VICROADS SPECIFICATION

TCS 026 – 4 – 2011

The Supply

Of

Trip Condition Signs

Issue Date: January 2011

Forward

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

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

VicRoads Standard Drawings, Specifications and Guidelines are available for downloading from VicRoads online bookshop at http://webapps.vicroads.vic.gov.au/vrne/vrbscat.nsf under 'Intelligent Transport Systems'.

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.

Road User Services
60 Denmark Street Kew 3101

Phone: (03) 9854 2103 Fax: (03) 9854 2319

Amendments

Contents

SECTION 1 – SCOPE AND GENERAL

1.1 SCOPE

1.1.1 This Specification covers the design and manufacture of Trip Condition Signs for use with the Drive Time System within the State of Victoria.

1.1.2 The Drive Time System provides real time, traffic density and travel time information on Melbourne's road network to road users through a number of electronic media. The Trip Condition Sign is one of a number of road-side information message devices through which the information is disseminated.

1.1.3 The sign shall generally be mounted behind the left shoulder of the road such that it is clearly visible from each lane of the carriageway of the approach to which the sign applies.

1.2 GENERAL

1.2.1 The sign shall provide legible, changeable, numeric information relating to travel time to nominated destinations together with changeable real time information regarding current traffic conditions on the route.

1.2.2 When activated, the changeable message may display one of the following messages:

- "LIGHT", "MEDIUM", "HEAVY" or "CLOSED" relating to the current traffic congestion level in the relevant section of the route.

1.3 DISPLAY TECHNOLOGIES

1.3.1 This specification has been developed based on the use of LED technology.

1.3.2 Other technologies that meet the photometric requirements of this specification may be considered.

1.4 RELATED SPECIFICATIONS AND DRAWINGS

1.4.1 The fabrication and supply of all components for Trip Condition Signs shall conform with all relevant Australian Standards.

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

1.4.3 The following related specifications and standard drawings are defined:

- AS/NZS 1170 Structural design actions
- AS/NZS 1170.2 Structural design actions—General principles
- AS 1742 Manual of uniform traffic control devices
- AS 1743 Road Signs—Specifications
- AS 1744 Standard alphabet for roads signs
- AS/NZS 3000 Wiring rules
- AS 4100 Steel structures
- AS 60038 Standard voltages
- AS 60529 Degrees of protection provided by enclosures for electrical equipment (IP code)
- AS/NZS 61000.6.1 Part 6.1: Generic standards—Immunity for residential, commercial and light-industrial environments
- AS/NZS 61000.6.3 Part 6.3: Generic standards—Emission standard for residential, commercial and light-industrial environments
- AS/NZS 61558 Safety of power transformers, power supply units and similar

SECTION 2 – SIGN REQUIREMENTS

2.1 GENERAL

2.1.1 The sign shall be constructed from marine grade aluminium alloy 5251 H32 to AS/NZS 1734, and treated to ensure optimum performance under prolonged exposure to atmospheric and site conditions prevalent in the Melbourne and Metropolitan area. The sign shall be rated to withstand the effects of solar radiation and the completed structure shall be rated to withstand wind forces for the region as defined in AS 1170.2 for a period not less than 15 years.

