

SUPERSEDED

Technical Specification

**Transport and Main Roads Specifications
MRTS203 Provision of Weigh-in-Motion System**

July 2020

Copyright

© The State of Queensland (Department of Transport and Main Roads) 2020.

Licence



This work is licensed by the State of Queensland (Department of Transport and Main Roads) under a Creative Commons Attribution (CC BY) 4.0 International licence.

CC BY licence summary statement

In essence, you are free to copy, communicate and adapt this work, as long as you attribute the work to the State of Queensland (Department of Transport and Main Roads). To view a copy of this licence, visit: <https://creativecommons.org/licenses/by/4.0/>

Translating and interpreting assistance



The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Contents

1 Introduction1

2 Definition of terms1

3 Reference documents3

4 Quality system requirements4

5 Functional requirements5

6 Mechanical and physical requirements5

6.1 General 5

6.2 WiM equipment 5

6.3 Site components 6

6.4 Environmental requirements 6

6.5 Design life 6

7 Operational requirements6

7.1 General 6

7.2 Accuracy 6

7.3 Recorded data 7

7.4 Vehicle classification 8

8 Control system8

8.1 Communications 9

 8.1.1 *Real time view*9

 8.1.2 *System configuration parameters*9

 8.1.3 *Data transfer*9

8.2 Data processing 9

8.3 Data security 9

9 Electrical requirements9

10 Telecommunications requirements9

11 Installation requirements 10

11.1 General 10

11.2 WiM site selection 10

 11.2.1 *Horizontal curvature* 10

 11.2.2 *Longitudinal gradient* 10

 11.2.3 *Cross carriageway gradient* 11

 11.2.4 *Lane width and line markings* 11

 11.2.5 *Surface evenness* 11

11.3 WiM site selection additional considerations 11

 11.3.1 *Proximity to intersections* 11

 11.3.2 *Lane discipline* 11

 11.3.3 *Free flowing traffic* 12

11.4 Field cabinet 12

11.5 Sensors installation 12

12 Testing and commissioning 12

12.1 Factory Acceptance Test (FAT) 12

- 12.2 Calibration and Installation Acceptance Test (IAT) 12
 - 12.2.1 Calibration vehicles 13
 - 12.2.2 Calibration procedure 13
 - 12.2.3 Installation Acceptance Test Criteria..... 14
 - 12.2.4 Commissioning test 14
- 12.3 WiM system Customer Acceptance Test (CAT) 14
- 13 Documentation..... 14**
- 13.1 Operations manual and maintenance manual..... 14
- 14 Training..... 15**
- 15 Maintenance 15**
- 15.1 Pavement..... 15
- 15.2 Recalibration 15
- 15.3 Culvert-based strain gauge WiM systems 15
- 15.4 Embedded in-road WiM systems..... 16
- 16 Handover 16**
- 17 Type approval checklist..... 16**
- Appendix A – Type Approval Compliance Checklist..... 17**

SUPERSEDED

1 Introduction

This Technical Specification applies to the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and handover requirements for a high-speed Weigh-in-Motion system (WiM system).

A high-speed WiM system is used for collecting traffic flow data and heavy vehicle mass and classification data.

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 MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definitions

Term	Definition
4G	Fourth generation mobile phone technology.
Accuracy	The closeness or degree of agreement (within a stated tolerance and probability of conformity) between a value measured or estimated by a WiM system and an accepted reference value.
ANPR	Automatic Number Plate Recognition.
ASCII	American Standard Code for Information Interchange.
Axle	The axis oriented transversely to the nominal direction of vehicle motion, and extending the full width of the vehicle, about which the wheel(s) at both ends rotate.
Axle Group Load	The sum of all tyre loads of the wheels on a group of adjacent axles, a portion of the gross vehicle weight. (An axle group can be defined in terms of the number of axles included in the group and their respective interspaces).
Axle Weight	The sum of all tyre loads of the wheels on an axle, a portion of the gross vehicle weight.
Calibration	Adjustment to a reference level of values from any measuring device.
Calibration Factor	Numerical factor by which the raw result of a measurement is multiplied to compensate for systematic error.
CAT	Customer Acceptance Test.
Coefficient of Variation	Ratio of the standard deviation to the mean.
Confidence Interval	Interval that contains the true value of a parameter represented by a random variable, with a given probability.
Confidence Level	Probability that an interval contains the true value of a parameter represented by a random variable.
CT	Commissioning Test.

