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VARIABLE MESSAGE SIGNS – FIXED

Intelligent Transport Systems (ITS) Delivery Specification

DOCUMENT STATUS: APPROVED
DOCUMENT NUMBER: ITS-SPEC-VMS-FIXED-202402

21 FEBRUARY 2024
VERSION 1.0

New Zealand Government

More information
This delivery specification is to be read in conjunction with the Notes to VMS Delivery Specification.
If you have further queries, contact the Intelligent Transport Systems Standards and Specifications (ITS S&S) team via email: itsspec@nzta.govt.nz

More information about ITS is available on the NZTA website at https://www.nzta.govt.nz/its

This document is available on the NZTA website at https://www.nzta.govt.nz/itsspecs

Template version
2.0, 02/02/2024

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1 OVERVIEW AND OUTCOMES

This section defines the purpose of the equipment within the operational system.

1.1 Purpose

This specification sets out the requirements for the procurement of variable message signs (VMS) by the Client. The target application of this document is SM031 and SM032 – State highway construction and maintenance contract proforma manuals.

1.2 Scope

This document specifies procurement requirements for fixed VMS, for these sign types:

i. motorway/expressway
ii. regional types A and C
iii. urban type D estimated journey time (EJT).

This delivery specification applies only to standard dimension, fixed-location VMS, ie those on which messages can be created because the finest individual pixels can be in multiple states (off or any available colour).

This document does not cover any other form of electronic roadside signage such as relocatable (mobile) VMS, lane control signals, school zone signs, speed-activated warning signs and advanced warning signs (regional intersection or ramp signal types A and B).

NZTA ITS class: 001 Signs. Equipment which provides visual messages or warnings to the users of the transport network. Class definitions

1.3 Outcomes

VMS must:

i. be able to display and maintain highly visible and legible messages to road users under all conditions
ii. be positioned in locations that maximise visibility both optically (optimising height and viewing angles) and logically (preceding important journey decision points); these graphics are covered in the latest version of ITS design standard: Variable message signs – fixed
iii. not constrain the ability to deliver required messages (noting message configuration will change with operations requirements)
iv. provide operational status feedback to confirm that the VMS is displaying the required message.

2 FUNCTIONAL REQUIREMENTS

This section outlines what the equipment and systems need to do, and how they need to do it.

2.1 Full-colour display matrix

Full-colour VMS must be able to display text and graphics as defined in section 3.4.1 ‘LED colour palette’.

2.1.1 Font visibility requirements

Font requirements to support visibility for messages displayed on VMS shall be consistent with *Table 1. NZTA VMS types* and *ITS core requirements standard: Electronic message signage fonts.*

Type	Motorway	Regional		Urban type D (EJT)
		Type A	Type C	
Location	**Motorways (urban state highways) and expressways**	**Rural state highways throughout New Zealand**		**Local road approaches to motorway interchanges**
Minimum character height (mm)	400	300	200	
Minimum border (mm)	100	75	50	
Lines of text	3	4		3
External VMS dimensions (mm)	7600 × 2300	4960 × 2390	3300 × 1590	1675 × 990
Minimum display area dimensions (w × h) (mm)	7040 × 1760	4800 × 2080	3072 × 1280	1536 × 896
Minimum pixel quantities (w × h)	352 × 88	240 × 104	192 × 80	96 × 56
Maximum pixel pitch (mm)	20		16	
Maximum power consumption (W)	2000	1500 (460 typical)	1250	440 (105 typical)
Maximum weight (kg)	800	625	280	60
Procurement documentation must require that structural supports and foundation are acceptable to accommodate both the dead weight and sail area of the VMS.				

Table 1. NZTA VMS types

VMS shall interface seamlessly with the DYNAC TMS

2.2 Display uniformity

The display of the VMS must appear to be uniform and consistent across the display matrix and in the following areas.

2.2.1 Luminous intensity (brightness)

There must be no visible variation in brightness across the display. The luminous intensity of the VMS must be capable of automatically adjusting to align with ambient lighting conditions. The luminance and LR levels required for scenarios when the sun is low in the sky are detailed in Table 2: VMS luminance and LR levels.

		Luminance limits for specified colour on reference axis – L3, L3* (cd/m^2)					
Row ref.	VMS illuminance (lx)	White		Yellow		Orange	
		$L_{a(min)}$	$L_{a(max)}$	$L_{a(min)}$	$L_{a(max)}$	$L_{a(min)}$	$L_{a(max)}$
1	40,000	12,400	37,200	7440	22,320	4800	14,400
2	10,000	12,400*	37,200	7440*	22,320	4800*	14,400
3	4000	2200	6600	1320	3960	852	2556
4	400	600	1800	360	1080	232	696
5	40	250	750	150	450	100	300
6	≤4	75	225	45	135	28	84

Row ref.	VMS illuminance (lx)	Green		Red		Blue	
		$L_{a(min)}$	$L_{a(max)}$	$L_{a(min)}$	$L_{a(max)}$	$L_{a(min)}$	$L_{a(max)}$
1	40,000	3720	11,160	3100	9300	1240	3720
2	10,000	3720*	11,160	3100*	9300	1240*	3720
3	4000	660	1980	550	1650	220	660
4	400	180	540	150	450	60	180
5	40	75	225	63	189	25	75
6	≤4	23	69	19	57	7.5	22.5

		Minimum LR					
Class	Colour	White	Yellow	Orange	Green	Red	Blue
R3	On reference axis	16.7	10	6.5	5	4.2	1.7
	Vertical off axis	8.35	5	3.25	2.5	2.1	0.85

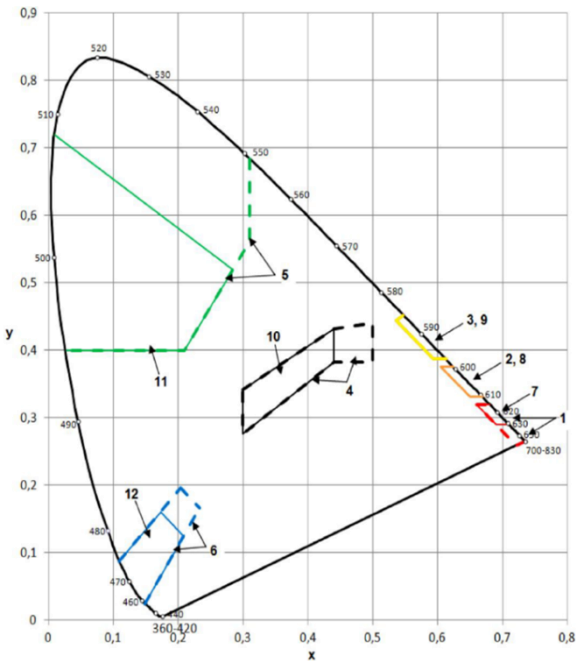
Table 2: VMS luminance and LR levels

2.2.2 Colour

Optically there must be no visible variation in the colour of the light produced across the display, consistent with Table 3: Colour chromaticity.