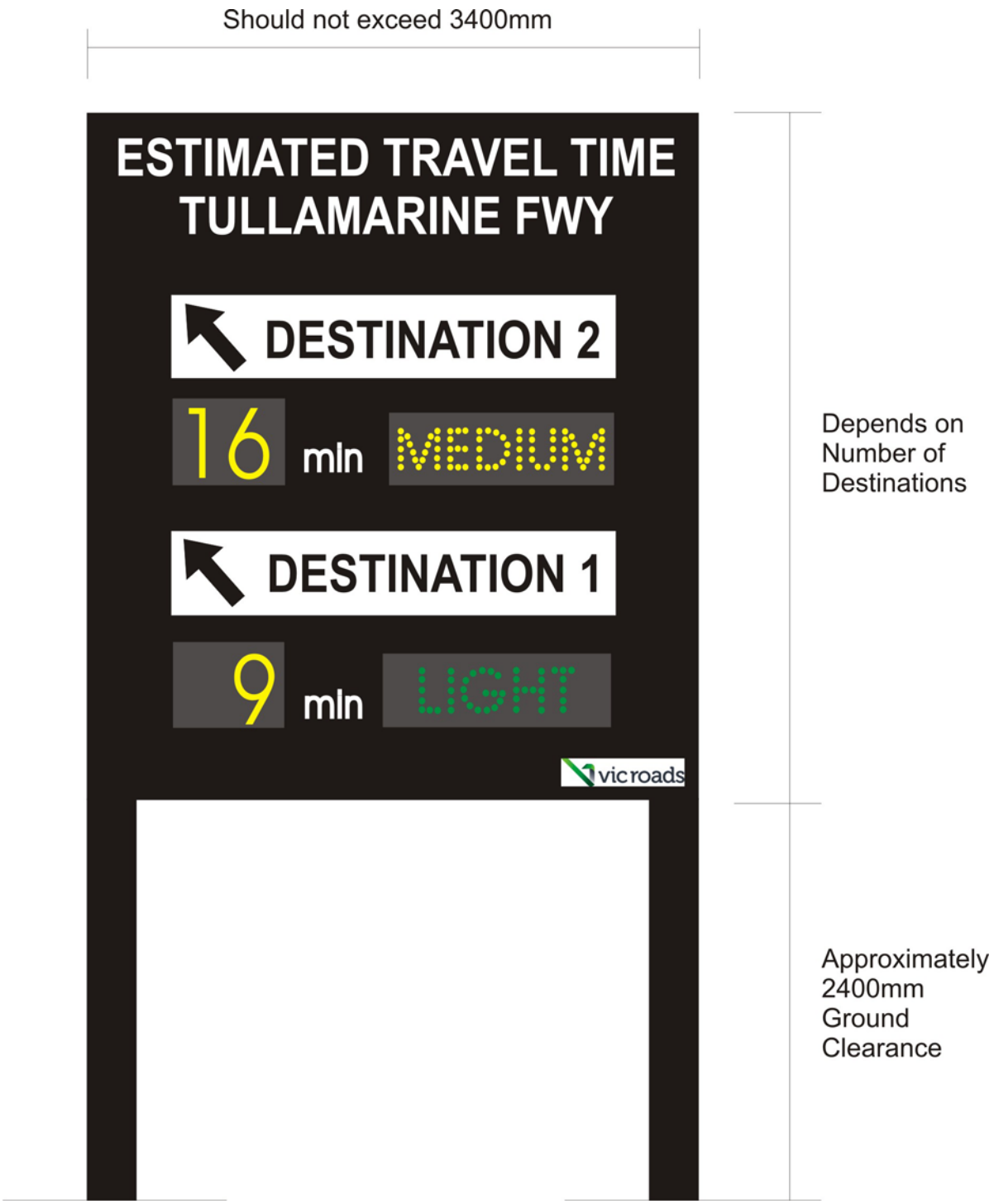
2.2 SIGN CONSTRUCTION

2.2.1 The general construction requirements for the sign are such that:

- dimensions should not exceed those shown in Figure 1;
- all surfaces of the sign (including all structural supports and/or bracing components) are suitably treated (e.g. Polyester powder coated) to ensure prolonged operation within the intended application;
- the colour of all exposed metal surfaces on the sign face shall be black and shall be a matte finish;
- the rear may be matte gray;
- all surfaces of the signs shall be free from sharp edges or protrusions;
- 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.

2.2.2 The completed sign shall incorporate:

- ready access from the rear of the sign to all integral display, control and communications components via hinged panels capable of being opened by a single operator and incorporating approved locks (e.g. Southco) with VicRoads standard key for routine and/or fault maintenance purposes;
- rear safety access platforms suitably located to provide standing access to the integral components together with suitable fixed means of travel between the platforms. This requirement is intended to remove the need for a travel tower for each attendance to the sign. Such platforms shall not be accessible from ground level without the use of a ladder or steps;
- suitable venting and (if necessary) a fan forced air circulation system to ensure suitable conditions for ongoing operation of all integral display, control and communication components;
- an approved moisture inhibitor system.



Note: This is an indicative sketch only – NOT TO SCALE

Figure 1

SECTION 3 – DISPLAYS

3.1 GENERAL

3.1.1 The finished signs shall have display layouts similar to that shown in Figure 1. Individual elements of the display shall comply with the general requirements listed below.

3.1.2 Specific destination details shall be provided in individual tender documents.

3.2 DISPLAY FACE

3.2.1 The display face shall be constructed from high impact, anti-glare clear plastic sheeting of casting grade acrylic copolymer or polycarbonate.

3.2.2 The static “destination” information on the display face shall be provided as black lettering (on a white background) complying to the requirements of AS 1742, AS 1743 and AS 1744.

3.2.3 The static display area shall be internally illuminated using uniform dimmable lighting, free from internal shadows for all static sections of the display. The lighting shall be activated by an integral light sensing device and by command generated from the control system.

3.2.4 The on site dimming system shall contain not less than ten (10) discrete levels of dimming that can be automatically adjusted depending on the level of ambient light.

3.2.5 The contractor shall submit details of the peak normal and dimmed operational loads of the sign at the time of tender.

3.2.6 The VicRoads logo located at the bottom right hand side of the display face shall be a retro reflective (diamond grade) sticker, in VicRoads standard format and colours and be approximately 500mm in length.

3.3 TRAVEL TIME NUMERIC INDICATION PANELS

3.3.1 The Travel Time displays shall be generated by LED’s (or other approved method) in a two digit numeric format which appears white, yellow or yellow/green in colour in the active state and matte black in the inactive state.

