



Construction Specification for Civil Works

C261 - Pavement Markings

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ORIGIN OF DOCUMENT, COPYRIGHT

This document was originally based on AUS-SPEC - Development Construction Specification C261 - Pavement Markings. Substantial parts of the original AUS-SPEC document have been deleted and replaced in the production of this Armidale Regional Council Specification for Civil Works. The parts of the AUS-SPEC document that remain are still subject to the original copyright.

This document has been developed for use with the construction of civil works within the Armidale Regional Council local government area.

This is not a controlled document. A full copy of the latest version of this document can be found on the Armidale Regional Council Internet website: <https://www.armidaleregional.nsw.gov.au/development/planning-controls-guidelines/construction-specifications/construction-specifications>

REVISIONS: C261 - PAVEMENT MARKINGS

REVISION	CLAUSES AMENDED	AMENDMENT DETAILS	DATE
0		Original Issue	25/09/2023

GENERAL

C261.01 SCOPE

This Specification is for the setting out, supply and application of pavement marking paint, thermoplastic pavement marking material and raised pavement markers as shown on the approved design drawings.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B9*.

Quality

C261.02 DEFINITIONS

The Works – Defined as follows:

The Works

- **Developer Infrastructure Works** - work includes subdivisions and any public infrastructure work associated with an approved Development in the ARC local government area requiring a construction certificate.
- **Contracted Works** – infrastructure work undertaken by a Principal Contractor or subcontractor formally appointed by ARC and supervised by ARC.
- **Internal Works** - infrastructure work undertaken by ARC’s day labour workforce.

Constructor – Defined as the organisation responsible for construction of the Works and the Principal Contractor as defined in the *Work Health and Safety Act 2011*.

Constructor

ARC Representative – Defined as follows:

ARC Representative

- **Developer Infrastructure Works** – Nominated ARC officer(s) for the approved Development.
- **For Contracted Works** – the Superintendent.
- **For Internal Works** – ARC Asset Owner.

Constructor’s Representative – Defined as follows:

Constructor’s Representative

- **Contracted Works** – the Principal Contractor’s nominated representative as per the relevant contract.
- **Internal Works** – ARC officer responsible for delivery.

Developer’s Representative– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works.

Developer’s Representative

C261.03 REFERENCE DOCUMENTS

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Documents Standards Test Methods

Where not otherwise specified in the relevant Armidale Regional Council (ARC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the ARC Construction Specifications at the time of the Works approval.

Currency

(a) Armidale Regional Council (ARC) Specifications

- C201 - Control of Traffic.
- C244 - Sprayed Bituminous Surfacing.
- C245 - Asphaltic Concrete.
- CQC - Quality Control Requirements

ARC Specifications

(b) Australian Standards

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS. **Australian Standards**

- AS 1580.107.3 - Determination of wet film thickness by gauge.
- AS 1742.2 - Traffic control devices for general use.
- AS 1906.3 - Raised pavement markers (retroreflective and non-retroreflective).
- AS 2009 - Glass beads for road-marking materials.
- AS 2700S - Colour standards for general purposes.
- AS 4049.1 - Solvent-borne paint - For use with drop-on beads.
- AS 4049.2 - Thermoplastic road marking materials.
- AS 4049.3 - Waterborne paint - For use with drop-on beads.

(c) Transport for NSW (TfNSW) Publications

- TfNSW QA Specification 3359 - Profile Thermoplastic Roadmarking Material. **TfNSW Publications**
- TfNSW QA Specification 3360 - Two Part Cold Applied Roadmarking Material.
- TfNSW QA Specification 3353 - Glass Beads (For Application to Road Marking Materials)
- TfNSW QA Specification 3354 - Adhesives for Raised Pavement Marker Installation.
- TfNSW Supplement to Australian Standard AS 1742.2.
- RMS Delineation Guide.

