

1143 SPRAYED BITUMINOUS SURFACING
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1 GENERAL**1.1 RESPONSIBILITIES****Objectives**

General: Provide sprayed bituminous surfacing for roads and related applications, as documented, comprising:

- Prime.
- Primerseal.
- Seal:
 - . With conventional bitumen, cutback bitumen or bitumen emulsion binder.
 - . With modified binder, e.g. multigrade binder, polymer modified binder.
 - . Incorporating geotextile fabric, with or without modified binder.

Performance

~~Requirements: [complete/delete]~~

Design

Designer: Design the composition of the seal materials.

~~Authority requirements: [complete/delete]~~

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

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

Precedence

General: The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, as detailed in the **Schedule of Job Details**. For multiple treatments, the binder and aggregate may be required to be laid in one or more separate applications. Read this section in conjunction with the **Schedule of Job Details**. If there is conflict between the requirements of this section and **Selections**, the requirements of the **Selections** apply.

1.3 REFERENCED DOCUMENTS**Standards**

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

AS 1160-1996	Bituminous Emulsions for Construction and Maintenance of Pavements
AS 1742	Manual of uniform traffic control devices,
AS 1742.3-2009	Traffic control devices for works on roads
AS 2008-1997	Residual bitumen for pavements
AS 2124-1992	General conditions of contract
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
AS/NZS ISO 9001-2008	Quality Management Systems – Requirements

Other publications

AAPA

AAPA-2004	National asphalt specification. 2nd edition
AAPA HS&E Guide No 8	Guide for Environmental Management when Spraying Bituminous Materials
AAPA-2003	Guide to the Selection, Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt
ASTM D6140-2009	Standard test method to determine asphalt retention of paving fabrics used in asphalt paving for full width applications
<i>AUSTROADS</i>	
<i>Manual of Test Procedures</i>	(www.austroroads.com.au/tm/testmethods.htm)
AGPT03-2009	Guide to Pavement Technology Part 3 – Pavement surfacings
AGPT04F-2008	Guide to Pavement Technology Part 4F - Bituminous binders
AGPT04K-2009	Guide to pavement technology Part 4K - Seals
AP-C87-2010	Austroroads glossary of terms
AP-G41-2008	Bituminous materials sealing safety guide
AP-T37-2005	Geotextile reinforced seals
AP-T40-2005	Audit and surveillance of sprayed sealing contract works
AP-T42-2006	Guide to the selection and use of Polymer Modified Binders and multigrade bitumens
AP-T68-2006	Update of the Austroroads sprayed seal design method
AGPT-T190-2010	Specification framework for polymer modified binders and multigrade bitumens
AGPT-T252-2006	Commentary to AG: PT/T252-2006 - Penetration of road bases by bituminous primers or primebinders

1.4 INTERPRETATION

Definitions

General: For the purposes of this worksection the definitions in AP-C87 and those given below apply.

- Binder: A material used in the mix to improve temperature susceptibility, response to transient loads and cohesive strength.
- Cutter oil: A light petroleum distillate (e.g. kerosene) added to bitumen to temporarily reduce its viscosity.
- Double/double seal: 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.
- Prime: An application of a primer to a prepared base, without cover aggregate.
- Primer: A bituminous material of low viscosity and low surface tension used in priming.
- Primerseal: An application of a primerbinder with a cover aggregate to a prepared base.
- Primerbinder: A material, more viscous than a primer, and required to act both as a primer and binder, and used in primersealing.
- Seal: A sprayed application 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.
- Reseal: A seal applied to an existing sealed, or asphalt surface.
- Residual Binder: The volume of bituminous binder at 15°C including the volume of any polymer, crumb rubber and flux oil but not including the volume of any cutter oil, water, emulsifier or adhesion agent.
- Single/double seal: A seal consisting of a single application of binder followed by a double application of aggregate.
- Single/single seal: A seal consisting of a single application of binder followed by a single application of aggregate.
- High Stress Seal or Reseal (HSS): The application of a polymer modified binder into which aggregate is incorporated to provide a durable wearing surface.

- Strain Alleviating Membrane (SAM): The application of polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.
- 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.
- Geotextile Reinforced Seal (GRS): The applications of C170 tack coat, geotextile or polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.

1.5 SUBMISSIONS

Approval

Submissions: To the Superintendent's approval.

Documents

Submit the following for approval:

- Materials: Refer to material clauses.
- Drawings: Prepare drawings or other documentation to record extent and constitution of final works.
- Execution details: In conformance with worksection requirements.

Type tests: ~~[complete/delete]~~

Type test results: ~~[complete/delete]~~

Calculations: ~~[complete/delete]~~

Manuals: ~~[complete/delete]~~

Prototypes: ~~[complete/delete]~~

Samples: ~~[complete/delete]~~

Technical data: ~~[complete/delete]~~

Warranties: ~~[complete/delete]~~

Design of sprayed seals

Submit the design of sprayed seals as follows:

- The types of sprayed seal treatment as listed in the schedule of job requirements, or as shown on drawings.
- Determine rates of application of binder and aggregate for the nominated sprayed seal treatment types based on Austroads *Sprayed sealing guide*. If specified, submit the seal design for assessment by the Superintendent for compliance with the requirements of this worksection. This is a **WITNESS POINT**.

Materials and application rates: The selection of materials and application rates for surfacing treatments not covered by the Austroads *Seal Design Method*, such as priming, primersealing and special treatments, to be in conformance with guidelines for accepted good practice.

1.6 HOLD POINTS AND WITNESS POINTS

Notice

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

HOLD POINTS table

Clause title/Item	Requirement	Notice for inspection	Release by
PRE-CONSTRUCTION PLANNING			
Sampling and testing	Quality plan to nominate testing frequency	2 weeks before testing materials	<i>Principal Certifying Authority</i>
Traffic management	Submit a traffic	3 weeks before	<i>Principal Certifying</i>

Clause title/Item	Requirement	Notice for inspection	Release by
	management plan for approval	commencing site work	<i>Authority</i>
Plant	Evidence that plant is registered and insured	2 weeks before using plant	<i>Principal Certifying Authority</i>

WITNESS POINTS table – On-site activities

Clause title/Item	Requirement	Notice for inspection
GENERAL		
Submissions, Design	Submit the sprayed seal design for approval	2 weeks before commencing work
MATERIALS		
Aggregate	Source of materials submit for approval	3 weeks before commencing work
Removal of loose aggregate, Loose aggregate particles	Completion within specified time	Various to allow inspection of performance in conformance with Tables of time limits
Removal of surplus and waste material	Demonstrate that materials are properly disposed	Progressive
Protection, New work	Demonstrate that line marking and warning signs are in place to protect new work	Progressive

2 PRE-CONSTRUCTION PLANNING

2.1 GENERAL

Proposed testing frequency

Quality plan: Nominate in the Quality plan the proposed testing frequency including, but not limited to:

- Specification compliance of bituminous materials.
- Specification compliance of aggregates.
- Measurement of loose aggregate on completed work. This is a **HOLD POINT**.

Traffic management

Plan: Submit a Traffic Management Plan for approval. Provide for traffic in conformance with *1101 Control of traffic* while undertaking the work and include the following:

- Supply of labour and materials to *1101 Control of traffic*.
- 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. This is a **HOLD POINT**.

Plant

Registration and insurance: Provide for all plant as appropriate to its use on a public road.
Operation: Conform to statutory environmental regulations. This is a **HOLD POINT**.

3 MATERIALS

3.1 BITUMINOUS MATERIALS

Bitumen

Standard Classes of bitumen: To AS 2008.

Bituminous binders: To AGPT04F.

Multigrade bitumen: To AGPT/T190 available from www.austroads.com.au.

Polymer modified binders

Polymer modified binder: To AGPT/T190 available from www.austrroads.com.au.

Bitumen emulsion

Bitumen emulsion: To AS 1160.