3.3.2 When displaying numerals ‘1’ through ‘9’, no leading ‘0’ shall be displayed.

3.3.3 Each character shall have a nominal height of approximately 300mm with a character width to height ratio not less than 0.7:1. Each digit shall be centrally placed within the individual character matrix provided. Each numeral within a two digit array shall be separated by a spacing not less than twice the stroke width of the provided character.

3.3.4 The numeric display shall be visible through a clear, anti-glare window section within the display face and be centred within the module. The size of this section shall be designed such that the sides and bottom edges of the numeric display are fully visible at viewing angles of 45^{o} and 30^{o} respectively to the 0.0 axis of the sign face.

3.3.5 The pixel modules shall be capable of being removed and re-instated in-situ by hand and the construction and design of the cabinet, framework and electronic driver networks should facilitate same. The pixel display system shall incorporate an appropriately designed dimming circuit.

3.4 COLOUR CODED TRAFFIC CONDITION INDICATOR

3.4.1 The Colour Coded Traffic Condition Indicator shall be generated by LED technology fabricated in a matrix format which appears green, yellow or red in colour in the active state and matte black in the inactive state.

3.4.2 The required displays for use in the Sign are:

"LIGHT"	in	Green
"MEDIUM"	in	Yellow
"HEAVY"	in	Red
"CLOSED"	in	Flashing Red

3.4.3 The colours of the light output for all of the above displays shall be in accordance with AS-2144 (traffic signal lanterns). Character heights shall be approximately 250mm with a width to height ratio should be no less than 0.7:1.

3.4.4 LEDs shall comply with the performance requirements detailed in Appendix B of this specification.

SECTION 4 – CONTROL SYSTEM

4.1 GENERAL

4.1.1 The control system for the sign shall be capable of switching any of the required displays via remote operations communicating with VicRoads.

4.1.2 The communications medium shall be specified in individual tender documents. The typical methods are Next G™ or Fibre optic cable.

4.1.3 The remote operation shall also be capable of running a test procedure on the sign. The test procedure shall include the ability to initiate a continuous cycling operation of each individual display function and light settings.

4.1.4 In addition, the sign shall have the facility to locally switch the static display, numeric travel time displays and the colour coded traffic condition indicator display. The operation of testing shall be through push buttons for each function and shall be housed in a termination box incorporating approved locks with VicRoads standard key.

4.2 COMMUNICATION PROTOCOL

4.2.1 Each sign shall have multiple buffers, each buffer representing the segment and associated travel time information.

4.2.2 In the example below, “sign #5" has one segment. To command the sign to display travel time of 9 minutes with the respective traffic condition indicator colour of yellow, the data commands would be as follows:

>xx05K0109ycc<cr>

Where	'>'	is the start byte
	‘xx’	is the unique packet identifier (2 character ascii encoded hex (00-ff))
	‘05'	is the sign number (ascii encoded hex)
	‘K’	is the command to control an output
	01	is the segment number
	09	is the travel time data
	r, y, g	is the colour and operation of the associated Traffic Condition Indicator, where; r=Heavy y=Medium g=Light
	cc	is the checksum

4.3 MONITORING

4.3.1 The system shall be capable of monitoring the operation of the sign and generating a series of distinguishable status messages when interrogated from the remote location. Typical message information includes:

a. the loss of communications with the sign;
b. the loss of mains power at the sign;
c. the unique numeric digits being driven (or instructed to be driven) for the sign;
d. the status of the internal illumination and any failure of same.

4.4 FALL-BACK

4.4.1 The system shall incorporate the ability to automatically fall-back to a "blank" (blacked out) display where:

a. mains power is lost at the sign;
   or
b. the communications to or from the sign are lost or adversely affected;
   or
c. a serious malfunction in the control or switching of any element which may lead to inappropriate or misleading displays being generated is detected.

SECTION 5 – ELECTRICAL REQUIREMENTS

5.1 GENERAL

5.1.1 The electrical installation for the sign and associated components shall comply with all relevant requirements of AS/NZS 3000.

5.1.2 Transformers used within the sign and/or sign control system shall comply with AS/NZS 61558.

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

5.1.4 The modules and associated driver network and the control and communications equipment shall operate at extra low voltage (ELV). All ELV operations shall have a suitably enclosed and secure isolation point at ground level.

5.1.5 The electrical system shall incorporate the following facilities:

i. A circuit-breaker board comprising appropriately rated mains isolation switch and circuit breaker;
ii. The ability to be isolated from mains supply at ground level using a suitable switch/breaker system.

5.2 OPERATING VOLTAGE

5.2.1 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%.

5.3 INTERNAL PROTECTION

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

i. Lightning striking at or near the sign/gantry;
ii. Electrical transients on power cabling;
iii. Electrical transients on communications wiring;
iv. Radio frequency interference;
v. Static electrical discharge.

SECTION 6 – ENVIRONMENTAL REQUIREMENTS

6.1 TEMPERATURE AND HUMIDITY

6.1.1 The sign and associated equipment shall be designed to operate under any combination of the following conditions:

a. Ambient air temperatures within the range –15°C to 50°C;
b. Insolation of up to 1000 W/m2, incident at an angle of 30° from the vertical, applied to the maximum exposed surface of the equipment.