Term	Definition
FAT	Factory Acceptance Test.
Gross Vehicle Weight	The total weight of the vehicle or the vehicle combination including all connected components, also, the sum of the tyre loads of all wheels on the vehicle.
IAT	Installation Acceptance Testing.
Piezo Sensor	A piezo sensor (also known as piezoelectric sensor) is a device that uses the piezoelectric effect, to measure changes in pressure, strain or force by converting them to an electrical signal. Piezo sensors used in high-speed WiM applications can be based on piezo-ceramic sensors, piezo-polymer sensors, brass linguine or piezo-quartz crystal strip sensors.
POS	Point of electrical supply.
QTDF	Queensland Traffic Data Format.
Single Axle Load	The load transmitted to the road surface by the tyres of all wheels lying between two parallel transverse vertical planes one metre apart, extending across the full width of the vehicle, a portion of the gross vehicle weight.
Tandem Axle Load	The total load sent to the road surface by the tyres on all wheels of two consecutive vehicle axles in a tandem group, that are less than 2.1 m apart, a portion of the gross vehicle weight.
Tolerance	The defined limit of allowable departure of a value measured or estimated by a WiM system from an accepted reference value.
Triaxle Load	The total load sent to the road surface by the tyres on all wheels of three consecutive vehicle axles in a triaxle group, a portion of the gross vehicle weight.
Weigh-in-Motion (WiM)	The process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, or axle group, or combination thereof, by measurement and analysis of dynamic vehicle tyre forces.
Weight	<p>The external force of gravity acting vertically downwards upon a body with a magnitude equal to the body's mass multiplied by the local acceleration of free fall. (The force of gravity, thus the acceleration of free fall, is different at various locations on or near the surface of Earth, therefore, weighing devices in commercial use or in official use by government agencies for enforcement of traffic and highway laws or collecting statistical information are usually used in one locality and are adjusted or calibrated to indicate mass at that locality.</p> <p>The indicated mass can be converted to weight (in units of force) by multiplying by the local value of the acceleration of free fall, if it is known. The conventional value adopted by ISO is 9.806 65 m / s². Weight is a special case of force, as weight is due only to the local force of gravity that is always directed vertically downwards).</p>
WiM Logger	A local electronic device(s) designed to collect signals from various field sensors, processing of signals, performing calculations, storing data, and transmission locally and remotely of the required traffic data. This includes all electronic component(s) that together provide the required functionality.

Term	Definition
WiM system	The WiM system comprises equipment installed at the WiM site. The WiM system includes a set of sensors, supporting instruments and WiM Logger that measure the presence of a moving vehicle and the related dynamic tyre forces at specified locations with respect to time, estimated tyre loads, calculated speed, axle spacing, vehicle class according to axle arrangement, and other parameters concerning the vehicle. Using a WiM Logger, the WiM system shall process and store data locally and allow transmission of this information to a locally connected laptop computer and/or remote computer via a telecommunications network such as 4G and/or Ethernet.

3 Reference documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 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
AGTM03-20	<i>Austrroads Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS14	<i>Road Furniture</i>
MRTS30	<i>Asphalt Pavements</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS91	<i>Conduits and Pits</i>
MRTS92	<i>Traffic Signal and Road Lighting Footings</i>
MRTS200	<i>General Requirements for Intelligent Transport Systems (ITS) Infrastructure</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS207	<i>Traffic Monitoring Foundation Equipment</i>
MRTS210	<i>Provision of Mains Power</i>
MRTS226	<i>Telecommunications Field Cabinets</i>
MRTS263	<i>Standalone Solar (PV) Power Systems</i>
QTDF V1.04	<i>Queensland Traffic Data Format (Version 1.04)</i>
SD1906	<i>ITS – WiM Piezo Sensor Installation Details</i>
SD1908	<i>ITS – WiM Sensor Configuration Piezo-Loop-Piezo</i>
SD1909	<i>ITS – WiM Sensor Configuration Piezo-Piezo-Loop-Piezo-Piezo</i>
SD1910	<i>ITS – WiM Sensor Configuration Piezo-Piezo</i>
SD1911	<i>ITS – WiM Sensor Configuration Strain Gauge Sensor</i>

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant to this Technical Specification are defined in Table 4.

There are no Milestones defined in the document.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
10	1. The telecommunications network connection shall be confirmed by the Contractor with the Principal prior to procurement.		
11.2	2. Contractor shall provide adequate operating environment for the system's sensors and instruments. The final location shall be confirmed by the Contractor to the Principal.		
11.2.5		1. The WiM system pavement surface shall be smooth before sensor installation. The deviation from a 3 m straightedge placed anywhere within a lane and the road roughness count measured at 20 m intervals shall not exceed the limits as specified on Table 11.2.5.	
12.1	2. The Contractor shall supply a certificate showing that each supplied tyre-force sensor has met the FAT requirements of Clause 12.1.		
12.2		2. The IAT shall be conducted on site by the Contractor immediately after the WiM system has been installed and calibrated to the manufacturer's specification.	

5 Functional requirements

The WiM system shall detect, collect, process, store, and transmit traffic information related to the counting, classifying and speed monitoring of all vehicles and the weighing of heavy vehicles at highway speeds.

The WiM system shall be capable of interfacing locally with a co-located ANPR system to reliably and accurately identify the vehicles being weighed by the WiM system, if requested by Transport and Main Roads.

The WiM system shall be able to accommodate vehicles and vehicle combinations with up to 25 axles and shall automatically determine for each vehicle, by lane of travel: vehicle classification, vehicle speed, axle spacing and axle / axle group weight.

The WiM system shall process data in real time in the field in a WiM Logger and provide a connection for the purposes of configuration and data retrieval. The WiM system shall also allow data to be viewed in real time, both locally and remotely.

The WiM system shall provide a system integration interface allowing real-time identification of vehicle classifications. The Interface may be system-to-system or through the use of voltage free contacts. A desirable feature for the WiM system is for the user to be able to configure over length and mass thresholds which triggers voltage free contacts or digital outputs in real time.

6 Mechanical and physical requirements

6.1 General

Pits and conduits to accommodate power and communication cables shall be supplied and installed according to the requirements of MRTS91 *Conduits and Pits*. The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Unless otherwise specified the pole footing shall be as per MRTS92 *Traffic Signal and Road Lighting Footings* and its referenced documents. Poles footings shall be designed and approved by a structural RPEQ.

