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TfNSW is not under any duty to inform you of any errors in or changes to this Specification.
## RECORD OF AMENDMENTS

<table>
<thead>
<tr>
<th>Issue</th>
<th>Summary</th>
<th>Date</th>
<th>Approved by</th>
</tr>
</thead>
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<tr>
<td>1.0</td>
<td>Original</td>
<td>01 Feb 16</td>
<td>Manager TSI</td>
</tr>
<tr>
<td>2.0</td>
<td>Modifications were removal of incorrect references to AS2144 in item (i) of submission contents, and requirement added for pixel element service life related to AS4852.1.</td>
<td>14 May 18</td>
<td>Manager TSI</td>
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<tr>
<td>3.0</td>
<td>Major changes including removal of references to TSI-SP-067 (that being the specification for CMS), AS 4852.1 and other documents not directly VAS related, however including some of the requirements therein as applicable to VAS.</td>
<td>6 May 19</td>
<td>Director, ITS Engineering</td>
</tr>
<tr>
<td>4.0</td>
<td>Some formatting and requirements changes as follows:</td>
<td>3 Dec 19</td>
<td>Manager TSI</td>
</tr>
<tr>
<td></td>
<td>1) Accentuate the standalone aspect of the power supply;</td>
<td></td>
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<tr>
<td></td>
<td>2) Align requirements with RCM and EMC regulatory arrangements and if RCM used to indicate electrical safety, amended requirements to that effect;</td>
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<td></td>
<td>3) Configurable detection zone upper limit was ‘200 m’ now rectified to ‘100 m’;</td>
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<td></td>
<td>4) Pixel failure detection in display blank state made optional;</td>
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<td></td>
<td>5) Added prompt for supplier to declare any underlying display modes other than the specified modes;</td>
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<td>6) Added heading list numbers to clauses;</td>
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<td>7) Added missing requirement for AS/NZS 3000 as applicable to equipment powered by standalone (battery-solar) power systems. Added guidance reference to AS/NZS 4509 for standalone power systems and AS 4086 for secondary batteries for use with standalone power systems. Rectified errors in submission contents. Added Appendix B for example of minimum/typical date data set; and</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>8) Updated submission contents clause.</td>
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APPENDIX A – GUIDANCE

APPENDIX B – EXAMPLE OF MINIMUM OR TYPICAL DATA SETS
1 INTRODUCTION

1.1 Scope

This specification covers the equipment requirements for fixed warning type Vehicle Activated Signs (VAS). This specification also covers the type approval requirements for this type of sign. A fixed warning type VAS, typically, consists of the following items:

- Sign display consisting of a
  - diamond-shaped warning sign and
  - rectangular text sign,
- sign enclosure (of each above sign display),
- sign controller,
- light sensor,
- speed detector (typically a radar device),
- 3G/4G/5G/other wireless capability for remote communications,
- TIA-232 and Ethernet ports for local communications,
- standalone solar-battery power supply unit (i.e. solar panel, associated battery and power regulator/charger unit), and
- pole and associated mounts.

The primary function of the sign is to display a pre-determined warning message to the motorist when a vehicle exceeds a certain trigger condition (such as the local area speed limit), and to keep that message displayed for a pre-determined duration before blanking.

1.2 Exclusions

This specification excludes the following:

- Project/site specific requirements;
- Policy for sign dimensions, shape, and display content;
  (see “Sign face and display contents approval” requirements of this specification);
- Policy of where a VAS is installed or the thresholds which are set to trigger it;
- Policy for sign locations;
- Signage where the display contains a variable message;
- Where the sign is not activated by speed, but by some other input; and
- Enforcement speed detection, relating to legality of vehicle speed.
1.3 Illustration of Typical Sign

The diagram (Figure 1) below shows a typical VAS installation and illustrative signage.

This is a typical sign where the speed detector is affixed on the same post as the sign.

Alternative scenarios might be where the

(a) speed detector is on a separate post; where that post may be either leading or trailing the post on which the sign is mounted, depending on site requirements;
(b) sign display consists of a static warning sign and active “SLOW DOWN” sign;
(c) sign display consists of an active “your speed” sign and active “SLOW DOWN” sign;
(d) any alternative, as relevant to project/site-specific requirements.

NOTE:
The diagram above is for illustration purposes only, and is not representative of all VAS scenarios. See above sections for what is covered by this specification and its exclusions.

1.4 Sign Variants

The VAS may be constructed in either of two variants, at the manufacturer’s discretion.

The white graphic and text may be both in yellow, at the manufacturer’s discretion (see display area requirements of this specification).

However approval of these will be in accordance with Approval section of this specification.
Display contents (Figure 2) above are examples for illustrative purposes only; refer to relevant specified standards for display content and dimensional requirements.

The above description defines a typical sign. Other functional variations to the above default sign might be the inclusion of add-ons, such as rain/snow/fog sensor for sites that require that facility, and sign face variations such as a speed limit sign with “SLOW DOWN” sign in lieu of the default diamond-shaped warning sign (and as per road rules [17]; for enquiries see “Sign face and display contents approval” section of this specification).

