

Engineering Construction Specification C09 Sprayed bituminous surfacing

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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide sprayed bituminous surfacing for roads and related applications, as documented.

1.1.2 Design

Authority requirements: Design bituminous surfacing in accordance with the procedures contained in the latest update of the AUSTRROADS Sprayed Seal Design Method.

Where directed for Main Roads under the control of the Roads and Maritime Services, design is to be in accordance with the RMS Sprayed Sealing Guide.

1.2 Precedence

1.2.1 General

Schedule of job details: If there are conflicts between the requirements of this worksection and the **ANNEXURE – SCHEDULE OF JOB DETAILS**, the requirements of the **ANNEXURE – SCHEDULE OF JOB DETAILS** apply.

1.3 Cross references

1.3.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C08 Flexible pavement base and subbase*

1.4 Interpretation

1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- ALD: Average least dimension.
- PMB: Polymer modified bitumen.
- v/l/d: Vehicle/lane/day.

1.4.2 Definitions

General: For the purposes of this worksection the definitions in Austroads AP-C087 and those given below apply:

- Adhesion agent: A substance for promoting adhesion between binder and aggregates, normally in the presence of water.
- Average least dimension: The average height of the aggregate particles when they are spread as a single layer with their dimensions vertical.
- Binder: A bituminous material used for waterproofing the surface and holding an aggregate layer to the base.

- Cutter: A light petroleum distillate (e.g. kerosene) added to bitumen to temporarily reduce its viscosity (cutback bitumen).
- Cutback bitumen: Bitumen to which cutter oil (kerosene) has been added to achieve a temporary reduction in viscosity.
- Double/double seal (D/D): A seal consisting of two successive applications of binder each followed by an application of aggregate.
- Flux oil: A petroleum distillate (e.g. diesel) added to bitumen to produce a long-term reduction in viscosity.
- Flaky aggregate is defined as an aggregate particle with a least dimension (thickness) less than 0.6 of the mean of the smallest sieve size through which the particle passes and the largest sieve size on which the particle is retained.
- The flakiness index is defined as the percentage by mass of stones in an aggregate having an ALD of less than 0.6 times their average dimension.
- Geotextile reinforced seal (GRS): An application of a bituminous binder into which both aggregate and geotextile are incorporated to provide a durable wearing surface. A layer of binder is applied first, followed by a layer of geotextile fabric, then a second coat of binder, followed by the aggregate.
- High stress seal or reseal (HSS): A bituminous seal or reseal treatment which may be a single/single or double/double seal, but with a polymer modified binder (PMB) to improve seal performance in areas of high traffic loading and stress.
- Initial seal: An application of a sprayed seal to a prepared basecourse which has not been primed. It is intended to adhere to the base, whilst providing a temporary wearing course for traffic.
- Initial treatment: An application of a prime (prime coat) or initial seal to a prepared basecourse.
- Prime: An application of a primer to a prepared base, without cover aggregate, to provide penetration of the surface, temporary waterproofing and to obtain a bond between the pavement and the subsequent seal or asphalt. It is a preliminary treatment to a more permanent bituminous surfacing.
- Primer (AUS-SPEC): A bituminous material of low viscosity and low surface tension used in priming.
- Primerbinder: A material, more viscous than a primer, and required to act both as a primer and binder, and used in initial sealing.
- Reseal: A sprayed seal applied to an existing sealed, or asphalt surface.
- Residual binder: A binder that remains in services after any volatiles have evaporated.
- Retreatment: An application of a sprayed bituminous treatment on an existing bituminous surfacing.
- Secondary treatment: An application of a sprayed bituminous treatment on an initial treatment.
- Seal: A thin surface layer of bituminous binder into which aggregate is incorporated. A sprayed seal may incorporate more than one application of binder and aggregate and may also be combined with a layer of geotextile fabric.
- Single/double seal: A seal consisting of a single application of binder followed by a double application of aggregate.
- Single/single seal (S/S): A seal consisting of a single application of binder followed by a single application of aggregate.

- Strain alleviating membrane (SAM): A sprayed seal with the binder containing a relatively large concentration of rubber or polymer modifier. It is used to absorb strains that occur in a road pavement and thereby reduce reflection cracking.
- Strain alleviating membrane interlayer (SAMI): The application of a polymer modified binder into which aggregate is incorporated. A SAMI is used as an interlayer between an asphalt wearing course and underlying layers to provide alleviation from tensile strains developed beneath it.

1.5 Submissions

1.5.1 Planning Requirements

Testing: Conform to the following:

- All testing of properties required by the worksection is to be undertaken in a laboratory registered by the National Association of Testing Authorities (NATA) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian Standard or Austroads Manual of Test Procedures.
- Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard or Manual provides a choice of procedures, adopt the method endorsed by the RMS.

Register and Insure Plant: Conform to the following:

- Register and insure all plant as appropriate to its use on a public road. Plant to comply with statutory environmental regulations. This is a HOLD POINT.
- Provide all the plant and equipment and labour necessary for carrying out the work in accordance with this worksection.
- All plant and equipment used on the work is to be suitable and in accordance with the Contractor's submitted quality documentation and kept in good operating condition.
- Do not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent. This is a WITNESS POINT.

Protection of services and road fixtures: Conform to the following:

- Prevent tack coat, binder, aggregate, asphalt or other material used on the work from entering, adhering or obstructing gratings, hydrants, valve boxes, inspection pit covers, access chamber covers, bridge or culvert decks, kerbs and other road fixtures, Including driveways and other types of laybacks running off or near the pavement. Immediately after the asphalt has been spread, clean off or remove any waste material and other unsuitable material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent. Waste material to be taken to licenced facility or otherwise directed by the superintendent.

Notification of work: Conform to the following:

- Before commencing site operations, all affected residents and businesses are to be notified. Such notification shall consist of two parts:
 - Part 1: Written notice delivered at least seven days in advance of proposed work; and Part 2: further written or verbal confirmation delivered not less than 24 hours prior to commencement of work. Such notices shall detail:
 - intended date of commencement
 - duration of project;
 - hours of work
 - name of street(s) affected and limits of work;

- a contact phone number of the site supervisor;
 - description of work;
 - any precautions to be followed by the public.
- A sample of proposed written notification for residents and businesses shall be submitted to the Superintendent for approval prior to use.

Control of Traffic: Conform to the following:

- Provision for traffic: Provide for traffic in accordance with C03 Control of traffic while undertaking the work.
- Take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users.

1.5.2 Execution details

Sprayed seal design: Submit evidence that the seal design conforms to Austroads AGPT04K clause 4 for the following:

- Seal type and grade selection.
- Binder application rates and aggregate spread rate for the required seal treatment type.

1.5.3 Products and materials

Mix design: Submit details of the following:

- Type and source of constituent materials: Including for aggregates and binders.
- Proportions of constituent materials used: Including binders, bituminous emulsion content, adhesion agents and additives).
- The combined aggregate particle size distribution as a single grading (not a range).
- Nominal size of the design mix.
- Application rate litres/m² of sealed road surface at minimum 15 °C.
- Test certificates: Submit evidence of conformance from a NATA accredited laboratory (for the required test method) for each constituent material (aggregates/mineral fillers/binders/additives) including any previous documented conformance and performance and including the following:
 - Aggregates: Quality and grading.
 - Blended aggregates: Proportions of the various sizes, including coarse aggregates.

Sprayed seal treatment type: Submit evidence of conformance to **ANNEXURE – SCHEDULE OF JOB DETAILS** or drawings.

Bituminous materials: Submit evidence of conformance to **MATERIALS**.

- Evidence of previous satisfactory performance, if applicable.

Aggregates: Submit details of material source and evidence of conformance to AS 2758.2.

Bitumen binder: Submit of cutter oil content required.

1.5.4 Records

Machinery and equipment: Submit evidence that spray machinery and other road plants are registered and insured.

Ambient condition before spraying: Submit record of pavement temperature, air temperature and weather conditions during the course of the work.

Drawings: Submit work-as-executed drawings and other documents with details of the extent and condition of final works.

Spraying details: Submit the following:

- Sprayer certificate.
- Binder spraying temperature.
- Work record for each sprayer run.

1.5.5 Tests

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES.**

1.6 Inspections

1.6.1 Notice

General: Give notice so that inspection may be made of the following:

- Surface preparation: Completed surface preparation, including repair of surface defects.
- Spraying rate.
- Spreading: Completed surfacing.
- Non-conforming sections: Completed replacement and rectification of non-conforming sections.