The equipment and enclosures shall be of suitable design to protect against vandalism and prevent infestation by vermin. Ingress protection (IP) rating for enclosures shall be no less than IP55 as defined in AS 60529 *Degrees of protection provided by enclosures (IP Code)*. This includes all cable penetrations and equipment that may be located external to the enclosure.

6.2 WiM equipment

The equipment shall be established, reliable and have been used successfully in applications equivalent to those required by the Contract. Equipment of experimental or unproven design is prohibited.

The WiM system shall include all necessary sensor, electrical, electronic, electro-mechanical hardware and software required to calculate, store and transmit all data specified in this Technical Specification.

6.3 Site components

The WiM site shall include the following general components:

- weight sensors, necessary cabling and mounting hardware for each lane to be instrumented
- sufficient axle sensors per lane to determine vehicle speed and axle spacings
- a vehicle detector per lane, such as an inductive loop detector, to separate vehicle events
- a WiM Logger
- all necessary interconnecting cables and miscellaneous materials to make an operational system, and
- all other associated supporting infrastructure including equipment enclosures, power supplies, communications hardware, POS connection, pits, conduits, poles, road pavement and footings.

The selection of the weight sensing method shall be determined by the Contractor unless specified by the Principal. The sensor selection shall take into account the general location of the WiM site and the accuracies required.

6.4 Environmental requirements

The Contractor shall supply evidence that the offered WiM System has previously performed satisfactorily (within accuracy tolerances specified in Clause 7.2) throughout the specified ambient air temperature range specified in MRTS201 *General Equipment Requirements*.

6.5 Design life

Unless otherwise specified, the design life of all WiM System equipment shall comply with MRTS200 *General Requirements for Intelligent Transport Systems (ITS) Infrastructure* Table 6.2 – ITS design life requirements.

7 Operational requirements

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

7.1 General

Installed equipment shall meet the accuracy requirements specified in Clause 7.2 for the different classes of equipment based on axle weights, gross vehicle weights, speeds and axle spacings.

The WiM system must provide for single threshold weighing, and operate over a speed range of 16 km/h to 130 km/h.

Single threshold weighing will be performed by weight sensors in each lane of measurement. The weight sensors shall cover the entire lane width.

7.2 Accuracy

The WiM system must be capable of performing the indicated functions within the accuracy tolerances described in Table 7.2 with a minimum 95% Confidence Level.

Table 7.2 – Accuracy

Function	Accuracy Tolerance		
	Class A	Class B	Class C
Single Axles	± 15%	± 20%	± 30%
Axle Groups	± 10%	± 15%	± 20%
Gross-Vehicle Weight	± 6%	± 10%	± 15%
Speed	±2 km/h		
Axle-Spacing	±15 mm		

The classes mentioned in the above table refer to the required accuracy tolerances for each class. Different needs may lead to different accuracy requirements for the intended application. If the Contract does not specify the accuracy requirement of the site, then Class B as a minimum shall be delivered.

The WiM shall provide calibration features such that the required accuracy can be met and maintained over the design life and for the conditions installed.

7.3 Recorded data

The WiM Logger shall store the following data:

- vehicle counts by vehicle class and by speed range summarised to a quarter hour interval, and
- individual vehicle records for all vehicles, with the option of selecting specific Austroads vehicle types to be recorded.

Individual vehicle records shall be classified in accordance with Clause 7.4. Such classification parameters can be reprogrammable by the trained Transport and Main Roads personnel. Each vehicle record shall include, as a minimum, the following data:

- Date and Time (to a resolution of at least two decimal places of a second)
- Lane Number
- Vehicle Speed
- Vehicle Classification
- Axle Load
- Axle Group Load
- Gross Vehicle Weight, and
- Spacings in between each sequentially numbered axle.

The WiM Logger shall calculate and store all specified data with the capacity to store a minimum of three months of vehicle count data and individual vehicle records. The WiM Logger shall be capable of remote alarming when the data capacity reaches 90%. The WiM Logger shall continue to calculate and store data for all vehicles passing through the system during periods of access for purposes of programming, real-time view and transfer of data.

Data shall be calculated, recorded and formatted such that it can be intuitively understood when viewed in an ASCII text editor.

7.4 Vehicle classification

Vehicle classification shall be accomplished by the WiM system by the following data:

- number of axles
- axle spacing, and
- number of axle groups.

The WiM system shall use the axle count and axle spacing information to classify the Austroads vehicle types as described briefly below. Refer to *Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods* (in particular Table A.8) for the complete description of vehicle types. The axle spacing values used for this process shall be associated with each vehicle type as listed in Table 7.5. These values shall be able to be retrieved, viewed, and updated by trained Transport and Main Roads personnel. The classified vehicle type shall be indicated by the 2-digit code shown in Table 7.5.

Table 7.5 – Austroads vehicle types

2-digit code (Austroads Class)	Brief description
01	Short Vehicle
02	Short Vehicle Towing
03	Two-axle Truck or Bus
04	Three-axle Truck or Bus
05	Four-axle Truck
06	Three-axle Articulated Vehicle
07	Four-axle Articulated Vehicle
08	Five-axle Articulated Vehicle
09	Six-axle Articulated Vehicle
10	B Double
11	Double Road Train
12	Triple Road Train

8 Control system

The control system, referred to as the WiM Logger in this Technical Specification, shall be provided as an integral part of the WiM System. The WiM Logger shall communicate with a locally connected computer and remote computer(s) over an IP network, to enable access to any logged data, configuration parameters, alarms, and system status.