(d) Other Publications

- ARC Engineering Design Code **Other Publications**

C261.04 TYPE OF MARKINGS

Details of the various types of pavement markings and devices are generally in accordance with the requirements of AS 1742.2. **Standard**

C261.05 TYPES OF MATERIALS TO BE APPLIED

The materials shall be applied as follows: **Locations for Use**

- (a) Pavement Marking Paint**
Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified.
- (b) Thermoplastic Pavement Marking Material**
Permanent markings where explicitly indicated on the approved design drawings.
- (c) Reflective Glass Beads**
To be applied to all painted and thermoplastic markings.
- (d) Raised Pavement Markers**
To be installed as permanent and temporary markings as shown on the approved design drawings.

C261.06 MATERIAL QUALITY

The Constructor shall submit to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) sufficient evidence that the materials meet the quality requirements, including paint, glass beads, raised pavement markers and thermoplastic material (refer Hold Points). **Constructor's Responsibility**

Only materials conforming to the requirements of the referenced Specifications and Standards shall be used.

Quality Requirements

C261.07 SETTING OUT

The Constructor shall set out the work to ensure that all markings are placed in accordance with the approved design drawings. Setting out lines are to be covered by the permanent marking so it is not visible once completed.

Constructor's Responsibility

The locations of pavement markings shall not vary by more than 20mm from the locations shown on the approved design drawings. Where new pavement markings require a taper to transition to existing pavement markings, a minimum taper length of 15:1 shall be adopted.

Tolerance

C261.08 SURFACE PREPARATION

Pavement markings shall only be applied to clean dry surfaces. The Constructor shall clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement. The surface shall be free of aggregate, dirt, gravel and any other material that may compromise adhesion.

Clean Dry Surface

Pavement marking shall not be carried out during wet weather or, if in the opinion of the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works), rain is likely to fall during, or immediately after, the process.

Wet Weather

Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled to remove fine mortar material (laitance).

Scabbling

C261.09 PROVISION FOR TRAFFIC AND PROTECTION OF WORK

The Constructor shall provide for traffic, in accordance with *C201 - Control of Traffic*, while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage.

Constructor's Responsibility

C261.10 MAINTENANCE OF PAVEMENT MARKINGS

The Constructor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement marking during the duration of the Works and the Security Bond for Contracts and the Maintenance Bond Period for Developer Infrastructure Works.

Maintenance Responsibilities

PAVEMENT MARKING PAINT

C261.11 MATERIALS

Paint shall comply with the requirements of *AS 4049.1* or *AS 4049.3*. In this Specification, the term 'paint' shall mean 'pavement marking paint'.

Paint Quality

Glass beads shall comply with the requirements of *AS 2009* for drop-on beads.

Glass Beads Quality`

The nominated paint colours shall comply with the following reference colours in accordance with *AS 2700S*:

Colour

- White: Y35
- Yellow: Y14
- Red: R62

C261.12 MIXING OF PAINT

All paint shall be thoroughly mixed in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product.

Uniform Product

C261.13 APPLICATION OF PAINT AND BEADS

All longitudinal lines shall be sprayed by an approved self-propelled machine. The two sets of lines forming a one-way or two-way barrier line pattern shall be sprayed concurrently.

Longitudinal Lines

Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.

Hand Spraying

The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.30 mm nor more than 0.40 mm.

Paint Thickness

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 0.30kg/m² immediately after application of the paint prior to a skin forming. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

Beads for Longitudinal Lines

Glass beads shall be similarly applied to all other paint markings at a net application rate of 0.30kg/m² immediately after application of the paint.

Beads for other Markings

Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement.

Pavement Marking Finish

The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown in AS 1742.2. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown in AS 1742.2.

Longitudinal Line Tolerances

The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown in AS 1742.2.

Transverse Line Tolerance

The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 50mm from the dimensions shown on the design plans or in AS 1742.2 as appropriate. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Arrows, Chevrons Tolerance

Waterborne pavement markings shall be applied in a two stage application process for new Sprayed Bituminous Surfacing. The second coat shall be applied after two months, but before three months after the initial markings are placed.

