1191 PAVEMENT MARKINGS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives

General: Provide pavement markings, as documented.

Performance

Requirements: Conform with this worksection, *0161 Quality (Construction)*, the drawings, specifications and directions by the Superintendent, consistent with requirements and appropriate State or Local Government legislation.

~~Requirements: [complete/delete]~~

Design

~~Designer: [complete/delete]~~

Authority requirements: This worksection does not override any applicable State or Local Government legislation and is to be read in conjunction with AS 1742.3 and the Roads and Maritime Services (NSW) RMS QA Specification DCM R141 Pavement Marking (or equivalent document in other states).

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:

- *0136 General requirements (Construction).*
- *0152* Schedule of rates – supply projects.
- *0161 Quality (Construction).*
- *0167 Integrated management.*
- *1101 Control of traffic.*

~~[complete/delete]~~

1.3 REFERENCED DOCUMENTS

Standards

General: The following documents are incorporated into this worksection by reference:

AS 1289	Methods of testing soils for engineering purposes
AS 1289.2.1.4-2005	Soil moisture content tests - Determination of the moisture content of a soil - Microwave-oven drying method (subsidiary method)
AS 1580	Paints and related materials—Methods of test
AS/NZS 1580.107.3-1997	Determination of wet film thickness by gauge
AS/NZS 1580.401.8-1997	No-pick-up time of road marking paints
AS 1742	Manual of uniform traffic control devices
AS 1742.2-2009	Traffic control devices for general use
AS 1742.3-2009	Traffic control devices for works on roads
AS 1906	Retroreflective materials and devices for road traffic control purposes
AS 1906.3-1992	Raised pavement markers (retroreflective and non–retroreflective)
AS/NZS 2009:2006	Glass beads for pavement-marking materials
AS 2700-2011	Colour Standards for general purposes
AS 4049	Paints and related materials—Pavement marking materials
AS 4049.1-2005	Solvent-borne paint - For use with surface applied glass beads
AS 4049.2-2005	Thermoplastic pavement marking materials - For use with surface applied glass beads
AS 4049.3-2005	Waterborne paint—- For use with surface applied glass beads
ASTM D3335-2009	Standard test method for low concentrations of lead, cadmium, and cobalt in paint by atomic absorption spectroscopy

Other publications

Roads and Maritime Services (NSW)
RMS Delineation manual 2008 Section 1 to 5
RMS Test method T841 2001 Field measurement of film thickness of road marking paint
RMS QA Specification DCM R141 Pavement Marking 2011

1.4 STANDARD

General

Pavement markings: To AS 1742.2.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the definitions given below apply:
- CAP: Two part cold applied plastic material.
- Paint: In this worksection implies 'pavement marking paint'.
- Thermoplastic material: In this worksection implies 'thermoplastic pavement marking material'.

Definitions

General: For the purposes of this worksection the definitions given below apply:
- Longitudinal linemarking: All lines that are generally parallel to the traffic flow, such as centre, lane , edge, turn, continuity and transition lines and outline markings.
- Other markings: All diagonal and chevron markings on the pavement symbols, words, numerals and arrows, kerb markings and markings for parking.
- Pavement marking: All longitudinal linemarking, transverse lines, raised pavement markers and other markings placed on the road to control traffic movement or parking.
- Transverse lines: All lines that are marked at right angles to the general traffic flow, such as Stop/Give way lines and pedestrian crosswalk lines.

1.6 SUBMISSIONS

Approval

Submissions: To the Superintendent's approval.
Requirement: Conform to the drawings, specified procedures and Standards.
Approvals: Submit NATA Certificates, conform to **HOLD POINTS**, **WITNESS POINTS**

Documents

Submit the following for approval:
- Proposed supplier.
- Materials and components: Submit Certification of materials as specified.
- Execution details: Refer to **HOLD POINTS**, **WITNESS POINTS**.
- Submit details of set-out.