The WiM Logger shall process data to generate the specific ASCII files required by the QTDF specification generally, and specifically for vehicle classification and weigh-in-motion. It shall be possible to perform all configurations and data transfer tasks locally from a laptop computer running Microsoft Windows 10. Remote configuration of all configurable variables described in this Technical Specification shall also be provided.

8.1 Communications

Acceptable communications protocols shall be one or more of the following: SSH, FTP, SNMP, HTTP, HTTPS or as approved by the Principal. Any protocols used in proprietary software shall be disclosed to the Principal to allow appropriate independent security checking to be performed.

8.1.1 Real time view

The WiM System shall provide a real time view (via the manufacturer's application or, preferably, a HTML-based interface with common browser support) on-line monitoring of traffic. The real time view shall be able to be used locally at site or remotely over a network.

The display shall depict the axle configuration of each vehicle passing through the site. The user shall have the options of displaying either all traffic or any selected Austroads vehicle types, the weight violation table, as well as the option of displaying a selected individual lane or all lanes.

8.1.2 System configuration parameters

The WiM Logger shall support on-line (local and remote) modification to the data logging configuration parameters such as speed and weight calibration factors, vehicle classification parameters, weight violation table parameters, and front axle weight threshold. The WiM Logger shall retain all system configuration parameters in the event of a power failure.

8.1.3 Data transfer

The WiM Logger shall support the transfer of data log files to a local or remote computer via FTP or similar. The WiM Logger shall provide for the transfer of the current day's data stored as of the time of transfer.

8.2 Data processing

The WiM Logger shall provide for the generation of data files which are compliant with Transport and Main Roads QTDF data format. Details of this data format can be obtained from the Principal.

8.3 Data security

Data security shall be provided locally via user login and password. Industry-standard security protocols used for secure TCP / IP shall be used for remote communication via the WiM Loggers Ethernet port. Industry-standard secure FTP shall be used for data transfer of data log files. Acceptable security protocols for FTP are SFTP, FTPS or SCP.

9 Electrical requirements

The WiM site shall be provided with either a permanent mains electrical supply to the site cabinet, or, from a local solar powered supply. For mains power the requirements of MRTS210 *Provision of Mains Power* apply. For a solar powered installation, the requirements of MRTS263 *Standalone Solar (PV) Power Systems* apply. The WiM system shall be powered by an ELV power supply. Battery backup is required at all sites.

10 Telecommunications requirements

The telecommunication requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. The connection of the WiM system to a STREAMS Field Processor is optional.

The WiM Logger shall be equipped with at least one dedicated local serial access port and one Ethernet port for dedicated remote communications.

The WiM Logger shall support remote connectivity via Cellular 4G network, ADSL and the Principal's Telecommunications Network. The WiM Logger shall have session management or a similar method in order to protect the system against unauthorised access via communication ports.

During the design stage the Contractor shall arrange with the Principal the connection of the WiM system to the Principal's telecommunications network as described in MRTS201 *General Equipment Requirements*.

Prior to procurement, the Contractor shall confirm the details of the required telecommunications network connection and reach agreement with the Principal. The telecommunications network connection shall be confirmed by the Contractor with the Principal prior to procurement. **Hold Point 1**

11 Installation requirements

The installation requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional testing and commissioning requirements relevant to work provided under this Technical Specification are described below.

11.1 General

The Contractor shall provide full-time on-site supervision during weigh-in-motion system installation and system start-up. The Contractor shall use an installer who is accredited to perform the installation by the WiM System manufacturer.

11.2 WiM site selection

For the WiM system to perform properly, the Contractor shall provide and maintain an adequate operating environment for the system's sensors and instruments. Selection, construction and continuing maintenance of each WiM site, as well as continuing maintenance of the sensors, are extremely important considerations.

The following site conditions, or better, shall be provided by the Contractor to meet the performance criteria specified herein consistently.

This applies to both new road constructions where a WiM site is specified and an existing road installation. The Contractor is responsible for any site assessments and investigations required to satisfy the site conditions.

The final location and site conditions shall be confirmed by the Contractor to the Principal.

Hold Point 2

11.2.1 Horizontal curvature

The horizontal curvature of the roadway lane for 100 m in advance of and 50 m beyond the WiM system sensors shall have a radius not less than 1700 m measured along the centreline of the lane.

11.2.2 Longitudinal gradient

The longitudinal gradient of the road surface for 100 m in advance of and 50 m beyond the WiM system sensors shall not exceed $\pm 2\%$.

11.2.3 Cross carriageway gradient

For bi-directional single carriageways the cross-slope (lateral gradient) of the road surface for 100 m in advance of and 100 m beyond the WiM system sensors shall not exceed -3%.

For dual carriageways the cross-slope (lateral gradient) of the road surface for 100 m in advance of and 50 m beyond the WiM system sensors shall not exceed -3%.

11.2.4 Lane width and line markings

The width of the paved roadway for 100 m in advance of and 50 m beyond the WiM system sensors shall accommodate a sealed shoulder of minimum 1.0 m wide on each side of the road and 3.5 m per trafficable lane.

The trafficable lane is the portion of the road devoted particularly to the use of vehicles moving in a forward direction as demarcated by appropriate line markings which shall be 100 mm to 150 mm wide.