New Bituminous Surfacing

C261.14 FIELD TESTING

The thickness of the wet film applied to the road pavement shall be checked by the method described in AS 1580.107.3 Method B, comb gauge.

Paint Application

Road Speed (km/h)	Line Widths			
	75mm	100mm	125mm	150mm
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

1. Tolerance of +10% shall be permissible when measuring the above volume.
2. When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53 grams per millilitre (ml).

Table C261.1 - Volume of glass beads (ml) required in 10 seconds of operation

THERMOPLASTIC PAVEMENT MARKING MATERIAL

C261.15 MATERIALS

Thermoplastic pavement marking material shall comply with the requirements of *AS 4049.2* and *TfNSW QA Specification 3359*. ***Thermoplastic Quality***

In this Specification, the term 'thermoplastic material' shall mean 'thermoplastic pavement marking material'. ***Definition***

Glass beads shall be incorporated in thermoplastic material, in the proportion of 10% of the total mass, as part of the aggregate constituent and shall comply with the requirements of *AS 2009*, Intermix type. ***Glass Bead Proportion***

Glass beads for surface application shall comply with the requirements of *AS 2009*, Drop-on beads. ***Glass Bead Quality***

Tack coat material shall be to the manufacturer's specification as approved by the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works). ***Tack Coat***

C261.16 PREPARATION OF THERMOPLASTIC MATERIAL ON SITE

For sprayed applications, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not be heated above the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than six (6) hours for hydrocarbon resins and four (4) hours for wood and gum resins. Should over-heating occur and/or the time expire for molten materials, then the thermoplastic material shall be discarded. ***Heating***

C261.17 APPLICATION OF THERMOPLASTIC MATERIAL AND BEADS

Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the ARC Representative and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material. ***Tack Coat Requirement***

All longitudinal lines shall be sprayed by a self-propelled machine. The two sets of lines forming a one-way or two-way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be greater than 1.8mm. ***Longitudinal Lines***

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 0.40kg/m² immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line. ***Beads for Longitudinal Lines***

All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, with templates to control the pattern. ***Screed***

The thermoplastic material for transverse lines, symbols, legends and arrows shall be applied uniformly and the cold film thickness shall be 3.0mm with a tolerance of plus or minus 1.0mm. The surface finish shall be smooth. ***Tolerance***

Glass beads for other than longitudinal lines shall be uniformly applied to screeded markings at a net application rate of 0.30kg/m² immediately after application of the thermoplastic material by a method approved by the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works). ***Beads for Other Markings***

Pavement marking shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement. ***Pavement Marking Finish***

The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown in AS 1742.2. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown in AS 1742.2.

**Longitudinal
Line
Tolerances**

The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown in AS 1742.2.

**Transverse
Line
Tolerances**

The dimensions of arrows, chevrons, painted medians, painted left turn islands and speed markings shall not vary by more than 50mm from the dimensions shown on the approved design plans or in AS 1742.2 as appropriate. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

**Arrows,
Chevrons,
Tolerance**

C261.18 FIELD TESTING

The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate.

**Thickness of
Thermoplastic
Material**

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in **Annexure C261A**.

**Glass Beads
Application
Rate**

HOLD POINT

The following details shall be submitted to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least ten (10) working days prior to the commencement of pavement marking work:

- Traffic Management Arrangements;
- Materials proposed and evidence of conformance;
- Material application rates; and
- Spray Equipment and work methodologies.

PROCESS HELD: Application of Pavement Markings.

Hold Point

RAISED PAVEMENT MARKERS

C261.19 MATERIALS

Raised pavement markers, both reflective and non-reflective, shall comply with AS 1906.3 and shall have the dimensions shown on the approved design drawings.

Standard

The adhesive used for attaching the raised pavement markers to the wearing surface shall comply with *TfNSW QA Specification 3354*.