Colour	Axis	Colour coordinates of corner points			
		1	2	3	4
Red	*x*	0.660	0.680	0.710	0.690
	y	0.320	0.320	0.290	0.290
Orange	*x*	0.624	0.605	0.650	0.669
	y	0.370	0.370	0.331	0.331
Yellow	*x*	0.536	0.547	0.613	0.593
	y	0.444	0.452	0.387	0.387
White	*x*	0.300	0.440	0.440	0.300
	y	0.342	0.432	0.382	0.276
Green	*x*	0.009	0.284	0.209	0.028
	y	0.720	0.520	0.400	0.400
Blue	*x*	0.109	0.173	0.208	0.149
	y	0.087	0.160	0.125	0.025

Table 3: Colour chromaticity



1: Red, 2: Orange, 3: Yellow, 4: White, 5: Green, 6: Blue,
7: Red, 8: Orange, 9: Yellow, 10: White, 11: Green, 12: Blue

2.3 Contrast ratio

The VMS must support the ability to automatically increase or decrease the luminous intensity (brightness) in response to ambient conditions to maintain the contrast ratio under all operating conditions.

The contrast ratio must ensure that all images displayed on the VMS are clearly legible under all conditions.

2.3.1 Border sizing to support the contrast ratio

A border is required around the display matrix to support the contrast between the displayed message and ambient lighting conditions. The width must measure between 5% and 15% of whichever measurement is smaller and must be the same width on all sides consistent with Figure 1.

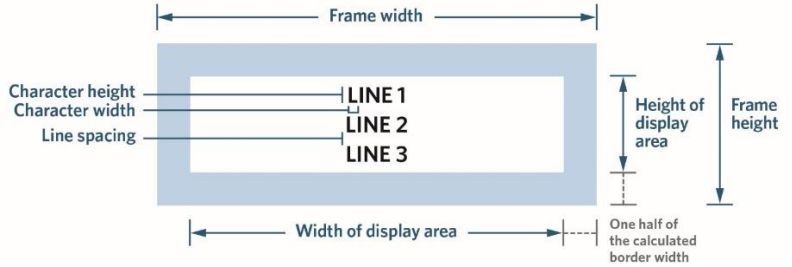


Figure 1. VMS dimensions

For a fixed frame size the border width can be reduced to maximise the usable space available on the display matrix area (subject to section 3.2 ‘Display matrix finish’).

2.4 Display matrix pixel control

Each individual pixel must be able to be addressed and controlled separately, to support future anti-aliasing requirements for fonts and graphics. The VMS shall be full colour and graphics capable – in addition to alphanumeric characters or predefined symbols.

The minimum message display dimensions shall be in accordance with *Table 1. NZTA VMS types.*

2.5 Display matrix parameters

The VMS display must consist of a full matrix and be capable of displaying a single steady screen and two alternating screens depending on message length.

2.6 Visible flicker – machine readability

During testing there shall be no visible light flicker, whether the light-emitting diodes (LEDs) of a VMS are operating at full intensity or are dimmed. Further, VMS messages must be machine readable (eg by closed-circuit television (CCTV) cameras).

2.6.1 Frequency

The VMS must meet the frequency requirement of 100Hz or greater.

2.7 Sign controller

2.7.1 Status reporting

The sign controller must:

i. retain fault logs locally until retrieved by the client or logging system
ii. report VMS fault conditions to the central control system as soon as the communication network is available.

2.7.1.1 Retention period

Minimum of 24 months.

2.7.2 Fault reporting

The sign controller must monitor the operation and health of the VMS and communicate status with the control room. Alerts on operators' workstations indicate whenever a problem occurs that will prevent correct display of messages on the VMS.

Alerts must indicate the level of criticality. There are three levels:

i. Critical: detected fault results in unit outage or have safety implications
ii. Urgent: detected fault prevents designed operation to support outcomes
iii. Routine: detected fault has no impact on operation to support outcomes.

2.7.2.1 Fault reporting error types

The minimum error types are shown in Table 4. Fault reporting error types.

Error type	Definition	Action
Pixel	A pixel error must be raised when pixels fail. The error reporting must include the total number of failed pixels and the location of the failed pixels. Any LED pixel shall be deemed failed if it does not behave as expected. Such behaviour shall include pixels remaining in the wrong state (on or off), pixels that flicker, and pixels that exhibit reduced or increased brightness compared to properly functioning pixels.	The sign shall blank and register a fault if: i. more than 5% of the pixels have failed, or ii. if more than four contiguous pixels in either horizontal or vertical direction have failed. The display module(s) where faults have occurred must have a visible fault indicator to facilitate efficient maintenance, removal and replacement.
Message	The sign is not able to display any message either because of internal device failure(s) or because the VMS is unable to resolve a message in the format in which it is presented (eg if the characters contained exceed the maximum message length).	
Power	This error is raised when one or more power supplies become faulty or the mains power supply fails.	The VMS must log the fault.
Temperature	If the temperature inside the enclosure exceeds a critical threshold level, the VMS must report the temperature and log it.	The sign must be turned off to protect the sensitive electronic components from damage.
Photocell	A pair of photocells are used to measure the ambient light at the sign and adjust the brightness of the LEDs to suit.	If a photocell fails, the sign could become either too dim or too bright to be legible.
Internal communication	This error advises a communication failure within the VMS unit.	

Table 4. Fault reporting error types

2.7.3 Error handling

Incorporate an error handler to detect out-of-program conditions and reset the controller.

The error handler must put the VMS into a known state (eg clear the message automatically and immediately) in the event of internal or external critical failures such as a communications failure.

All errors must be logged.

