiring diagrams.
- Listings of replaceable components and sub-components.
- Any and all operational and maintenance documentation.

1.4 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
Base mounted sign	A sign where the base section of the sign housing is mounted directly to the top of a pole
DC	Direct current
DTP	Department of Transport and Planning (formerly Department of Transport, formerly VicRoads)
ELV	Extra Low Voltage (nominally 12 Vdc)
EMC	Electromagnetic Compatibility
ESLS	Electronic Speed Limit Sign
GNSS	Global Navigation Satellite System (Also referred to as GPS)
ILAC-MRA	International Laboratory Recognition Arrangement–Mutual Recognition Arrangement
IP	Ingress Protection (degree of protection)
ITS	Intelligent Transport System
LED	Light Emitting Diode
LUMS	Lane Use Management Signs
LV	Low Voltage (nominally 240 Vac)
NATA	National Association of Testing Authorities
NMCS	Network Management and Control System
NMS	Network Management System
NZS	New Zealand Standard
PHCS	Product Host Control System
POS	Point of supply
RCD	Residual Current Device
RCM	Regulatory Compliance Mark
SNMP	Simple Network Management Protocol
SRAS	Side Road Activated Speed
TCP/IP	Transmission Control Protocol/Internet Protocol
UTC	Coordinated Universal Time

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 1742.2	Manual of Uniform Traffic Control Devices, Part 2, Traffic Control Devices for General use
AS 1743	Road signs – Specifications
AS/NZS 3000	Wiring Rules
AS 4086.2	Secondary batteries for use with stand-alone power systems - Installation and maintenance
AS/NZS 4509.1:2019 (reconfirmed 2017)	Stand-alone power systems – Safety and installation
AS 5156:2020	Electronic speed limit signs
AS 60529	Degrees of protection provided by enclosures (IP code).
AS IEC 62619	Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for secondary lithium cells and batteries, for use in industrial applications
AS/NZS 61000.6.1	Electromagnetic compatibility (EMC), General Standards – Immunity for residential, commercial and light industrial environments
AS/NZS 61000.6.3	Electromagnetic compatibility (EMC), 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 Standard Sections are referenced:

Standard Section 730	Traffic signal installation
Standard Section 732	ITS Devices installation
Standard Section 733	Conduits and pits for underground wiring and cabling
Standard Section 736	ITS device testing and integration.

2.2.3 The following DTP Specifications are referenced:

TCG 018	Register of ITS approved products
TCN 011	Modems for ITS devices
TCS 043	Electrical Distribution cabinets
TCS 060	VicRoads Extensions to RTA Protocol for Roadside Devices
TCS 071	Side Road Activated Speed (SRAS)

2.3 DTP STANDARD DRAWINGS

The following Standard Drawings are referred to.

TC-1100	Traffic signal posts – Types 2A, 2B and Type 3
TC-1200	Pedestals Foundation

2.4 EXCEPTIONS AND CLARIFICATIONS TO AS 5156

Changes or clarifications to AS 5156:2020 are summarised in Table 2.1 below.

AS 5156 Clause	Description	TCS 007 Exception / Clarification
3.1 (a)	Sign enclosure – viewing window	Refer to clauses 3.1.3 and 3.1.4.
3.1 (b)	Sign enclosure –doors	Refer to Clauses 3.1.5 – 3.1.7
3.2	Sign Mounting facilities	Refer to Clause 3.2
3.3	Roadside cabinet	Refer to Clause 3.3
3.4	Facility switch	Refer to Clause 3.4
4.2.1	Operating voltage - General	Refer to Clause 4.2
4.2.2	Battery backup	Refer to Clause 4.5
4.3	Solar power	Refer to Clause 4.4
4.4	Communications equipment	Refer to Clause 6.7
4.5	Real-time clock	Refer to Clause 6.4
4.6	EMC	Refer to Clause 4.6
5.1.1.1	Display characteristics	Refer to Clause 5.2
5.1.2.6	Annulus display	Refer to Clause 5.3
5.7.7	Conspicuity devices	Refer to Clause 5.5
5.2.5	Flashing annulus	Refer to Clause 5.6
6	Operation and control	Refer to Section 6

TABLE 2.1 – Changes and clarifications to AS 5156

SECTION 3 MECHANICAL REQUIREMENTS

3.1 GENERAL

3.1.1 Signs shall conform to the requirements of Section 3 of AS 5156.

3.1.2 The sign enclosure, except for the front door, shall be matt grey.

3.1.3 Where a viewing window is provided, it shall comply with the requirements of AS5156, Clause 3.1(a).

3.1.4 Where a viewing window is not provided, it shall comply with the requirements of AS5156, Clause 3.1(b).

3.1.5 Signs shall include a front opening door.

3.1.6 The front opening door and the front face of the sign shall be matt black as specified in AS 5156, Clause 3.1.

3.1.7 Unless otherwise specified in individual contract documents, the front opening door shall hinge on the left side. The sign shall be capable of hinging on the right side where specified in individual contracts.

3.1.8 The door shall be fitted with a tamper switch to sense when it is open or incorrectly secured.

3.1.9 The sign enclosure shall include an internal battery enclosure as specified in Clause 4.3.2.

3.1.10 All metal seams shall be continuous welded. Spot welding shall not be used.

3.1.11 The height and width dimensions of the sign face shall not exceed 100 mm difference compared with the equivalent static sign (R4-1).

3.1.12 The height and width of the sign enclosure shall be designed so that no part of the annulus is closer than 40mm to the outside edge of the enclosure.

3.1.13 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.

3.1.14 Alternative rotary action latches may be considered, provided they use the same key as detailed in 3.1.12 above.

3.1.15 A shroud or visor is not required. Signs shall be designed in such a way that a shroud or visor is not required to achieve the requirements of Section 6 of this specification.

3.2 SIGN MOUNTING FACILITIES

3.2.1 Unless otherwise specified in individual contract documents, signs shall be designed to be mounted from the rear of the enclosure.

3.2.2 The rear of the sign enclosure shall include two lengths of mounting channel (unistrut® or similar) horizontally affixed to the rear of the housing for mounting the sign using an appropriate clamp or bracket.

