

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R111

SPRAYED BITUMINOUS SURFACING (WITH BITUMEN EMULSION)

NOTICE

This document is a Transport for NSW QA Specification. It has been developed for use with roadworks and bridgeworks contracts let by Transport for NSW or by local councils in NSW. It is not suitable for any other purpose and must not be used for any other purpose or in any other context.

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		New specification.	GM, RNIC (W Ho)	07.04.97
Ed 1/Rev 1	3 5.2 5.10 Annexure R111/2 Annexure R111/3	Delete reference to prime and primerseal Include minimum percentage of residual binder Include the use of other types of rollers. New Hold point. Additional requirement to sweep and remove loose aggregate Include testing frequencies for aggregate properties Schedule of Identified Records added.	GM, RNIC	31.08.01
Ed 1/Rev 2	1.1 Global 5.9 5.10 5.11 5.11	General sealing requirements Removed references to "mechanical" with spreaders and sprayers. Replaced references to AS1141.12 with RTA T203. Replaced references to RTA Form 395C, D and F with RTA Form 395K. Traffic control minimum period stipulated Clarified Max allowable limits for loose aggregates after final sweeping and before opening to traffic WITNESS POINT Final sweeping and loose aggregate measurement prior to opening to the traffic.	GM, RNIC	03.04.03

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 2 (cont'd)	6.2.2	Deductions for consistency removed		
	6.2.3	Added deductions for deviation from target spray rate		
	7	Aggregate application rate to be paid at design target rate		
	Annexure R111/2	Loose aggregate spread rate frequency test of RTA T277		
	Annexure R111/2	Fractured Faces requirement changed for 'drill and blasted' rocks.		
	Annexure R111/3	Schedule of Hold and Witness Points		
Annexure R111/4	Supplementary information for max. loose aggregate particles.			
Ed 2/Rev 0	Various	Formatting changed. "Contractor" replaced by "you". "Superintendent" replaced by "Principal". Grammatical changes.	GM, RNIC	20.09.06
	Various	Clauses renumbered (old/new): 1.3 /1.2.4, 2.5./4.1, 4/5.1, 5.1/4.2, 5.2/6.1, 5.3/5.2, 5.4/3.3, 5.5/6.3, 5.6/6.3, 5.7.1/7.1, 5.7.2/7.2, 5.7.3/7.3, 5.7.4/6.2, 5.8/4.4, 5.9/6.5, 5.10/8, 5.11/9, 5.12/5.4, 6/B2.		
	Foreword	Foreword added. Notes on "Revisions" and "Project Specific Changes" moved to the Foreword.		
	1.1	Summary of work to be executed added. Defects liability period replaced by 12 months. Surface texture measurement defined		
	1.2	New clause explaining format. References transferred to Annexure R111/M.		
	1.3	Definitions added.		
	1.4	Transferred to Annexure R111/D.		
	1.1, 3.2, 5.1, 6.1, 6.2, 6.3, 8, 9, Annex A2, B, M	Minor editorial changes or changed to align with RTA R106.		
	2.1.1, 2.4.1	Evidence of conformity and samples of materials required.		
	2.1.2	New subclause.		
	2.3.1	Sample to be provided.		
	2.3.2	New subclause.		
	3.1	Submit test results.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 0 (cont'd)	3.2.2 3.2.3 4.1 5.2 6 7 8 9 Annexures Annexure R107/D Annexure R107/M	New subclause. Hold Point: submit 7 days prior and include planning documents. Sample to AS 2008. Paragraphs added. Requirement for masking of longitudinal thermoplastic line marking removed. Option for masking of large thermoplastic pavement markings added. Transferred to Annex B2. Transferred to Annex B1. Report spread rates on Form 500D. Show reporting system in PQP. Renumbered with letters. New items in accordance with changes to requirements in R106. AS 1141.6.1, Test Method T240 added.		
Ed 2/Rev 1	Global	References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

Using Specification R111

Specification TfNSW R111 is a QA Specification and the use of QA Specifications requires the Contractor to implement a quality management system that meets the quality management system requirements specified in TfNSW Q. To comply with the intention of Government policy as well as TfNSW R111, sprayed bituminous surfacing works carried out using R111 require adequate surveillance and audit by the Principal.

TfNSW R111 requires the TfNSW Project Manager to select appropriate parameters identified in TfNSW R111 and nominate them in Annexure R111/A.

Masking should be considered for large thermoplastic pavement markings such as pedestrian crossings and chevrons prior to application of an emulsion seal or reseal.

Seals should not be applied over a primed surface unless it has been cured for a period of at least 48 hours or such longer period as is necessary for the primer to become completely dry.

For a primersealed surface, a period of at least twelve months must elapse, or the hardness of the primersealed surface measured using TfNSW Test Method TfNSW T271 must be less than 2.5 mm, before the subsequent seal can be applied. Primes and primerseals should be performed in accordance with TfNSW Specification R106 Sprayed Bituminous Surfacing (With Cutback Bitumen). Limits on loose aggregate particles, after final sweeping and prior to the work being opened to the traffic, have been included.

Where Electric Arc Furnace Slag (also known as EAF Slag) aggregate is to be used in a double/double seal, the second application may be delayed for about 14 days.

The aggregate spread rate must be determined using a 1 m² mat or a 500 mm x 500 mm tray in accordance with Test Method TfNSW T274 along the length being sealed or by other appropriate means approved by the Principal and in accordance with the PROJECT QUALITY PLAN.

It is recommended that a scatter coat (or “rack in”) be applied for emulsion seals using aggregate with nominal size 10 mm or greater.

As emulsion seals develop strength much more slowly than cutback bitumen seals, careful attention must be paid to ensure adequate after-care for up to 48 hours after sealing.

Information on test certificates and test results should be forwarded to Pavements & Geotechnical Section when requested or where important design and performance issues have arisen.



