

Main Roads Technical Standard

MRTS225

Imaging Equipment

October 10

 **Queensland** Government

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Imaging Equipment

1 INTRODUCTION

This Standard applies to the requirements for the design, documentation, materials, equipment and installation of imaging equipment for ITS Applications associated with the Principal's Traffic Management System.

The scope of this Standard includes the following:

- Supply and/or installation of imaging equipment;
- Supply and/or installation of supporting infrastructure including field cabinets, conduits, mounting poles and the like;
- Act as the Principal's agent with the local electricity supply authority including arranging connection of supply as described in ITS-10;
- Act as the Principal's agent with a telecommunications service provider as necessary, including arranging connection of supply
- All design, documentation, supply, installation, disconnection, removal, relocation, connection, testing and commissioning of the abovementioned works

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.

All equipment and material, where not otherwise specified, shall be in accordance with the appropriate Australian Standard Specifications, where such exist; and in their absence, with appropriate British Standard Specifications.

Where standard specifications are quoted or implied, the latest version shall be applicable, including its amendments to date.

All electrical wiring and associated equipment shall comply with the requirements of AS/NZS 3000, 'Wiring Rules'.

All telecommunications equipment shall comply with relevant Australian Communications & Media Authority technical standards and requirements.

All radio communications shall comply with the requirements of the Australian Department of Communications.

2 DEFINITION OF TERMS

For the purpose of this Standard, in addition to those defined in Clause 2 of MRTS01 the definitions in Table 2 apply.

Table 2 – Definitions

Term	Definition
CCTV	Closed Circuit Television
Codec	Encoder / Decoder pair
Electrical Legislation	<i>Electricity Act 1994</i> and associated Amendments and Regulations and <i>Electrical Safety Act 2002</i> and associated Amendments, Regulations and Codes of Practice
Imaging equipment	Lens, camera, housing, Pan-Tilt unit, mounts, pole, field cabinet, transmitters, receivers, associated cabling and any other equipment and works necessary to operate as intended.
Image Quality	Parameters of image information such as resolution, colour, contrast and image refresh rate

Term	Definition
PTZ	Pan-Tilt-Zoom
Local electricity supply authority	Interchangeable between local authorities responsible for electricity distribution network and/or retail sale of electricity
Wiring Rules	AS/NZS 3000

3 REFERENCE DOCUMENTS

This document makes reference to the appropriate Australian or international standards and specifications and are summarised in Table 3.

Table 3 – References summary

Document	Description
AS/NZS 1768	Lightning Protection
AS 2578.1	Traffic signal controllers - Physical and electrical compatibility
AS/NZS 3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3015	Electrical installations – Extra-low voltage d.c. power supplies and service earthing within public telecommunications networks.
AS/NZS 3085.1	Telecommunications installations - Administration of communications cabling systems - Basic requirements
AS/NZS 4117	Surge protection devices to telecommunication applications
AS 4262.1	Telecommunication over voltages - part 1 Protection of Persons
AS 4262.2	Telecommunication over voltages - part 2 Protection of Equipment
AS/NZS ISO 9001	Quality Management Systems – Requirements
MRTS210	Mains Power Supply
MRTS226	Communications Field Cabinets
MRTS234	Telecommunications Cables
MRTS01	Introduction to Technical Standard
MRTS50	Quality System Requirements
MRTS91	Conduits and Pits
MRTS95	Switchboards and Cables
S-005	Road Lighting & Camera Poles and Outreach Arms

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 of MRTS01.

The Hold Points, Witness Points and Milestones applicable for this Standard are summarised in Table 4.1.

Table 4.1 – Hold Points

Clause	Hold Points
8.5	1. Written acceptance of design documents and proposed switchboard, cabling works and planned disruptions to existing connected loads.
10.3	2. Equipment certified and compliance of all respective components.
10.4	3. Equipment commissioned and compliance of all respective components.
10.5	4. Warranty provisions and compliance of all respective components.

