Austroads

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Guidelines and Specifications for Microsurfacing

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Abstract

Guidelines and Specification for Microsurfacing provides guidelines for the use of microsurfacing treatments in Australia. Microsurfacing is presently the only type of bituminous slurry surfacing applied in Australia.

The publication provides specific guidelines to assist road asset owners or managers in the use of microsurfacing materials and a model specification to be used as a framework when developing a national or local microsurfacing specification.

The document was produced by the Austroads Bituminous Surfacings Working Group. The guidelines are based on extensive experience gained in the use of the material across the country over the last 25 years.

Keywords

Slurry, seal, microsurfacing, emulsion, paver, surfacing, design, specification, spreading, rolling, testing, construction, bituminous surfacing

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Changes to this edition include:

- Bitumen emulsion changed to bituminous emulsion throughout.
- Additional information provided about applications of microsurfacing in Section 3.1.
- Clarification on the use of Size 7 microsurfacing in Section 3.3.
- Additional information about the minimum time between layers in Section 7.3.
- Additional Section A.9.6 Rolling.
- Clarification on the measurement of surface shape in Section A.10.2.
- New hold point added in Section A.10.3.
- References and cross references updated throughout.
- Minor text edits throughout.

About Austroads

Austroads is the peak organisation of Australasian road transport and traffic agencies.

Austroads' purpose is to support our member organisations to deliver an improved Australasian road transport network. To succeed in this task, we undertake leading-edge road and transport research which underpins our input to policy development and published guidance on the design, construction and management of the road network and its associated infrastructure.

Austroads provides a collective approach that delivers value for money, encourages shared knowledge and drives consistency for road users.

Austroads is governed by a Board consisting of senior executive representatives from each of its eleven member organisations:

- Roads and Maritime Services New South Wales
- Roads Corporation Victoria
- Queensland Department of Transport and Main Roads
- Main Roads Western Australia
- Department of Planning, Transport and Infrastructure South Australia
- Department of State Growth Tasmania
- Department of Infrastructure, Planning and Logistics Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- The Department of Infrastructure, Regional Development and Cities
- Australian Local Government Association
- New Zealand Transport Agency.

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This report has been prepared for Austroads as part of its work to promote improved Australian and New Zealand transport outcomes by providing expert technical input on road and road transport issues.

Individual road agencies will determine their response to this report following consideration of their legislative or administrative arrangements, available funding, as well as local circumstances and priorities.

Austroads believes this publication to be correct at the time of printing and does not accept responsibility for any consequences arising from the use of information herein. Readers should rely on their own skill and judgement to apply information to particular issues.

Summary

Guidelines and Specification for Microsurfacing provides guidelines for the use of microsurfacing treatments in Australia. It is based on a previous Austroads working document on microsurfacing that has gradually been updated based on practitioners' experience gained over the last 25 years.

This document consists of two components. The guidance section presented in the main text aims to provide road asset owners or managers with information on the use of microsurfacing materials. The model specification (presented separately in Appendix A) primarily aims to provide a framework for national microsurfacing specification. The model could also be adopted for local use to promote consistency across their specifications.

Specification limits used in the model specification were determined based on typical values used in the International Slurry Surfacing Association guidelines. These limits have been modified as necessary for Australian conditions to achieve the desired field performance in various applications.

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1. Scope

This document provides road asset owners or managers with guidelines and information on the use of microsurfacing materials. Additionally, a model specification for microsurfacing is provided in Appendix A to be used as a framework for national or local specifications. It is intended that the guidelines be read in conjunction with the model specification.

Microsurfacing is presently the only type of bituminous slurry surfacing applied in Australia with slurry seals having not been used for many years. The guideline and model specification therefore solely provide information on the application of microsurfacing.

2. Definitions

Bituminous emulsion

A system of fine droplets of bitumen with or without polymer, suspended in a mixture of water and emulsifier which begins to set up on contact with surfaces and when exposed to air.

Polymer modified emulsion (PME)

A bituminous emulsion containing a polymer modifier to assist in the development of early aggregate retention and enhanced performance during service. The polymer modifier may be added prior to, during or post emulsion manufacture to achieve specific performance attributes.

Bituminous slurry surfacing

A general term for slurry seal and microsurfacing.

Microsurfacing

A bituminous slurry surfacing that contains polymer modified emulsion binder, which is capable of being spread in layers with variable thickness for rut-filling and correction courses, and for wearing course applications requiring good surface texture.

Slurry seal

A thin layer of bituminous slurry surfacing containing bituminous emulsion, usually without a polymer modifier.

Paving unit

A purpose-built continuous flow mixing unit capable of accurately metering each individual component material into a mixer which thoroughly blends these materials to form a homogeneous bituminous mixed material and delivers this material into a spreader box for application to the pavement surface.

Higher performance additives

Materials added to microsurfacing materials to provide enhanced performance for strength and flexibility properties of the final delivered surfacing. These materials may be such materials as fibres or emerging technologies, and their use and inclusion should be substantiated by laboratory testing for the desired attributes.

Definitions for other terms used in this Guide are provided in Austroads (2015).

3. Descriptors

3.1 Applications of Microsurfacing

Generally, microsurfacing can be used as an alternative to sprayed sealing or asphalt in the following circumstances:

- where a non-structural wearing course is required such as for pavement preservation strategies
- where the increase in surface level must be minimised, for example, at kerbs, etc.
- where a dense graded asphaltic type surface is desirable at minimal cost, for example, in low traffic urban areas where sprayed sealing type surface could be appropriate from a design perspective, but not acceptable due to traffic noise
- where loose aggregate would be a problem, such as from sprayed sealing operations in shopping and pedestrian areas
- as a means of improving surface shape and providing a uniform surface texture prior to a reseal
- to correct cross-sectional shape and fill ruts
- to improve riding quality
- to improve skid resistance
- to reduce the noise level of sprayed seals.

Size 7 microsurfacing will result in a sand patch texture depth of about 1.1 to 1.5 mm at new, and during its life cycle.

Microsurfacings do not provide any structural strength. Where used on a pavement with high curvature values, a microsurfacing will crack early in its life.

A microsurfacing should not be considered as a treatment to prevent crack reflection, and is likely to reflect existing cracks within months of placement. If it is used on a cracked pavement it is suggested that another treatment, such as strain alleviating membrane (SAM) seals or geotextile seals, be placed first to mitigate crack reflection. A microsurfacing can then be placed to provide the benefits described above.

3.2 Types of Bituminous Slurry Surfacings

Information on slurry seals is presented below for historical context only as they are no longer used in Australia.

3.2.1 Slurry Seal

Slurry seals have generally been applied as a thin wearing course, typically on low volume roads such as residential streets as either preventative maintenance on existing sound pavements, or as corrective maintenance. Slurry seals typically utilise smaller sized aggregate for areas such as car parking lots, school yards and bicycle paths. Slurry seals may also be suitable on airfields to restore skid resistance and to serve as a preventative maintenance treatment. These finer types have been used because of the reduced chance of coarse aggregate being plucked out of the surface.