11.2.5 Surface evenness

The surface of the paved roadway for 100 m in advance of and 50 m beyond the WiM system sensors shall be smooth before sensor installation and maintained in a condition such that the deviation from a 3 m straightedge placed anywhere within a lane and the road roughness count measured at 20 m intervals shall not exceed the limits as specified on Table 11.2.5. **Witness Point 1**

Table 11.2.5 – Surface evenness

	Surface evenness requirements		
	Class A	Class B	Class C
Rutting (3 m straightedge)	less than or equal to 4 mm	less than or equal to 7 mm	less than or equal to 10 mm
Roughness (NRM)	< 33 counts per km	< 70 counts per km	< 105 counts per km

In the event that the site fails the surface evenness test and another site is not able to be chosen, the Principal shall advise if a corrective course and tie-in to the existing pavement is required. The preparation and application for the corrective course and tie-in layer shall comply to MRTS30 *Asphalt Pavements*.

11.3 WiM site selection additional considerations

The following characteristics should be considered for data quality and accuracy.

11.3.1 Proximity to intersections

The site should be away from intersections, overtaking lanes and other access points (for example, caravan parks, small shopping centres) to reduce the likelihood of vehicles accelerating or decelerating over the sensors.

11.3.2 Lane discipline

The site should be located on a carriageway that allows free flowing traffic for vehicles to travel at a constant speed, preferably close to the regulatory sign posted speed. A vehicle should traverse the sensors at a right angle to its direction of travel.

11.3.3 Free flowing traffic

The WiM site selected shall allow for free flowing traffic. Changes in vehicle speeds will affect data accuracy in weight, classification and speed.

11.4 Field cabinet

All electronics associated with the WiM system with the exception of sensors shall be housed in a field cabinet that complies with MRTS201 *General Equipment Requirements*, MRTS226 *Telecommunications Field Cabinets*, MRTS207 *Traffic Monitoring Foundation Equipment*, and relevant Standard Drawings SD1905.

11.5 Sensors installation

WiM sensor installation shall be in accordance with SD1906 ITS – *WIM Piezo Sensor Installation Details*, SD1908 ITS – *WIM Sensor Configuration Piezo-Loop-Piezo*, SD1909 ITS – *WiM Sensor Configuration Piezo-Piezo-Loop-Piezo-Piezo*, SD1910 ITS – *WiM Sensor Configuration Piezo-Piezo* and SD1911 ITS – *WiM Sensor Configuration Strain Sensor* unless the Contractor is able to prove otherwise with better performance based on the manufacturer's detailed installation guidelines.

12 Testing and commissioning

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification.

Additional testing and commissioning requirements relevant under this Technical Specification are described below.

12.1 Factory Acceptance Test (FAT)

The Factory Acceptance Test shall meet the following requirements:

- Prior to installation, the Contractor shall provide a manufacturer supplied certificate showing that each supplied tyre-force sensor has been factory tested under a simulated tyre load and found to produce an output signal that was linearly proportional to the applied load of range between 0% and 90% of the sensor's rated load capacity, and
- Additionally, the contractor shall visually inspect the tyre-force sensor for visible damage and perform an electrical test to the Principal's satisfaction measuring against the manufacturer's specification.

Hold Point 3

12.2 Calibration and Installation Acceptance Test (IAT)

The Contractor shall demonstrate that the WiM system is available for use by successfully completing the IAT for each lane of data collection at each WiM site.

The IAT shall verify accuracy of the recorded data as described in Clause 7.2 and pass all electrical measurement tests to the satisfaction of the Principal.

The IAT shall be conducted on site by the Contractor after the WiM system has been installed and calibrated to the manufacturer's specification. The Contractor is required to perform electrical tests on all sensors after a minimum 72 hours of the installation. The calibration of the WiM system shall not be performed prior to the confirmation of the performance of all sensors and proof that the logger is compensating for temperature. **Witness Point 2**

The following steps are required for calibration of each instrumented lane:

12.2.1 Calibration vehicles

The calibration requirements for the WiM systems differs for culvert-based strain gauge type sensors and embedded in-road type sensors. The calibration process requires a number of test vehicles that are loaded, pre-weighed (on a suitable static scale or weighbridge) and measured, that will make multiple runs over the WiM system sensors in each lane at differing speeds. Individual (single) axle weighing must be used to weigh the calibration vehicle.

The reference test vehicles used in the WiM sensor calibration procedures are:

- two-axle rigid truck (Austroads vehicle type 03)
- three-axle truck (Austroads vehicle type 04), and
- six-axle articulated vehicle (Austroads vehicle type 09).

The six-axle articulated vehicle shall be equipped with air suspension.

For calibrating culvert-based strain gauge type sensors, the test vehicles required are two-axle rigid trucks and six-axle articulated vehicles. The two-axle rigid truck test vehicles shall be loaded to approximately 4, 6, 8 and 10 tonnes on the drive axles with a non-shifting, approximately symmetric (side-to-side) load. Additionally, the test vehicle carrying 10 tonnes shall be certified as safely capable of carrying a 10 tonne load and be approved with an 'Over Mass' Permit. The six-axle articulated test vehicles shall be loaded with differing payloads. The first being a fully loaded payload and the second being half a payload.

For calibrating embedded in-road type sensors, the test vehicles required are two two-axle rigid trucks, a three-axle rigid truck and a six-axle articulated vehicles. Each of these vehicles are required to be fully loaded with a non-shifting, approximately symmetric (side-to-side) load. Additionally, one of the two-axle rigid truck test vehicles shall be loaded to 10 tonnes on the drive axle. This test vehicle shall also be certified as safely capable of carrying a 10 tonne load and be approved with an 'Over Mass' Permit.

