# PAVEMENT MARKING

DIPL Roadworks Master – July 2023

## Standards and Publications

Conform to the following Standards and Publications unless specified otherwise:

**AUSTRALIAN STANDARDS**

| **Table – Australian Standards** | |
| --- | --- |
| Use Standards, and their amendments, current as at the date for the close of tenders except where different editions and/or amendments are required by statutory authorities, including, but not limited to, NATA and the National Construction Code including the Building Code of Australia. | |
| **Designation** | **Title** |
| AS/NZS 1580(series) | Paints and related materials - Methods of test |
| AS/NZS 1580.205.4 | * Application properties - Airless spraying |
| AS 1742(series) | Manual of uniform traffic control devices |
| AS 1742.3 | * Traffic control for works on roads |
| AS 1744 | Standard alphabets for road signs |
| AS 1906(series) | Retroreflective materials and devices for road traffic control purposes |
| AS 1906.1 | * Retroreflective sheeting |
| AS/NZS 1906.3 | * Raised pavement markers (retroreflective and non-retroreflective) |
| AS/NZS 2009 | Glass beads for road marking materials |
| AS/NZS 2310 | Glossary of paint and painting terms |
| AS/NZS 2433 | Plastics - Method for exposure to ultraviolet lamps |
| AS 2700 | Colour standards for general purposes |
| AS 2890 (series) | Parking facilities |
| AS/NZS 2890.1 | * Off-street car parking |
| AS 2890.2 | * Off-street commercial vehicles facilities |
| AS 2890.3 | * Bicycle parking |
| AS 2890.5 | * On-street parking |
| AS/NZS 2890.6 | * Off-street parking for people with disabilities |
| AS 4049(series) | Paints and related materials – Pavement marking materials |
| AS 4049.1 | * Solvent-borne paint – For use with surface applied glass beads |
| AS 4049.2 | * Thermoplastic road marking materials - For use with surface applied glass beads |
| AS/NZS 4049.3 | * Waterborne paint - For use with surface applied glass beads |
| AS/NZS 4049.4 | * High performance pavement marking systems. |
| AS 4049.5 | * Performance assessment of pavement markings |

**APAS SPECIFICATIONS**

APAS AP-S0041/2 Pavement marking paint, solvent-borne

APAS AP-S0041/3 Pavement marking paint, cold applied plastic

APAS AP-S0041/4 Pavement marking paint, thermoplastic

APAS AP-S0041/5 Pavement marking paint, water borne

APAS AP-S0041/6 Airport runway markings

APAS AP-S0042 Glass beads for pavement marking paint

**TEST METHODS**

NTTM 401.1 Operation of wet film thickness comb

NTTM 402.1 Field procedure for measurement of the rate of application of spherical glass beads

NTTM 405.1 Certification of pavement line marking apparatus

**CIVIL STANDARD DRAWINGS**

CS 3400 Line marking

CS 3401 Pavement markings – Chevrons and raised retroreflective pavement markers – Sheet 1

CS 3402 Pavement markings – Chevrons and raised retroreflective pavement markers – Sheet 2

CS 3403 Edge line with audio-tactile ribs

## Definitions

| **Table – Definitions** | |
| --- | --- |
| **TERM** | **DEFINITION** |
| **AADT** | Annual Average Daily Traffic |
| **ATLM** | Audio Tactile Line Marking. |
| **APAS** | Australian Paint Approvals Scheme. |
| **Approved** | Approved by the Superintendent |
| **CS** | Civil Standard drawings. Use the most recent version. These are accessible via |
| <https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/standard-drawings> |
| **CSR** | Contractor Service Report |
| **GPS** | Global Positioning System |
| **Longlife Materials** | Generally thermoplastic, cold applied plastic or pliant polymer materials, with lifespans between 2 to 5 times that of waterborne paint. |
| **Longitudinal Lines** | Any line which runs parallel to the road centre line, e.g. broken line, edge line, separation line, barrier line. |
| **NTMTM** | NT Materials Testing Manual accessible via |
| [https://dipl.nt.gov.au/industry/technical-standards-guidelines-and-specifications/materials-testing-manual](https://transport.nt.gov.au/infrastructure/technical-standards-guidelines-and-specifications/materials-testing-manual). |
| **NTTM** | NT Test Methods, found in NT Materials Testing Manual. |
| **Other Markings** | All diagonal lines, chevron markings and messages on the pavement, including symbols, words, numerals, arrows and kerb markings. |
| **PCCP** | Painting Contractors Certification Program. |
| **PRP** | Permanent Reference Point |
| **Retroreflectivity** | The reflectivity provided by glass beads expressed as minicandela per lux per square metre (mcd/lux/m2) as measured by a reflectometer approved by the Superintendent. |
| **RRPM** | Raised retroreflective pavement marker. |
| **Rural** | Rural areas are areas not defined as urban. |
| **Traffic Control Device** | Any sign, signal, pavement marking or other installation placed or erected for the purpose of regulating, warning, guiding or providing for the safety of road users. It does not include temporary warning devices and control measures erected only for the construction period. |
| **Transverse Markings** | Any line which is at right angles to the centre line of the road, e.g. stop line, hold line, pedestrian cross walk. |
| **Type B-HR** | Highly retroreflective spherical glass beads of Type B to AS/NZS 2009 |
| **Type D-HR** | Highly retroreflective spherical glass beads of Type D to AS/NZS 2009 |
| **Urban** | Urban area for Darwin region is nominated as – North of Cox Peninsula Road (Stuart Highway), West of Trippe Road (Arnhem Highway) and the end of seal on Gunn Point Road. Other urban areas are nominated as being within, and extending to, town boundaries. |