2 Pre-construction planning

2.1 General

2.1.1 Sealing treatment

General: To the **Categorisation of sealing treatments table.**

Initial treatment	Secondary treatment
Prime	S/S
S/S	S/D
S/D	D/D
D/D	HSS
HSS	SAM
Graded Seal	SAMI
	Inverted seal
	Coloured Surface Treatment
	High Friction Surface Treatments (HFST) ¹
	Multiple Layer Applications (bleeding in wheel tracks)
	Aggregate Retention Seal
	Fibre Reinforced Seals
	Geotextile Reinforced Seal
	Surface rejuvenation ²
	Surface enrichment ²

Source: Austroads AP-T310.

Notes:

1. For High friction surface treatment refer to *ARRB High friction surface guide to good practice.*

2.1.2 Design of sprayed seals

Seal design: To Austroads AP-T310 or Austroads AGPT04K Section 5 and 6.

2.1.3 Plant

Registration and insurance: Register and insure all plant for use on a public road, as appropriate.

Operation: Conform to statutory environmental regulations.

2.2 Environmental risk

2.2.1 Risk assessment

Requirement: Assess and manage the risk of environmental damage from primer or primerbinder being washed into adjacent drains and open watercourses from rain on uncured materials.

2.2.2 Priming and initial seal risk assessment table

Weather conditions (Note 2)	Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)			
	0 – 12 hours	12 – 24 hours	24 – 48 hours	Over 48 hours
(a) Cutback bitumen				
Fine, sunny, warm/hot	Moderate	Moderate	Low	Low
Fine, overcast, cool/warm	High	Moderate	Low	Low
Damp, overcast, warm	High	High	Moderate	Moderate
Damp, overcast, cool	Unacceptable	High	High	Moderate
Wet, overcast, warm	Unacceptable	Unacceptable	High	High
Wet, overcast, cool	Unacceptable	Unacceptable	Unacceptable	Unacceptable
(b) Bitumen emulsions				
Fine, sunny, warm/hot	Moderate	Low	Low	Low
Fine, overcast, cool/warm	Moderate	Low	Low	Low
Damp, overcast, warm	High	Moderate	Low	Low
Damp, overcast, cool	High	Moderate	Moderate	Moderate
Wet, overcast, warm	Unacceptable	High	High	Moderate
Wet, overcast, cool	Unacceptable	Unacceptable	Unacceptable	High
Notes:				
1. The risk levels reflect the likelihood of a wash-off from granular pavements on moderate grades with typical crossfall. For roads on steep grades, or with abnormal crossfall, or with low porosity base course, the risk of wash-off is higher than that documented.				
2. Typical temperatures associated with different weather conditions are: Hot = 25°C, Warm = 15 to 25°C, Cool = 15°C.				
3. If risk is classified as unacceptable, delay application until conditions improve.				
4. If risk is classified as high, delay application or supervise application and curing continuously until dry. Precautionary measures include blocking of stormwater entry points, placing of spill response equipment, regular weather checks and frequent inspections.				
5. If risk is classified as moderate, inspections must be frequent enough to respond to rain events. Stormwater entry points should be blocked and spill response equipment available on site.				
6. If risk is classified as low, inspections may be less frequent but weather should be monitored to make sure prompt response to rain events.				

3 Materials

3.1 Bituminous surfacing

3.1.1 Types

Requirement: Use the following types of sprayed bituminous surfacing:

- Prime.
- Initial seal.
- Seal.

3.2 Bituminous materials

3.2.1 Bitumen

Classification and properties and testing of bitumen and bituminous binders: To AS 2008 and Austroads AGPT04F Section 4.6.

Multigrade bitumen: To AS 2008.

3.2.2 Cutback bitumen

Standard grades of cutback bitumen: To AS 2157, Austroads AGPT04F section 5 and AGPT04K.

Field preparation: If required, prepare cutback bitumen by blending bitumen and cutter oil in proportions for the particular application.

Proprietary grades of cutback bitumen: To the manufacturer's specification.

3.2.3 Polymer modified binders

Binder properties, classification and testing: To Austroads AG:PT/T190 and Austroads AGPT04F section 6 and AGPT04K section 4.6.3.

3.2.4 Bitumen emulsion

Standard: To AS 1160.

Type, grade and testing: To Austroads AGPT04F section 7 and AGPT04K section 4.6.4

Proprietary grades of bitumen emulsion: To the manufacturer's specification.

3.2.5 Adhesion agent

Addition to bituminous binder or aggregate precoating material: Provide agent type and proportion depending on the following:

- Previous documented conformance and performance with the proposed combination of binder, aggregate source and precoating material based on trials or previous use.
- Materials selected are approved by the road authority.

3.2.6 Cutter oil and flux oil

Standard: To AS 3568.

3.2.7 Aggregate precoating materials

Materials: Flux oil, flux oil and bitumen mixture, cutback bitumen, proprietary bitumen emulsion or other proprietary products. Proprietary products may be used subject to previous satisfactory field performance as an aggregate precoating material.

Approved adhesion agent content in precoating material: Minimum 1%.

3.3 Aggregates

3.3.1 Properties

Source: Use aggregates from a nominated location.

Aggregates: To AS 2758.2 and the following:

- Conformance to ANNEXURE – SCHEDULE OF JOB DETAILS for aggregate class, polishing resistance, method of determination of aggregate shape, and combination of hardness and durability test measures.
- Apply only one method of aggregate shape determination and one combination of hardness and durability.
- If no aggregate details are documented in ANNEXURE –SCHEDULE OF JOB DETAILS, select the aggregate class, polishing resistance and test methods combination based on the service conditions and customary test procedures used in the state where the works are located.

3.3.2 Aggregate size

Selection of aggregate size: Select the appropriate aggregate size based on traffic, pavement life expectancy and climate conditions To AGPT04K Table 4.3.

- For lower traffic volume roads: Provide 7mm aggregate.
- For higher traffic volume: Provide 10mm or 14mm aggregate.

3.3.3 Selection of aggregate size combinations

For single/single seals: Conform to the following:

- Provide 7 mm aggregate for low traffic applications.
- Provide 10mm aggregates for higher traffic applications. Do not use for high-stress traffic movements, extreme heat, or predominantly wet conditions.
- Do not use 14 mm aggregates for single/single initial seals and for light traffic applications. Use only when high viscosity binder is required to retain the aggregate and provide adequate bonding with the binder.

For double/double initial seals:

- Double/ double initial seals, or single/single initial seals: Conform to the following:
 - Incorporate scatter coat, for high traffic and high stress sites.
 - Use aggregate size combinations of 14/7 mm with double/double seals. Other combinations such as 10/5 and 10/7 will be considered and must be approved by Council.

3.3.4 Aggregate dimensions (ALD)

For double/double or single/single seals: Provide ALD for second application to be half the ALD of the aggregate in the first application.

Sampling and testing: Apply appropriate sampling techniques and testing procedures for ALD to ensure correct aggregate design spread rates and accurate design binder application rates.

3.3.5 Flaky aggregate

Flakiness index: To AS C08.15.

3.4 Selecting a sprayed Seal

3.4.1 General

Sprayed seal selection: Select sprayed seal to Austroads AGPT04K Table 4.7, based on the design traffic (v/l/day), equivalent heavy vehicles, air and road temperatures, stress locations such as sharp

corners, roundabouts, turning lanes, intersections and steep grades. Cracked pavements will require special treatments. Obtain specialist advice to manage variations based on local experience. If any pavement layers contain stabilised material, a SAMI seal is required.

3.5 Design of a sprayed seal

3.5.1 Design of single/single seals

Design principles: To Austroads AGPT04K Section 5.1.

3.5.2 Design traffic

General: Details for traffic design, traffic data and distribution of traffic to Austroads AGPT04K Section 5.2.

3.5.3 Procedure for determining design traffic.

Single carriageway - two way road: Apportion traffic to each lane for single carriageway in rural areas and estimate design traffic to AGPT04K Table 5.1.

Dual carriageway - one way road: Apportion half the traffic count to each lane and estimate design traffic to Austroads AGPT04K Table 5.2.

Equivalent heavy vehicles (EHV %): For the effects of heavy vehicles and for adjustments to the basic voids factor to cater for this extra loading factor to AGPT04K Clause 5.2.5.

Short term traffic variations: Make provisions for events such as grain harvests, show days, seasonal tourists, school holidays especially if they coincide with seasonal wet weather events.

Access roads to sites such as quarries and mining locations: To Austroads AGPT04K Section 5.2.7.

3.5.4 Design of a double/double seal

General: For double/double seal design to AGPT04K Figure 5.3 and Section 5.5.2.