The test vehicles shall be in sound mechanical condition. Special care shall be exercised to ensure that the tyres on the test vehicles are in sound condition, dynamically balanced and inflated to recommended pressures.

12.2.2 Calibration procedure

After the settings have been installed on the WiM system, each of the reference test vehicles shall make a minimum of 10 runs over the sensors in each lane at the sign posted speed or at a speed deemed safe for the payload. With a calibrated radar speed meter, or by some other means (such as wheelbase / time) that is acceptable to both the Principal and the Contractor, the speed of each test vehicle every time it passes over the WiM system sensors shall be measured. All data shall be recorded, and the vehicle record number shall be noted for every run of each test vehicle. The radar speed meter, if used, shall be calibrated by the method recommended by its manufacturer within 30 days prior to use.

12.2.3 Installation Acceptance Test Criteria

All specified data collection features, data processing features, and options of the system described herein shall be fully documented and demonstrated to function properly before the systems are released for the Customer Acceptance Test (CAT). If any part of the WiM system fails to function properly, or if more than 5% of the calculated differences for any applicable data item resulting from all passes of the two test vehicles exceed the tolerance specified herein, the WiM system will be deemed to have failed the IAT and/or CAT.

12.2.4 Commissioning test

The CT requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additionally, the equipment shall be commissioned by integrating the operation, monitoring and control with other equipment and/or systems as appropriate. This shall include initialising performance parameters to suit the Site-specific function of operation. Commissioning shall prove the correct operation, monitoring and control as required to meet the requirements of the Contract. Additionally, the Contractor shall demonstrate that the WiM system is connected to the Principals' communications network and can reconnect successfully upon restarting in the event of a power failure.

12.3 WiM system Customer Acceptance Test (CAT)

With the exception to the requirement of 'Streams' integration, the CAT requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

13 Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional minimum documentation requirements relevant under this Technical Specification are described below.

13.1 Operations manual and maintenance manual

The WiM system sections in the operations manuals and the maintenance manuals shall detail all WiM system assets including the sensor units, WiM Logger and software.

The manuals shall include, as a minimum, the following items:

- specifications
- design characteristics
- operation theory
- function of all controls
- signal responses and acceptable thresholds
- maintenance activities including on the pavement
- list of component parts with stock numbers
- documentation for the control system, and
- documentation for the WiM Logger including all protocols used for communications, data formats used, and all initial calibration / configuration settings.

14 Training

The training requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. In addition, onsite training for at least three operations personnel nominated by the Principal shall be provided.

The training shall generally cover the elements contained within MRTS201, this Technical Specification and not less than the following:

- how the site is accessed
- tools required
- installation
- system configuration
- confirmation of system accuracy
- system testing to confirm – classification, speed, lane, direction, temperature compensation, mass
- calibration with known control vehicle
- preventative maintenance actions, and
- spare parts required.

15 Maintenance

The Principal will nominate the ongoing WiM maintenance support period, if required. The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Additional maintenance requirements relevant under this Technical Specification are described below.

15.1 Pavement

The surface of the paved roadway at each WiM site shall be maintained in a condition that meets or exceeds the surface evenness requirements specified in Clause 11.2.5. Verification of the pavement smoothness following any significant pavement maintenance shall be performed, but no less frequently than annually. The maintenance plan produced by the Contractor shall incorporate full details of such tests.

15.2 Recalibration

The Contractor shall document the requirements for recalibrating the WiM system following any significant maintenance. Recalibration shall be performed no less frequently than annually.

The maintenance plan documentation produced by the Contractor shall incorporate full details of such recalibrations.

15.3 Culvert-based strain gauge WiM systems

Additional to the Clauses 15.1 and 15.2, the Contractor shall document how to undertake annual inspections of the road condition around the sensors, the culvert and the WiM system equipment. Care should be taken to ensure the culvert is kept clean and free of flammable debris, to reduce the possibility of damage occurring to the strain-gauge sensors should a bushfire at the site occur.

Additional to any recalibration required, the Contractor shall also document how to measure and record the electrical properties of each road sensor and strain-gauge of the WiM system. The maintenance plan for culvert-based strain gauge WiM systems shall include these details and inspection response times to significant weather events local to the site.

15.4 Embedded in-road WiM systems

Additional to the Clauses 15.1 and 15.2, the Contractor shall document how to undertake annual inspections and measurements of the road condition around the sensors and the WiM system.

Additional to any recalibration required, the Contractor shall also document how to measure and record the electrical properties of each embedded in-road sensor of the WiM system.

The maintenance plan for embedded in-road WiM systems shall include these details and inspection response times to significant weather events local to the site.

16 Handover

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

17 Type approval checklist

The checklist for the type approval evaluation is published as Appendix A to this Technical Specification.