## Scope

This section specifies the materials, testing and standards of workmanship for marking of pavements.

Pavement Marking treatments include, but are not limited to:

* Traffic control
* Set out of pavement markings to Australian and Northern Territory Standards
* Painting of Markings with waterborne and cold applied paints
* Installation and removal of raised reflective pavement markers
* Removal and disposal of temporary pavement markers
* Remarking of aerodromes (if applicable)

## Contractor Accreditation

All pavement marking work shall be carried out by a contractor accredited to the “Painting Contractor Certification Program” (PCCP) in a class or category applicable to the work. The PCCP is administered by the CSIRO. Information regarding the PCCP can be obtained via <http://www.apas.gov.au/>*.*

The Superintendent may give an exemption for this clause for airstrip reseals, small quantity work, or unusual circumstances.

## Pavement Marking Paint – hold point

Use approved water based white pavement marking paint conforming to APAS AP-S0041/5 and suitable for application by spray equipment in accordance with Test Method AS/NZS 1580.205.4 to asphalt and bituminous seal road surfaces and for use with Type B HR and/or Type D HR drop-on spherical glass beads.

**Hold Point** - Submit Certificates of Compliance, issued by an accredited testing authority, stating that all paints being used comply with the relevant Australian Standards and/or APAS specifications.

Pavement marking paint colours:

The standards for pavement marking paint colours are:

* White pavement marking paint must have a white colour to AS 2700,
* Yellow pavement marking paint must have a golden yellow colour to AS 2700,
* Black pavement marking paint must have a black colour to AS 2700.

White pavement marking paint with an off-white colour to AS 2700 may be accepted by the Superintendent.

Pavement marking paint is acceptable for remarking aerodromes.

## Glass Beads – hold point

Use glass beads conforming to AS/NZS 2009 and APAS specification AP-S0042

**Hold Point** - Submit Certificates of Compliance, issued by an accredited testing authority, stating that the glass beads being used comply with, the relevant Australian Standards and APAS specifications.

**In urban areas** use**:** Type B-HR for initial new works application

Type D-HR beads for subsequent remark and all remarking works

**In rural areas** use: Type B-HR beads for initial new works application

Type B-HR beads for subsequent remark and all remarking works.

Refer to ***Table – Application Times – All Longitudinal and Transverse Pavement Markings***

## Pavement Marking Setting out

The location of all pavement markings on new surfaces, including reflective raised pavement markers, shall be set out by spotting with paint or other approved method prior to application of the markings.

Ensure the distance between the centre line of the marking and the centre line of the set out mark is less than 30 mm. The apparent line of the markings is a smooth continuous alignment when viewed in the direction of the line.

**Roads New work**: Set out line marking to the line pattern specified in accordance with AS 1742 and the Standard Drawings for Line Marking CS 3400, CS 3401, CS 3402, and CS 3403, including the setting out of arrows, letters, numerals and chevrons and RRPMs.

**Aerodromes New work**: Set out pavement marking to the line pattern specified in accordance with the specification drawing for Aerodrome Pavement Marking, and in accordance with the Manual of Standards Part 139— Aerodromes Chapter 8: Visual Aids Provided by Aerodrome Markings, Markers, Signals and Signs

The Superintendent will supply the design drawings for aerodromes when the work order is issued.

**Existing Pavement Markings (including aerodromes)**

Remark along the line of the existing line marking as per ***Table – Dimensional Tolerances of Pavement Markings.***

## Pavement Marking Application – Witness Point

Apply the marking materials using a self‑propelled mobile sprayer, hand sprayer, hand painting or hand screeding as directed by the Superintendent

**Witness Point** - Obtain approval from the Superintendent for the type of equipment to be used for applying pavement marking materials.