Whilst slurry seals can be used to seal minor surface cracks, they will not stop reflective cracking. It is preferable that all but very minor surface cracks be sealed with an appropriate crack filler/sealant prior to application of the slurry seal.

The surface texture depth of a slurry seal may not be appropriate for high-speed roads.

3.2.2 Microsurfacing

Microsurfacing has the advantage over slurry seals with improved binder characteristics through the incorporation of polymer. This also allows the use of larger nominal sized aggregate and enables its application in higher traffic areas (> 3000 v/l/d) and in layers up to 20 mm thick. Figure 3.1 illustrates a typical finish for microsurfacing.

Figure 3.1: Typical microsurfacing surface

Source: Downer Group (2017).

Microsurfacing is able to address a number of pavement maintenance requirements that cannot be readily met by sprayed seals or asphalt, e.g. minor shape correction while matching into existing levels.

Larger sized mixes may be designed to achieve shape correction in excess of 20 mm in multiple layers. The mixes can usually be applied without prior milling or tack coating.

Microsurfacing offers enhanced performance characteristics and wider scope for application in comparison to slurry seal which is why it is the only type of bituminous slurry surfacing being used in Australia.

3.2.3 High Performance Microsurfacing

Higher performance attributes can be derived through inclusion of additives such as fibres or emerging technologies. These additives may improve flexibility or strength of material in the applied microsurfacing and are generally proprietary.

3.3 Nominal Sizes of Microsurfacing

Various nominal sizes of microsurfacing are specified based on the nominal largest aggregate size. The nominal aggregate sizes typically used in Australia are as follows for typical applications (the numerical designation refers to millimetres):

- Size 4 and Size 5 microsurfacing are in common use in Australia for local government residential resurfacing type works, airfield and shared pathways.
- Size 7 microsurfacing is predominantly used by state road agencies for shape and correction courses, or as a final wearing course for lower speed roads.
- Size 10 microsurfacing is used for rut or shape correction or on sites where higher final texture depth is required.

4. Materials

Testing to determine material properties should be carried out by a National Association of Testing Authorities (NATA) accredited laboratory.

4.1 Mineral Aggregate

In general, all aggregates should meet the requirements set out in the model specification (Appendix A.6.1). Where an aggregate is proposed for use and does not conform to the specification the onus should be on the Contractor to demonstrate fitness for purpose. Specification requirements for the Los Angeles Value, Polished Aggregate Friction Value and the Degradation Factor may vary due to limitations in the quality of locally sourced aggregates.

There may be times when non-conforming materials are available at significant cost savings. The decision to use such materials should be by mutual agreement between the Contractor and Principal, and the properties and outcomes should be in accordance with the mix properties in Table A 4 of the Specification.

4.2 Mineral Filler

Mineral filler is added to the materials to increase the proportion of fines, give more ‘bulk’ or consistency to the mix, or as a means of controlling the curing characteristics. The type and amount of mineral filler needed should be determined as part of the mix design and is considered as part of the aggregate particle size distribution. An increase or decrease of less than one percent may be permitted during placement of microsurfacing.

4.3 Binder

Bituminous emulsions used are normally proprietary products, typically manufactured using bitumens that conform to AS 2008.

Each batch of emulsion should be tested to ensure that the binder content is as specified by the requirements of the registered/approved/nominated mix design. Alternatively, the Superintendent may accept a certificate of compliance from the manufacturer showing the binder content and other specified properties for each delivery of emulsion.

Where a proprietary binder is used, the Contractor and the Superintendent should agree on test methods which are to be used as part of the Contractor's quality system to prove that the binder supplied is the same as that used in the approved mix design. The Contractor may suggest suitable test methods for acceptance by the Superintendent. The test methods to be used should be accepted prior to commencement of the physical works.

The softening point, determined in accordance with AS 2341.18, of binder recovered from the bituminous emulsion should be a minimum of 57 °C. The binder should be extracted from the bituminous emulsion in accordance with the supplier-recommended method.

4.4 Water

It is preferable to use potable water in the preparation of microsurfacing. Water from the actual job source should be used in the development of mix designs.

4.5 Additives

Additives may be used to control the curing and flow characteristics of the microsurfacing. The use of additives should be made initially in quantities specified in the approved mix design, with minor adjustment to be made in the field if required, to allow for changes in pavement temperature, weather conditions and moisture levels in the aggregates.

4.6 Higher Performance Additives

Additives to nominated mix designs such as fibres and emerging technologies can be incorporated to provide the final surfacing with enhanced properties such as pavement flexibility or strength characteristics. Where such additives are nominated for use, these should be specified in the mix design including the supplier, source, and dose rates that can be verified by the Superintendent. Any such additives nominated must be approved for use prior to commencing works. The Contractor should provide evidence that the mix containing nominated additives conforms to the mix properties of Table A 4.

5. Mix Design

The mix design is a fundamental statement of the materials used for microsurfacing including the conformance of raw materials to specified tolerances, the required amounts of each component material used in the design and reporting of compliance to the specified performance testing criteria in the specifications document. The submission of a nominated mix design is required prior to commencing works, and this should form a hold point for works; i.e. work is not to commence until the mix design is submitted, and the hold point is released.

Testing of mix designs should be carried out by a NATA accredited laboratory.

5.1 Responsibility for Mix Design

The Contractor is responsible for the design and submission of the mix design to the Superintendent.

5.2 Mix Design Criteria

5.2.1 Aggregate and Binder Properties

A mix design should nominate the name and source of materials used in the mix design and provide a summary demonstrating conformance of the nominated materials to the specified properties as outlined in Appendix A.6. These items should include the softening point of the binder recovered from the bituminous emulsion and aggregate density used in the design.

5.2.2 Abrasion (Wear) Loss

Wear loss is determined by the procedure described in AGPT/T272. This test method describes the measurement of the wearing qualities of material under wet abrasion conditions. The test is a simulated performance test, which can be correlated to the wearing resistance of materials applied in the field. The test can be used to establish the minimum permissible binder content of the mixture.

5.2.3 Traffic Time/Material Cohesion

Traffic time is indicative of earliest safe traffic access and is measured by the cohesive strength of the mixture.

Cohesion is determined as described in AGPT/T271. The test measures torque as the mix sets and develops cohesive strength, and defines ‘set time’ and ‘early rolling traffic time’ as a function of developed torque. A torque value of 1.2 N.m in this test is considered to indicate that the material has ‘set’, the material will not soften or separate in rain, and the set time is the time taken to reach this value. When the torque value has reached 2.0 N.m, the material is regarded as trafficable under controlled conditions.

Microsurfacing may not be required to meet the traffic time requirement when used in applications such as footpaths or shared paths.

5.2.4 Excess Binder Content

Excess binder content is determined as described in AGPT/T273. This test is intended to compact fine aggregate bituminous mixtures by means of a loaded rubber-tyred reciprocating wheel. The test may be used to establish the maximum limits of binder content to reduce the propensity to flushing in service. A test value less than or equal to the specified value is considered to represent the ability of a mix design to cope with traffic counts greater than 3000 v/l/d without flushing.

