

Technical Specification

**Transport and Main Roads Specifications
MRTS231 Road Weather Monitor (RWM) Systems**

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1 Introduction

This Technical Specification defines the design, supply, installation, testing and commissioning, performance, documentation, training and maintenance requirements for Road Weather Monitors (RWM). The RWM shall be capable of providing data from the Principal's chosen combination of weather variables for each RWM location. These may include wind speed, wind direction, rainfall intensity, visibility, surface friction indicator, temperature and humidity, and other weather sensors as specified.

The data collated from RWMs shall be made available to STREAMS via the Principal's telecommunications network.

Flood sensors are not part of this Technical Specification. For flood monitoring systems, refer to MRTS233 *Roadway Flood Monitoring Systems*.

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

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms defined in Clause 2 of *MRTS01 Introduction to Technical Specifications* and *MRTS201 General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant under this Technical Specification is defined in Table 2 below.

Table 2 – Definitions of terms

Term	Definition
ADSL	Asynchronous Digital Subscriber Line
BoM	Bureau of Meteorology
FAT	Factory Acceptance Testing
HRC	High Rupture Capacity
IPRT	Internet Protocol Remote Telemetry (Transport and Main Roads ITS Network system supplied by Telstra)
ITS	Intelligent Transport System
MOR	Meteorological Optical Range
Principal	Queensland Department of Transport and Main Roads
RPEQ	Registered Professional Engineer – Queensland
RH	Relative Humidity
RWM	Road Weather Monitors
SI	Système international (d'unités) – International Unit System
STREAMS	Transport and Main Roads Traffic Management System. (Primary user interface to ITS field devices)
TMC	Traffic Management Centre

3 Referenced documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and the referenced MRTS (including those referenced in MRTS201 *General Equipment Requirements*), the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AS/NZS 3000	<i>Electrical installations (known as Australian/New Zealand Wiring Rules)</i>
AS/NZS 3100	<i>Approval and test specification – General requirements for electrical equipment</i>
AS 4509	<i>Stand-alone power systems</i>
AS 5033	<i>Installation and safety requirements for photovoltaic (PV) arrays</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS61	<i>Mounting Structures for ITS Devices</i>
MRTS233	<i>Roadway Flood Monitoring Systems</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS232	<i>Provision of Field Processors</i>
MRTS245	<i>ITS Telecommunications Network (ITS TN)</i>

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points and Witness Points applicable for this Technical Specification are summarised in Table 4.1. There are no Milestones defined.

Quality system requirements for this Contract shall be in accordance with this Technical Specification, MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and MRTS201 *General Equipment Requirements*.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
10	1. Inspection of mounting structures	1. After installation of the cables, the conduits shall be sealed to prevent vermin entry	
11	2. Certified Electrical Wiring diagram		
13	3. Testing and Commissioning		
14	4. Documentation		

5 Functional requirements

The RWM shall measure the specified weather parameters. Some of the main weather parameters required by the Principal, and their units, include:

- wind speed (km/hr)
- wind direction (degrees (°) bearing relative to geographic North)
- rainfall intensity (mm/hr)
- visibility (metres)
- surface friction indicator (dimensionless)
- Temperature (°C), and
- Humidity (%RH).

The RWM shall be able to accommodate additional sensors that collect weather parameters other than those specified above where required by the Principal. Measured data shall be transmitted to STREAMS via the Principal's telecommunications network.

The RWM equipment shall interface with STREAMS for real time data monitoring remotely from the TMC. It shall also be capable of providing configurable alarms/events to alert the TMC operator and/or provide direct input to enable/disable other ITS systems.

6 Equipment components

A road weather monitor shall consist of the following components:

- a) specified road weather sensors (refer Clause 5)
- b) all associated electronics
- c) mounting structure
- d) configuration and diagnostic software
- e) STREAMS Field Processor and associated device driver, and
- f) power supply, telecommunications field cabinet, and associated infrastructure and accessories.

7 Operational requirements

7.1 General

The operational requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

In addition, the RWM sensors shall be installed as per the manufacturer's mandatory specifications and in any case shall not be installed in the roadway pavement itself.

The components of the RWM including the sensors shall not incorporate mechanical moving parts. All RWM sensors must be provided with their associated calibration and accuracy information.

The preference for sensors without moving parts is to ensure the longevity of the RWM since moving parts will accelerate degradation and thus require more maintenance. In some instances, however, due to operational requirements and integration with other systems, rainfall sensors with moving parts may be used. See Clause 7.4 below.

Additional operational requirements for equipment provided under this Technical Specification are described below.

