Main Roads
Technical Standard

MRTS202

Provision of Variable Message Signs

October 10

Queensland Government

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Provision of Variable Message Signs

1 INTRODUCTION

This standard defines the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and handover requirements for Variable Message Signs (VMS), consisting of either one display (standard VMS) or two discrete displays, also known as Enhanced VMS (EVMS), in a single enclosure.

These VMS may be used as:

- part of the overall traffic management system utilising STREAMS to manage traffic on the road network; and/or
- a stand alone device with manual and automatic control.

These VMS shall allow variable graphical and textual information to be provided at strategic locations on the road network as part of the traveller information and incident management system.

The requirements for mobile VMS (such as trailer-mounted VMS) are not included in this standard.

This Technical Standard shall be read in conjunction with MRTS01 *Introduction to Technical Standards*, MRTS50 *Specific Quality System Requirements* and other Technical Standards as appropriate.

This Technical Standard forms part of the Main Roads Specifications and Technical Standards Manual.

2 DEFINITION OF TERMS

The terms defined in MRTS201 apply to this standard. Additional terminology relevant to this standard is defined in Table 2 below.

Table 2 – Definitions

Term	Definition
LED	Light Emitting Diode(s)
VMS	Variable Message Sign(s)
TDU	Textual Display Unit of the VMS
GDU	Graphical Display Unit of the VMS
DU	Display Units, TDU and/or GDU of the VMS
Event	Sign status change, frame change, occurrence of a fault in VMS controller or sign display
Field Processor (FP)	An industrial computer complying with requirements of MRTS232 – Provision of Field Processors
LFS	Local facility switch
NATA	National Association of Testing Authorities
PHCS	Product host control system: control/diagnostic software that runs on a laptop and can control, interrogate and program the VMS controller
Pixel	The smallest discreetly controlled light emitting component of the sign dot matrix display
PTN	Principal's Telecommunications Network
RAM	Random Access Memory
VMS Controller	A local control unit providing the operational interface to the TDU and GDU.
Simultaneously	At the same time as apparent to the eye of an observer

Term	Definition
STREAMS	The Principal's traffic management system and primary user interface to ITS field devices
Stroke width	The apparent width of active pixel(s)
TMC	Traffic Management Centre
TMS	Traffic Management System (STREAMS)
TRUM	Traffic and Road Use Management Manual

3 REFERENCE DOCUMENTS

The requirements of the referenced documents listed in Table 3 of MRTS201 and Table 3 below apply to this standard. Where there are inconsistencies between this standard and the referenced MRTS the requirements specified in this standard shall take precedence.

Table 3 – Referenced Documents

Document ID	Document Name / Description
AS 1744	Forms of letters and numerals for road signs
AS 1939	Degrees of protection provided by enclosures for electrical equipment
AS 3990	Mechanical equipment-steelwork
AS 4070	Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient over-voltages
AS 4100	Steel Structures
AS 4852.1	Variable Message Signs – Part1: Fixed signs
AS / ACIF S009	Installation Requirements for Customer Cabling – Wiring Rules
AS/NZS 1170.1	Structural Design Actions, Permanent, imposed and other actions
AS/NZS 1170.2	Structural Design Actions, Wind Actions
AS/NZS 1664	Aluminium structures
AS/NZS 1665	Welding of aluminium structures
AS/NZS 2144	Traffic Signal Lanterns
AS/NZS 3000	Electrical installation-building structure and premises (Wiring Rules)
AS/NZS 3100	Approval and test – General requirements for electrical equipment
EN12966	Road Vertical Signs- Variable Message Traffic Signs Part 1 Product Standards
MRTS91	Pits and Ducts
MRTS201	General Equipment Requirements
MRTS210	Provision of Mains Power Supply
MRTS232	Provision of Field Processors
MUTCD	Manual of Uniform Traffic Control Devices
TR2136 / Highways Authority (UK)	Optical Performance Functional Specification for Discontinuous Variable Message Signs
TSI-SP-003 / NSW RTA	Communications Protocol For Roadside Devices
TRUM Manual	Traffic & Road Use Management Manual – "Variable Message Signs Use and

Document ID	Document Name / Description
Section 2.9	Operation"
VMS Use and Operations Guidelines	TMR Use and Operations guidelines for VMS and Enhanced VMS

4 QUALITY SYSTEM REQUIREMENTS

4.1 General

The quality system requirements defined in MRTS201 apply to this standard. Additional quality system requirements relevant to this standard are defined in Table 4.1 below.