~~Drawings: [complete/delete]~~
~~Calculations: [complete/delete]~~
- Components: Refer materials.

~~Design: [complete/delete]~~
~~Manuals: [complete/delete]~~
~~Prototypes: [complete/delete]~~
~~Samples: [complete/delete]~~
~~Warranties: [complete/delete]~~
- Technical data: Equipment suitability and application measurement as specified.

~~Type tests: [complete/delete]~~
~~Type test results: [complete/delete]~~
. Field testing for thermoplastics and CAP.

1.7 HOLD POINTS AND WITNESS POINTS

Notice

General: Give notice so that the documented inspection and submissions may be made to the **HOLD POINT table** and the **WITNESS POINT table**.

HOLD POINTS table

Clause title/subclause	Requirement	Notice for inspection	Release by
Certificate of compliance – Material quality	Submit NATA Test Reports on materials	7 days before work is scheduled to commence	*Principal Certifying Authority*
Establishment Surface preparation	Approval for surface preparation required	7 days before commencement of activity	*Principal Certifying Authority*
Establishment - Surface preparation	Superintendent direction on suspension of work	Progressive	*Principal Certifying Authority*
Removal of redundant markings – Removal method	Submit method for approval	1 working day before commencement of activity	*Principal Certifying Authority*

WITNESS POINTS table – On-site activities

Clause title/subclause	Requirement	Notice for inspection
Paint marking - Application of paint and beads	Application of paint and beads to be checked for quality	Progressive
Thermoplastic marking – Field testing	Application of paint and beads to be checked for quality	Progressive
Two part cold applied pavement marking – Field testing	Application of paint and beads to be checked for quality	Progressive
Pavement marking tape - Application	Direction to remove pavement marking tape	Progressive
Raised pavement markers – Installation	Application of paint and beads to be checked for quality	Progressive

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program for the works

Requirements: Program the works to ensure adequate resources for the following:

- Provide planning resources to collate the technical requirements for materials consistent with Authority's legislation/standards.
- Engage NATA Laboratory for material certification.
- Plan the Setting Out and Control of Traffic Activities.
- Program the work to meet the constraints of **HOLD POINTS**, **WITNESS POINTS**.

2.2 CERTIFICATES OF COMPLIANCE

Material quality

Test reports: Submit, to the Superintendent, NATA Registered Laboratory Test Reports on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use. Provide only materials conforming to the

requirements of the referenced worksections/standards. Testing must be within 36 months of the products use for validity. This is a **HOLD POINT**.

3 MATERIALS

3.1 PAVEMENT MARKING PAINT

Type

Waterborne paint: To AS 4049.3.

Type: Do not use Solvent-borne paint.

3.2 QUARTZ FOR NON-SKID PAVEMENT MARKINGS

Quality

Transverse markings: Incorporate quartz as follows:

- Clean, sound, hard, durable, non-plastic and free from adherent coatings and any other foreign matter.
- When placed in a cylindrical container of minimum diameter 50 mm and minimum depth of 20 mm with the surface screeded off.
- Moisture content of less than 5% when tested to conform with AS 1289.2.1.4.

Particle size distribution: To the **Particle size distribution table**.

Particle size distribution table

Sieve mesh size (µm)	% Passing
425	100
300	50-90
150	25 – 55
75	0 – 30

Transport: Package quartz to prevent damage during transportation and handling, and ensure that contamination does not occur.

3.3 THERMOPLASTIC MATERIAL

Standard

Thermoplastic marking: To AS 4049.2.

Non-profile thermoplastic pavement marking material

Sprayed or extruded thermoplastics: Generally used for longitudinal line marking and must be applied uniformly.

Screeded or preformed thermoplastic: Generally used for transverse lines and other markings.

3.4 TWO PART COLD APPLIED PAVEMENT MARKING MATERIAL

Quality

Lead content: When determined by method ASTM D3335, the lead content must be no greater than 0.25 %.

No pick up time: Measured at 23°C and tested to AS 1580.401.8.

