TCS 021-3-2006

SPECIFICATION

FOR

ELECTRONIC SPEED INDICATOR SYSTEMS

Issued
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PREFACE

A. GENERAL

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

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

B. APPROVED PRODUCTS

Items covered by this specification are not required to hold formal VicRoads 'Type Approval' certification. Rather, they are required to obtain VicRoads acceptance in accordance with Appendix E of this specification and the requirements of individual tender documents.

To obtain VicRoads acceptance the Contractor must submit evidence of compliance in accordance with Appendix E of this specification and the requirements of individual tender documents.

Acceptance issued in accordance with individual tender documents does not constitute automatic acceptance for future works.

C. ELECTROMAGNETIC COMPATIBILITY (EMC)

All equipment covered by this specification is required to comply with all relevant requirements of the Australian Communications Authority (ACA) for EMC as detailed in this specification.

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

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1.0 SCOPE

This Specification covers the design, manufacture and installation of an electronic speed indicator system. The purpose of the system is to measure approaching vehicle speeds and provide the measured output to the motorist via a roadside sign.

The design, manufacture and installation, including commissioning, of all components of speed indicator systems shall be undertaken in accordance with the requirements of this specification and individual tender documents.

2.0 GENERAL

Speed indicator systems use a speed detection device to measure the speed of an approaching vehicle and then display that speed on an associated electronic sign. The speed may be displayed on a dedicated speed indicator sign or on a Variable Message sign (VM sign). Where a VM sign is installed, it can also be used to display road and traffic information to motorists. This specification covers dedicated speed indicator system signs only. Where a VM sign is intended to be used it should also comply with the requirements of VicRoads specification TCS 015 for Variable Message Signs

The system shall generally consist of:

a) A sign or signs capable of providing one speed output display per lane (each display shall be centrally mounted over each of the approach lanes);

b) one speed detector device per approach lane; and

c) a processing and sign control unit for each speed output display.

The system shall be capable of operating during both day and night.

See Figure 1 below for a typical speed indicator sign.

Figure 1 – Typical Speed indicator Sign

2.1 System Overview

A speed indicator system typically consists of:

- advanced static warning signs;
- signs indicating the point at which the motorist speed is displayed; and
- electronic speed display sign (typically mounted on a gantry structure).

A typical system would be installed as shown in Figure 2.

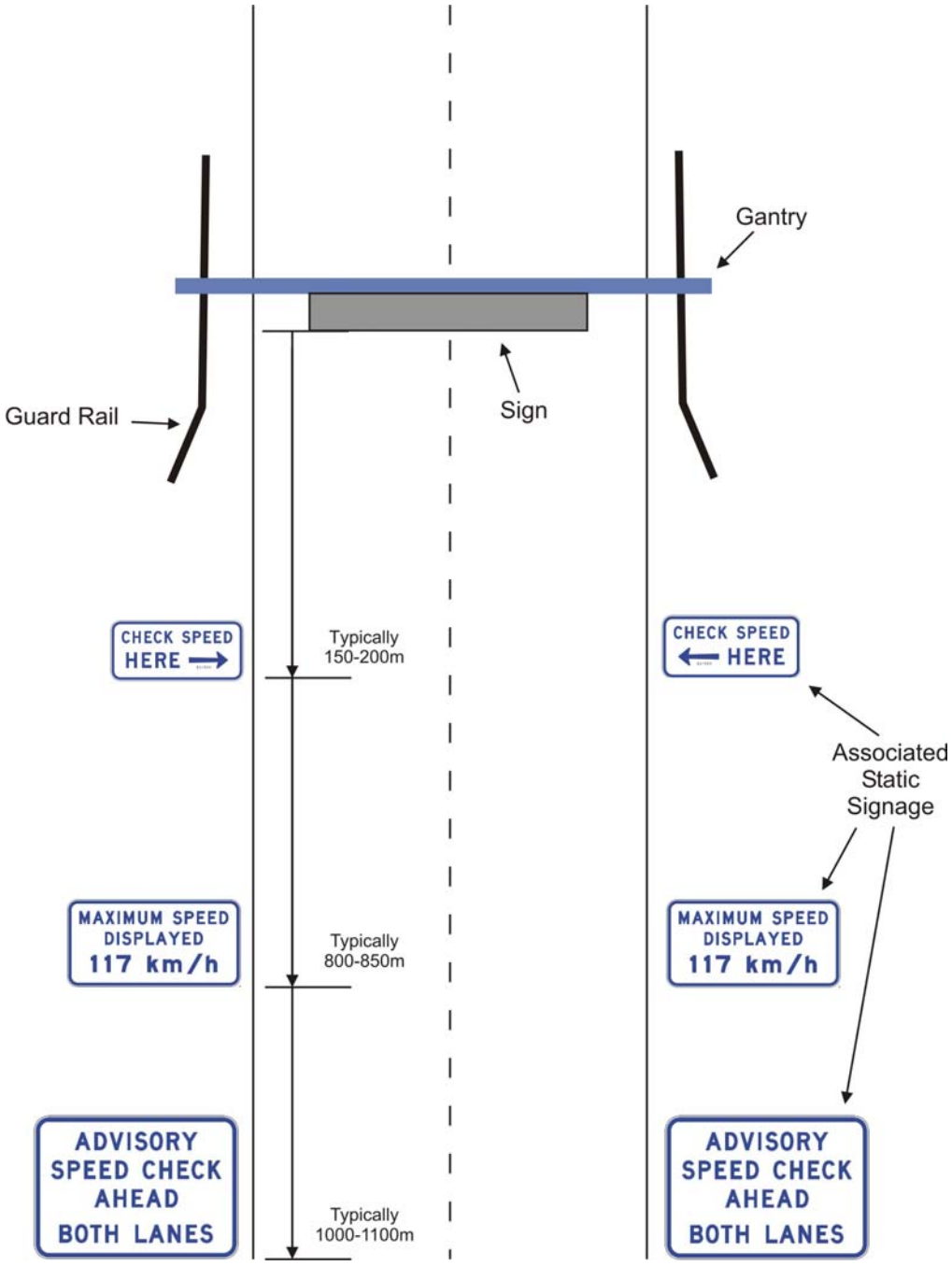


Figure 2 – Typical Speed Indicator System Installation

3.0 RELATED SPECIFICATIONS AND DRAWINGS

The fabrication and supply of all components for Speed Indicator Systems shall conform with all relevant Australian Standards or, in the absence of same, with appropriate international standards.

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

The following specifications, standards, documents and standard drawings are referred to or relevant to this specification:

- AS 1170.2 – Structural Design Actions, Part 2 Wind Actions
- AS 1742 - Manual of Uniform Traffic Control Devices
- AS 1743 - Road Signs – Specifications
- AS 1744 - Standard Alphabet for Roads Signs
- AS/NZS 3000:2000 - Wiring Rules
- AS 3100 - Approval and test specification–General requirements for electrical equipment
- AS 4251.1 - Electromagnetic Compatibility – Generic Emission Standard Part 1: Residential, Commercial and Light Industry
- AS 4252.1 - Electromagnetic Compatibility – Generic Immunity Standard Part 1: Residential, commercial and light industry
- AS/NZS 5000.1 - Electric cables – Polymeric insulated - For working voltages up to and including 0.6/1 kV.
- AS 60038-2000 – Standard Voltages
- AS 60529 - Degrees of protection provided by enclosures (IP code).
- AS 61558.2.4 – Safety of power transformers, power supply units and similar - Particular Requirements for Isolating Transformers for general use
- TCS 015 – VicRoads specification for Variable Message Signs
- Drg No. 445812 – Advisory Speed Check Ahead Both or All Lanes Signs P1-V137 (VicRoads Design Department)
- Drg No. 445813 – Maximum Speed Displayed 117 km/h or 107 km/h Sign P1-V138 (VicRoads Design Department)
- Drg No. 445814 – Check Speed Here (Right) Sign P1-V139(R) (VicRoads Design Department)

- Drg No. 445815 – Check Speed Here (Left) Sign P1-V139(L) (VicRoads Design Department)

4.0 SIGN ENCLOSURE REQUIREMENTS

4.1 General

The sign enclosure shall be constructed from marine grade aluminium treated to ensure optimum performance under prolonged exposure to atmospheric and site conditions prevalent in the State of Victoria. The enclosure shall be rated to withstand the effects of solar radiation for a period not less than ten years and shall be rated to withstand wind forces for the region as defined in AS 1170.2 for a period not less than ten years.