Surface texture allowance: If the second seal is delayed about 3 months and up to 24 months then assess the surface texture allowance to **Double/double seal design surface texture allowance and time between seals table**.

Double/double seal design surface texture allowance and time between seals table

Time between seal applications	Surface texture allowance – as a percentage of the standard allowance
Less than 3 months	30%
Between 3 and 6 months	30 to 50%
Between 6 and 12 months	50 to 75%
12 months to 24 months	75 to 100%

Austroads Part 4K Table 5.3

3.5.5 Initial treatment

General: Design of primes To **Guide to grades and application rates for primer table**.

Grades and application rates of primer table

Pavement types	Grade AS 2157	Primer application rates
Tightly bonded (impervious)	AMC 00	0.6 to 1.1
Medium porosity	AMC 0	0.8 to 1.1
Porous	AMC 1	0.9 to 1.3
Very porous (limestone and sandstone)	AMC 1	2 application rates: 1 st @ 0.7 to 0.9 2 nd @ 0.5 to 0.7

Hill gravels, granitic sands	AMC 0	0.8 to 1.1
Stabilised	AMC 00 ⁽¹⁾	0.5 to 0.8
Concrete	AMC 00 ⁽¹⁾	0.2 to 0.4
1. Can also consider using proprietary materials, or additional cutter in these cases.		

Trials: Conduct small scale trials on pavement materials in situ test and compare the appropriateness of the prime grade and the application rate.

3.5.6 Design of Initial Seals

Initial seals: For the design of initial seals conform to the following:

- Determine binder application rate.
- Adjust the application rate and apply allowances for:
 - Surface texture.
 - Binder absorption.
 - Aggregate embedment To AGPT04K Section 5.5.

3.5.7 Other seals

SAMI treatments: Conform to the following:

- Use highly modified binders applied at a high rate of application.
- Overlay with asphalt within 1 day after construction.
- For effective crack sealing performance provide 1.8 L/ m² minimum design binder rate.

3.5.8 Geotextile reinforced seals

General: To Austroads AGPT04K and Austroads AP-T37 and to the **Geotextile reinforced seals table**.

Type: Non-woven, needle punched fabrics with a melting point of 165°C and a minimum fabric mass of 130 g/m²

3.5.9 Fibre reinforced seals (FRS)

General: Conform to AGPT04K Section 5.5 and the following:

- Design of FRS based on single/single design procedures.
- Include allowances for polymer and bitumen emulsion and coating glass fibres.
- Use a scatter coat of 5 or 7 mm aggregate over a 14mm seal and 5mm aggregate on a 10mm seal.

3.6 Seal Design Input Parameters

3.6.1 Basic voids factor Vf

Basic voids factor Vf for single/single seals: To AGPT04K Figure 6.1 and 6.2.

Basic voids factor Vf for double/double seals: To AGPT04K Figure 6.3 and 6.4.

Adjustments to voids factor Va and Vt: To AGPT04K Table 6.1 for aggregate shape (Va) and Table 6.2 for traffic effects (Vt).

3.6.2 Design voids factor VF

Design voids factor: Determine by using the following:

$$VF = Vf + Va + Vt$$

Where Vf = basic voids factor

- Va = adjustment for aggregate shape

- V_t = adjustment for traffic effects

3.6.3 Basic binder application rate (B_b)

Binder application rate B_b : Determine the binder application rate for the proposed seal by using the formula:

- $B_b = VF \times ALD(L/m^2)$ where VF is the design voids factor and ALD is the average least dimension of aggregate.

3.6.4 Allowances applied to the basic binder application rate

General: Make allowances for:

- Surface texture of existing surface to AGPT04K Table 6.3 and Section 6.2.2 for asphalt, microsurfacing, concrete, timber and primed surfaces.
- Potential aggregate embedment into the existing surface.
- Embedment of aggregate in initial treatments over a soft base or primed surfaces to AGPT04K Figure 6.5.
- Potential binder absorption allowance into the existing pavement to AGPT04K section 6.2.4 for:
 - . Initial seals for each type of pavements, granular unbound, cementitious binders, bitumen stabilised, with chemical binders ranging from -0.1 to +0.2 L/m^2 allowance factor.
 - . Reseals will seldom be a problem unless the surface is visibly open and porous.
- Potential binder absorption into the sealing aggregate for porous e.g. sandstone or rhyolite, or vesicular e.g. scoria and slags.

3.6.5 Binder factors

Binder factors for single/single seals: To AGPT04K Table 6.4.

Binder factors for double/double seals: To AGPT04K Table 6.5.

3.6.6 Design binder application rate (B_d)

General: Determine to AGPT04K Section 6.4 and Section 6.2.2.

- Design binder application rate, $B_d = B_{bm} + \text{allowances}$.
- Where B_{bm} = modified basic binder application rate (rounded to the nearest L/m^2)
- Allowances = any applicable allowances.

3.6.7 Geotextile reinforced seals (GRS)

General: Use a minimum fabric mass of $130g/m^2$ and 10mm aggregate maximum size to reduce potential to puncture the fabric.

Binder fabric retention allowance: To the **Geotextile reinforced seals table**.

3.6.8 Geotextile reinforced seals table

Geotextile grade	Application	Retention allowance (L/m^2)
130 – 140 g/m^2	Resealing	0.9 to 1.0
175 – 200 g/m^2	Initial seal on low quality base material	1.1 to 1.3

3.6.9 Bond coat

Application of bond coat: Conform to the following:

- Apply the bond coat to the existing surface as a proportion of the binder fabric retention allowance. Add the balance of the fabric retention allowance to the seal coat on top of the fabric.
- Make sure the bond coat is sufficient to hold the fabric in place, without bleeding through the fabric and adhering to the tyres of the fabric spreading and rolling equipment.
- Bond coat application rate: 0.4 - 0.8 L/m².

3.6.10 Fibre reinforced seals (FRS)

Binder application rate: Use similar procedures as for conventional sprayed seals.

Binder allowance for glass fibres: To AGPT04K Table 6.7.

3.6.11 Aggregate spread rate

General: The aggregate spread rate is influenced by ALD and traffic.

- Make sure the binder application rate fills the voids in the aggregate to a depth of about two-thirds up the aggregate.
- The aggregate spread rate for low traffic roads (less than 200 v/l/d) is 5% heavier than that for heavier trafficked roads.
- When ordering aggregate for works, make allowance for stockpile wastage and order additional 5 - 10% over the required quantity.

3.6.12 Single/single seals aggregate spread rates

Aggregate spread rates: To the **Aggregates rates for single/single seals table**.

Aggregates rates to the single/single seals table

Binder	Aggregate spread rate (m ² /m ³)
C0170, C0240, C0320, Multigrade bitumen, PMB	900/ALD
Emulsion, AMC04 and AMC05 cutback binders	800/ALD
Application	
Scatter coat	400
SAMI	1000/ALD to 1100/ALD

3.6.13 Double/double seals aggregate spread rates

Aggregate spread rates for first application: To the **Aggregates rates for double/double seal first application table**.

Aggregates rates for double/double seal first application table

Binder	Aggregate spread rate (m ² /m ³)
C0170, C0240, C0320, Multigrade bitumen, PMB	950/ALD
Emulsion, AMC04 and AMC05 cutback binders	850/ALD

Aggregate spread rates for second application: To the **Aggregates rates for double/double seal second application table**. If the second application for the double/double seal is delayed use **Aggregates rates to the single/single seals table** to determine aggregate spread rates.

Aggregates rates for double/double seal second application table.

Binder	Aggregate size mm	Aggregate spread rate (m ² /m ³)
All binder types	10, 7	900/ALD

	5 (No ALD)	225
Note: For the second aggregate application the design spread rate is 20% less than for single/single seal design based on the spread rate of the first application.		

4 Testing

4.1.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Pavement surface preparation: To the ball penetration test AGPT/T251.

5 Execution

5.1 Storage and handling of raw materials

5.1.1 Aggregates

Aggregate stockpile: Arrange and manage as follows:

- Lot size: Not more than 250 m³ (approximately 350 tonnes).
- Stockpile location: Locate each stockpile on firm levelled ground that sheds water away from the stockpile. Separate stockpiles to prevent cross-contamination and interfering with loading and/or precoat operations.
- Stockpiles clearances: Allow adequate clearance between machinery and overhead power lines.
- Stockpile management: Prevent environmental damage from dust or bituminous material run-off.
- Signpost: Show stockpile quantity and material type at all times.
- Contamination prevention: If necessary, cover stockpiles to reduce contamination by dust or water.
- Recovery from stockpiles: Avoid contaminating aggregates.
- Contamination: Observe effect of weathering and dust causing a reduction in effectiveness of precoat of aggregates in stockpiles: Rectify or replace stockpile.