SPRAYED BITUMINOUS SURFACING (WITH BITUMEN EMULSION)

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VERSION FOR: DATE:

CONTENTS

CLAUSE	PAGE
FOREWORD	III
TfNSW Copyright and Use of this Document	iii
Revisions to Previous Version	iii
Project Specific Changes	iii
1 GENERAL	1
1.1 Scope	1
1.2 Structure of the Specification	1
1.3 Definitions	2
2 MATERIALS	3
2.1 Bitumen Emulsion	3
2.2 Aggregate Precoating agent	4
2.3 Aggregate	4
2.4 Water	4
3 NOMINATED MATERIALS AND DESIGN OF BITUMINOUS SURFACING USING BITUMEN EMULSION	4
3.1 General	4
3.2 Submission of Nominated Design	4
3.3 Review of Nominated Application Rates	5
4 PROCESS CONTROL	6
4.1 Sampling and Testing	6
4.2 Application of Sprayed Bituminous Surfacing	6
4.3 (Not Used)	6
4.4 Work Records	6
5 CONDITION FOR COMMENCEMENT	7
5.1 Precoating of Aggregate	7
5.2 Preparation of Pavement Surface	7
5.3 Pavement Temperature and Weather Conditions	7
5.4 Protection of Services and Road Fixtures	8
6 APPLICATION OF SPRAYED BITUMINOUS SURFACING	8
6.1 Plant	8
6.2 Operation of the Sprayer	8
6.3 Bitumen Emulsion Temperature Requirements	9
6.4 (Not Used)	10
6.5 Traffic Management	10
7 APPLICATION OF CURING MEMBRANE AND BINDER	10
7.1 General	10
7.2 Curing Membrane	11
7.3 Binder	11
8 APPLICATION AND INCORPORATION OF AGGREGATE	11
9 SWEEPING AND LOOSE AGGREGATE REMOVALS (10 MM AND 14 MM SEALS/RESEALS ONLY) ...	12
ANNEXURE R111/A – DETAILS OF WORK	13
A1 For Curing Membrane Application	13

A2	For Seal/Reseal Application	13
A3	Supplementary Information	13
ANNEXURE R111/B – MEASUREMENT AND PAYMENT AND RESOLUTION OF NONCONFORMITIES		14
B1	Measurement and Payment	14
B2	Resolution of Nonconformities	15
ANNEXURE R111/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS		18
C1	Schedule of Hold Points and Witness Points	18
C2	Schedule of Identified Records	18
ANNEXURE R111/D – SCHEDULE OF KEY QUALITY PLANNING ACTION POINTS		19
ANNEXURES R111/E TO R111/K – (NOT USED)		20
ANNEXURE R111/L – MINIMUM FREQUENCY OF TESTING		21
ANNEXURE R111/M – REFERENCED DOCUMENTS		23
LAST PAGE OF THIS DOCUMENT IS		25

FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R111 Edition 2 Revision 0.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R111

SPRAYED BITUMINOUS SURFACING (WITH BITUMEN EMULSION)

1 GENERAL

1.1 SCOPE

Take responsibility for the design, supply of all materials and the application of the following types of bitumen emulsion sprayed bituminous surfacing as required under the Contract:

- (a) Curing membrane: Consisting of the application of a bitumen emulsion binder onto a concrete pavement surface to retard loss of moisture during hardening;
- (b) Seal or reseal: Consisting of the application of a bitumen emulsion binder into which aggregate is incorporated to provide a durable wearing surface.

The scope of this Specification excludes surfacing incorporating fibre reinforcement or enrichment work.

The work to be executed under this Specification includes all of the following:

- (i) Supply and delivery of all materials;
- (ii) Storage and handling of raw materials;
- (iii) Precoating of aggregate;
- (iv) Preparation of pavement surfaces;
- (v) Preparation of bitumen emulsion binder;
- (vi) Application of curing membrane, seal or reseal;
- (vii) Application and incorporation of aggregate including scatter coat;
- (viii) Removal of loose aggregate.

The locations and required types of sprayed bituminous surfacing, including types of emulsion binders and aggregate sizes, must be as shown on the Drawings and as detailed in Annexure R111/A.

The seal/reseal must not peel, pluck, strip, flush or bleed and aggregate must not crush during the period 12 months after Completion. The seal/ reseal must be uniform in colour and texture.

Measure surface Texture measurement, for the purposes of design (refer to Clause 3.1), in accordance with TfNSW T240. Minimum frequency of testing is shown in Annexure R111/L.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Details of Work

Details of work are shown in Annexure R111/A.

1.2.2 Measurement and Payment and Resolution of Nonconformities

The method of measurement and payment must comply with Annexure R111/B.

Acceptance of materials and work must be in accordance with Annexure R111/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure R111/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure R111/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The **PROJECT QUALITY PLAN** must include each of the documents and requirements listed in Annexure R111/D and must be implemented.

Where appropriate, use the TfNSW Sprayed Sealing Guide when planning and carrying out work under this Specification. The TfNSW Sprayed Sealing Guide must be regarded as a guide and not a specification.

In all cases where this Specification refers to the manufacturer's recommendations, these must be included in the **PROJECT QUALITY PLAN**.

1.2.5 Referenced Documents

Unless specified otherwise or specifically supplied by the Principal, the applicable issue of a referenced document, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (eg AS 1234). For convenience, the full titles are listed in Annexure R111/M.

1.3 DEFINITIONS

For the purpose of this Specification, the following definitions apply:

Prime	An application of a primer to a prepared base, without cover aggregate, to provide penetration of the surface (preferably from 5 mm to 10 mm), temporary waterproofing and to obtain a bond between the pavement and the subsequent seal or asphalt.
Primer	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 primersealing.
Primerseal	An application of a primerbinder with a cover aggregate to a prepared base to provide penetration of the surface (preferably from 2 mm to 5 mm) and retain a light cover of aggregate.