SUPERSEDED

Appendix A – Type Approval Compliance Checklist

Type Approval Compliance Checklist

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
Structural / Mechanical								
1	Where required, pits and conduits to accommodate power and communication cables shall be supplied and installed according to the requirements of MRTS91.	6.1	X			X		
2	The mechanical and physical requirements defined in MRTS201 apply to this standard. This includes the enclosure and its fixing arrangement.	6.1	X			X		
3	The materials and methods of construction of the materials, equipment and enclosures shall be such that they have the strength and durability to withstand expected conditions of transportation, installation, and operation when installed in the intended environment.	6.1	X			X	X	
4	The equipment and enclosures shall be of suitable design to protect against vandalism and prevent infestation by vermin. Ingress protection (IP) rating for enclosures shall be no less than IP55 as defined in AS 60529. This includes all cable penetrations and equipment that may be located external to the enclosure.	6.1	X	X		X	X	
5	Unless otherwise specified the pole footing shall be as per MRTS92 and its referenced documents. Poles footings shall be designed and approved by a structural RPEQ.	6.1	X			X		
6	The WiM system shall include all necessary sensor, electrical, electronic, electro-mechanical hardware and software required to calculate, store and transmit all data specified in this Technical Specification.	6.2	X				X	
7	The Contractor shall supply evidence that the offered WiM System has previously performed satisfactorily (within accuracy tolerances specified in Clause 7.2) throughout the specified ambient air temperature range specified in MRTS201.	6.4	X		X		X	
Operational Requirements								
8	The WiM system shall detect, collect, process, store, and transmit traffic information related to the counting, classifying and speed monitoring of all vehicles and the weighing of heavy vehicles at highway speeds.	5	X		X		X	
9	The WiM system shall be capable of interfacing locally with a co-located ANPR system to reliably and accurately identify the vehicles being weighed by the WiM system, if requested by Transport and Main Roads.	5	X		X	X	X	

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
10	The WiM system shall be able to accommodate vehicles and vehicle combinations with up to 25 axles and shall automatically determine for each vehicle, by lane of travel: vehicle classification, vehicle speed, axle spacing and axle / axle group weight.	5	X		X		X	
11	The WiM system shall process data in real time in the field in a WiM Logger and provide a connection for the purposes of configuration and data retrieval. The WiM system shall also allow data to be viewed in real time, both locally and remotely.	5	X		X		X	
12	The WiM system shall provide a system integration interface allowing real-time identification of vehicle classifications. The Interface may be system-to-system or through the use of voltage free contacts.	5	X		X	X	X	
13	A desirable feature for the WiM system is for the user to be able to configure over length and mass thresholds which triggers voltage free contacts or digital outputs in real time.	5	X				X	
14	The WiM system shall provide for single threshold weighing and operate over a speed range of 16 km/h to 130 km/h.	7.1	X		X		X	
15	The WiM system shall be capable of performing the indicated functions within the accuracy tolerances described in Table 7.2 with a minimum 95% Confidence Level.	7.2	X		X		X	
16	The WiM Logger shall calculate and store all specified data with the capacity to store a minimum of three months of vehicle count data and individual vehicle records.	7.3	X		X		X	
17	The WiM Logger shall be capable of remote alarming when the data capacity reaches 90%.	7.3	X		X		X	
18	The WiM Logger shall continue to calculate and store data for all vehicles passing through the system during periods of access for purposes of programming, real-time view and transfer of data.	7.3	X		X		X	
19	Data shall be calculated, recorded and formatted such that it can be intuitively understood when viewed in an ASCII text editor.	7.3	X		X		X	
20	The WiM system shall use the axle count and axle spacing information to classify the Austroads vehicle types. Refer to Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods (in particular Table A.8) for the complete description of vehicle types.	7.4	X		X		X	
21	The axle spacing values used for this process shall be associated with each vehicle type as listed in Table 7.5.	7.4	X		X		X	
22	The classified vehicle type shall be indicated by the 2-digit code shown in Table 7.5.	7.4	X		X		X	

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
23	These values shall be able to be retrieved, viewed, and updated by trained Transport and Main Roads personnel.	7.4	X		X		X	
Control								
24	The control requirements defined in MRTS201 apply to this standard.	8	X		X		X	
25	The control system, referred to as the WiM Logger in this Technical Specification, shall be provided as an integral part of the WiM System. The WiM Logger shall communicate with a locally connected computer and remote computer(s) over an IP network, to enable access to any logged data, configuration parameters, alarms, and system status.	8	X		X		X	
26	The WiM Logger shall process data to generate the specific ASCII files required by the QTDF specification generally, and specifically for vehicle classification and weigh in motion.	8	X		X		X	
27	It shall be possible to perform all configurations and data transfer tasks locally from a laptop computer running Microsoft Windows 10.	8	X		X		X	
28	Remote configuration of all configurable variables described in this Technical Specification shall also be provided.	8	X		X		X	
29	The WiM System shall provide a real time view (via the manufacturer's application or, preferably, a HTML based interface with common browser support) on-line monitoring of traffic.	8.1.1	X		X		X	
30	The real time view shall be able to be used locally at site or remotely over a network.	8.1.1	X		X		X	
31	The display shall depict the axle configuration of each vehicle passing through the site.	8.1.1	X		X		X	
32	The user shall have the options of displaying either all traffic or any selected Austroads vehicle types, the weight violation table, as well as the option of displaying a selected individual lane or all lanes.	8.1.1	X		X		X	
33	The WiM Logger shall support on-line (local and remote) modification to the data logging configuration parameters such as speed and weight calibration factors, vehicle classification parameters, weight violation table parameters, and front axle weight threshold.	8.1.2	X		X		X	
34	The WiM Logger shall retain all system configuration parameters in the event of a power failure.	8.1.2	X		X		X	
35	The WiM Logger shall provide for the transfer of the current day's data stored as of the time of transfer.	8.1.3	X		X		X	
36	The WiM Logger shall provide for the generation of data files which are compliant with Transport and Main Roads QTDF data format.	8.2	X		X		X	