NOTE: Where it is not practical to provide the required insolation during testing, it is acceptable to increase the upper ambient temperature limit by 10°C as a substitute.

6.1.2 Consideration shall be given to protection against the effects of high humidity, including condensation following a drop in ambient temperature.

6.2 ENCLOSURE PROTECTION

6.2.1 The following levels of enclosure protection in accordance with AS 60529 shall be provided:

a. IP65 for the complete sign enclosure;
b. IP45 for the complete control housing.

6.3 WIND LOADING

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

6.3.2 Notwithstanding, the minimum wind-loading conditions applicable shall be those for Region A, Terrain Category 2 in accordance with AS/NZS 1170.2.

6.4 ELECTROMAGNETIC COMPATIBILITY (EMC)

6.4.1 Immunity

6.4.1.1 The sign shall comply with the relevant requirements of AS/NZS 61000.6.1.

6.4.2 Electromagnetic emissions

6.4.2.1 The sign shall comply with the relevant requirements of AS/NZS 61000.6.3.

SECTION 7 – STRUCTURAL REQUIREMENTS

7.1 GENERAL

7.1.1 Unless otherwise specified in individual documents, the sign is to be centrally mounted on suitably designed columns (2 off) and associated footings. A mower strip not less than 0.5 m larger than the base projection of the sign cabinet shall be installed (at ground level) around the base of the columns.

7.1.2 The design of all structural steel work shall be carried out in accordance with the relevant requirements of AS 4100 and AS/NZS 1170, except where otherwise stated in the Specification.

7.1.3 All structural components of the project shall be designed for an operating life of 100 years, except where otherwise stated in the Specification.

7.1.4 Design of the structure shall be proof engineered by an independent engineering consultant and the details provided to VicRoads.

7.2 MOUNTING STRUCTURE

7.2.1 The mounting method shall ensure that the rear section of the housing and the face of the display modules are vertical. The sign shall be suitably aligned to point to the centre of the proposed carriageway at a distance of 250 metres from the face of the sign. Suitably designed struts or braces within the housing shall be used to ensure stability of the installed sign. Detailed plans of the footings, columns and associated fixtures shall be provided to VicRoads for review (for a period of seven (7) days) prior to manufacture of same.

7.2.2 Access for all power supply, control and communication cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.

7.2.3 Except where otherwise approved, ground clearance shall be in accordance with the requirements of AS 1742.2.

APPENDIX A

MISCELLANEOUS

(INFORMATIVE)

The following information should be requested as part of the tender requirements:

A1. MAINTENANCE

A1.1 The contractor should provide a proposed schedule for routine operational checks and preventative maintenance tasks to be performed on the sign and system equipment for the long term use of the sign by others.

A2. SPARE COMPONENTS

A2.1 The contractor should provide a schedule of spare components recommended for retention for service and/or fault maintenance purposes and shall maintain a stock of such items until the expiration of the defects liability period.

A2.2 VicRoads should consider the purchase of all or part of the recommended maintenance stocks upon the completion of the defects liabilities period.

A3. DOCUMENTATION

A3.1 Commissioning of Sign

A3.1.1 Prior to the commissioning of the sign and associated system, the contractor should provide:

a. a statement detailing the warranty provisions associated with the sign and associated systems;
b. one (1) bound copy of the final design drawings and "as built" installation details of the unit;
c. one (1) bound copy of the "Operation and Maintenance" manual for the sign, local control and remote control systems detailing the functionality of all components and suggested maintenance schedule;
d. recommendations for routine maintenance tasks on the sign and associated system;
e. recommendations on spare parts;
f. wiring and cabling layouts and circuit diagrams;
g. manufacturer's specifications (catalogue extracts) of all major components detailing ratings and performance characteristics of same;
h. a schematic layout of sign components and interconnection diagrams;
i. all component compliance details as required or implied under this document; and
j. all test reports conducted by the contractor to ensure compliance to the specification.

A3.1.2 The supplier shall submit test results from a NATA accredited testing organisation to demonstrate compliance with the following:

Clause 6.2	IP rating
Clause 6.4	EMC compliance
Clause B1.	Photometric performance requirements

A4. SIGN ACCEPTANCE

A4.1 For the purpose of acceptance of the sign the contractor should be required to arrange:

a. undertaking of a controlled seven (7) day continuous "burning in" test program designed to operate all mechanical and electrical/electronic aspects of the system including pixel, lights, monitoring and communications;
b. an inspection of the sign, sign housing and control equipment (including remote communications equipment) at an agreed location;
c. submission of all required documentation and relevant details of compliance of the sign and system as specified;
d. a demonstration of the operation and monitoring facilities of the sign (including remote operation).

A4.2 The acceptance of the sign should be subject to satisfactory compliance by the contractor to each of the above items and the submission of verified test reports relating to the same.