2 REFERENCES AND APPLICABLE DOCUMENTS

2.1 Australian and International Standards

[1] AS/NZS 1170.2 Structural design actions - Wind actions
[2] AS/NZS 1734 Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
[3] AS 1743 Road signs - Specifications
[4] AS/NZS 3000 Electrical installations (known as Australian/New Zealand Wiring Rules)
[5] AS/NZS 3820 Essential safety requirements for electrical equipment
[6] AS/NZS 3845.2 Roadside safety systems and devices - Road safety devices
[7] AS/NZS 4509 Standalone power systems
[8] AS 4086 Secondary batteries for use with standalone power systems
[9] AS/NZS 4417.2 Regulatory compliance mark for electrical and electronic equipment - Part 2: Specific requirements for particular regulatory applications
[10] AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
3 DEFINITIONS AND GLOSSARY OF TERMS

For the purposes of this specification, the following definitions and abbreviations shall apply:

ACMA Australian Communications and Media Authority
(URL: http://www.acma.gov.au)

COTS Commercial off-the-shelf

Display area(s) The light emitting area(s) of the front of the sign.

DoC Declaration of Conformity; a signed document provided by a supplier for a sign model declaring that that sign and its replicas are compliant with applicable requirements listed therein.

For RCM DoC, see ACMA website for definition.

ELV Extra-low voltage (up to 50 V AC r.m.s. or 120 V DC ripple-free)

See “In-Scope Electrical Equipment” definition on ERAC website

EMC Electromagnetic compatibility;

EMC has two aspects: emission and immunity.

ERAC Electrical Regulatory Authorities Council
(URL: http://www.erac.gov.au)

Event log A log that lists events other than sign faults.

Fault log A log that list sign faults.

Manufacturer Manufacturer of a VAS
(see “Applicant” as defined in IC-QA-TS201)

OEM Original Equipment Manufacturer

PHCS Product host control system
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCM</td>
<td>Regulatory compliance mark (see AS/NZS 4417.2)</td>
</tr>
<tr>
<td>Sign controller</td>
<td>The electronic unit that monitors speed detector and rain sensor inputs and operates the sign displays accordingly.</td>
</tr>
<tr>
<td>Sign display</td>
<td>The combined display areas of both the</td>
</tr>
<tr>
<td></td>
<td>(a) diamond-shaped warning sign or</td>
</tr>
<tr>
<td></td>
<td>(b) rectangular text sign (e.g. “SLOW DOWN”).</td>
</tr>
<tr>
<td>Sign enclosure</td>
<td>An enclosure that houses a sign display.</td>
</tr>
<tr>
<td>Sign type</td>
<td>Refers to sign size where sign types A, B and C refer to corresponding sign size A, B and C, respectively, and their font sizes as per warning signs (W series) in AS 1743, respectively. This excludes size D as there is no corresponding sign size for two-line rectangular (capitalised) text signs (e.g. in AS 1743-2018 under Appendix A, W8-8 “WHEN FROSTY”, W8-7 “WHEN WET”, W8-9 “UNDER SNOW”, W8-16 “ONE LANE”).</td>
</tr>
<tr>
<td>Submission for approval</td>
<td>Refers to a submission of a VAS in an application for approval evaluation under IC-QA-TS201 to ITSHelpDesk by a manufacturer/supplier.</td>
</tr>
<tr>
<td>Supplier</td>
<td>Supplier of a VAS (see “Applicant” as defined in IC-QA-TS201)</td>
</tr>
<tr>
<td>TfNSW</td>
<td>Transport for New South Wales.</td>
</tr>
<tr>
<td>Trigger</td>
<td>A passing vehicle exceeding a predetermined speed.</td>
</tr>
<tr>
<td>VAS or sign</td>
<td>Vehicle Activated Sign consisting of all constituent parts, including pole, as described in the scope of this specification.</td>
</tr>
</tbody>
</table>
4 GENERAL REQUIREMENTS

4.1 Applicable standards and specifications

Where not otherwise specified, the sign shall be in accordance with relevant Australian Standards or Specifications, and in their absence, with relevant IEC or ISO Standards or Specifications.

4.2 Design life

4.2.1 The design life of the sign shall be as follows:

(a) 10 years minimum for the sign and all other parts including COTS equipment,
(b) 15 years minimum for posts and fittings,
(c) 10 years minimum for the solar panel, and
(d) 5 years minimum for the battery.

4.2.2 Where a part has a design life other than that specified, that information shall be declared.

5 REGULATORY REQUIREMENTS

5.1 Work health and safety

The sign shall comply with the requirements of the NSW Work Health and Safety Act.

5.2 RCM and EMC Emission

5.2.1 Regulatory Compliance Mark (RCM)

5.2.1.1 For RCM and EMC emission (intentional and unintentional) as per ACMA, the sign shall comply with AS/NZS 4417.2 requirements for compliance level 2/medium-risk device or higher, whichever is applicable to this sign.

5.2.1.2 If RCM is used on the sign to indicate electrical safety (this sign falling within “not in-scope equipment” category), that usage shall comply with AS/NZS 4417.2.

