Main Roads
Technical Standard

MRTS45

Road Surface Delineation

April 11

Queensland Government

TRADEMARKS ACKNOWLEDGEMENT

Terms mentioned in this document that are known or understood to be trademarks, whether registered or not, have been identified. Where trademarks have been confirmed as registered in Australia, this has been indicated by the addition of the ® symbol, otherwise the ™ symbol is used. While all care has been taken to identify trademarks, users should rely on their own inquiries to determine trademark ownership. Use of a term in this document as a trademark should not be regarded as affecting the validity of any trademark.

IMPORTANT INFORMATION

The requirements of this document represent Technical Policy of the department and contain Technical Standards. Compliance with the department's Technical Standards is mandatory for all applications for the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

This document will be reviewed from time to time as the need arises and in response to improvement suggestions by users. Please send your comments and suggestions to the feedback email given below.

FEEDBACK

Your feedback is welcomed. Please send to mr.techdocs@tmr.qld.gov.au.

DISCLAIMER

This publication has been created for use in the design, construction, maintenance and operation of road transport infrastructure in Queensland by or on behalf of the State of Queensland.

Where the publication is used in other than the department's infrastructure projects, the State of Queensland and the department gives no warranties as to the completeness, accuracy or adequacy of the publication or any parts of it and accepts no responsibility or liability upon any basis whatever for anything contained in or omitted from the publication or for the consequences of the use or misuse of the publication or any parts of it.

If the publication or any part of it forms part of a written contract between the State of Queensland and a contractor, this disclaimer applies subject to the express terms of that contract.

COPYRIGHT

Table of Contents

Page

Pavement Marking

1 INTRODUCTION

This Technical Standard applies to the supply and installation of pavement markings, raised pavement markers and audio tactile line marking (ATLM).

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

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

2 DEFINITION OF TERMS

The terms used in this Standard shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Standards*. Additional terms used in this Standard shall be as defined in Table 2.

Table 2 – Definition of Terms

Term	Definition
ATLM	Audio Tactile Line Marking.
Longitudinal lines	Dividing, barrier, lane, edge and continuity lines and outline markings.
Pavement markings	Longitudinal lines and transverse lines.
MUTCD	Manual of Uniform Traffic Control Devices
Retroreflectivity	The value of reflected light measured in millicandellas per lux per m^2, using a retroreflectometer calibrated to a nationally recognised standard, using a 30 m geometry instrument.
Transverse lines	Stop and give way lines, turn lines, markings at stop and give way signs, pedestrian crosswalk lines, diagonal and chevron markings, arrows, shapes, symbols, numerals, parking areas and kerb markings.

3 REFERENCED DOCUMENTS

Table 3 lists documents referenced in this Technical Standard.

Table 3 – Referenced Documents

Reference	Title
Australian Paint Approval Scheme – Specification 0041/4	Roadmarking paint, thermoplastic
Australian Paint Approval Scheme – Specification 0041/5	Roadmarking paint, water borne
AS 1580.205.4	Paints and related materials – Methods of test – Application properties – Airless spraying
AS 1906.1	Retroreflective materials and devices for road traffic control purposes – Retroreflective sheeting
AS 1906.3	Retroreflective materials and devices for road traffic control purposes – Raised pavement markers (retroreflective and non-retroreflective)
AS 2009	Glass beads for pavement-marking materials
AS 2700	Colour standards
AS 4049.2	Paints and related materials – Pavement marking materials – Thermoplastic pavement marking materials – For use with surface applied beads

Reference	Title
AS 4049.3	Paints and related materials – Pavement marking materials – Waterborne paint – For use with surface applied beads

4 TEST METHODS

Test methods are as specified throughout this Technical Standard.

5 QUALITY SYSTEM REQUIREMENTS

5.1 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 Standards*.

The Hold Points applicable to this standard are summarised in Table 5.1. There are no Witness Points or Milestones defined.