The VMS must take appropriate action when faults arise. Under no circumstances can the VMS display to road users:

i. brightness levels that are inconsistent with ambient lighting or are not uniform across the display
ii. partial, incomplete or otherwise potentially unintelligible messages.

2.7.4 Configuration and administration

The sign controller must:

i. provide an interface in the VMS for a device to be connected to upload and download graphics and facilitate diagnostic testing
   - The VMS must support both local and remote access for Contractor's proprietary software.
   - Associated software must be provided by the Contractor for use by the client or its agents.
ii. store 150 text-based messages or graphic images for immediate display
iii. have sufficient random access memory (RAM) to upload and download messages as defined above.

2.7.5 Command and control

The sign controller must:

i. be able to operate the VMS in both local-control mode (ie no external communications) and remote-control mode (ie communicating with an external central control system)
ii. in both local and remote modes, support technician/operator selection of all NTCIP 1203 v03 National Transportation Communications for ITS Protocol – Object Definitions for Dynamic Message Signs (DMS) (NTCIP 1203) functions (such as manually changing dimming level, commanding display of pre-stored messages, and running diagnostic routines capable of testing full VMS operation).

2.8 Message conflict

The VMS must be able to display aspects that resemble alphanumeric characters or pictograms requested from approved external sources such as TOCs or as part of a local response such as from a remote tunnel supervisory control and data acquisition (SCADA) system.

2.9 Remote configuration

The VMS must support remote configuration by Client or their appointed agents such that text and graphics can be uploaded into the onboard library and modifications can be made to font files and other configurable objects.

2.10 Status information

The VMS must be able to communicate status information (including fault, confirm-receipt and read-back messages) and any required performance parameters to the approved external source(s).

2.10.1 Status update in real time

Status information must be updated in real time (in less than two seconds from the point when a message is received by the VMS network interface).

2.11 Storage of text and graphics

The VMS must be able to display alphanumeric messages and graphics from an onboard library that can be commanded without sending the full content of the message. For example, a complex message stored with the label ‘Message1’ would display when the VMS receives a properly formatted request to display Message1.

2.12 Internal logging requirement

The VMS must maintain logs and retain performance parameters, including fault conditions, until they are retrieved (and removed) during the prevailing periodic maintenance cycle for resolution. Log data shall be available for export analysis in a non-proprietary common format (eg CSV, XML, JSON files) and recorded with a time stamp.

2.12.1 Internal logging retention period

Logs, including errors and performance parameters captured by the VMS, must be retained for a minimum two-year period.

2.13 Communication failure

Fifteen minutes after a communication failure, the VMS must blank the aspect currently being displayed on the display matrix.

Note: A communication failure is deemed to have occurred when a defined period of time from the last received communication from the associated controlling entity (such as the back-office system or local controller) has been exceeded.

2.13.1 Communication timer

The communication failure timer must be configurable.

2.13.2 Communication timeout

The default setting for the communication failure timer is a period of two minutes from the last incoming communication.

2.13.3 Post-communication timeout state

The VMS must blank into the lowest priority state (idle) so that the asset is ready for service on recovery of communications.

2.14 Prompt message display

The time difference between receipt and display of all messages must be such that there is no discernible lag between one device updating and updating of the adjacent VMS.

2.14.1 Display update time

For VMS in a group or pair, the maximum lag between sequential VMS updating is one second.

2.15 Message queuing and prioritisation

Message prioritisation (contention) must be resolved solely on NTCIP 1203 parameters.

The VMS must be able to order incoming messages based on the priority of the message received and against the current run time message priority. The message with the highest priority must be displayed on the VMS.

Incoming messages must be stored and queued in priority order, pending display.

2.16 Compliance with NZTA protocols and other control interfaces

The VMS must be configured to comply with prevailing client protocols and other control interfaces as specifically requested in the procurement documentation.

2.17 Integration with existing NZTA traffic management system

VMS procured using this delivery specification must be able to interface seamlessly with the Client current advanced traffic management system (ATMS).

3 PERFORMANCE REQUIREMENTS

This section outlines the reliability and availability requirements of equipment, which require independent certification and/or declarations of conformity.

3.1 Resistance to the effects of external conditions

3.1.1 Design life

The specified design life (operational service life) of the VMS equipment is 15 years. Equipment shall continue to operate effectively while exposed to New Zealand climate conditions[1] for a minimum of 15 years. It is essential that materials and manufacturing processes take this into account.

VMS shall be capable of continuous, normal operation (24 hours a day, 7 days a week) and maintaining performance criteria in the conditions described below:

i. installed and operated in direct sunlight
ii. ambient temperature range between −25°C and +55°C (class T2 as per EN 12966:2014+A1:2018 Road vertical signs – Variable message traffic signs (EN 12966))
iii. enclosure air temperature between −20°C and +75°C
iv. maximum wind conditions likely to occur at the installation site as per AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions
v. solar radiation with value of up to 2000W/m² at direct sunlight, incident at an angle of 30° from the vertical
vi. varied light intensity due to shadows
vii. altitude up to 1000m
viii. humidity between 10% and 95% non-condensing
ix. conditions, both permanent and temporary, unique to the specified location (eg instances of thick smoke and electromagnetic interference)
x. vibrations expected in the installed location
xi. marine environment
xii. road surface reflection.

3.2 Display matrix finish

The finish of all VMS surfaces shall not result in specular (mirror) reflection that distracts road users.

3.2.1 Display matrix surfaces

The display matrix must:

i. not reflect light back to the user, in order to support contrast of the message being displayed
ii. be finished as per BS4800:2011 colour chart (matt black 00 E 53)
iii. be powder-coated
iv. not use smooth, monolithic front screens (such as polycarbonate panels).

[1] New Zealand climate data is available from the National Institute of Water and Atmospheric Research (NIWA) website: https://niwa.co.nz/education-and-training/schools/resources/climate.

3.2.2 Frame surfaces

Frame surfaces (internal and external) must be powder-coated as per AS 4506-2005 Metal finishing – Thermoset powder coatings. The colour of the frame coating is to be grey. The coating must facilitate the removal of graffiti.

3.3 Structural

The VMS frame shall be designed to support its own weight through its mounting points and resist all static and dynamic forces to, or from, the mounting structures.

VMS must meet:

i. class WL9 as per EN 12966 for wind loading
ii. class DSL4 as per EN 12966 for dynamic snow loading
iii. class TBD6 as per EN 12966 for temporary bending deflection.