5.2.1.3 The sign’s compliance/risk level (for RCM and EMC) and equipment level (if RCM used to indicate electrical safety) shall be stated in the declaration of conformity of submission contents for this requirement.

5.2.1.4 In addition to the information required by AS/NZS 4417.2, the supplier shall also include the information required in RCM and EMC related submission contents.

NOTE: See Appendix A for guidance.

5.2.2 EMC Emission: Unintentional

The sign, with all its intentional emitters set to non-emitting mode, shall comply with EMC emission in accordance with AS/NZS 61000.6.3.

5.2.3 EMC Emission: Intentional

The sign, with all its intentional emitters set to emitting mode, shall comply with EMC emission in accordance with their corresponding regulatory arrangements and requirements.

5.3 Electrical Safety

5.3.1 The sign shall comply with AS/NZS 3820 and relevant electrical safety requirements.
5.3.2 The sign shall comply with AS/NZS 3000 as applicable to equipment powered by standalone (solar-battery) power systems.

5.3.3 The supplier shall provide a declaration of conformity for the sign, for this requirement.

6 FUNCTIONAL REQUIREMENTS

6.1 Detection Requirements

6.1.1 The detection requirements of the sign shall be as follows:

(a) The VAS shall operate autonomously;
(b) The VAS display shall be completely blank, unless triggered;
   
   \textit{NOTE:} See ‘Trigger’ in definitions and glossary of terms of this document.
(c) The detection zone-to-post clearance shall be typically, and no less than, 10 m;
(d) The VAS shall illuminate its display within 1 s of a trigger event;
(e) The trigger speed shall be configurable as follows:
   
   (i) lower limit of 10 km/h and
   (ii) increments of no more than 5 km/h,
   (iii) upper limit of at least 110 km/h.
(f) The detection zone shall be configurable as follows:
   
   (i) lower limit of 10 m,
   (ii) increments of no more than 10 m, and
   (iii) upper limit of at least 100 m,
   (iv) able to cover at least two adjacent lanes approaching the sign,

   \textit{NOTE: It is not expected that the lanes be separately distinguished.}
(g) The speed detector shall have a detector accuracy/tolerance of better than \(\pm 2\) km/h, and

(h) The sign shall not be triggered by vehicles travelling in the opposite direction.

6.1.2 Whether the sign inherently has any underlying capability that differs from these detection requirements, shall be declared with rationale.

6.2 Means to depower display

6.2.1 The sign shall provide a means to locally depower the display, in event the sign operates incorrectly or deviates from this specification.

6.2.2 This facility shall be accessible to maintenance technicians.

6.2.3 This shall be in addition to any remote means to depower the display.

6.3 Fault Monitoring

6.3.1 The sign shall detect faults and events related to the sign display, sensors, speed detector, communication links and any part of the solar-battery power supply unit.
6.3.2 The sign shall detect display area pixel failures when the sign display is in active state. Optionally, the sign should detect display area pixel failures when the sign display is in blank state.

In the event of a fault, the sign shall log the fault immediately. The sign shall then send a fault notification to the PHCS (notification-to-PHCS time) within no later than 6 hours. To allow for project/site-specific conditions, the notification-to-PHCS time shall be configurable to within no later than 24 hours.

6.3.3 The sign shall log faults that are active as “ON” and faults that are cleared as “OFF”.

6.3.4 That logged fault information shall be obtainable by the host upon a status update poll.

6.3.5 The supplier shall provide the details of the PHCS, and how the sign communicates with it.

6.3.6 When a fault has been cleared or rectified, the sign shall log it as cleared. Fault entries that are not cleared shall remain until fault manually rectified by a maintenance technician.

6.3.7 Examples of faults may include:

(a) Battery voltage falling below operational threshold;
(b) Battery voltage rising above operational threshold;
(c) Battery health status;
(d) Power supply unit failure – solar-panel / battery / regulator (charger) unit;
(e) Communications (with host) faults/failures;
(f) Rain sensor failures;
(g) Sign display driver failures;
(h) Sign display internal communications failures;
(i) Multiple pixel failures (showing pixel percentage failed);
(j) Radar/speed detector failures;
(k) Sign controller operational faults; and
(l) Erroneous speed displays.

6.3.8 If a critical fault is detected, the sign shall blank its display.

NOTE: Critical faults can be defined as those faults that may adversely impact the sign display or cause display contents that may be confusing to the motorist.

6.3.9 The sign shall log all faults including those for the following conditions:

(a) Multiple pixel failures (including partial display of display contents);

For the purpose of this requirement, the percentage of pixel failures of the sign display shall be configurable between 1% and 20% both inclusive, with a default of 2%. The aggregate of the two display areas of the sign display shall apply to this requirement;

(b) Any other detected faults or failure which may adversely impact the display, or correct sign operation in accordance with this specification.

6.3.10 The supplier shall provide a list of all faults and events and associated error/fault conditions and event conditions implemented by the sign, with their trigger/clear thresholds and show which of those blank the display.
6.4 Fault Log and Event Log

6.4.1 The VAS shall log faults and related error conditions in a fault log, including the date and time of those events. Logging shall be on a first-in-first-out (FIFO) basis.