Table 4.1 – Hold Points and Witness Point

Clause	Hold Point	Witness Point
4.2	1. Detailed design documentation to be provided prior to manufacture 2. Optical performance test results to be provided prior to delivery to site	
7.3	3. Detailed design documentation of mounting structure and footings location and reduced levels (RLs)	
15.2		1. Factory Acceptance Tests

4.2 Sample Variable Message Sign

Requirements of MRTS201 apply to this standard. Detailed designs of the sign layout, fabrication and assembly drawings, calculations, specifications and certifications of the VMS components (signed by the Contractor's RPEQ) shall be submitted to the Principal via the Administrator for verification prior to manufacture. These components include the VMS controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including surge protection and back-up batteries), communication ports, cable termination, enclosure and mounting accessories. **Hold Point 1**

Optical performance test methodology and NATA certification confirming the VMS performance requirements specified in this standard shall be submitted before delivery to site. **Hold Point 2**

As specified in MRTS201, a sample VMS shall be provided for the SAT. The sample VMS shall be complete with display and control units of the type to be used in the VMS to be provided under the Contract.

The sample TDU of the VMS shall not exceed 2 metres (width) x 1 metre (height) and shall be provided with:

1. the same number of (smaller) horizontal and vertical pixels as the full-size VMS; or
2. a single line with a minimum of three (3) full size horizontal characters. The display resolution of each character shall be five (5) pixels wide and seven (7) pixels high. Characters shall be spaced two (2) pixels apart.

The sample GDU of the VMS shall not exceed 1 metres (width) x 1 metre (height) and shall be provided with the same number of (smaller) horizontal and vertical pixels as the full-size VMS.

5 FUNCTIONAL REQUIREMENTS

5.1 General

The overall functions are described in the VMS Use and Operations Guidelines.

It shall be possible to monitor and control both the TDU and the GDU of the VMS by STREAMS via a single VMS controller.

5.2 Control methods

The VMS shall be able to be selected using the following methods by the VMS controller:

1. locally, when the VMS controller has been selected for LOCAL operation using a local facility switch and/or hardwired inputs to select one of a number of pre-determined messages;
2. locally, when the VMS controller has been selected for MAINTENANCE operation via the PHCS; and
3. remotely by the TMS when the VMS controller has been selected for REMOTE operation. This shall be the normal mode of operation.

5.3 VMS Controller

As a minimum the VMS controller shall:

i) support both the TDU and GDU;

ii) monitor, log and support TMS requests for its own operation and status;

iii) monitor, log and support TMS status requests for the TDU and the GDU;

iv) allow the TDU and the GDU to be controlled individually or as a logical group;

v) allow the request by the TMS to change the displays (TDU and GDU) of VMS to be executed as one command (atomic addressing);

vi) be capable of storing up to 255 frames in its non-volatile memory for each DU;

vii) allow local automatic reset of the VMS display and the VMS controller itself such as via watchdog(s);

viii) be capable of dimming connected signs based on the average of the light sensor outputs; and

ix) accept/reject valid or invalid commands made by the TMS and/or PHCS

Additional information and functionality of the VMS controller required is described in the following sections.

5.4 Communications Timeout

The VMS controller shall be capable of monitoring loss of communications with the TMS and timeout after a specified period. When the VMS controller is in the REMOTE mode, expiry of this time period shall cause the VMS controller to blank the entire VMS. This period shall be a configurable parameter. The VMS controller shall also be capable of monitoring communications with each DU and timeout after a specified period when such communication is lost. Communications timeout check shall be performed periodically and shall be a configurable parameter. In LOCAL mode, the communications timeout check with the TMS shall be ignored.

5.5 Configuration Management

All settings in the VMS controller shall be accessible using the PHCS.

5.6 Sign Fault Management

The VMS controller shall monitor and log the following conditions:

- loss of communication with the FP and each DU;
- high enclosure temperature;
- illumination faults; and
- other faults relating to the VMS.

The log shall identify the DU and its respective fault.

5.7 Local Event Logging

The VMS controller shall log in non-volatile memory, operational and fault events such as message changes, hardware resets, establishment or discontinuation of communications, local manual operations and clearance of faults. Each event shall be date and time stamped, accurate to at least one hundredth of a

second. Once a fault has occurred and been logged, a recurrence of the same fault need not be logged again until after the fault has been cleared.