Quality system requirements for this contract shall be in accordance with this Standard, MRTS01 and MRTS50.

The Principal reserves the right to evaluate the subcontractor’s quality system throughout the contract. Arrangements for conducting evaluations shall be at a time, convenient to both parties and shall be confirmed in writing.

In contracts where a subcontractor becomes the major supplier, the subcontractor shall meet the requirements of AS/NZS ISO 9001 and this Standard.

5 OPERATIONAL REQUIREMENTS

5.1 Functional Requirements

The imaging equipment shall be used as part of an overall Traffic Management System. In accordance with the project specific requirements, the imaging equipment must allow the Principal’s traffic management staff to:

- a) detect, verify and manage incidents and other congestion;
- b) verify the display of each dynamic message sign (for example VMS, CMS, VSL, LCS, VSL/LCS and ramp signalling system);
- c) monitor and control the imaging equipment from the Principal’s Traffic Management Centre (TMC), and/or other nominated location(s);
- d) monitor pedestrian and/or cycleway activities and each help phone;
- e) monitor operation of the Principal’s Heavy Vehicle Management System, including security at the associated interception sites.

5.2 Performance Requirements

5.2.1 General

Images must be captured, transmitted and displayed at the highest quality and refresh rate permitted by the capacity of the imaging equipment and the attached telecommunications network.

Video and control signals associated with a particular camera must be transmitted digitally over the same telecommunications channel. Non-vendor specific video compression may be used. Images must be transmitted to the Principal’s TMC, and other sites as specified in the Contract.

Digital imaging technology may be used throughout the entire image data chain, including the camera and displays. However, the imaging equipment, and images provided by this equipment must be interoperable with the imaging display and control systems being utilised by the Principal, current at the time of the provision of the equipment. In addition, imaging equipment must utilise proven, industry-standards that are current at the time of the provision of the equipment.

Video images shall be either real time or slow scan as determined by the communication system used to each camera site. End-to-end image compression / decompression must retain the maximum image quality

to ensure that the functional requirements are met. The image quality and resolution displayed at the Principal's TMC must satisfy the identification requirements as specified below:

5.2.2 Image Data Rate

Where images are transmitted from the field cabinet to the TMC entirely by fibre, the transmitted image must be refreshed with at least 25 frames per second at maximum camera resolution over the full dynamic ranges of the camera.

Where the image will be transmitted other than entirely by fibre, the transmitted image must be refreshed with at least four (4) frames per second at minimum CIF resolution over the full dynamic ranges of the camera.

Where reduced bandwidth conditions occur due to failure and/or degradation of the normal (primary) image transmission channel, the image quality must automatically throttle back to retain maximum image quality as allowed by the reduced channel bandwidth. The absolute minimum image quality parameters acceptable over a reduced bandwidth and/or secondary transmission channel must be at least four (4) frames per second at CIF resolution (minimum) using the full dynamic ranges of the camera.

Upon resumption of normal (primary) transmission channel bandwidth, the image quality must automatically return to normal image quality.

5.2.3 Type "P" (Pedestrian) Applications

At all points in the area(s) nominated in the Contract, the entire body of a person approximately 1.8m tall must occupy at least 240 vertical pixels of the uncompressed image captured by the camera.

Human characteristics such as hair, skin and clothing colour (during daylight hours), and bodily appearance, sufficient to make positive identification at locations nominated in the Contract in all lighting conditions.

The decompressed image at the Principal's TMC must display the same person with at least 240 vertical pixels when shown at 100% of image size.

5.2.4 Type "V" (Vehicle) Applications

At all points between CCTV camera installation sites, an entire small passenger sedan vehicle must occupy at least 25 vertical pixels (approximately 60 mm per vertical pixel) of the uncompressed image captured by the camera.

Vehicle characteristics such as colour (during daylight hours) and shape must be easily discernable at all points between CCTV camera installation sites in all lighting conditions.