5.1.2 Binder

Heating of binder at time of application: Conform to the following:

- Heating temperature: ≤ 200°C and to the manufacturer's recommendations.
- Do not use overheated bituminous material.
- If there are no manufacturer's recommendations, adopt the temperature guidelines in AAPA Advisory Note 7.

Storage and handling: Store and handle binder to Austroads AGPT08 Section 8.2.2 and as follows:

- Time and temperature: To the manufacturer's recommendation.
- Procedures: Flush binders with liquids or other materials to prevent segregation and contamination.
- Straining devices: Use at all times for transferring binders into sprayers to eliminate hardened bituminous material particles or other contaminants that may block spraying jets.

5.2 Pavement surface condition for spraying

5.2.1 Surface condition assessment.

Flexible pavement base and subbase: Assess for conformance to the *C08 Flexible pavement base and subbase* worksection. Obtain all as-constructed granular pavement results including moisture content, dryback and compaction before spraying.

Pavement surface hardness: Before any spray seal surface treatments, perform embedment test as follows:

- Method: To Austroads AG:PT/T251.
- Time of testing: Within 48 hours before application of sprayed seal.
- Embedment value allowance: Not more than 3 mm.

5.2.2 Defective pavement surface

Rectification: Do not start sprayed sealing work until defects in the pavement surface have been rectified.

Defects requiring rectification: Before starting sprayed sealing work, inspect for pavement defects that may adversely affect the quality of the finished work including the following:

- Excessive moisture in unbound granular base requiring priming or initial sealing.
- Loose, poorly bonded, or inadequately compacted materials in the surface of unbound granular base requiring priming or initial seal.
- Poorly shaped unbound granular base requiring priming or initial seal.
- Soft, fatty or bleeding patches in pavements requiring resealing.
- Uncured patching materials, crack sealing.
- Porous patches in surface requiring resealing.
- Significant variations in surface texture requiring corrective treatment before resealing.
- Inadequate repair of weak or cracked pavements.
- Inadequate curing of primed surfaces before sealing.
- Inadequate curing of initial seal pavements before resealing. Generally, allow minimum 12 months curing for cutback bitumen primerbinders.

5.2.3 Preparation of pavement surface

Surface preparation: Conform to the following:

- Before the application of primer, primerbinder or binder, sweep pavement surface with a rotary road broom or suction broom to provide a uniformly clean surface.
- If necessary, carry out further sweeping by hand, using stiff brooms.
- Extend sweeping at least 300 mm beyond the edge of each spraying area.
- If sealing work is carried out on localised areas and/or half pavement widths, remove any remaining loose material from the pavement surface immediately adjacent to the swept areas.
- Remove adherent patches of foreign material from the surface of the pavement.
- Remove raised pavement markers and replace with temporary markers.

5.2.4 Pavement temperature and weather conditions

Measure and record pavement temperatures: At regular intervals during the course of the work, using appropriate equipment and measurement procedures.

Pavement is partly in sun and partly in shade: Record the temperatures for both conditions. Use the lower recorded temperature as a basis for spraying and selection of cutter oil proportions requirements.

Primers, primerbinders and binders: Spray only if the pavement temperature, one hour before start of spraying and during the spraying period, conforms to **Pavement temperature table**.

Ambient temperatures: Do not spray below that recommended unless the risk of poor bitumen adhesion can be adequately managed through suitable type and proportion of cutter oil, traffic control, speed of aggregate covering, rolling and aftercare of completed work.

5.2.5 Pavement temperature table

Binder type	Minimum pavement temperature (°C)	
	with cutter oil	without cutter oil
Hot bitumen	15	35
Polymer modified binder ⁽¹⁾	20	45 ⁽²⁾
Crumb rubber bitumen	20	45 ⁽²⁾
Bitumen emulsion	-	5

1 Does not apply to SAMI seals.
2 This will vary by binder type and could be as high as 65°C in some cases.

5.2.6 Selecting binders for maximum permissible vertical road gradients

Selection of binders: To the **Recommended maximum permissible gradients for various binders table**.

Recommended maximum permissible gradients for various binders table

Surfacing Binder Type	Maximum gradient (%) ⁽¹⁾
Hot bitumen	12
Hot cutback bitumen	10
Polymer modified binder	>12 ⁽²⁾
Bitumen emulsion	8 ⁽³⁾
Multigrade (M500)	12

1 The gradient will also depend to some extent on the existing surface texture and surface temperatures.
2 Depends on the PMB type and concentration.
3 Depends on the percentage of residual bitumen content, with higher residual bitumen content or polymer modified emulsions preferred for steeper grades.

5.2.7 Surface condition

Wet pavement: Do not carry out spraying on a wet pavement, if rain appears imminent or during strong winds or dust storms.

Surfaces for priming: Surface dry, and no more than damp to the depth of pavement penetration.

Surfaces for initial sealing: Damp, but not wet. If necessary, lightly water the pavement surface shortly before applying the primer binder.

Surfaces for sealing: Dry and clean.

5.3 Preparation of aggregates

5.3.1 Precoating of aggregate

Requirement: Precoat aggregate to provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

Precoating for stockpile: Precoat at the quarry, or on site as follows:

- Bitumen based materials: Use a bitumen, flux oil/cutter oil and adhesion agent mixture or bitumen emulsion formulated for precoating aggregate materials so that a thin film of bitumen adheres to the aggregate.
- Curing period for bitumen/flux oil mixtures: One week before use.
- Precoated aggregates stockpiled for more than one month: Re-assess precoating effectiveness and determine if rejuvenation is required before use.
- Protection of stockpiles: Cover stockpiles to prevent dust settlement, moisture penetration or drying out of aggregate precoating.

Precoating for immediate use: Precoat on site as follows:

- Use bitumen/flux oil mixture, flux oil, flux oil/cutter oil mixture, cutter oil or bitumen emulsion specifically formulated for use as aggregate precoating material.
- Adhesion agent: Add 1% (by volume) of agent to oil based precoating materials if aggregates are damp or when the weather conditions are unfavourable, humid conditions or if rain is imminent.
- Field precoating of aggregates for immediate use: Do not carry out when rain is imminent. If aggregates have been precoated and rain appears imminent, adequately cover the aggregates to prevent the fresh precoating material being washed from the aggregate particles.

Application rate of precoating agent: Conform to the following:

- Application rate: Determine rate based on the **Typical precoating rates table**.
- Porous aggregates: Increase rates by up to 2 L/m³ from the values in the **Typical precoating rates table**.
- Smooth, hard aggregates: Reduce by up to 2 L/m³ from the values in the **Typical precoating rates table**.

5.3.2 Typical precoating rates table

Aggregate condition	Precoating material (L/m ³)	
	Bitumen based, including bitumen emulsions	Oil based
Clean	6 to 12	4 to 10
Dirty	8 to 14	6 to 12

5.4 Preparation of bitumen binder

5.4.1 Adding cutter oil

Requirement: If cutter oil is required, add to binder in conformance with the following:

- Oil content:
 - Class 170 or 320 bitumen, multigrade binder: To the **Basic cutting practice for Class 170 bitumen and multigrade binder table**.

- Polymer modified binders: To the **Guide to cutting practice for PMBs for SAM and HSS applications table**.
- Temperature of binder when adding cutter oil: To the Binder temperature table.
- Moisture contamination: Make sure materials added to hot binder are free of moisture. Check materials considered at risk from moisture contamination, with a water-finding paste before use, for example, drummed materials stored in the open.
- Standard bitumen binders: Place the cutter oil into a sprayer that has not been previously heated, followed by the hot bitumen.
- Polymer modified bitumen binders, including crumb rubber binders: Place hot binder into the sprayer followed by the cutter oil.
- Circulating sprayer load: Circulate the sprayer load of cutback bitumen at a rate of not less than 700 litres/min (approximately 350 rpm) for minimum 20 minutes before spraying.

Returned cutback bitumen: If part of a sprayer load is not used on the day of mixing and needs to be returned to the heater tanks, place it in a tank reserved for that purpose. Do not add bitumen or cutter oil to the returned bitumen unless the tank is fitted with an effective circulation system. When the returned bitumen is subsequently used as part of a sprayer load, make allowance for the cutter oil contained in the returned cutback bitumen mix to be used the next day.