**Bitumen
Adhesive**

C261.20 INSTALLATION OF RAISED PAVEMENT MARKERS

For new work, the raised pavement markers shall be installed in accordance with the approved design drawings.

**Adhesive
Quality**

Raised pavement markers shall be fixed to the wearing surface of the pavement using a hot melt bitumen adhesive or an equivalent product. The adhesive shall be freshly heated to the Manufacturer's instructions and thoroughly mixed. The adhesive shall not be allowed to cool and be reheated prior to use.

The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set.

Method

On rough surfaces, such as newly laid coarse sprayed bituminous seals, and where directed by the ARC Representative, an initial pad of adhesive of diameter 20mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level.

Rough Surfaces

The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the pavement, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface to ensure good adhesion.

HOLD POINT

Hold Point

The following details shall be submitted to the ARC Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least ten (10) working days prior to the Installation of Raised Pavement Markers:

- Traffic Management Arrangements.
- Raised Pavement Marker type and conformance.
- Adhesive type and proposed methodology.

PROCESS HELD: Installation of Raised Pavement Markers.

REMOVAL OF PAVEMENT MARKINGS

C261.21 GENERAL

The Constructor shall remove pavement markings and other delineators (i.e. stick and stumps or raised pavement markers), no longer required or incorrectly installed by the Constructor, from the wearing surface of pavements without significant damage to the surface.

Undamaged Pavement

The method of removal shall be permanent. Painting over existing line marking is not permissible.

Removal Method

LIMITS AND TOLERANCES

C261.22 SUMMARY OF LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses of this Specification are summarised in Table C261.2 below:

Item	Activity	Limits/Tolerances	Spec Clause
1	Location of Markings		
	Location of Markings	± 20mm from specified location	C261.07
2	Longitudinal Lines		
	(a) Length	± 20mm from lengths shown in AS 1742.2	C261.13 C261.17
	(b) Width	± 10mm from widths shown in AS 1742.2	C261.13 C261.17
3	Transverse Lines		
	(a) Length (b) Width	± 10mm from lengths and widths shown in AS 1742.2	C261.13 C261.17
4	Arrows, Chevrons, Painted Medians, Speed Markings etc.		
	Arrows, Chevrons, Painted Medians, Speed Markings etc.	± 50mm from the dimensions shown in AS 1742.2	C261.13 C261.176
5	Application of Paint		
	(a) Film Thickness	>0.30mm, <0.40mm	C261.13
6	Application of Thermoplastic		
	(a) Longitudinal Lines - Cold Film Thickness	2.0mm ± 0.5mm	C261.17
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	3.5mm ± 1.5mm	C261.17
7	Glass Beads		
	(a) Volume used for longitudinal lines (Paint)	0.30 kg/m ² + 10%	C261.13
	(b) Volume used for other markings (Paint)	0.30 kg/m ² + 10%	C261.13
	(c) Volume used for longitudinal lines (Thermoplastic)	0.40 kg/m ² + 10%	C261.17
	(d) Volume used for other markings (Thermoplastic)	0.40 kg/m ² + 10%	C261.17

Table C261.2 - Summary of Limits and Tolerances

ANNEXURE C261A - PROCEDURE FOR MEASUREMENT OF RATE OF APPLICATION OF SPHERICAL GLASS BEADS

1. SCOPE

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

2. SPHERICAL GLASS BEADS

The glass beads shall comply with AS 2009.

3. MEASUREMENT

The method of field measurement shall be as follows:

- (a) 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.
- (b) 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.
- (c) Compare the volume of glass beads collected with the correct figure given in Table C261.1.

Table C261.1 shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kilograms per square metre for different line widths and road speeds. The glass bead volume figures given in Table C261.1 are calculated for an actual application rate of 0.34 kilograms per square metre. 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. For the calibration of application rates to suit class D beads, the above table will need to be altered to 0.50kg/m².

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