Cutback bitumen

Cutback bitumen: To AS 2157 or may be prepared by the Contractor, in the field, by blending bitumen and cutter oil in proportions documented or selected as appropriate to the particular application.

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

Adhesion agent

Type and proportion: Add the type and proportion of adhesion agent to bituminous binder or aggregate precoating material subject to either of the following:

- Evidence provided of previous satisfactory performance with the proposed combination of binder, aggregate source and precoating material.
- Selection from materials listed as approved by the relevant state road authority (if applicable).

Cutter oil and flux oil

Cutter oil and flux oil: To AS 3568.

Aggregate precoating materials

Aggregate precoating materials: Flux oil, flux oil and bitumen mixture, cutback bitumen, proprietary bitumen emulsion or other proprietary product are subject to evidence of previous satisfactory field performance as an aggregate precoating material. All precoating material to contain a minimum of 1% of an approved adhesion agent.

3.2 AGGREGATE**General**

Source: The source of all materials is subject to inspection and approval by the Superintendent. Only use material from a nominated quarry face or location. This is a **WITNESS POINT**.

Aggregate: To AS 2758.2 with the following additional requirements:

- Specify the class of aggregate, resistance to polishing, method of determination of aggregate shape, and combination of hardness and durability test measures in the **Schedule of Job Details**.
- Apply only one method of determination of aggregate shape and one combination of hardness and durability.
- If no aggregate details are specified in the **Schedule of Job Details**, select the particular aggregate class, polishing resistance and combination of test methods based on the service conditions and customary test procedures used in the State in which the works are located.

3.3 OTHER MATERIALS**Protective paper**

Heavy duty protective paper: Use a heavy-duty protective paper, weighing not less than 120 gm/m², for all start, finish and taper operations. Ensure that the paper is of sufficient width to prevent overspray and of sufficient strength to prevent spillage during removal.

Geotextile

Properties: Geotextile fabric used in geotextile reinforced seals:

- Non-woven.
- Needle punched fabric:
 - . Minimum melting point 190°C.
 - . Minimum mass 130 g/m².

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General

Requirement: Conform to *1101 Control of traffic*.

4.2 APPLICATION

General

Application: Adopt **Annexure A** for procedure.

Scope: Provide the following:

- Supply and delivery of materials.
- Storage and handling of raw materials.
- Precoating of aggregate (if aggregates are not purchased suitably precoated).
- Preparation of bituminous materials, including selection and incorporation of appropriate proportions of cutter oil, adhesion agent and any other additives. To Austroads AP-T42/06.
- Control of traffic through the works, including recording of traffic control measures.
- Removal and disposal, or protection, of existing raised pavement markers.
- Sweeping and cleaning pavement surfaces prior to spraying.
- Protection of road furniture from spray.
- Supply and placing of geotextile, as documented.
- Application of primer, primerbinder and/or binder, uniformly to the target application rate.
- Spreading of aggregate, uniformly to the target application rate.
- Rolling of aggregate.
- Removal of loose aggregate
- Removal and disposal of all surplus and waste materials.
- Installation of temporary pavement markers.
- Care of completed work.

Performance: In conformance with recognised industry standards, AGPT04K, including the following:

- Completed and cured primes to have a uniform appearance.
- Completed primerseals and single/single seals with aggregates of 7 mm size, or less, to have a uniform surface retaining a matrix of aggregate.
- Completed single/single seals with aggregates of 10 mm size, or greater, to have a uniform, single retained layer of aggregate.
- Completed single/double seals to have a uniform layer of retained aggregate with both sizes fitting together to produce a uniform surface texture.
- Completed double/double seals to have uniform double retained layers of aggregate with the second aggregate fitting inside the texture of the aggregate used in the first layer.
- Finished work to have clean straight edges and no obvious defects related to poorly constructed longitudinal or transverse joints, blocked spray nozzles or any other construction fault.

4.3 TESTING

Laboratory testing

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

- Perform in a laboratory registered by the National Association of Testing Authorities (NATA) or International Accreditation New Zealand (IANZ) for the appropriate tests. Perform in conformance with procedures contained in the relevant Australian or New Zealand Standard or Austroads Manual of Test Procedures.
- If there is no applicable Australian Standard or Austroads Test Method or if the Standard/Manual provides a choice of procedures, adopt a procedure endorsed by the relevant state road authority in the State in which the work is being undertaken.

Exceptions: Requirements for NATA or IANZ registration do not apply to field tests such as surface texture measurements or aggregate spreader calibration undertaken by competent and trained personnel.

4.4 REMOVAL OF LOOSE AGGREGATE

Loose aggregate particles

Extent: After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10 mm, or larger, aggregates not to exceed the values specified in **Loose stone particles remaining after sweeping table**.

Windrow aggregate: Remove any windrow of aggregate on either the sealed surface or shoulder that could constitute a traffic hazard. If documented, uplift and remove from the works all surplus aggregate.

Timing: Complete the removal of loose aggregate from the trafficked pavement within the time specified in **Time limit for removal of loose aggregate table**. This is a **WITNESS POINT**.

Loose stone particles remaining after sweeping table

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

Time limit for removal of loose aggregate table

Traffic volume (vehicles/lane/day)	Maximum time limits
> 2000 and all freeways	Within 8 hours of sealing
1000 to 2000	Within 24 hours of sealing
250 to 1000	Within 48 hours of sealing
< 250	Within 5 days of sealing

4.5 REMOVAL OF SURPLUS AND WASTE MATERIAL

Cleaning

Completion: Prior to leaving the work site, ensure that all services are uncovered and cleaned, if necessary. Remove from site all waste paper and rubbish arising from the sprayed sealing operations. Clean the stockpile site and store any excess material in a tidy heap or remove, depending on the requirements of the Superintendent. This is a **WITNESS POINT**.

4.6 PROTECTION

New work

Warning signs: Protect the new work by providing signage as follows:

- Provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers.
- Maintain signs until loose aggregate has been removed and linemarking reinstated.
- If linemarking is to be undertaken by others, erect warning signs indicating the absence of linemarking to be maintained by the organisation responsible for linemarking. These activities are a **WITNESS POINT**.

Services and road Fixtures

Protection: Take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, bridge or culvert decks and other road fixtures.

Cleaning: Immediately after aggregate has been spread, clean off or remove any sprayed material and leave the services and road fixtures in a condition equivalent to that existing when the sprayed surfacing work commenced.

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT BY AREA OR LENGTH

Pay Items	Unit of measurement	Schedule rate scope
1143.1 Priming, primer sealing or sealing	m ² -Area	No deductions for openings each not exceeding 1 m ² . All costs associated with priming, primer sealing or sealing.
1143.2 Removal and disposal of existing raised pavement markers	Measured by length in kilometres	

5.2 MEASUREMENT BY QUANTITY OF MATERIAL SUPPLIED

Pay items	Unit of measurement	Schedule rate scope
1143.3 Supply and spray primer or primer binder (including preparation of surface) @ 15°C	Litres Determine the quantities (in litres) by either: - Multiplying the target application rate of the combined mixture of primer or primerbinder (including any cutter or flux oil) at 15°C (in litres/m ²) by the area of road surface sprayed for each sprayer run (in m ²); or - Measurement of actual volume (at 15°C) of materials used.	All costs associated with the preparation of surface and supply and spray primer or primebinder
1143.4 Supply and spray binder (including adhesion agent where required, and preparation of surface) @ 15°C	Litres Determine the quantities (in litres) by either: - Multiplying the target application rate of the residual (excluding any cutter oil or flux oil) at 15°C (in litres/m ²) by the area of road surface sprayed for each sprayer run (in m ²); or - Measurement of actual volume (at 15°C) of materials used.	All costs associated with the supply and spray binder.
1143.5 Supply, incorporate and spray cutter oil, flux oil and adhesion agent in binder at ambient temperature or 15°C	Litre Determine the quantities from either: - The target proportion of cutter, oil flux oil, or adhesion agent added to the binder; or	All costs associated with the supply of cutter oil, flux oil and adhesion agent in the binder.