5.2.5 Mix Consistency

Mix consistency is determined as described in AGPT/T270. The mixture should be homogeneous throughout the mixing and spreading process. It should be free from excess water or bituminous emulsion, which can cause segregation of the bituminous emulsion and fine aggregate from the coarser aggregate.

5.2.6 Mix Performance

Notwithstanding compliance with the specified test criteria, the microsurfacing should also be easy to lay and finish to provide a stable, durable treatment, which satisfies skid resistance and texture depth requirements.

5.3 Mix Design Currency

Mix designs may be current for a period of up to two years. There should be no change to the source and quality of the component materials. Where aggregate quality is likely to be highly variable between projects, a mix design should be undertaken for each new proposed project.

6. Plant

6.1 Provision of Plant

All plant and equipment used in the performance of the work should be provided by the Contractor and maintained in good working condition with appropriate equipment calibrated on a regular basis.

6.1.1 Paving Unit

Paving units are usually continuous-flow mixing machines which can accurately proportion and deliver mineral aggregate, mineral filler, emulsion and water to a pug-mill or similar mixer and discharge the mixed materials on a continuous basis.

Paving units may be either truck mounted, where raw material storage is limited and once exhausted, the unit is required to cease paving in order to be reloaded with further raw materials, or continuous type paver, where raw materials can be reloaded without disruption to paving process. Continuous type pavers may be specified where longer paving lengths are desired to minimise transverse joints in the paved surface.

Paving units are equipped with a fines feeder that can accurately meter a predetermined amount of mineral filler into the mixer at the same time and location as the mineral aggregate. Calibrated controls for mineral aggregate, water and emulsion should be provided and be capable of accurately proportioning the component materials. Where high performance additives are included, systems for calibrated delivery of these should also be fitted to the paving machine.

Paving units should also be fitted with a guidance system, which assists the driver in following the correct line.

Problems have occasionally been experienced where flow meters measure the volume of froth instead of fluid. For this reason, tank dipsticks and calibrated hoppers are suggested as back-up measurement of component material usage.

The spreader box (Figure 6.1) should be equipped with mechanical devices to agitate and spread the mixed materials within the box, and to ensure the manufactured material is spread according to pavement surface demand. The spreader box should be able to compensate for variations in the pavement geometry and equipped with a front seal to ensure no loss of the mixture at the road contact point. The rear strike-off should be adjustable to regulate the shape and thickness of the material laid.

Figure 6.1: Spreader box

Source: Downer Group (2017).

6.1.2 Ancillary Equipment

Any necessary ancillary equipment, such as rotary brooms, signs, lamps, barricades, hand squeegees (Figure 6.2), shovels and hand brooms, will be supplied as specified and each of these should meet all statutory requirements.

6.2 Paving Unit Calibration

To achieve the desired proportions of component materials, it is necessary for the metering devices on the paving unit to be correctly calibrated. These devices need to be recalibrated at least every 12 months to allow for wear. Recalibration is required if any device critical to the proportioning of component materials is overhauled or replaced. Adjustments to metering of materials need to be made on a job-by-job basis to allow for varying aggregate density and moisture content or varying binder content of the emulsion.

The paving unit should be adjusted with reference to the nominated mix design component materials prior to the start of any contract for each design used in the work.

Figure 6.2: Squeegee for edge work

Source: Downer Group (2017).

7. Field Application

7.1 Preparation of Existing Surface

7.1.1 Set Out

Before the commencement of operations, the Contractor should set out the work to ensure a straight edge is maintained along kerbs and shoulders and through intersections. Paving plans should be determined so that longitudinal joints are placed outside wheel path running areas and wherever possible aligned with line-marking reinstatement.

7.1.2 Cleaning

Prior to application, the pavement surface should be cleaned sufficiently well to ensure that a good bond is formed with the microsurfacing. This normally requires mechanical brooming or in extreme cases, washing.

7.1.3 Protection of Services and Road Fixtures

Services and road fixture protection can be readily achieved by using plastic sheeting, paper or cardboard as a mask. Figure 7.1 shows the protection of a utility hole. Figure 7.2 shows plastic masking the start of a microsurfacing application area to create a neat edge, and protection of a drain.

Figure 7.1: Protection of services (utility hole)

Source: Downer Group (2017).

Figure 7.2: Protection of services (bridge joint)

Source: Downer Group (2017).

7.1.4 Surface Defects

It is important that all surface defects, including cracks, potholes and pavement failures, be repaired at least 3 months, but preferably 12 months, prior to the application of the microsurfacing to ensure curing of this repair work. Cold mix repairs should be removed and replaced with hot mix asphalt or other permanent patching material at least 3 to 6 months prior to the application of the microsurfacing to avoid the entrapment of volatiles that can lead to bleeding. Poor pavement and surface repairs will adversely affect the performance of the microsurfacing. There should be few, if any, defects for the Contractor to rectify.

7.1.5 Tack Coat

Tack coating is generally not required but may be beneficial on very old oxidised pavement surfaces, surfacings with ravelling and on concrete or brick surfaces. For small or relatively inaccessible areas, a hand lance or low-pressure spray bar should be used.

7.1.6 Water Fog Coat

Pre-wetting of the pavement surface is not normally required but may be used where extreme pavement surface temperatures are experienced. The use of water fogging assists the spreading of the mixed materials and cools hot pavement surfaces to prevent premature breaking of the bituminous emulsion. Pre-wetting should leave the surface damp but with no apparent flowing water in front of the spreader box.

7.2 Weather Limitations

If cold and wet conditions are experienced on fresh microsurfacing, severe damage may result, particularly at locations with high volume traffic and/or heavy vehicles. Application of microsurfacing should therefore be avoided if wet weather is imminent. Microsurfacing can be applied at night with suitable mix design utilised to cater for lower pavement temperatures and lack of sunlight. Microsurfacing should not be placed if the pavement temperature is less than 10 °C or above 55 °C.

7.3 Rut-filling and Correction

A correction course may be required to produce a suitable and stable finish over ruts in excess of 10 mm deep. A rut-filling operation is shown in Figure 7.3. Correction courses are usually applied using a stiff strike-off screed on a standard spreader box for shallow ruts and a purpose-built rut-filling spreader box for ruts in excess of 10 mm deep. For ruts in excess of 40 mm, consideration should be given to the use of asphalt for shape correction.

Figure 7.3: Rut-filling

Source: Downer Group (2017).

Rut-filling courses are usually applied in layers of 1.5 to 2.0 times the nominal aggregate size. Guidance on the use of varying size mixes for shape correction is shown in Table 7.1.

Table 7.1: Rut-filling and correction

Nominal size	Sizes 4 & 5	Size 7	Size 10
Void filling (e.g. cape seals)	✓		
For rutting 10–15 mm deep	✓	✓	
For rutting 15–25 mm deep		✓ (see note below)	✓
For rutting 25–40 mm deep		✓ (see note below)	✓ (see note below)

Note: Application in multiple layers (Section 7.4) is suggested where the depth of a rut exceeds 2–2.5 times the nominal size of the mix.