- For trowel or screed applied material (containing intermix glass beads), maximum 20 minutes for 2.0 ± 0.25 mm applied film thickness.
- For spray material (contains no glass beads), maximum 5 minutes for 0.200 ± 0.025 mm applied film thickness.

Luminance: White road marking material luminance factor as delivered must be not less than 75%.

Abrasion resistance: Loss in mass must not exceed 0.3 g for 500 cycles.

Sprayed material: Generally used for longitudinal line markings.

Trowelled, screeded, sprayed or extruded material: Generally used for transverse lines and other pavement markings.

3.5 REFLECTIVE GLASS BEADS

Quality

Standard: To AS/NZS 2009.

Glass bead proportion: Incorporate glass beads in thermoplastic material as follows:

- In the proportion of a minimum 20% of the total mass.
- As part of the aggregate constituent and to conform to the requirements of AS/NZS 2009.

Glass beads: Conform to the following:

- Type B 'Drop-on beads' or type D 'wet weather beads'.
- Supply type D wet weather beads intended for use with thermoplastic applications with a proprietary adhesive coating and clearly labelled on the packaging.

3.6 PAVEMENT MARKING TAPE

Type

Temporary markings: Strippable tape approved by the Superintendent.

Permanent pavement marking tape: Must be approved by the Superintendent.

3.7 RAISED PAVEMENT MARKERS

Type

Markers: Reflective and non-reflective markers to AS 1906.3 and the dimensions shown on the drawings.

Adhesive to wearing surface: Hot melt bitumen adhesive or an equivalent product approved by the Superintendent.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General

Requirement: Conform to *1101 Control of traffic*.

4.2 ESTABLISHMENT

Colour

All pavement marking materials: White Y35 to AS 2700 with a luminance factor > 80% to AS 4049.3 unless otherwise specified.

Quartz: White, equivalent to or whiter than Y35, Off White to AS 2700 unless otherwise specified.

Setting out

Locations: Place all markings to conform with drawings, schedules or as directed.

Surface preparation

Clean dry surface: Apply pavement markings only to clean dry surfaces. Clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement.

Existing material: If the existing surface is flaking or chipping, or in a condition where adhesion of the new material to the road surface cannot be guaranteed for the required life of the marking. Approval required for the extent and type of surface preparation required. This is a **HOLD POINT**.

Curing compound: If a curing compound has been applied, remove by physical abrasive means.

Wet weather: Do not carry out the pavement marking during wet weather or, if in the opinion of the Superintendent, rain is likely to fall during the process (unless otherwise directed). This is a **HOLD POINT**.
Concrete wearing surface: Lightly scabble the full area under each raised pavement marker to remove fine mortar material (laitance).

Provision for traffic and protection of work

Traffic: Provide for traffic, to conform with *1101 Control of traffic*, while undertaking the work.
Protection: Protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage.

Maintenance of pavement markings

Responsibility: Born by the Contractor for the maintenance, and replacement if necessary, of raised pavement markers and for all pavement marking during the contract period and the contract defects liability period.

4.3 PAINT MARKING

Mixing of paint

Requirement: Thoroughly mix all paint in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product.

Application of paint and beads

Paint thickness: Apply uniformly and at the minimum dry film thickness as follows:
- Type B beads: 0.20 mm
- Type D beads: 0.30 mm. This is a **WITNESS POINT**.

Longitudinal lines

General: Conform to the following:
- Spray all longitudinal lines by an approved self propelled machine.
- Spray the two sets of lines forming a one-way or two-way barrier line pattern concurrently (unless otherwise directed by the superintendant).

Tolerances:
- Setting out: No more than 50 mm from the locations shown on the Drawings.
- Lengths: To any applicable local or state requirements and not vary by more than ± 50 mm.
- Widths: ± 5 mm.
- Gap between double lines: ± 10 mm.
- Beads for Longitudinal Lines: Conform to the following:
- Apply Type B glass beads to the surface of all longitudinal lines at a minimum application rate of 0.50 kg/m^2 immediately after the application of the paint.
- Set the actual application rate to overcome any loss of beads between the bead dispenser and the sprayed line.