See EN 12966 section titled ‘Mechanical performance requirements’.

3.3.1 Resistance of electrical/electronic components to the effects of pollution

The Contractor shall declare the degree of resistance in accordance with EN 12966 section titled ‘Resistance of electrical/electronic components to the effects of pollution’.

3.3.2 Resistance to surface corrosion

The surface protection of VMS enclosures against corrosion shall meet the requirements of EN 12966 section titled ‘Resistance to corrosion of discontinuous VMS’.

3.3.3 Enclosure: ingress protection against water and dust

All VMS enclosures must meet a minimum IP rating of IP56 (P3 as per EN 12966).

3.3.4 Enclosure: protection against external mechanical impacts

The VMS must meet a rating of IK10 (as per EN 62262:2002+A1:2021 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)).

3.3.5 Vibration resistance

The VMS shall be capable of withstanding vibration in accordance with table 19 of EN 12966 section titled ‘Environmental and mechanical tests’.

3.4 Visual performance

3.4.1 LED colour palette

When observing the whole VMS front screen from all viewing angles within the specified beam width, colours shall not be discernible as individual red, green and blue light sources.

Each individual red, green and blue LED must be capable of displaying 256 shades of corresponding colours equating to 255 × 255 × 255 colour (>16M colours).

3.4.2 Colour

All VMS must meet colour class C2 as per EN 12966. The chromaticity coordinates of the required colour parameters are defined in table 3 and figure 1 of EN 12966 section titled ‘Colour’.

3.4.3 Luminance

All VMS must meet luminance levels to class L3 as per tables 4 to 9 of EN 12966 section titled ‘Luminance’.

3.4.4 Luminance ratio

All VMS must meet luminance ratio (LR) class R3 as per table 10 of EN 12966 section titled ‘Luminance ratio’.

3.4.5 Beam width

High-speed roads with two or more running lanes shall use beam width B5 as per EN 12966 section titled ‘Beam width’. All other roads typically use beam width B6. It is the designer’s responsibility to select the correct beam width, and this shall be reflected in procurement documentation.

3.4.6 Uniformity of luminous intensity

Each colour (as specified in section 3.4.2 ‘Colour’) must meet the luminous intensity requirements listed below in Table 5.

Luminous intensity		Ratio of output
Highest 12%	Lowest 12%	3:1
Highest 4%	Lowest 4%	5:1

Table 5. Uniformity of luminous intensity

3.4.7 Degradation of visual performance

VMS design solutions must consider the impact to visual performance (ie colour, luminance and LR) caused by ageing effects. The visual performance requirements are minimum requirements and must be achieved during the entire operational lifetime of the VMS (see section 4 ‘Technical requirements’).

3.5 Maintainability

The VMS shall be designed:

i. so all the internal components can be easily and quickly replaced in the field (see mean time to repair (MTTR) in section 4.6 ‘General requirements’)
ii. to be installed and maintained by local technicians following Contractor’s supplied documentation

iii. to have a standard access from the rear
iv. for easy cleaning
v. to minimise onsite cyclic maintenance
vi. so that no specialist tools are required.

4 TECHNICAL REQUIREMENTS

This section outlines specific technical and physical constraints for the equipment.

4.1 Electrical safety

All ITS equipment must comply with and be installed in accordance with Electricity (Safety) Regulations 2010 (SR 2010/36).

4.1.1 Equipment declaration of conformity

The Contractor shall supply a declaration of conformity for the VMS in accordance with SR 2010/36, sections 80(2) and 81.

4.1.2 Installation of electrical equipment

The Contractor is required to supply a certificate to confirm the equipment has been installed correctly and is compliant with AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules. The contractor who installs the equipment must provide the required certification. This includes acceptance of the declaration of conformity.

4.2 Electrical

4.2.1 Power supply

The VMS must be supplied with reticulated mains power 230V AC.

The VMS shall have the necessary termination equipment to cater for reticulated mains power supply or other type(s) (specified during the procurement). Earthing/equipotential bonding connection point must be provided within the VMS.

The VMS enclosure must not contain an uninterruptable power supply (UPS) or batteries. If required a UPS, an alternative power source shall be housed separately near to the enclosure.

4.2.2 Power consumption

Contractors must state typical and maximum power consumption figures throughout the expected design life for consideration in procurement evaluation.

The maximum power consumption for the VMS with all LEDs illuminated at maximum brightness must not exceed the ratings listed in Table 1. NZTA VMS types.

4.2.3 Nominal voltages

The standard nominal voltage for connection to the public supply shall be taken to be 230V AC RMS single phase.

4.2.4 AC operating voltage range

Variations in the nominal supply voltage defined in EN 12966 section titled ‘Operating voltage range’ shall not affect the VMS functions. This shall be tested in accordance with tables 16 and 17 of EN 12966 section titled ‘Electrical tests’ and shall meet the requirements given therein.

4.2.5 Mains frequency

Variations within the frequency range of 50±1Hz shall not affect the VMS functions.

4.2.6 Power-up activation

The VMS shall be ready for activation when the supply voltage reaches a value within its operating voltage range. At no time during power-up activation shall partial, incomplete or false messages be displayed.

4.2.7 Low voltage – switch-off voltage response

A drop in the nominal voltage of more than 13% shall not cause partial, incomplete or false messages to be displayed or cause damage to the VMS.

4.2.8 Low voltage – voltage interruption

The effect of voltage interruption shall be as per EN 12966 section titled ‘Voltage interruption’.

4.2.9 Low voltage – temporary over-voltage

When protection for temporary (not transient) over-voltage is incorporated, the operating voltage range of the protective device shall be stated and shall be tested in accordance with table 16 of EN 12966 and shall meet the requirements given therein.

4.2.10 Electromagnetic emission and immunity

For all types of environment, the VMS shall conform to EN 50293:2012 Road traffic signal systems – Electromagnetic compatibility.

The performance of any external equipment must not be interrupted by any radio frequency or electromagnetic interference generated by the VMS or vice versa.

4.2.11 Electrical surge protection

All equipment shall be internally protected against damage resulting from:

i. lightning strikes near the VMS or gantry
ii. electrical transients on power cabling
iii. electrical transients on internal and external signal wiring
iv. electromagnetic interference
v. static electrical discharge.

Surge protection shall be provided on the incoming power circuits and communications circuits.