7.2 Wind speed sensors

Wind speed sensors shall be capable of measuring wind speed in units of kilometres per hour (km/hr). The wind speed sensor shall be capable of operation when mounted up to 10 m above the roadway and/or bridge structure. The range, resolution and accuracy requirements are shown in Table 7.9.

7.3 Wind direction sensors

Unless otherwise specified, wind direction sensors shall be capable of measuring the wind direction as degrees (°) deviation from North (0°). The wind direction sensor shall be capable of operation when mounted up to 10 m above the roadway and/or bridge structure. The range, resolution and accuracy requirements for wind direction sensors are as shown in Table 7.9.

7.4 Rainfall sensors

Where rainfall data is required solely for the control of other traffic management equipment such as traveller information systems of variable speed limit signs via STREAMS, it is preferred the rainfall sensor have no moving parts.

Where in addition to control of traffic management equipment, integration with BoM systems is essential, rainfall sensors shall be of tipping bucket type. Bucket capacity shall be 0.2 mm unless otherwise specified.

It is planned that in future the department will send roadway flood level data collected from ITS Field sites to the Bureau of Metrology (BoM) and also receive selected relevant flood data from BoM (refer to MRTS233 *Roadway Flood Monitoring Systems*). Since flood data and rainfall data are closely linked, it is expected that the departmental rainfall sensors match those used by BoM for consistence where they are to be integrated.

All rainfall data shall be provided real-time and provide instantaneous rainfall intensity in mm/hr as well as discrete events, peak and average precipitation rates, and accumulated rainfall over a period. The range, resolution and accuracy requirements for rainfall sensors are as shown in Table 7.9.

7.5 Visibility sensors

Unless otherwise specified, visibility sensors shall be of a laser transmissometer type or the infrared forward scatter visibility sensor type and report the visibility in metres. The range, resolution and accuracy requirements for visibility sensors are as shown in Table 7.9.

7.6 Surface friction indicators

Unless otherwise specified, surface friction indicators shall be of the infrared beam type. The range resolution and accuracy requirements for surface friction indicators are as shown in Table 7.9.

The surface friction indicator may be categorised based on predetermined ranges which could then be used as input to weather algorithms to control speed on managed motorways.

7.7 Temperature sensors

The sensing element of the temperature sensor shall be a semiconductor integrated circuit. The response time shall be less than five minutes in air. The range, resolution and accuracy requirements for temperature sensors are as shown in Table 7.9.

7.8 Humidity sensors

The sensing element of the humidity sensor shall be a semiconductor integrated circuit. The response time shall be less than five minutes in air. The range, resolution and accuracy requirements for humidity sensors are as shown in Table 7.9.

7.9 Other sensors

The road weather monitor shall allow additional weather sensors (for other weather conditions) to be added to the installation in future, by others. Such weather parameters may include, but not limited to, pavement surface moisture and solar radiation.

Table 7.9 – RWM parameter specification

Parameter	Minimum specification	
wind speed (km/hr)	range	0-216 km/hr
	resolution	1.8 km/hr
	accuracy	+/- 1.8 km/hr
wind direction (degrees (°) bearing relative to geographic North)	range	0-359
	resolution	5°
	accuracy	± 5°
rainfall intensity (mm/hr)	range	0-200 mm/hr
	resolution	0.5 mm/hr
	accuracy	± 5% for 0-120 mm/hr
rainfall (mm)	range	0-400 mm
	resolution	0.1
	accuracy	± 0.1 mm for 5 mm ± 4% for > 5 mm
visibility (m)	range (MOR)	10-2000 m
	resolution	50 m
	accuracy	± 50% for 50 m ± 20% for > 50 m
surface friction indicator (dimensionless)	range	0-1
	resolution	0.01
	accuracy	± 0.02

Parameter		Minimum specification
Temperature (°C)	range	- 20 to 60
	resolution	0.3°C
	accuracy	± 0.3
Humidity (%RH)	range	0-100%
	resolution	0.5%rh
	accuracy	± 2% for 10-90RH ± 4% for 90-100RH

8 Control system

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional control system requirements for RWM equipment provided under this Technical Specification are described below.

8.1 General

- a) It shall be possible to retrieve equipment data and status information remotely from STREAMS, via the Principal's telecommunications network.
- b) It shall be possible to retrieve data and status 'on demand' via a STREAMS request, and automatically on a pre-determined interval.
- c) It shall be possible to remotely retrieve via STREAMS, operating characteristics and errors that may adversely impact the reliability or credibility of the reported weather measurements.
- d) Where the equipment performs local calculations based on sensor inputs, it shall be possible to extract both raw data and calculated data via STREAMS.
- e) Unless otherwise specified, a minimum of two configurable digital outputs shall be provided for each RWM controller.
- f) Have one EIA/ RS-232 or EIA/ RS-422 serial port to connect the Principal's Telecommunications System via a Field Processor.
- g) Have one EIA/ RS-232 serial port or Ethernet another interface to allow for the configuration of the station.
- h) Upon restoration of power after a power loss and/or reset, the RWM controller shall operate normally and show no signs of damage, impairment or loss of data or configuration settings.