Transverse lines

Tolerances:
- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.

Other markings

Dimensions: Conform to any applicable local or state requirements for the following:
- Arrows.
- Chevrons.
- Painted medians.
- Painted left turn islands.
- Speed markings.

Tolerance: Each dimension ± 50 mm.
Arrows and speed markings: Place square with the centreline of the traffic lane.
Hand spraying: Hand spraying with the use of templates (where necessary) to control the pattern and shape is to be permitted for transverse lines, symbols, legends, arrows and chevrons.
Beads for other markings:

- Type B glass beads to be similarly applied to all other paint markings at a minimum application rate of 0.30 kg/m^2 immediately after application of the paint by a method approved by the Superintendent.
- Type D glass beads to be similarly applied to all other markings at a minimum application rate off 0.5 kg/m^2.

Pavement marking appearance: Straight or with smooth, even curves where applicable. All edges to have a clean, sharp cut off.
Faulty application: Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.

Field tests

Wet film thickness: To AS/NZS 1580.107.3 Method B, comb gauge.
Beads application: Check the application rate of glass beads by the method described in Annexure A.

4.4 QUARTZ APPLICATION

Anti-Skid material

Minimum application rate: To the **Application rate for quartz table**.
Surface application: Apply the quartz prior to the application of glass beads.

Application rate for quartz table

Material	Transverse Lines
0.4 – 0.7 white crushed quartz: - If stirred into the paint prior to application - If applied	 > 500 g/litre > 200 g/m²

4.5 THERMOPLASTIC MARKING

Preparation of thermoplastic material on site

Heating: Immediately before application, uniformly heat the thermoplastic material in a suitable kettle to the temperature recommended by the manufacturer, without overheating.
Molten pot life: No more than six hours for hydrocarbon resins and four hours for wood and gum resins.
Rejection: Should over-heating occur and/or the time expire for molten materials, discard the thermoplastic material.

Tack coat

Requirement: If the wearing surface of the pavement is smooth or polished.
Application: In conformance with the recommendations of the thermoplastic manufacturer.
Timing: Immediately before the application of the thermoplastic material.

Longitudinal lines

General: Conform to the following:

- Spray all longitudinal lines (or extruded in the case of profiled markings) by a self propelled machine approved by the Superintendent.
- Spray the two sets of lines forming a one-way or two-way barrier line concurrently.
- Apply the thermoplastic material uniformly with a cold film thickness of 3.0 mm.

Tolerances:

- Setting out: No more than 50 mm from the locations shown on the drawings.
- Lengths: To any applicable local or state requirements and not vary by more than ± 50 mm.

- Widths: ± 5 mm. Negative tolerance of 10 mm is allowable for no more than 5% of the length of line.
- Gap between double lines: ± 10 mm.
- Thickness: ≥ 1.8 mm, sprayed or extruded.

Beads for longitudinal lines: Conform to the following:

- Apply Type B glass beads by air propulsion or gravity feed to the surface of all longitudinal lines at a net application rate of 0.30 kg/m^2 immediately after application of the thermoplastic material.
- Set the actual application rate to overcome any loss of beads between the bead dispenser and the sprayed line.
- Apply Type D glass beads at a minimum rate of 0.5 kg/m^2.

Transverse lines

Tolerances:

- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.
- Thickness: 3 mm ± 1 mm, screeded.

Other marking

Dimensions: Conform to any applicable local or state requirements for the following:

- Arrows.
- Chevrons.
- Painted medians.
- Painted left turn islands.
- Speed markings.

Tolerance:

- Each dimension ± 50 mm.
- Thickness: 3 mm ± 1 mm, screeded.