4.1 Construction

The general construction requirements for the sign are such that:

a) all surfaces of the enclosure (including all structural supports and/or bracing components) are suitably treated (eg. Polyester powder coated) to ensure prolonged operation within the intended application;
b) the colour of all exposed metal surfaces shall be a matt black finish;
c) all surfaces of the enclosure shall be free from sharp edges or protrusions;
d) 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 product for a period not less than ten (10) years;
e) the finished product is suitably sealed to prevent the ingress of dust and moisture (IP-65);
f) rear safety access platform suitably located to provide standing access to the integral components. The platform shall not be accessible from ground level without the use of a ladder or steps and shall comply with all OH&S requirements; and
g) the sign enclosure shall be designed to be base mounted or rear mounted (without effect on the rear access door requirements) on the gantry or structure. The type of mounting required shall be detailed in individual tender documents.
h) the construction and layout of the enclosure and any framework shall provide for easy access to all internal components for both installation and maintenance purposes.

The sign enclosure shall incorporate:

- a front viewing window of high impact, anti-glare clear plastic sheeting of casting grade acrylic copolymer or polycarbonate (or similar). The size of window area shall be such that, when installed, the sides and bottom edges

of the display face may be fully visible at viewing angles of 45^{o} and 30^{o} respectively to the 0.0 axis of the display face;

- where the manufacturer's design does not incorporate a covering window, details regarding matrix sealing, cleaning and other pertinent matters shall be provided in the tender;
- a surrounding border of not less than 150mm;
- lockable, hinged (left or right opening) door/s located on the rear of the housing. The door/s shall be used to provide adequate access to all internal components of the sign for both installation and maintenance purposes; and
- a suitably filtered venting and/or fan forced air circulation system in accordance with the recommendations of the display matrix manufacturer.

The front viewing window and rear access doors shall be suitably sealed to prevent ingress of dust and moisture and the completed housing shall comply with the degree of protection required of IP-65 as defined in AS 60529-2004.

All sundry components used for connection and/or bracing of the sign enclosure onto the support structure shall be manufactured or constructed from suitably protected materials. Contact between untreated, dissimilar metals (both within and external to the sign housing) shall be avoided.

5.0 SPEED DETECTION DEVICE

5.1 General

Each speed display shall be triggered by an independent speed detection device, which will accurately measure the speed of an approaching vehicle in the lane over which the applicable sign is mounted.

The device shall be capable of measuring vehicle speeds in the range 20kph to 150kph, and shall be capable of detecting all typical vehicle types including motor cycles, passenger vehicles, commercial vehicles, buses and articulated vehicles.

The system shall be capable of instantaneously processing the data and displaying the detected speed of each approaching vehicle passing through the target zone.

5.2 Typical Detection Devices

The type of detection device required for the speed indicator system shall be detailed in individual tender documents and shall typically be one of the following types of devices.

5.2.1 Laser Detection

Where a laser detection device is used it shall:

- be a Class 1 laser product, or similar, with a proven accuracy of +/-2 kph;
- typically be aimed at a target distance of approximately 200 to 250 metres;
- be capable of being adjusted through a range of angles, to enable accurate targeting of the approach vehicle at the nominated distance; and
- be mounted on or within the sign enclosure structure.

Where individual tender documents require that the detection device be mounted external to the sign enclosure, it shall be encased within a suitable weather-proof housing.

5.2.2 Piezo Detection

Where a piezo detection device is used it shall:

- have a proven accuracy of at least +/-2 kph;
- be located at a target distance of approximately 200 to 250 metres; and
- be installed in accordance with the manufacturers installation instructions.

Interface equipment required for piezo detectors shall be installed within the sign enclosure or within a suitable enclosure located on the upright of the kerb side gantry leg. Such enclosure shall have the degree of protection required of IP-65 as defined in AS 60529-2004.

6.0 SIGN DISPLAY & OPERATIONS

6.1 General

Each speed display shall be mounted centrally over the associated lane. The sign shall be able to display up to three numeric characters, in individual increments in the range 20 kph to 120 kph, for the output derived directly from the speed detection device.

The displays generated on the sign shall generally comply with the requirements of AS 1742, AS 1743 and AS 1744 and/or to layouts approved by VicRoads. The minimum legibility range of the sign (when displaying standard formats as defined in this document) shall be 50 to 250 m during both day and night time operation.

The indicated speed shall be displayed for not more than 2.0 seconds, after which time the indicator shall go to blank or display the speed of the next approaching vehicle.

The signs shall only display speeds up to and including 7 kph above the posted speed limit. Speeds in excess of 7 kph above the posted speed limit shall be denoted by the successive displays “Too Fast”, and “Slow Down” (refer to Figure 3).

Figure 3 – Typical ‘Too Fast/Slow Down’ Display

6.2 Display Technology

The required displays shall be generated by pixel outputs fabricated in a suitable matrix format and consisting of yellow LED pixel outputs on a matt black background. The yellow colour shall comply to the colour defined as traffic signal yellow in AS 2144.

LED’s used in the sign shall be nominally rated for not less than 100,000 hours, and shall be driven at not greater than 65% of peak rating.

All pixels shall be arranged in modules of a size capable of being removed and re-instated in-situ by hand.

The LED pixel technology used shall generally comply with the requirements detailed in Appendix A of this specification.

6.3 Photometric Performance

Optical and photometric requirements of LED pixel outputs shall comply to the individual requirements detailed in Appendix A of this specification.

The luminance of the display, when measured in accordance with the procedures detailed in Appendix B, shall be not less than 10,000 cd/m^2.

The pixel lighting shall be controlled by:

- an automatic dimming system capable of adjusting light output in accordance with ambient light conditions to not less than five mid range pre-defined intensity levels appropriate to site and equipment conditions. The system shall commence to dim the output when the ambient light level is approximately 1100 lux; and
- both local and remote software command input.

The on-site dimming system shall contain not less than three photoelectric sensors. The photoelectric sensors shall be located so that they sense the ambient light levels striking the front and back of the sign along with one pointed downwards.

6.4 Character Formats

6.4.1 Speed Indicator Display

Standard operation of the sign shall permit the simultaneous generation of up to three numeric characters. Such characters shall be not less than 400 mm and not more than 500 mm high, and have a height to width ratio of 7:5. Within such operation, spacings between the start and end of each numeral shall be proportional and not less than two times the stroke width of the generated character.

6.4.2 Too Fast/Slow Down Display

The characters for the 'Too Fast' and 'Slow Down' displays shall be as high as practicable to fit within the display area on two lines while maintaining a height to width ratio of 7:5.

7.0 CONTROL SYSTEM

The control system shall be capable of performing all detection control, processing and sign output control processes using the software supplied by the contractor to accommodate all programming, operational and monitoring features of this specification.

The system shall incorporate a maintenance test program suitable for operation during routine servicing or during fault attendance and capable of displaying all standard modes for the purpose of identifying faults.

The system shall be capable of storing a minimum of 500,000 individual elements of speed displays in the format speed-lane-date-time. The system should be capable of down loading this information using similar methods currently used with VicRoads assets of a similar nature.

Where the control system is mounted within the sign or detection housings, the contractor shall provide:

- facilities (via RS-232 connector) for in-situ control and operation of the sign at ground level for test and maintenance purposes using a suitable lap-top computer; and
- a separate on/off power switch located on the upright of the kerb side gantry leg. This switch shall be mounted within a sealed, lockable enclosure at a

height accessibly from ground level. Such enclosure shall have the degree of protection required of IP-65 as defined in AS 60529-2004.

The ground level access to the RS-232 connector shall also include a 240 Volt GPO. Such GPO shall be protected by an integral Residual Current Device (RCD) in accordance with the requirements of AS/NZS 3000:2000.

7.1 Fall-Back System

The system shall incorporate a self-monitoring system with the ability to detect major system failures (eg. processor failure or display driver failure) and send the sign to fall-back mode.

Fall-back mode shall ensure that the sign output display of the affected sign is completely blanked.

8.0 ELECTRICAL REQUIREMENTS

In addition to complying with this specification, the sign and associated system shall comply with all relevant requirements of AS/NZS 3000:2000 and AS 3100.

Transformers used within the sign and/or sign control system shall comply with the requirements of AS 61558.2.4, Safety of isolating transformers, power supply units and similar - Particular Requirements for Isolating Transformers for general use.

All cables and wires shall be insulated with a material not inferior to V90HT grade PVC and shall be suitably labelled.

The modules and associated driver network and the control and communications equipment shall operate at extra low voltage (ELV).

8.1 Mains Supply

The mains supply voltage shall be deemed to be 230Vac +10%, -6% in accordance with Section 2 of AS 60038-2000 – Standard Voltages.