The decompressed image at the Principal's TMC must display the same vehicle with at least 25 vertical pixels when shown at 100% of image size.

5.2.5 CCTV Control System

The effect of commands issued by the operator in the Principal's TMC must be observed by the operator within 200msec.

5.3 Design Requirements

Design calculations for full resolution shall use the greater of the codec's bandwidth at the image quality described above and 4.2 Mbps.

Design calculations for reduced resolution shall use 90% of the reduced channel bandwidth.

Camera locations must consider occlusion from vegetation (when fully grown) and other objects such as signs and structures. Wherever practicable, cameras shall be located on the outer curve.

The Contractor must provide:

- i. Calculations for telecommunications bandwidth requirements
- ii. Drawings illustrating each camera's fields of view
- iii. Statement of design co-ordination with landscaping/environmental design and sign design

6 EQUIPMENT REQUIREMENTS

6.1 *Colour Camera*

Cameras shall be colour and shall conform to the CCIR standard of 625 lines interlaced, 50 frames per second with a composite PAL video signal output of 1 Volt peak to peak, negative sync.

The semiconductor imagery shall be of the CCD type with the imagery chip having a minimum active area of 6.1 mm (1/4 inch) diagonal.

The lens mount shall be a standard 1/4 inch diameter C mount and include a CS lens adaptor.

Sensitivity shall be better than 0.05 lux scene illumination at maximum iris opening for a useable picture that is un-enhanced by averaging techniques and 6 lux for a picture signal of -6db.

The camera shall operate with a supply voltage of 24 Volts AC $\pm 10\%$, 50Hz ± 1 Hz.

6.2 *Lens*

Lenses shall be a motorised zoom type with a minimum optical zoom ratio of 10:1 with auto iris and position feedback. Focus tracking shall be such that the lens will not require focus adjustment for an object at infinity (>10m) over the entire zoom range.

The lens mount shall be 1/4 inch diameter CS (or C with C-CS mount adaptor) suitable for attachment to the video cameras described above.

Maximum aperture shall be at least F1.2 with a focus range of 1.2 metres to infinity.

The motorised zoom and auto-iris shall operate from 8 or 12 Volts DC $\pm 10\%$.

6.3 *Camera Housing*

Each camera shall be enclosed in a weatherproof housing to provide protection from driving rain, moisture and dust to at least IP66.

The housing, including a sunscreen, shall be corrosion resistant in construction. Coatings and fittings shall tolerate exposure to salt atmosphere and motor vehicle fumes.

The camera housing design shall maintain the ambient environment inside the housing to within the rated operating conditions of the equipment it houses, in all weather conditions and ambient temperatures likely to be experienced in the installed location. The layout of the equipment shall maximise the cooling capabilities of each item of equipment.

The housing shall include a minimum 100 mm sunscreen to shade the lens from direct sunlight.

Internal and exterior surface finishes shall be white or light grey.

6.4 *Pan-Tilt Unit*

The camera housing shall be mounted on a pan tilt unit. This unit shall be capable of continuously panning the camera assembly through 360 degrees in the horizontal plane. It shall also be capable of continuously tilting in the vertical plane between +10 degrees and -83 degrees to horizontal.

6.5 *Camera Mount*

Where the camera is fixed to a tunnel portal or building, it shall be mounted on a hinged outreach, to allow maintenance from a permanent, safe working area.

In other locations, cameras shall be mounted on a hinged type standard column complying with S-005. The height of the camera mounting pole shall be:

- a) 15 m where the footings are installed 3 m or less above of carriageway height;
- b) 12 m where the footings are installed higher than 3 m above carriageway height; or
- c) 8 m where mounted on overpass or other structures.

The pole shall be of welded steel construction, tapered with a round or polygonal section of smooth appearance.

The pole shall be base plate mounted and be suitable for mounting on a rag bolt assembly in a concrete footing or equivalent.