A5. COMMISSIONING

A5.1 The contractor shall be responsible for the commissioning of the whole system including:

a. full sign operation and associated control equipment;
b. access for local display switch for maintenance purposes;

A6. LIFETIME PERFORMANCE TESTING

A6.1 Lifetime performance testing should be specified in individual tender documents and carried out in accordance with Appendix B3.

APPENDIX B

LIGHT EMITTING DIODES

Any Light Emitting Diodes (LEDs) used to create the displays for this sign shall meet the following general requirements:

B1. PHOTOMETRIC REQUIREMENTS

B1.1 Luminance Ratio

B1.1.1 The Luminance Ratio levels are set so that the presence of external sources of light will not cause a lowering of the contrast of the display such that it becomes ineffective. If the 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 C.

B1.1.2 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	-	-

B1.2 Luminance

B1.2.1 The signs are to be used 24 hours a day in which case 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, 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 C.

B1.2.2 Luminance Requirements:

Ambient Lighting Condition	White or Yellow Legend		Red or Green Legend	
	Min. Luminance (cd/m^2)	Max Luminance (cd/m^2)	Min. Luminance (cd/m^2)	Max Luminance (cd/m^2)
Daytime	6000	60,000	2500	25,000
Night-time/ Urban/ Lighting	300	3000	150	1500
Night-time/ No Lighting	50	300	30	300

B1.2.3 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.

B1.3 Luminance or Luminous Intensity Uniformity

B1.3.1 The luminance or luminous intensity uniformity shall be met for each colour and each intensity setting. For reflective elements, the luminance or luminous intensity uniformity shall be met for daytime and nighttime conditions.

B1.3.2 The luminance or luminous intensity of any two elements shall not vary by more than the ratio of 5:1.

B1.3.3 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.

B1.3.4 The test procedures for the measurement of luminance or luminous intensity are given in Appendix C.

B1.4 Viewing Angle

B1.4.1 There are two separate requirements for viewing angle. The measurement criteria for viewing angle is the minimum Luminance Ratio (LR).

B1.4.2 The Luminance Ratio requirements as set out in the Table below are to be achieved at $\pm$ 10^o horizontal and $\pm$ 2.5^o vertical.

B1.4.3 Viewing Angle - Luminance Ratio Requirements:

Sign Illuminance (lux)	Minimum Luminance Ratio (LR)	
	White or Yellow Legend	Red or Green Legend
40,000	5	3
<4	5	3

B2. COLOURS

B2.1 When tested in accordance with Appendix E, the light emitted by each colour present in the message must comply with the chromaticity coordinates in the Table below and illustrated in Figure 2.

B2.2 Chromaticity Coordinates:

Colour		**1**	**2**	**3**	**4**
Red	x y	0.690 0.290	0.710 0.290	0.680 0.320	0.660 0.320
Yellow	x y	0.536 0.445	0.545 0.454	0.592 0.407	0.583 0.398
Restricted Yellow *	x y	0.535 0.445	0.545 0.454	0.566 0.415	0.575 0.424
Green	x y	0.009 0.720	0.284 0.520	0.207 0.397	0.012 0.494
Blue	x y	0.090 0.137	0.186 0.214	0.233 0.167	0.148 0.025
White	x y	0.440 0.382	0.285 0.264	0.285 0.332	0.440 0.432

*Restricted Yellow colour will be used whenever Red and Yellow are used together.