**Witness Point** - Produce documented evidence to show that the spraying equipment has been calibrated in accordance with PCCP requirements and is certified by PCCP as being suitable for the works to be carried out under this contract.

**Witness Point**: Obtain Superintendent’s approval for variation to any of the above requirements.

**Substrate:** Ensure that the pavement surface is free from dirt, loose detritus, mud and other extraneous matter, and is dry before and after painting operations

Protect all applications from traffic until the binder has hardened sufficiently to retain the glass beads.

Produce markings so that they are straight, with smooth even curves where necessary. Remove any marking material beyond the defined marking leaving a neat and smooth marking on the pavement.

Produce markings free from ghosting and raggedness on the sides and ends and parallel with the general alignment of the carriageway with the lines level, uniform and free from streaks.

Reinstate pavement markings that are damaged by traffic during paint drying time and remove all tyre pickup marks.

### Longitudinal Application

Apply the marking materials using a self‑propelled mobile sprayer having a minimum capacity of 200 litres of paint.

Apply paint evenly to the pavement surface at the specified film thicknesses and immediately after apply an even application of glass beads at the specified rates.

On all new work, apply one coat of paint and glass beads to the pavement in the direction of traffic flow.

For remarking, apply one coat of paint and glass beads to the pavement surface in the direction of traffic flow.

### Transverse and Other Marking Applications

Apply the marking materials using a self-propelled or hand sprayer with a capacity of 20 litres of paint or a different capacity as directed by the Superintendent.

Apply paint evenly to the pavement surface to the specified film thickness and immediately after apply an even application of glass beads at the specified rates.

### Markings on Concrete Pavement

Prime the concrete pavement surface with an approved primer before applying markings. Allow sufficient time for primer to cure to manufacturer’s recommendations before applying markings.

### Glass Beads

Apply glass beads by low pressure or delivered by gravity dispenser, D-HR beads may require application by static drop method in conjunction with air pressures to retain beads.

Maximum application speed for glass beads shall be as per manufacturer’s recommendations.

The application rates specified for glass beads are the amounts that are retained in the painted surface after three weeks of trafficking.

Ensure that the loss in glass beads after three weeks traffic does not exceed ten per cent of total applied.

## Pavement Marking CONFORMANCE ToleranceS – HOLD POINT

**Hold Point** – Provide evidence that the pavement marking complies with the requirements of this specification.

Pavement marking for road and aerodrome work shall conform to the following tables:

* ***Table – Application Rates – All Longitudinal and Transverse Pavement Markings***
* ***Table – Application Times – All Longitudinal and Transverse Pavement Markings***
* ***Table – Dimensional Tolerances for Pavement Marking*s**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table – Application Rates – All Longitudinal and Transverse Pavement Markings** | | | | | |
| **Location** | **Works** | **Wet film paint thickness** | **Dry film paint thickness** | **Glass beads type** | **Rate of glass beads to be retained** |
| URBAN | Initial marking | > 0.360 mm | > 0.230 mm | B-HR | > 300g/m2 |
| Remarking | > 0.515 mm | > 0.330 mm | D-HR | > 400g/m2 |
| RURAL | Initial marking | > 0.360 mm | > 0.230 mm | B-HR | > 300g/m2 |
| Remarking | > 0.360 mm | > 0.230 mm | B-HR | > 300g/m2 |
| AERODROMES | Initial marking | > 0.360 mm | > 0.230 mm | Not required | > 300g/m2 |
| Remarking | > 0.360 mm | > 0.230 mm | Not required | > 300g/m2 |
| **Note:** Paint film thickness tolerances exclude surface applied glass beads. | | | | | |

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| --- | --- | --- | --- | --- |
| **Table – Application Times – All Longitudinal and Transverse Pavement Markings** | | | | |
| **Location** | | **Works** | **Longitudinal markings** | **Transverse markings** |
| URBAN | New Pavement Marking | Initial marking | Before opening of works to traffic | Before opening of works to traffic |
| Resurfacing and/or resealing | Within 2 days | Hold lines – 1 day. Other lines within 2 days |
| Remarking | 9 months maximum | 9 months maximum |
| RURAL | New Pavement Marking | Initial marking | Before opening of works to traffic | Before opening of works to traffic |
| Resurfacing and/or resealing | Within 21 days | Within 21 days |
| Resurfacing and/or resealing - Overtaking lanes | Within 5 days | Within 5 days |
| Remarking | 3 to 6 months | 3 to 6 months |
| AERODROMES | | Resurfacing and/or resealing | Before opening of Aerodrome to aircraft traffic. To be as per the project drawings. | Before opening of Aerodrome to aircraft traffic. To be as per the project drawings. |
| Remarking | Before opening of Aerodrome to aircraft. To be as per the project drawings. | Perform works at night. |