Seal	A thin layer of bituminous material into which aggregate is incorporated.
Reseal	A seal applied to an existing sealed, asphalt, timber or concrete surface.
High Stress Seal or Reseal (HSS)	Consisting of the application of a polymer modified binder into which aggregate is incorporated to provide a durable wearing surface.
Strain Alleviating Membrane (SAM)	Consisting of 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)	Consisting of the application of polymer modified binder into which aggregate is incorporated. A SAMI is used as an interlayer between an asphalt wearing surface and underlying layers to provide alleviation from tensile strains developed beneath it.
Geotextile Reinforced Seal (GRS)	Consisting of applications of C170 tack coat, geotextile and polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.

For all other descriptions, definitions in Section 9 of the TfNSW Sprayed Sealing Guide will apply.

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

2 MATERIALS

2.1 BITUMEN EMULSION

2.1.1 Properties

The binder for curing membrane, seals and reseals must be as specified in Annexure R111/A.

Provide documentary evidence of the binder conformity for each delivery used in the work. Also sample at the point of delivery and provide a representative sample of the delivered binder to the Principal.

Bitumen emulsion must conform to Specification TfNSW 3254.

Polymer modified bitumen emulsion must conform to TfNSW 3254 and the binder residue must conform to Specification TfNSW 3252.

For bitumen emulsion with polymer additives, the bitumen emulsion must conform to TfNSW 3254 and the polymer additives must conform to TfNSW 3252.

2.1.2 Storage and Handling

Handle and store binder in accordance with the TfNSW Bitumen Emulsion Guide and the manufacturer’s written recommendations.

Implement procedures for storage and handling of binder that ensure prevention of segregation and contamination of the binder by flushing liquids or other materials.

2.2 AGGREGATE PRECOATING AGENT

Aggregate precoating agent must conform to Specification TfNSW 3258.

2.3 AGGREGATE

2.3.1 Properties

The supply and delivery of aggregate must conform to Specification TfNSW 3151.

Obtain test results for each Lot of aggregate, in accordance with TfNSW 3151, before aggregate from the Lot is incorporated in the Works. If requested, provide a sample to the Principal from the same Lot by riffing or quartering your own samples. The amount of material obtained for each sample must be in accordance with the nominal size of the aggregate as per AS 1141.3.

2.3.2 Stockpiles

Arrange and manage aggregate stockpiles in accordance with the following requirements:

- (a) The maximum Lot size is limited to 250 cubic metres;
- (b) Each stockpile must each be located on firm level ground and effectively separated from other stockpiles to prevent cross-contamination and interference with the loading and/or precoating operations;
- (c) The quantity and type of each stockpile must be clearly signposted on the stockpile at all times;
- (d) Recovery from stockpiles must be such as to minimise segregation and contamination.

Stockpiles that exhibit visible segregation, contamination or weathering must be rectified or replaced.

2.4 WATER

Water used for the dilution of bitumen emulsion must be compatible when tested in accordance with TfNSW T569 and must be potable and free from any deleterious material.

3 NOMINATED MATERIALS AND DESIGN OF BITUMINOUS SURFACING USING BITUMEN EMULSION

3.1 GENERAL

Carry out the design of bituminous surfacing in accordance with TfNSW Form 395K and submit the design details including all results from texture testing for reseals and ball embedment tests for seals. Design application rates are the "nominated application rates" and materials used for the design are the "nominated materials".

3.2 SUBMISSION OF NOMINATED DESIGN

Submit to the Principal the nominated design together with certification for the nominated materials at least seven days prior to the commencement of sprayed bituminous surfacing works.

Include the following details in the submission:

- (a) Each constituent material;
- (b) Verification of conformity of the nominated materials;
- (c) Endorsement.

(a) Each Constituent Material

Details must include:

- (i) Test results for all nominated materials;
- (ii) Aggregate - source, geological type, particle size distribution, nominated average least dimension;
- (iii) Precoating agent - type and proportion;
- (iv) Bitumen emulsion - source, type, grade, class and minimum percentage of residual binder;
- (v) Polymer additives - source, type, class and grade;
- (vi) Polymer modified bitumen emulsion - source, type, class, grade, minimum percentage of residual binder and manufacturer's recommendation; and
- (vii) Water - source.

(b) Verification of Conformity of the Nominated Materials

Details must include:

- (i) Submission of test results to verify conformity to Clauses 2 and 3 of each constituent material proposed for the use in the Contract, including stripping and initial adhesion for the combination of nominated materials;
- (ii) Carrying out the sampling and testing of a nominated material within the six months period prior to the date of submission to the Principal. Performance of all phases of any particular test at one laboratory.

(c) Endorsement

Details must include a statement signed by you stating that each design and its constituent materials meet the requirements of Clauses 2 and 3. The statement must include NATA endorsed test results for all specified tests. Attach a copy of your completed verification checklist.

HOLD POINT

Process Held:	Sealing operation using the proposed design.
Submission Details:	Documents referred to in Clause 1.2.4 and the proposed bituminous surfacing design together with certification for the nominated materials and design verification documentation at least seven days prior to the commencement of sprayed bituminous surfacing work.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

3.3 REVIEW OF NOMINATED APPLICATION RATES

Select the locations where each Lot of aggregate is to be incorporated in the Works.

R111

Sprayed Bituminous Surfacing (with Bitumen Emulsion)

Review the bituminous surfacing design at each location based on the actual ALD test result for the actual aggregate to be used instead of the ALD value of the nominated aggregate and using the appropriate TfNSW 395 design form. The revised application rates are “target application rates”.