3.2.3 Unless otherwise specified in individual contract documents, each mains powered sign shall be designed to be mounted directly onto a 2A traffic signal pedestal (typically for A size signs) or a 2B pedestal (typically for B and C size signs). See Standard Drawing TC-1100.

3.2.4 Other mounting methods may be considered.

3.2.5 Where specified in individual contract documents, signs may be required to be mounted on a purpose-built pole designed for the sign enclosure to be secured at the base.

3.2.6 The mounting method, for base mounted signs, shall ensure that the display face of the sign is vertical and has provision for adjustment of the vertical and horizontal alignment.

3.2.7 For signs mounted on a 2A or 2B pedestal, access for all power supply, control and communication cabling shall be through the centre of the pedestal and shall enter the sign housing through appropriately constructed, sealed entry holes.

3.2.8 For base mounted signs, access for all power supply, control and communication cabling shall be through the centre of the pole and shall enter the sign housing through an appropriately constructed, sealed entry hole in the base on the sign enclosure.

3.3 ROADSIDE CABINET

3.3.1 For ESLS at school and strip shopping centre speed zones, a roadside cabinet, as specified in AS 5156, Clause 3.3, shall not be used.

3.3.2 All equipment such as the sign controller, modem, batteries, etc shall be housed within the sign enclosure.

3.3.3 For ESLS as part of a SRAS system, a roadside cabinet shall be used in accordance with TCS 071.

3.4 FACILITY SWITCH

3.4.1 An external facility switch on the sign enclosure shall not be provided.

3.4.2 Each sign shall incorporate an internal facility switch function or manual override function (manual switch and/or software switch), accessible from the inside of the housing.

3.4.3 The function shall include the following options:

(a) For single speed signs the options detailed in Table 3.1 below.
(b) For dual speed signs the options detailed in Table 3.2 below.
(c) For multiple speed signs the options detailed in Table 3.3 below.

Option	Function
AUTO	Shall allow the sign to operate normally and be controlled via the management system
OFF	Shall switch the sign off and prevent control via the management system
ON	Shall switch on the display and prevent control via the management system

Table 3.1 - Single Speed Signs

Option	Function
AUTO	Shall allow the sign to operate normally and be controlled via the management system
OFF	Shall switch the sign off and prevent control via the management system
SPEED 1	Shall switch on the lowest speed and prevent control via the management system
SPEED 2	Shall switch on the second speed and prevent control via the management system

Table 3.2 - Dual Speed Signs

Option	Function
AUTO	Shall allow the sign to operate normally and be manually switched via the management system
OFF	Shall switch the sign off and prevent control via the management system
SPEED 1	Shall switch on the 1st (lowest) speed and prevent control via the management system
SPEED 2	Shall switch on the 2nd speed and prevent control via the management system
SPEED (n)	Shall switch on the nth speed and prevent control via the management system

Table 3.3 – Multiple speed ESLS

3.4.4 The local manual override shall override all commands received from the management system.

3.4.5 The network management system shall not be capable of overriding the local facility switch function.

SECTION 4 ELECTRICAL REQUIREMENTS

4.1 GENERAL

4.1.1 The mains supply voltage shall be deemed to be 230Vac +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 ±15%.

4.1.2 All LV works shall comply with the requirements of AS/NZS 3000.

4.1.3 All signs shall be designed to operate from a nominal 12volt DC power supply.

4.1.4 Internal sign voltages shall not exceed ELV.

4.1.5 Signs shall include an IP65 rated connector to enable the external power supply or solar panel to be easily connected and disconnected from the sign.

4.1.6 All cables and wires shall be insulated with a material with a degree of protection not inferior to V-90 grade PVC and shall be suitably labelled.

4.1.7 Internal cables shall be laid out and secured to ensure typical maintenance activities, such as the opening and closing of the door, will not crease or damage cables or components within the sign.

4.1.8 All equipment shall be internally protected against damage resulting from:

(a) lightning strikes at or near the sign
(b) electrical transients on power cabling
(c) electrical transients on communications wiring
(d) radio frequency interference
(e) static electrical discharge

4.1.9 Inrush current at switch on shall be managed to ensure it does not create nuisance tripping when connected to an unmetered point of supply protected by a 2 amp, D-curve circuit breaker.

4.1.10 The requirements of Clause 4.1.9 shall apply for a maximum of two signs connected to any single 2 amp circuit breaker.

4.1.11 The supplier shall submit the following details of the power load of each individual sign:

(a) Normal peak operation.
(b) Dimmed operation
(c) In rush current at switch on.

4.2 MAINS POWERED SIGNS

4.2.1 Signs connected to mains supply power shall be powered via an external 240Vac/12Vdc power supply (referred to as the 'external power supply') mounted on the support post external to the sign enclosure.

4.2.2 The enclosure used for the external power supply shall be rated at not less than IP 65 and be UV stabilised for outdoor applications.

4.2.3 The external power supply shall connect to the sign via the IP 65 rated connector specified in Clause 4.1.5.

4.2.4 The external power supply shall incorporate an easily accessible circuit breaker (D-Curve) on the LV side, as a means to isolate power.

4.3 SOLAR POWER

4.3.1 Where specified in individual tender documents, the sign shall be designed for solar operation.

4.3.2 The solar power system shall be designed, constructed and installed in accordance with AS 4509.2, AS 4086.1 and AS 4086.2 as specified in Clause 4.3 of AS 5156.

4.3.3 Where solar power is specified, the contractor shall be responsible for the design of a suitable standalone solar power system. All solar system calculations shall be checked by a suitably qualified or experienced solar power expert.

4.3.4 When designing the standalone solar power system consideration must be given to the power consumption, the hours of operation, the surrounding environment and the average amount of sunlight available.

4.3.5 The solar charge controller shall be mounted within the sign enclosure.

4.3.6 The solar panel shall connect to the sign via the IP 65 rated connector specified in Clause 4.1.5.

4.3.7 The solar panel shall be installed in a position that minimises the possibility of vandalism and theft.

4.3.8 The support post shall be suitable for carrying the load associated with the solar panel, storage batteries and the sign.