6.4.2 Speed detection events, and events other than faults, shall be logged in an events log, including the date and time of those events. Logging shall be on a first-in-first-out (FIFO) basis.

6.4.3 The event log shall be separate from the fault log.

6.4.4 The logging capacity of the fault log shall be sufficient for the latest 200 entries. The logging capacity of the event log shall be at a minimum of the same capacity as the fault log. The maximum logging capacity for the event log shall be determined by the manufacturer. The capacity of the fault log and event log shall be provided by the supplier, when making a submission for approval.

6.4.5 The logged data shall be stored locally in the sign.

6.4.6 The fault log and event log shall be accessible remotely and locally.

6.5 Communication System

6.5.1 Communication Links

6.5.1.1 The sign shall provide one or more of the following primary communication links:
   (a) 3G wireless;
   (b) 4G wireless;
   (c) 5G wireless or other wireless communication types subject to prior approval by TfNSW.

6.5.1.2 In addition, as secondary/backup communication links, for local access and control, the sign shall have at least one TIA-232 communications port, and one Ethernet port. These shall meet the respective requirements of TSI-SP-071.

6.5.1.3 The sign communication links shall provide the means for maintenance technicians to communicate with the sign for the purpose of sign control, maintenance, and diagnostics (this may be via SMS or other form; see Appendix B for an example).

6.5.2 Product Host Control System

6.5.2.1 The supplier shall provide a Product Host Control System (PHCS) with the sign.

6.5.2.2 Communications and access to this PHCS shall be secured. The means taken to achieve that security shall be declared by the supplier.

6.5.2.3 In the event of one or more faults, the sign shall report the primary fault to the PHCS.

6.5.2.4 The PHCS shall report a fault occurrence to maintenance personnel, immediately upon receipt of the fault notification from the sign. The PHCS shall provide the means to look at the details of the fault. The reporting shall be in SMS or email form. The notification time shall be configurable to within 24 hours, inclusive.

6.5.2.5 The sign shall be able to locally and remotely communicate at least its operational status, faults and related errors, fault log, and event log to the PHCS.

6.5.2.6 The communication of sign status information shall be web-based or any other relevant method accessible to TfNSW. The PHCS shall allow checking status of each sign and notify relevant maintenance technician/s if any sign is faulty, inoperative or non-responsive.
6.5.2.7 The supplier shall provide this information including the minimum and maximum applicable logging/polling frequencies of the sign/host, when making a submission for approval.

6.5.3 Remote Disabling of Display

It shall be possible to remotely disable the sign display.

7 DISPLAY AREA AND OPTICAL REQUIREMENTS

7.1 Display Area

7.1.1 General

7.1.1.1 The front face of the sign shall be matt black.

7.1.1.2 The sign display shall consist of one or more display areas, the combination of which shall be activated simultaneously to present a complete sign message to the motorist.

7.1.1.3 The colour(s) of the graphic and text shall be either, both white (preferred), both yellow, or as determined by the approval process in Clause 13.2.

7.1.1.4 The colour of the lit border shall be yellow, or as determined by the approval process in Clause 13.2.

*NOTE: The default sign should typically be able to display the colour-inverse of “warning signs” in AS 1743, such that the display background is black and not yellow. Nonetheless, the sign face and display contents would be subject to the approval process in Clause 13.2.*

7.1.2 Display Dimensions

7.1.2.1 The sign size shall be commensurate with the speed limit of the intended traffic site. The manufacturer/supplier shall provide the intended site speed limit and relevant intended sign size when making a submission for approval.

7.1.2.2 For signs that are not covered in AS 1743, the sign types and sizes in Table 1 shall apply.

<table>
<thead>
<tr>
<th>Table 1 VAS/sign types and constituent sign sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VAS/sign Type</strong></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

*NOTE: For determining sign type/size and font sizes, subject to the approval process in Clause 13.2, the VAS diamond-shaped warning sign display area and rectangular text sign display area may have at least the same dimensions as the respectively sized road signs as defined in AS 1743 under warning signs (W series). For that purpose, rectangular text signs may be at least the same dimensions as the two-line rectangular (capitalised) text signs (for example, AS 1743-2018 under Appendix A titled “Warning Signs (W Series)”, see W8-8 “WHEN FROSTY”, W8-7 “WHEN WET”, W8-9 “UNDER SNOW”, W8-16 “ONE LANE”).*
7.1.3 Display resolution

7.1.3.1 The sign display resolution shall be sufficient to ensure clarity and legibility of display contents. The supplier shall provide photographs showing the display face for this purpose.

7.1.3.2 Where two display colours meet, in order to compensate for fringe effects such as chromatic aberration, the display contents shall have an unlit gap at the interface of those two colours.