To obtain an even and uniformly textured surface, it is most important that rut-filling and correction courses be overlaid by a wearing course. If this is not done, the coarser aggregate fractions can settle into the mix, resulting in a low or uneven surface texture and an unsightly appearance due to 'fatty' spots. The minimum time between layers should be overnight, or a lesser period of time as agreed between the Contractor and Superintendent.

7.4 Multiple-layer Applications

Where multiple layers are required to be applied to achieve desired final surface levels, each separate layer should be allowed sufficient time to achieve final cure. Typically it is suggested that each individual layer is applied following trafficking of the previous layer by a minimum of one hour to ensure final cure is achieved and all moisture is removed from the previous layer. For heavier traffic locations or deep ruts, a period of at least 24 hours may be required to achieve a stronger surfacing and remove moisture from thicker layers.

7.5 Spreading

7.5.1 Process

The mixture should be produced at the optimum consistency and stability. If the mixture is too stiff, it may prematurely set in the spreader box or may tend to drag behind the strike-off screed (Figure 7.4). If the mix is too fluid, it may run into channels or across completed work and emulsion and binder-rich fines can migrate to the surface, impacting upon skid resistance.

Figure 7.4: Dragged mix

Careful control of the paving unit is required to ensure that the mixed materials are of a satisfactory consistency and stability, and that segregation does not occur. There may be an occasional requirement for the operator to squirt minor amounts of water into the corners of the spreader box to overcome temporary build-up of mixed materials, but this should have no detrimental effect on the performance of the final surfacing.

7.5.2 Surface Finish

A secondary strike-off may be fastened across the full width of the spreader box, and trailed behind the spreader box to provide an enhanced texture surface. Final surface should be of uniform texture across the extent of the paving width being applied.

7.5.3 Shape

Where the existing shape deviation exceeds 1 to 1.5 times the nominal size of the aggregate, it may be necessary to apply a correction course or, in more extreme cases, a rut-filling course, prior to overlay by a wearing course.

Shape should be determined with a 3 m straight edge in accordance with an appropriate method for testing a road surface.

7.5.4 Joints

Neither excessive build-up nor unsightly appearance should be visible along longitudinal or across transverse joints.

It is desirable to limit overlap to a maximum of 200 mm on longitudinal joints. Generally, the overlapping pass should be on the higher side of the crossfall to prevent ponding of water after completion in the vicinity of joints (Figure 7.5). Joints should not be placed in wheelpaths. The end of each run should be squared off at the point where ‘feathering’ commences. Hand squeegees should be used in areas inaccessible to the paving unit.

Figure 7.5: Joints

Source: Downer Group (2017).

7.5.5 Traffic Time

Under field conditions, the paved material should be able to carry traffic within 60 minutes. Where this time exceeds 60 minutes, and no method can reduce the time to less than 60 minutes, work should cease unless there is clearly no likelihood of permanent damage to the new surface or unacceptable delays to road users.

Traffic time usually varies considerably with temperature. Without adjustment of the component material flows, traffic time would be expected to increase as temperature decreases and vice versa. Sections which have been placed in thicker layers, or in shaded areas, may experience slower curing than for the majority of the work, and this should be taken into account when allowing traffic on to the new surface.

7.5.6 Rolling

In general, microsurfacing does not require rolling. Rolling however is considered beneficial in some circumstances, such as where the newly laid microsurfacing will not receive traffic, or it may receive a high proportion of turning traffic (e.g. *cul-de-sacs* and car parks). Care is required to ensure that rolling does not occur prior to material cure as this can result in delamination. If rolling is required, it should be carried out using a self-propelled pneumatic-tyred multi-wheel roller. Rolling should be undertaken when the surface has cured sufficiently to prevent pick-up on the roller tyres. Rolling (where required) is typically to simulate initial traffic on the new surface and not required for reasons of material compaction. As such, pneumatic tyred rollers for microsurfacing can be unballasted and less than 10 tonnes gross weight. The use of steel rollers should be avoided as the rolling of paved material with steel rollers can crush aggregate particles rather than compact.

8. Sampling and Testing

8.1 Compliance Testing

Compliance testing is undertaken to ensure that the materials and manufactured mix conform to and achieve the properties of the approved mix design. This also confirms the validity of the paving unit calibration where there is a discrepancy. Where there is a discrepancy, work should cease until the cause has been rectified.

8.2 Compliance Criteria

8.2.1 Method of Sampling

Samples should be taken in accordance with the procedures set out in AGPT/T221, in line with the agreed inspection and testing plan frequency and as approved by the Superintendent.

8.2.2 Frequency of Testing

The sample testing frequency should be sufficient to ensure compliance with the Specification. As a guide, samples of manufactured material should be drawn at least daily and from each paving unit used on site. The Contractor should outline the proposed inspection and testing plan (ITP) to the Superintendent prior to work commencing for approval and acceptance. The submission and approval of the contract ITP should form a contract hold point.

8.2.3 Surface Finish

To ensure an adequate surface finish is achieved, measurement of surface texture should be conducted after one month, when exposed binder films on the aggregate have worn off. Surface texture is normally initially evaluated via visual inspection and testing only required where the surface texture is identified as potentially not complying with the Specification.

9. Defective Work or Materials

Any lot of work which fails to achieve conformance will be regarded as a non-conformance and the affected lot should be replaced or corrected unless conditionally accepted subject to a reduced payment.

10. Measurement and Payment

10.1 Surface Preparation

Payment for surface preparation should be at a rate per m^2, and should include payment for the set out, cleaning, protection of services, tack coat, and any other similar items covered by the Specification.

10.2 Microsurfacing

Payment for microsurfacing should be at a rate per quantity of dry mineral aggregate (excluding mineral filler), and include payment for mix design and approval, supply of component materials, and any other work associated with placement of the microsurfacing. Typical rates of application of microsurfacing are shown in Table 10.1. These rates are indicative only as the actual rates will depend on such factors as aggregate density and the shape and texture of the existing pavement.

Table 10.1: Typical application rates of microsurfacing

Nominal size	Sizes 4 & 5	Size 7	Size 10
kg/m^2	10–18	14–24	18–28
m^2/m^3	200–110	140–80	110–70

Correction of rutting prior to placement of microsurfacing should be at a rate per m^3 of dry mineral aggregate. The volume can be calculated based on the width and length of the rutting to be corrected and the average depth of the rutting taken as half of the maximum rut depth obtained from network data.

As a guide to verification of quantities, the Superintendent may verify quantities of aggregate or emulsion supplied to a respective job site to confirm the volume of material placed is aligned with material supplied for the works and in line with quantities required as per the nominated mix design proportions.

11. Quality Assurance (QA)

11.1 Quality Requirements

The quality assurance (QA) requirements may vary from purchaser to purchaser and vary according to the scope and magnitude of the work. These Guidelines and Specification assume that the Contractor and its materials suppliers have quality systems in place.

11.2 Quality Plan

The Contractor should carry out design of the mix, preparation, testing, traffic control and application in accordance with its quality plan.

11.3 Hold Points

The following hold points should apply:

- submission of mix design and supporting test results
- submission of evidence of calibration and compliance of plant and equipment
- submission of an inspection and test plan (ITP) for the proposed works.