4.3.9 The proposed support post and associated foundation shall be proof engineered by a DTP (VicRoads) pre-qualified engineering consultant.

4.3.10 Standard Type 2 pedestals shall not be used for mounting solar panels.

4.3.11 The solar panel shall be designed for ease of cleaning and equipped with deterrents to bird roosting.

4.4 BATTERY BACKUP

4.4.1 General

4.4.1.1 Battery backup shall be provided for each sign.

4.4.1.2 The installation of batteries shall comply with relevant requirements of AS 4086.1.

4.4.1.3 For signs connected to mains power, the capacity of the battery backup shall be capable of maintaining normal operation for a minimum period of 48 hours.

4.4.1.4 For signs connected to solar power, the backup battery system shall be capable of maintaining normal operation for a minimum period of:

(a) One week, operating for 3 hours per day, for school speed zones.
(b) Three days for other signs, based on the number of hours per day the sign will be operating.

4.4.1.5 Batteries shall:

(a) be fully sealed, maintenance free type.
(b) have a maximum individual weight not exceeding 10kg.
(c) be capable of operating in ambient temperatures in the range specified in AS 5156 (i.e. -15^{O}C to 55^{O}C).
(d) have a rated service life of not less than three years.

Note: Lead-acid batteries shall not be used. The use of lithium batteries is currently under review.

4.4.1.6 Batteries shall be held in place, within the battery enclosure, with a suitable bracket(s).

4.4.2 Internal Battery Enclosure

4.4.2.1 Batteries installed as an integral part of the sign enclosure shall be located within a battery enclosure.

4.4.2.2 The battery enclosure shall be:

(a) Only accessible internally in the sign through the front opening door.
(b) Accessible by removing a front access panel.
(c) Sealed on the front access panel to prevent a reduction in the signs IP rating and prevent any gases from leaking into the sign enclosure.
(d) Vented through the exterior of the sign enclosure to prevent the build-up of temperature or gas.
(e) Be rated at not less than IP45.

4.4.2.3 Venting of the battery enclosure shall not reduce the IP rating of the rest of the sign enclosure.

4.4.3 External Battery Enclosure

4.4.3.1 Where an internal battery enclosure is insufficient to hold the required number of batteries, an external battery enclosure may be used.

4.4.3.2 Where suitable, an external battery enclosure not larger than the associated ESLS shall be used.

4.4.3.3 The support post shall be suitable to carry the additional weight of the external battery enclosure complete with the required batteries.

4.4.3.4 Where a post mounted, external battery enclosure is not suitable, a ground mounted enclosure may be used if approved by DTP.

4.5 ELECTROMAGNETIC COMPLIANCE (EMC)

In addition to the requirements of AS 5156, Clause 4.6, signs shall be labelled with a RCM label as required by ACMA. See Figure 4.1

Figure 4.1 - RCM Compliance Label

SECTION 5 DISPLAY AND OPTICAL REQUIREMENTS

5.1 GENERAL

5.1.1 The display shall conform to the relevant requirements of AS 5156.

5.1.2 The speed limit values and sign sizes to be supplied shall be as specified in individual contract documents.

5.1.3 The display shall be formed from LED pixels to comply with Section 5 of AS 5156 and this specification.

5.1.4 Where 3mm LED's are used, greater pixel spacing may be considered**.**

5.1.5 If 20% or more of the LEDs in any one element of the display fail, the whole display shall be shut down and the sign deemed to have failed.

5.1.6 Any single numeral shall be considered a single element. The annulus shall be deemed to be a single element.

5.1.7 When displaying other than the normal speed limit, the red annulus shall be designed so that all inner rings of the annulus flash on and off. The number of rings of the annulus that flash shall be in accordance with Clause 5.6 below.

5.1.8 Signs shall incorporate features to provide a completely blank (all pixels inactive) display.

5.1.9 The design of the sign display shall ensure that there is an adequate space between the inner ring of the annulus and any numeral adjacent to the annulus. This is to prevent 'bleeding' of the LED's into adjacent LED's and provide a clear display.

5.2 DISPLAY CHARACTERISTICS

5.2.1 General

Further to Clause 5.1.1.1 of AS 5156, the numeral display types shown in Table 5.1 shall be used.

Number of Speed Displays	Approved Sign Display Type
Single speed	Discrete character or Matrix (where protocol allows)
Dual speed	Discrete character or Matrix (where protocol allows)
Three or more speed	Matrix (only)

Table 5.1 – Approved ESLS versions

5.2.2 Matrix Numerals

5.2.2.1 Where a matrix display is employed for the numerals the display shall be unable to display numerals which are not specified in the tender, through exclusion of those frames.

5.2.2.2 The pixel pitch shall be equal in the vertical and horizontal direction.

5.2.2.3 Figure 5.1 shows a typical layout for a matrix display.

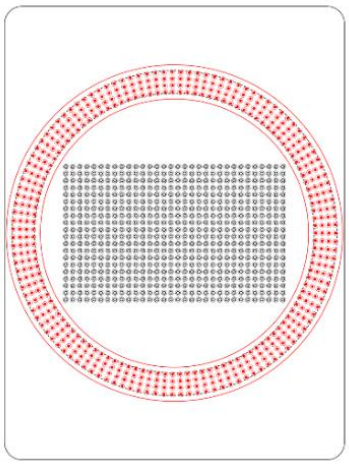

Figure 5.1 - Example matrix layout (R4-1B)

5.2.3 Discrete Numerals

5.2.3.1 Numerals shall be configured in accordance with Table 5.2 below, for the respective R4-1 sign sizes specified in AS 1743:

Sign Size	Number of pixel rows	Stroke width
A	2	~25mm
B	2	~35mm
C	2	~45mm

Table 5.2 - Discrete numeral requirements

5.2.3.2 The total size of the stroke width (i.e., outside to outside of the LED's) shall be designed to compensate for the flaring of the LED's and will typically be narrower than the requirement of AS 1743.