Table 5.1 – Hold Points

Clause	Hold Point
7.4.1	1. Setting out of pavement markings

5.2 Construction Procedures

The Contractor shall prepare documented procedures for all construction processes as defined in Clause 5 of MRS50 *Specific Quality System Requirements*.

Construction procedures which are required to be prepared by the Contractor and submitted to the Administrator in accordance with the quality system requirements of the Contract are listed in Table 5.2.

Table 5.2 – Construction Procedures

Clause	Procedure
7.5	Application of pavement markings.

5.3 Testing Frequencies

The testing frequency requirements shall be as stated in Clause 1 of Annexure MRTS45.1.

6 MATERIAL REQUIREMENTS

6.1 Pavement Markings

6.1.1 Performance Criteria

Longitudinal line marking, excluding ATLM, when applied, shall have a minimum retroreflectivity of 350 mcd/lux/m^2 measured between 10 and 20 days of wear.

6.1.2 Paint

Paint shall be suitable for use on roads surfaced with a sprayed seal, hot and cold mixed asphalt and concrete.

Except where specifically shown otherwise on the design documents, paint shall be white, equivalent to or whiter than Y35, Off White as detailed in AS 2700. Where yellow paint is shown on the design documents or otherwise required by the Contract, the colour shall be equivalent to Y12, Wattle or Y14, Golden Yellow as detailed in AS 2700 or any other colour deemed to lie between these two colours. Where red paint is shown on the design documents or otherwise required by the Contract, the colour shall be equivalent to R13 Signal Red, R14 Waratah or R15 Crimson as detailed in AS 2700.

Paint used shall be water-borne road marking paint conforming to the requirements of AS 4049.3 and having approval under the Australian Paint Approval Scheme – Specification 0041/5.

6.1.3 Reflective Glass Beads

Reflective glass beads shall comply with the requirements for Type B, C or D glass beads as described in AS 2009. The type to be used shall be as stated in Clause 2 of Annexure MRTS45.1.

6.1.4 Anti skid

Transverse markings shall incorporate an anti skid treatment with a skid resistance greater than 45 BPN. The application of anti-skid shall comply with the manufacturer's requirements.

6.1.5 Thermoplastic Materials

Thermoplastic materials shall comply with the requirements of AS 4049.2 and have approval under the Australian Paint Approval Scheme – Specification 0041/4.

6.2 Raised Retroreflective Pavement Markers

Raised retroreflective pavement markers shall comply with the requirements of AS 1906.3 and shall be Type A1 either uni-directional or bi-directional.

Bi-directional raised retroreflective pavement markers shall be white or yellow as shown on the Drawings. Uni-directional raised retroreflective pavement markers shall be white, red, green or yellow as shown on the Drawings.

6.3 Non-retroreflective Raised Pavement Markers

Non-retroreflective raised pavement markers shall comply with the requirements of AS 1906.3 and shall be Type B.

Non-retroreflective raised pavement markers shall be circular, approximately 100 mm in diameter, and 15 mm high. The colour shall be white.

6.4 Temporary Raised Pavement Markers

Temporary raised pavement markers shall comply with the requirements of AS 1906.

6.5 Pavement Bars

Pavement bars shall be manufactured in accordance with details shown on the design documents. Where not otherwise shown, pavement bars shall be manufactured from concrete and painted white.

6.6 Adhesives for Raised Pavement Markers

The adhesive used to install raised pavement markers shall be soft adhesives specified as single part, bituminous based materials which are applied by heating to high temperature.

7 INSTALLATION OF PAVEMENT MARKINGS

7.1 Setting Out

The Contractor shall carry out all work necessary to establish satisfactory alignment of pavement markings, within the specified tolerances, using any device or method which will not damage the pavement nor conflict with other traffic control devices.

Prior to resealing or placement of an asphalt overlay, the Contractor shall take such measurements, prepare such drawings and establish such offset marks that will allow the existing pavement markings to be reinstalled following completion of the surface re-treatment.

Prior to spotting on reseals and asphalt overlay, the Contractor shall install a control line at 20 metre intervals.