The event log shall have space for at least 255 entries. Where separate logs are used for operational and fault events, each log shall have space for at least 255 entries. The oldest event record shall be overwritten first when this allocated space has been exceeded.

All log entries shall be available for upload from any and all communication ports upon request from the TMC and/or PHCS. The log shall be uploaded in order of most recent to oldest record. A request by the TMS for the event log shall provide for no less than 20 entries at a time.

Events shall be retained in the log even after retrieval by the PHCS and/or TMS

5.8 Watchdog

The VMS controller and the DU shall monitor the state of its respective processor and blank the respective display/s in accordance with the VMS Use and Operations Guidelines if processor failure occurs.

5.9 Time synchronisation

The VMS controller shall be provided with an internal system clock in accordance with MRTS201 and allow synchronisation of the clock in response to a TMS and/or PHCS command.

6 EQUIPMENT COMPONENTS

Each VMS shall include either:

- One variable message display primarily for the display of text (TDU); or
- Two discrete variable message displays, one primarily for display of text (TDU) and one primarily for display of graphics (GDU)

housed within a single display enclosure.

In addition, it shall also include a VMS controller, FP, mounting structure, a telecommunications field cabinet, a switchboard and associated infrastructure/equipment.

7 MECHANICAL AND PHYSICAL REQUIREMENTS

The mechanical and physical requirements defined in MRTS201 and MRTS61 apply to work provided under this standard. Additional mechanical and physical requirements for equipment provided under this standard are described below.

7.1 Design Life

Unless otherwise specified, the design life of the VMS components shall be as follows:

- structures: a minimum of forty (40) years;
- enclosures: a minimum of twenty (20) years;
- LEDs/pixels: a minimum of 5 years; and
- electronics: a minimum of ten (10) years.

7.2 Display Enclosure

The sign enclosure shall house the TDU, GDU and associated control electronics, and comply with the requirements of MRTS201 *General Equipment Requirements*. Where installed in a tunnel, the enclosure shall be made of Marine Grade Aluminium.

7.3 Mounting Structure

The location and type of mounting structure to be provided to mount each VMS shall be shown on the design documentation. The mounting structure shall comply with the requirements of MRTS201 and MRTS61.

The final design documentation shall include details of the final footing design, location of the structure and the reduced levels (RLs) and the Contractor shall not commence fabrication of the footing and support structure until that final design documentation has been accepted by the Administrator. **Hold Point 3**

7.4 Field Cabinets

All telecommunications equipment including the FP and the VMS controller associated with the VMS shall be installed in a suitable roadside enclosure, being either:

- a ground mounted field cabinet complying with requirements of MRTS226; or
- an integral enclosure complying with the requirements of MRTS201 installed on the VMS mounting structure.

8 VARIABLE MESSAGE DISPLAY REQUIREMENTS

8.1 General

Variable message displays shall utilise a series of pixels forming a dot matrix display system. A “full matrix” configuration shall be used to allow the display of graphics as well as alphanumeric characters. The horizontal and vertical pitch of the pixels in the matrix shall be the same.

The variable message display pixels shall be in modules of a size capable of being removed and installed by hand via the rear access door(s).

8.2 Variable Message Display Technology

The display technology shall be light emitting diode (LED). The display pixels may be formed by arranging one or more LEDs in a cluster to achieve the required luminance levels.

8.3 Failures

Facilities shall be included to detect failures within the display control system. The TDU and GDU shall blank the display in the event of a sign processor fault. Time to blank shall be a configurable setting.

The DU shall monitor communications with the VMS controller and blank the displays if loss of communication experienced. The communications timeout period shall be configurable setting.

The VMS controller shall be able to detect LED failure even if the LEDs is required to be ‘off’ at the time of the periodic check. The display shall be blanked upon failure of 2% of contiguous pixels for each displayed image or failure of more than 20% of LEDs.

On power restoration after loss of power, the VMS shall become available for activation and remain blank until commanded by the VMS controller or STREAMS. The power recovery delay time shall be configurable. At no time shall partial or incomplete frames be displayed.

The VMS controller shall allow the sign’s display to remain blank for a minimum time once the display has been blanked irrespective of the cause. This minimum blank time shall be configurable.