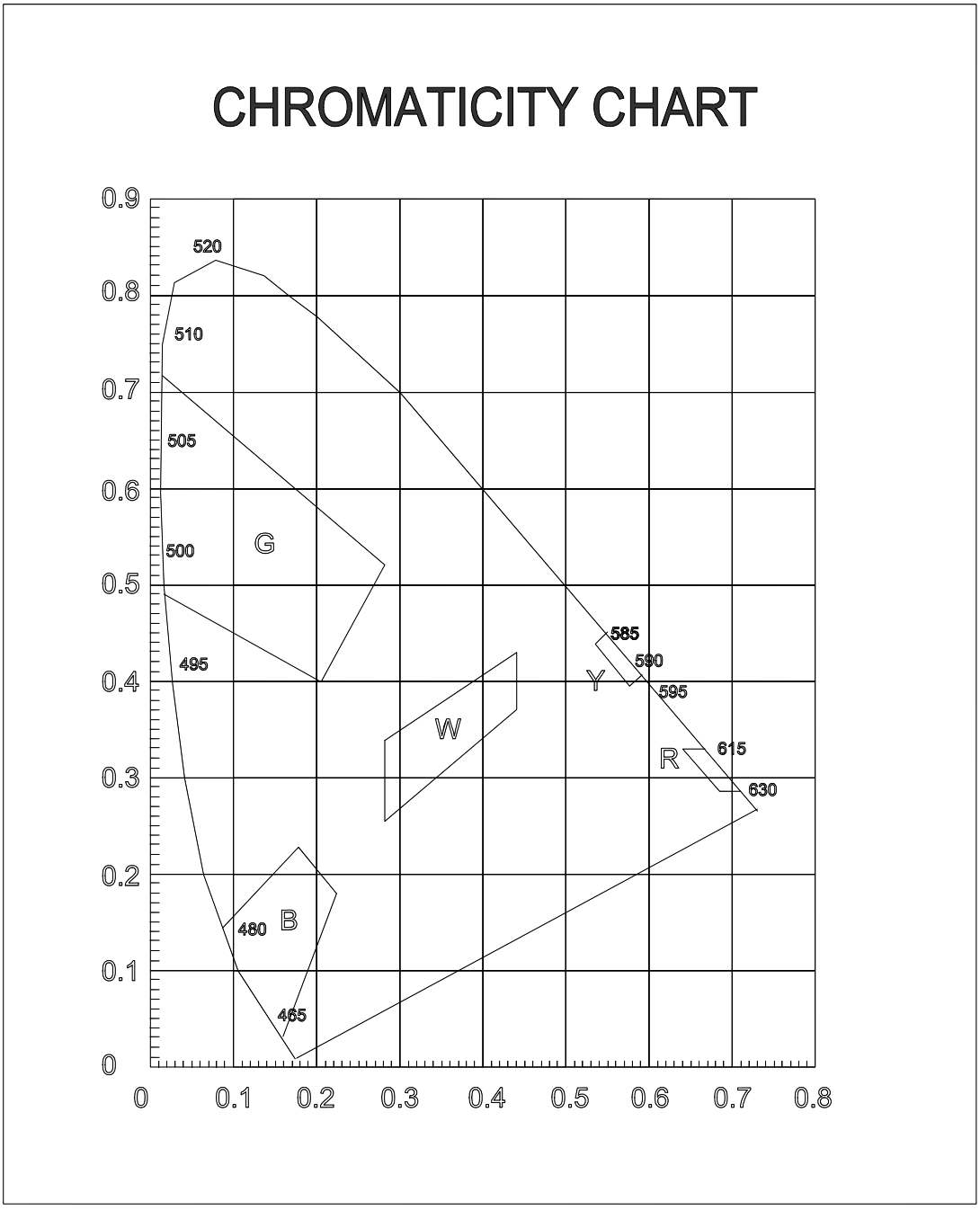


Figure 2

B3. LIFETIME PERFORMANCE TESTING

B3.1 General

B3.1.1 The purpose of this test is to ensure that the degradation of the 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.

B3.2 Requirements

B3.2.1 The requirements are that:

(i) after 12 months operation in the field, the sign shall demonstrate an optical performance as described in this document that is no less than 95% of the values determined at its initial compliance testing, and

(ii) after 36 months operation in the field, the sign shall demonstrate an optical performance as described in this document that is no less than 85% of the values determined at its initial compliance testing.

B3.3 Sample Preparation

B3.3.1 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 sign 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.

B3.3.2 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 this document. The casing is then placed outdoors again to continue weathering for a further 24 months i.e a total of 36 months.

B3.3.3 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 this document.

APPENDIX C

PHOTOMETRIC TEST PROCEDURES

C1. TEST PROCEDURES FOR LUMINANCE RATIO MEASUREMENT

C1.1 The configuration of the sign, the solar source and the luminance meter for measurement purposes and all associated test procedures shall be agreed by the Department.