The system and or sub-elements of the system shall be capable of operating satisfactorily from the mains supply voltage within ±15%.

8.2 Electrical Facilities

The electrical system shall incorporate the following facilities:

- a circuit breaker board comprising appropriately rated mains isolation switch and circuit breaker/s; and
- the ability to be isolated from mains supply at ground level as detailed in clause 6.0; and

8.3 Internal Protection

All equipment including data lines shall be internally protected against damage resulting from:

- lightning strikes at or near the sign/gantry;
- electrical transients on power cabling;
- electrical transients on communications wiring;
- radio frequency interference; and
- static electrical discharge.

8.4 EMC Compliance

8.4.1 General

All equipment covered by this specification shall comply with all relevant requirements of the Australian Communications Authority (ACA) for EMC and shall be labelled with a conforming 'C-Tick'.  .

8.4.2 Generic Emission

The sign and all integral control and/or communication components shall be provided with radio interference suppression to comply with the requirements of AS 4251.1 Electromagnetic Compatibility – Generic Emission Standard – Part 1: Residential, Commercial and Light Industry.

Evidence of compliance with AS 4251.1 shall be provided in accordance with Appendix E.

8.4.3 Noise Immunity

The sign and all integral control and/or communication components shall be provided with protection against transients and surges present on the 230Vac mains supply, electrostatic discharge and radiated or conducted radio frequencies to comply with the requirements of AS 4252.1 Electromagnetic Compatibility – Generic Immunity Standard Part 1: Residential, commercial and light industry.

9.0 MARKINGS

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

a) the name, trade name or trademark of the manufacturer or responsible supplier.

b) catalogue number or marking which shall distinguish the particular sign from other similar items supplied and/or manufactured by the supplier.

c) batch or serial number or other mark which will clearly identify the date of manufacture of the item.
d) other information required under AS-3100 (Approval and test specification - general requirements for electrical equipment).

APPENDIX A

Optical & Photometric Performance Requirements

FOR
VARIABLE MESSAGE SIGNS EMPLOYING DISCRETE ELEMENTS

A1. SCOPE

This document covers the dimensional, photometric and colorimetric requirements for all Variable Message Signs (VMS) employing discrete elements and for use on roads for VicRoads.

Variable Message Signs with discrete elements are those signs which normally employ light emitting diodes, fibre optics, fluorescent, reflective or retro reflective elements whose legends or messages are composed of a series of discrete elements and which are capable of displaying more than one message. (It should be noted that in this context a blank face will normally be classified as a message condition). The different types of elements may be the sole type of element in the VMS or there may be two or more types on one VMS.

A2. REFERENCED DOCUMENTS

- AS2144-2002 - Australian Standard for Traffic Signal Lanterns. Standards Australia.

- CIE (1987) - Methods of characterizing illuminance meters and luminance meters. CIE Pubn.No. 69-1987.

- CIE (1989) - The measurement of luminous flux. CIE Pubn.No. 84 -1989

- CIE (1994) - Technical Report on Variable Message Signs. CIE Pubn. No. 111-1994

- CIE (1997) - Technical report on the Measurement of LED's. CIE Pubn. No.127-1997.

- European Standard Discontinuous (Interim (1995) - Optical Performance Functional Specification for Variable Message Signs TR2136, Issue A - 1995.

A3. DEFINITIONS

Backing Board: A surround or extension to the sign face used for the reasons listed below:

- to improve conspicuity of a sign by increasing its size and isolating it from its background;
- to improve conspicuity of a sign by virtue of the colour of the backing board;
- to reduce the effects of glare when the sun is low and behind the sign.

Border: Part of the sign face which outlines its shape.

Character height: The height of an upper case character in millimetres (see Figure A1).

Character matrix: A number of elements constructed in a square lattice or other arrangement from which characters can be constructed (see Figure A1).

Character spacing: The separation between the closest character elements in the same word or numeral set expressed in terms of the number of inactive unit elements (see Figure A2).

Element (or Pixel): A light emitting or reflective component which forms the smallest active part of the sign face. An element may comprise two or more emitters or reflective components (see Figure A3).

Element size: The diameter of an element expressed in millimetres (see Figure A3).

Emitter: A light emitting component which, perhaps with other emitters, forms an element of the sign face. A number of emitters may be combined to form a single light emitting component (see Figure A3).

Line separation: The separation between lines of characters expressed in terms of the number of inactive elements of consecutive character lines (see Figure A2).

Luminance Ratio (LR): Luminance Ratio indicates the capacity of the sign to overcome the effects of direct sunlight. The levels are set to ensure washout does not occur when the sun is at a low angle and a high intensity commensurate with the elevation of the simulated sun. It is defined in measurement terms as:

LR = (La - Lb) / Lb

Where La is the measured luminance resulting from the active sign under external illumination, and Lb is the measured luminance resulting from the inactive sign under external illumination.

Veiling Reflections: Specular reflections that appear on the sign face and that partially or wholly obscure details of the sign by reducing contrast.

Stopping Sight Distance: (SSD) The Stopping Sight Distance is the distance in metres it takes for a driver to recognise the sign, react and bring the vehicle to a halt.

Stroke-width: This is the apparent width of an active element. For a reflective only sign this corresponds to the physical width of the element. For a self-luminous element it is the apparent equivalent width of the element or elements that make up a vertical stroke of the letter or numeral. It is usually taken as the centre to centre distance between elements times the number of elements making up the width of the vertical stroke (see Figure A4).

Washout: The phenomenon caused by the non-specular and specular reflection of light from the sign face when light falls on a sign from a source or sources external to the sign. Washout causes the Luminance Ratio of the sign to fall below its permitted limit.

Width to height ratio: The ratio of the character width to character height.

Word Separation: The separation between character elements of adjacent words expressed in terms of the number of inactive elements between the beginning and end of adjacent words (see Figure A2).

Character Height

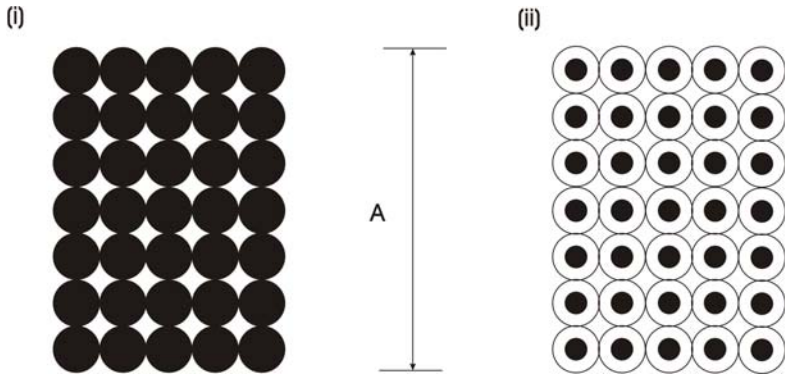


Figure A1.

A is the character height (in mm) for:

- A reflective matrix, and
- Equivalent height of light-emitting matrix.

Note: Dotted areas represent the equivalent area of light-emitting elements.

Legend Spacings

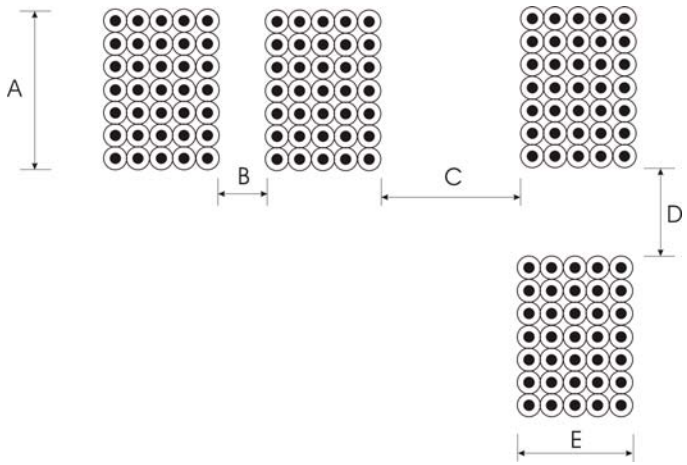


Figure A2.

A is the character height with equivalent area,
B is the character spacing,
C is the word spacing,
D is the line spacing,
E is the character width with equivalent area.

Note: dotted area around each element represents the equivalent area or stroke-width.