4.2.12 Service socket

All enclosures shall be fitted with a single-phase switched 10A-rated power outlet socket, in accordance with AS/NZS 3112:2017 Approval and test specification – Plugs and socket-outlets.

4.2.13 Operating voltages tests

Operational voltage test sequencing shall be consistent with Table 6: Operational voltage test sequencing

Test sequence	Voltage value	Measurements
1	No power	No power supply
2	Nominal	Switch ON the VMS/test module and check that there is no partial, incomplete or false display
3	Nominal	Function test
4	Drop to the minimum voltage	Check that there is no partial, incomplete or false display
5	Drop to 50% of the nominal voltage	Check that there is no partial, incomplete or false display
6	Nominal	Check that there is no partial, incomplete or false display
7	Nominal	Function test
8	Raise to the maximum voltage	Check that there is no partial, incomplete or false display
9	Nominal	Check that there is no partial, incomplete or false display
10	Nominal	Function test
11[a]	Maximum voltage stated by the protection device	Check that there is no partial, incomplete or false display no visual damage of the VMS/test module.
12[a]	Nominal	Check that there is no partial, incomplete or false display
13[a]	Nominal	Function test
[a] Test only to be undertaken if a protection device is incorporated		

Table 6: Operational voltage test sequencing

4.2.14 AC operating voltage tests

The functional test shall be repeated for different combinations of voltage and frequency in accordance with the following table:

Test sequence	Frequency value	Voltage value
1	Lower	Lower
2	Nominal	Nominal

3	Upper	Upper

Table 7: AC operating voltage tests

4.2.15 Permutations of voltage and frequency

The effect of voltage interruption shall be as follows:

Duration (ms)	Effect
Less than 50	No effect
50 to less than 100	The VMS shall continue to display the current message but can be affected by a variation of luminance during the voltage interruption.
Greater than or equal to 100	Shutdown is allowed unless specified by the purchaser. This shall not cause partial, incomplete or false messages to be displayed or cause damage to the VMS. When the power supply is restored the VMS shall behave as described in section 4.2.6 ‘Power-up activation’.

Table 8: Permutations of voltage and frequency

4.3 Sign controller

The embedded controller must:

i. support both local and remote access through the same RJ45 ethernet port with 100Mbps and higher
ii. support a fully featured, industry standard, embedded operating system
iii. be able to support as a minimum the following communication interface standards:
   - Transmission Control Protocol (TCP) as per Request for Comments (RFC) 793
   - User Datagram Protocol (UDP) as per RFC 768
   - Internet Protocol (IP) as per RFC 791
   - Dynamic Host Configuration Protocol (DHCP) as per RFC 2131
iv. as a minimum provide two communication ports, one for administration and one to connect to the ATMS.

The controller must:

i. support NTCIP 1203 including mark-up language for transportation information (MULTI) and, as a minimum, support message information block (MIB) elements defined in the test plan (available by emailing NZTA at: itsspec@nzta.govt.nz)
ii. comply with the Client cyber security requirements
iii. support user authentication remotely and locally
iv. support time synchronisation from an external clock (eg Coordinated Universal Time (UTC), Network Time Protocol (NTP)).

4.4 Physical characteristics

4.4.1 Front panels

VMS front panels shall be designed in such a way that no part of the message displayed is obscured when observed from the required viewing positions. They shall be designed in such a way as to minimise the effects of ice and snow.

4.4.2 Front screens

Front screens adversely impact the intensity of light being transmitted from the VMS and can be prone to degradation caused by weathering and exposure to intense direct sunlight. Consequently, monolithic screens such as polycarbonate panels or louvres are not permitted.

VMS that allow portions of the front screen to be removed (modular) can risk weather tightness of the enclosure and are not permitted.

4.4.3 Display matrix

4.4.3.1 Physical layout

The display must be formed using a regular matrix, ie the spacing between individual light sources in both the *x* and *y* axes is uniform.

The display area (height × width) is specified in Table 1. NZTA VMS types, for different VMS types (based on road operating speed and location).

4.4.3.2 Display technology options

LED technologies shall be the default choice for the displays for all VMS applications. This technology provides good visibility under most viewing conditions, high reliability, low optical degradation, and has low maintenance requirements.

4.4.3.3 Pixel pitch

On large VMS installed above or alongside state highways, the maximum pixel pitch must be 20mm. For smaller VMS used on local roads, the maximum pixel pitch must be 16mm.

4.4.3.4 Beam width

The minimum beam width shall be in accordance with EN 12966 section titled ‘Beam width’. The following table provides additional information.

Beam width class	Beam angles				Typical	
	Horizontal			Vertical	Application	Character height
B1	−5°	0°	+5°	0° 0° −5°	High-speed road, two running lanes plus one safety lane. VMS gantry-mounted centrally over running lanes.	300mm 400mm
B2	−7°	0°	+7°	0° 0° −5°	High-speed road, three running lanes plus one safety lane. VMS gantry-mounted centrally over running lanes.	300mm 400mm
B3	−10°	0°	+10°	0° 0° −5°	High-speed road, four running lanes plus one safety lane. VMS gantry-mounted centrally over running lanes or at side of road, requiring a wider beam to cover up to two lanes.	300mm 400mm
B4	−10°	0°	+10°	0° 0° −10°	As B3 above. VMS mounted at height of 6m or more.	300mm 400mm
B5	−15°	0°	+15°	0° 0° −5°	As B3 above, but extra-wide VMS covering more than two lanes.	200mm 300mm 400mm
B6	−15°	0°	+15°	0° 0° −10°	As B5 above. VMS mounted at height of 6m or more.	200mm 300mm 400mm
B7	−30°	0°	+30°	0° 0° −20°	For special applications, where very wide horizontal and vertical beam widths are required. In urban areas B7 could be suitable for cyclist and pedestrian audiences.	Not specified; however, 200mm character height is minimum for urban roads in New Zealand.

Table 9. Beam width class

4.4.3.5 LEDs

Contractors shall provide evidence that LEDs supplied as part of any VMS meet the quality requirements, luminous intensity ratings, batch requirements and life expectancy requirements defined in this section and in section 3.1.1.

The contractor shall provide details of the current rating of the proposed LEDs to be used, and what actual current they will be driven at to meet the luminous intensity requirements. LEDs must be sourced from the same batch/bin in order to mitigate the risk of minor variations in colour output.