Pay items	Unit of measurement	Schedule rate scope
	- Measurement of actual volume of materials used.	
1143.6 Supply, precoat, apply aggregate	m ³ - Volume. - Determine the quantity of aggregate (in m ³) by dividing the area of road surface covered by each sprayer run (in m ²) by the target application rate (in m ² /m ³)	All costs associated with the supply, precoat and application of aggregate
1143.7 Roll and incorporate aggregate	m ²	All costs associated with the rolling of aggregate
1143.8 Supply and place geotextile	m ² - Pavement area covered	All costs associated with the supply and placement of geotextile to exclude laps and application of binder and aggregate.
1143.9 Sweeping	m ²	All costs associated sweeping prior to seal and post seal

5.3 NON COMPLYING MATERIALS

Non compliance

General: If the work or materials supplied is not within the standards defined for supply and application of sprayed bituminous surfacing, the Superintendent may direct:

- That the reduced service life arising from the non compliance is offset by reducing payment for the non complying portion of work or material by the method defined in **Schedule of Job Details**; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.

6 SELECTIONS

6.1 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 (1)
		Map ref. (1)	Chainage	Distance markers or ref. points				Type (2)	Desc (3)	Apps (4)	Size (s)	Class min (5)	PSV/ PAFV min (6)	veh/lane/day (7)	heavy eh. % (8)	Binder L/m ² (9)	Agg. m ² /m ³ (10)	

1. Map references should nominate directory used
2. Treatment type: Prime only (PO), Primerseal (PS), Prime and seal (P&S), Reseal (R).
3. Treatment description: Strain alleviating membrane (SAM), Strain alleviating membrane interlayer (SAMI), Geotextile reinforced seal (GRS), Surface enrichment (SE)
4. Number of applications: Single/single (S/S), Single/double (S/D), Double/double (D/D)
5. Aggregate Class: A, B or C (AS 2758.2)
6. Aggregate PSV or PAFV: 48 for Class A aggregates unless otherwise specified.
7. Veh/lane/day (v/l/d): Annual Average Daily (24 hr) Traffic / Number of traffic lanes.
8. % Heavy vehicles: Percentage of AADT that are counted as heavy vehicles.
9. Estimated binder application rate for tendering purposes only. Actual rates to be determined after measurement of surface and aggregate properties.
10. Estimated aggregate spread rate for tendering purposes only. Actual rates to be determined after measurement of aggregate ALD.
11. Other requirements may include job specific requirements such as binder type or surface pretreatment.

7 ANNEXURE A: PROCEDURE FOR PERFORMING SPRAYED SEALING WORKS

7.1 GENERAL

This section details the procedure, based on good practice, to achieve satisfactory outcomes and durable performance from sprayed sealing work. The following procedures may be incorporated in the Contractor's Quality Plan or provide a benchmark for assessing the effectiveness of the process standards adopted by the Contractor.

7.2 STORAGE AND HANDLING OF RAW MATERIALS

Aggregates

Requirement: Arrange and manage aggregate stockpiles in conformance with the following requirements:

- The maximum lot size limited to 250 m³ (approximately 300 tonnes).
- Stockpiles each located on a firm level ground and effectively separated to prevent cross-contamination and interfere with the loading and/or precoating operations.
- Siting of stockpiles ensure adequate clearance between machinery and overhead power lines.
- Stockpiles managed to avoid environmental damage from dust or run-off of bituminous materials.
- The quantity and type of each stockpile clearly signposted on the stockpile at all times.
- Stockpiles covered, if necessary, to reduce contamination by dust or water.
- Recovery from stockpiles is to avoid contamination of aggregates.
- Contamination, weathering or reduction in effectiveness of precoating of aggregates in stockpiles to be rectified or the stockpile replaced.

Binder

Heating of binder: Heat binder in conformance with the manufacturer's written recommendations but never exceed 200°C. Do not use any bituminous material that has been overheated unless tested for compliance with the relevant specification. If no specific recommendation is provided, adopt the temperature guidelines set out in AAPA-2003.

Storage: Store binder in conformance with the temperature and time combinations specified in the manufacturer's written recommendation. Implement procedures for storage and handling of binder that ensure prevention of segregation and contamination of the binder by flushing liquids or other materials. Use straining devices at all times when transferring binders into sprayers to avoid particles of hardened bituminous material or other contaminants that could cause blockages in spraying jets.

7.3 CONDITION FOR COMMENCEMENT

Acceptance of surface condition

Inspection: Prior to commencing sprayed sealing work, make an inspection to determine any pavement defects that could adversely affect the quality of the finished work. Sprayed sealing work is not to proceed until defects have been corrected or agreement reached with the Superintendent's Representative on responsibility for consequences of any recorded defects.

Defects requiring correction may include, but are not limited to:

- Excessive moisture in unbound granular base to be primed or primersealed.
- Loose, poorly bonded, or inadequately compacted materials in the surface of unbound granular base to be primed or primersealed.
- Poorly shaped unbound granular base to be primed or primersealed.
- Presence of soft, fatty or bleeding patches in pavements to be resealed.
- Presence of uncured patching materials, crack sealing, etc.

- Presence of porous patches in surface to be resealed.
- Significant variations in surface texture requiring corrective treatment before resealing.
- Inadequate repair of weak or cracked pavements.
- Inadequate curing of primed surfaces prior to sealing.
- Inadequate curing of primersealed pavements (generally a minimum of 12 months for cutback bitumen primerbinders) prior to resealing.

Preparation of pavement surface

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

Pavement temperature and weather conditions

Record of weather conditions: Conform to the following:

- Measure and record pavement temperatures at regular intervals during the course of the work using appropriate equipment and measurement procedures.
- If the pavement is partly in sun and partly in shade, record the temperatures for both conditions. The lower recorded temperature to be used as a basis for decisions on suitability for spraying and selection of cutter oil proportions.
- Spraying primers, primerbinders and binders only if the pavement temperature has been at or above for the temperature shown in **Table A1** at least one hour before commencement of spraying and does not fall below the recommended minimum pavement temperature during the period of spraying.
- Spray at temperatures below that recommended only if 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.

Table A1 Minimum pavement temperature

Type of work	Minimum pavement temperature
Priming	10°C
Primersealing	10°C
Sealing: -Class 170, Class 320 bitumen, Multigrade binder or bitumen emulsion -PMB binder (hot)	15°C 20°C

Surface condition

General: Conform to the following:

- 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 primersealing: Damp, but not wet. If necessary, the pavement surface may be lightly watered shortly before applying the primerbinder.
- Surfaces for sealing: Dry and clean.

Environmental Risk

Risk assessment: The risk of environmental damage due to primer or primerbinder being washed off into adjacent drains and open watercourses as a result of rain on uncured materials must be considered as an element of an overall risk management plan. A guide

to the risk of primer or primerbinder wash-off as a result of rain within stipulated periods after spraying is shown in **Table A2**.

Table A2 Priming Primersealing Risk Assessment

(From: *Guide for Environmental Management when Spraying Bituminous Materials, AAPA HS&E Guide No 8*)

(a) Cutback bitumen				
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
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				
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
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
<ol style="list-style-type: none"> 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 shown. 2. Typical temperatures associated with different weather conditions are: Hot = 25°C, Warm = 15–25°C, Cool = 15°C. 3. If risk is classified as unacceptable, application should be delayed until conditions improve. 4. If risk is classified as high, application should be delayed or the application and curing supervised 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 ensure prompt response to rain events. 				

7.4 PREPARATION OF AGGREGATES

Precoating of aggregate

Aggregate: Conform to either of the following:

- Precoated at the quarry, or on site, and stockpiled for later use, or
- Precoated on site, immediately prior to use.