5.2.3.3 Figures 5.2 and 5.3 show typical layouts for a discrete numeral sign.

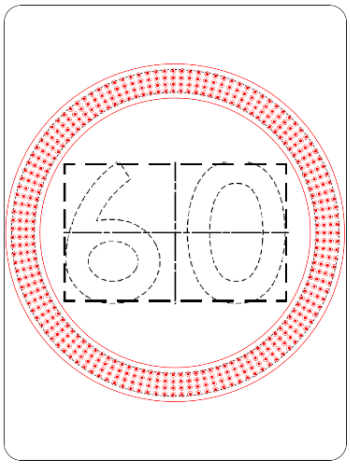

Figure 5.2 - Example discrete numeral layout (R4-1B)

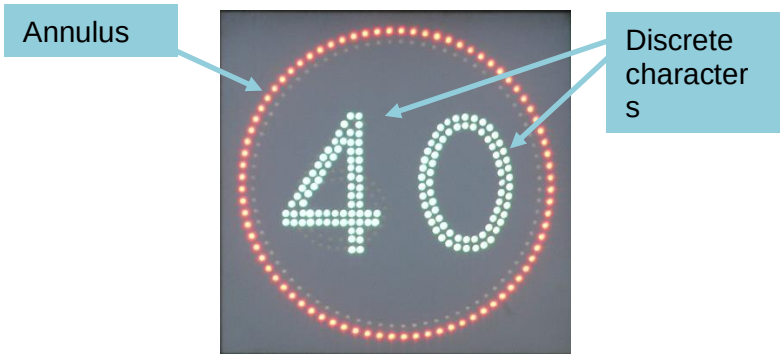

Figure 5.3 – Example of B-size discrete numeral ESLS

5.3 ANNULUS DISPLAY

The annulus display shall comply with the requirements of AS 5156, Clause 5.1.2.2 and Clause 5.1.2.6

5.4 SYNCHRONISATION OF NUMERIC DISPLAY CHANGES

ESLS used for school speed zones and shopping centre speed zones shall be synchronised using GNSS timing.

5.5 CONSPICUITY DEVICES

Conspicuity devices shall not be used.

5.6 FLASHING ANNULUS

5.6.1 The sign shall be designed to flash the inner rings of the annulus when displaying a speed other than the default speed limit.

5.6.2 Further to AS 5156, Clause 5.2.5, the default number of annulus rings programmed to flash shall be all inner rings.

SECTION 6 OPERATION AND CONTROL

6.1 GENERAL

6.1.1 The operation and control of the sign shall comply with the general requirements of AS 5156, Section 6.

6.1.2 Where this specification differs from AS 5156, this specification shall take precedence.

6.1.3 The **host control system** used by DTP to operate and control ESLS, used for school and strip shopping centre speed zones, is NMS as detailed in Clause 6.2.

6.1.4 Individual ESLS shall typically operate as autonomous signs.

6.1.5 ESLS as part of a SRAS installation shall operate on the SRAS system as detailed in TCS 071.

6.2 ESLS NETWORK MANAGEMENT SYSTEM

6.2.1 Signs shall be fully compliant and compatible with the NMS platform as detailed in Appendix A.

6.2.2 Manufacturers shall obtain a compliance certificate or other evidence of compliance as part of the product evaluation process (See Appendix B).

6.2.3 There are two versions of NMS in use by DTP, the original version or NMS1 and the later version or NMS2.

6.2.4 The version of NMS required shall be as follows:

- **Existing site, replacing some, not all signs** - shall be like-for-like (i.e. NMS1 for NMS1 and NMS2 for NMS2).
- **Existing site, replacing all signs** - shall be based on NMS version used by sign supplied.
- **New site** - shall be based on NMS version used by sign supplied.

6.3 SIGN ACTIVATION

6.3.1 Signs operating as part of a school or strip shopping centre speed zone shall be activated via a time-based schedule.

6.3.2 Programming of the time-based schedule shall be achieved by downloading of a pre-programmed calendar into each autonomous sign, or Master sign, using NMS.

6.3.3 If no calendar is present in the sign, it shall blank in accordance with Clause 6.7.

6.4 SYNCHONISATION OF SIGNS REAL-TIME CLOCK

6.4.1 Every sign within a single speed zone or treatment shall be synchronised to ensure all signs within a single treatment display the same speed at all times.

6.4.2 To achieve clock synchronisation, each sign shall obtain its own time synchronisation signal from the GNSS.

6.4.3 The internal time clock shall remain synchronised with the GNSS clock within ±1 second at all times.

6.4.4 The internal time clock shall include calendar functions that enables the sign to operate independent from the management system and communications carrier for periods of at least 30 days with a time error of no more than one minute at any instant during the 30 days.

6.4.5 An error of more than one minute shall be considered a major system failure and result in a blank display.

6.4.6 The sign internal time clock shall display local time for the operator (e.g. UTC plus 10 hours).

6.4.7 The internal time clock shall automatically update for daylight saving time.

6.4.8 The internal time clock shall allow a schedule to be programmed at least twelve months in advance.

6.5 LOCAL CONTROL

Signs shall be capable of being controlled locally using the PHCS via a communications port as specified in AS 5156, Clause 6.2.

6.6 REMOTE CONTROL

Signs shall be capable of being controlled remotely via NMS.

6.7 COMMUNICATIONS EQUIPMENT

6.7.1 Unless otherwise specified in individual tender documents, communications between NMS and each sign shall be via a 4G mobile data connection.

6.7.2 Modems shall comply with the relevant requirements specified in TCN 011.

6.7.3 Modems shall be accepted for use and included in the list of accepted modems in TCG 018.

6.8 MONITORING

6.8.1 Signs shall provide alarm notification to the monitoring system for all faults as specified in Clause 6.6 of AS 5156.

6.8.2 A list of the minimum required alarm notifications is provided in Appendix B1.

6.8.3 The notification and clearance of alarms shall be logged.

6.9 LOGGING

6.9.1 Signs shall provide all fault logging as specified in Clause 6.6 of AS 5156, with a minimum of 500 entries.

6.9.2 In addition, a separate event log will be provided to record all operational, maintenance and regulatory requirements for a period of 90 days.