Spraying temperature: To the **Cutback bitumen spraying temperature table**. Interpolate spraying temperatures for proportions of cutter oil between those shown in the table.

5.4.2 Basic cutting practice for Class 170 bitumen and multigrade binder table

(Parts by volume of cutter oil to be added to bitumen measured at 15°C).

Pavement temperature (°C)	Aggregates of 10 mm nominal size or larger			Aggregates of 7 mm nominal size or smaller		
	Traffic (vehicles/lane/day)			Traffic (vehicles/lane/day)		
	< 100	100 – 1500	> 1500	< 100	100 – 1500	> 1500
15 – 19	10	8	6	12	10	8
20 – 25	8	6	4	10	8	6
26 – 32	6	4	2	8	6	4
33 – 38	4	2	0	6	4	2
39 – 45	2	0	0	4	2	0
> 45	0	0	0	2	0	0

Notes:

1. Rates are based on fine, stable weather conditions and active, freshly applied or partially dried oil or bitumen precoating.
2. For dry or inactive precoating, add 2 parts except for heavy traffic and high pavement temperatures.
3. For damp aggregates, add 2 parts, except for heavy traffic and high pavement temperatures.
4. For periods of falling temperatures, add 2 parts or up to 4 parts if very cold overnight temperatures are expected to follow.
5. Add a further 2 parts of cutter oil for pavement temperatures below 15°C, provided that sprayed sealing work should not be carried out at temperatures below 10°C.
6. Subtract 5°C from measured pavement temperature for wind chill and fresh breeze. Cease spraying in strong winds.

7. In double/double seals, where the second application is to be applied the same day, or without any significant period of trafficking, it is undesirable to include any cutter oil in the first binder application. If cutter oil is considered necessary, it should be a maximum of 2 parts.
8. If cutter proportions are added as percentage of total binder, the proportions shown here as parts per 100 parts of bitumen may be taken as a reasonable approximation of percentage by volume.
9. If pavements are not intended to carry normal design traffic for a period of time after sealing, the proportion of cutter oil may be varied to reflect the conditions likely to prevail at the time of opening to traffic.
10. Traffic volume.

5.4.3 Guide to cutting practice for PMBs used in for SAM and HSS applications 1, 2 table

(Parts by volume of cutter oil to be added to 100 parts by volume of PMB-measured at 15°C)⁴

Pavement temperature ⁵ (°C)	Traffic	Class of PMB ⁽¹⁾			
		S15E ⁽²⁾	S20E ⁽²⁾ S25E	S35E ⁽²⁾	S45R ⁽²⁾ S15RF ^{6,7}
20 to 25	< 1000	6 - 8	8	6	10
	≥ 1000	6	6 - 8	4	8
26 to 32	< 1000	4 - 6	6	4	8 - 10
	≥ 1000	4	4 - 6	2	6 - 8
33 to 38	< 1000	4	4 - 5	2	6 - 8
	≥ 1000	2	3 - 4	2	6
39 to 45	< 1000	Min 2	Min 3	0 - 2	4 - 6
	≥ 1000				4 - 6
> 45	All	Min 2	Min 3	0 - 2	Min 4

Notes:

- Sealing grade of PMB to Austroads AGPT04F Table 6.1.
- In SAMI applications, if the seal is to be covered by asphalt within a short period, it is undesirable to include any cutter oil. If cutter oil is considered necessary, include a maximum of 2 parts of cutter oil to 100 parts of PMB. Similar provisions apply to the first binder application of a double/double seal if the second application is to follow the same day, or within a short period.
- In aggregate retention applications using lower levels of polymer modification, i.e. S10E, and some proprietary blends of PBD, cut back binder as per normal Class 170 bitumen.
- If cutter proportions are added as percentage of total binder, take the proportions documented as parts per 100 parts of PMB as a reasonable approximation of percentage by volume.
- Base pavement temperature on the worst condition, i.e. shaded areas.
- Pre-blended crumb rubber grades can contain process oil used in their manufacture. This oil will reduce the viscosity compared to field blended grades, and allow a small reduction, say 2 parts, in added cutter oil compared to field produced grades.
- At high rates of application of binder (e.g. higher than 2 L/m²) the proportion of cutter oil can be reduced by 2 parts.

5.4.4 Binder temperature table

Binder type	Temperatures for adding cutter oil (°C)
Bitumen Class 170, Multigrade 600/170	160 - 180
Bitumen Class 320	170 - 190
PMB	Within a range of 10°C below the maximum recommended application temperature.

5.4.5 Cutback bitumen spraying temperature table

AS grade (if applicable)	Viscosity at 60°C (Pa.s)	Equivalent cutter oil content (%)	Temperature range (°C)
AMC 00	0.008-0.016	56	ambient
AMC 0	0.025-0.05	44	35 – 55
AMC 1	0.06-0.12	34	60 – 80
AMC 2	0.22-0.44	27	75 – 100
AMC 3	0.55-1.1	21	95 – 115
AMC 4	2.0-4.0	16	110 – 135
AMC 5	5.5-11	11	120 – 150
		9	130 – 155
AMC 6	13.0-26.0	7	135 – 160
		5	145 – 170
AMC 7	43.0-86.0	3	155 – 180
		2	150 – 175

5.4.6 Adding flux oil

Requirement: If flux oil is required, add oil to binder in conformance with the following:

- Moisture content: Make sure flux oil added to hot binder is free of moisture.
- Circulating sprayer load: Add flux oil to the bitumen in the sprayer and circulate the mixture at a rate not less than 700 litres/min for 20 minutes before spraying.

5.4.7 Adding bitumen adhesion agent

Requirement: If bitumen adhesion agent is required, add oil to bitumen in conformance with the following:

- Circulating sprayer load: Add adhesion agent to the bitumen in the sprayer after adding the last component. Circulate the mixture at a rate of not less than 700 litres/min for 20 minutes, before spraying.
- Bitumen containing adhesion agent: If not used within 8 hours of mixing agent with hot bitumen, disregard the active contribution of adhesion agent in subsequent use of the bitumen material. Make allowance for the oil component of the adhesion agent in the returned bitumen.

5.5 Application of primer, primerbinder and binder

5.5.1 Primer and primerbinder

Class and grade of primer and primerbinder: To ANNEXURE – SCHEDULE OF JOB DETAILS.

Application rate of primerbinder: To Austroads AGPT04K Table 4.3.

Temperature at mixing and spraying: Measure application rates and quantities of primer and primerbinder applied to the mixture at 15 degrees C, including cutter oil or water content of the bitumen emulsion.

Primer drying period: At least 72 hours after applying primer. If required, allow additional time for the primer to dry completely before applying binder for seals.

Traffic restrictions: Conform to the following:

- Keep all traffic off the primed surface.
- If limited traffic access is required to the primed surface, apply a light layer of grit on the surface to avoid pickup. Do not apply gritting until a substantial proportion of the primer has been absorbed into the pavement.

5.5.2 Binder

Class or type of bitumen: To the **ANNEXURE – SCHEDULE OF JOB DETAILS**, including for modified bitumen, cutback bitumen or bitumen emulsion.

Application rate and binder quantity: Allow as follows:

- Base rates on bitumen volume measured at 15 degrees C, not including adhesion agent, cutter oil or water content of emulsions.
- If flux oil has been added to the bitumen, include flux oil quantity as part of the binder.
- If adhesion agent and/or cutter oil has been added to the binder, adjust the binder application rate at 15 degrees C to suit the adhesion agent and oil content in the mixture.

Forward speed of bitumen sprayer: Determine speed based on either of the following:

- Hot application rate of total binder: Including adhesion agent and/or cutter oil.
- Temperature and adhesion agent and cutter oil content, measured at 15 degrees C.

Volume correction factors: Convert the volume of bituminous binders from 15°C to elevated temperatures, or from elevated temperatures back to 15 degrees C to the **Volume conversion for bitumen table** or **Volume conversion for bitumen emulsion table**.