For new construction, the Contractor shall install a control line at 20 metre intervals in accordance with the Drawing requirements prior to spotting.

7.2 Weather Conditions

Pavement markings shall not be applied when freshly applied pavement markings may become damaged by rain, fog or condensation before they have dried or set. Pavement surfaces shall be thoroughly dry immediately prior to the application of pavement markings.

Pavement markings shall not be applied when the temperature is below, or likely to drop below, the temperature specified in Table 7.2.

Table 7.2 – Minimum Application Temperature – Pavement Markings

Material	Minimum Temperature (ºC)
Paint, water-borne – Type 3	Not applicable †
Thermoplastic material	7 (surface)

† Drying time may be affected at low temperatures

7.3 Surface Preparation

Surfaces which are to receive pavement markings shall be cleaned of all dirt, loose material and other contaminants. Pavement surfaces shall be thoroughly dry immediately prior to the application of pavement markings.

7.4 Spotting

7.4.1 General

Spotting shall consist of spots approximately 30 mm wide and 150 mm long painted on the pavement surface.

The Contractor shall obtain approval from the Administrator of the spotting prior to any application of pavement markings. **Hold Point 1**

7.4.2 Longitudinal Lines

Spotting for longitudinal lines shall be carried out generally at 5 metre intervals with 3 metre intervals on curves of less than 50 m radius.

7.4.3 Transverse Markings

Spotting for transverse markings shall be carried out as shown on the design documents.

7.5 Application of Pavement Markings

7.5.1 Procedure

The Contractor shall submit its procedure for application of pavement markings. The procedure shall include details of the materials, application rates, equipment and method, including manufacturer's recommendations, to be used when applying pavement markings.

7.5.2 Paint

7.5.2.1 Mixing

Mixing of paint shall be carried out strictly in accordance with the manufacturer's recommendations.

7.5.2.2 Application Equipment

Mechanical means shall be used to apply painted pavement markings.

All equipment used in the application of pavement markings shall produce pavement markings of uniform quality which conform to the requirements of this standard.

The longitudinal line application machine shall be capable of accurately superimposing succeeding coats of paint upon the first coat and upon existing lines.

The longitudinal line application machine shall consist of a rubber-tyred vehicle which is manoeuvrable to the extent that straight lines can be followed and normal curves can be painted in true arcs. The machine shall be capable of applying road marking paints and glass beads at the rates specified.

The longitudinal line application machine shall be equipped with the following –

a) a positive acting cut-off device to prevent depositing paint in gaps of broken lines; and

b) a glass bead dispenser located behind the paint applicator nozzle and which is controlled simultaneously with the paint applicator nozzle.

Where the configuration or location of a longitudinal line is such that the use of a longitudinal line application machine is unsuitable, road marking paint and glass beads may be applied by hand-sprayed means.

Stencils, boards and hand spray equipment shall be used to paint transverse markings. Stencils shall conform to the dimensions shown on the design documents or in the Manual of Uniform Traffic Control Devices.

7.5.2.3 Application of Paint and Glass Beads

All markings shall be of uniform thickness and intensity. Care shall be taken to avoid overspray on to the surrounding area.

Water-borne paint shall not be heated to a temperature greater than 65 degrees Celsius.

Two coats of paint and glass beads shall be applied on longitudinal lines to new surfaces. The first coat shall be cured to 'no pick up time' prior to the application of the second coat.

Each coat of paint for any longitudinal line group, including glass beads, shall be applied in one pass of the longitudinal line application machine, regardless of the number, width, and pattern of the individual lines involved.

Table 7.5.2.3 – Maximum Temperature of Paint

Material	Maximum Temperature (ºC)
Paint, water-borne	65

Glass beads shall be uniformly incorporated in all coats of paint concurrently with the application of the paint.

7.5.2.4 Application Rates

The minimum application rates for the paint and glass beads shall be as specified in Table 7.5.2.4.