Test Area 100mm Diameter

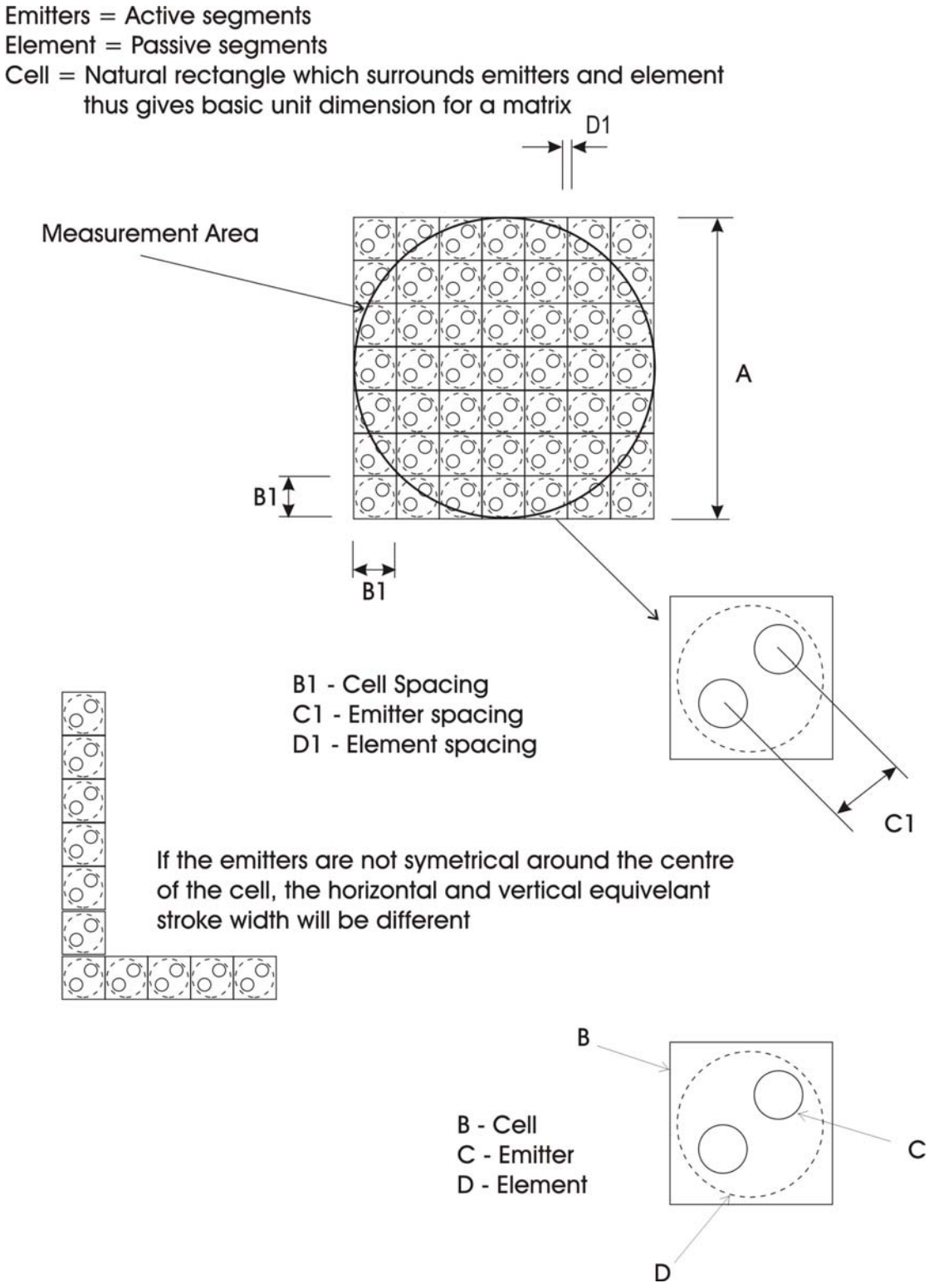
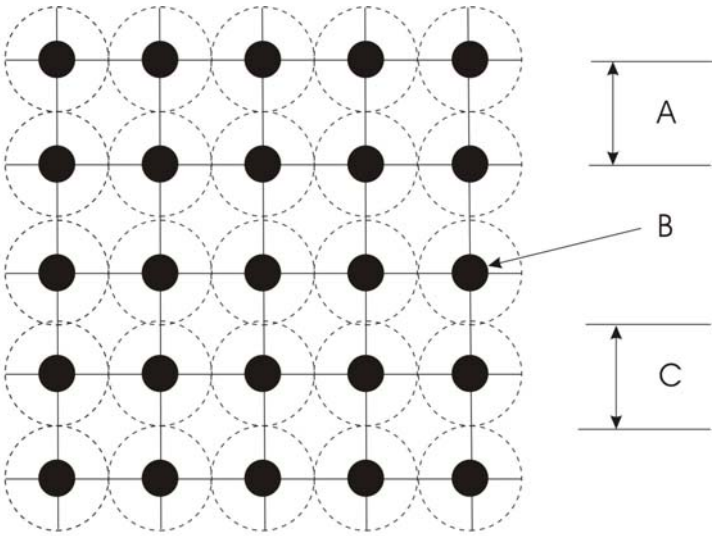


Figure A3.

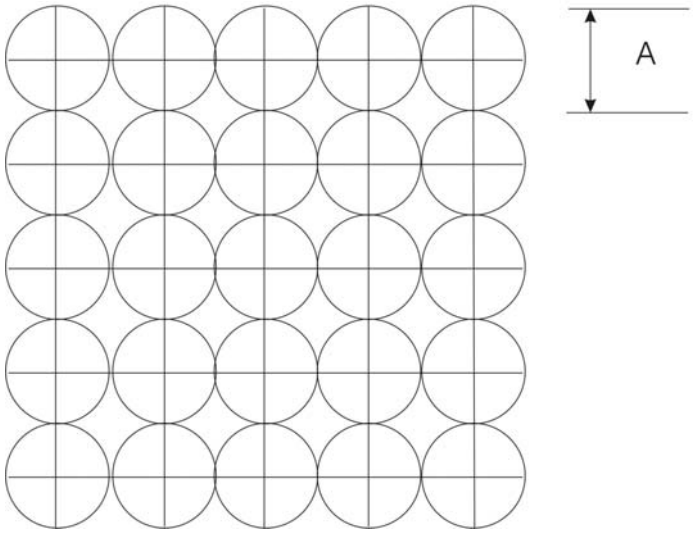
Sections of Manufacturer's Regular Matrix

a. Light-emitting



A is the element spacing,
B is the element diameter,
C is the equivalent diameter or stroke-width.

b. Reflective



A is the element diameter or stroke-width

Figure A4

A4. CHARACTER AND LEGEND DIMENSIONS

Set out in the Table below are the dimensional requirements for Variable Message Signs according to the type of traffic environment in which the VM Sign is to be used.

Table A1
Character and Legend Dimensions

Traffic Environment Characteristics		Minimum Dimensions of Sign Character and Legend					
Speed (km/hr)	SSD	Character height (mm)	Stroke Width (mm)	Character Spacing (N**)	Word Spacing (N**)	Line Spacing (N**)	Width of Border (mm)
40	35(m)	80	10	2	4	3	40
60	65	150	20	2	4	3	75
80	105	250	35	2	4	3	125
100	160	370	50	2	4	3	185
110	190	440	60	2	4	3	220

* SSD is the Stopping Sight Distance and is the distance needed to recognise the sign's message and bring the vehicle to a stop at the sign.
For variable message signs that are used for pedestrians in the road environment, the dimensional and format requirements are given in Australian Standard AS2144-1995.
** N is the number of inactive Elements
The character width to height ratio shall be no less than 0.7:1.

A5. PHOTOMETRIC REQUIREMENTS

A5.1 LUMINANCE RATIO

The Luminance Ratio levels (see Table A2) are set so that the presence of external sources of light will not cause a lowering of the contrast of the message such that it becomes ineffective. If the variable message sign has a variable luminance setting, then the Luminance Ratio requirement should be met first and then the minimum levels of luminance must be met at that luminance level or greater. The test procedures for the measurement of Luminance Ratio are given in Appendix B.

Table A2
Luminance Ratio Requirements

Sign Illuminance (lux)	Minimum Luminance Ratio (LR)	
	White or Yellow Legend	Red or Green Legend
40,000	10	5
4000	10	5
400	10	5
40	-	-
<4	-	-

A5.2 LUMINANCE

Variable Message Signs are often used 24 hours a day in which case some method of automatic dimming will be required as the levels of luminance necessary to be effective during the day will cause far too much glare to the driver at night. There are three levels of luminance specified (see Table A3), one for use in the daytime, one for use at night in well lit urban areas and one for use in unlit areas. The test procedures for the measurement of Luminance are given in Appendix A.

