AUSTRALIAN ASPHALT PAVEMENT ASSOCIATION

Australian Asphalt Pavement Association

EME2 Model Specification

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Revision register

Version	Date	Changes
2.0	8 June 2018	Included additional clarification on sieve size and binder type for delta ring and ball requirement Included changed requirement for percentage of crushed aggregate. This test now only required for metasediments

Preface

This national model specification is intended as a guide for asset owners in the creation of technical specifications for the supply of EME Class 2 (EME2) asphalt mixes. The design criteria in this model specification are based on the EME2 mix design requirements contained in Austroads report AP-T283-14 *High Modulus High Fatigue Resistance Asphalt (EME2) Technology Transfer,* Austroads, Sydney, NSW, 2014.

The content of this specification builds on the information in following documents:

- *PSTS107 High Modulus Asphalt (EME2)*, State of Queensland Department of Transport and Main Roads*,* Brisbane, QLD, 2015.
- *National Asphalt Specification*, 2nd edition, Australian Asphalt Pavement Association, Melbourne, VIC, 2004.

Acknowledgements

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- the Austroads Asphalt Research Working Group
- the AAPA state Technology and Leadership committees
- the AAPA national Technology and Leadership committee

1. General

1.1. Scope

This model specification sets out requirements for EME Class 2 (EME2) high modulus asphalt mixes. The specification covers:

- Constituent materials
- EME2 mix design requirements
- Process control in manufacture and placement of asphalt
- Acceptance criteria for the finished EME2 pavement
- Quality systems, minimum process standards, plant requirements and sampling and testing frequencies.

1.2. Quality system requirements

The Contractor shall establish, implement and maintain a Quality System in accordance with this Specification and the requirements of AS/NZS ISO 9001, or an equivalent system approved by the Principal. The Quality System shall include the appropriate Occupational Health and Safety procedures and Safe Working Method Statements.

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

1.3. Testing requirements

All testing of properties required by this Specification shall be undertaken in a laboratory accredited by the National Association of Testing Authorities (NATA) or International Accreditation New Zealand (IANZ) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian Standard or Austroads Manual of Test Procedures. Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard/Manual provides a choice of procedures, the method to be adopted shall be agreed between the Principal and the Contractor.

2. Constituent materials

2.1. Aggregate & mineral filler

2.1.1. General

All aggregates shall be obtained from established quarries and have established properties. Each individual aggregate fraction shall be obtained from the same quarry as the materials used in the design of the Job Mix.

An appropriate system of stockpile management shall be implemented at the asphalt plant to ensure contamination does not occur.

Aggregate from a different quarry face or bench will be regarded as a different source and require testing to confirm compliance with the requirements of Clauses 2.1.2 and 2.1.3.

All mineral filler shall come from established sources and have established properties.

2.1.2. Coarse aggregate

Coarse aggregate is comprised of crushed rock particles that are substantially retained on the 4.75 mm sieve. Coarse aggregate shall comply with Australian Standard AS 2758.5 with the application of those test properties specified in Table 2-1 as appropriate. A minimum PAFV value for coarse aggregate is included to allay any concerns around reuse of the material as RAP in asphalt.

Table 2-1: Coarse aggregate requirements

Property	Test Method	Requirement
Particle size distribution (PSD)	AS 1141.11.1	Report
Crushed particles(1)	AS 1141.18	100% crushed aggregate
Flakiness index	AS 1141.15	≤ 25 %
Los Angeles abrasion loss	AS 1141.23	≤ 25 %
Polished aggregate friction value (PAFV)	AS 1141.40	≥ 44
Water absorption	AS 1141.6.1	≤ 2.5 %
Ten percent fines value (wet)	AS 1141.22	≥ 150 kN
Wet/dry strength variation	AS 1141.22	≤ 35 %

Notes:

1. Test only required on river gravels and metasediments.

2.1.3. Fine aggregate

Fine aggregate shall consist of crushed rock particles substantially passing the 4.75 mm sieve and manufactured from an approved source complying with the requirements of Section 2.1.2.