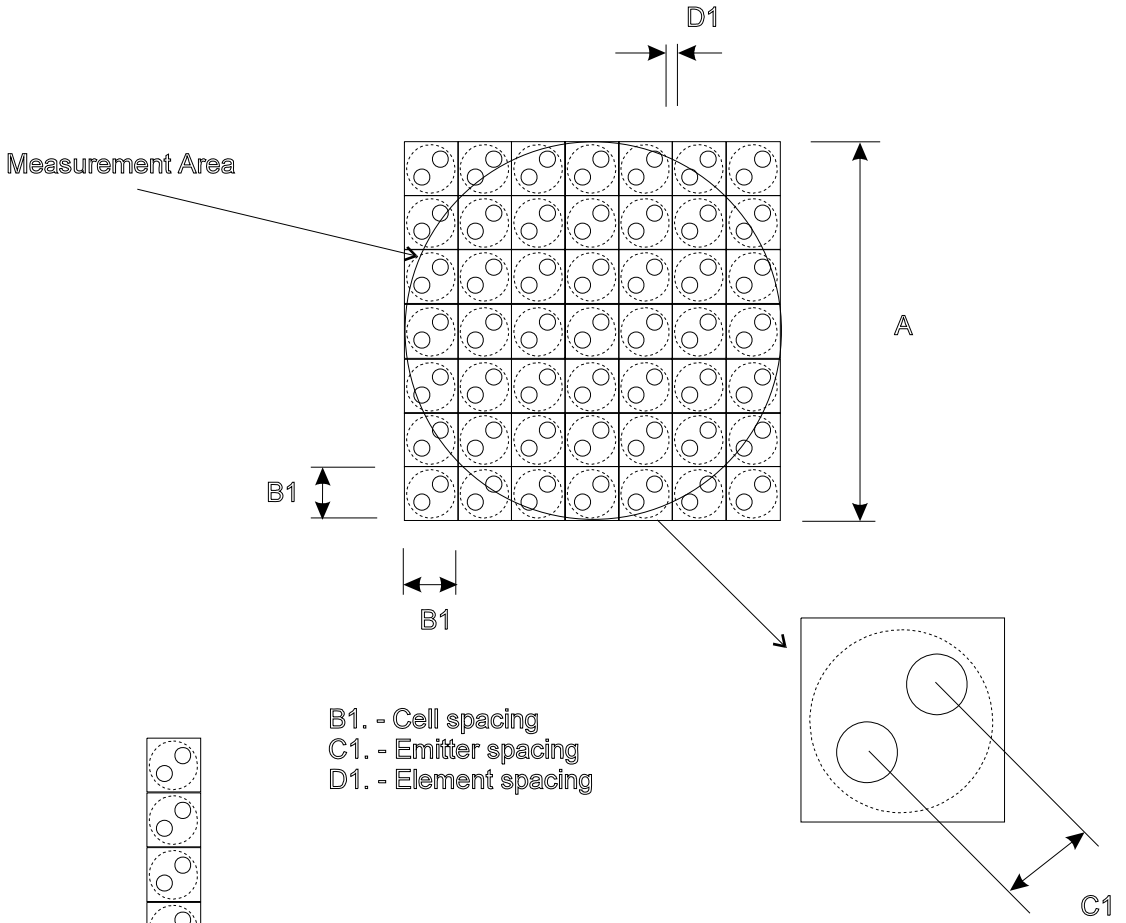
C1.2 The sign's illuminance over the test area shall be measured and shall be 40,000, 4000, 40 and <4 lux. The illuminance shall be uniform over the test area, the measurements of illuminance shall be within ± 10% of the nominal values. The test area must be at least 100mm in diameter or consist of a minimum of a 5x5 matrix of elements whichever is the greater.

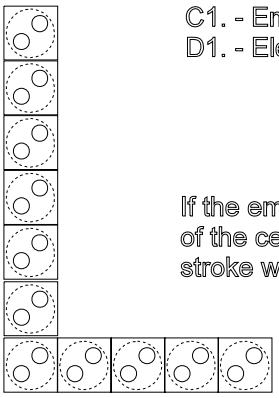
C1.3 Measurements of luminance shall be taken with the sign in the following states:

i. with all elements of the test area active (La)The ability to be isolated from mains supply at ground level using a suitable switch/breaker system;

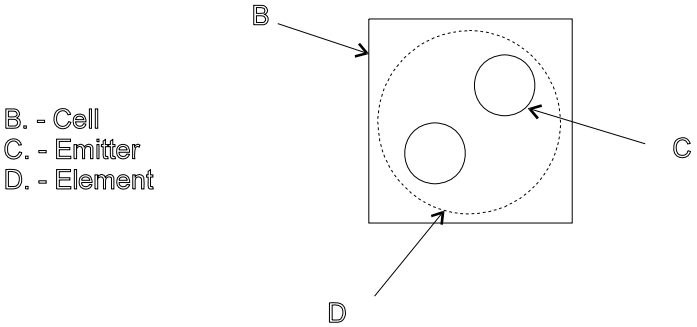
ii. with all areas of the test area inactive (Lb).

Emitters = Active segments.
Element = Passive segments.
Cell = Natural rectangle which surrounds emitters and element thus gives basic unit dimension for a Matrix.



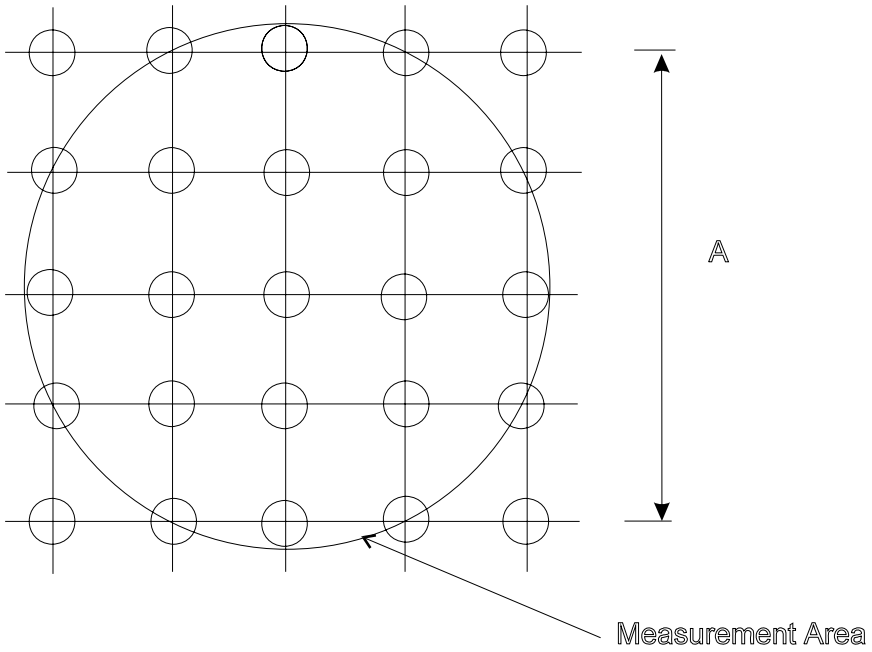


If the emitters are not symetrical around the centre of the cell , the horizontal and vertical equivalent stroke width will be different.