Single LED failure, provided that the cumulative LED loss remains below the 2% and/or 20% thresholds described above or VMS light sensor failure, should not result in blanking of the display

8.4 LED Output

Each individual LED shall be driven with a continuous current with no peak and/or magnitudes exceeding 70% of the LED manufacturer's maximum continuous rating. For LEDs in a 5mm or smaller diameter package, peak magnitudes of the LED current shall not exceed 20 mA.

8.5 Character and Graphical Display Formats

8.5.1 Text Display Unit (TDU)

Each alphanumeric character in the TDU shall be formed by a matrix arrangement of horizontal and vertical pixels. The complete TDU shall consist of:

1. 4 lines, each of 18 characters for a Type A sign; and
2. 3 lines, each of 18 characters for Type B and Type C signs.

The display resolution of each alphanumeric character shall be five (5) pixels wide and seven (7) pixels high. Characters shall be spaced two (2) pixels apart.

The character height and border width requirements shall be as defined in Table 8.5.1.

The minimum legibility (sight) distance shall be as indicated in Table 8.5.1 for both daytime and night-time viewing.

Table 8.5.1 – Character and Display Requirements

Sign Type	Design Speed (km/hr)	Minimum Legibility Distance	Character Height	Border Width
A	60 and below	100 m	150 mm	125 mm
B	70-90	160 m	300 mm	185 mm
C	100 and over	250 m	400 mm	220 mm

The type of VMS proposed for each location shall comply with the requirements of the DTMR TRUM Manual Section 2.9 and shall be specified on the design documentation.

8.5.2 Graphics Display Unit (GDU)

The GDU shall be formed by a matrix arrangement of a minimum of 64 horizontal pixels and a minimum of 64 vertical pixels. The pixels in the GDU shall be evenly spaced to match the overall vertical dimension of the TDU.

The minimum legibility (sight) distance shall be as defined in Table 8.5.1 for both day-time and night-time viewing.

8.6 Display Fonts

As a minimum, the variable message display shall generate single stroke alphanumeric character fonts generally to the requirements of AS 1744. The characters shall be arranged so as to have a minimum of 2 pixels between characters and 2 pixels between lines.

8.7 Display Changes

Variable message display changes shall be in accordance with the VMS Use and Operations Guidelines. All display changes shall be effected by first blanking the respective TDU and/or GDU, and then activating all required pixels of the respective display simultaneously (as apparent to the eye).

8.8 Display Colour

8.8.1 Text Display Unit (TDU)

The TDU shall be provided with yellow LEDs with wavelength of 592 nm on a matte black background.

8.8.2 Graphics Display Unit (GDU)

As a minimum, each pixel in the GDU shall be provided with by one red, one green, and one yellow high visibility LEDs on a matte black background.

The colours for the red, green and yellow LEDs shall conform to the colours defined by the colour coordinates in AS 4852.1 Table 3.4.

8.9 Fallback Displays

Facilities shall be included to detect failures within the variable message display(s) and the display control system(s). On detection of a failure, the relevant display(s) shall be blanked to prevent confusing displays to the motorist. Loss of communications with STREAMS shall also be considered a VMS failure and shall result in the display(s) being blanked after a preset time period. This time period shall be a variable, able to be set by STREAMS, with a range of 60 seconds to 600 seconds.

8.10 Flashing Yellow Lanterns

Flashing yellow lanterns shall be located on the face of each VMS at the four corners of the display enclosure. At Sites with a posted speed limit greater than 60 km/hr, the lantern size shall be 250 mm. At Sites with a posted speed limit of less than or equal to 60 km/hr, the lantern size shall be 100 mm.

As a minimum, the flash sequence shall alternate the pair of diagonally opposite lanterns. Where additional flash sequences are provided, these shall allow local and remote selection by the user.

The flash rate parameters shall be selectable via all of the communications ports, with an initial cycle time of one (1) second, and diagonal flashing duty cycle of 50/50 (lit/unlit).

Lanterns shall be dimmed in coordination with the LED display.

8.11 Optical Performance

8.11.1 Luminance

The luminance and luminance ratio of the LED shall comply with the requirements of AS 4852.1 Table 3.3.

8.11.2 LED Dimming

The LED intensity shall be controlled to provide maximum legibility distances for the complete range of ambient light under which the VMS shall operate.

A VMS shall have a minimum of 10 and a maximum of 100 LED brightness levels. The brightness levels shall be in units of percentage of maximum brightness.

The intensity of the yellow lanterns shall be controlled by the same system that controls the intensity of the LED displays.