Where equipment is commercially available in a format compatible with the mounting arrangements provided within the intended housing enclosure, it shall be provided in that format.

6.6 Field Cabinets

Weatherproof field cabinets shall be supplied for each camera site to house the camera control, video transmission equipment and power supply.

The field cabinets shall comply with the requirements of document MRTS226.

6.7 Camera Controls

CCTV cameras must have control facilities for pan, tilt, zoom and focus that are compatible with the CCTV control network in the Principal's TMC current at the time of the provision of the CCTV cameras.

6.8 Lightning Protection

Each imaging installation shall be protected from damage from transients from mains power supply and/or induced by lightning strikes.

Each imaging installation (power, data and video cables; camera, lens and housing assembly shall comply with the requirements of AS/NZS 1768 and AS 4262. Surge protection devices shall comply with AS/NZS 4117.

7 ENVIRONMENTAL REQUIREMENTS

The equipment must be capable of continuous, normal operation in the conditions described below:

- a) installed directly in sunlight;
- b) ambient air temperature range between -5°C and 50°C ;
- c) ambient ground temperature not exceeding 40°C ;
- d) a range of temperature and humidity prescribed in Figure 1.1 of AS 2578 - Part 1;
- e) maximum wind conditions likely to occur at the installation site;
- f) Queensland coastal environment with salt deposit densities in the range of 2.0 to 3.0 g/m²;
- g) varied light intensity due to shadows;
- h) a humidity of up to 95% non-condensing;
- i) conditions, both permanent and temporary, that may be unique to the specified location, for example instances of thick smoke and electromagnetic interference;
- j) vibrations reasonably expected in the installed location; and
- k) an altitude not exceeding 500 metres above sea level.

The equipments' performance must be unaffected by a humidity of 90% combined with a temperature of 40°C followed by a sudden drop in temperature of up to 10°C .

Equipment operation must cause no adverse effect on the surrounding environment in which it is installed.

8 MAINS POWER

8.1 General

Mains power to the field cabinets shall comply with the requirements of document MRTS210.

8.2 Design and Documentation

The mains power supply shall be designed to meet the requirements of each individual field site and as shown on the drawings.

Connected load shall be taken to mean all electrical power loads, including devices connected via socket outlet and this figure shall be used for the pricing of energy consumption. Maximum demand shall be calculated in accordance with the Wiring Rules.

Existing switchboards shall not be used as a source of power (during construction or operation) unless the local electricity supply authority has been advised of the changes in connected load in accordance with this Standard, and has authorised the use of such loads.

8.3 Surge Protection

Each imaging installation (power, data and video cables; camera; lens and housing assembly) shall be protected from damage from transients from mains power supply and/or induced by lightning strikes.

8.4 Step-Down Power Supplies

Provide hardwired step-down power supplies for the imaging equipment. Where multiple cameras are connected to a single field cabinet, separate hardwired step-down power supplies must be provided for the imaging equipment associated with each camera.

8.5 Commencement of Works

At least 14 days prior to intended commencement of the mains power works, the Contractor shall forward the following additional documentation to the Principal as a minimum:

- Proposed switchboard and cabling works
- Details of any planned disruptions to supply to existing connected loads

The Contractor shall not proceed with the works or contact the local electricity supply authority until the Principal has issued written acceptance of the design documents and proposed works. **Hold Point 1**

8.6 Materials

8.6.1 General

All materials shall be supplied and installed by the Contractor and shall meet the requirements of the relevant standards listed in Table 3.1 of MRTS95. The materials shall also meet the requirements of the relevant local electricity supply authority.

8.6.2 Ducts and Pits

All electrical ducts and pits necessary to complete the mains power supply shall comply with the requirements of MRTS91.

8.7 Installation Works

The Contractor shall perform all works associated with the provision of mains power including supply and installation of:

- Earthing system as necessary
- Conduits, pits, cables (including Consumer's Mains) and the works defined by Note 2 on Main Roads Standard Drawing 1327
- All associated works and materials.