Advance precoating is preferred to be done with a bitumen-based material that leaves a thin film of bitumen adhering to the aggregate. Bitumen based materials may be a mixture of bitumen, flux oil/cutter oil and adhesion agent or bitumen emulsion specifically

formulated for use as aggregate precoating material. Bitumen/flux oil mixtures to be cured for a minimum of one week before use. Precoated aggregates that have been stockpiled for more than one month to be re-assessed for effectiveness of precoating and possible rejuvenation before use.

Precoating on site, for immediate use, to be done with either 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 to be added to oil based precoating materials at the rate of 1% by volume when aggregates are damp or the weather conditions are unfavourable with rain threatening or humid conditions.

Apply the aggregate precoating agent to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

A guide to rates of application on clean, dry aggregates is given in **Table A3**. Dusty or dirty aggregates require a heavier rate of precoating than clean dry aggregates of the same type and size. For porous aggregates, rates may need to be increased by up to 2 L/m³, and for smooth, hard aggregates, reduced by up to 2 L/m³, from the values shown in **Table A3**. Generally, bitumen based materials and emulsions require heavier rates of application than oil based precoating materials.

Field precoating of aggregate for immediate use is not to be carried out when rain is imminent. If aggregate has been precoated and rain appears imminent, adequately cover the aggregate to prevent the fresh precoating material being washed from the aggregate particles.

Take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the precoating material on the stockpiled aggregate.

Table A3 Typical precoating rates (L/m³)

Aggregate condition	Precoating material	
	Bitumen based, including bitumen emulsions	Oil based
Clean	6 to 12	4 to 10
Dirty	8 to 14	6 to 12

7.5 PREPARATION OF BITUMEN BINDER

Proportion of cutter oil

Determine and record the proportion of cutter oil required for each sprayer load.

Tables A4 and **A5** provide a guide to the proportions of cutter oil for Class 170 or 320 bitumen, multigrade binder and polymer modified binders, respectively.

Adding cutter oil: Binder to be within the temperature range shown in **Table A6** when cutter oil is incorporated. The sprayer load of cutback bitumen to be circulated at a rate of at least 700litres/min (approximately 350 rpm) for a minimum of twenty minutes before spraying.

Take care to ensure that any material that is to be added to hot binder is free of moisture. Materials considered at risk from moisture contamination, for example drummed materials stored in the open, should be checked with a water-finding paste before use. When adding cutter oil to standard bitumen binders, risks associated with moisture can be reduced by placing the cutter oil into a sprayer that has not been previously heated, followed by the hot bitumen.

When adding cutter oil to polymer modified bitumen binders, including crumb rubber binder, the cutter oil is to be added to the hot binder.

If a part sprayer load of field prepared cutback bitumen is unused on the day of mixing, and needs to be returned to the heater tanks, place it in a tank reserved for that purpose. No bitumen or cutter oil to be added to the returned cutback bitumen unless the tank is fitted with an effective circulation system. When the returned cutback bitumen is subsequently used as part of a sprayer load, make allowance for the cutter oil contained in the returned cutback bitumen.

Cutback bitumen to be within the temperature range shown in **Table A7** at the time of spraying. Spraying temperatures for proportions of cutter oil between those shown in the table may be established by interpolation.

Adding flux oil

If flux oil is to be included, it is to be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres/min for 20 minutes before spraying. Take care to ensure that flux oil that is to be added to hot binder is free of moisture.

Adding bitumen adhesion agent

If bitumen adhesion agent is to be included, add it to the bitumen in the sprayer and the entire mixture circulated at a rate of at least 700 litres/min for 20 minutes, after addition of the last component, before spraying.

If bitumen containing adhesion agent is not used within 8 hours of mixing with hot bitumen, the active contribution of adhesion agent is to be ignored in subsequent use of the bitumen material. However, make allowance for the oil component of the adhesion agent in the returned bitumen.

Table A4 Basic Cutting Practice for Class 170 Bitumen and Multigrade Binder

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

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

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.

Table A5 Guide to Cutting Practice for PMBs used in SAM and HSS Applications 1, 2
(Parts by volume of cutter oil to be added to 100 parts by volume of PMB-measured at 15°C) (Note 3)

Pavement Temperature ⁴ (°C)	Traffic (veh/lane/day)	Class of PMB				
		S15E	S20E	S35E	S45R	
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	

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 at all. If cutter oil is considered necessary, it should be 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.
2. In aggregate retention applications using lower levels of polymer modification i.e. S10E, and some proprietary blends of PBD, the binder should be cut back as per normal Class 170 bitumen
3. If cutter proportions are added as percentage of total binder, the proportions shown here as parts per 100 parts of PMB may be taken as a reasonable approximation of percentage by volume.
4. Pavement temperature should generally be based on the worst condition, i.e., shaded areas.
5. Pre-blended crumb rubber grades may contain process oil used in their manufacture. This oil will most likely reduce the viscosity compared to field blended grades, and may allow a small reduction, say 2 parts, in added cutter oil compared to field produced grades.
6. At high rates of application of binder (greater than say 2 L/m²) the proportion of cutter oil may be reduced by 2 parts.

Table A6 Binder Temperature

Binder	Temperature range (°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

Table A7 Cutback Bitumen Spraying Temperature

AS Grade (if applicable)	Equivalent Cutter Oil (%)	Temperature Range (°C)
AMC 00	56	ambient
AMC 0	44	35–55
AMC 1	34	60–80
AMC 2	27	75–100
AMC 3	21	95–115
AMC 4	16	110–135
AMC 5	11	120–150
	9	130–155
AMC 6	7	135–160
	5	145–170
AMC 7	3	150–175
	2	155–180

7.6 APPLICATION OF PRIMER, PRIMERBINDER AND BINDER

General

The area to be sprayed with primerbinder or binder is to be limited to the area that can be covered with aggregate within fifteen minutes of spraying.

Primer and primerbinder

The class and grade of primer and primerbinder to be as specified in **Schedule of job details**.

Application rates and quantities of primer and primerbinder applied to the mixture, including cutter oil or the water content of bitumen emulsion, are measured at 15°C.

After application of a primer, a period of at least seventy-two hours, or such longer period as determined to be necessary for the primer to become completely dry, is to elapse before the binder for a seal is applied. All traffic to be kept off the primed surface.

If it is necessary to give traffic limited access to the primed surface, the surface is to have a light layer of grit applied to avoid pickup. Gritting is not to be applied until a substantial proportion of the primer has been absorbed into the pavement.

Binder

The class or type of bitumen, modified bitumen, cutback bitumen, or bitumen emulsion is to be as specified in the **Schedule of job details**.

Nominated and target application rates and quantities of binder to be based on the volumes of bitumen measured at a temperature of 15°C and not include any adhesion agent and/or cutter oil or the water content of emulsions. If flux oil has been added to the bitumen, the quantity of flux oil is to be included as part of the binder.

If adhesion agent and/or cutter oil have been added to the binder, adjust the application rate of the total binder at 15°C to allow for the quantities of adhesion agent and/or cutter oil in the mixture.

Determine the forward speed of the bitumen sprayer based on either:

- the hot application rate of total binder, including adhesion agent and/or cutter oil, or
- allowances for temperature and proportion of adhesion agent and cutter oil, measured at 15°C.

Volume correction factors for converting volume of bituminous binders from 15°C to elevated temperature, or from elevated temperature back to 15°C are shown in **Tables A8** and **A9**.