6.9.3 Lists of the minimum required details to be recorded in the event log are provided in Appendix B2.

6.10 FALL-BACK OPERATION

6.10.1 Under the following conditions, the sign shall default to a blank display:

(a) If no calendar is present in the sign.
(b) In the event a major system failure.
(c) Where battery power has less than 2 hours charge left (see Table B1). The sign shall also send an alarm notification via NMS.
(d) When there is a 'Device State Conflict' alarm.
(e) Where the internal time clock has not synchronised with the GNSS for more than 24 hours.

6.10.2 When operating from a mains power supply, where primary power is lost, the sign shall continue to operate on battery power.

6.11 PROGRAMMING AND MAINTENANCE

6.11.1 General

6.11.1.1 In addition to Clause 6.9 of AS 5156, the manufacturer shall provide:

(a) Copies of all software tools required for the programming, operation and maintenance of the signs to DTP.

(b) Permission in writing to DTP to allow such programming, operation and maintenance tools to be provided to DTP authorised contractors to enable the programming, operating or maintenance of signs.

6.11.1.2 Such tools shall include, but not be limited to, the following:

- Software required to program and configure individual signs.
- Software required to enable maintenance and fault finding of signs.

6.11.2 Maintenance Requirements

6.11.2.1 Field manuals, technical manuals, schematic diagrams, fault finding, and diagnostic guide shall be provided to enable routine and non-routine maintenance of signs.

6.11.2.2 The manufacturer shall provide details of recommended routine maintenance requirements.

6.11.3 Replacement Components

6.11.3.1 Signs shall be designed to allow for faulty components to be replaced within the sign.

6.11.3.2 Signs should be designed such that it is possible to replace main components in the field for maintenance purposes. Typical replaceable components should include such things as:

(a) Sign door.
(b) Sign controller.
(c) Modem.
(d) Internal power supply.
(e) External power supply.
(f) Solar management module (where installed).

6.11.3.3 Details of all replaceable sign components shall be provided.

6.11.3.4 Details of what components are as spare parts shall be provided including what parts are available as *replacement* parts and what parts are available as *changeover* parts.

6.11.3.5 The manufacturer shall provide a change-over or replacement service to maintenance contractors for all replaceable components.

6.12 SIDE ROAD ACTIVATED SPEED

6.12.1 Where specified in the contract documents, the signs shall be designed for monitoring and control through a SRAS system.

6.12.2 Control and interfacing of the ESLS shall be as specified in TCS 071.

SECTION 7 MARKINGS AND DOCUMENTATION

7.1 MARKINGS

7.1.1 In addition to the markings and labels identified in AS 5156 Section 4.7, each individual sign shall be legibly and durably marked on the rear or interior surfaces with:

(a) the DTP Sign ID.
(b) the DTP site number.

7.1.2 In addition to the markings and labels identified in AS 5156 Section 4.7, each individual module within the sign shall be legibly and durably marked with:

(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) the type approval number of the relevant Certificate of Suitability (if applicable).
(f) RCM certification (as applicable).
(g) the rated supply voltage, power and/or current.

7.2 DOCUMENTATION

The manufacturer shall provide the following documentation:

(a) Programming manual, including any required programming software or tools (see Clause 6.11.1).
(b) Technical and operation manual (see Clause 6.11.2).
(c) Field manual (see Clause 6.11.2).
(d) Fault finding and diagnostic guide, including any required diagnostic software or tools (see Clause 6.11.2).
(e) Recommended maintenance requirements (see Clause 6.11).
(f) Schematic diagrams.
(g) Circuit diagrams.
(h) List of all recommended spare components to enable fault and maintenance repairs (see Clause 6.11.3).

SECTION 8 INSTALLATION AND COMMISSIONING

8.1 GENERAL

8.1.1 The Contractor shall carry out all works necessary for the proper installation, commissioning, and operation of the ESLS in accordance with:

(a) Individual contract documents.
(b) This specification.
(c) Standard Section 732.
(d) The manufacturers installation guideline.

8.1.2 The Contractor shall ensure correct communication with the DTP NMS.

8.1.3 The contractor shall carry out all works associated with pre-installation testing of the ESLS.

8.1.4 Preference should be given to powering signs from mains power where available.

8.2 FOUNDATIONS AND POSTS

8.2.1 All Type 2 pedestals and foundations shall be installed in accordance with Standard Section 730.

8.2.2 Where other support posts and foundations are proposed, the support post and foundation shall be proof engineered by a DTP (VicRoads) pre-qualified engineering consultant prior to installation.

8.2.3 Where other support posts and foundations are proposed, details of the post and foundation, including proof engineering, shall be provided for DTP approval prior to installation.

8.2.4 Foundations for Type 2 posts shall be installed in accordance with Standard Drawing TC-1200.

8.2.5 Foundations shall be located to ensure a minimum clearance of 500mm from back of kerb to the pole.

8.2.6 Where the support post is non-frangible, the contractor shall confirm with DTP whether protection is required, such as guard rail.

8.2.7 A hard stand area shall be provided at the base of the sign support post for ladder access to the sign and batteries for maintenance purposes.

8.2.8 The hard stand area shall be not less than 2m wide (parallel with the sign) and extend not less than 1.5m in front and behind the sign support post.

8.3 CONDUITS AND PITS

8.3.1 Where specified in individual contract documents, conduits and pits shall be installed in accordance with Standard Section 733.

8.3.2 Where installed in grassed areas, all pits shall include a concrete surround.

8.3.3 VESI style 400mm pits shall include a concrete surround a minimum of 150mm wide and 200mm deep, in accordance with standard VESI practice.

8.3.4 All road crossing conduits shall be 100mm in accordance with Standard Section 733, terminating on either side of the road in 600mm cable pits.

8.3.5 Where specified in individual contract documents, or approved by the Superintendent, 50mm conduits may be installed for purposes other than for road crossings.

8.3.6 Where specified in individual contract documents, or approved by the Superintendent, 400mm VESI type pits may be installed for purposes other than for terminating road crossing conduits.

8.3.7 Where 400mm VESI style pits are installed, the minimum depth of cover of all conduits shall comply with the requirements of Standard Section 733.