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| --- | --- | --- |
| **Table – Dimensional Tolerances for Pavement Markings** | | |
| **Properties** | **Tolerances** | |
| **New work** | **Remarking work** |
| If no tolerance is explicitly stated for an attribute of the works the tolerance is zero. | | |
| **Locations other than Aerodromes** | | |
| Locations of centrelines of markings | < 20 mm from locations as shown on drawings | +/- 5 mm |
| Widths of lines | +/- 5 mm | +/- 10 mm |
| Lengths of lines | +/- 50 mm | +/- 100 mm |
| Locations of arrows, chevrons, letters, numerals | +/- 50 mm | +/- 50 mm |
| Deviation and/or trueness of lines | < 15mm in 2 metres | < 15mm in 2 metres |
| **Aerodromes** | To MOS Part 139, Chapter 8 | |

## Field Testing

The Department, at the Superintendent’s discretion, will perform on site conformance testing. The Contractor shall assist the testing laboratory with sampling and other requirements of the testing in the field.

**Wet film thickness**: Check the thickness of the wet film applied to the pavement by the method NTTM 401.1 - Operation of Wet Film Thickness Comb.

**Glass bead application**: Check the application rate of glass beads to the surface of the marked line by the method NTTM 402.1 - Field Procedure for Measurement of the Rate of Application of Spherical Glass Beads.

**Wear assessment limits**: The degree of wear is defined as the area of pavement marking remaining after a period of time, relative to the initial area of the pavement marking.

**Degree of wear**: At the Superintendent’s discretion determine the degree of wear using Image Analysis in accordance with AS 4049.3:2005 Appendix K, Method A, Photographic Method.

Wear limits for pavement marking: 95% intact area after six months.

Remark pavement marking that does not conform to the specified limits, including the costs of all testing, at no cost to the Principal.

## Cold Applied plastic Materials – HOLD POINT – WITNESS POINT

Use approved plastic pavement marking materials to APAS AP-S0041/3 Cold applied plastic.

**Hold Point:** Approval from Project Director Civil Asset Management is required before cold applied plastic materials are used.

**Witness Point** - Provide evidence that all proprietary products such as epoxy or plastic products have demonstrated satisfactory field performance for a period of at least three years.

**Material** - Generally: A two part Poly Methyl Methacrylate resin based pavement marking material that complies with the requirements for colour, luminance and bead content of AS 4049.2, and which complies with AS 4049.4, sprayed or screeded onto the pavement, containing pre-mixed glass beads, with additional drop-on beads being added during application, conforming with the following requirements of AS 4049.2: Clause 5.1 – Colour, Clause 5.2 - Luminance and Clause 7 - Field Testing. The material shall have a maximum no-pick-up time of 60 minutes.

Do not use cold applied plastic materials on new asphalt works.

## Audio Tactile Line Marking (ATLM) – Hold Point

**Hold Point:** Approval from Project Director Civil Asset Management is required before audio tactile line marking materials are used.

Use cold applied plastic pavement marking materials.

### Site Preparation

The area to be marked is to be dry and free of dirt, gravel, oil and other loose or foreign material to ensure the best possible adhesion of new material. Remove existing paint or other material which is flaking or chipped. Cleaning may be carried out by brooming, blowing or washing.

Use a tack coat or primer material for surface or other conditions requiring it in accordance with the Manufacturer’s Specification to ensure satisfactory adhesion of the material.

### Application

Apply by extrusion methods, including application of glass beads and anti-skid material, in a single uniform layer.

For longitudinal lines and transverse markings, apply material at a rate to achieve a minimum final tolerances and dimensions as stated in drawing CS 3403.

Glass beads that are to be mixed in are to be Class C (intermix 20 to 30 % by mass).

Additional Type B-HR beads shall be uniformly applied to the surface of thermoplastic at the rate of > 300g/m2 (retained) as part of the application process and before the material has commenced to set.

The marking produced shall be uniform in texture, width and thickness and the surface substantially free from blisters, streaks, lumps and other defects.

Remove any occurrence of overspray, gun dribble and defective ribs.