Table A8 Volume Conversion Table – Bitumen (Including cutback bitumen)

MULTIPLY BY "A" TO REDUCE VOLUME AT T° TO VOLUME AT 15° MULTIPLY BY "B" TO INCREASE VOLUME AT 15°C TO VOLUME AT T°					
Multiplier A	Temp. °C T	Multiplier B	Multiplier A	Temp. °C T	Multiplier B
.9856	38	1.0146	.9189	148	1.0883
.9844	40	1.0158	.9178	150	1.0896
.9831	42	1.0172	.9166	152	1.0910
.9819	44	1.0184	.9154	154	1.0924
.9806	46	1.0198	.9142	156	1.0939
.9794	48	1.0210	.9130	158	1.0953
.9782	50	1.0223	.9119	160	1.0966
.9769	52	1.0236	.9107	162	1.0981
.9757	54	1.0249	.9095	164	1.0995
.9745	56	1.0262	.9084	166	1.1009
.9732	58	1.0275	.9072	168	1.1023
.9720	60	1.0288	.9060	170	1.1038
.9708	62	1.0301	.9049	172	1.1051
.9695	64	1.0315	.9037	174	1.1066
.9683	66	1.0327	.9025	176	1.1080
.9671	68	1.0340	.9014	178	1.1094

MULTIPLY BY "A" TO REDUCE VOLUME AT T° TO VOLUME AT 15° MULTIPLY BY "B" TO INCREASE VOLUME AT 15°C TO VOLUME AT T°					
Multiplier A	Temp. °C T	Multiplier B	Multiplier A	Temp. °C T	Multiplier B
.9659	70	1.0353	.9002	180	1.1109
.9646	72	1.0367	.8990	182	1.1123
.9634	74	1.0380	.8979	184	1.1137
.9622	76	1.0393	.8967	186	1.1152
.9610	78	1.0406	.8956	188	1.1166
.9597	80	1.0420	.8944	190	1.1181
.9585	82	1.0433	.8933	192	1.1195
.9573	84	1.0446	.8921	194	1.1209
.9561	86	1.0459	.8909	196	1.1224
.9549	88	1.0472	.8898	198	1.1239
.9537	90	1.0486	.8886	200	1.1253
.9524	92	1.0500			
.9512	94	1.0513			
.9500	96	1.0526			
.9488	98	1.0540			
.9476	100	1.0553			
.9464	102	1.0566			
.9452	104	1.0580			
.9440	106	1.0593			
.9428	108	1.0607			
.9416	110	1.0620			
.9404	112	1.0634			
.9392	114	1.0647			
.9380	116	1.0661			
.9368	118	1.0675			
.9356	120	1.0688			
.9344	122	1.0702			
.9332	124	1.0716			
.9320	126	1.0730			
.9308	128	1.0743			
.9296	130	1.0757			
.9284	132	1.0771			
.9272	134	1.0785			
.9260	136	1.0799			
.9249	138	1.0812			
.9237	140	1.0826			
.9225	142	1.0840			
.9213	144	1.0854			
.9201	146	1.0868			

Table A9 Volume Conversion Table – Bitumen Emulsion

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
.9998	16	1.0002	.9977	20	1.0023	.9974	20	1.0026
.9989	18	1.0011	.9951	25	1.0049	.9948	25	1.0052
.9980	20	1.0020	.9924	30	1.0076	.9921	30	1.0079
.9971	22	1.0029	.9899	35	1.0102	.9895	35	1.0106
.9962	24	1.0038	.9872	40	1.0129	.9868	40	1.0134
.9953	26	1.0047	.9840	46	1.0162	.9837	46	1.0166
.9944	28	1.0056	.9830	48	1.0172	.9826	48	1.0177

.9935	30	1.0065	.9819	50	1.0184	.9816	50	1.0187
.9926	32	1.0074	.9809	52	1.0194	.9805	52	1.0199
.9917	34	1.0083	.9798	54	1.0206	.9794	54	1.0210
.9908	36	1.0092	.9788	56	1.0216	.9783	56	1.0222
.9899	38	1.0102	.9777	58	1.0228	.9773	58	1.0232
.9890	40	1.0111	.9767	60	1.0238	.9762	60	1.0244
.9881	42	1.0120	.9752	62	1.0254	.9751	62	1.0255
.9872	44	1.0129	.9746	64	1.0260	.9740	64	1.0267
.9863	46	1.0138	.9736	66	1.0271	.9730	66	1.0277
.9854	48	1.0148	.9725	68	1.0282	.9719	68	1.0289
.9845	50	1.0157	.9715	70	1.0293	.9709	70	1.0300
.9836	52	1.0166	.9704	72	1.0305	.9698	72	1.0311
.9827	54	1.0176	.9693	74	1.0316	.9687	74	1.0323
.9818	56	1.0185	.9683	76	1.0327	.9677	76	1.0334
.9809	58	1.0194	.9672	78	1.0339	.9667	78	1.0344
.9800	60	1.0204	.9662	80	1.0349	.9656	80	1.0356
.9791	62	1.0213	.9651	82	1.0361	.9643	82	1.0370
.9782	64	1.0222	.9640	84	1.0373	.9630	84	1.0384
.9773	66	1.0232	.9630	86	1.0384	.9616	86	1.0399
.9764	68	1.0241	.9619	88	1.0396	.9603	88	1.0413
.9755	70	1.0251	.9608	90	1.0407	.9590	90	1.0427

7.7 APPLICATION OF SPRAYED BITUMINOUS SURFACING

Plant

Use a mechanical sprayer to apply primer, primerbinder and binder. The sprayer is to have a current Sprayer Certificate issued by a NATA accredited testing authority. Keep a copy of the test certificate with the sprayer.

A register of accredited sprayers is maintained by AAPA and available on the AAPA Web Site (www.aapa.asn.au).

The spray nozzles are to be of the make and type endorsed on the Sprayer Certificate. Any nozzles that may be damaged or become unduly worn or defective are to be replaced. Use mechanical spreading equipment to spread aggregate which is capable of achieving a uniform spread rate.

Rollers to be pneumatic tyred multi-wheel rollers with a minimum mass of 7 tonnes, smooth tyres and a minimum tyre pressure of 550 kPa, or combination rollers having a rubber coated, vibratory drum on one axle and pneumatic tyres on the other. Rollers must be capable of achieving effective incorporation of aggregate into the binder without breakdown or crushing of the cover aggregate.

Remove from the work any plant or equipment not fully operational or not in a satisfactory condition for carrying out work in conformance with this worksection.

Operation of the sprayer

The type of spray nozzles to be used on the spray bar of the sprayer is to be compatible with the nature of the binder to be sprayed and its application rate.

Where the longitudinal edges of spray runs are not required to overlap, either special type end nozzles or intermediate nozzles set with a jig as end nozzles may be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs to be 50 mm for special type end nozzles or jig set intermediate nozzles. If intermediate nozzles, set in the normal manner, are to be used to overlap adjacent longitudinal sprays, the overlap is to be 300 mm.

The spraying of primer, primerbinder or binder for each run of the sprayer is to commence on a protective strip of heavy paper laid across, and held securely to, the pavement surface beforehand. The sprayer is to commence moving at a sufficient distance

in advance of the protective strip to ensure that the road speed for correct application is attained at the commencement of spraying.

The sprayer to maintain a constant road speed throughout the length of each sprayer run. The spraying for each run to terminate on protective paper laid across, and held securely, to the pavement surface beforehand.

Cease spraying immediately any defect develops in the spraying equipment and the fault rectified before further spraying.

If any blockage or partial blockage of nozzles occurs, cease spraying immediately.

Spraying is not to recommence until the cause of the blockage is identified and rectified. Areas not within 5% of the target application rate of primer, primerbinder or binder shall constitute a 'Non-conformance' under the contract.

If a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, spray such areas by means of the hand spray equipment attached to the sprayer.

After each sprayer run, check the quantity of binder sprayed against the area covered. If the actual application rate is not within specified limits, make adjustments to ensure that the target application rate is achieved in subsequent runs.

Temperature

Measure and record the temperature of the binder.