7.1.4 Display modes

7.1.4.1 The following display modes shall be provided:

- AUTO: Automatic operation; display blank when vehicles under trigger speed; Display ON when vehicle/s detected exceeding trigger speed; Communicates with PHCS at specified time intervals;

- OFF: Display OFF (blanked) and remains in that state despite triggers; Communicates with PHCS at specified time intervals;

- TEST (optionally): If provided, may set display ON with ALL pixels for example for maintenances or troubleshooting purposes.

7.1.4.2 If the sign has any other display modes, those shall be fully described including:

- the purpose for including those modes,
- use cases for each of those modes and
- the steps to switch the sign to/from each of those modes.

7.2 Optical requirements

7.2.1 General

7.2.1.1 The supply shall at the time of submission for approval, provide photometric and colorimetric test report/s for the sign with the following information:

(a) Luminance and luminance ratio,

(b) Luminous intensity uniformity,

(c) Luminous intensity half angle, and

(d) Chromaticity coordinates for each LED of a pixel.

7.2.1.2 The entries for luminance and luminance ratio, and chromaticity coordinates shall be shown for each dimming level specified. In addition, the sign display shall present no noticeable flickering of the displayed contents or its background, when either active or inactive.

7.2.1.3 The sign shall deliver the specified optical requirements for its specified design life.

7.2.2 Display luminance and luminance ratio

7.2.2.1 The sign display luminance and minimum luminance ratio shall be within the levels for the colours Red, Yellow, and White as specified in Tables 2 and 3, respectively.

NOTE: Tables 2, 3 and 4 are based on class L2/L3, R2/R3 and C2, respectively, as per EN 12966. Also see EN 12966 for photometric and colorimetric test procedures.
7.2.2.2 The luminance and minimum luminance ratio applicable shall be either Tier L2 with Tier R2 or Tier L3 with Tier R3, respectively, but not any other combination.

Table 2 – Luminance for colours Red, Yellow and White

<table>
<thead>
<tr>
<th>Dimming level (or table entry number)</th>
<th>Illuminance (lx)</th>
<th>Luminance (cd/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier L2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>40000</td>
<td>1550</td>
</tr>
<tr>
<td>2</td>
<td>4000</td>
<td>275</td>
</tr>
<tr>
<td>3</td>
<td>400</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>≤ 4</td>
<td>15</td>
</tr>
<tr>
<td>Tier L3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>40000</td>
<td>3100</td>
</tr>
<tr>
<td>2</td>
<td>4000</td>
<td>550</td>
</tr>
<tr>
<td>3</td>
<td>400</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>63</td>
</tr>
<tr>
<td>5</td>
<td>≤ 4</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 3 – Minimum luminance ratio (LR) for colours Red, Yellow and White

<table>
<thead>
<tr>
<th>Colour</th>
<th>Minimum luminance ratio (LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On reference axis</td>
</tr>
<tr>
<td>Tier L2</td>
<td>Tier L3</td>
</tr>
<tr>
<td>Red</td>
<td>2.5</td>
</tr>
<tr>
<td>Yellow</td>
<td>6</td>
</tr>
<tr>
<td>White</td>
<td>10</td>
</tr>
</tbody>
</table>

7.2.3 Luminous intensity uniformity

7.2.3.1 This requirement shall apply separately to each display colour.

7.2.3.2 For any individual pixel of the sign display area the following shall apply:

(a) the ratio of the average output from the highest 12% of the pixels, to the lowest 12%, shall be less than 3:1; and

(b) the ratio of the average output from the highest 4% of the pixels, to the lowest 4%, shall be less than 5:1.

7.2.3.3 The number of pixels in consideration shall be rounded to the next highest whole number.
7.2.3.4 Results shall be provided in accordance with the visual performance test methods defined in EN 12966 demonstrating whether requirements (a) and (b) above have been met across the full range of display colours and dimming levels.

7.2.4 Luminous intensity half-angle
The sign display area luminous intensity half-angles shall be as specified in Table 4.

<table>
<thead>
<tr>
<th>Luminous intensity half-angle ( \theta_{1/2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
</tr>
<tr>
<td>-15°</td>
</tr>
<tr>
<td>+15°</td>
</tr>
<tr>
<td>0°</td>
</tr>
</tbody>
</table>

7.2.5 Display colours
The sign display area shall be able to implement the colours Red, Yellow and White in accordance with the chromaticity coordinates as specified in Table 5.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Colour coordinates of corner points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Red</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
<tr>
<td>Yellow</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
<tr>
<td>White</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
</tbody>
</table>

7.2.6 Display dimming levels
7.2.6.1 The sign display shall provide a minimum of 5 dimming levels corresponding to illuminance levels of 40,000 lx, 4,000 lx, 400 lx, 40 lx and \( \leq 4 \) lx, as listed in Table 2.

8 ELECTRICAL REQUIREMENTS

8.1 Power supply unit
8.1.1 The sign shall be powered by a standalone solar-battery power supply unit.

NOTE: Applicable guidelines/principles may be found in AS/NZS 4509 and AS 4086.
8.1.2 This power supply unit shall consist of, as a minimum, a solar panel, associated battery and power regulator/charger unit; details of this shall be declared.