8.8 Testing

The mains power supply shall be tested in accordance with the Electrical Legislation, Wiring Rules and MRTS95.

9 TELECOMMUNICATIONS REQUIREMENTS

9.1 Performance Requirements

Where images are not transmitted between the field cabinet and TMC entirely by fibre, each camera shall be provided with its own dedicated telecommunications channel with a data signalling rate of at least 512 kbps to the TMC.

9.2 Public Telecommunication Services

Where necessary, the Contractor must act as the Principal's agent in arranging for permanent connection of a public telecommunications service to the site in the name of the Principal. Within 14 days of a written request, the Principal will provide relevant details to enable the Contractor to complete the forms required by the public telecommunications service provider.

Temporary connections to a public telecommunications service must be in the name of the Contractor.

Provision for telecommunications lines must be provided in accordance with the requirements of ACIF and AS 3085.1.

9.3 Materials

9.3.1 Ducts and Pits

All electrical ducts and pits necessary to complete the mains power supply shall comply with the requirements of MRTS91.

9.3.2 Telecommunication Cables

Telecommunication cables provided by the Contractor must comply with the requirements of MRTS234.

10 TESTING & COMMISSIONING

10.1 General

The Contractor must demonstrate compliance of each ITS system, device and associated infrastructure with the requirements of the Contract by performing:

1. Installation Acceptance Tests (IAT);
2. Commissioning Tests (CT); and
3. Customer (Field) Acceptance Tests (CAT).

The Contractor must identify and provide all equipment, materials and other works necessary to perform the tests. Any damage incurred as a result of undertaking tests must be rectified by the Contractor.

Where the manufacturer of test equipment indicates that the test equipment can be calibrated, the test equipment must be calibrated by a certified NATA laboratory. The certificate of calibration must be current at the time(s) of the test(s). A copy of the relevant certificate(s) of calibration must be included in the operations manuals (refer Clause 11.4).

10.2 Testing and Commissioning Plans

Prior to commencing each test listed in Clause 10.1, the Contractor must supply a customised:

1. IAT plan;
2. CT plan; and
3. CAT plan.

to the Principal's Representative 28 days prior to the proposed start date for each test.

Each plan must detail the customised tests, test sheets and procedures for each ITS device and associated infrastructure. Each test must be shown as a Milestone on the Contractor's schedule of works. Test plans and record sheets must be suitable for recording compliance with the respective technical requirements of the Contract.

The IAT plan must address as a minimum:

- electrical tests;
- equipment and/or system operation; and
- compliance with the respective functional and operational requirements.

Test plans must include different traffic volumes and weather / lighting conditions where these may be reasonably expected to impact on the performance and/or accuracy of the device and/or system.

10.3 *Installation Acceptance Tests*

Once installed on site, the Contractor must demonstrate and certify that the equipment has been installed to allow correct operation. Compliance details of all respective components as required or implied under this document must be included in the operations manuals prior to commencement of the CT **Hold Point 2**

10.4 *Commissioning Tests*

The equipment must be commissioned by integrating the operation, monitoring and control with other equipment and/or systems as appropriate. This must include initialising performance parameters to suit the site specific function of operation. Commissioning must prove the correct operation, monitoring and control as required to meet the requirements of the Contract.

Compliance details of all respective components as required or implied under this document must be included in the operations manuals prior to commencement of the CT **Hold Point 3**

10.5 *Customer Acceptance Testing*

Commissioned equipment and/or systems must simulate continuous operation under normal operating conditions for a period of 15 consecutive days (hereafter referred to as CAT period).

Failure of the equipment and/or system to meet the requirements in the technical standards for more than three (3) hours (accumulated) during the CAT period shall be cause for the CAT to be repeated for the full duration of the CAT period.