Table 7.5.2.4 – Application Rates for Paint and Glass Beads

Work Type	Coverage (minimum per coat)	Wet Application Rate
Longitudinal lines – first coat Type B (drop-on beads)	> 300 g/m^2	0.375 lit/m^2 ± 0.25
Longitudinal lines – second coat Type B (drop-on beads)	> 300 g/m^2	0.375 lit/m^2 ± 0.25
Longitudinal lines – repaint Type B (drop-on beads)	> 200 g/m^2	0.300 lit/m^2 ± 0.20
Longitudinal lines – second coat or repaint applying Type D beads	> 400 g/m^2	0.500 lit/m^2 ± 0.25
Transverse lines – Type B (drop-on beads)	> 300 g/m^2	0.375 lit/m^2 ± 0.25
Transverse lines – Type D beads	> 400 g/m^2	0.500 lit/m^2 ± 0.25

The combination application rates for anti skid and glass beads shall not exceed the values specified above and in Clause 6.1.4 unless specified by the manufacturer.

7.5.3 Thermoplastic Material

7.5.3.1 Primer

A primer, of the type recommended by the manufacturer of the thermoplastic material, shall be applied to the surface immediately in advance of, but concurrent with, the application of thermoplastic material.

The primer shall be applied at the application rate recommended by the manufacturer and shall not be thinned.

7.5.3.2 Application of Thermoplastic Material

Thermoplastic material may be applied by screeding, spraying, extrusion or profiling or as preformed material.

Thermoplastic material shall be applied to the pavement at a temperature between 180°C and 200°C unless a different temperature is recommended by the manufacturer.

The pavement surface to which thermoplastic material is applied shall be completely coated by the material and any voids in the pavement surface shall be filled.

7.5.3.3 Application Rate

Thermoplastic material shall be applied at the minimum thickness specified in Table 7.5.3.3.

Table 7.5.3.3 – Thermoplastic Application Thickness

Location	Minimum Application Thickness (mm)
Longitudinal Lines	2
Transverse Markings	2

Where specified, glass beads shall be applied immediately to the surface of the molten thermoplastic material at a rate of not less than 0.12 kg per m^2.

7.6 Raised Pavement Markers

7.6.1 Application of Retro Reflective Pavement Markers

The use of raised retroreflective pavement markers shall be in accordance with Clause 4.6.3 of the MUTCD.

7.6.2 Application of Non Reflective Pavement Markers

The use of non reflective raised pavement markers shall be in accordance with Clause 4.6.3 of the MUTCD.

7.7 AudioTactile Line Marking

7.7.1 Application of Audio Tactile Line Marking

Where shown on the design documents, ATLM, configured as a pattern of raised ribs, shall be applied directly to the road surface on existing painted edge lines or centre double barrier lines. At locations where edge lines have not been marked (such as across narrow structures) ATLM shall not be applied.

ATLM shall be applied in a controlled manner, to produce a finished longitudinal line with a consistent appearance and profile that provides a significant audible warning.

7.7.2 Application on Existing Painted Lines

All extraneous or loose material shall be removed from areas where the material is to be applied, immediately prior to application of ATLM. In addition, existing line markings shall be prepared and primed, in accordance with the thermoplastic manufacturer's recommendations, to ensure satisfactory adhesion of the thermoplastic material.

7.7.3 Audio Tactile Line Marking

Where nominated in the Contract, ATLM shall be applied to both edge and double barrier lines and shall conform to the tolerances shown in Table 7.9.2.

The height of the thermoplastic raised ribs is measured from the plane surface formed by the tops of the aggregate.

Diagrams depicting these requirements are provided in Figure 7.7.3-A, Figure 7.7.3-B and Figure 7.7.3-C.