If the temperature of the bituminous material is below the applicable lower limit from **Tables A6** or **A7**, the bituminous material may be heated provided that safe heating practices are adopted. All heating activities to conform to the Austroads AP-G41 *Bitumen Sealing Safety Guide*.

Do not use burners unless the level of the material in the heating tank is at least 150 mm above the tops of the heating tubes, or as indicated by the manufacturer of the equipment. Two or more suitable fully charged pressurised chemical fire extinguishers to be placed conveniently to the heaters at all times while heating is in progress.

During heating, the temperature of the bituminous material not to exceed the applicable upper limit from **Tables A6** or **A7**. The rate of heating is not to exceed the rate shown in **Table A10**. Materials to be circulated at all times while heating and for a further minimum of 15 minutes after burners are turned off.

Table A10: Maximum Heating Rate for Bituminous Materials

Material	Maximum Heating Rate (°C/hr)
Bitumen & Multigrade binder	40
Cutback Bitumen:	
- Priming grades	30
- Primersealing grades	30
- Sealing grades	30
Crumb rubber bitumen	40
Polymer modified binder	Refer manufacturer's recommendations
Bitumen emulsion	15

Geotextile

Apply geotextile if nominated in the **Schedule of details**. 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. The rate of application of tack coat is 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).

Joins to be butt joined or overlapped by a minimum of 200 mm as specified in the **Schedule of details**. Longitudinal joins not to be placed in wheel paths.

Work records

Record details of the work performed. Details of primer, primerbinder, binder and aggregate applied to be recorded immediately after every sprayer run. Each form is to be signed by the Contractor's representative as a true record of the work performed. Supply to the Superintendent a copy of each completed form.

Control of traffic

Provide for traffic in conformance with the requirements of AS 1742.3 while undertaking the work and take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate. Where early use of the new seal is needed to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no displacement of aggregate occurs. Where necessary, use patrol vehicles to ensure that traffic travels at an acceptable speed.

Take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or sidetracks are included in the Contract or are otherwise available, direct traffic temporarily while the work is in progress.

If facilities for the diversion of traffic are not available, spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway or schedule spraying operations in such a manner so as to restrict traffic delays to a maximum of 15 minutes. All traffic movement through the work are to cease during the actual spraying operation.

Detailed records of traffic control including control device type, precise location of device and the time at which such device was installed and removed, to be maintained throughout the works and then kept on file.

7.8 SPREADING AND ROLLING OF AGGREGATE

Proceed with spreading of aggregate as soon as practical after spraying of the binder has commenced and complete within fifteen minutes of spraying.

Apply the aggregate of the specified nominal size and at the target aggregate application rate. The method to determine the actual aggregate spread rate is to be detailed in the Quality Plan. Ensure that sufficient loaded and measured trucks of aggregate are at the site to provide full cover for the area sprayed.

Spread the aggregate uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Calibrate spreaders with aggregate from the stockpile to be used for the work. Calibration is best done off-road. A calibration site needs to be of sufficient length to allow the aggregate spreading unit to reach normal operational speed before applying the aggregate. Calibration can be done with standard calibration mats or by painting 1 m² areas on the test site. The total width of the aggregate spreader must be calibrated.

Any bare or insufficiently covered areas to be re-run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Remove any local excess of aggregate before rolling is commenced.

Supply sufficient rollers to ensure that total area sprayed receives the minimum coverage (roller hours) derived from **Table A11**. Allow adequate time at the end of the day's work to ensure that the last materials spread receive the same amount of rolling as that placed earlier in the day.

After the aggregate has been applied to each section of the work, carry out initial rolling with one or more rollers complying with Application of primer, primerbinder and binder.

Continue initial rolling until the aggregate is firmly adhered to the primerbinder or binder. Reduce the amount of rolling while the aggregate is wet, but resume normal rolling as soon as aggregate dries. Trafficking during this period to be avoided, or kept to a minimum speed, until aggregate has dried sufficiently for adhesion to be established.

Table A11 Area that can be effectively rolled, per hour, with each pneumatic tyred multi-wheel roller

Aggregate size (mm)	Traffic Volume (vehicles per lane per day)		
	< 300	300–1200	> 1200
	Area – m ² per 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

If the aggregate is not evenly distributed over the surface of the pavement, traverse the surface with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primerbinder or binder, defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor may substitute light hand brooming.

Then carry out backrolling until the effective amount of rolling in terms of roller hours for the total area sprayed achieves that shown in **Table A11**.

When the aggregate has been evenly distributed and adhered to the binder, remove any remaining loose particles of aggregate from the pavement.

Variations to spreading and rolling procedures are to be applied to different types of seals as follows:

- Single/single seals A single application of aggregate is to be applied on a single application of binder and then the seal is rolled and, where necessary, brooming carried out as described above.
- Single/double seals In a single/double seal, the second application of aggregate is applied after initial rolling of the first application, and before final rolling and trafficking.
- Double/double seals Where both applications of binder and aggregate are to be applied on the same day, the first application of binder and aggregate to be completed as described above, except that the aggregate application is reduced by approximately 10% compared to that required for a single/single seal. The second application of aggregate, following the second application of binder, is to be applied at a rate that is just sufficient to fill the voids in the first application, and rolling and removal of any remaining loose aggregate completed as described above. Where the binder in the first application is a bitumen emulsion, the second application must not be applied until the binder in the first coat is completely broken to form a stable seal.

Where the first application of a double/double seal is to be trafficked for a short period of time, generally not exceeding several weeks, the first application is to be completed as a single/single seal and the aggregate in the second application reduced by about 30% to occupy the voids in the first application.

Where the second application is applied after a significant period of trafficking, both applications are to be completed as single/single seals.

8 ANNEXURE B: NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

HEADINGS BELOW RELATE TO THE CLAUSE TITLES USED IN THE MAIN BODY OF THE WORKSECTION

8.1 GENERAL

Applicability

General: The worksection covers the supply of materials and application of sprayed sealing. It is applicable to contract works where the Principal defines the type of treatment required and the Contractor undertakes those activities associated with supply of materials, determination of application rates of binder and aggregate, preparation and spraying of binder, preparation and application of aggregates, rolling of aggregates and clean-up of completed work. Where some of the activities described in this worksection are undertaken by others, responsibility for the relevant items must be clearly defined in the **Responsibilities**.

This worksection will normally be used as contract documentation in conjunction with a standard General Conditions of Contract such as AS 2124. Contract documentation may also include other works. The terms used in the worksection guidelines are consistent with AS 2124, and include Principal, Superintendent, and Superintendent's Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Schedule of Details: The type of seal, class and nominal size of aggregate and any special binder requirements should be specified in the **Schedule of Job Details**.

Careful consideration of the Schedule of Job Details is required to ensure that the sprayed seal is of the appropriate type and quality, and provided in a cost effective manner.

Surface preparation: Preparation of surfaces under this worksection is limited to preliminary sweeping and cleaning of surfaces immediately prior to spraying of bituminous material. The scope of work does not include preparation of granular pavements for priming or primersealing, rectification or maintenance of surfacings prior to resealing or the reinstatement of linemarking, raised pavement markers, etc.

Surface preparation is extremely important to the success of sprayed sealing work.

Granular pavements should be prepared to a smooth dense surface and dried back to a suitable moisture content (typically 70% of saturation level) to avoid weakening of the granular pavement with trapped moisture. Preliminary work for retreatment of existing surfacings should be carried out well in advance of sealing work (typically six weeks or more). Embedment of aggregate and variable texture of patches is a major cause of blemishes in finished work. Effective application of sprayed seals requires an underlying surface of uniform texture. Corrective treatments may be required for variable surfaces prior to, or in conjunction with sprayed sealing treatments.