HOLD POINT

Process Held:	Bitumen emulsion sprayed sealing work for each work location.
Submission Details:	Aggregate Lot details and target application rates.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

4 PROCESS CONTROL

4.1 SAMPLING AND TESTING

Carry out sampling and testing of materials in accordance with the relevant material specifications in Clause 2 and AS 2008. Testing must comply with Annexure R111/L. Nominate in the PROJECT QUALITY PLAN the proposed testing frequency, which must not be less than that specified in Annexure R111/L. Where a minimum frequency is not specified, nominate an appropriate frequency.

The Principal may conditionally agree to your proposal to reduce the specified minimum frequency of testing. The proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics. The Principal may vary or restore the specified minimum frequency of testing, either selectively or permanently, at any time.

4.2 APPLICATION OF SPRAYED BITUMINOUS SURFACING

Carry out sprayed bituminous surfacing so as to:

- (a) provide a uniform application of emulsion binder with adequate adhesion to the underlying surface;
- (b) provide a complete cover of interlocking aggregate particles (except for curing membrane); and
- (c) achieve effective bond between binder and aggregate (except for curing membrane).

Include in the PROJECT QUALITY PLAN details of the plant and equipment and methods to be used for sprayed bituminous surfacing and the manufacturer’s recommended temperatures.

4.3 (NOT USED)

4.4 WORK RECORDS

Record the particulars of the work performed on TfNSW Form 500D. Record details of binder and aggregate applied immediately after every sprayer run. Each form must be signed by your representative as a true record of the work performed. Supply the Principal with a copy of each completed form.

5 CONDITION FOR COMMENCEMENT

5.1 PRECOATING OF AGGREGATE

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

Do not precoat aggregate when rain is imminent. If aggregate has been precoated and rain appears imminent, the aggregate must be adequately covered to prevent the 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 agent on the stockpiled aggregate. Include in the PROJECT QUALITY PLAN details of the precautions to be taken to protect aggregates.

5.2 PREPARATION OF PAVEMENT SURFACE

Before the application of binder, sweep the pavement surface by the use of a rotary road broom or suction broom to provide a uniformly clean surface. If necessary, carry out additional sweeping by hand, using stiff bass or similar brooms. Sweeping must extend at least 300 mm beyond each edge of the area to be sprayed.

Where 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. Include in the PROJECT QUALITY PLAN details of the arrangements for the removal of loose materials.

Remove adherent patches of foreign material from the surface of the pavement. Mask or remove raised pavement markers. Mask large thermoplastic pavement markings if indicated in Annexure R111/A.

The pavement surface must be slightly damp for the spraying of the curing membrane.

5.3 PAVEMENT TEMPERATURE AND WEATHER CONDITIONS

Measure and record pavement temperatures at regular intervals during the course of work.

For this purpose, place a spirit or mercury-in-glass thermometer or other suitable type of thermometer in direct contact with the pavement and allow it to remain in position until the reading becomes steady. Other certifiable means of temperature measurement may be used subject to the approval of the Principal. When a spirit or mercury-in-glass thermometer is used to measure pavement temperature, cover the bulb of the thermometer from direct sunlight with a small heap of grit or similar material.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions must be taken and recorded.

Undertake the spraying of conventional bitumen emulsion binders only if the pavement temperature has been at or above 10°C for at least one hour before commencement of spraying and does not fall below the specified minimum pavement temperature for spraying during the period of spraying.

Undertake the spraying of bitumen emulsion incorporating polymer additives only if the pavement temperature has been at or above 5°C for at least one hour before commencement of spraying and does not fall below the specified minimum pavement temperature for spraying during the period of spraying.

Do not spray wet pavement or while rain appears imminent or during strong winds or dust storms.

5.4 PROTECTION OF SERVICES AND ROAD FIXTURES

Take all necessary precautions to prevent curing membrane, 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.

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

6 APPLICATION OF SPRAYED BITUMINOUS SURFACING

6.1 PLANT

Apply binder by using a sprayer. The sprayer must have a current Sprayer Certificate (TfNSW Form 354) issued or accepted by the TfNSW.

The spray nozzles must be of the make and type endorsed on the Sprayer Certificate. Replace any nozzles that are damaged or become unduly worn or defective by new nozzles of the same type and size. A sufficient number of nozzles for this purpose must be available at all times.

Spreading equipment (including box spreaders) must be used to spread aggregate and must be capable of achieving a uniform spreading rate.

Rollers used must be in accordance with Clause 8. Use of other types of rollers will be considered subject to you demonstrating by way of an onsite trial that the proposed roller can effectively embed the aggregate into the binder while achieving mechanical interlock between the aggregate without breaking down/crushing of the cover aggregate with the combinations of the relevant materials to be used and actual pavement conditions.

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

6.2 OPERATION OF THE SPRAYER

The type of spray nozzles to be used on the spray bar of the sprayer must 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 must be about 50 mm for special type end nozzles or intermediate nozzles set with a jig. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays, set the nozzles in the normal manner for intermediate nozzles and the overlap must be 300 mm.

Each run of the sprayer must commence on a protective strip of heavy paper weighing not less than 120 grams per square metre laid across and held securely to the pavement surface before spraying commences. The sprayer must 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 must maintain a constant road speed throughout the length of each sprayer run.

Terminate each spraying run on a protective strip of paper laid across and held securely to the pavement surface before spraying commences. The width of paper at the commencement and/or termination of each run must not be less than that endorsed on the Sprayer Certificate.

Cease spraying immediately when any defect develops in the spraying equipment and do not recommence spraying until the fault has been rectified.

Where any blockage or partial blockage of nozzles occurs, cease spraying immediately. If the blockage is due to the condition of the binder being sprayed, do not use that load together with any binder from the same bulk tanker or supply.

Areas not within 5% of the target application rate of binder constitute a “Nonconformity” under the Contract.