Natural sand shall not be used.

The fine aggregate shall be clean, hard, durable and free from lumps of clay and other aggregations of fine materials, organic material and any other deleterious material. Fine aggregate shall comply with the criteria in Table 2-2.

Table 2-2: Fine aggregate requirements

Property	Test Method	Requirement
Particle size distribution (PSD)	AS 1141.11.1	Report
Degradation Factor, Crusher fines	AS 1141.25.3	≥ 60

2.1.4. Mineral filler

Mineral filler is that portion of mineral matter passing a 0.075 mm sieve, and includes rock dust derived from coarse and fine aggregates used in the production of asphalt in accordance with this specification, and any other materials added to supplement the quantity and properties of filler in the mix.

The combined filler shall comply with the requirements in Table 2-3

Table 2-3: Combined filler requirements

Property	Test Method	Requirement
Voids in dry compacted filler	AS 1141.17	≥ 28 % and ≤ 45 %
Delta ring and ball[1]	EN 13179-1 and AS 2341.18	≥ 8 and ≤ 16
Methylene blue test[2]	AS 1141.66	≤ 10

Notes:

1. This test assesses the stiffening effect of the filler on the binder-filler mastic, NATA accreditation for the EN 13179-1 method is not required. The test shall be performed on combined material passing the 0.125 mm sieve in accordance with EN13179-1, using Class 170 bitumen instead of 70/100 grade bitumen. The softening point of the Class 170 bitumen used in the test, determined in accordance with AS 2341.18, shall be between 43ºC and 51ºC.
2. Test to be performed on combined filler excluding hydrated lime

Added filler (material not derived from the aggregate components) shall comply with the relevant standards listed in Table 2-4. Note that use of stiffening fillers (e.g. hydrated lime or fly ash) are likely to result in a mastic that will not pass the Delta ring and ball requirement in Table 2-3. Rock dust that is not derived from the other aggregate components in the mixture may also be used as added filler provided that it is derived from materials that meet the requirements of Clause 2.1.2

Table 2-4: Standards for materials used as filler

Material	Standard[1]
Hydrated lime	AS 1672.1
Fly Ash	AS/NZS 3582.1
Cement Kiln Dust	See note 2
Slag	AS/NZS 3582.2
Ground Limestone	See note 3

Notes:

1. Provision of test certificates for compliance with the relevant Australian Standard and this specification shall be limited to those tests listed in Table 2-6.
2. Cement kiln dust shall be solid material extracted from the flue gases in the manufacture of Portland cement, having a maximum water soluble fraction of 20% by mass and complying with the grading limits specified in Table 2-5
3. Ground limestone shall consist of rock dust derived from the grinding of sound limestone and complying with the grading limits specified in Table 2-5.

Table 2-5: Grading limits for ground limestone and cement kiln dust materials for use as added filler

Test method	Sieve size (mm)	Percentage passing sieve size (by mass)
AS 1141.11.1	0.600	100
	0.300	95–100
	0.075	75–100

Each type of added filler from each source shall be mineral material, dry and free from lumps, organic material or other deleterious matter, and conform to AS 2150. The added filler shall comply with the requirements in Table 2-6.

Table 2-6 Requirements for added filler

Property	Test Method	Requirement
Particle size distribution (PSD)	AS 1141.11.1	Report
Moisture content	AS 4489.6.1	≤ 3 %
Water-soluble fraction (cement kiln dust)	AS 1141.8	≤ 20 %

2.2. Bitumen

The bitumen shall comply with the requirements for either 10/20 or 15/25 Penetration Grade bitumen in Table 2-7.