Notes on the preparation of pavements are provided in **Annexures A** and **B**. Further detailed guidance for the selection of sprayed seal treatments and preparation of surfaces is provided in the Austroads AGPT03 *Pavement Surfacing*, AGPT04K *Seals*, AGPT/T190 *Specification framework for polymer modified binders and multigrade bitumens* (www.austroads.com.au/pavements), AP-T42/06 *Guidelines for the Selection and Use of Modified Binders*.

Quality systems

The quality requirements of *0161 Quality (Construction)* are designed to apply the AUS-SPEC quality system requirements.

The following paragraphs may be substituted if desired:

‘The Contractor shall establish, implement and maintain a Quality System in conformance with this worksection and the requirements of AS/NZS ISO 9001, or a recognised equivalent.’

‘Where required in the contract general clauses, the Contractor shall submit a Quality Plan prior to commencement of any works. The Quality Plan shall take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. Appendix B provides Guidelines for process items which may be included in the Quality Plan. No part of the Quality System shall be used to pre-empt or otherwise negate the technical requirements of the contract documents.’

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor’s Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

8.2 MATERIALS

Bituminous materials: The type and/or grade of primer, primerbinder or binder should be specified in **Schedule of Job Details**.

Cutback bitumen for priming and primersealing (and occasionally for sealing) may be specified in terms of the following alternatives:

- Standard grades of cutback bitumen manufactured conforming to AS 2157;
- Cutback bitumen produced in the field by blending Class 170 bitumen with an appropriate type and proportion of cutter oil in a bitumen sprayer, tanker, etc.;
- Proprietary grades of cutback bitumen;
- Standard grades of bitumen emulsion conforming to AS 1160;
- Proprietary grades of bitumen emulsion.

Suppliers of proprietary products should be required to submit their own product specifications for use as a basis for quality control.

Depending on their viscosity, standard grades of cutback bitumen are classified as follows:

- Priming classes (AMC00, AMC0, AMC1);
- Primersealing classes (AMC2, AMC3, AMC4);
- Sealing classes (AMC5, AMC6, AMC7).

When used for primersealing, an adhesion agent (usually 1%) should be added to cutback bitumen primerbinders. Adhesion agents may also be added to priming classes, although this is not mentioned in AS 2157.

A guide to the properties of cutback bitumen is provided in **Tables B1** and **B2**. **Table B1** provides a guide to the proportions of cutter oil required for field preparation of cutback bitumen. **Table B2** provides a guide to practical grades of cutback bitumen primer and primerbinder for various applications based on the viscosity of the binder.

The selection of particular priming and/or primersealing products should be based on field trials or experience. Guidance on the selection of grade and application rate of primer and primerbinder is given in **Design of spray seals**.

Generally, Class 170 (also Class 320) bitumen is used as the binder for sprayed sealing work with the addition of cutter oil as required, depending on ambient conditions.

Modified binders, as well as bitumen emulsion, may also be used. Guidance on the selection of modified binders and other binders for special application is provided in the references outlined in GENERAL, above.

The use of standard grades of cutback bitumen for sealing is uncommon, as sealing binders are generally prepared at the time of application with the proportion of cutter oil adjusted to the ambient conditions at that time.

Table B1 Field preparation of medium curing cutback bitumen

Class (AS 2157 designation)		Approx. parts kerosene per 100 parts bitumen (vol. at 15°C)	Equivalent percent of kerosene (vol. at 15°C)	Viscosity at 60°C (Pa.s)
Precoating and priming classes	AMC00	127	56	0.008–0.016
	AMC0	78	44	0.025–0.05
	AMC1	51	34	0.06–0.12
Primersealing classes	AMC2	37	27	0.22–0.44
	AMC3	27	21	0.55–1.10
	AMC4	19	16	2.0–4.0
Sealing classes	AMC5	12	11	5.5–11.0
	AMC6	7	7	13.0–16.0
	AMC7	3	3	43.0–86.0

Table B2 Grades of primers and primerbinders

Grade	Viscosity Range Pa.s @ 60°C
Primer:	
– Very light	0.010–0.020
– Light	0.025–0.050
– Medium	0.050–0.080
– Heavy	0.080–0.200
– Very Heavy	0.200–0.400
Primerbinder:	
– Light / Medium	1.0–3.0
– Heavy	4.0–7.0

Aggregate: The worksection refers to AS 2758.2, which requires the user to select from a number of options for determination of aggregate hardness and soundness. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards are applied on a state by state basis as follows:

- Soundness based on Los Angeles Abrasion and Unsound Stone Content: Victoria and Western Australia.
- Soundness based on Ten Percent Fines Value and Wet/Dry Strength Variation: All other States.

AS 2758.2 provides for three classes of aggregate based on the following pavement classifications:

- Class A – premium quality aggregates suitable for freeways, highly trafficked highways or pavements carrying a high volume of heavy vehicles.
- Class B – aggregates suitable for highways or main roads carrying medium traffic volumes, medium to lightly trafficked pavements, general parking areas and similar.
- Class C – aggregates suitable for lightly trafficked roads.

The class of aggregate should be nominated in the **Schedule of job details** as well as the minimum value of polishing resistance (PSV or PAFV), if required. For general application, a minimum value of 48 should be specified for applications where Class A aggregates are required. No minimum value of PSV or PAFV is usually required for Class B or Class C applications. Surface friction requirements will vary according to the

risks associated with operating environment or particular sites, which will also influence design factors associated with surface texture. This may lead to the adoption of higher or lower minimum polishing resistance values for some applications.

8.3 DESIGN OF SPRAY SEALS

General: A distinction is made between selection of treatment type and determination of application rates of binder and aggregate for a selected sprayed seal treatment type. The worksection requires the Contractor to determine rates of application using Austroads AP-T68/06 *Sprayed Seal Design Method*.

In the context of this worksection, the Principal is required to nominate the treatment type as well as provide sufficient information for an accurate assessment of traffic volume for determination of binder application rates.

The traffic volume should be based on actual traffic counts, including the proportion and distribution of heavy vehicles. Where actual traffic counts are not available, or difficult or impractical to measure, a reasonable estimate should be made based on expected usage. Estimates of traffic should only be used for low volume roads. Actual measurement of traffic volumes is particularly important at high traffic volumes or where there is a large proportion of heavy vehicles. Traffic counts should also take into account seasonal variation such as local events, crop harvesting or seasonal tourist traffic. Generally, summer traffic volumes are more critical to design of application rates than winter traffic volumes.

Further critical inputs to determination of application rates using the AP-T68 Method include condition and texture of the existing surface and measurement of aggregate properties.

Estimates of existing surface conditions and aggregate average least dimension (ALD) may be made by the Principal as a basis for determining nominal rates of application for tendering purposes. Before commencing spraying operations, nominal rates of application must be checked by the Contractor, and adjusted as necessary, based on actual measurement of surface texture and aggregate grading, shape and ALD determined from testing of materials sampled from stockpiles of the aggregates to be used on the work. Variations to texture within the job and use of corrective treatments must be noted. Aggregate properties must be determined on current materials and not be based on assigned values or estimates from previous work.

Geotextile Reinforced Seals: Binder application rates for geotextile reinforced seals should be determined in conformance with standard procedures (AP-T68 Method). The binder retention allowance will depend on the grade or thickness (mass) of the fabric and may vary between different manufacturers. Typical allowances are shown in **Table B3**, however, guidance on the selection of a binder retention allowance should be sought from the geotextile supplier or may be determined using test method ASTM D6140.

A minimum fabric mass of 130 g/m² is used for general sealing applications. On soft substrates, such as initial treatment on low quality granular base materials, heavier grades of fabric (175 g/m² to 200 g/m²) should be used to minimise the potential for aggregate to puncture the fabric, particularly when using aggregates of 14 mm nominal size, or greater. Austroads AP-T37/05 *Geotextile Reinforced Seals* should be consulted for guidance on field procedures.

Priming: A guide to selection of grade of cutback bitumen primer and primer application rates is shown in the **Table B4**.