5.5.3 Volume conversion for bitumen* table

Multiply by "A" to reduce volume at T°C to volume at 15°C					
Multiply by "B" to increase volume at 15°C to volume at T°C					
A	Temp. (T °C)	B	A	Temp. (T °C)	B
0.9856	38	1.0146	0.9356	120	1.0688
0.9844	40	1.0158	0.9344	122	1.0702
0.9831	42	1.0172	0.9332	124	1.0716
0.9819	44	1.0184	0.9320	126	1.0730
0.9806	46	1.0198	0.9308	128	1.0743
0.9794	48	1.0210	0.9296	130	1.0757
0.9782	50	1.0223	0.9284	132	1.0771
0.9769	52	1.0236	0.9272	134	1.0785
0.9757	54	1.0249	0.9260	136	1.0799
0.9745	56	1.0262	0.9249	138	1.0812
0.9732	58	1.0275	0.9237	140	1.0826
0.9720	60	1.0288	0.9225	142	1.0840
0.9708	62	1.0301	0.9213	144	1.0854
0.9695	64	1.0315	0.9201	146	1.0868
0.9683	66	1.0327	0.9189	148	1.0883

Multiply by "A" to reduce volume at T°C to volume at 15°C					
Multiply by "B" to increase volume at 15°C to volume at T°C					
0.9671	68	1.0340	0.9178	150	1.0896
0.9659	70	1.0353	0.9166	152	1.0910
0.9646	72	1.0367	0.9154	154	1.0924
0.9634	74	1.0380	0.9142	156	1.0939
0.9622	76	1.0393	0.9130	158	1.0953
0.9610	78	1.0406	0.9119	160	1.0966
0.9597	80	1.0420	0.9107	162	1.0981
0.9585	82	1.0433	0.9095	164	1.0995
0.9573	84	1.0446	0.9084	166	1.1009
0.9561	86	1.0459	0.9072	168	1.1023
0.9549	88	1.0472	0.9060	170	1.1038
0.9537	90	1.0486	0.9049	172	1.1051
0.9524	92	1.0500	0.9037	174	1.1066
0.9512	94	1.0513	0.9025	176	1.1080
0.9500	96	1.0526	0.9014	178	1.1094
0.9488	98	1.0540	0.9002	180	1.1109
0.9476	100	1.0553	0.8990	182	1.1123
0.9464	102	1.0566	0.8979	184	1.1137
0.9452	104	1.0580	0.8967	186	1.1151
0.9440	106	1.0593	0.8956	188	1.1166
0.9428	108	1.0607	0.8944	190	1.1181
0.9416	110	1.0620	0.8933	192	1.1195
0.9404	112	1.0634	0.8921	194	1.1209
0.9392	114	1.0647	0.8909	196	1.1224
0.9380	116	1.0661	0.8898	198	1.1239
0.9368	118	1.0675	0.8886	200	1.1253
*Including for cutback bitumen					

5.5.4 Volume conversion for bitumen emulsion table.

Hot litres x A = Cold litres (at 15°C)			Cold litres x B = Hot litres (T°C)					
60% bitumen emulsion			70% bitumen emulsion			80% bitumen emulsion		
A	Temp. (T°C)	B	A	Temp. (T°C)	B	A	Temp. (T°C)	B
1.0000	15	1.0000	1.0000	15	1.0000	1.0000	15	1.0000
0.9998	16	1.0002	0.9977	20	1.0023	0.9974	20	1.0026
0.9989	18	1.0011	0.9951	25	1.0049	0.9948	25	1.0052
0.9980	20	1.0020	0.9924	30	1.0076	0.9921	30	1.0079
0.9971	22	1.0029	0.9899	35	1.0102	0.9895	35	1.0106
0.9962	24	1.0038	0.9872	40	1.0129	0.9868	40	1.0134
0.9953	26	1.0047	0.9840	46	1.0162	0.9837	46	1.0166
0.9944	28	1.0056	0.9830	48	1.0172	0.9826	48	1.0177
0.9935	30	1.0065	0.9819	50	1.0184	0.9816	50	1.0187
0.9926	32	1.0074	0.9809	52	1.0194	0.9805	52	1.0199
0.9917	34	1.0083	0.9798	54	1.0206	0.9794	54	1.0210
0.9908	36	1.0092	0.9788	56	1.0216	0.9783	56	1.0222
0.9899	38	1.0102	0.9777	58	1.0228	0.9773	58	1.0232
0.9890	40	1.0111	0.9767	60	1.0238	0.9762	60	1.0244
0.9881	42	1.0120	0.9752	62	1.0254	0.9751	62	1.0255
0.9872	44	1.0129	0.9746	64	1.0260	0.9740	64	1.0267
0.9863	46	1.0138	0.9736	66	1.0271	0.9730	66	1.0277
0.9854	48	1.0148	0.9725	68	1.0282	0.9719	68	1.0289
0.9845	50	1.0157	0.9715	70	1.0293	0.9709	70	1.0300
0.9836	52	1.0166	0.9704	72	1.0305	0.9698	72	1.0311
0.9827	54	1.0176	0.9693	74	1.0316	0.9687	74	1.0323
0.9818	56	1.0185	0.9683	76	1.0327	0.9677	76	1.0334
0.9809	58	1.0194	0.9672	78	1.0339	0.9667	78	1.0344
0.9800	60	1.0204	0.9662	80	1.0349	0.9656	80	1.0356
0.9791	62	1.0213	0.9651	82	1.0361	0.9643	82	1.0370
0.9782	64	1.0222	0.9640	84	1.0373	0.9630	84	1.0384
0.9773	66	1.0232	0.9630	86	1.0384	0.9616	86	1.0399
0.9764	68	1.0241	0.9619	88	1.0396	0.9603	88	1.0413
0.9755	70	1.0251	0.9608	90	1.0407	0.9590	90	1.0427

5.6 Application of sprayed bituminous surfacing

5.6.1 Plant and equipment

Spraying: Use a mechanical sprayer to apply primer, primerbinder and binder.

- Use a mechanical sprayer to apply primer, primerbinder and binder.
- A current sprayer certificate issued by a registered testing authority.

Spray nozzles: Use nozzles which conform to the following:

- Make and type endorsed on the sprayer certificate.
- Nozzles types used on the spray bar of the sprayer: Compatible with the nature of the binder type to be sprayed and its application rate.

- Replace damaged, or unduly worn or defective nozzles.

Aggregate spreading equipment: Use mechanical spreader capable of achieving a uniform spread rate.

Rollers: Use rollers that conform to the following:

- Pneumatic tyred multi-wheel rollers: With a minimum mass of 7 tonnes mass, smooth tyres and a minimum tyre pressure of 550 kPa.
- Combination rollers: With a rubber coated, vibratory drum on one axle and pneumatic tyres on the other.
- Capable of achieving effective incorporation of incorporating aggregates into the binder without breaking breakdown or crushing of the cover aggregates.

Non-conforming plant: Remove plant or equipment not fully operational or not capable of carrying out the works in conformance with this worksection.

5.6.2 Spraying area

Extent of spray run: Limit the spraying area to that can be covered with aggregates within 15 minutes of spraying.

5.6.3 Adjacent longitudinal spray runs

Where overlap is not required: Use special type end nozzles or intermediate nozzles set with a jig as end nozzles.

Where an overlap is required: Provide the following overlaps between adjacent longitudinal runs:

- Overlap of spray between adjacent longitudinal runs: 50 mm.
- For special type end nozzles or jig set intermediate nozzles: 50 mm.
- Overlap of adjacent longitudinal sprays if for intermediate nozzles set in the normal manner: 300 mm.
- Overlap on to existing seal by 300mm minimum if doing patches.

5.6.4 Spraying operation

Procedure: Spray primer, primerbinder or binder onto surface as follows:

- Start of spraying: Start spraying for each sprayer run on a protective strip of heavy paper laid across and held securely to the pavement surface.
- Sprayer movement: Start moving the sprayer at a sufficient distance in advance of the protective strip to attain the road speed for correct application.
- Road speed: Maintain a constant road speed throughout the length of each sprayer run.
- End of sprayer run: Terminate each spraying run on protective paper laid across and held securely to the pavement surface beforehand.
- Hand spraying: If required, use hand spray equipment attached to the sprayer for small areas or areas of irregular shape.
- After each sprayer run: Check the quantity of binder sprayed against the area covered. If the actual application rate is not within the required limits, adjust to achieve the required target application rate in subsequent runs.

Defective equipment: Cease spraying immediately if any defect develops in the spraying equipment. Rectify the fault before further spraying.

Blockages: If any nozzle blockages occur, cease spraying immediately. Do not recommence spraying until the cause of the blockage is identified and rectified.

Non-conforming sprayed areas: Areas not within 5% of the required application rate.

5.6.5 Temperature

Bituminous material temperature: If the temperature is below the lower limits in the **Binder temperature table** or **Cutback bitumen spraying temperature table**, heat the bituminous material to Austroads AP-G41 Section 7.