TEST AREAS

(i) 5 x 5 Matrix



A is a five element minimum or 100 mm diameter

(ii) 100mmDiameter

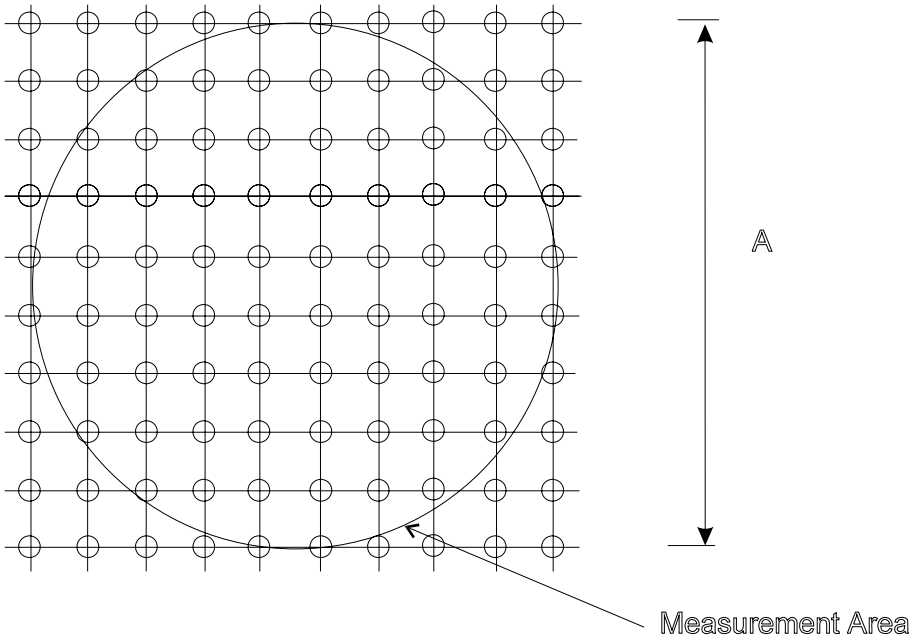


Figure 3

C2. TEST PROCEDURES FOR LUMINANCE MEASUREMENTS

C2.1 The luminance of the sign 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 nighttime luminances are to be measured with no external illuminance. It is also possible to measure the luminance of the sign that has only self-luminous elements without any external source.

C2.2 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.

C3. VIEWING ANGLE

C3.1 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 and if the sign is 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 sign module mounted on a goniometer.

C3.2 Within the field of measurement the luminance pattern shall be substantially uniform.

C4. LUMINOUS INTENSITY UNIFORMITY.

C4.1 Luminance or luminous intensity uniformity tests are required to ensure all the active elements can be clearly seen 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.

C4.2 The luminance or luminous intensity of individual elements shall be measured on the geometric axis and at the combined positions as detailed below without external illuminance from the solar source.

C4.3 Combined uniformity test points for each element

Horizontal angle (^{o})	Vertical angle (^{o})
-7	-2
+7	-2
0	0

C4.4 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.

C4.5 A minimum of 25 adjacent individual elements shall be measured.

C4.6 The following formula shall be applied to the three highest and three lowest measurements of each of the three sets of measurements:

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

C4.7 For each of the three sets of readings, this ratio shall not vary by more than that given in Clause B1.3.

C4.8 For each of the three sets of readings, the output of any two individual elements shall not vary by more than that given in Clause B1.3.

APPENDIX D

COLORIMETRIC TEST PROCEDURES

D1. COLORIMETRIC TEST PROCEDURES

D1.1 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.

D1.2 The spectral distribution of LEDs is quasi-monochromatic and so the measurement of the colour of LEDs is more sensitive to errors of mismatch between the spectral response of the photometer and the V(λ) curve. Consequently, it is recommended in the CIE (1997) document that the photometer response should have a spectral response with

$$f_1' < 1.5\%$$

D1.3 Colour measurements shall be in terms of the chromaticity measurements of the CIE 1931 Standard colorimetric system.

D1.4 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.

D1.5 Care should be taken that only the colour of the emitted light is measured and that adequate precautions are taken to eliminate stray light.

D1.6 The colour measurement should be taken over the test area with all the elements within that area active.

D1.7 The test module should be operated according to the conditions specified by the manufacturer at the daytime luminance and at the fully dimmed luminance.

D1.8 The colour shall be measured along the geometric axis and at the angles specified in Clause C4.