Figure 7.7.3-A – ATLM Edge Line

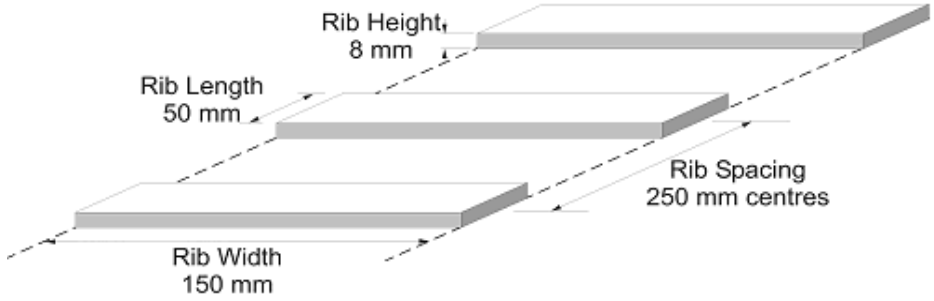


Figure 7.7.3-B – ATLM Centre Double Barrier Lines

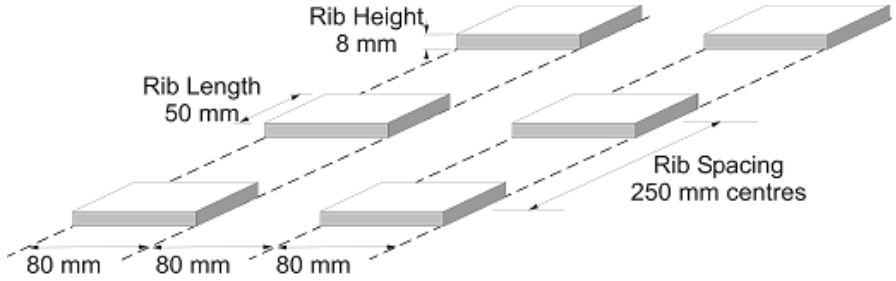
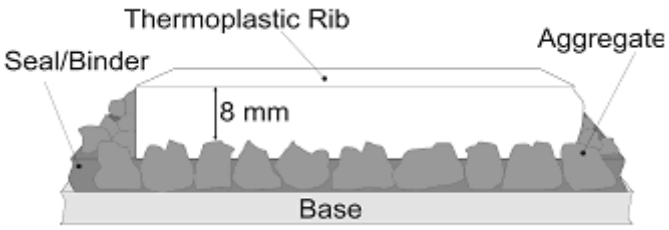


Figure 7.7.3-C – Height Measurement of the Raised Rib



7.7.4 Gaps for Cyclists

A 1.5 m gap spaced every 20 m shall be provided in the ATLM edge line.

7.7.5 Adjacent Residences – Noise Considerations

Edge line ATLM shall not be installed within a 200 metre radius of a residential building.

7.7.6 Luminance and retro-reflectivity

Glass beads in accordance with AS 2009 Type C shall be mixed into the thermoplastic material at a rate of not less than 30% by mass prior to application.

Glass beads in accordance with AS 2009 Type B shall be applied immediately to the surface of the molten thermoplastic material. The minimum rate to be retained on the thermoplastic surface is 200/m^2. In order to enhance retention, the beads shall have a proprietary adhesive coating.

The thermoplastic material shall have a minimum titanium dioxide content of 10% by mass.

Acceptance of the retro reflectivity of the road marking shall be based on the marking achieving a minimum level of reflectivity of 350 mcd/lux/m^2 measured at the time of application.

7.8 Protection of the Work

Newly placed pavement markings shall be protected from damage by traffic or other causes, using acceptable traffic management procedures; until paint is dry (no pick up condition) or thermoplastic material has hardened sufficiently to prevent such damage.

7.9 Tolerances

7.9.1 Pavement Markings

Completed pavement markings shall –

a) be uniform;

b) have clean and well-defined edges without running or deformation; and

c) conform to the dimensions shown on the design documents or in the Manual of Uniform Traffic Control Devices (Qld).

Longitudinal lines shall be straight on straight alignment and shall be on a true arc on curved alignment.

When completed, pavement markings shall conform to the tolerances specified in Table 7.9.1.

Additionally, arrows and letters shall be placed square to the centreline of the traffic lane.

Drips, overspray, improper markings, and paint and thermoplastic material tracked by traffic shall be immediately removed from the pavement surface by methods which do not damage the pavement surface.