Table 2-7: Bitumen requirements

Penetration Grade				**10/20**	**15/25**
Property	**Test method**	**Unit**	**Limit**	**value**	**Value**
Penetration at 25 °C	AS 2341.12	pu(1)	Minimum	10	15
			Maximum	20	25
Softening point	AS 2341.18	°C	Minimum	59	56
			Maximum	79	72
Viscosity at 60 °C(2)	AS/NZS 2341.2	Pa.s	Minimum	1050	900
Loss on heating	AGPT/T103	%	Maximum	N/A	0.5

Penetration Grade				10/20	15/25
Property	**Test method**	**Unit**	**Limit**	**value**	**Value**
Retained penetration[3]	AS/NZS 2341.10, AS 2341.12	%	Minimum	N/A	55
Increase in softening point after RTFO treatment[4]	AS/NZS 2341.10, AS 2341.18	°C	Maximum	10	8
Viscosity at 135 °C	AS/NZS 2341.2, AS 2341.3, AS/NZS 2341.4 or AGPT/T111	Pa.s	Minimum	0.7	0.6
Matter insoluble in toluene	AS/NZS 2341.8	% mass	Maximum	N/A	1.0

Notes:

1. One pu equals 0.1 mm.
2. Test shall be performed using an Asphalt Institute viscosity tube.
3. Percent change in penetration shall be calculated using the equation: (Penetration at 25 °C after RTFO x 100) / (Penetration at 25 °C before RTFO).
4. Increase in softening point shall be calculated as softening point after RTFO treatment (ºC) – softening point on binder before RTFO treatment (ºC).

2.3. Additives

2.3.1. Adhesion agent

Adhesion agent may be added to improve the water sensitivity properties of the EME2 mix, where required to meet the moisture sensitivity criterion in Table 3-1. The type and proportion of the adhesion agent shall be in accordance with an approved specification. An approved specification may be a manufacturer's recommendation, purchaser's specification or as agreed between the parties.

2.3.2. Warm mix asphalt additive

Warm mix asphalt additive may be included in the asphalt mix design to reduce the EME2 manufacturing temperature and/or improve workability in the field. The type and proportion of the warm mix additive shall be in accordance with an approved specification. An approved specification may be a manufacturer's recommendation, purchaser's specification or as agreed between the parties.

2.4. Reclaimed asphalt pavement

EME2 mix designs may include up to 15% reclaimed asphalt pavement (RAP). RAP may contain a combination of material obtained from milling or excavation of existing asphalt layers and asphalt mix discarded during production. RAP shall be free of foreign material such as unbound granular base, broken concrete, or other contaminants. Asphalt containing tar shall not be used.

RAP shall be crushed, homogenised and screened. RAP shall be stored in stockpiles not exceeding 1000 tonne and separately metered into the mixing process. The aggregate particles in the RAP shall be 100 % passing the 14 mm sieve.

A RAP management plan must be provided. The plan shall include a statement detailing how variations in the aggregate grading, binder content and moisture content of the RAP material will be controlled, such that it will not affect the asphalt properties.

The properties of the RAP material shown in Table 2-8 shall be reported for every stockpile.

Table 2-8: RAP properties

Property	Test Method	Requirement
Binder content and grading	AS/NZS 2891.3.1, or AS/NZS 2891.3.2, or AS/NZS 2891.3.3	Report
Moisture content	AS/NZS 2891.10	Report

The binder extracted from the RAP shall comply with the requirements in Table 2-9. The binder shall be extracted from a representative sample of each RAP stockpile in accordance with AGPT/T191-15, or alternative suitable extraction method as approved by the Superintendent.

Table 2-9: RAP binder properties

Property	Test Method	Requirement
Penetration at 25 °C	AS 2341.12	> 5 pu
Softening point	AS 2341.18	< 79 °C

3. Mix design

3.1. General

The Contractor shall provide a mix design that complies with the requirements of this specification. Where the proposed mix design incorporates additives listed under Clause 3.4, compliance shall be tested on the mix including these additives. Where specified, the Contractor's mix design shall be submitted for approval, or registration.