References

Austroads 2015, *Austroads glossary of terms*, 6th edn, AP-C87-15, Austroads, Sydney, NSW.

Australian and New Zealand Standards

AS 2008, *Bitumen for pavements*.

AS 2341.18, *Methods of testing bituminous and related roadmaking products: determination of softening point (ring and ball method)*.

Austroads Test Methods

AGPT/T221, *Sampling of bituminous slurry*.

AGPT/T270, *Determination of Optimum Amount of Added Water for Bituminous Slurry (Consistency Test)*.

AGPT/T271, *Determination of set and cure for bituminous slurry (cohesion test).*

AGPT/T272, *Determination of abrasion loss of bituminous slurry (wet track abrasion test).*

AGPT/T273, *Determination of excess binder in bituminous slurry (loaded wheel test).*

Appendix A Model Specification for Microsurfacing

A.1 Scope

The Specification sets out the requirements for the manufacture and placement of microsurfacing for use on road pavements and includes requirements for the following:

1. component materials
2. properties of the microsurfacing
3. mix design responsibility
4. manufacturing and application
5. sampling and testing.

This document is intended to be used as an aid or reference in the preparation of a national or local specification for microsurfacing.

A.2 Referenced Documents

Unless specified otherwise, the applicable issue of a reference document, must be 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.

Austroads

Austroads 2015, *Austroads glossary of terms*, 6th edn, AP-C87-15, Austroads, Sydney, NSW.

Austroads Test Methods

AGPT/T221, *Sampling of bituminous slurry*.

AGPT/T250, *Modified surface texture depth (Pestle method).*

AGPT/T270, *Determination of Optimum Amount of Added Water for Bituminous Slurry (Consistency Test).*

AGPT/T271, *Determination of set and cure for bituminous slurry (cohesion test).*

AGPT/T272, *Determination of abrasion loss of bituminous slurry (wet track abrasion test).*

AGPT/T273, *Determination of excess binder in bituminous slurry (loaded wheel test).*

Main Roads Western Australia Test Method

WA 313.2, *Surface shape using a straight edge*.

Australian and New Zealand Standards

AS 1141.3.1, *Methods for sampling and testing aggregates: sampling: aggregates.*

AS 1141.11.1, *Methods for sampling and testing aggregates: particle size distribution: sieving method*.

AS 1141.12, *Methods for sampling and testing aggregates: material finer than 75 µm in aggregates (by washing).*

AS 1141.22, *Methods for sampling and testing aggregates: wet/dry strength variation*.

AS 1141.23, *Methods for sampling and testing aggregates: Los Angeles value*.

AS 1141.25.2, *Methods for sampling and testing aggregates: degradation factor: coarse aggregate*.

AS 1141.25.3, *Methods for sampling and testing aggregates: degradation factor: fine aggregate.*

AS 1141.40, *Methods for sampling and testing aggregates: polished aggregate friction value: vertical road-wheel machine*.

AS 1141.41, *Methods for sampling and testing aggregates: polished aggregate friction value: horizontal bed machine.*

AS 1160, *Bitumen emulsions for construction and maintenance of pavements*.

AS 1289.3.7.1, *Methods of testing soils for engineering purposes: soil classification tests: determination of the sand equivalent of a soil using a power operated shaker.*

AS 2008, *Bitumen for pavements*.

AS 2150, *Hot mix asphalt: a guide to good practice*.

AS 2341.18, *Methods of testing bituminous and related roadmaking products: determination of softening point (ring and ball method)*.

AS/NZS 2341.23, *Methods of testing bitumen and related roadmaking products: determination of residue from evaporation.*

AS/NZS 2891.3.1, *Methods of sampling and testing asphalt binder content and aggregate grading: reflux method.*

AS/NZS 2891.3.2, *Methods of sampling and testing asphalt binder content and aggregate grading: centrifugal extraction method.*

AS/NZS 2891.3.3, *Methods of sampling and testing asphalt binder content and aggregate grading: pressure filter method.*

International Slurry Surfacing Association Standards

ISSA TB-114, *Wet stripping test for cured slurry seal mix.*

ISSA TB-144, *Classification of aggregate filler: bitumen compatibility by Schulze-Breuer and ruck procedures.*

A.3 Definitions

Bituminous emulsion

A system of fine droplets of bitumen with or without polymer, suspended in a mixture of water and emulsifier which begins to set up on contact with surfaces and when exposed to air.

Polymer modified emulsion (PME)

A bituminous emulsion containing a polymer additive to assist in the development of early aggregate retention and enhanced pavement properties. The polymer additive may be added prior to, during or post emulsion manufacture to achieve specified performance attributes.

Bituminous slurry surfacing

A general term for slurry seal and microsurfacing.

Microsurfacing

A bituminous slurry surfacing that contains polymer modified emulsion binder, that is capable of being spread in layers with variable thickness for rut-filling and correction courses, and for wearing course applications requiring good surface texture.

Slurry seal

A thin layer of bituminous slurry surfacing, usually without a polymer modifier.

Paving unit

A purpose-built continuous flow mixing unit capable of accurately metering each individual component material into a mixer which thoroughly blends these materials to form a homogeneous bituminous mixed material and delivers this material into a spreader box for application to the pavement surface.

Higher performance additives

Materials added to microsurfacing materials to provide enhanced performance for strength and flexibility properties of the final delivered surfacing. These materials may be such materials as fibres or emerging technologies, and their use and inclusion should be substantiated by laboratory testing for the desired attributes.

Definitions for other terms used in the Specification are defined in the *Austroads Glossary of Terms* (Austroads 2015).

A.4 Work Items

The standard work items are listed in Table A 1.

Table A 1: Standard work items

Item	Description	Unit of measurement*
1	Preparation of existing surface	m^2
2	Microsurfacing Size 4	m^3
3	Microsurfacing Size 5	m^3
4	Microsurfacing Size 7	m^3
5	Microsurfacing Size 10	m^3

**The m^3 unit is measured by volume of dry mineral aggregate (excluding added mineral filler).*

A.5 Work Operations

1. Preparation of the existing surface is described in Appendix A.9.1.
2. Microsurfacing shall include the following operations
   a. submission of a mix design for registration/approval/nomination
   b. supply, delivery and storage of materials
   c. manufacture/mixing of materials to meet the requirements of the mix design
   d. spreading and, if required, rolling of the mixed materials in accordance with Appendix A.9.6
   e. testing of materials, microsurfacings and finished road surface
   f. traffic management.

A.6 Materials

A.6.1 Mineral Aggregate

Mineral aggregate shall consist of crushed rock or crushed gravel but may include proportions of natural sand particles.

The aggregate shall be clean, hard, angular, durable and free from clay and other aggregations of fine material, soil, organic material or other deleterious material.

To ensure adequate physical strength and durability characteristics, the aggregate shall be derived from source rock that when crushed meets the requirements set out in Table A 2 and Table A 3. The Contractor shall nominate the source/s of materials together with evidence that they meet the specified requirements.

Materials source assessments shall be provided with each new mix design submitted for approval, unless waived by the Superintendent.