8.11.3 Luminance Intensity Half Angle

The luminance half angle shall be at least 15° for Type A signs, and at least 6° for Type B and Type C signs.

8.11.4 Luminance Intensity Uniformity

When measured on axis and at the combined horizontal and vertical half angle positions, the ratio of the average of the three highest element outputs to the average of the three lowest element outputs shall not vary by more than 2.5:1. The outputs of any two elements shall not vary by more than a ratio of 5:1. The luminance intensity uniformity shall be maintained at all dimming levels.

8.11.5 Sun Phantom

The action of sunlight or other bright light sources on the optical elements shall be controlled such that inactive pixels shall not appear active.

9 CONTROL SYSTEM

The control system requirements defined in MRTS201 apply to this standard. Additional control system requirements for equipment provided under this standard are described below.

9.1 General

Each VMS shall be operated by an integral control system that is controlled in the following order of priority:

1. Local facility switch;
2. Hardwired input(s);
3. Maintenance communications port; and
4. Control communications ports.

Software shall be provided in accordance with Clause 9.5.

The TDU and the GDU shall be able to be controlled individually or simultaneously.

9.2 Local Facility Switch(s)

A 5-position key operated facility switch that complies with MRTS201, shall be provided to enable selection of the following 5 display functions for each of the text display and the graphics display:

- OFF – display blank; control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional;
- Normal – display active; displayed message selected via the maintenance communications port and/or the control communications port; and

- Message 1, Message 2, Message 3 – display either message 1, 2 or 3; control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional.

9.3 Maintenance Communications Port

It shall be possible to control and interrogate the VMS via an EIA / RS-232 maintenance communications port via the VMS controller. The RS-232 port shall allow local and remote communications via a laptop computer (provided by others) containing VMS messaging and diagnostics software to be provided by the Contractor. The maintenance communications port shall also allow remote connection of a similar computer via a modem.

A physical change of connection between remote and local operation shall not require further interaction from the user, nor in anyway interrupt operation or require rebooting of VMS control system or computer/ software. The hardware handshaking lines of the EIA/ RS-232 interface shall be used such that connection/ disconnection of the maintenance PC (either locally or by modem) results in the immediate initiation/ termination of the maintenance port communications session with the VMS.

The VMS control and diagnostics software shall be capable of operating at all possible modem connection and serial port speeds.

9.4 Control Communications Port

It shall be possible to control and interrogate the VMS via either of two EIA/ RS-232 control communications ports. The control communications port shall allow local connection of a field processor/ modem for communications with STREAMS.

While a PC/ laptop computer is connected to the VMS via the maintenance communications port, control of the VMS via the control ports shall be inhibited. However, status and diagnostic interrogation by STREAMS via the control ports shall remain possible.

Complete control and monitoring by STREAMS shall be possible through either, and/or both control communications ports as determined by telecommunications infrastructure provided at each Site.

Where communications equipment is connected to both control communications ports, the primary port shall be used for control commands to/from the VMS, and the secondary port shall be used for status-only communications with the VMS.

Where communications equipment is connected to only one control communications port (or in the case of failure of either communications port or attached equipment) the VMS shall automatically revert to full control AND status communications through the active port.

VMS communications software shall be capable of operating at all possible modem connection and/or serial port speeds.

9.5 Control / Diagnostics Software

The VMS integral control system shall fully implement all VMS functions as required by Clause 9.9 for all communications ports.

The computers may use Microsoft Windows® operating systems, from XP to those industry standards current at the time of use. Any software provided shall be capable of operating on all such operating systems.

The software shall report the selected position of the facility switch.

9.6 Hardwired Inputs

The VMS controller shall have the ability to display a predefined message when it receives a voltage free contact closure or similar input from an external device such as a loop detector or vehicle over-height detector.

Unless otherwise specified, the VMS controller shall be capable of accepting a minimum of six (6) hardwired inputs.

9.7 LED Intensity Control

The LED intensity shall be controlled to provide constant apparent brightness, and maximum legibility distance, for the complete range of ambient light under which the VMS shall operate.

Each VMS shall support automatic brightness variation, where the VMS determines the LED brightness level using a light sensor reading and a predefined set of light sensor values.

Each VMS shall be provided with at least two (2) light sensors to detect ambient light levels. These sensors shall be located as follows:

- one sensor facing forward perpendicular to the sign face; and
- one sensor facing backward perpendicular to the sign face.