Application of thermoplastic materials and beads

Arrows and speed markings: Place square with the centreline of the traffic lane.
Application: Uniformly apply the thermoplastic material Cold film thickness: 3.5 mm.
Screed application: Apply the screeded thermoplastic material using a mobile applicator, approved by the Superintendent, using templates to control the pattern.
Pavement marking appearance: Straight or with smooth, even curves where applicable. Provide a clean, sharp cut off. to all edges.
Faulty application: Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.

Beads

Scope: Other than longitudinal lines.

Application:

- Uniformly apply Type B glass beads to screeded markings at a minimum application rate of 0.30 kg/m^2 immediately after application of the thermoplastic material by a method approved by the Superintendent.
- Apply Type D glass beads at a minimum application rate of 0.50 kg/m^2.

Field testing

Thickness of thermoplastic material: Check the thickness of the cold film of thermoplastic material applied to the road pavement by measurement, using a vernier or suitable dry film thickness gauge. Measure the thickness of the thermoplastic material applied to a metal test plate and take the mean of at least six readings distributed over the test area.

Glass beads application rate: Check the application rate of glass beads applied to the surface of the markings by the method described in **Annexure A.** This is a **WITNESS POINT**.

4.6 TWO PART COLD APPLIED PAVEMENT MARKING

Apply primer: If the surface is concrete or is smooth or polished or where recommended by the manufacturer. Apply to the manufacturer's recommendations
Uniformly apply anti-skid material and glass beads onto the two part cold applied material while fluid and immediately after it has been applied to the pavement.
Separate bead applications: For longitudinal lines.
Method: Must ensure the retention of the beads in the material.
Application rate: As specified in the following table:

Table Application rates – two part cold applied pavement materials and glass beads

Material	**Longitudinal Linemarking**	**Transverse lines and other markings**	
	Sprayed application	**Trowelled, screeded or extruded**	**Sprayed**
Cold applied material thickness (excluding surface applied beads)	0.5 ± 0.05 mm (wet)	2.0 ± 0.2 mm (dry)	1.00 ± 0.1 mm (wet)
Completed marking thickness			2.0 ± 0.2 mm
Surface applied glass beads *: - Type (AS/NZS 2009) - Rate retained in the painted surface	Type D-HR (adhesive coated) ≥ 400 g/m^2	Type B ≥ 300 g/m^2	Type B ≥ 300 g/m^2
1.0 – 2.0 mm anti-skid material	≥ 200 g/m^2		
0.4-0.7 mm anti-skid material		≥ 200 g/m^2	≥ 200 g/m^2
* Glass beads must be coated with a compatible coupling agent to form an improved adhesive bond with thermoplastic or PMMA (two part cold applied) road marking material.			

Longitudinal lines

Tolerances:

- Setting out: No more than 50 mm from the locations shown on the drawings.
- Lengths: To any applicable local or state requirements and not vary by more than ± 50 mm.
- Widths: ± 5 mm. Negative tolerance of 10 mm is allowable for no more than 5% of the length of line.
- Gap between double lines: ± 10 mm.

Transverse lines

Tolerances:

- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.

Field testing

Verify the thickness of the unbeaded material applied to the road pavement using Test Method RMS T841. This is a **WITNESS POINT**.

4.7 PAVEMENT MARKING TAPE

Application

Application: To conform with the manufacturer's recommendations.
Removal: When directed remove pavement marking tape to conform with the manufacturer's recommendations. This is a **WITNESS POINT**.

4.8 RAISED PAVEMENT MARKERS

Installation

Adhesive preparation: Freshly heat and mix the adhesive to the Manufacturer's instructions. Do not allow the adhesive to cool and do not reheat prior to use.
Application of adhesive: Spread the adhesive uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm.
Adhesion of marker to pavement: Conform to the following:

- Press the raised pavement marker onto the pavement surface in its correct position and rotate slightly until the adhesive is squeezed out around all edges of the marker.
- Do not disturb the raised pavement marker until the adhesive has set. This is a **WITNESS POINT**.