8.3.8 For solar powered sites, where specified in individual contract documents, a 50mm conduit shall be installed between the support post and a 400mm VESI style pit.

8.4 SIGNS

8.4.1 Signs shall not be installed in the field prior to the successful completion of all pre-installation testing as specified in Clause 8.5 below.

8.4.2 Signs shall be installed in accordance with the requirements of individual contract documents, this specification, and Standard Section 732.

8.4.3 Attachment of the sign to the support post shall be in accordance with Clause 3.2.2 and the manufacturer's directions.

8.4.4 Signs shall be aimed to maximise viewing distance.

8.5 MAINS POWER SUPPLY

8.5.1 Where available, signs shall be powered from a mains supply.

8.5.2 The contractor shall submit all necessary paperwork to the appropriate electrical distribution company and provide copies to DTP.

8.5.3 Unless otherwise specified in individual contract documents, the typical mains power supply arrangement shall be a 2 Amp, unmetered POS.

8.5.4 The circuit breaker for an unmetered POS shall be a 2 Amp, 'D-curve' type.

8.5.5 The 240/12 volt power supply detailed in Clause 4.2 shall be mounted on the support post behind the sign or above the sign face.

8.5.6 Where specified in individual contracts, a Type 2 distribution cabinet shall be installed in accordance with the relevant requirements of standard section 730.

5.5.7 Connection to mains power shall be from the external power supply to the mains in one of the following configurations:

(a) **Direct connection** with the cables installed within corrugated conduit and fed through a hole in the support post. The hole shall be sealed where the hose enters the pole to prevent water ingress into the pole. The cable shall then be directly connected to the POS.

(b) Via an **upper mounting assembly (UMA)** with the incoming mains cable and the external power supply cable terminated in the UMA.

8.5.8 Where option (a) is used, a weather-proof cap shall be securely fitted to the top of the support post to prevent the ingress of water.

8.6 SOLAR POWER

8.6.1 Where mains power is not available, and if approved by DTP, solar power may be used.

Note: Solar power shall not be installed without approval from DTP. A request to use solar power shall be made in writing to DTP, detailing the why mains power is not practicable and solar is the only reasonable option.

8.6.2 Where solar panels and associated batteries are used, they shall be installed on a proof engineered, DTP approved, support post and associated foundation.

8.6.3 Type 2 pedestals shall not be used for supporting solar panels other than at school speed zones.

8.6.4 Unless otherwise specified in individual contract documents, solar panels shall be installed at the top of the support post.

8.6.5 Solar panels shall be installed at an appropriate angle, and facing the appropriate direction, to optimise the panels efficiency.

8.6.6 Solar panels shall be located away from obstructions that will block access to direct sunlight, adversely affecting the efficiency of the panel.

8.6.7 Where site conditions require the sign to be located in a position that does not provide adequate access to sunlight, the solar panel may be installed on a separate pole in a location that maximises exposure to sunlight.

8.7 COMMUNICATIONS

8.7.1 The contractor shall install the DTP provided SIM into the sign modem.

8.7.2 The contractor shall ensure correct communications is established with NMS prior to carrying out 'sign pre-installation testing' detailed in Clause 8.5.

8.8 SIGN PRE-INSTALLATION TESTING

8.8.1 Prior to installation of ESLS in the field, all required testing shall be carried out in accordance with Standard Section 736.

8.8.2 All pre-installation testing must be completed in the Contractors premises, or other agreed premises, before signs are installed in the field.

8.8.3 Pre-installation testing shall be conducted on all signs being supplied for each individual site in accordance with individual contracts.

8.8.4 Pre-installation testing shall be conducted with all signs connected to NMS.

8.8.5 Pre-installation tests shall include the following:

(a) Factory acceptance test (FAT) in accordance with 736.07(b)
(b) Off-site Proof of Performance Testing (Pre-POP) in accordance with 736.07(c).
(c) Off-site Subsystem Integration Testing (Pre-SIT) in accordance with 736.07(d).

8.8.6 Completed and signed reports of the above tests shall be submitted to the Superintendent for approval prior to installing any signs in the field.

8.9 COMMISSIONNG

8.9.1 Following the installation of the ESLS in the field, commissioning and all required testing shall be carried out in accordance with Standard Section 736.

8.9.2 The commissioning and post-installation tests shall include the following:

(a) Proof of Performance Testing (POP) in accordance with 736.07(f).
(b) Subsystem Integration Testing (SIT) in accordance with 736.07(g).
(c) System Acceptance Testing (SAT) in accordance with 736.07(h).
(d) Integration Testing in accordance with 736.09.
(e) Operational Performance Testing (OPT) in accordance with 736.07(i).

8.9.3 The contractor shall apply the post label with the site number to each post facing the roadway.

8.10 HANDOVER

8.10.1 Following the completion of any building warranty or defects liability period, and in accordance with any contract specific requirements, the site shall be handed over to the DTP ITS Asset Management Team to be placed under the relevant maintenance contract.

8.10.2 Prior to hand-over, the DTP ITS Asset Management Team shall be provided with the opportunity to carry out a site audit to ensure compliance with DTP specifications.

8.10.3 The following documentation shall be provided to the DTP ITS Asset Management Team at the time of handover:

(a) Copy of all applications and notices relating to the supply of power.
(b) For mains power sites, copy of earth resistance test report and continuity test report.
(c) For mains powered sites, all Certificates of electrical safety
(d) Copy of the FAT report
(e) Copies of the Pre-POP and POP test reports.
(f) Copies of Pre-SIT and SIT test reports.
(g) Copy SAT test report.
(h) Copies of ‘as built’ drawings.

APPENDIX A – NETWORK MANAGEMENT SYSTEM

(Normative)

A1 GENERAL

A1.1 The ESLS Network Management System (NMS) is a monitoring/management system developed by Johnson Controls (formerly Tyco) used to monitor and remotely manage ESLS devices connected to the VicRoads communication network. See Figure A.1 below.

A1.2 A large number of ESLS at school speed zones and strip shopping centres currently use the ESLS Network Management System (NMS).