Table A3
Luminance Requirements

Ambient Lighting Condition	White or Yellow Legend	
	Min. Luminance (cd/m^2)	Max. Luminance (cd/m^2)
Daytime	6,000	60,000
Night time/ Urban/Lighting	300	3,000
Night time/No Lighting	50	300

For self-luminous elements, the luminance shall be measured with no external illumination. For non-self-luminous signs the daytime luminance is measured with an external illumination of 40,000 lux.

A5.3 LUMINANCE OR LUMINOUS INTENSITY UNIFORMITY

The luminance or luminous intensity uniformity shall be met for each colour and each intensity setting. For reflective VMS, the luminance or luminous intensity uniformity shall be met for daytime and night time conditions.
The luminance or luminous intensity of any two elements shall not vary by more than the ratio of 5:1.

The ratio of the average of the highest three elements outputs to the average of the lowest three elements outputs shall not vary by more than 2.5:1.

The test procedures for the measurement of luminance or luminous intensity are given in Appendix B.

A5.4 VIEWING ANGLE

There are two separate requirements for viewing angle. The measurement criteria for viewing angle is the minimum Luminance Ratio (LR).

For a narrow beam sign the Luminance Ratio requirements as set out in Table A4 below are to be achieved at $\pm$ 5^o horizontal and -2.5^o vertical.

For a wide beam sign the Luminance Ratio requirements as set out in the Table below are to be achieved at $\pm$ 10^o horizontal and -2.5^o vertical.

Table A4
Viewing Angle - Luminance Ratio Requirements

Sign Illuminance (lux)	Minimum Luminance Ratio (LR)
	White or Yellow Legend
40,000	5
<4	5

A6. LEGEND COLOURS

When tested in accordance with Appendix B, the light emitted by each colour present in the message must comply with the chromaticity coordinates in Table A5 below and as illustrated in Figure A5.

Table A5
Chromaticity Coordinates

Colour		**1**	**2**	**3**	**4**
Yellow	x y	0.536 0.445	0.545 0.454	0.592 0.407	0.583 0.398

CHROMATICITY CHART

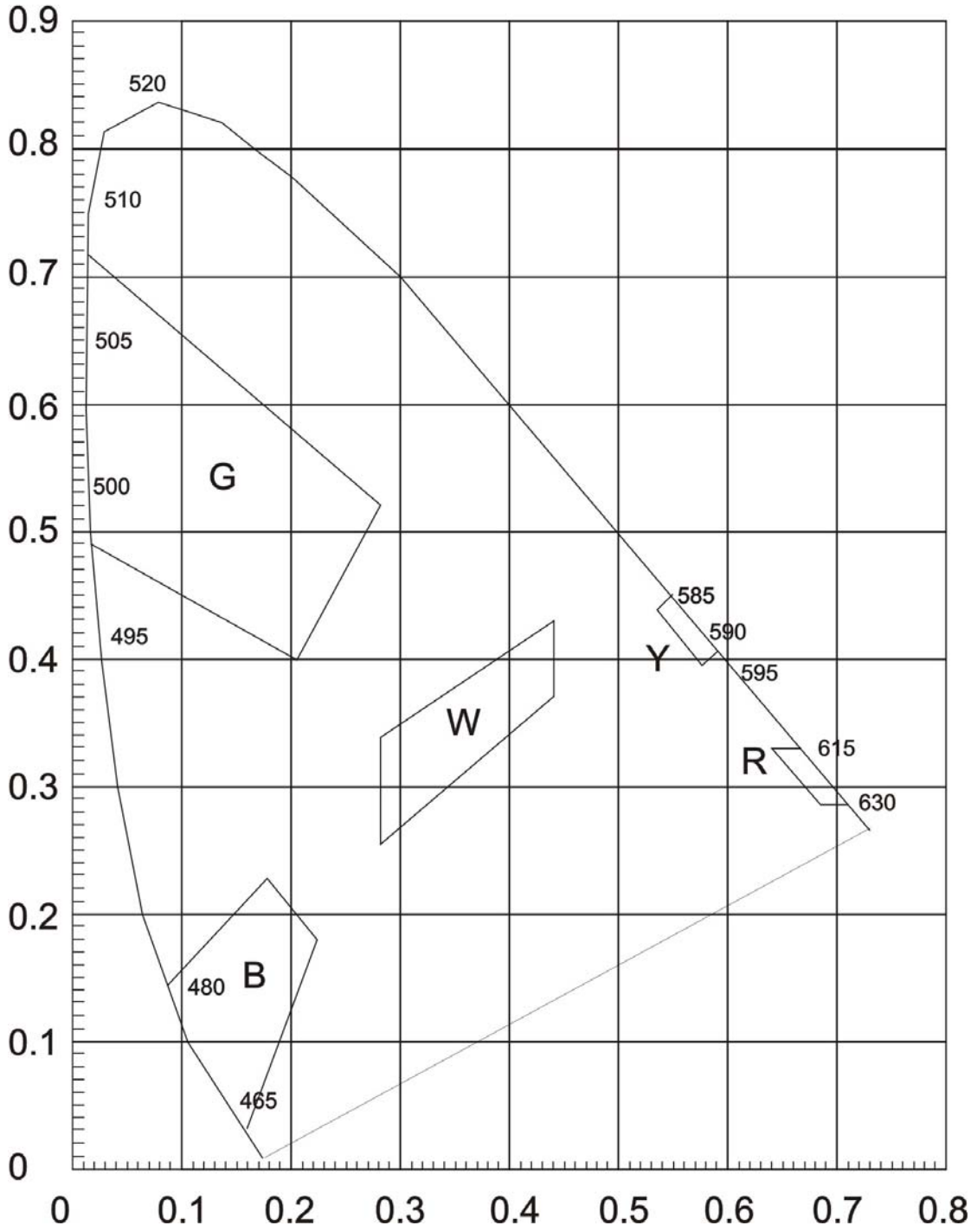


Figure A5.

A7 LIFETIME PERFORMANCE TESTING

A7.1 SCOPE

The purpose of this test is to ensure that the degradation of the VMS unit is within acceptable limits. The test is designed to measure the deterioration in performance of the optical properties of the active elements as well as the deterioration in the optical properties of any transparent protective cover.

A7.2 REQUIREMENTS

The requirements of lifetime performance testing are that:

a. after 12 months operation in the field, the Variable Message Sign shall demonstrate an optical performance as described in paragraphs A5.1, A5.2, A5.3 and A5.4 that is no less than 95% of the values determined at its initial compliance testing; and

b. after 36 months operation in the field, the Variable Message Sign shall demonstrate an optical performance as described in paragraphs A5.1, A5.2, A5.3 and A5.4 that is no less than 85% of the values determined at its initial compliance testing.

A7.3 SAMPLE PREPARATION

The sample provided at the time of the initial compliance testing will be taken and located outdoors in the same position as its intended use in the field. This will then be left to weather for 12 months. The intention is that the transparent protective cover be exposed to similar weathering conditions as the initially compliant VMS placed in the field. Consequently, it is not necessary that the discrete element module, initially provided in the casing, remains in the casing for the weathering exposure periods.

After the initially compliant sign has been operating in the field for 12 months, a module is selected from the sign face and removed. This module is then placed in the weathered casing and the tests carried out as described in paragraphs A5.1, A5.2, A5.3 and A5.4.

The casing is then placed outdoors again to continue weathering for a further 24 months *i.e.* a total of 36 months.

After the initially compliant sign has been operating in the field for 36 months, a module is selected from the sign face and removed (not the module that replaced the one that was removed at the 12 months period). This module is then placed in the casing which has now been weathered also for 36 months and the tests carried out as described in paragraphs A5.1, A5.2, A5.3 and A5.4.

APPENDIX B

Photometric Test Procedures

B1. TEST PROCEDURES FOR LUMINANCE RATIO MEASUREMENT

The measurement configuration of the VMS, the solar source and the luminance meter shall be arranged as shown in Figure B1.

The sign's illuminance over the test area shall be measured and shall be 40,000, 4000, 40 and <4 lux. The illuminance shall be uniform over the test area, the measurements of illuminance shall be within ± 10% of the nominal values.