3.2. Aggregate grading

EME2 shall have 100% of the aggregate particles by mass passing the 19.0 mm sieve. There are no other specified requirements for combined aggregate grading of the mix design. The contractor shall nominate the target grading as part of the mix design submission. Production tolerances to this target grading will apply as per Clause 4.6.

3.3. Binder content

The binder content shall be selected such that the richness modulus (K) for the mix design exceeds a minimum value of 3.4. K shall be calculated as follows:

$$K = \frac{\left(\frac{100B}{100 - B}\right)}{\alpha \sqrt[5]{\Sigma}}$$

Where

B = Binder content (% by mass of the total asphalt mix)

ρ_a = Particle density of the combined mineral aggregate determined in accordance with AS/NZS 2891.8 (t/m^3)

α = $\frac{2.65}{\rho_a}$

Σ = $(0.25G + 2.3S + 12s + 150f)/100$

G = Percentage of aggregate particles greater than 6.30 mm

S = Percentage of aggregate particles between 6.30 mm and 0.250 mm

s = Percentage of aggregate particles between 0.250 mm and 0.075 mm

f = Percentage of aggregate particles less than 0.075 mm.

G, S and s may be interpolated using a linear relationship from the grading curve using Australian Standard sieves.

3.4. Mix performance properties

Testing shall be performed on laboratory mixed asphalt, prepared in accordance with AS 2891.2.1. Reheating of plant produced mix for sample preparation is not permitted. The EME2 mix design shall comply with requirements in Table 3-1.

Table 3-1: EME2 laboratory performance criteria

Property		Test method	Unit	Limit	Value
Air voids in specimens compacted by gyratory compactor at 100 cycles		AS/NZS 2891.2.2(1)	%	Maximum (mensuration)	6.0(2)
Water sensitivity		AGPT/T232(3)	%	Minimum	80
Wheel tracking	At 60 ˚C and 30 000 cycles (60 000 passes)	AGPT/T231(4,5)	mm	Maximum	4.0
	At 60 ˚C and 5 000 cycles (10 000 passes)	AGPT/T231(4,5)	mm	Maximum	2.0
Minimum stiffness modulus at 50 ± 3 με at 15 °C and 10Hz		AGPT/T274(4)	MPa	Minimum	14 000
Fatigue resistance at 20 °C, 10Hz and 10^6 cycles		AGPT/T274(4)	με	Minimum	150
Resilient modulus at 25ºC, 0.04s rise time		AS 2891.13.1	MPa	N/A	report

Notes:

1. Test parameters for AS/NZS 2891.2.2 shall be as follows: Vertical loading stress of 600 ±18 kPa, gyratory angle (internal) of 0.82 ±0.02° and a rate of gyration of 30 ±0.5 revolutions per minute. Specimens should have a diameter of 150 mm and a target compacted thickness of 135 mm. Laboratory compaction temperature for preparing test specimens should be determined in accordance with AS 2891.2.2, Appendix A.
2. Bulk density of gyratory compacted specimens shall be determined by mensuration in accordance with AS 2891.9.3. This property shall be determined from the average of three (minimum) test specimens.
3. The freeze/thaw moisture conditioning of specimens detailed in Section 5.2 of AG:PT/T232 is mandatory.
4. Specimens shall be compacted to an air void content of 1.5 – 4.5% when the bulk density is determined in accordance with AS 2891.9.2.
5. This property shall be determined from the average of two (minimum) test specimens.

3.5. Mix design report

The mix design report shall include the following information:

1. Details of manufacturer and manufacturing plant where the mix will be produced.
2. Design grading and binder content.
3. Details of all constituent materials and their proportions, as well as test results from a NATA accredited laboratory demonstrating that the constituents comply with the requirements in Clause 2.
4. Test results provided by a NATA accredited laboratory demonstrating that the mix design complies with the performance requirements in Clause 3.4.
5. A signed declaration that the mix design complies with the requirements of this specification.

4. Manufacture and storage

4.1. General

Asphalt manufacturing plant shall be capable of consistently producing asphalt mixes with the properties specified and at a rate suitable for smooth, continuous asphalt placing.