Where a 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 and make any necessary adjustments to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder for each of three consecutive runs differs by more than 5% from the target application rate, do not use the sprayer until a new Sprayer Certificate has been obtained.

6.3 BITUMEN EMULSION TEMPERATURE REQUIREMENTS

Bitumen emulsion must be within the temperature range shown in Table R111.1 at the time of spraying.

Table R111.1 – Bitumen Emulsion Spraying Temperatures

Bitumen Content (%)	Temperature Range (°C)
60	40 – 60
67	75 – 85
80	80 – 90
Proprietary Product	Manufacturer’s recommendation

Measure and record the temperature using a mercury-in-steel dial thermometer, a maximum recording mercury-glass thermometer or other suitable means. The thermometer must be accurate to within 2.5% of the correct temperature.

If the temperature of the bituminous material is below the applicable lower limit from Table R111.1, heat the bituminous material at a maximum rate of 15°C per hour providing safe heating practices are adopted. Do not use burners unless the level of the material in the heating tank is at least 250 mm above the tops of the heating tubes. Comply with the Rural Fires Act, 1997 and the Local Government Act 1993.

Place two or more suitable fully-charged pressurised chemical fire extinguishers conveniently to the heaters at all times while heating is in progress. Refer to the Austroads Bitumen Sealing Safety Guide.

R111

Sprayed Bituminous Surfacing (with Bitumen Emulsion)

During heating, the temperature of the bituminous material must not exceed the applicable upper limit from Table R111.1. Check the temperature of the bituminous material just above the heating tubes at regular intervals to ensure that there is no local overheating.

Do not use bituminous materials held at temperatures within the ranges shown in Table R111.1 for periods in excess of ten hours in the work.

Do not use any bituminous material that has been overheated in the work.

6.4 (NOT USED)

6.5 TRAFFIC MANAGEMENT

Provide for traffic in accordance with the requirements of Specification TfNSW G10 while undertaking the work and take all necessary precautions to protect the work from damage until such time the new binder 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 escort 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 work. Where adequate detours or side tracks are included in the Contract or are otherwise available, temporarily divert traffic while the work is in progress.

If facilities for the diversion of traffic are not available, you may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work must cease. Traffic must not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.

The new surface may be opened to traffic immediately upon completion of the rolling. Controlled traffic speeds must be continued for at least 4 hours.

Light brooming of excess loose aggregate must be carried out on the same day. Provide rollers and a suction broom with operators and traffic management personnel for a minimum of five (5) hours after covering an emulsion seal with aggregate while subject to trafficking.

7 APPLICATION OF CURING MEMBRANE AND BINDER

7.1 GENERAL

Limit the area to be sprayed with binder to the area that can be covered with aggregate at the target application rate within fifteen minutes of spraying the binder.

Determine the hot application rate of binder using TfNSW Form 500D.

The grade and class of binder must be as specified in Annexure R111/A.

7.2 CURING MEMBRANE

Apply curing membrane at a minimum rate of 0.5 L/m² of residual bitumen where nominated in Annexure R111/A. Base the quantities of curing membrane on the volume of residual bitumen measured at 15°C.

After application of a curing membrane, a period of at least forty-eight hours, or such longer period as determined to be necessary for the curing membrane to become completely dry, must elapse before the binder for a seal is applied. Keep all traffic off the curing membrane.

7.3 BINDER

Base nominated and target application rates and quantities of emulsion binder on the volumes of residual bitumen measured at 15°C.

8 APPLICATION AND INCORPORATION OF AGGREGATE

Use only precoated aggregate.

For seal or reseal, the application of aggregate must proceed immediately after spraying is commenced and must be completed within fifteen minutes of spraying bitumen emulsion.

Do not use aggregate containing surface moisture or free surface water.

Apply the aggregate of the specified nominal size and at the target aggregate application rate. The method to determine the actual aggregate spread rate must conform to TfNSW T274 or a method approved by the Principal and be detailed in the PROJECT QUALITY PLAN. Report aggregate spread rate as actual rate using TfNSW Form 500D. Sufficient loaded and measured trucks of dry aggregate must be at the site to provide full cover for the area sprayed.

Spread the aggregate uniformly over the sprayed surface by means of suitable spreading equipment (including box spreaders). Payment is at the target application rate. Any bare or insufficiently covered areas must be re-run by the spreader or covered by hand as necessary to give a uniform and complete coverage at the target application rate. Where a bitumen emulsion sprayed seal is specified with a scatter coat, apply the cover aggregate first followed by the scatter coat. Rolling of the seal must not commence until after the application of the scatter coat.

After the aggregate has been applied to each section of the work, carry out initial rolling with two or more dual axle smooth pneumatic tyred multi-wheel rollers of minimum load of one tonne per tyre and minimum tyre pressure of 550 kPa. Continue initial rolling until the aggregate is firmly embedded in the binder.

Roll the cover aggregate with pneumatic tyred multi-wheel rollers at not less than 8 passes within one hour of spraying at every point on the surface. There must be sufficient rollers on site and in use to complete the specified minimum amount of rolling as a continuous operation with successive spray runs.

Backrolling for up to a maximum of 48 hours after the aggregate has been applied may be required to ensure aggregate incorporation. Include in the PROJECT QUALITY PLAN details of the methods and procedures for backrolling.

Use a vacuum broom to remove excess aggregate during backrolling.

R111

Sprayed Bituminous Surfacing (with Bitumen Emulsion)

When the aggregate has been evenly spread and embedded in the binder remove any remaining loose particles of aggregate from the pavement. During the progress of the work and for a period of 48 hours thereafter, sweep and remove any remaining loose aggregate. Include in the PROJECT QUALITY PLAN details of the method and timing of removal of loose aggregate and traffic management to protect persons and property.