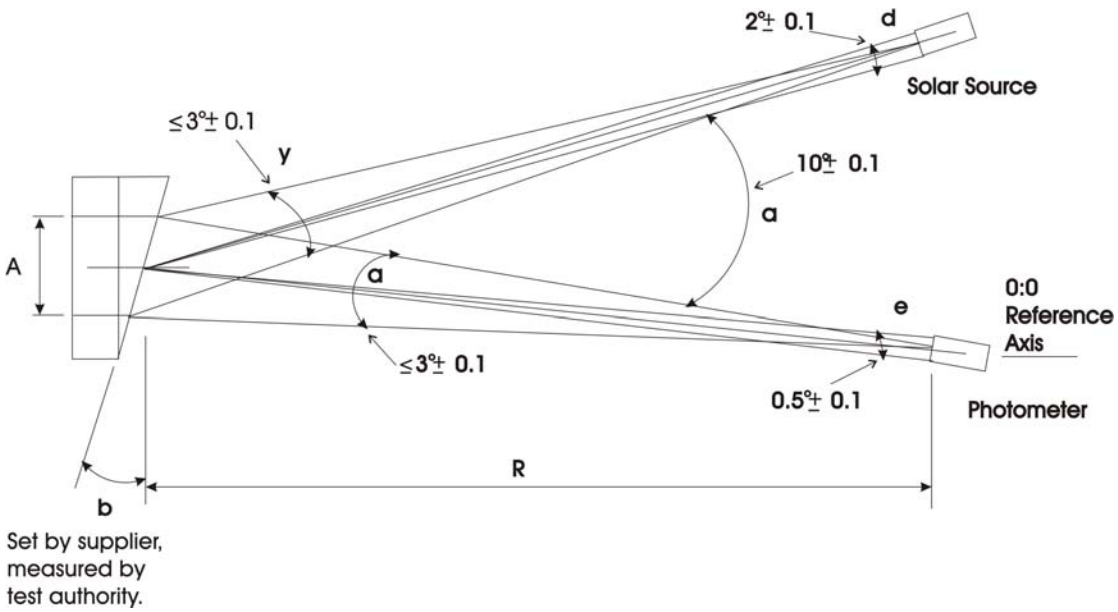


Figure B1
Geometry for Measuring Luminance Ratio

The test area must be at least 100mm in diameter or consist of a minimum of a 5x5 matrix of elements whichever is the greater (see Figure B2). For VMS with a symbolic display the test area should encompass the complete symbol.

Measurements of luminance shall be taken with the sign in the following states:

a. with all elements of the test area active (La); and

b. with all areas of the test area inactive (Lb).

B2. TEST PROCEDURES FOR LUMINANCE MEASUREMENTS

The luminance of the VMS after any adjustment to comply with the Luminance Ratio requirements is simply (La - Lb). This is the case for self-luminous signs, reflective

signs and hybrid signs. Thus the daytime luminance requirement is to be measured with an external illuminance of 40,000lux, and the two night time luminances are to be measured with no external illuminance. It is also possible to measure the luminance of the VMS that has only self-luminous elements without any external source.

The test area for luminance measurements must be at least 100mm in diameter or consist of a minimum of a 5x5 matrix of elements whichever is the greater. For VMS with a symbolic display then the test area should encompass the complete symbol.

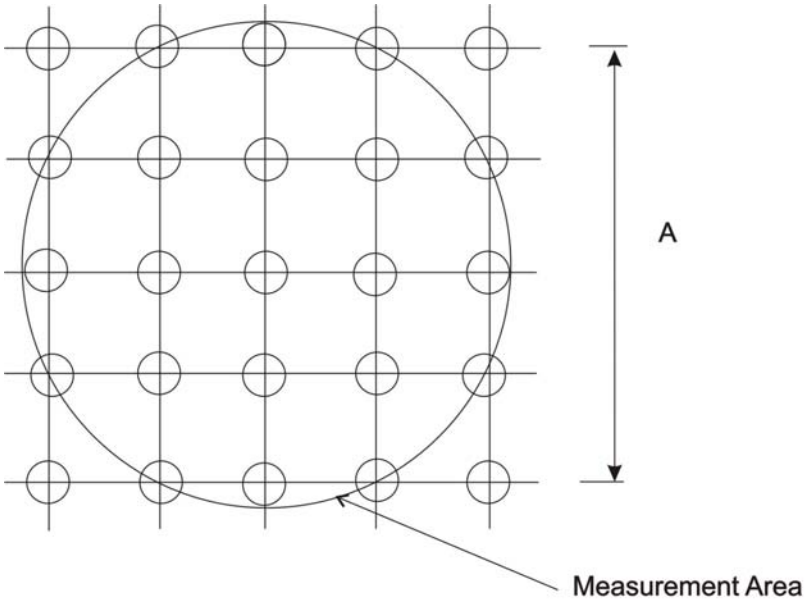
B3. VIEWING ANGLE

The viewing angle performance of the test module is to check the ability of the sign to be read from any point across a road whether the sign is located beside the roadway or cantilevered over the road. The viewing angle performance shall be determined using a series of Luminance Ratio tests. The test procedure is the same as for the Luminance Ratio test but with the luminance meter moved to the required angles or the VMS module mounted on a goniometer.

Within the field of measurement the luminance pattern shall be substantially uniform.

Test Areas

a. 5 x 5 Matrix



b. 100mm Diameter

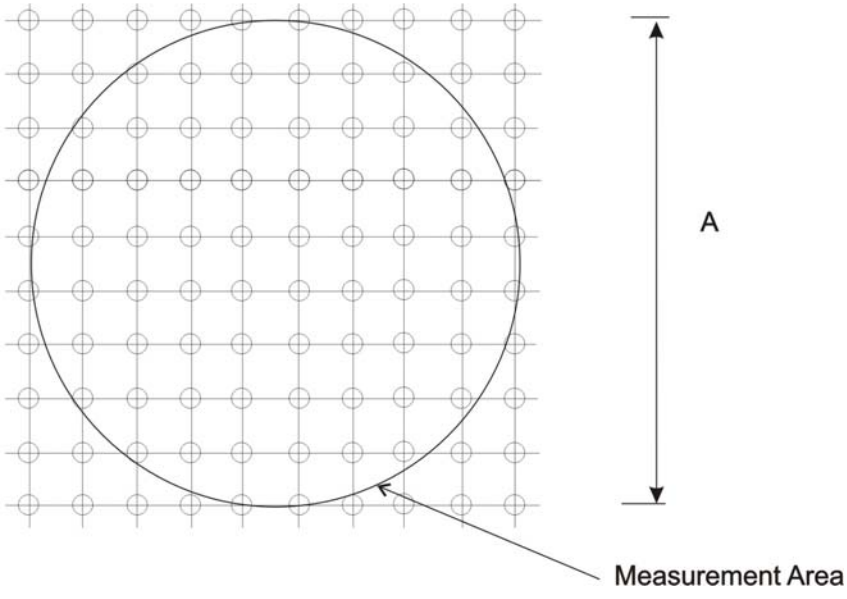


Figure B2

NOTE: “A” is a five element minimum test area (i) or 100 mm diameter test area (ii)

B4. LUMINOUS INTENSITY UNIFORMITY

Luminance or luminous intensity uniformity tests are required to ensure all the active elements can be clearly seen from any point from any point across a road or when cantilevered over the road. Misalignment of the elements could cause loss of legibility when viewed from different positions.

The luminance or luminous intensity of individual elements shall be measured on the geometric axis and at the combined positions as detailed in Table B2 without external illuminance from the solar source.

Table B2
Combined Uniformity Test Points for Each Element

Narrow Beam		Wide Beam	
Horizontal angle (°)	**Vertical angle (°)**	**Horizontal angle (°)**	**Vertical angle (°)**
-3	-2	-7	-2
+3	-2	+7	-2
0	0	0	0

The measurements of luminous intensity must be carried out at a sufficient distance from the source element that the inverse square law applies. Measurements of luminance of each source element must ensure that the element is central and completely inscribed within the measurement aperture.

A minimum of 25 adjacent individual elements shall be measured.

The following formula shall be applied to the three highest and three lowest measurements of each of the three sets of measurements:

$$\frac{\text{Average of the highest three elements}}{\text{Average of the lowest three elements}}$$

For each of the three sets of readings, this ratio shall not vary by more than that given in paragraph A5.3 of Appendix A

For each of the three sets of readings, the output of any two individual elements shall not vary by more than that given in paragraph A5.3 of Appendix A

APPENDIX C

Colormetric Test Procedures

The measurement of colour required by this specification may be made by any method which gives results of the required standard of accuracy, that is ±0.003 in the CIE 1931 chromaticity coordinates at the 95% confidence limit.

The spectral distribution of LED's is quasi-monochromatic and so the measurement of the colour of LED's is more sensitive to errors of mismatch between the spectral response of the photometer and the V(A) curve. Consequently, it is recommended in the CIE (1997) document that the photometer response should have a spectral response with "$f_1' < 1.5\%$".

Colour measurements shall be in terms of the chromaticity measurements of the CIE 1931 Standard colorimetric system.