4.2. Storage of raw materials

Raw materials shall be stored at the mixing site in sufficient quantities to ensure continuity of production and enable effective sampling and testing prior to use. The facilities for handling particular materials shall comply with the following:

a. Aggregates shall be handled and stored in such a manner as to prevent contamination and avoid segregation.
b. Filler shall be handled and stored in such a manner as to keep it dry and free flowing at all times. Where more than one type of filler is to be used, each shall be handled and stored separately.
c. Additives shall be protected from moisture or contamination.
d. Tanks for heating and storage of bitumen shall be thermostatically controlled and each shall be fitted with a thermometer that is located so that the temperature can be read conveniently.
e. An appropriate bitumen sampling point shall be provided.
f. Heating and storage of binder must comply with the temperature and time limits set out in Advisory Note 7 published by the Australian Asphalt Pavement Association.

The Contractor shall outline adequate procedures in the Quality Plan that will ensure that contamination of the binder will not occur. Such procedures may include flushing of the storage tank with EME2 binder, or sampling of binder and verifying that the penetration and softening point of the binder in the storage tank complies with the requirements in Table 2-7.

4.3. Mixing temperatures

Temperature of bitumen and aggregates at the mixing plant, and the temperature of asphalt as it is discharged from the asphalt plant, shall not exceed the limits specified in Table 4-1.

Table 4-1: Maximum material temperatures

Material	Maximum temperature (ºC)
Bitumen delivered into mixer	190
Aggregates before mixing with binder	200
Asphalt at discharge from the plant	190

4.4. EME2 mixes incorporating RAP

RAP shall only be used from stockpiles that have been tested in accordance with Clause 2.4 for consistency in grading and binder content with materials used in mix design. RAP must be in a consistent, free flowing state at time of incorporation into the mix.

In batch mixing plants, the RAP shall be either:

- Metered into the asphalt plant after heating and drying of aggregates
- Added directly to the weigh hopper with the other aggregate materials, for each batch
- Weighed separately and added direct to the pugmill.

Batch mixing time shall be increased, if necessary, to ensure adequate heat transfer and dispersion of RAP.

In drum mix plants, RAP shall be protected from excessive temperatures by a combination of entry point to the drum and shielding from direct flame contact.

4.5. Moisture content

After completion of mixing the moisture content of the mix shall not exceed 0.5% as determined in accordance with AS/NZS 2891.10.

4.6. Particle coating

The degree of particle coating shall be not less than 99%, when determined in accordance with AS/NZS 2891.11, once discharged from the asphalt plant into delivery vehicles

4.7. Production tolerances

The proportion of each constituent may be varied for the purpose of process control provided that:

a. the asphalt produced remains essentially uniform and consistent and in compliance with the nominated mix submission, and
b. the variation does not result in a proportion of RAP exceeding the RAP proportion nominated in the mix design.

The actual particle size distribution and binder content of the production mix may vary from the values nominated in the mix design report within the limits shown in Table 4-2.

Table 4-2: Production tolerances

Description	Test method	Tolerance
Permissible variation to nominated combined particle size distribution during production (% by mass of total aggregate)	AS/NZS 2891.3.1, or AS/NZS 2891.3.2, or AS/NZS 2891.3.3	
Passing 4.75 mm sieve and larger		± 7
Passing 2.36 mm and 1.18 mm sieves		± 5
Passing 0.600 mm and 0.300 mm sieves		± 4
Passing 0.150 mm sieve		± 2.5
Passing 0.075 mm sieve		± 1.5
Permissible variation to the nominated binder content during production (% by mass of total mix)	AS/NZS 2891.3.1	± 0.3
Permissible variation to the nominated maximum density during production (t/m^3)	AS/NZS 2891.7.1	± 0.035(1)

Notes:

1. A larger tolerance may apply provided that the Contractor can demonstrate to the satisfaction of the Principal that a larger tolerance does not result in changes of richness factor K, calculated in accordance with Clause 3.3, exceeding ± 0.2.