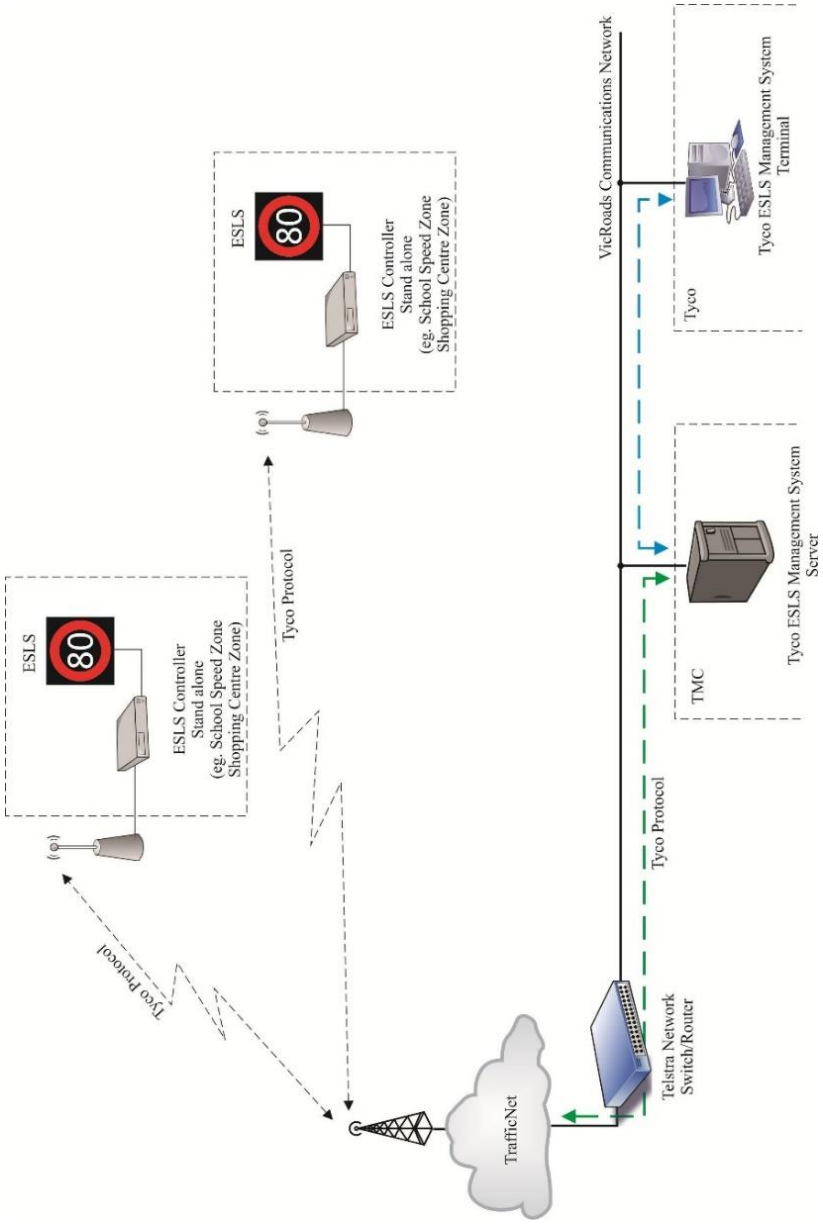

Figure A.1 – NMS communication/control schematic

A2 NMS PROTOCOLS

A2.1 There are two versions of NMS protocol currently in use. These are:

(a) NMS (version 1), and

(b) NMS (version 2).

A2.2 Copies of the NMS sign protocol specifications are available from DTP upon request.

APPENDIX B – FAULT NOTIFICATIONS AND LOGGING

(Normative)

B1 MINIMUM REQUIRED FAULT NOTIFICATIONS

Each ESLS shall provide to NMS, as a minimum, the alarm notifications detailed in Table B.1.

Alarm	Description	Classification	Required System Response
GPS Invalid	The sign has failed to obtain a valid data string from the GPS network to synchronise its internal time clock for the past 24 hours.	Critical	Display Alarm & raise a fault.
GPS Fail	The sign has failed to obtain any data from the GPS network for the past 24 hours.	Critical	Display Alarm & raise a fault.
Calendar	No calendar present in the sign	Critical	Display Alarm & raise a fault.
Processor Watchdog	The sign processor has flagged a watchdog alarm.	Critical	Display Alarm & raise a fault.
Processor or System Failure	The sign processor or system has failed.	Critical	Display Alarm & raise a fault.
Communications Failure	The sign has stopped communicating with the management system.	Critical	Display Alarm & raise a fault.
Power Supply Failure	The sign has lost internal power.	Critical	Display Alarm & raise a fault.
Mains Failure	The external power source to the sign has failed.	Critical	Display Alarm & raise a fault.
Solar Panel Failure	The solar panel has stopped operating.	Critical	Display Alarm & raise a fault.
Solar panel tamper	The solar panel has been moved.	Critical	Display Alarm & raise a fault.
Battery Level Warning 1	The battery has 24 hours of charge left.	Critical	Display Alarm & raise a fault.
Battery Level Warning 2	The battery has less than 6 hours charge left.	Critical	Display Alarm & raise a fault.
Battery Failure	The battery has failed or has less than 2 hours charge left.	Critical	Display Alarm & raise a fault.
Battery Overcharge	The battery is overcharged or exceeded maximum operating temperature.	Critical	Display Alarm & raise a fault.
Excessive Internal Temperature	The internal temperature of the sign has exceeded the maximum safe level for the internal components.	Critical	Display Alarm & raise a fault.
Display shut down - Numerals	20% of the LED's in a numeral have failed and the sign has shutdown.	Critical	Display Alarm & raise a fault.

Table B.1 - Minimum required fault notifications

Alarm	Description	Classification	Required System
Display shut down - Annulus	20% of the LED's in the annulus have failed and the sign has shutdown.	Critical	Display Alarm & raise a fault.
Facility Switch – Not in AUTO	Facility switch has been set to a set speed.	Critical	Display Alarm & raise a fault.
Facility Switch – OFF	Facility switch has been turned to the 'OFF' position.	Critical	Display Alarm & raise a fault.
Door	The sign door is open	Critical	Display Alarm & raise a fault.
Tilt	The sign is no longer vertical	Critical	Display Alarm & raise a fault.
Surge Protection	Surge Protection device is low or failed	Minor	Display Alarm & raise a fault.