Table 7.9.1 – Tolerances – Pavement Marking

Dimension	Tolerance (mm)
Longitudinal Lines	
Width of line	± 5
Width of gap between adjacent lines	± 5
Length of line and/or gap • new construction, reseals and asphalt overlays; and • repaints	 ± 100 ± 300
Placement from spotting for new construction, reseals and asphalt overlays	± 20
Placement from existing line (repaints.).	± 15
Trueness of line	< 15 in 10 metres
Transverse Markings	
Dimension of transverse markings and shapes	± 20
Placement from spotting	± 10
Placement from existing markings	± 10

7.9.2 Audio Tactile Line Marking

The distance between the centreline of the completed marking and the centreline of the existing painted line marking is to be less than 10 mm. The apparent line of the markings is to be a smooth, continuous alignment when viewed in the direction of the line.

Audio tactile material shall comply with the requirements of Clause 6.1.5. The contractor shall install thermoplastic ATLM within the limits outlined in Table 7.9.2.

Table 7.9.2 – ATLM Tolerances

Aspect	Dimension	Tolerance (mm)
Height of raised rib	8 mm	plus 2 mm or minus 1 mm
Spacing of raised rib	250 mm	plus or minus 10 mm
Length of raised rib	50 mm	plus or minus 2 mm
Slope angle of raised rib	45 degrees	approximately

Aspect	Dimension	Tolerance (mm)
Width of raised rib (edge line)	150 mm	plus or minus 2 mm
Width of raised rib (Centre barrier line)	80 mm	plus or minus 2 mm

7.9.3 Raised Pavement Markers

When installed, raised pavement markers shall conform to the tolerances specified in Table 7.9.3.

Table 7.9.3 – Tolerances – Raised Pavement Markers

	Tolerance (mm)	Distance
Lateral position –		
• barrier/edge line	+ 25, - 50	from edge of line
• broken line	± 10	from edge of line
• flush medians	± 10	from centre of line
Longitudinal position –		
• broken line	± 10	1 m from start of line
• new construction	± 100	1 m from start of line
• replacement	± 300	1 m from start of line

7.10 Removal of Existing Pavement Markings

Where required under the Contract, existing pavement markings shall be removed by the appropriate method stated in Table 7.10. Where a method is stated in Clause 1 of Annexure MRTS45.1, that method shall be used.

Table 7.10 – Method of Removal of Existing Pavement Marking

Method of Removal	Duration of Result
Emulsion and sand	< 2 weeks
Skid resistant enhanced black cold applied resin or plastic	< 6 months
Chip seal	Permanent
Line grinder (asphalt only)	Permanent
Profiler (asphalt only)	Permanent
Abrasive blasting	Permanent

8 INSTALLATION OF RAISED PAVEMENT MARKERS AND PAVEMENT BARS

Raised pavements markers and pavement bars shall be installed to the details and in the locations shown on the design documents or in the Manual of Uniform Traffic Control Devices (Qld).

Prior to installation of the markers or bars, any material detrimental to the adhesion between the item and the pavement shall be removed.

Adhesive shall be prepared, applied and cured strictly in accordance with the manufacturer's recommendations.

Care shall be taken when heating soft adhesives. A proprietary built, gas heated kettle shall be employed for this purpose.

9 COMPLIANCE TESTING

9.1 General

Compliance testing shall be carried out for each lot during installation and maintenance.

9.2 Testing Frequencies and Number of Tests

The Contractor is responsible for performing sufficient tests to ensure that the Works comply with the Contract, including the requirements of this standard.

However, the Contractor's testing program shall be such that the testing frequencies and number of tests are not less than those stated in Clause 5.3.

9.3 Geometrics

The geometric tolerances shall be checked at regular intervals not greater than those specified in the Annexure.

10 SUPPLEMENTARY REQUIREMENTS

The requirements of MRTS45 *Road Surface Delineation* are varied by the supplementary requirements given in Clause 4 of Annexure MRTS45.1.