The latest high-quality manufacturing techniques must be used to ensure that:

i. exposure of components to mechanical or thermal stress is minimised
ii. manual handling of sensitive componentry is minimised
iii. conformal coatings are consistently applied to circuit boards to minimise exposure to condensation.

Modules forming the display shall be of a size that is easy to replace with the VMS in situ in the field and without the need to dismantle any part of the VMS. No soldering or heat-based bonding is permitted to be undertaken as part of VMS maintenance. Removal or replacement of display modules must be tool free.

4.4.4 Heating and forced ventilation

The provision of heaters and fans for supplementary environmental control within the enclosure is not generally permitted.

4.4.5 Doors and maintenance access

All covers, doors, protective screens, plates, glands, external connectors etc shall be provided with rubber seals or equivalent materials that are maintenance free and shall remain effective for the design life of the equipment.

Where access doors are provided, they shall be fitted with a suitable retention stay to hold the door in the open position for the safety of maintenance personnel working inside the enclosure. The VMS shall have a mechanism to restrict the door opening from left to right and from right to left at a 90° or 120° angle. They must include physical security against unauthorised access and have a door-open alarm capability to remotely report that any of the doors were opened.

For security, access doors and panels shall be fitted with suitable locks (one lock per door/panel), designed for outside conditions. Unless specified otherwise, all access door locks shall have an identical key and the Contractor shall provide at least four copies of the key.

For regional VMS, the enclosure is located approximately 3m above the ground. The contractor’s installation design shall ensure ease of access to components for ladder-based access or facilitate the use of portable access equipment (eg scissor lift or cherry picker).

4.4.6 Cable entries

All power supply, control and communication cabling shall enter the VMS enclosure through appropriately constructed, sealed and glanded entry holes. All the cable entry points must be through the bottom of the VMS frame as standard.

4.4.7 Electrolytic compatibility

Components shall comprise materials that when assembled into the VMS are electrolytically compatible and environmentally stable.

4.4.8 Lifting eyes

The enclosure shall be provided with at least two lifting eyes that enable the VMS to remain vertical and upright when lifting the enclosure onto the support structure.

The lifting eyes shall be appropriately located ensuring sufficient structural strength to allow the VMS to be lifted or moved without causing any damage or deformation to any part of the VMS.

4.4.9 Mounting to support structure

The VMS must be designed to be mounted to the structure on which it will be supported. Modifications to the VMS enclosure are not permitted once it has left the place of manufacture.

The VMS enclosure mounting points must be agreed with the Client. The mounting points are specified in the site or gantry design.

Penetration through the enclosure for mounting is not permitted. Captive nuts in the VMS must be used to attach the structure to the VMS with appropriately sized fixings (bolts or screws).

4.4.10 Transportation

VMS shall be shipped in containers that protect their contents from damage in transit, including extreme temperature, humidity, impact/shock etc. The units shall be wrapped to prevent contamination and the packaging shall be fitted with a device to indicate whether the unit has been subjected to rough treatment during its journey.

4.5 Documentation

4.5.1 Certification and declarations of conformity

All VMS supplied to the Client must include:

i. certification from an accredited independent testing facility demonstrating compliance with EN 12966
ii. a declaration of conformity for each of the following industry standards:
    - AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions
    - AS/NZS 3112:2017 Approval and test specification – Plugs and socket-outlets
    - BS4800:2011 colour chart (matt black 00 E 53)
    - EN 50293:2012 Road traffic signal systems – Electromagnetic compatibility
    - IEC 61508 series (for functional safety)
    - ISO/IEC 27001:2013 Information technology – Security techniques – Information security management systems – Requirements
    - ISO/IEC 27002:2013 Information technology – Security techniques – Code of practice for information security controls
    - SR 2010/36 Electricity (Safety) Regulations 2010.

The Contractor must provide supplementary report information from the testing facility stating all the tests performed, including, but not limited to, the LED colour(s), pixel pitch, beam width, luminance, LR and IP rating of the specific VMS type being supplied under the NZTA contract.

The Contractor must supply original equipment manufacturer (OEM) maintenance, service and operations guidelines and manuals, which will include maintenance schedules and procedures, handling and storage instructions, and a spares list.

4.5.2 Software and licensing

The Contractor must supply all software and licensing required to configure and manage the VMS to the Client or its agents.

4.6 General requirements

Item	Requirement
Reliability	99.99% excluding mains power or external communications failures.
Failure modes (power or communications failures)	i. Display or enter default mode. ii. Shutdown in safe manner where specified. iii. Automatic restart in safe manner upon restoration of power or communications.
Privacy/security of data	Comply with: i. ISO/IEC 27002:2013 Information technology – Security techniques – Code of practice for information security controls ii. ISO/IEC 27001:2013 Information technology – Security techniques – Information security management systems – Requirements.
Functional safety	i. Comply with the IEC 61508 series (for functional safety). ii. Carry out functional safety study in conjunction with the Client to determine any safety integrity level requirements.
Alarms, events and status	Configurable and monitored from TOCs.
Communications	Interface to the Client communications network.
Mean time between failure (MTBF)	All VMS equipment shall have a specified MTBF of 55,000 hours or greater, unless otherwise specified or approved in writing by the Client.
Mean time to repair (MTTR)	Ability to readily replace modules or components from when the Contractor turns off the power supply to the unit, until the unit is powered back on and working. The default MTTR is 10 minutes, which applies to VMS components for onsite repair only.
Disposal	VMS shall utilise materials where possible that are recyclable to minimise the adverse environmental effect of disposal.

Table 10. General requirements

5 APPENDIX: SUPPLEMENTAL INFORMATION

5.1 Requirements from industry standards

VMS mechanical performance requirements

Condition	Applicable standard
Temporary deflections caused by wind loads	EN 12899-1:2007 Fixed, vertical road traffic signs – Fixed signs
Permanent deflections caused by dynamic loads	EN 12899-1:2007 Fixed, vertical road traffic signs – Fixed signs
Impact resistance	IEC 60598-1:2014/ AMD1:2017 Amendment 1 – Luminaires – Part 1: General requirements and tests
Vibration resistance	IEC 60068-2:2020 SER Environmental testing – Part 2: Tests – ALL PARTS

Resistance of VMS to surface corrosion

Condition	Applicable standard
Resistance to corrosion – salt spray test	EN ISO 9227:2022 Corrosion tests in artificial atmospheres – Salt spray tests

Enclosure: ingress protection against water and dust

Condition	Applicable standard
Water ingress	IEC 60529:1989/ AMD2:2013 Amendment 2 – Degrees of protection provided by enclosures (IP Code)
Dust ingress	IEC 60529:1989/ AMD2:2013 Amendment 2 – Degrees of protection provided by enclosures (IP Code)

6 REFERENCES

This section lists external and NZTA references included in this document.