9.8 Temperature Control

Each VMS shall be provided with at least one temperature sensor to measure the temperature inside the display enclosure near the top centre. The sensor shall not be mounted directly against the top face of the display enclosure. The temperature reading shall be available through the use of a protocol message via STREAMS. The temperature shall be in units of degrees centigrade.

9.9 Communication Protocol

Communication between the Field Processor and the VMS shall comply with TSI–SP–003 and MRTS201.

9.10 Bus Arbitration

Each VMS shall act as a slave on the EIA RS–422A / modem bus.

9.11 Message Hierarchy

Each VMS controller shall provide a user-configurable message hierarchy for message selection commands and hardwired inputs.

10 MECHANICAL, PHYSICAL AND ENCLOSURE REQUIREMENTS FOR THE DISPLAY ENCLOSURE

10.1 General

The mechanical, physical and enclosure requirements defined in MRTS201 apply to the display enclosure. Additional mechanical, physical and enclosure requirements for the display enclosure are described below.

10.2 Mounting

The display enclosure shall be capable of being mounted in both the verge, and mounted over the carriageway as defined in MRTS201.

Rear doors shall be provided to allow access to the rear of the VMS for maintenance from the working platform on the mounting structure. The door arrangement shall be compatible with the mounting structure members. The mounting structure shall comply with MRTS201.

10.3 Exterior Finish and Surfaces

A ripple finish is required to all painted surfaces. Surface colours shall be:

- Front face surrounding the active display, and bottom external face: matte black, or APO Grey with external matte black target board;
- Remainder of external surfaces: APO grey; and
- Interior: matte black, or natural finish with internal black backing board.

Where an internal backing board is used, this shall allow easy removal to access the variable message display.

10.4 Weather Resistance

The display enclosure shall provide a degree of protection of not less than that required for the classification of IP65 in accordance with AS 1939, in normal service.

10.5 Equipment Racks

The display enclosure shall incorporate a standard 19-inch racking system to facilitate installation of all equipment. The height of the racks shall be sufficient for the installation of all equipment.

10.6 Front Cover

10.6.1 Material

A protective front cover shall be fitted to the display enclosure to form a viewing window. The front cover material shall be a single, clear Lexan® sheet, or equivalent, with a non-reflective finish. The sheeting shall be manufactured from sign-grade material SG300 with a thickness at least equal to that recommended by the manufacturer, and in all cases, at least 4.5 mm. The viewing window shall be such that when installed, the sides and bottom edges of the display face are fully visible at viewing angles of ± 45° (horizontal) and ± 30° (vertical) to the axis perpendicular to the front plane of the display.

10.6.2 Retention Method

The front cover shall be able to be removed from outside the VMS for maintenance without requiring removal of internal components. Fasteners and retaining cover strips shall be easily accessible.

The front cover retention and seal design shall allow for thermal expansion properties of the front cover material. The front cover surrounding framework and cover strips shall provide the required weather proofing and strength for both positive and negative wind pressures.

10.7 Demister

A demister shall be provided to prevent condensation on the inside surface of the front cover.

11 ENVIRONMENTAL

The environmental conditions defined in MRTS201 apply to this standard.

12 ELECTRICAL

The electrical requirements defined in MRTS201 apply to work provided under this standard.

13 INSTALLATION REQUIREMENTS

The installation requirements defined in MRTS201 apply to this standard.

14 TELECOMMUNICATIONS REQUIREMENTS

The telecommunications requirements defined in MRTS201 apply to work provided under this standard.

15 TESTING AND COMMISSIONING

15.1 General

The testing and commissioning requirements defined in MRTS201 apply to work provided under this standard. The minimum additional testing and commissioning requirements for equipment provided under this standard are described below.

15.2 Factory Acceptance Tests

The optical performance shall be determined by measurement under laboratory conditions of the minimum luminance ratio and the minimum and maximum luminance for the five sign illuminance levels listed in Table 5 in accordance with the test procedures defined in document TR2136 – Appendix 1 – “Test Procedures”. The performance of the VMS shall meet or exceed the parameters listed in Table 8.11.1. **Witness Point**

16 DOCUMENTATION

The documentation requirements defined in MRTS201 apply to work provided under this standard.

17 TRAINING

The training requirements defined in MRTS201 apply to work provided under this standard.

18 MAINTENANCE

The maintenance requirements defined in MRTS201 apply to work provided under this standard.

19 HANDOVER

The handover requirements defined in MRTS201 apply to work provided under this standard.