8.1.3 The solar-battery power supply unit shall provide sufficient availability to meet the following:

(a) The minimum storage capacity of the battery shall be able to support at least five (5) consecutive days of operational uptime to the sign at a duty cycle range relevant to its intended project/site, in heavily overcast conditions in NSW;

(b) The minimum solar panel capacity shall be sufficient to replenish the charge of the battery at 3 times the rate at which it discharges in (a) when in fully sunlit clear sky conditions in winter solstice (worst case scenario) in NSW.

*NOTE:* As a guidance note, the average daily solar exposure levels published by the Australian Bureau of Meteorology for NSW in July (i.e. winter) were between 6 MJ/m$^2$ to 12 MJ/m$^2$, as at the time of this specification revision.

(c) The supplier shall cater for project/site specific requirements other than the above minima.

8.1.4 A submission for approval of the sign shall be accompanied with details of analysis performed and calculations of the solar panel output and battery energy storage capacity required to meet the above specified level of availability.

8.1.5 The solar-battery power supply unit shall provide over-current and over-voltage protection. The solar-battery power supply unit shall provide over-discharge protection as appropriate to the battery type used. The battery type used shall be provided in the sign submission information. The solar-battery power supply unit shall be protected against reversal of the polarity of the battery.

### 8.2 Electrical design/wiring standards

8.2.1 See electrical safety requirements in Regulatory Requirements clause of this specification.

8.2.2 The supplier shall provide a detailed electrical wiring and schematic diagrams for the sign.

### 8.3 EMC Immunity

The sign shall comply with EMC immunity in accordance with AS/NZS 61000.6.1.

### 8.4 EMC Emission

See EMC emission requirements in Regulatory Requirements clause of this specification.

### 9 MECHANICAL REQUIREMENTS

#### 9.1 General

9.1.1 The default pole shall be able to withstand the sign static/dead loading and wind loading in accordance with wind loading requirements of the environmental section of this specification.

9.1.2 If the sign is required to be supplied with a frangible pole (e.g. clear zones as per guidelines in [18]), the pole shall meet the relevant requirements of AS/NZS 3845.2.
9.2 Sign Enclosure

9.2.1 Front face
The front face of the sign enclosure shall be matt black.

9.2.2 Removal of sharp edges
The sign construction, internal and external, shall be free from sharp edges.

9.2.3 Access to components
The sign shall provide a convenient means to access key components for maintenance purposes. This access shall be lockable.

9.3 Pole, Mounting Brackets and Mounting Points

9.3.1 The sign shall be provided with a default pole.

9.3.2 The pole, mounting brackets and mounting points shall meet the static/mechanical loading and wind loading requirements of this specification.

9.4 Nameplate

9.4.1 A nameplate shall be affixed to the exterior of the sign enclosure. The nameplate shall remain attached to the sign and legible for at the design life of “all other parts of the sign”.

9.4.2 The nameplate shall provide the following information about the Sign:
   (a) Product/model number and name;
   (b) Manufacturer’s name;
   (c) Manufacturer’s type number;
   (d) RCM approval number;
   (e) A unique serial number.

9.5 Vandal Resistance

9.5.1 The VAS shall be vandal resistant.

9.5.2 The supplier shall provide information on how the sign complies with this requirement.

9.6 Corrosion Resistance

9.6.1 The sign shall provide corrosion resistance to last the specified design life.

9.6.2 In the event COTS equipment are used as parts of the sign, the supplier shall provide evidence to demonstrate how those COTS equipment and the conjoining contacts and interfaces with the sign, meet this requirement.

9.6.3 For example, one method may be sign constructed of marine grade aluminium alloy 5251 H32 to AS/NZS 1734 and treated with powder coating to a suitable thickness (typically 50 microns), and all steel works, fittings and fasteners hot-dip galvanized as per AS/NZS 4680.

9.6.4 The supplier shall provide details of the construction and materials used, and the expected effect on design life to enable assessment of corrosion resistance.
10 ENVIRONMENTAL REQUIREMENTS

10.1 Temperature and Humidity
10.1.1 The sign shall operate within temperature ranging from -15 °C to 60 °C and relative humidity of up to 100% (i.e. dew point), as applicable to the state of NSW.
10.1.2 The supplier shall provide supporting evidence and information to demonstrate how the sign meets this requirement (e.g. evidence such as laboratory test reports or field data extrapolations, and associated design calculations explanations/rationale).

10.2 Enclosure Protection
10.2.1 The enclosure ingress protection for the sign shall be IP55 in accordance with AS 60529.
10.2.2 The supplier shall demonstrate how the electrical parts are protected from moisture such that the sign functions are not affected.
10.2.3 The supplier shall provide an enclosure protection test report for the sign, when making a submission for approval. The test report shall show the test results and overall compliance verdict for the sign (see definitions), submitted for approval.
10.2.4 In the event COTS equipment or components are used as parts of the sign, the test report shall demonstrate how the sign, all those COTS equipment parts used and their conjoining contacts and interfaces with the sign, meet this requirement.