Table B.1 - Minimum required fault notifications… (continued)

B2 MINIMUM LOGGING REQUIREMENTS

B2.1 Each Sign shall provide internal fault logging for all fault events detailed in Table B1, with a minimum history of 500 entries.

B2.2 In addition, each Sign shall provide internal event logging for all events detailed in Table B2 with a minimum history of 500 events.

Entry	Description	Classification
10% LED failure - Annulus	10% of the LED's in annulus have failed.	Sign display fault/status
Dimming mode	Automatic or manual dimming mode	Sign status
Luminance level	Current luminance level	Sign status
Luminance controller failure	Sign luminance controller failure	Sign fault/status
Sign time	Current sign time in seconds	Sign status
Firmware version	Current sign firmware of the sign	Sign status
Sign manufacturer	Sign manufacturer	Sign status
Sign model	Sign model	Sign status
Critical error	The sign is disabled due to a critical error and hasn't been overridden or cleared to run automatically by an operator or technician	Sign status/error

Table B.2 - Minimum logging requirements

Entry	Description	Classification
Sign up time	The time/duration of continuous operation of the sign	Sign status
Sign rings	Number of rings of in the annulus to flash	Sign status
Control mode	Manual or automatic sign operation mode	Sign status
Door	Sign open door alarm	Sign status/alarm
GPS status	Current status of GPS	Sign status
Site ID	Site ID of the sign	Sign status
Sign ID	ID allocated to the sign	Sign status
Temperature	Current temperature of the sign	Sign status
Phone number	Phone number of the sign's sim card	Sign status
Number of signs in Group	Number of signs in Group	Sign status
Solar current	Solar current measurement	Sign status
Battery status	Current battery measurement	Sign status
Voltage level	Current battery voltage measurement	Sign status
Internal communication error	Internal communications failure	Sign status/error
Display time-out	Sign display time-out	Sign status/error
Master/Slave comms failure	Master/Slave comms failure	Sign status/error
Watchdog	The sign processor has flagged a watchdog alarm.	Sign status/error

Table B.2 - Minimum logging requirements… (continued)

APPENDIX C GUIDELINES FOR PURCHASING AND INSTALLATION

(Informative)

DETAILS TO BE INCLUDED WHEN TENDERING

C1 Installation requirements will be site specific and detailed in individual tender documents.

C2 The following details should be considered when preparing tender documents:

(a) The size of the proposed signs, i.e. whether A, B or C size.
(b) Whether single speed, dual speed or multiple speed.
(c) Which side the door is required to hinge from.
(d) Whether the proposed signs are mains or solar powered.
(e) Requirements for battery backup.
(f) Whether the display is discrete or a matrix.
(g) The numbers of signs and speed values to be provided.
(h) The mounting arrangements for the signs

APPENDIX D - REQUIREMENTS FOR TYPE APPROVAL

(Normative)

D1 PREREQUISITE

Suppliers submitting signs for DTP evaluation must hold current pre-qualification at Supply of On-Roads Electronic Devices (SOED) level.

D.2 GENERAL

D2.1 Electronic Speed Limit signs for use on DTP projects are required to hold current DTP Type Approval.

D2.2 The Product Compliance evaluation process shall be carried out in accordance with DTP Guideline TCG 016.

D2.3 To enable assessment for the purpose of granting Type Approval, the 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 the requirements of DTP 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.

D2.4 Any new item of equipment, including sub-assemblies or modules, or major re-design shall require the Supplier to resubmit the equipment for Type Approval.

The Supplier shall not commence production of any new or re-designed item of equipment (including module or sub-assembly) until after receipt of written notification from DTP that evaluation the item has been successfully completed and approved.

D3 REQUIRED NATA ACCREDITED TESTING

The Supplier shall provide the following test reports from a NATA accredited (or equivalent ILAC-MRA certified), testing organisation to demonstrate compliance with the following.

AS 5156 Clause	Requirement
4.6.1	EMC Immunity
4.6.2	EMC Emissions
5.2.1	Luminance and luminance ratio
5.2.2	Luminance matching of colours
5.2.3	Luminance intensity uniformity
5.2.4	Colours (chromaticity)
7.1	Temperature and humidity
7.2	Enclosure protection for sign enclosure
7.4	Vibration

D4 BATTERY TECHNOLOGY

The supplier shall provide details of the proposed back-up battery technology. This shall include:

(a) Battery chemistry
(b) Manufacturers data sheet
(c) Evidence of battery suitability for safe operation within the temperature range specified in AS 5156.
(d) Details of method used to maintain safe battery temperature during charging.

D5 COMPATIBILITY WITH NMS

D5.1 ESLS intended to be connected to the NMS must be fully compliant and compatible.

D5.2 To ensure compliance the supplier shall obtain a compliance certificate prior to operation on the NMS.

D5.3 A copy of this certification shall be provided to DTP.

D6 OTHER REQUIRED INFORMATION

D6.1 Confirmation that the manufacturer is on the DTP (VicRoads) Register for the Pre-qualification for Supply of On-Road Electronic Devices.

D6.2 Copy of LED manufacturer's specification for each LED type used.

D7 ASSESSMENT PROCEDURE

D7.1 The assessment procedure for an ESLS 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.
(c) Review of test reports.
(d) Testing on NMS.

(e) Continuous sign operation connected to NMS at the manufacturer's premises (or other agreed location) for a period of not less than 3 months.

D7.2 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.

D7.3 The supplier is to state whether tests carried out prior to formal submission were carried out on an identical sample of the sign.

D7.4 DTP may require a field trial of the sign to be undertaken.

D8 TYPE APPROVAL

D8.1 The decision to grant a Certificate of Type Approval is at the sole discretion of DTP.

D8.2 DTP may require additional information or testing to be carried out as part of its evaluation of the product.

D8.3 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 DTP works.