The requirement that the measured chromaticity coordinates lie within the specified regions of the colour diagram is to aid identification by road users that have a colour deficiency.

Care should be taken that only the colour of the emitted light is measured and that adequate precautions are taken to eliminate stray light.

The colour measurement should be taken over the test area with all the elements within that area active.

The test module should be operated according to the conditions specified by the manufacturer at the daytime luminance and at the fully dimmed luminance.

The colour shall be measured along the geometric axis and at the angles specified in Table B2 of Appendix B.

APPENDIX D

Guidelines For Purchasing and Installation

INFORMATIVE

D1. DETAILS TO BE CONSIDERED AND/OR INCLUDED WHEN TENDERING

When tendering, the following details should be considered and included in the tender document as required:

- The total number of lanes to be covered;
- The use of speed indicator signs only or the use of a full VMS sign;
- The installation of a suitable gantry
- The installation of guard rail (where required);
- The installation of a new CCTV camera (where required) to enable the TMC to observe the signs operation (specifically where a full VMS is installed);
- Availability of power and communications;
- The supply and installation of associated static signage (see Appendix F for details of drawings); and
- The requirement to supply and install stickers on each gantry, in accordance with either standard drawing TC-2100 for Standard Cabinet Label or standard drawing TC-2105 for Pedestal Controller Label, displaying the site number.

D2. DOCUMENTATION

The contractor shall be required to provide, as a minimum, the following documentation with the tender submission:

- Details of the proposed speed indicator system sign displays;
- Details of the proposed technology to be used for speed detection;
- Documentation demonstrating compliance with this specification in accordance with Appendix B;

The contractor shall be required to provide, as a minimum, the following documentation at the completion of works:

- a schematic diagram or chart showing the, as supplied, electrical circuits contained within the system;
- a schematic diagram showing the 'As Built' installation and cabling of the system. A copy of this diagram should be included within the local control cabinet;
- a list of all major electrical sub-components detailing their electrical characteristics and operational limits;
- any and all operational and maintenance requirements to ensure the optimal operation of the system;
- a schedule of spare components recommended for retention for service and/or fault maintenance purposes. The contractor should be required to maintain a stock of such items until the expiration of the defects liabilities period. (VicRoads may elect to purchase all or part of the recommended maintenance stocks upon the completion of the defects liabilities period); and
- two (2) separate copies of the sign control system and maintenance software, together with a complete protocol listing for the software.

APPENDIX E

Requirements For Acceptance

E1 GENERAL

Speed detection systems shall not be subject to VicRoads formal Type Approval process.

Rather, speed detection systems shall be subject to acceptance in accordance with the requirements of individual tender documents. This acceptance process shall generally require the contractor to demonstrate compliance with this specification and the relevant contract specific clauses of individual tender documents.

E2 REQUIRED COMPLIANCE

As a minimum, Contractors must demonstrate compliance with the following:

a) IP65 rating in accordance with clause 4.1 (Test report or certificate from a NATA approved facility);
b) Optical and photometric compliance;
c) EMC certification in accordance with clause 7.4 (Test report or certificate from a NATA approved facility); and
d) Accuracy and reliability of the speed detection laser.

E3 SIGN ACCEPTANCE

For the purpose of individual sign acceptance the contractor shall arrange:

a) undertaking of a controlled seven day continuous "burning in" test program designed to operated all mechanical and electrical/electronic aspects of the system including pixel, lights, monitoring and communications;
b) an inspection of the sign at operational stage, sign housing and control equipment (including remote operation equipment) at an agreed location;
c) submission of all required documentation and relevant details of compliance of the sign and system as specified; and
d) a demonstration of the programming, operation and monitoring facilities of the sign (including remote operation) where a VMS is used.

The sign acceptance shall be subject to satisfactory compliance by the contractor to each of the above items and the submission of verified test reports relating to same.

APPENDIX F

Associated Standard Drawings

LEGEND

Dimensions

Dimensions from left edge of sign

557 235 823 348

Dimensions to left Extremity of Letters

A 0	S 0	A 0	B 0
D 264	P 223	H 264	O 209
V 470	E 448	E 508	T 418
I 712	E 661	A 700	H 623
S 814	D 873	D 964	785
O 1017	1035	1125	L 1029
R 1250	C 1242		A 1212
Y 1453	H 1470		N 1476
1656	E 1714		E 1720
	C 1908		S 1914
	K 2135		2075
	2300		

OVERALL SIZE OF SIGN (mm) : 2770 x 1950
SURFACE AREA OF SIGN (sq m) : 4·72

NOTES: (As applicable)

- All dimensions are in millimetres
- Legend and border - RETROREFLECTIVE BLUE CL.2
- Background and edgestrip - RETROREFLECTIVE WHITE CL.2
- Sign to be manufactured in accordance with VICROADS Specification 860.

ADDITIONAL NOTES:

- "BOTH LANES" - 2 LANE CARRIAGEWAY
- "ALL LANES" - 3 OR MORE LANE CARRIAGEWAY.

LEGEND

Dimensions

Dimensions from left edge of sign

446

Dimensions to left Extremity of Letters

A 0	
L 264	
L 467	
614	
L 832	
A 1016	
N 1279	
E 1524	
S 1717	
1879	

ISSUE	APP'D	DATE	AMENDMENT
E			
D			
C			
B			
A			

GENERAL NOTES

(REFER ABOVE)

DESIGNED P. VAN REYK APR 2002

APPROVED T. KANE APR 2002

CATALOG: PTED PROJECT: stdsigns

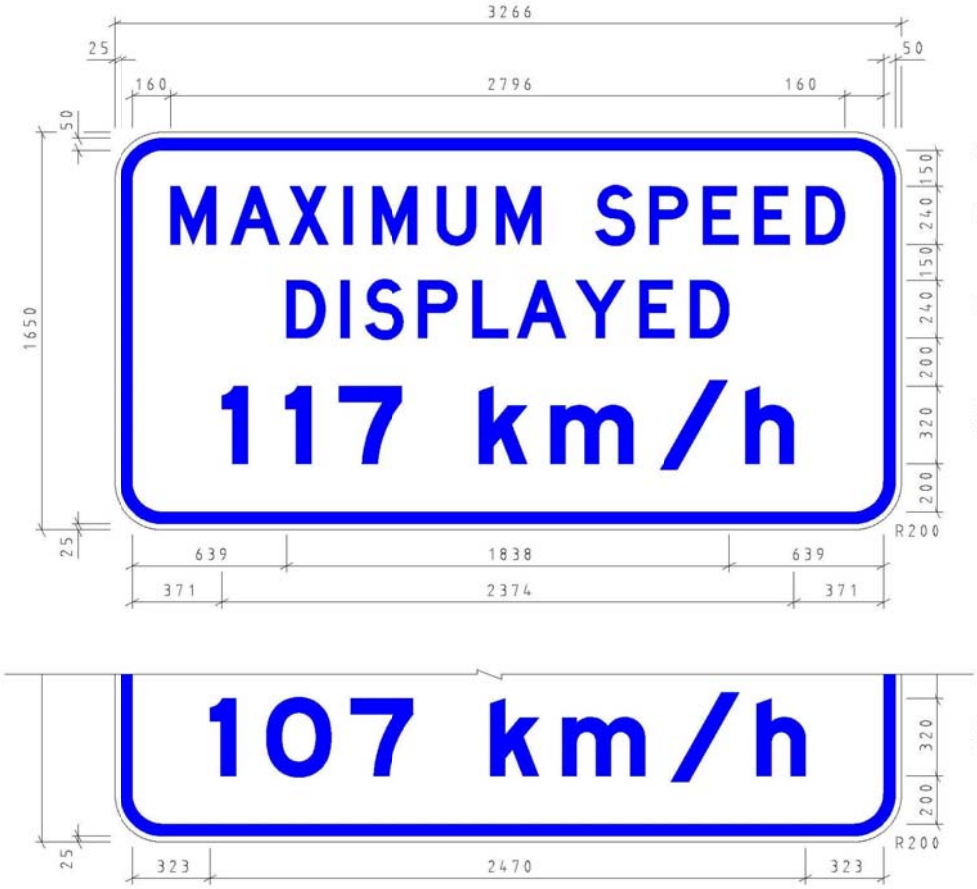
vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

COMPUTER FILE: 445812.dgn

SCALE OF METRES HOR N.T.S. VER

ADVISORY SPEED CHECK AHEAD BOTH OR ALL LANES SIGN
P1-V137

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
			445812	



Series

240 DM

240 DM

320 E Mod/
240 L. C.

320 E Mod/
240 L. C.

LEGEND

Dimensions

Dimensions from left edge of sign

235 714 446

Dimensions to left Extremity of Letters

M 0 D 0 1 0
A 249 I 225 1 263
X 492 S 327 7 486
I 716 P 549 749
M 836 L 774 k 1068
U 1106 A 958 m 1364
M 1350 Y 1200 / 1800
1536 E 1464 h 2173
S 1761 D 1676 2374
P 1984 1838
E 2209
E 2422
D 2634
2796

OVERALL SIZE OF SIGN (mm) : 3266 x 1650
SURFACE AREA OF SIGN (sq m) : 5·39

NOTES: (As applicable)

- All dimensions are in millimetres
- Legend and border - RETRORELECTIVE BLUE CL.2
- Background and edgestrip - RETROREFLECTIVE WHITE CL.2
- Sign to be manufactured in accordance with VICROADS Specification 860.