Once commenced, the CAT period need not be restarted provided that the failure is not caused as a result of the Contractor's works in the following events:

- unavailability of the Principal-supplied equipment and/or systems; and/or
- failure (not attributable to the Contractor) of a telecommunication channel leased by the Principal to transmit data.

The following documents must be included in the operations manuals prior to handover **Hold Point 4**:

- a statement confirming the warranty provisions associated with the tested device and associated equipment; and
- compliance details of all respective components as required or implied under this document.

11 DOCUMENTATION

11.1 *ITS Program*

The Contractor's ITS program must include:

- a) detailed design activities and drawings, manufacturers specifications and schematic layout of components for review by the Principal's Representative;
- b) applications for electricity supply;
- c) applications for telecommunications services;
- d) updates to operations manuals;
- e) updates to program schedule;
- f) quality plans;
- g) testing and commissioning plans;
- h) IAT, CT and CAT activities; and
- i) equipment delivery.

The Contractor must provide to the Principal's Representative updates to the ITS program of works on a fortnightly basis.

11.2 Calculations and Design Data

The Contract must include in the final design documentation copies of all calculations, assumptions and design data relating to equipment provided in accordance with this standard.

All such information must be certified by an RPEQ as meeting the requirements of the Contract. The RPEQ must only certify documents within their registered field of practice.

11.3 Design and Manufacturing Certifications

The Contractor must include in the final design documentation (and also include in the operations manuals) copies of relevant compliance certificates for equipment and materials, including:

- a) radio frequency interference;
- b) electromagnetic compatibility;
- c) Austel approvals; and
- d) other relevant certifications.

The Contractor must include in the final design documentation the following documents where relevant:

- i. fabrication and assembly drawings, detailing all of the components to be installed;
- ii. manufacturer's specifications of the cabinet and of all major components, detailing ratings and performance characteristics;
- iii. a schematic layout of components, building details and interconnection diagrams;
- iv. recommendations for routine maintenance tasks; and
- v. recommendations on spare parts.

Prior to construction completion all documentation must be updated to reflect any variations from the certified final design documentation. All updated manufacturer equipment manuals, maintenance manuals, procedures, design documentation, engineering drawings and system specific software and hardware configurations must be supplied to the Principal's Representative.

All engineering design drawings must be certified by a RPEQ. The RPEQ must only certify documents within their registered field of practice. Design drawings must be arranged and presented to clearly allow such certification(s).

11.4 Operations & Maintenance Manuals

Prior to construction completion three (3) copies of a comprehensive operations must be provided to the Principal's Representative. The manual must be presented in 3 or 4 D-ring binders.

The manuals must consist of a dedicated section to cover each separate ITS application or equipment. Each physical volume of the manual must be provided with a high level Table of Contents that contains a comprehensive list of the ITS applications / equipment provided. The table of contents in each volume must highlight the installation sites for the ITS applications / equipment it contains. Each installation site must be further sub-divided with following headings as appropriate:

1. Operating Procedures;
2. Maintenance, Diagnostics & Troubleshooting;
3. Manuals;
4. Compliance Certificates;
5. Recommended Spares;
6. Calculations & Design Data;
7. Test & Commissioning Records;
8. Drawings & System Schematics;
9. Wiring & Termination Diagrams;
10. Mains Power Details;

11. Telecommunications Details; and
12. Recommended Maintenance.

Where generic documents (such as the user manual for a specific ITS device) are relevant to more than one site installation, only one copy need be provided in each copy of the operations manuals.

The "Recommended Maintenance" section must list activities recommended by the manufacturer, and be supplemented by those additional activities which are recommended by the Contractor.

Cross-reference(s) to the site installation section in the operations manuals that contains the relevant documentation must be provided in the other site installation sections.

11.5 Test & Commissioning Results

Copies of all test and commissioning results must be provided in the respective section of the operations manuals.

Where results are hand written, the original copy must be provided. Results recorded by hand must be in blue ink.