4.8. Storage of mixed asphalt

Asphalt may be stored prior to delivery to the purchaser, subject to the following requirements being observed:

a. The mix is consigned to and deposited in the storage bins in such a manner as to minimise segregation.
b. The storage bin shall be insulated.
c. The method of discharge shall be such as to minimise segregation. Any caked or segregated portions of mix shall be discarded.
d. The total time of storage shall be limited to 24 hours unless otherwise approved.

5. Sampling and testing during production

5.1. General

The Contractor shall arrange for all relevant testing.

Samples from asphalt production shall be taken at the required frequency in Table 5-1 in accordance with AS2891.1.1. Samples shall not be mixed. In addition, each loaded truck shall be visually inspected for segregation, uncoated particles, excess bitumen or overheating, before dispatch from the plant.

5.2. Frequency of sampling and testing

Frequency of sampling and testing shall be not less than that shown in Tables 5-1 and 5-2. Table 5-1 provides for two levels of minimum frequency. The reduced frequency may only be adopted where the process is demonstrated to be under statistical control as specified in Section 5.3. Where a non-conformance occurs in any test requirement, the frequency of sampling and testing for that particular property shall be increased to the normal level until conforming results have been obtained on five consecutive samples. Loose asphalt mix shall be samples in accordance with AS/NZS 2891.1.1.

Table 5-1: Frequency of sampling and testing of produced asphalt

Property	Test Method	Normal minimum frequency	Reduced minimum frequency
Binder content and grading	AS/NZS 2891.3.1, or AS/NZS 2891.3.2, or AS/NZS 2891.3.3	One test per 300 t of asphalt production, or part thereof	One test per 500 t of asphalt production, or part thereof
Maximum density	AS/NZS 2891.7.1	One test per 300 t of asphalt production, or part thereof	One test per 500 t of asphalt production, or part thereof
Temperature of asphalt discharged from plant	Steel probe digital thermometer	Each loaded truck	Lesser of a sample from each loaded truck or sample one truck per 15 minutes

Table 5-2: Frequency of testing of constituent materials

Property	Test Method	Normal minimum frequency
Crushed particles	AS 1141.18	3 Monthly
Flakiness index	AS 1141.15	Monthly
Los Angeles abrasion loss	AS 1141.23	3 Monthly
Ten percent fines value (wet)	AS 1141.22	3 Monthly
Wet/dry strength variation	AS 1141.22	3 Monthly
Voids in dry compacted filler	AS 1141.17	Monthly
Delta ring and ball[1]	EN 13179-1 and AS 2341.18	Monthly
Binder properties delivered bitumen	As per Table 2-7	Certification of each delivery
Added filler	As per Table 2-4 and 2-5	Certification of each delivery
RAP properties	As per Table 2-8 and Table 2-9	One test per stockpile on combined sample taken in accordance with AS1141.3.1

Notes:

1.Test only required on river gravels and metasediments

2. This test assesses the stiffening effect of the filler on the binder-filler mastic, NATA accreditation for the EN 13179-1 method is not required. The test shall be performed on combined material passing the 0.125 mm sieve in accordance with EN13179-1, using Class 170 bitumen instead of 70/100 grade bitumen. The softening point of the Class 170 bitumen used in the test, determined in accordance with AS 2341.18, shall be between 43ºC and 51ºC.

5.3. Process control

The Contractor shall implement process control measures in accordance with or exceeding the requirements in Austroads / AAPA Pavement work tips No. 15 *Asphalt Statistical Process Control.* Statistical process control shall include results for tests in Table 5.1

6. Delivery

Asphalt shall be transported to the point of delivery in vehicles complying with the following requirements:

a. The inside of vehicle bodies shall be kept clean and coated with a thin film of an appropriate release agent to prevent asphalt sticking to the body of the vehicle. Care shall be taken to remove surplus release agent before loading asphalt into the vehicle.
b. After loading with asphalt, the body of the vehicle shall be covered to prevent contamination and reduce the rate of cooling of the mix.
c. Where the length of the haul or the weather is such that the temperature of the asphalt may drop below a suitable placing temperature, or where excessive local cooling of the mix may occur, the vehicles shall be suitably insulated.