ADDITIONAL NOTES:

- 117 km/h FOR 110 km/h SPEED ZONE
- 107 km/h FOR 100 km/h SPEED ZONE.

LEGEND

Dimensions

Dimensions from left edge of sign

398

Dimensions to left Extremity of Letters

1 0
0 233
7 582
845
k 1164
m 1460
/ 1896
h 2269
2470

ISSUE	APP'D	DATE	AMENDMENT
E			
D			
C			
B			
A			

GENERAL NOTES

(REFER ABOVE)

DESIGNED: P. VAN REYK APR 2002

APPROVED: T. KANE APR 2002

CATALOG: PTED
PROJECT: stdsigns

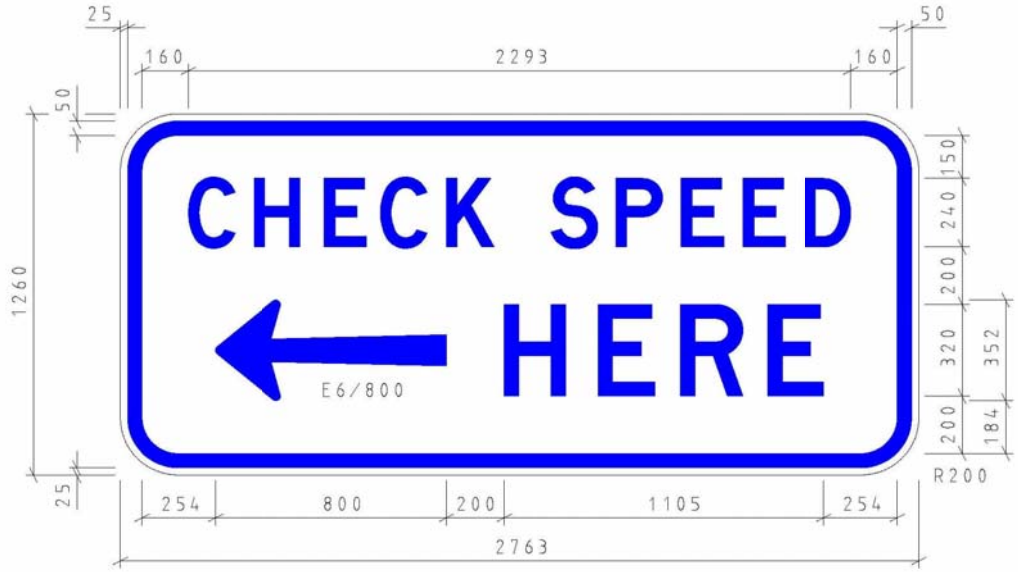
vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

COMPUTER FILE: 445813.dgn

SCALE OF METRES HOR N.T.S. VER

MAXIMUM SPEED DISPLAYED 117 km/h OR 107 km/h SIGN P1-V138

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
			445813	



Series	LEGEND		
	Dimensions		
	Dimensions from left edge of sign		
	235	1329	
	Dimensions to left Extremity of Letters		
240 DM	C	0	H 0
	H	228	E 326
	E	472	R 609
	C	666	E 910
	K	893	1105
		1058	
320 DM	S	1258	
	P	1481	
	E	1706	
	E	1919	
	D	2131	
		2293	

OVERALL SIZE OF SIGN (mm) : 2763 x 1260
SURFACE AREA OF SIGN (sq m) : 3·48

NOTES: (As applicable)

- All dimensions are in millimetres
- For Arrow details refer to Dwg No: 18906B
- Legend, arrow and border - RETRORELECTIVE BLUE CL.2
- Background and edgestrip - RETROREFLECTIVE WHITE CL.2
- Sign to be manufactured in accordance with VICROADS Specification 860.

ISSUE	APP'D	DATE	AMENDMENT
E			
D			
C			
B			
A			

GENERAL NOTES
(REFER ABOVE)

DESIGNED
P. VAN REYK APR 2002

APPROVED
T. KANE APR 2002

CATALOG: PTED
PROJECT: stdsigns

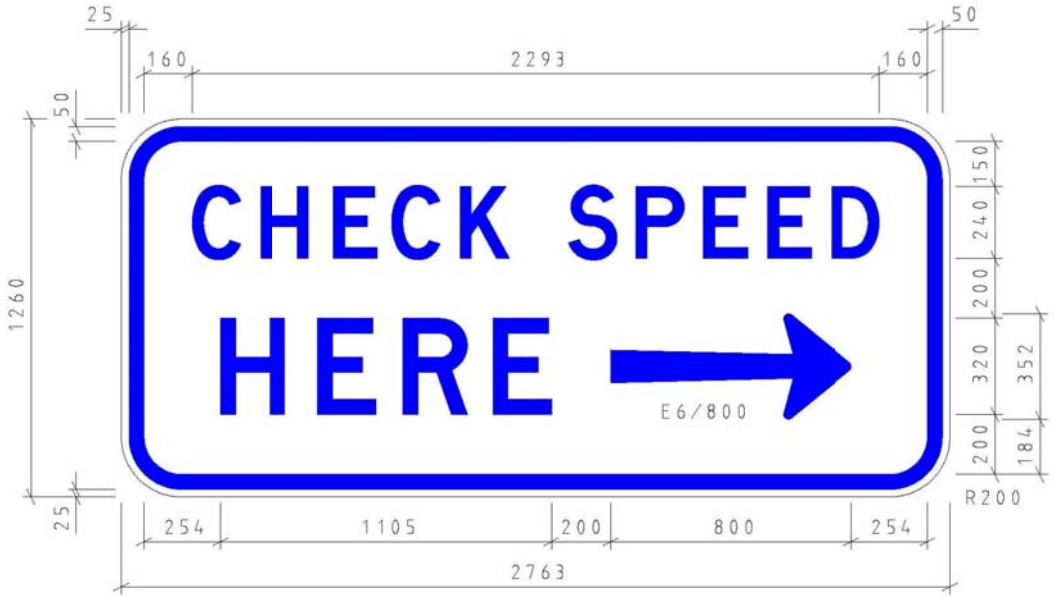
vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

COMPUTER FILE
445815.dgn

SCALE OF METRES HOR N.T.S. VER

CHECK SPEED HERE (LEFT) SIGN
P1-V139(L)

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
			445815	



Series	LEGEND
	Dimensions
	Dimensions from left edge of sign
	235 329
	Dimensions to left Extremity of Letters
240 DM	C 0 H 0
	H 228 E 326
	E 472 R 609
	C 666 E 910
	K 893 1105
320 DM	1058
	S 1258
	P 1481
	E 1706
	E 1919
	D 2131
	2293

OVERALL SIZE OF SIGN (mm) : 2763 x 1260
SURFACE AREA OF SIGN (sq m) : 3·48

NOTES: (As applicable)

- All dimensions are in millimetres
- For Arrow details refer to Dwg No: 18906B
- Legend, arrow and border - RETRORELECTIVE BLUE CL.2
- Background and edgestrip - RETROREFLECTIVE WHITE CL.2
- Sign to be manufactured in accordance with VICROADS Specification 860.

ISSUE	APP'D	DATE	AMENDMENT
E			
D			
C			
B			
A			

GENERAL NOTES
(REFER ABOVE)

DESIGNED: P. VAN REYK APR 2002
APPROVED: T. KANE APR 2002
CATALOG PTED
PROJECT: stdsigns

vicroads design
ENGINEERING & TECHNOLOGY CONSULTANTS

COMPUTER FILE: 445814.dgn
SCALE OF METRES HOR N.T.S VER

CHECK SPEED HERE (RIGHT) SIGN
P1-V139(R)

FILE NO.	CONTRACT NO.	SHEET NO.	DRAWING NO.	ISSUE
			445814	