Table A 2: Aggregate properties

Property	Limit	Test method
Degradation factor	50 minimum	AS 1141.25.2 and 1141.25.3
Los Angeles value	30% maximum	AS 1141.23
Wet strength	150 kN minimum	AS 1141.22
Wet/dry strength variation	30% maximum	AS 1141.22
Polished aggregate friction value	45 minimum*	AS 1141.40 or AS 1141.41
Sand equivalent	60% minimum	AS 1289.3.7.1

**Or higher value as specified.*

Table A 3: Particle size distribution limits for combined aggregate and mineral filler

Sieve size (mm)	Percent passing by mass			
	Size 4	Size 5	Size 7	Size 10
13.2	100	100	100	100
9.50	100	100	100	95–100
6.70	100	100	85–100	85–90
4.75	90–100	90–100	70–90	60–85
2.36	65–90	50–70	45–70	40–60
1.18	45–70	30–50	28–50	28–45
0.6	30–50	20–35	19–34	19–34
0.3	18–30	12–25	12–25	12–25
0.15	10–21	7–18	7–18	7–18
0.075	5–15	4–10	5–15	4–8

When tested in accordance with AS 1141.11.1 and AS 1141.12, the aggregate (including mineral filler) shall conform to the particle size distribution limits shown in Table A 3.

A.6.2 Mineral Filler

Mineral filler shall consist of an approved material such as Portland cement, hydrated lime or flyash with a minimum of 85% passing a 0.075 mm sieve.

The mineral filler shall be dry, free from lumps, clay, organic material and any other deleterious material and shall comply in all other respects with the requirements of AS 2150.

The quantity of mineral filler added to the mixed materials during placement shall not vary by more than 1% from the mineral filler content prescribed in the mix design.

A.6.3 Binder

Bituminous emulsions used in this process are typically proprietary grades with polymer modification so that the mix design meets the performance requirements specified in Appendix A.7. The Contractor shall provide sufficient information for the Superintendent to be able to verify that the bituminous emulsion supplied is the same as that nominated in the mix design.

The softening point, determined in accordance with AS 2341.18, of binder recovered from the bituminous emulsion shall be a minimum of 57 °C. The binder shall be extracted from the bituminous emulsion in accordance with the supplier's recommended method.

Bitumen used in emulsion manufacture shall comply with the requirements of AS 2008.

A.6.4 Water

Water added to the mixture shall be compatible with the component materials such that the performance requirements specified in Appendix A.7 are met.

A.6.5 Additives

Additives may be incorporated and nominated in a proposed mix design for a variety of purposes including material-break accelerant, retardant or for the provision of higher performance in service attributes (such as fibre or new emerging technologies).

The likely range of additive levels expected to be used shall be stated in the mix design. Where the use of additive is stated in the mix design, supportive test data shall be provided which shows that the wear loss, traffic time and excess binder content of the mix design remain within the property limits shown in Table A 4 for mixes containing additive at both extremes of the nominated design range for the additive.

A.7 Mix Design

A.7.1 Responsibility for Mix Design

The Contractor shall be responsible for the design of the microsurfacing. Where the use of an additive is recommended but not included in the original design process, additional validation testing shall be performed.

A.7.2 Mix Design Criteria

The component materials shall be proportioned such that the Consistency of the bituminous mixture meets the requirements of test method AGPT/T270. The mix design shall also conform to the properties shown in Table A 4.

Table A 4: Mix properties

Property	Test method	Limits
Wear loss	AGPT/T272	
	1 hour soak	540 g/m^2 maximum
	6 days soak	800 g/m^2 maximum
Traffic time	AGPT/T271	
	30 minutes	1.2 N.m minimum
	60 minutes	2.0 N.m minimum
Adhesion	ISSA TB 114 Or ISSA TB 144	≥ 90% 11 grade points minimum (AAA, BAA)
Excess binder content	AGPT/T273	540 g/m^2 maximum

A.7.3 Mix Design Submission

Unless otherwise specified, the Contractor shall submit the following details and samples to the Superintendent for approval at least 14 days prior to the date on which production of microsurfacing is to commence:

1. A statement detailing the nominal size of the mix design, the aggregate source and properties as required in Appendix A.6.1, the combined aggregate/mineral filler particle size distribution, bituminous emulsion type and content of the mix design, the residual binder content of the emulsion with binder properties required in Appendix A.6.3, and the intended proportion of each component material including the proportion of additive in the binder if applicable.
2. A statement detailing the NATA certified performance test results as per Table A 4 obtained by the Contractor on the submitted mix design.

Mix design approval/registration only confirms that the mix complies with the test criteria. It does not relieve the Contractor of the responsibility of supplying and placing materials which meet the compliance criteria as set out in Appendix A.10. If the results of all tests submitted by the Contractor and any additional tests comply with the specified requirements, the mix design shall be termed the Job Mix design. The combined aggregate/mineral filler particle size distribution and the binder content of the Job Mix design shall be termed the Job Mix particle size distribution and the Job Mix binder content, respectively.

Approved mix designs shall be manufactured to the Job Mix design within the maximum permitted variations specified in Table A 5.

Table A 5: Maximum permitted variations from Job Mix design

Sieve size (mm)	Maximum permitted variation of aggregate particle size distribution in percent passing (by mass)		
	Sizes 4 & 5	Size 7	Size 10
13.2	Nil	Nil	Nil
9.50	Nil	Nil	± 7
6.70	Nil	± 7	± 7
4.75	± 7	± 7	± 7
2.36	± 5	± 5	± 5
1.18	± 5	± 5	± 5
0.6	± 4	± 4	± 4
0.3	± 4	± 4	± 4
0.15	± 2.5	± 2.5	± 2.5
0.075	± 1.5	± 1.5	± 1.5
The maximum permitted variation in residual binder content shall be not more than 0.5% below or 1.0% above that stated in the Job Mix design.			

The Contractor's Job Mix design will be deemed to be current for a period of two years from the date of registration/approval, subject to the following:

1. The sources and quality of the component materials in the Job Mix design remain unchanged from the approved mix design.
2. The proportions of the component materials in the Job Mix design remain unchanged from the approved mix design.
3. The mix continues to demonstrate satisfactory performance in service.

Hold Point

Process held: Operation using the proposed mix design

Submission details: Proposed microsurfacing design together with certification for the nominated materials and design verification documentation at least 14 days prior to the commencement of the surfacing work

Release of hold point: The Superintendent will consider the submitted documents, prior to releasing the Hold Point.

A.8 Plant

A.8.1 Provision of Plant

All plant and equipment used in the performance of this work shall be provided and maintained in good working condition by the Contractor. The plant and equipment to be used shall be nominated by the Contractor 14 days before the commencement of work and shall not be changed without reference to the Superintendent.

The Contractor shall provide evidence to the Superintendent to verify that the equipment will perform the work as specified and that all metering devices are accurately calibrated prior to commencement of work.

Ancillary equipment necessary for the performance of the work, such as rotary road brooms, signs, lamps, barricades, hand squeegees, shovels and hand brooms, shall be provided by the Contractor and shall meet all statutory requirements.