**9 SWEEPING AND LOOSE AGGREGATE REMOVALS
(10 MM AND 14 MM SEALS/RESEALS ONLY)**

After final sweeping and prior to the work being opened to traffic at the pre-existing signposted speed, the number of loose aggregate particles (per m²) not including aggregate particles from scatter coat, determined in accordance with TfNSW T277 must not exceed the values shown in Annexure R111/A Clause A3. The test location must be representative of the section and as agreed by the Principal. Include in the PROJECT QUALITY PLAN the reporting system to be used to record test results of loose aggregate after final brooming. If values are not specified in Annexure R111/A Clause A3, the values shown in Table R111.2 apply.

Areas where speed limits exceed 60 km/h and that are opened to traffic prior to final sweeping must have temporary speed zone ‘loose stones’ and ‘slippery’ warning signs and temporary 60 km/h speed zoning in place until the maximum allowable loose aggregate requirement is met.

Table R111.2 – Maximum Allowable Loose Aggregate Particles

Urban areas	20 particles / m ²
Other medium to high traffic (>250 v/l/d)	30 particles / m ²
Low traffic (≤ 250 v/l/d)	40 particles / m ²

WITNESS POINT

Process Witnessed: Final sweeping and loose aggregate measurement prior to opening to traffic.
Submission Details: Notification of the time and location prior to commencement.

ANNEXURE R111/A – DETAILS OF WORK**A1 FOR CURING MEMBRANE APPLICATION**

Section		Emulsion grade, class and minimum percentage of residual binder in the emulsion	Nominal Aggregate Size (mm)
From	To		

A2 FOR SEAL/RESEAL APPLICATION

Section		Emulsion grade, class and minimum percentage of residual binder in the emulsion	Nominal Aggregate Size (mm)	
From	To		Cover	Scatter

Masking of thermoplastic pavement markings required: (Clause 5.2)Yes/No

A3 SUPPLEMENTARY INFORMATION

Clause	Maximum Allowable Loose Aggregate Particles	
9	Nominal Aggregate Size	= _____ mm
	Maximum Loose Aggregate after final sweeping	= _____ /m ²
	Nominal Aggregate Size	= _____ mm
	Maximum Loose Aggregate after final sweeping	= _____ /m ²

ANNEXURE R111/B – MEASUREMENT AND PAYMENT AND RESOLUTION OF NONCONFORMITIES

B1 MEASUREMENT AND PAYMENT

Payment will be made for all activities associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless otherwise specified, a lump sum price for any of these items will not be accepted.

Pay Item R111P1 - Supply and Spray Bitumen Emulsion (including Preparation of Surface)

The unit of measurement is the litre of residual bitumen measured at 15°C.

The quantities (in litres) must be determined by multiplying the target application rate of residual bitumen at 15°C (in litres per square metre) by the area of road surface sprayed for each sprayer run (in square metres).

A separate unit rate is to be given for each type of binder specified in Annexure R111/A, as follows:

R111P1.1 (Not Used)

R111P1.2 (Not Used)

R111P1.3 Seal or Reseal

R111P1.4 Curing Membrane

Pay Item R111P2 - Supply, Precoat, Apply, Incorporate and Sweep Aggregate

R111P2.1 5 mm Aggregate (precoated)

R111P2.2 7 mm Aggregate (precoated)

R111P2.3 10 mm Aggregate (precoated)

R111P2.4 14 mm Aggregate (precoated)

The unit of measurement is the cubic metre.

The quantity of aggregate (in cubic metres) must be determined by dividing the area of road surface covered for each sprayer run (in square metres) by the target application rate (in square metres per cubic metre).

Aggregate application rate is paid at the design target rate and any additional aggregate applied is at no cost to the Principal.

A separate unit rate must be given for each nominal size of aggregate precoated as specified.

Pay Item R111P3 - Deductions in accordance with Annexure R111/B2

R111P3.1 Bitumen Emulsion (with or without polymer additives)

R111P3.2 Polymer Modified Bitumen Emulsion

Deductions must be made on the target application rate and must not be subject to adjustment for rise and fall in costs.

B2 RESOLUTION OF NONCONFORMITIES

B2.1 General

If the nonconformity is not acceptable in accordance with Annexure R111/B2, the nonconforming material must be replaced or the nonconforming section of sprayed bituminous surfacing work must be either replaced or corrected.

The cost of rectifying nonconformities, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, must be borne by you. Materials removed from the site by you must be replaced with materials that conform to this Specification.

B2.2 Acceptance of Nonconformities

Nonconformities may be accepted by the Principal subject to deductions to the schedule rate, as specified hereunder, applied to the quantity of material represented by the failed sample.

B2.2.1 Bitumen Emulsion (with or without polymer additives)

In the case of the residue from evaporation having a viscosity at 60°C within the specified limits but having any other property outside the limits specified in TfNSW 3254, a deduction of 2% of the schedule rate for the supply and spraying of bitumen emulsion applies.

In the case of the residue from evaporation having a viscosity at 60°C outside the limits specified in AS 1160, the deductions shown in Table R111/B.1 apply.

Table R111/B.1 - Deduction for Actual Viscosity at 60°C (Pa.s)

Viscosity as percentage of the nominal viscosity of the class of bitumen	Deduction (Percent of Schedule Rate)
Under 40	50
40 - 44	25
45 - 49	10
50 - 54	5
55 - 59	2
60 - 125	Nil
126 - 130	2
131 - 135	5
136 - 140	10
141 - 145	25
Over 145	50

Calculate viscosity to the nearest whole number.

B2.2.2 Polymer Modified Bitumen Emulsion

In the case of polymer modified bitumen emulsion, where the residual binder has a Torsional Recovery outside the range specified in Table 3252.1 of TfNSW 3252, consideration will be given to acceptance of the material subject to deductions of the schedule rate for supply and spraying of polymer modified bitumen emulsion as follows:

For Torsional Recovery:

- lower than specified by 1, 2 or 3 percentage points - 2% deduction
- lower than specified by 4, 5 or 6 percentage points - 10% deduction
- lower than specified by 7 or more percentage points - 20% deduction

If any other property is found to be nonconforming, consideration will be given to acceptance subject to a deduction of 5% in payments by way of liquidated damages.