6.1 Industry standards

Standard number/name
AS 1744:2015 Standard alphabets for road signs (Series D)
AS 4506-2005 Metal finishing – Thermoset powder coatings
AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions
AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules
AS/NZS 3112:2017 Approval and test specification – Plugs and socket-outlets
BS4800:2011 colour chart (matt black 00 E 53)
EN 12899-1:2007 Fixed, vertical road traffic signs – Fixed signs
EN 12966:2014+A1:2018 Road vertical signs – Variable message traffic signs
EN 50293:2012 Road traffic signal systems – Electromagnetic compatibility
EN 62262:2002+A1:2021 Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
EN ISO 9227:2012 Corrosion tests in artificial atmospheres – Salt spray tests
IEC 60068-2:2020 SER Series – Environmental testing – Part 2: Tests – ALL PARTS
IEC 60529:1989/AMD2:2013 Amendment 2 – Degrees of protection provided by enclosures (IP Code)
IEC 60598-1:2014/AMD1:2017 Amendment 1 – Luminaires – Part 1: General requirements and tests
IEC 61508 series (for functional safety)
ISO/IEC 27001:2013 Information technology – Security techniques – Information security management systems – Requirements
ISO/IEC 27002:2013 Information technology – Security techniques – Code of practice for information security controls
NTCIP 1203 v03 National Transportation Communications for ITS Protocol – Object Definitions for Dynamic Message Signs (DMS)
RFC 793: Transmission Control Protocol
RFC 768: User Datagram Protocol
RFC 791: Internet Protocol
RFC 2131: Dynamic Host Configuration Protocol
SR 2010/36 Electricity (Safety) Regulations 2010

6.2 NZTA standards, specifications and resources

6.2.1 Standards and specifications

See the NZTA website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS design standard: Variable message signs – fixed
ITS core requirements standard: Electronic message signage fonts

6.2.2 Resources

Document name/code	NZTA website link
Land Transport Rule: Traffic Control Devices 2004 Rule 54002/2004 Updated 19 May 2022 (TCD rule)	https://www.nzta.govt.nz/assets/resources/rules/docs/traffic-control-devices-2004-as-at-19-may-2022.pdf
Traffic Control Devices manual (TCD manual)	https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

6.3 Other resources

Document name/code	NZTA website link
NIWA climate data and activities	https://niwa.co.nz/education-and-training/schools/resources/climate

6.4 ITS standard drawings

See the NZTA website for the latest versions of the ITS standard drawings listed below.

7 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of NZTA.
PENDING	The document has been finalised and is pending approval and ratification by NZTA. It can be used for procurement at this status.
RATIFIED	The document is an official NZTA document. NZTA projects and other road controlling authorities connected to NZTA back-end systems must include this document in the contracts. The obligation to follow the requirements in this document would come from the inclusion of the S&S document in the contract.
RETIRED	The document is obsolete, and/or superseded.
NZTA	This is noted as being equivalent to the New Zealand Transport Agency.
AC	Alternating current
AS	Australian standard
ASD	Acceleration spectrum density
AS/NZS	Australian/New Zealand standard
ATMS	Advanced traffic management system
Border	Border surrounding an active display matrix on an electronic sign or signal
BS	British standard
CCTV	Closed-circuit television
cd	Candela
Character height	Height of an upper-case character expressed in millimetres
Character spacing	Horizontal spacing between individual characters on the same line of a message, expressed as a ratio of stroke width
Continuous VMS	A VMS that has a bi-stable display matrix that can maintain the display message even after power has been removed
CSV	Comma separated values
DHCP	Dynamic Host Configuration Protocol
Discontinuous VMS	A VMS that uses luminous elements to show different messages on a single sign face
Display matrix	Visible part of an electronic sign or signal that contains the pixels that can be activated to display the message
DMS	Dynamic message sign (this term is from NTCIP 1203 v03)
EJT	Estimated journey time
EN	Europäische Norm (European standard)
Enclosure	Housing for electronics systems to protect against environmental conditions
FAT	Factory acceptance testing

Term	Definition
Frame surface	Internal and external surfaces of an electronic sign or signal enclosure
Front screen	Screen protecting the display matrix or the parts of it against dust, water etc (see 'Display matrix')
Gantry	Support structure spanning a carriageway for the purpose of supporting electronic signs and signals
IEC	International Electrotechnical Commission
IK code	International numeric classification for the degrees of protection provided by enclosures for electrical equipment against external mechanical impacts
IP	Internet Protocol
IP code	The International Protection code (sometimes interpreted as Ingress Protection code) classifies the degree of protection provided by mechanical casings and electrical enclosures against intrusion, dust, accidental contact and water.
ISO	International Organization for Standardization
ITS	Intelligent transport systems
JSON	JavaScript Markup Language
LED	Light-emitting diode
Line spacing	Vertical space between lines of text, expressed as a percentage of the upper-case font height
LR	Luminance ratio
Message	Configuration consisting of symbols and/or text
MIB	Message information block
MTBF	Mean time between failure
MTTR	Mean time to repair
MULTI	Mark-up language for transportation information
NIWA	National Institute of Water and Atmospheric Research
NTCIP	National Transportation Communications for Intelligent Transport Systems (ITS) Protocol
NTP	Network Time Protocol
OEM	Original equipment manufacturer
Pictogram	Pictorial aspect that conveys its meaning through resemblance to a physical object.
Pixel	Smallest controllable element of a display matrix for an electronic sign or signal
Pixel pitch	Distance between centres of adjacent pixels
RAM	Random access memory
RCA	Road controlling authority
RFC	Request for Comments