10.3 Wind Loading
10.3.1 The sign, mounting brackets and mounting points and declared post shall withstand at least the wind loading conditions of Region B, Terrain Category 2 in accordance with AS/NZS 1170.2.
10.3.2 Wind loading certification by a qualified structural engineer shall be provided to demonstrate how the sign meets this requirement.

11 MANUALS
11.1.1 Manuals shall be provided to cover operation and maintenance of the sign, at an appropriate level of detail.
11.1.2 A copy in PDF format is expected at approval stage.
11.1.3 All manuals shall be in accordance with TSI-SP-062.
11.1.4 Each manual shall be provided with a compliance statement to that effect, if in a submission for approval.

12 QUALITY ASSURANCE
12.1 Quality Management System
12.1.1 The supplier and the manufacturer of the signs shall operate a quality management system complying with AS/NZS ISO 9001.
12.1.2 The supplier shall provide evidence of their quality certification by an accredited body, in a submission for approval.
12.2 Quality Plan

12.2.1 The supplier shall provide a quality plan for the sign, in a submission for approval.

12.2.2 Each sign shall be marked with a model number, batch code, serial number, and/or other marking to provide traceability under the sign manufacturer’s quality management system to all key manufacturing, inspection and test processes, including batch identifications of key components (e.g. sign controller, sign displays, power supplies, speed detector, etc.).

13 SUBMISSION FOR APPROVAL

13.1 Submission process for sign approval

13.1.1 For submissions for approval of a sign, the supplier shall follow IC-QA-TS201.

13.1.2 This shall include the

(a) submission contents required in Clause 13.3, and
(b) all relevant supporting evidence.

13.1.3 The supplier shall furnish any further information, as requested by TfNSW.

13.1.4 In the event any contents are pending at the time of submission this shall be indicated at the relevant requirement in the clause-by-clause compliance statement for the sign with an intended follow-on date where available, by the supplier.

13.1.5 Other approvals for an overall installation may apply, such as those that may be included in policy, but are excluded from the scope of this document.

13.2 Sign face and display contents approval

13.2.1 Approval evaluation of all sign face and display contents will be by the TfNSW’s Guidance and Delineation unit. Upon receipt of that unit’s verdict, that will then be integrated into the TfNSW’s TSI unit’s approval evaluation of the sign.

13.2.2 This approval shall be sought by the supplier by providing all relevant sign face details and display contents during a submission for approval via ITSHelpDesk.

13.3 Submission contents

When making a submission, in addition to the supporting evidence required in the relevant clauses of this specification, the following shall be provided for the sign:

(a) Sign model number, sign type and serial number as a minimum clearly declared in all relevant submission contents and supporting evidence.

NOTE: Sign model number provides a means to limit the range of items and constituent parts associated with a sign under submission for approval;

(b) Clause-by-clause compliance statement(s) to this specification (TSI-SP-066);
(c) For RCM and EMC requirements for Clauses 5.2.1, 5.2.2 and 5.2.3:

(i) RCM declaration of conformity for the sign as per AS/NZS 4417.2, showing

   i. sign model number,

   ii. regulatory arrangements that apply to each EM radiating part of the sign (see EMC Emission: Unintentional and EMC Emission: Intentional, and Electrical Safety requirements of this specification),
iii. identified standards applicable to each regulatory arrangement that the sign needs to be tested to, for demonstration of compliance,
iv. test report number for each identified standard,
v. compliance verdict from each test report, and

(ii) Dated evidence of listing of the sign on the ACMA/ERAC website.

(d) EMC emission (unintentional) test report for Clauses 5.2.1 and 5.2.2 (and 8.4);
   
   \textit{NOTE: This is supporting evidence with the RCM DoC in Clause 13.3 (c) (i).}

(e) EMC emission (intentional) test reports for Clauses 5.2.1 and 5.2.3 (and 8.4);
   
   \textit{NOTE: These are supporting evidence with the RCM DoC in Clause 13.3 (c) (i).}

(f) Electrical safety declaration of conformity for Clause 5.3 (and 8.2);
   
   \textit{NOTE: This is supporting evidence with the RCM DoC in Clause 13.3 (c) (i).}

(g) EMC immunity test report for Clause 8.3;

(h) Display resolution calculations and rationale for Clause 7.1.3;

(i) Photometric and colorimetric test reports for Clause 7.2;

(j) Detailed analyses and calculations of the solar panel output and battery energy storage capacity and power supply unit dis/charging capability for Clause 8.1;

(k) Electrical wiring and schematic diagrams (detailed) for Clause 8.2;

(l) Nameplate sample or image for Clause 9.4;

(m) Vandal resistance information for Clause 9.5;

(n) Corrosion resistance construction and treatment details for Clause 9.6;

(o) Temperature and humidity supporting evidence for Clause 10.1;

(p) Enclosure protection test report for Clause 10.2;

(q) Wind loading certification by a qualified structural engineer for Clause 10.3;

(r) Manuals for the sign, for Clause 11
   
   \textit{NOTE: The locations in the manuals where O&M details can be found should be declared in the compliance statement to this specification for relevant requirement (e.g. display modes, communication system, fault monitoring, PHCS, etc.).}

(s) For each manual, compliance statement to TSI-SP-062 for Clause 11;

(t) Quality management system certification each by an accredited body, for the sign’s (i) manufacturer and (ii) supplier, for Clause 12.1;

(u) Quality plan for the sign for Clause 12.2;

(v) Sign face and display contents and their details for Clause 13.2;

(w) In the event any supporting evidence (e.g. test reports, certifications, declarations of conformity, and so on) refer to requirements other than Australian standards and TfNSW specification (e.g. EN, IEC, etc.), a compliance traceability map showing rationale as to how those supporting evidences demonstrate how the sign meets the requirements in this specification, shall be provided by the supplier.
   