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
37	Data security shall be provided locally via user login and password.	8.3	X		X		X	
38	The WiM Logger shall have session management or a similar method in order to protect the system against unauthorised access via communication ports.	10	X		X		X	
Communications								
39	The telecommunications requirements defined in MRTS201 apply to this standard.	8.1	X		X			
40	Acceptable communications protocols shall be one or more of the following; SSH, FTP, SNMP, HTTP, HTTPS or as approved by the Principal.	8.1	X		X		X	
41	Any protocols used in proprietary software shall be disclosed to the Principal to allow appropriate independent security checking to be performed.	8.1	X		X		X	
42	The WiM Logger shall support the transfer of data log files to a local or remote computer via FTP or similar.	8.2	X		X		X	
43	The WiM Logger shall provide for the transfer of the current day's data stored as of the time of transfer.	8.2	X		X		X	
44	Industry-standard security protocols used for secure TCP/IP shall be used for remote communication via the WiM Loggers Ethernet port. Industry-standard secure FTP shall be used for data transfer of data log files. Acceptable security protocols for FTP are SFTP, FTPS or SCP.	8.3	X		X		X	
45	The WiM Logger shall be equipped with at least one dedicated local serial access port and one Ethernet port for dedicated remote communications.	10	X		X		X	
46	The WiM Logger shall support remote connectivity via Cellular 4G network, ADSL and the Principal's Telecommunications Network.	10	X		X		X	
Power / Electrical								
47	The WiM site shall be provided with either a permanent mains electrical supply to the site cabinet, or, from a local solar powered supply.	9	X		X		X	
48	For mains power the requirements of MRTS210 apply.	9	X			X	X	
49	For a solar powered installation, the requirements of MRTS263 apply.	9	X			X	X	
50	The WiM system shall be powered by an ELV power supply.	9	X		X	X	X	
51	Battery backup is required at all sites.	9				X	X	
General / System Integration								
52	The Contractor shall arrange with the Principal the connection of the WiM system to the Principal's telecommunications network as described in MRTS201.	10				X		

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NATA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
53	The Contractor shall confirm the details of the required telecommunications network connection and reach agreement with the Principal.	10				X		
54	The Contractor shall use an installer who is accredited to perform the installation by the WiM System manufacturer.	11.1					X	
55	For the WiM system to perform properly, the Contractor shall provide and maintain an adequate operating environment for the system's sensors and instruments.	11.2	X				X	
56	All electronics associated with the WiM system with the exception of sensors shall be housed in a field cabinet that complies with MRTS201 <i>General Equipment Requirements</i> , MRTS226 <i>Telecommunications Field Cabinets</i> , MRTS207 <i>Traffic Monitoring Foundation Equipment</i> , and relevant Standard Drawings SD1905.	11.4				X	X	
57	WiM sensor installation shall be in accordance with SD1906 <i>ITS – WiM Piezo Sensor Installation Details</i> , SD1908 <i>ITS – WiM Sensor Configuration Piezo-Loop-Piezo</i> , SD1909 <i>ITS – WiM Sensor Configuration Piezo-Piezo-Loop-Piezo-Piezo</i> , SD1910 <i>ITS – WiM Sensor Configuration Piezo-Piezo</i> and SD1911 <i>ITS – WiM Sensor Configuration Strain Sensor</i> unless the Contractor is able to prove otherwise with better performance based on the manufacturer's detailed installation guidelines.	11.5				X	X	
58	The testing and commissioning requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.	12			X		X	
59	The Contractor shall provide a manufacturer supplied certificate showing that each supplied tyre-force sensor has been factory tested under a simulated tyre load and found to produce an output signal that was linearly proportional to the applied load of range between 0% and 90% of the sensor's rated load capacity.	12.1			X		X	
60	The WiM system sections in the operations manuals and the maintenance manuals shall detail all WiM system assets including the sensor units, WiM Logger and software as per Clause 13.1.	13.1					X	
61	The Contractor shall document the requirements for recalibrating the WiM system following any significant maintenance. The maintenance plan documentation produced by the Contractor shall incorporate full details of such recalibrations.	15.2					X	
62	Recalibration shall be recommended to be performed no less frequently than annually.	15.2					X	
63	Culvert-based strain gauge WiM systems. The Contractor shall document how to undertake annual inspections of the road condition around the sensors, the culvert and the WiM system equipment.	15.3					X	

Row Number	MRTS203 – Compliance Requirement	Reference Clause	Verification Method					Product Compliance (Y, TBC, N, N/A)
			Visual Inspection	NAlA approved certificate (or equivalent)	Field / Bench Test	Detailed Drawings	Manufacturer conducted test records / other documents	
64	Culvert-based strain gauge WiM systems. Additional to the Clauses 15.1 and 15.2, the Contractor shall also document how to measure and record the electrical properties of each road sensor and strain-gauge of the WiM system. The maintenance plan for culvert-based strain gauge WiM systems shall include these details and inspection response times to significant weather events local to the site.	15.3					X	
65	Embedded in-road WiM systems - Additional to the Clauses 15.1 and 15.2, the Contractor shall document how to undertake annual inspections and measurements of the road condition around the sensors and the WiM system.	15.4					X	
66	Embedded in-road WiM systems - The maintenance plan for embedded in-road WiM systems shall include these details and inspection response times to significant weather events local to the site.	15.4					X	

Note. It is an expectation that a request for a new WiM system type approval will suitably demonstrate field test results against the compliance requirements. The submission of only bench test results without field testing will not be adequate for type approval acceptance.

SUPERSEDED

SUPERSEDED