5.6.6 Geotextile

Placing geotextile: If required in the **ANNEXURE – SCHEDULE OF JOB DETAILS**, place geotextile as follows:

- Use a purpose-built geotextile fabric spreading device.
- Fix the geotextile to the pavement smoothly and without wrinkles, using a tack coat of up to 0.8 L/m² (residual) of Class 170 bitumen.
- Rate of application of tack coat application rate: Included in, and not additional to, the overall design binder application rate for the geotextile reinforced seal (including allowances for surface texture and absorption by the fabric).

Joints: Overlap minimum 200 mm or butt joint to **ANNEXURE – SCHEDULE OF JOB DETAILS**.

Longitudinal joints: Do not place in wheel paths.

5.7 Aggregate Spreading and rolling

5.7.1 Spreading

Spreading time: Spread aggregates as soon as practicable after binder spraying has commenced and complete within 15 minutes of spraying.

Spreader calibration: Calibrate spreader as follows:

- To Austroads AG:PT/T537, with using aggregates from the stockpile to be used for the work.
- Calibrate off-road.
- Calibration site: With sufficient length to allow the aggregate spreader to reach normal operational speed before applying the aggregates.
- Calibrate the total width of the aggregate spreader.
- Spreading process: Spread aggregate as follows:
 - Application: Apply the required sized aggregates at the required application rate.
 - Aggregate quantity: Make sure there are sufficiently loaded trucks at the site to provide full cover for the sprayed area.
 - Coverage: Spread the aggregates over the sprayed area uniformly with a mechanical spreader.
 - Bare or insufficiently covered areas: Re-run with a mechanical spreader or cover by hand to provide uniform and complete coverage.
 - Localised excess aggregates: Remove any local excess of aggregate before rolling.

5.7.2 Rolling

Rolling process: Roll areas covered with aggregates as follows:

- Rollers and rolling area: Supply sufficient pneumatic tyred multi-wheel rollers to cover the sprayed areas to the Area that can be effectively rolled table.
- Rolling time: Schedule rolling times Allow adequate time at the end of the day's work so that the last materials spread for each day receives the same amount of rolling as that placed earlier in the day.

- Initial rolling: Carry out after the aggregates are applied to each work section with one or more rollers. Continue initial rolling until the aggregates are firmly adhered to the primerbinder or binder.
- Rolling period: Reduce the amount of rolling while the aggregate is wet, but resume normal rolling as soon as aggregate dries. Avoid trafficking during this period, or keep to a minimum speed, until aggregate has dried sufficiently adhered.
- Unevenly distributed aggregate: If the aggregates are not evenly distributed over the pavement surface, traverse the surface with a light drag broom after the initial rolling, without dislodging aggregate particles bedded in the primerbinder or binder.
- If drag brooming is not used: Substitute with light hand brooming.
- Carry out backrolling until the total sprayed area achieves the roller hours to the **Area that can be effectively rolled table**.
- After adhesion: After the aggregates have been evenly distributed and are adhered to the binder, remove any remaining loose aggregate particles from the pavement.

5.7.3 Area that can be effectively rolled table2

Aggregate size (mm)	Traffic Volume (vehicles per lane per day)		
	< 300 v/l/d ⁽¹⁾	300 – 1200 v/l/d ⁽¹⁾	> 1200 v/l/d ⁽¹⁾
	Rolling rate (m ² /roller hour)		
7 or smaller	4500 – 5000	5000 – 5500	5500 – 6000
10	3000 – 3500	3500 – 4000	4500 – 5000
14	2500 – 3000	3000 – 3500	3500 – 4000

Note:

- Traffic volume.
- Area that can be rolled, per hour, with each pneumatic tyred multi-wheel roller.

5.7.4 Spreading and rolling variations for different seal types

Single/single seals: Apply a single application of aggregates on a single application of binder, roll the seal and, if required, light hand or drag broom.

Single/double seals: Apply the second application of aggregates after initial rolling of the first application, and before final rolling and trafficking.

Double/double seals:

- Binder and aggregates are applied on the same day: Complete the first application as a single/single seal. Reduce the aggregate application by 10% of that required for a single/single seal. Apply the second binder application of binder, followed by a second aggregate application, at a rate required to fill the voids. Roll and remove any remaining loose aggregates.
- Bitumen as the binder in the first application: Do not apply the second binder until the binder in the first coat is completely broken to form a stable seal.
- Trafficking the first application: Allow trafficking for a period not exceeding several weeks. Complete the first application as a single/single seal and reduce the aggregates in the second application by 30% to fill the voids from the first application.
- Second application applied after a significant period of trafficking: Complete both applications as single/single seals.
- Other occasionally trafficked facilities: Allow for an in-service follow-up rolling after 12 months in warm conditions.

5.8 Performance

5.8.1 Bituminous surfaces

Completed surface: Make sure the complete surface conforms to Austroads AGPT04K and the following:

- Generally: The work has clean, straight edges and no obvious defects related to poorly constructed longitudinal or transverse joints, blocked spray nozzles or any other construction fault.
- Cured primes: Have a uniform appearance.
- Primerseals and single/single seals with maximum 7 mm aggregates: Have a uniform surface and retains a matrix of aggregates.
- Single/single seals with minimum 10 mm aggregates: Have a uniform, single retained layer of aggregate.

- Single/double seals: Have a uniform layer of retained aggregate with both sizes fitting together to produce a uniform surface texture.
- Double/double seals: Have uniform double retained layers of aggregate with the second layer of aggregate fitting inside the texture of the aggregate used in the first layer.

5.9 Testing

5.9.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE – MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

5.9.2 Laboratory testing

Requirements: Test the properties required by the worksection as follows:

- Perform in a NATA accredited laboratory (for the required test method) in conformance with procedures required by the relevant Austroads Test Method or Australian Standard.
- If there is no applicable Australian Standard or Austroads Test Method or if the Standard or Test Method provides a choice of procedures, adopt a procedure endorsed by the state road authority where the work is undertaken.

Exceptions: Requirements for NATA accredited laboratories do not apply to field tests such as surface texture measurements or aggregate spreader calibration. These may be completed by a competent, trained personnel.

5.10 Removal of loose aggregates

5.10.1 Loose aggregate particles removal

Surface of seals with minimum 10 mm aggregates: After final sweeping and before the removal of speed restriction and warning signs, make sure the number of loose aggregate particles remaining on the surface do not to exceed the values in the **Limits for loose stone particles remaining after sweeping table**.

Aggregate windrows: Remove any windrows on the sealed surface or shoulder that may be a traffic hazard. If required, remove all surplus aggregates.

Timing: Complete the removal from the trafficked pavement to the **Time limit for removal of loose aggregate table**.

5.10.2 Limits for loose stone particles remaining after sweeping table

Road type	Maximum loose stones (particles/m ²)
Urban areas	20
Other medium to high traffic (> 250 v/l/d)	30
Low traffic (< 250 v/l/d)	40

5.10.3 Time limit for removal of loose aggregates table

Traffic volume	Maximum time limit
> 2000 and all freeways	Within 12 to 24 hours of sealing
1000 to 2000	Within 12 to 24 hours of sealing
250 to 1000	Within 12 to 24 hours of sealing
< 250	Within 12 to 24 hours of sealing

5.11 Safety and protection

5.11.1 Newly completed surfacing

Warning signs: Provide signage to protect the public as follows:

- Provide signs and temporary raised pavement markers to warn the public of loose stones and absence of linemarkings.
- Install reduce speed signage if appropriate.
- Maintain signs until loose aggregates have been removed and linemarkings are reinstated.

5.11.2 Services and fixtures adjacent to the surfacing area

Protection: Take precautions to prevent the primer, primerbinder, binder, aggregates or other materials used on the work from entering or adhering to gratings, hydrants, valve boxes, manhole covers, bridges, culvert decks and other road fixtures.

Cleaning: Immediately after spreading aggregates, clean off or remove any sprayed material on the services and/or road fixtures. Leave in a condition equivalent to that before spraying.

5.11.3 Defects liability period

Responsibility: Protect the new work and correct any defects occurring within the defects liability period with the exception of damage caused by accident and other events outside the control of the contractor.

5.12 Removal of surplus and waste materials

5.12.1 Final cleaning

Completion: Before leaving the work site, uncover and clean all services. Remove from site all waste from the sprayed sealing operations, including paper. Clean the stockpile sites and store any excess material in a tidy heap or remove, if required.

5.12.2 Disposal

Special requirements: For disposal of surplus aggregate at stockpile sites specify additional requirements or include in the **ANNEXURE - SCHEDULE OF JOB DETAILS**.