   See Appendix A guidance step 2;

(x) Technical design drawings for the sign including the following:
(i) Block diagrams of electronic and power/electrical system of the sign;
(ii) Any terminal block and wiring layouts;
(iii) Structural drawings containing dimensions, components and assemblies,
(iv) Display dimensional drawings all sign face and display contents;
(y) Display pixel (bit)map of all display contents;
(z) Photographs and/or video of the sign demonstrating the operation of the display.

13.4 Changes

If a design, material or manufacturing method change is made to an approved VAS, the supplier shall notify the ITS help desk (ITSHelpDesk@rms.nsw.gov.au) and the requirements of IC-QA-TS201 regarding changes shall be followed.
APPENDIX A – GUIDANCE

For regulatory requirements, the supplier may choose to follow the following checklist, which may also be applicable to other requirements in this specification that need similar supporting tests or empirical evidence for demonstration of compliance of the sign:

(1) Determine if the sign (with all its constituent parts including speed detector radar and 3G/4G/5G/other wireless modem) is subject to regulatory compliance requirements. This might include RCM, EMC (intentional and unintentional) emission and electrical safety requirements;

(2) Identify which regulatory arrangements and standards are applicable as listed by the relevant regulatory bodies (e.g. see ACMA, ERAC, NSW Fair Trading, etc.). For any COTS or equipment certified external to Australia and NSW, determine how those map to applicable Australian standards and NSW requirements. List those mappings in declarations of conformity documents;

(3) Test the sign for compliance in accordance with the identified standards in (2) by accredited test laboratories. If any parts of the sign is COTS (e.g. speed detector radar, 3G/4G/5G/other modem, etc.), identify which applicable EMC and electrical safety standards those have been tested to by their respective OEMs; then obtain the test reports and certifications for those from the relevant OEMs or test providers;

(4) Provide a declaration of conformity document confirming that the sign complies with each standard identified in (2), by way of the following information:
   a. part of the sign is subject to regulatory compliance (if entire sign then this could be indicated as 'sign' insofar as all intentionally emitting parts are shown as included with the 'sign'),
   b. regulatory arrangement/s applicable to each part in a.,
   c. standard/s applicable to each part in a.,
   d. regulatory body listing regulatory arrangement in b. and standard/s in c.,
   e. test report number/s demonstrating compliance with standard/s in d.,
   f. compliance verdict as extracted from the test report/s in e.
   g. where there is more than one test report in f., the overall compliance verdict.

NOTES:

(1) Albeit the sign is solar-battery powered thus extra low voltage (ELV), the attachment of intentionally EM emitting radar and 3G/4G/5G/other wireless modem (whether COTS or not) could render the sign at compliance level 2/medium risk device or higher.

(2) For guidance, following are some reference websites relevant to this requirement:
APPENDIX B – EXAMPLE OF MINIMUM OR TYPICAL DATA SETS

As a guide, the following is an example using SMS as a data format (i.e. 160 characters), of the minimum or typical data sets that may be applicable to sign side, PHCS side or both.

Sign side:
(1) SMS ID : SMS identifier;
(2) SMS encryption code : SMS encryption, encoding and decoding information
(3) Phone Number : Sign or sign site 3G/4G/5G/other phone number;
(4) Sign ID : Sign or sign site ID;
(5) SMS sent date : Date SMS was sent via 3G/4G/5G/other modem;
(6) SMS sent time : Time SMS was sent via 3G/4G/5G/other modem;
(7) SMS data type : Fault, event, sign status, test, other, etc.
(8) SMS data type status : If data type is fault or event, then its active (ON) or cleared (OFF) status;
(9) Data logged date : Date data was logged by sign;
(10) Data logged time : Time data was logged by sign;
(11) SMS human readable text : SMS text that may include payload details in human readable form such as description of the event, fault, sign status, test, other, etc. of the SMS.

PHCS side:
(1) All Sign side applicable SMS contents; and
(2) Sign SMS received date : Date SMS was received via 3G/4G/5G/other modem;
(3) Sign SMS received time : Time SMS was received via 3G/4G/5G/other modem;
(4) SMS recipient type : Sign, technician, other, etc. that determines recipient;
(5) PHCS SMS sent date : Data SMS was sent via 3G/4G/5G/other modem;
(6) PHCS SMS sent time : Time SMS was sent via 3G/4G/5G/other modem.

NOTE: Any data format other than SMS may be used insofar as the minimum or typical data such as listed above can be securely exchangeable between the sign and PHCS.