Audio tactile line marking tolerances must conform to ***Table - Audio Tactile Line Marking Tolerances*** and to civil standard drawing CS 3403.

|  |  |  |
| --- | --- | --- |
| ***Table - Audio Tactile Line Marking Tolerances*** | | |
| **Aspect** | **Dimension** | **Tolerance (mm)** |
| Length of raised rib | 150 mm | +/- 10 mm |
| Width of raised rib | 50 mm | +/- 10 mm |
| Height of raised rib | 12 mm | + 1 mm |
| Spacing of raised rib | 250 mm | +/- 20 mm |

### Retro-reflectivity

When tested in accordance with AS 4049.2:2005 Appendix K marking must achieve a minimum level of reflectivity of 350 mcd/lux/m2 at time of application.

## Raised Retroreflective Pavement Markers (Rrpms)

### Raised Reflective Pavement Markers – Hold Point

Use raised reflective pavement markers conforming to AS 1906 Retroreflective materials and devices for road traffic control purposes

**Hold Point:** Submit details in relation the manufacturer’s warranties, performance, durability and maintenance of the raised retroreflective pavement markers

Provide raised retroreflective pavement markers with the following attributes:

|  |  |
| --- | --- |
| **Table – Raised Retroreflective Pavement Markers Dimensions** | |
| **Aspect** | **Dimension** |
| Height (above pavement level when installed) | 18 – 25 mm |
| Width at right angles to the direction of the traffic | 110 – 130 mm |
| Length parallel to the direction of the traffic | 80 – 110 mm |

### Materials

Use markers fixed to the pavement surface as recommended by the manufacturer of the marker.

Use adhesives as recommended by the manufacturer.

Use adhesives within the time recommended by the adhesive manufacturer.

### Pavement Preparation

Clean the pavement.

Ensure each RRPM site is free of dirt, oil, grease, paint and any other material that would affect the bond of adhesive to the pavement.

Abrasive blast, chip, or burn pavements that cannot be cleaned by sweeping.

Do not place markers if moisture is present. Ensure pavement is dry before applying markers.

### Placing Markers

Place markers in accordance with AS 1742.2 and Standard Drawings CS 3401, CS 3402.

Place the reflectors to face the oncoming traffic.

Do not obscure the reflective faces by adhesive.

Ensure that the surface finish is smooth.

Discard markers which are not positioned correctly within the time recommended by the manufacturer for use of the adhesive. Remove stale adhesive from the pavement surface.

Do not place markers over joints in concrete pavement.

Wear limits for pavement markers: 95% intact area after six months.

Replace markers that have dislodged within 12 months of installation.

## Removal of pavement Markings – Hold Point

**Hold Point –** Obtain approval from the Superintendent on the proposed method used for pavement marking removal before commencing removal operations.

Removal of pavement marking must not adversely affect the integrity of the pavement surface.

When longitudinal and transverse lines are removed, the marks left on the pavement surface must not confuse the motorist with ghosting or incorrect directions. Where removal is outside of 100 mm of the existing lines then the entire width of the lane is to be consistent with the line removal texture.

When arrows, letters or figures are to be removed or temporarily blacked out, the removal pattern must be in the shape of a rectangle or square to minimise confusion to the motorists.

Remove all materials and debris from removal operations and dispose at an authorised legal disposal site. Repair any surface defect caused by the removal process at no additional cost to the Principal.

The following methods may be considered and will be dependent on the type of surface, extent and application.

### Resealing and asphalting

Spray sealing and or Asphalt replacement is the preferred method for replacement. Determination of materials shall be in accordance with existing materials.

Where this method is used the reworking needs to be for the full width of the pavement.

### Sandblasting or water blasting

This methodology is the preferred method for marking removal on asphalt and concrete surfaces.

Use a skirt or guard around the blaster to minimise the spraying of material away from the immediate work area.

Remove waste material before it can be transported by rain, wind or traffic. This will generally require the use of a vacuum attachment operating concurrently with the blasting operation or alternative method approved by the Superintendent.

### Machine Grinding

This method may be considered for use on smaller removal jobs where surface finish is not a concern. It can be used on most asphalt and concrete surfaces.

### Paint Blackout – Hold Point

Paint blackout may be considered as a temporary measure only and must be removed upon completion of the works.

**Hold Point** – Obtain Superintendent’s approval before using this methodology.

### Other Methods

Other methods such as heat lance or paint stripping may also be considered by the Superintendent.

### Raised Retroreflective Pavement Marker Removal

Where required, remove raised retroreflective pavement markers by breaking the bond between the adhesive, the pavement surface and the base of the raised retroreflective pavement marker.

Repair all divots caused by the removal of raised retroreflective pavement markers with hot melt adhesive or epoxy adhesive to the level of the surrounding pavement.