Rough surfaces

Locations: Newly laid coarse sprayed bituminous seals, and where directed by the Superintendent.
Adhesion of marker: Conform to the following:

- Apply an initial pad of adhesive of diameter 20 mm larger than the diameter of the base of the raised pavement marker.
- Apply the adhesive to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level.
- Allow the adhesive pad to set.
- Apply additional adhesive to the pavement, as described above, and then press down the raised pavement marker onto the adhesive pad on the pavement surface to ensure good adhesion.

Tolerances:

- Longitudinal displacement: ± 20 mm.
- Lateral displacement: ± 20 mm.
- Directional: ± 4°.

4.9 REMOVAL OF REDUNDANT MARKINGS

Removal method

General: Conform to the following:

- Remove pavement markings without significant damage to the surface.
- Remove the markings in a 'block type manner, so as to avoid 'ghosted' images.
- Black out of markings only as a temporary measure and complete the removal within 48 hours.
- Submit the method of removal for approval by the Superintendent at least 24 hours before commencement of the work. This is a **HOLD POINT**.

4.10 LIMITS AND TOLERANCES

Application

Summary: The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

Summary of limits and tolerances table

Activity	Limits/Tolerances	Worksection Clause/subclause
Setting out	≤ 50 mm from specified location	**Paint marking**
Longitudinal Lines		
- Length	To any applicable local or state requirements and not vary by more than ± 50 mm.	**Thermoplastic marking and Two part cold applied pavement marking material**
- Width	± 5 mm	**Thermoplastic marking and Two part cold applied pavement marking material**
Transverse lines		
- Length and width	± 10 mm.	**Thermoplastic marking and Two part cold applied pavement marking material**
Arrows, chevrons, painted medians, speed markings etc.	Each dimension ± 50 mm.	**Thermoplastic marking and Two part cold applied pavement marking material**
Application of paint		
- Film thickness	Depends on the beads to be used: For type B beads—minimum 0.2 mm dry film; For type D beads—minimum 0.3 mm dry film	**Pavement marking**
Application of thermoplastic		
- Longitudinal lines—Cold Film Thickness	≥ 1.8 mm, sprayed or extruded.	**Thermoplastic marking**
- Transverse Lines, Symbols, Arrows etc. Cold film thickness	3 mm ± 1 mm, screeded.	**Thermoplastic marking**
Glass beads		
- Volume used in operation	Minimum type B—0.30 kg/m^2 Minimum type D—0.50 kg/m^2	**Pavement marking**
- CAP	**Table Application rates** – Two part cold applied pavement materials and glass beads	**Two part cold applied pavement marking**

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

General

Payments made to the Schedule of Rates: To *0152 Schedule of rates – supply projects* all activities associated with completing the work detailed in this Worksection on a schedule of rates basis in accordance with **Pay Items 11911.1** to **1191.6**.

Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology

The following methodology will be applied for measurement and payment:

- No additional payment is to be made for maintenance and replacement of pavement markers in accordance with **Maintenance of pavement markings**.
- Provision for traffic is measured and paid in accordance with this worksection and not *1101 Control of traffic*.