Term	Definition
RMS	Root mean square
SAT	Site acceptance testing
SCADA	Supervisory control and data acquisition
TCD manual	Traffic control devices manual
TCP	Transmission Control Protocol
TMS	Traffic monitoring system, a telemetry collection platform for statistical traffic data on the road network
TOC	Transport operations centre
UDP	User Datagram Protocol
UPS	Uninterruptable power supply
UTC	Coordinated Universal Time
VMS	Variable message sign, an electronic sign where the information shown can be changed or switched on or off as required. The information can be text or symbols. A VMS is an electronic traffic sign used on roadways to give travellers information about special events. They warn of traffic congestion, accidents, adverse weather conditions and incidents. They have the ability to provide information on alternative routes to road users, limit travel speed, warn of duration and location of incidents, or just inform road users of traffic conditions.
XML	Extensible Markup Language

8 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
2.1.1	Font visibility requirements	Electronic message board visibility design standard	001 Signs
3.1	Resistance to the effects of external conditions	Environmental core requirements standard	000 Core requirements
3.3	Structural	Environmental core requirements standard	000 Core requirements
3.4.5	Beam width, this sentence only: Selecting beam widths that are too wide for the location costs money, wastes energy and creates light pollution.	Variable message signs – fixed design standard	001 Signs
4.1.2	Installation of electrical equipment	Electrical core requirements standard	000 Core requirements
4.2	Electrical, excluding section 6.2.12 Service socket	Electrical core requirements standard	000 Core requirements
4.3	Sign controller, point iii only. The controller must: iii. support user authentication remotely and locally	Security core requirements standard	000 Core requirements
4.3	Sign controller, point iv only. The controller must: iv. support time synchronisation from an external clock, eg UTC, NTP.	Network time protocol design standard	012 System interfaces
4.4.5	Doors and maintenance access, last paragraph only: For regional VMS, the enclosure is located approximately 3m above the ground. The design shall ensure ease of access to components for ladder-based access or facilitate the use of portable access equipment (eg scissor lift or cherry picker).	Variable message signs – fixed design standard	001 Signs

Section reference	Section name	Future document	Class
4.4.6	Cable entries	Electrical core requirements standard	000 Core requirements
4.4.7	Electrolytic compatibility	Environmental core requirements standard	000 Core requirements

9 DOCUMENT CONTROL

9.1 Document information

Document number	ITS-SPEC-VMS-FIXED-202402
Previous document number/s (if applicable)	ITS-02-001-202110-SPEC-VMS-FIXED-Interim ITS-02-001-202107-SPEC-VMS-FIXED ITS-02-001-202010-SPEC-VMS-FIXED ITS-02-001-202002-SPEC-VMS-FIXED ITS-06-01
Document status	Approved
[IF RETIRED] New document details	
Online ISBN	978-1-99-106878-1
Document availability	The controlled version of this document can be accessed from https://www.nzta.govt.nz/roads-and-rail/intelligent-transport-systems/standards-and-specifications/its-current-interim-and-legacy-standards-and-specifications

9.2 Document owner

Role Head of Technology Engineering

Organisation NZTA

9.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
11/05/2023	Endorsed by Technical Standards Committee	Technical Standards Committee	NZTA
21/02/2024	Approved by Ratification Group chair and NMPAS	Delegated approver	NZTA

9.4 Full version history

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	25/02/2020	Kirill Yushenko Peter Bathgate	Consultant, Resolve Group Consultant, Resolve Group	Rewrite to capture colour VMS
0.2	26/02/2020	Karen Watson	Senior Product Analyst, NZTA	Transferring to the new ITS delivery specification template
0.3	07/07/2020	Peter Bathgate	Consultant, Resolve Group	Border updates including width calculations and maintaining visibility requirements for the smaller border
0.4	18/08/2020	Russell Pinchen Karen Watson	Design Engineer, NZTA Senior Product Analyst, NZTA	Mapping existing content into the new sections Addition of a VMS dimensions diagram Addition of the requirement for a service socket
0.5	25/08/2020	ITS Working Group Kirill Yushenko Peter Bathgate Editorial services	NZTA Consultant, Resolve Group Consultant, Resolve Group Final Word	Review of the changes to the document
0.6	23/10/2020	ITS Working Group	NZTA	Reviewed internally and version 2.0 finalised
0.7	27/05/2021	ITS Working Group Kirill Yushenko Peter Bathgate	NZTA Consultant, Resolve Group Consultant, Resolve Group	Review of the changes to the document to align with LCS
0.8	05/07/2021	ITS Working Group	NZTA	Updated fault reporting type definition for pixels
0.9	09/07/2021	ITS Working Group	NZTA	Reviewed internally and version 3.0 finalised
0.10	04/10/2021	ITS Working Group	NZTA	Updated section 4.13 Message currency (and subsections) to Communication failure (and subsections)
0.11	06/10/2021	ITS Working Group	NZTA	Reviewed internally and version 4.0 finalised

Version	Date	Author	Role and organisation	Reason
0.12	01/09/2022	Final Word	Editorial services	Updated to latest template version 1.22, updated file name, updated watermark from ‘interim’ to ‘draft’
0.13	14/11/2022	Kirill Yushenko	Consultant, Resolve Group	Update to implement recent changes and due to some information was transferred to electronic message signage fonts standard
0.14	01/03/2023	Kirill Yushenko	Consultant, Resolve Group	Update post industry feedback
0.15	08/03/2003	Anandita Pujara	Document Manager, NZTA	Minor updates to include application of SM0 series.
0.16	10/03/2023	Kirill Yushenko	Consultant, Resolve Group	Update post RCA feedback
0.17	15/03/2023	Matthew Bauer	Editor, Clear Edit NZ	Copyedit
0.18	20/03/2023	Kirill Yushenko	Consultant, Resolve Group	Update post Editor feedback
0.19	22/03/2023	Matthew Bauer	Editor, Clear Edit NZ	Proofread final draft
0.20	21/04/2023	Anandita Pujara	Document Manager, NZTA	Minor updates on section 5.2.2 and appendix A, as per feedback from the stakeholders
0.21	10/05/2023	Anandita Pujara	Document Manager, NZTA	Updates post Technical Standard Committee’s feedback
0.22	06/07/2023	Anandita Pujara	Document Manager, NZTA	Updated to clarify the contractual roles as per ratification group’s feedback
0.23 0.24	15/01/2024 30/01/2024	Anandita Pujara John MacDonald	Document Manager, NZTA Lead Advisor, Asset Management, NZTA	Updated document to address further feedback received from the ratification group chair
1.0	20/02/2024	Anandita Pujara	Document Manager, NZTA	Approved version