The deductions apply to the quoted rate plus any variations to which the supplier is entitled in accordance with a cost adjustment clause.

B2.2.3 Sprayed Binder

The deductions shown in Table R111/B.2 apply where the amount of actual binder sprayed differs from the target spray rate by more than 5%.

Table R111/B.2 - Deduction for Actual Sprayed Binder

Difference from Target Spray Rate (%)	Reduction (% of value)
±6	4
±7	8
±8	12
±9	16
±10	20

ANNEXURE R111/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3.2.3	Hold	Submission of planning documents and details for nominated materials and sprayed surfacing design using bitumen emulsion.
3.3	Hold	Submission of details for target application rates for each work location
9	Witness	Final sweeping and loose aggregate measurement prior to opening to traffic.

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

Clause	Description of Identified Record
3	Proposed bituminous surfacing design together with certification for the nominated materials and design verification documentation
3.3	Aggregate Lot details and target application rates
4.4	Copy of completed forms showing details of binder and aggregate applied for every sprayer run, signed by your representative as a true record of the work performed.

ANNEXURE R111/D – SCHEDULE OF KEY QUALITY PLANNING ACTION POINTS

Key Points to be shown and implemented in the Inspection and Test Plan/Checklists, and also additional requirements which are to be included in your PROJECT QUALITY PLAN documents:

H = Hold Point Release

I = Inspection Point

J = Joint Inspection Point

M = Measurement Point for payment

N = Notice to Principal

T = Test Point

R = Additional requirements to be shown in the PROJECT QUALITY PLAN

W = Witness Point

Clause	Description	Action Point (ISO 9001)
TfNSW Q 1.2	Quality management system fully complying and functional List of all documents to be held on site	R I
2 2 1.2.4	Materials: Proposed materials properties conforming to Specification Risks to consistent supply quality identified, discussed with subcontractor/Supplier, addressed and documented Manufacturer's written recommendations attached to PROJECT QUALITY PLAN Procedures and ITP's for: management and traceability of each materials Lot to its incorporation into bituminous surfacing on-going verification of materials conformance assessment and audit of subcontractor/Supplier quality management systems	I, T T R R R R
3.3 3.2 3.3 3.3 3.4 3.4	Design: Full design details submitted to Principal in agreed format Constituent proportions established and conforming Submission of planning documents and nominated design together with certification for the nominated materials at least 10 days prior to the commencement of sprayed bituminous surfacing work Hold Point on submitted nominated design has been released before work proceeds Submission of aggregate Lot details and target application rates Hold Point on aggregate Lot details and target application rates released before work proceeds	R R N I, H N I, H
2.1.2	Process Control: Manufacturer's written recommendations for temperatures of binder attached to PROJECT QUALITY PLAN	R
Annexure R111/L 4.3	Minimum frequency of testing included in PROJECT QUALITY PLAN Control charting system functional prior to commencement of work	R R

R111**Sprayed Bituminous Surfacing (with Bitumen Emulsion)**

Clause	Description	Action Point (ISO 9001)
6.6	Process temperature conforming	R
8	Methods and procedures for backrolling	R
9	Reporting system for recording test results of loose aggregate after final brooming.	R
9	Final sweeping and loose aggregate measurement prior to opening to the traffic	W
1.2.4	Procedures and ITP's for:	
	Management and traceability of each Lot to its incorporation into the pavement	R
	Calibration and NATA certification of laboratory equipment and procedures	R, T
	Submission of test results including timeframe constraints	R
	Management of stockpiles	R, I
	Handling, storage and transporting of binder	R
	Calibration of sprayer and precoating equipment	R, T
	Spraying small areas or areas of irregular shape	R
	Joints	R
	Calibration of thermometers	R, T
	Details of work performed must be recorded in the appropriate TfNSW Forms	R
	Procedure for precoating of aggregate	R
	Preparation of pavement surface	R
	Preparation of bitumen binder	R, T
	Spraying of bituminous surfacing	R, I
	Protection of services and road fixtures	R
	Removal of loose aggregate	R, T
	End Product Criteria:	
	Procedure and ITP's for:	
	Aggregate spread rate	R, T
	Binder sprayed rate	R, T
	Loose aggregate	R, T
	Surface texture	T

ANNEXURES R111/E TO R111/K – (NOT USED)

ANNEXURE R111/L – MINIMUM FREQUENCY OF TESTING**Table R111/L.1 - Minimum Frequency of Testing**

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
1.1	Surface Texture	TfNSW T240	Five measurements every 250 m and at changes in aggregate size or heavy patches (shoulder, wheelpaths, between wheelpaths and centre line) per lane of sprayed bituminous surfacing work ⁽¹⁾ .
2.1	Properties of Bitumen Emulsion	AS 2341.2 AS 2341.3 AS 2341.4 AS 2341.5 AS 2341.8 AS 2341.9 AS 2341.25 AS 2341.28 AS 2341.29 AS 2341.30 AS 3568 AS/NZS 2341.22 AS/NZS 2341.23 AS/NZS 2341.24 AS/NZS 2341.26 AS/NZS 2341.27 ASTM D244 BS 2586 TfNSW T560	As set out in TfNSW 3254
2.1	Properties of Polymer Additives and the Binder Residue of the Polymer Modified Bitumen Emulsion	AS 2341.12 MBT11 MBT22 MBT23 MBT27 TfNSW T511 TfNSW T741 TfNSW T742	As set out in TfNSW 3252
2.3	Aggregate Properties	TfNSW T203 TfNSW T230 TfNSW T238 TfNSW T239 AS 1141.6.1 AS 1141.11 AS 1141.14 AS 1141.20.1 AS 1141.20.2 AS 1141.22 AS 1141.41	1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 6 months and at change of quarry face 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ^{(1), (3)} 1 per 6 months and at change of quarry face 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 250 m ³ of aggregate ⁽¹⁾ 1 per 500 m ³ of aggregate ^{(1), (2)} 1 per 6 months or change of quarry face
2.4	Compatibility of Emulsion with Water	TfNSW T569	One each 10,000 litres of water