8.2 STREAMS device driver

The contractor shall engage Transmax at the contractor's cost and provide a device driver compatible with interfacing with the STREAMS field processor.

8.3 Internal clock

An internal clock shall be provided in accordance with MRTS201 *General Equipment Requirements*.

9 Mechanical and physical requirements

The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to equipment provided under this Technical Specification.

In addition, the sensor equipment shall be capable of being installed on a post that is mounted onto a bridge structure or on to a concrete footing and rag-bolt assembly. The post shall be of the hinged type to allow ease of maintenance. The mounting structure shall comply with the requirements of MRTS201 and MRTS61.

10 Installation requirements

The sensors and associated infrastructure shall be installed at locations shown on the design documentation. The contractor shall allow access for inspection of all mounting surfaces by the Administrator prior to installation. **Hold Point 1**

After installation of the cables, the conduits shall be sealed to prevent vermin entry. **Witness Point 1**

11 Electrical

Options to energise the RWM shall include Mains power and solar power. The electrical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

The RWM shall be able to operate normally for voltage variation prescribed by the electricity entity or supply source. Battery back-up shall be provided for the real-time clock and processor to allow orderly power down in the case of loss of power supply.

Power supply and control wiring connection/disconnection shall be designed without requirement for personnel to be holders of an electrical licence to perform this task. This will generally require the use of modular type connections. All wirings and connections shall comply with AS/NZS 3000 and AS 3100.

Electrical protection, switching and isolation and lightning protection shall be provided in accordance with AS 4509.2 and AS/NZS 3000. High Rupture Capacity (HRC) fuses only shall be used for circuit protection. The switchboard shall be labelled with nominal voltage and current, DC or AC, as well as the requirements of Fire Emergency Information required by AS 5033.

An electrical wiring diagram shall be provided in each enclosure, with details specific to each installation.

Detailed designs and calculations of the electrical wiring including, where applicable, the solar power and charging assembly, shall be reviewed and signed by the Contractor's RPEQ. They shall then be submitted and approved by the Principal or their delegate for verification and acceptance.

Hold Point 2

The solar power system, where required, shall be capable of operating the RWM autonomously without recharge for a minimum period of seven days throughout the entire warranty period.

Upon restoration of power after a power loss and/or reset, the RWM shall operate normally and show no signs of damage or impairment.

12 Telecommunications requirements

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* and MRTS245 *ITS Telecommunications Network (ITS TN)* apply to work under this Technical Specification. In addition, the equipment shall:

- a) have one EIA/ RS-232 or EIA/ RS-422 serial port to connect the Principal's Telecommunications System via a Field Processor

- b) have one EIA/ RS-232 serial port or Ethernet another interface to allow for the configuration of the station, and
- c) be capable of sending weather data at a rate greater than one measurement of all sensors, within 10 seconds.

Remote departmental RWM sites need to communicate data within STREAMS back to Transport and Main Roads.

In order to priority, the telecommunications backhaul links from RWM sites to head-end monitoring sites should be implemented as listed below:

1. Connection via the department's own existing private telecommunications networks using copper, fibre or point to point, or point to multipoint wireless systems back to the department's TMC's.
2. Connection via the department's default ITS network using departmental IPRT Network to connect to the department's TMC's using IPRT ADSL, Next G (3G) or 4G if available.

13 Testing and commissioning

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to equipment provided under this Technical Specification. In addition, test sheets shall be verified at commissioning and demonstrate compliance with the technical requirements of this Technical Specification. A calibration certificate shall be provided prior to the delivery of the equipment for installation on site. **Hold Point 3**

14 Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

Additional documentation requirements relevant to this Technical Specification are defined below.

Prior to the commencement of manufacturing works, the Contractor shall prepare and request approval of the Principal / Administrator of three copies of the following documents:

- a) fabrication and assembly drawings, detailing all the components to be installed
- b) manufacturer's specifications of the RWM and of all major components detailing ratings and performance characteristics
- c) a schematic layout of components, building details and interconnection diagrams
- d) system operating manual
- e) recommendations for routine maintenance tasks
- f) recommendations on spare parts.

15 Training

The training requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

16 Maintenance

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to equipment provided under this Technical Specification.

17 Handover

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to work under this Technical Specification.