A.8.2 Paving Unit Calibration

Each paving unit to be used to perform the work shall be calibrated with the component materials of the approved mix design prior to the commencement of construction. Previous calibration documentation covering the same approved mix design may be acceptable provided the calibration was carried out within the previous 12-month period. The documentation shall include an individual calibration for each component material at various settings which can be related to the paving unit's metering devices. No paving unit shall be allowed to incorporate mix into the work until the calibration has been completed and/or accepted by the Superintendent.

Hold Point

Process held: Operation using the paving unit

Submission details: Paving unit calibration documentation with component materials of approved mix design at least one day prior to the commencement of the surfacing work

Release of hold point: The Superintendent will consider the submitted documents, prior to releasing the Hold Point.

A.9 Field Applications

A.9.1 Preparation of Existing Surface

Set out

The Contractor shall place marks at intervals not exceeding 10 m on the line to be followed by the paving unit while mixing and spreading. If the line is already defined e.g. by a kerb or edge, the marking will not be necessary.

Care shall be taken to ensure that edges are parallel to kerbs and shoulders and that no runoff of bituminous materials onto these areas will occur. Lines at intersections will be kept straight to provide a good appearance. If necessary, masking shall be used to provide straight lines.

Cleaning

Prior to any application of microsurfacing, the pavement shall be swept to ensure that the surface is free of loose material, stones, dirt, dust and foreign matter. Spreading shall not be undertaken until the pavement has been prepared in accordance with this Specification and approved by the Superintendent.

Protection of services and road fixtures

The Contractor shall take all necessary precautions to prevent the mixed material used on the work from entering or adhering to gratings, hydrants, valve boxes, manhole covers, bridge or culvert decks or other road fixtures. After the microsurfacing has been spread, the Contractor shall remove any such material that has entered or adhered to gratings, manholes and other road fixtures.

Surface defects

If specified, surface defects shall be repaired, at least three months prior to spreading, and as directed by the Superintendent, or in accordance with an approved quality plan, prior to the spreading of microsurfacing. If the Contractor is concerned about the surface and appropriateness of the treatment, then the Superintendent should be advised in writing.

This may include crack filling, pothole repairs and repairs to failed pavement.

Tack coat

A tack coat is not required unless the surface to be covered is extremely oxidised, ravelled or comprises a concrete or brick surfacing. If required, a tack coat of bituminous emulsion shall be applied at a rate of 0.2 to 0.3 L/m^2 of residual binder at 15 °C. The bituminous emulsion shall be allowed to break prior to laying the microsurfacing. Such work shall only be carried out when specified.

Water fog coat

The surface may be pre-wet by applying a water fog coat ahead of the spreader box. Water used for pre-wetting the surface shall be applied so that the entire surface is damp but with no apparent flowing water ahead of the spreader box. The application rate of the fog spray shall be adjusted to suit pavement temperature, surface texture, humidity and dryness of the surface being covered.

A.9.2 Weather Limitations

Microsurfacing shall not be applied if either the pavement or air temperature is below 10 °C and falling but may be applied when both pavement and air temperatures are above 5 °C and rising. Spreading shall not proceed during rain or when rain appears imminent. Surfacing shall not proceed where the air temperature exceeds 40 °C without consultation with the Superintendent and verification that climate will not impact on the workability and delivery of the materials.

A.9.3 Rut-filling and Correction

Where wheel ruts of the surface to be covered are 15 mm or more in depth, a rut-filling or correction course shall be applied, prior to placing the microsurfacing. Rut-filling and correction shall be carried out using a spreader box capable of laying mix across the varying cross-sectional depth such that it fills the rut and is stable.

The number of layers of rut-filling or corrector course needs to be specified along with the maximum thickness of microsurfacing to be applied in each layer. The minimum time between layers shall also be specified.

A.9.4 Spreading

Process

The mixture shall be at the final laying consistency when deposited in the spreading box. Small amounts of water may be used for the purpose of overcoming temporary build-up of material in the corners of the spreader box.

The mixing time shall be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture shall be conveyed into the moving spreader box at a rate sufficient to always maintain an ample supply across the full width of the strike-off screed. The strike-off shall be adjusted to provide an application rate which will completely fill the surface voids and provide a nominal application rate of mix as scheduled. The bituminous emulsion tack coat shall be allowed to break prior to laying the microsurfacing.

Hand work

Areas that cannot be reached with the spreader box shall be surfaced using hand squeegees to provide complete and uniform coverage. If necessary, the area to be hand worked shall be lightly dampened or tack coated prior to mix placement. Care should be exercised to leave no unsightly appearance from hand work.

The same finish as applied by the spreader box shall be provided on hand worked areas. Hand worked areas shall be completed at the same time as the adjacent machine application process.

Surface finish

The surface shall be smooth and true to the specified crown and grades. Any section of paved material that is loose or broken, mixed with dirt or other impurities or is any way defective shall be removed and replaced.

Joints

The longitudinal joints of the wearing course shall be placed at or within 300 mm of either the edge or the centre of a traffic lane. If necessary, the edges and joints shall be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material.

Traffic time

The microsurfacing shall be capable of carrying slow moving traffic (< 40 km/h) within one hour of application without undue permanent damage occurring, such as rutting or ravelling. When the time before the paved materials is capable of carrying traffic exceeds one hour, work shall cease if so directed by the Superintendent.

Rolling

Where rolling of the surface is specified, it shall be undertaken when the mix has cured sufficiently to prevent pick-up on the roller tyres.

Clean up

All surplus microsurfacing shall be removed from the site. Any aggregate stockpile sites and/or loading areas occupied for the Works shall be restored to a condition similar to that which existed prior to the works commencing.

A.9.5 Control of Traffic

The Contractor must provide for traffic in accordance with the local road agency requirements while undertaking the work and must take all necessary precautions to protect the work from damage until such time as the new material has developed sufficient strength to carry normal traffic without disturbance. Where early use of the new surface 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 the material occurs. Where necessary, the Contractor must use patrol vehicles to ensure that traffic travels at an acceptable speed.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic must be temporarily diverted while the work is in progress.

A.9.6 Rolling

In general, microsurfacing does not require rolling. Rolling however is considered beneficial in some circumstances, such as where the newly laid microsurfacing will not receive traffic, or it may receive a high proportion of turning traffic (e.g. *cul-de-sacs* and car parks). Care is required to ensure that rolling does not occur prior to material cure as this can result in delamination. If rolling is required, it should be carried out using a self-propelled pneumatic-tyred multi-wheel roller. Rolling should be undertaken when the surface has cured sufficiently to prevent pick-up on the roller tyres. Rolling (where required) is typically to simulate initial traffic on the new surface and not required for reasons of material compaction. As such, pneumatic tyred rollers for microsurfacing can be unballasted and less than 10 tonnes gross weight. The use of steel rollers should be avoided as the rolling of paved material with steel rollers can crush aggregate particles rather than compact.