5.2 PAY ITEMS

Pay items	Unit of measurement	Schedule rate scope
1191.1 Pavement marking paint—longitudinal lines	Line pattern km (including any gaps) Calculate the area from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.	All costs associated with the setting out of the work, paint and beads and traffic control.
1191.2 Pavement marking paint—Transverse lines, symbols, legends, arrows, chevrons, traffic islands and kerbs -1191.2(1) Transverse lines -1191.2(2) Arrow -1191.2(3) Symbols -1191.2(4) Chevrons -1191.2(5) Kerbs -1191.2(6) Traffic Islands -1191.2(7) Legends	 Linear metres Each Each m² m m² Each or m²	Determine the extent of the painted surface by direct measurement of the markings as applied. All costs associated with the setting out of the work, all material, supply and application and traffic control.
1191.3 Thermoplastic (or cold Applied Plastics) pavement marking material—Longitudinal lines	Line pattern km (including any gaps) Calculate the area from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.	All costs associated with the setting out of the work, tack coating, supply and application of thermoplastic material and beads and provision for traffic.
1191.4 Thermoplastic (or cold Applied Plastics) pavement marking material - transverse lines, symbols, legends and arrows -1191.4(1) Transverse lines -1191.4(2) Arrow -1191.4(3) Symbols -1191.4(4) Chevrons -1191.4(5) Kerbs -1191.4(6) Traffic Islands -1191.4(7) Legends	 Linear metres Each Each m² m m² Each or m²	Determine the extent of the thermoplastic material applied by direct measurement of the markings as applied. All costs associated with the setting out of the work, tack coating, supply and installation of all material and the provision for traffic.
1191.5 Raised pavement markers (all applications)	'Each' raised pavement marker installed	All costs associated with the

Pay items	Unit of measurement	Schedule rate scope
		setting out of the work, supply and installation of all material and provision for traffic.
1191.6 Removal of pavement markings	m²	All costs associated with removal and disposal.

6 ANNEXURE A

6.1 GLASS BEADS

Types of glass beads

Type A beads (premix): Type A beads are mixed into road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking. Mix these beads at a rate of not less than 30% by mass.

Type B beads (drop-on): Type B glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

Smooth substrate: Apply on a smooth substrate.

Application: A nominal rate of 270–300 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher application rate to achieve the required level of retroreflectivity.

Coated: These beads have a moisture-proof coating to facilitate flow and reduce the risk of ‘caking’’

Type C beads (intermix): Type C beads are mixed into thermoplastic road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking.

Mix: Intermix these beads at a rate of not less than 20% by mass.

Type C: Type C beads may also be used for surface applications to a wet film of pavement marking to provide initial retroreflectivity. Apply on a smooth substrate. A nominal rate of 350 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity. These beads are not moisture-proof coated, and, if used for surface applications, could ‘cake’ during handling.

Type D beads (large wet-weather beads): Type D glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

Substrate: Apply on a smooth substrate.

Application: A nominal rate of 500 g/m^2 may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity.

Coating: These beads have no moisture-proof coating and are, therefore, also suitable for intermixing into thermoplastic road-marking material to provide retroreflectivity in both dry and wet conditions, throughout the life of the marking. Intermix at a rate of not less than 20% by mass.

Measurement of application rate of spherical glass beads

Scope: Adopt the following procedure for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

Spherical glass beads: To AS/NZS 2009.

Measurement: Use the following method of field measurement:

- Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.
- Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level, but do not compact, the glass beads in the cylinder.
- Compare the volume of glass beads collected with the correct figure given in **Volume of glass beads (ml) required in 10 seconds of operation table**.

Volume required for 0.30 kg/m^2: The **Volume of glass beads (ml) required in 10 seconds of operation table** shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kg/m^2 for different line widths and road speeds.

Volume required for 0.30 kg/m^2: The glass bead volume figures given in the **Volume of glass beads (ml) required in 10 seconds of operation table** are calculated for an actual application rate of 0.34 kg/m^2 . These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line and the volume is measured with beads not compacted.

Volume required for 0.50 kg/m^2: For the calibration of application rates to suit type D beads, alter the **Volume of glass beads (ml) required in 10 seconds of operation table** to 0.50 kg/m^2 .

Volume of glass beads (ml) required in 10 seconds of operation table

Road speed (km/h)	**Line widths**				
	80 mm	**100 mm**	**120 mm**	**150 mm**	**200 mm**
8	396	495	594	742	990
13	643	804	965	1207	1698
16	791	990	1188	1484	1484

Notes:
1 Tolerance of + 10% is be permissible when measuring the above volume.
2 When two or more glass bead dispensers are to be used, each dispenser is be checked separately to make up the totals shown.
3 Glass beads weigh approximately 1.53 g/ml.