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
8	Measurement of Aggregate Spread Rate	TfNSW T274	2 per day
9	Measurement of Loose Aggregate on Sprayed Seals	TfNSW T277	1 per 500 m lane length or part thereof

Notes:

- (1) Frequency of testing may be reduced in accordance with TfNSW Q subject to the Principal's agreement.
- (2) Provided that all of the six previous tests have met specification requirements for both wet strength and wet/dry strength variation then the following reduced frequencies apply:
 - where all wet/dry variation results < 25% : 1 per 6,500 m³
 - where all wet/dry variation results < 30% : 1 per 2,500 m³
 - where all wet/dry variation results < 35% : 1 per 1,250 m³
- (3) Aggregate sourced from 'drill and blast' quarries may be exempted providing that all other tests have met Specification requirements.

ANNEXURE R111/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.5.

TfNSW Specifications

TfNSW G10	Traffic Management
TfNSW Q	Quality Management System
TfNSW 3151	Aggregate for Sprayed Bituminous Surfacing
TfNSW 3252	Polymer Modified Binder for Pavements
TfNSW 3254	Bitumen Emulsion
TfNSW 3258	Aggregate Precoating Agent (for Bitumen)

TfNSW Test Methods

TfNSW T103	Pretreatment of Samples of Road Materials by Artificial Weathering
TfNSW T203	Materials Finer than 75 µm in Aggregates (by washing)
TfNSW T230	Resistance to Stripping of Cover Aggregates and Binders
TfNSW T239	Fractured Faces of Coarse Aggregate
TfNSW T240	Texture Depth of Coarse Textured Road Surfaces
TfNSW T271	Ball Penetration Test
TfNSW T274	Measurement of Aggregate Spread Rate During Sealing (Field method)
TfNSW T277	Measurement of Loose Aggregate on Sprayed Seals
TfNSW T506	Penetration of Bituminous Material
TfNSW T511	Thin Film Oven Test of Bitumen
TfNSW T535	Dynamic Viscosity of Bituminous Materials by the Vacuum Capillary Viscometer
TfNSW T560	Apparent Bitumen Content of Bitumen Emulsion and Recovery of Bitumen for Testing
TfNSW T569	Compatibility of Emulsion with Water
TfNSW T703	Flash Point by Pensky-Martens Closed Tester
TfNSW T741	Determination of Elastic Recovery and Viscosity of Polymer Modified Binders
TfNSW T742	Plastic Limit of Modified Binders
TfNSW T1005	Qualitative Analysis using The Infra-Red Spectrophotometer

TfNSW Forms

TfNSW 354	Sprayer Certificate
TfNSW 395K	Bitumen Emulsion Seal and Reseal – Design Calculation
TfNSW 500D	Bitumen Emulsion Seal and Reseal – Daily Record

TfNSW Guides

TfNSW Sprayed Sealing Guide

Australian Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.6.1	Particle density and water absorption of coarse aggregate – Weighing-in-water method
AS 1141.11	Particle size distribution by dry sieving
AS 1141.14	Particle shape, by proportional calliper
AS 1141.20.1	Average least dimension – Direct measurement (nominal size 10 mm and greater)
AS 1141.20.2	Average least dimension – Direct measurement (nominal sizes 5 mm and 7 mm)
AS 1141.22	Wet/Dry strength variation
AS 1141.41	Polished aggregate friction value – Horizontal bed machine
AS 1152	Test sieves
AS 1160	Bitumen emulsion for construction and maintenance of pavements
AS 2008	Residual bitumen for pavements
AS 2341	Methods of testing bitumen and related roadmaking products
AS 2341.2	Determination of dynamic (coefficient of shear) viscosity by flow through a capillary tube
AS 2341.3	Determination of kinematic viscosity by flow through a capillary tube
AS 2341.4	Determination of dynamic viscosity by rotational viscometer
AS 2341.5	Determination of apparent viscosity by ‘Shell’ sliding plate micro-viscometer
AS 2341.8	Determination of matter insoluble in toluene
AS 2341.9	Determination of water content (Dean and Stark)
AS 2341.12	Determination of penetration of residual bitumen
AS/NZS 2341.22	Determination of particle charge
AS/NZS 2341.23	Determination of residue from evaporation
AS/NZS 2341.24	Calculation of non-aqueous volatiles content (by difference)
AS 2341.25	Determination of consistency
AS/NZS 2341.26	Determination of sieve residue
AS/NZS 2341.27	Determination of sedimentation
AS 2341.28	Determination of stone coating ability and water resistance
AS 2341.29	Determination of breaking behaviour by setting time
AS 2341.30	Recovery of residual from bituminous emulsion
AS 3568	Oils for Reducing the viscosity of residual bitumen for pavements

Austrroads Test Methods

MBT11	Handling Viscosity of Polymer Modified Binders (Thermosel)
MBT22	Torsional Recovery of Polymer Modified Binders
MBT23	Force Ductility
MBT27	Brittle Point by Fast Fraass

Austrroads Guides

	Austrroads Bitumen Sealing Safety Guide
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American Society for Testing and Materials

ASTM D244	Test Methods for Emulsified Asphalts
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British Standards

BS 2586	Specification for Glass and Reference Electrodes for the Measurement of pH
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