Standard grades of bitumen emulsion are generally not suitable for priming but proprietary grades have been developed that should be used in conformance with manufacturer's guidelines.

Primersealing: A guide to the selection of type and grade of primerbinder is shown in **Table B5**.

The aggregate size will depend on traffic and climatic conditions. For less than 1200 vehicles/lane/day, 5 mm or 7 mm size aggregate is appropriate, and for higher traffic situations use 7 mm or 10 mm size aggregate. However, if the conditions are either very hot or wet and the traffic is in excess of 600 v/l/d, a 10 mm size aggregate may be used. The use of 10 mm aggregate may, however, result in a coarse texture that requires extra consideration in the placing of the subsequent seal.

There are no formal design procedures for primerbinder application rates for primerseals. **Table B6** offers some practical guidelines. The basic primerbinder application rates shown may need to be adjusted in line with allowances for absorption, existing surface condition and embedment. Austroads Commentary to AG:PT/T252 – Penetration of road bases by bituminous primers or primerbinders, may also provide assistance in estimating pavement absorption (www.austroads.com.au/pavements).

The primerbinder application rates shown refer to the total volumes of the mixtures (i.e., including cutter oils and/or water content) expressed at 15°C.

Aggregate spread rates should be:

- For 5 mm and 7 mm aggregates: 130 m²/m³ - 150 m²/m³
- For 10 mm aggregates: 110 m²/m³ - 130 m²/m³.

Table B3 Typical Geotextile Retention Allowances

Geotextile grade	Retention allowance (L/m ²)
130 - 140g/m ²	0.9 to 1.0
175 - 200g/m ²	1.1 to 1.3

Table B4 Guide to grade and rates of application of primer

Pavement	Primer	
	Grade	Rate of Application L/m ²
Tightly bonded	Light	0.6–1.1
Medium porosity	Medium	0.8–1.1
Porous	Heavy to Very heavy	0.9–1.3
Limestone	Heavy to Very heavy	2 applications: -1st @ 0.7–0.9 -2nd @ 0.5–0.7
Sandstone	Heavy to Very heavy	2 applications: -1st @ 0.7–0.9 -2nd @ 0.5–0.7
Hill gravels, granitic sands	Light	0.8–1.1
Stabilised	Very light to Light	0.5–0.8
Concrete	Very light	0.2–0.4

Table B5 Selection of type and grade of primerbinder

Primerbinder	Recommended use
Light-medium grade of cutback bitumen	- Cool and/or damp conditions. - Tightly bonded or medium porosity type pavements.
Heavy grade of cutback bitumen	- Warmer and/or dry conditions - Porous type pavements.
Bitumen Emulsion (60% and 67% bitumen content)	- All year, but more suited to cool and/or damp conditions - Porous type pavements - When final surfacing is to be applied immediately or within

Primerbinder	Recommended use
	3 months.

Table B6 Basic primerbinder application rates

Traffic (v/l/d)	Aggregate Size	Total Primerbinder Application Rate (L/m ² @ 15°C)		
		Cutback Bitumen	Bitumen Emulsion	
			60%	67%
≤ 150	7 or 5	1.3	1.6	1.4
	10	1.4	1.8	1.6
151–1200	7 or 5	1.2	1.5	1.3
	10	1.3	1.6	1.4
> 1200	7 or 5	1.1	1.4	1.2
	10	1.2	1.5	1.3

8.4 APPLICATION OF SPRAYED SEALING

The worksection does not include detailed procedures for carrying out sprayed sealing work. A general guide to good practice is provided in the Appendix to the worksection. The detailed provisions of are not mandatory but it is expected that the Contractor will adhere to the principles described and incorporate relevant procedures in his own Quality Plan. A guide to evaluating and auditing of quality plans and surveillance of contract activity is provided in a separate document prepared jointly by Austroads and AAPA (AP-T40/05).

8.5 REMOVAL OF LOOSE AGGREGATE

Removal of loose aggregate can generally commence when initial aggregate adhesion and interlock has been completed by rolling and traffic, the binder has hardened to a state where no more aggregate can be pressed into it, and the seal is less prone to damage by sweeping.

Factors that influence the timing of aggregate removal include:

- Traffic volume/road class.
- Type of binder.
- Aggregate size.
- Ambient temperature/pavement temperature.

High traffic volumes will rapidly fix aggregates into the binder so that removal of surplus stones may commence within a few hours of spreading. High traffic volumes are also often associated with roads in urban areas and other situations where it is important to minimise risks associated with loose aggregate, so that removal is often undertaken within about 12 hours of spreading.

On lighter trafficked roads, a period of up to 48 hours may be allowed to elapse before completing the removal of excess aggregate, provided the safety of the travelling public is appropriately considered.

Polymer modified binders develop cohesion more rapidly, particularly at higher ambient temperatures, so that aggregate removal can often be undertaken on the same day.

Emulsion binders develop cohesion more slowly. Up to 48 hours curing may be necessary, in some circumstances, before sweeping can be undertaken without a high risk of damage to the seal.

Extra care is required at higher temperatures, particularly in sunny conditions and air temperatures of 30°C or more. In such circumstances it is preferable to undertake

aggregate removal at night or early morning, when air and pavement temperatures are lower.

In urban areas, the use of a vacuum broom or suction sweeper to uplift and remove aggregate from site as well as removal from kerb and channel, adjoining paved areas, etc. should be specified. In rural areas, where loose aggregate can be safely swept onto unpaved verges, uplifting and removal of aggregate from site is generally not necessary.

8.6 REMOVAL OF SURPLUS AND WASTE MATERIAL

Special requirements for disposal of surplus aggregate at stockpile sites should be specified in additional clauses or included in the schedule of job details.

8.7 PROTECTION AND CARE OF NEW WORK

Generally the Contractor is responsible for protecting the new work and correction of 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.

8.8 SAMPLING AND TESTING

The worksection requires the Contractor to prepare a schedule for the nominated items. The Principal may, however, choose to specify test methods and minimum frequency of sampling and testing.

8.9 MEASUREMENT AND PAYMENT

The worksection provides for two alternatives, measurement by area only, or measurement of actual quantities used.

Measurement and payment by area may be used for straightforward works where conditions are readily identifiable at the time of tender.

Measurement by quantity of material supplied allows for variation in the design rates of application of binder and aggregate and compensation for actual amounts of cutter oil based on the conditions at the time of spraying. In such cases, the schedule may nominate provisional rates of application or quantities for tendering purposes, but incorporate schedule items for actual quantities or variations to rates of application. This type of payment schedule is particularly applicable to contracts incorporating a range of types or location of works.

Schedule items may also be included for other special items such as geotextiles, and for additional works such as reinstatement of raised pavement markers and linemarking, if required.

A typical schedule of rates is shown in **Table B7**.

Table B7 Typical Schedule of Rates

Activity	Unit	Rate
Control traffic to worksite	m ²	
Sweep surface prior to seal:		
-Gravel pavements	m ²	
-Sealed pavements	m ²	
Supply and spray binder @ 15°C	Litre	
Supply, incorporate and spray cutter oil @ 15°C	Litre	
Supply, incorporate & spray Adhesion agent @ 15°C	Litre	
Remove existing raised pavement markers	each	
Protect existing raised pavement markers	each	
Supply and install temporary raised pavement markers	each	
Supply, load, haul and spread precoated aggregate	m ³	
Roll and incorporate aggregate	m ²	

Activity	Unit	Rate
Post-sweep of seal including stone counts: -With rotary broom -With suction broom as stipulated	m ² m ²	
Supply and place geotextile	m ²	
Load, haul and spread additional where closest available stockpile greater than 5 km from jobsite	m ³ /km > 5 km	

8.10 SELECTIONS

The following actions should be taken in the preparation of the **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(s).
- 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 test methods and frequency of testing, if applicable.
- Prepare and insert special clauses for payment for non complying materials, 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.