5.13 Non-conformance

5.13.1 General

Non-conforming works: Provide remedial treatment as directed to provide the required level of service. Annexures


6 Annexures

6.1 Annexure – Project requirements

6.1.1 Definition of project requirements

Schedule of job: Take the following actions to prepare the **ANNEXURE - SCHEDULE OF JOB DETAILS** and schedule of rates:

- Define scope of work. In addition to a description of location, the limits of work should also be clearly marked on the road pavement.
- Define type of sprayed seal treatment.
- Define aggregate class and minimum PSV or PAFV, if required.

- 
- Define binder type or grade.
 - Include details of traffic for design purposes.
 - Include any special design requirements, if applicable.
 - Prepare and insert special clauses for submission of sprayed seal design details in advance of sprayed sealing work, if applicable.
 - Prepare price schedule based on the scope of work and method of measurement and payment.
 - Prepare a schedule for sites available for the stockpiling of aggregates, if applicable.
 - Prepare and insert special clauses for removal of loose aggregate by suction broom, if applicable.
 - Prepare and insert special clauses for reinstatement of line marking, if applicable.
 - Prepare and insert clauses for any other special job requirements, if applicable.

6.2 Annexure – Schedule of job details

Item	Road name	Location			Approx. length (m)	Approx. width (m)	Approx. area (m ²)	Treatment			Aggregate			Traffic		Estimated rates of application		Other requirements ⁽¹¹⁾
		Map ref. ⁽¹⁾	Chainage	Distance markers or ref. points				Type ⁽²⁾	Description ⁽³⁾	Application ⁽⁴⁾	Size(s)	Min. class ⁽⁵⁾	Min. PSV/PAFV ⁽⁶⁾	v/l/d ⁽⁷⁾	Heavy veh. (%) ⁽⁸⁾	Binder (L/m ²) ⁽⁹⁾	Aggregates (m ² /m ³) ⁽¹⁰⁾	

Notes:

- Map references: Nominate directory used.
- Treatment type: Prime only (PO), Primerseal (PS), Prime and seal (P&S), Reseal (R).
- Treatment description: Strain alleviating membrane (SAM), Strain alleviating membrane interlayer (SAMI), Geotextile reinforced seal (GRS), Surface enrichment (SE).
- Number of applications: Single/single (S/S), Single/double (S/D), Double/double (both immediate) (D/D)_i, Double/double (delayed second) (D/D)_d.
- Aggregate Class: A, B or C (AS 2758.2).
- Aggregates PSV or PAFV: Generally, 48 for Class A aggregates.
- Vehicle/lane/day (v/l/d): Use design traffic calculation methods included in Austroads AGPT04K or Austroads AP-T310.
- % Heavy vehicles: Percentage of AADT that are counted as heavy vehicles.
- Estimated binder application rate: For tendering purposes only, actual rates to be determined after measuring surface and aggregate properties.

Item	Road name	Location	Appro x. length	Appro x. width	Appro x. area	Treatment	Aggregate	Traffic	Estimated rates of application	Other requir emen
10. Estimated aggregate spread rate: For tendering purposes only, actual rates to be determined after measuring of aggregate ALD.										
11. Other requirements: May include job specific requirements such as binder type or surface pre-treatment										

6.3 Annexure – Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C09-HP01	SUBMISSIONS, Products and materials Mix design – Type and source of constituent materials; Test certificates	H	Documentation on material type, source and test certificates as evidence of conformance for each constituent.	3 weeks before commencement	Spray sealing
C09-HP02	SUBMISSIONS, Execution details Sprayed seal design	H	Sprayed seal design details	2 weeks before commencement	Spray sealing
C09-HP03	SUBMISSIONS, Records Plant and equipment	H	Evidence of plant and equipment registration and insurance	2 weeks before using plant	Spray sealing
C09-HP04	INSPECTIONS, Notice Surface preparation	H W for dried back moisture	Completed preparation and rectification of pavement surface defects. Contractor supplied test certificates for dried back moisture % prior to sealing.	2 days before spraying surfacing	Spraying of primer, primerbinder or binder, For development inspections book through "MyInspect".
C09-HP05	INSPECTIONS, Notice Primer/binder application	H	Completed sprayed surface	2 days before spreading aggregate	Aggregate spreading. For development inspections book through "MyInspect".
C09-HP06	INSPECTIONS, Notice Aggregate spreading and rolling	H	Completed rolled surface with linemarkings, services fixtures and warning signs cleaned and in place	1 day before inspection	Opening to traffic, For development inspections book through "MyInspect".
C09-WP07	INSPECTIONS, Notice Non-conforming sections	W	Completed remedial treatment of non-conforming sections.	1 day before the inspection	Linemarking application and opening to traffic

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C09-HP08	SUBMISSIONS, Records Work-as-executed documentation (WAE)	H	Work as Executed Drawings and Road attribute schedules.	On completion	Materials actually used.
*H = Hold Point, W = Witness Point					

6.4 Annexure – Maximum lot sizes and minimum test frequencies

6.4.1 Sprayed bituminous surfacing table

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Materials supply	Material quality – Supplier’s documentary evidence and certification of:			
	• Standard classes of bitumen	1 tanker load	1 per tanker load	AS 2008
	• Multigrade bitumen	1 tanker load	1 per tanker load	AS 2008
	• Polymer modified binder	1 tanker load	1 per tanker load	Austrroads AG:PT/T190
	• Bitumen emulsion	1 tanker load	1 per tanker load	AS 1160
	• Cutback bitumen	1 tanker load	1 per tanker load	AS 2157
	• Adhesion agent	1 delivery	1 per delivery	
	• Cutter oil and flux oil	1 delivery/ tanker	1 per delivery/tanker	AS 3568
	• Aggregate precoating material	1 delivery/ tanker	1 per delivery/tanker	
	• Aggregate	1 contract	1 per 400 m ³	AS 2758.2
	. Flakiness index			AS C08.15
	. ALD for 5 mm and 7 mm aggregate			AS C08.20.2
. ALD for 10 mm			AS C08.20.1	

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
	or larger aggregate			
	• Protective paper	1 contract	1 per sprayer run	
	- Geotextile	1 contract	1 per roll	Austrroads AP-T37
Pavement surface hardness	Embedment value allowance	2,000 m ²	10 per 200 lin. m	Austrroads AG:PT/T251
Application rates	Binder	1 day's operation	Calculate per spray run	
	Aggregates	1 day's operation	Calculate per spray run	
* Note: or part thereof, per lot				

6.4.2 Non-conformance

Requirement: Apply the following if the work or materials supplied are not within the documented requirements:

- Offset the reduced service life arising from the non-conformance by reducing payment for the non-conforming portion of work or material by the method defined in ANNEXURE – SCHEDULE OF JOB DETAILS.
- Any other remedial treatment that is expected to provide the required level of service.

6.5 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS C08.15	1999	Methods for sampling and testing aggregates- Flakiness index
AS C08.20.1	2000	Average least dimension - Direct measurement (nominal size 10mm and greater)
AS C08.20.2	2000	Average least dimension - Direct measurement (nominal sizes 5mm and 7 mm)
AS 1160	1996	Bitumen emulsions for construction and maintenance of pavements
AS 2008	2013	Bitumen for pavements
AS 2157	1997	Cutback bitumen
AS 2758		Aggregates and rock for engineering purposes
AS 2758.2	2009	Aggregate for sprayed bituminous surfacing
AS 3568	1999	Oils for reducing the viscosity of residual bitumen for pavements
AAPA Advisory Note 7	2013	Guide to the heating and storage of binders for sprayed sealing
ARRB	2018	High friction surface guide to good practice.
Austrroads AGPT		Guide to pavement technology
Austrroads AGPT04F	2017	Bituminous binders
Austrroads AGPT04K	2018	Selection and Design of Sprayed Seals
Austrroads AGPT08	2009	Pavement Construction
Austrroads AG:PT/T190	2014	Specification framework for polymer modified binders
Austrroads AG:PT/T251	2010	Ball penetration test

Austrroads AG:PT/T537	2005	Field spread rate of cover aggregate
Austrroads AP-C087	2015	Austrroads glossary of terms. 2015 edition.
Austrroads AP-G41	2015	Bituminous materials safety guide
Austrroads AP-T310	2016	Selection and design of initial treatments for sprayed seal surfacings
Austrroads AP-T37	2005	Geotextile reinforced seals.
Austrroads AP-T236	2013	Update of double/double design for Austrroads sprayed seal design method
RMS SpecificationsQA Specification R106		Sprayed Bituminous Surfacing (with cutback bitumen)
TP-GDL-001		RMS Sprayed Sealing Guide Ed. 2
NATSPEC GEN 025	2017	Sprayed preservation surfacing treatments