A.10 Sampling and Testing

A.10.1 Sampling

Compliance sampling shall be undertaken on a lot-by-lot basis. The methods, number and size of samples shall be as follows:

- Three samples of mixed material from each Lot in accordance with AGPT/T221. Each sample shall be a minimum of 1 kg of mixed material.
- Two 2 L samples of bituminous emulsion from each bulk delivery in accordance with AS 1160:1996. One sample is for testing as required whilst the second sample is to be retained for reference.
- Aggregates shall be sampled in accordance with AS 1141.3.1.
- Fillers shall be sampled in accordance with AS 2150.
- Shape testing at locations as agreed.

The Contractor shall supply all equipment and facilities for sampling including sample containers.

A.10.2 Compliance Testing

The quality of the completed product shall be the responsibility of the Contractor. Testing to demonstrate that the mixed material, component materials and road surface meet the specified requirements shall be as a minimum:

a. Mixed Material

Residual binder content and particle size distribution tests (AS/NZS 2891.3.1, 2891.3.2 or 2891.3.3). Water in the sample must be removed by solvent extraction or drying to constant mass before testing for binder content.

b. Emulsion

– Residue from evaporation in accordance with AS/NZS 2341.23

– other tests identified in the mix design

– softening point of the residual binder in accordance with AS 2341.18.

– The supplier of the emulsion shall provide a NATA endorsed report for each batch of emulsion supplied.

c. Aggregates and Filler

Tests on the aggregates and filler as specified at Appendix A.6 including PSD.

d. Surface Texture of Microsurfacing

The surface texture depth of the microsurfacing shall be assessed, as specified in Table A 6, for each Lot of completed work using the following methods:

– After trafficking for one month, the microsurfacing shall have an average surface texture depth in the wheel path not less than the value specified in Table A 6 based on the average of a minimum of four tests per Lot by a random sampling method; OR

– The Contractor and Superintendent shall undertake a joint visual inspection of each Lot of completed work.

Table A 6: Surface texture depth requirements for microsurfacing(1)

Property		
Surface texture depth	**Value**	**Test method(2)**
Sizes 4 & 5	0.4 mm minimum	AGPT/T250
Sizes 7 & 10	0.8 mm minimum	

1 *A correction course is not considered to be a microsurfacing for the purposes of this requirement.*
2 *Alternative test methods may be specified however the reported results must be the sand patch texture depth.*

e. Surface Shape

The finished surface of the final wearing course shall not vary by more than two thirds of the original maximum deviation from a three metre straight edge, measured relative to the immediate underlying surface, which may include rut filling.

Measurement of surface shape and selection of measurement location shall be carried out in accordance with the appropriate method for testing a road surface. Where a method for surface shape is not specified use test method WA 313.2.

A.10.3 Frequency of Testing

Compliance sampling shall be undertaken on a lot basis with a Lot being 50 m^3 or one day's production (whichever is the lesser).

Testing shall be undertaken at a frequency as specified in Table A 7. Where multiple paving units are used on a single job site, this testing frequency should equally apply to each paving unit utilised. Where the use of continuous paving units is applied, testing frequencies may be decreased based on the Contractor's ability to demonstrate consistency of material delivery.

Table A 7: Minimum testing and verification frequency

Process or product	Quality verification requirement	Minimum testing or verification frequency
Component materials	Emulsion and residual binder	One for each bulk delivery of emulsion
	Aggregate properties	Frequency as specified by each state road agency
	Mineral filler	Producers compliance test report per Lot
Microsurfacing production	Particle size distribution	One test per Lot
	Residual binder content	One test per Lot
Finished surface	Shape	Five tests per Lot as agreed
	Surface texture depth	Four tests per Lot

Hold Point

Process held: Operating using the inspection and testing plan

Submission details: Proposed inspection and testing plan prior to work commencing

Release of hold point: The Superintendent will consider the submitted documents, prior to releasing the Hold Point.

A.11 Defective Work or Materials

Any Lot which fails to achieve conformance with any property specified or which incorporates materials which fail to achieve conformance with any property specified shall constitute a non-conformance.

The Lot of non-conforming material shall be replaced or corrected unless conditionally acceptable subject to a reduction in price (Table A 8).

Table A 8: Reduction in value

Number of Lot defects	1–2	3	4	5	6	> 6
% reduction in value*	2	5	10	15	20	Replace or correct

** The reductions shown are indicative values and should be reassessed by the Client for each job undertaken. Where test results indicate defects arising from aggregate gradings and the Contractor can demonstrate by way of an alternative mix design that the gradings used have no detrimental effect on mix conformance with the requirements set out in Table A 4, then the number of defects will be re-calculated based on the alternative mix design.*

The cost of all replacement or correction works including any restoration work to the underlying or adjacent pavement, surface or structure shall be borne by the Contractor. Material removed from the works shall be replaced by conforming materials.

Calculation of defects can be based on variation of the aggregate particle size distribution and binder content from the approved mix design as shown in Table A 9. The aggregate particle size distribution determined from samples taken on the job should be within the appropriate particle size distribution band for that nominal size. The percent passing each sieve should also not vary from those specified in the approved mix design by more than the maximum permitted variation shown in Table A 5 of the Specification. Non-conforming microsurfacing may be either overlaid, removed or allowed to remain as agreed by the Superintendent. Any value exceeding the limits is counted towards calculation of the total number of defects. The number of defects in a Lot is determined from the average number of defects in the samples representing that Lot.

Table A 9: Defects schedule

Measurement	Variations*	Number of defects
% Passing	1 or 2 measurements 3 measurements	1 2
13.2 mm		
9.50 mm		
6.70 mm		
4.75 mm		
2.36 mm		
1.18 mm		
0.6 mm		
0.3 mm		
0.15 mm		
% Passing	Each increment of 0.5%	1
0.075 mm		
Binder content, % mass	Each 0.25 % in excess of 1.0% over or below 0.5% under the binder content nominated in the approved mix design	1

** Over the particle size distribution limits for the nominal size specified in Table A 3 of the model Specification, or the maximum permitted variations shown in Table A 5 of the Specification.*

A.12 Measurement and Payment

A.12.1 Surface Preparation

Surface preparation shall be measured in m^2. Payment at the scheduled rate per m^2 shall be full compensation for set out, cleaning, protection of services, tack coat and water fog coat.

A.12.2 Microsurfacing

Microsurfacing shall be measured by the quantity, in m^3, of dry mineral aggregate (excluding mineral filler) used in completing the works. Payment at the scheduled rate per m^3 shall be full compensation for mix design and approval, conformance testing, supply of all materials to the site, loading and mixing and spreading the mixture including finishing, joint treatment, hand work and clean up. Verification of quantities of aggregate or emulsion may be requested by the Superintendent to verify quantities provided are accurate.

A.12.3 Rolling

Rolling shall be measured by the area to be rolled, in m^2, for the number of passes as specified at Appendix A.13.

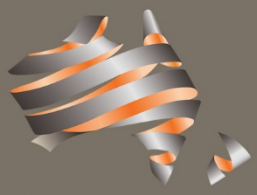
A.13 Application and Measurement Details

A.13.1 Rolling

Location	Number of roller passes

A.13.2 Surface Texture Depth

Method for demonstrating compliance at Appendix A.10.2	
Contractor to measure surface texture depth	Y/N
Contractor and Superintendent shall undertake a joint visual inspection	Y/N



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