7. Placing

7.1. General

Prior to tack coating and placing of asphalt, the surface shall be free of all deleterious material. Where required, the Contractor shall sweep clean the area on which asphalt is to be placed.

The Contractor shall prevent tack coat, binder, aggregate, asphalt or other material used on the work from entering, adhering or obstructing gratings, hydrants, valve boxes, inspection pit covers, kerbs and other road fixtures.

7.2. Tack coating

Tack coat shall be applied to the cleaned surface prior to placing asphalt.

Tack coat shall consist of bituminous emulsion complying with AS 1160. The type and breaking rate shall be suitable to the climatic and surface conditions of use such that it is fully broken, free of surface water and intact before the commencement of asphalt spreading.

Unless otherwise directed, tack coat shall be applied to provide a uniform application rate of residual binder of between 0.15 and 0.25 L/m^2.

Tack coat shall be applied by spray bar fitted to a mechanical sprayer, or purpose built tack coat spray truck. Hand spraying shall be carried out only in those areas where it is impracticable to use a spray bar.

Precautions shall be taken to protect kerbs, channels, adjoining structures, traffic and parked vehicles from tack coat spray.

Where asphalt is to be spread over clean, freshly placed asphalt, or over a clean primed surface, the Contractor may propose, to the Superintendent, the omission of the tack coat.

7.3. Spreading

Unless otherwise specified, self-propelled mechanical pavers shall be employed to place asphalt except for areas where the use of a paver is impracticable.

Asphalt shall be spread without tearing or segregation.

The Contractor shall conduct spreading operations to ensure that the paver speed matches the rate of supply so that the number of paving stops is minimised.

The paver shall not be left stationary for prolonged periods with the screed box in contact with either the previously placed asphalt or loose asphalt in front of the screed.

7.4. Ambient Conditions for Placing

The surface on which the asphalt is to be placed shall be essentially dry and free from free-standing water. If the Contractor proposes to place EME2 when the pavement surface temperature is below 5ºC., the process to do this must be suitably addressed in the Quality System.

7.5. Layer Thickness

The target thickness of the compacted layer shall be between 70 mm and 130 mm.

7.6. Level Control

The method of paver level control shall be as specified in the Schedule of Job Details. If no method is specified in the Schedule of Job Details, the Contractor shall apply suitable automatic or manual screed level controls to achieve the standards specified in Clause 9.

7.7. Compaction

Asphalt shall be uniformly compacted to the standards specified in Clause 9.4 as soon as the asphalt has cooled sufficiently to support the rollers without undue displacement. Compaction shall be achieved using suitable sized steel wheeled or vibratory rollers or a combination of steel wheeled or vibratory rollers and pneumatic tyred rollers.

7.8. Joints

7.8.1. General

Joints shall be provided as follows:

a. Longitudinally, if the width of the pavement is such that more than one paving run is necessary.
b. Transversely, after the completion of a day's paving operations, or where a delay in paving operation allows asphalt to cool and adversely affect placing, and elsewhere if a break in a longitudinal run is required.

The location of joints shall be planned before work commences.

The number of joints shall be minimised by adopting good asphalt paving practices.

All joints shall be well constructed and comply with the compaction requirements specified in Clause 9.

7.8.2. Longitudinal Joints

Longitudinal joints in the wearing course shall coincide with traffic lane lines unless otherwise specified or agreed. Longitudinal joints shall be offset from layer to layer by not less than 150 mm provided that no joint is placed directly below a trafficked wheel path. The longitudinal joints between EME2 paving runs should be established accordingly.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 140ºC it shall be considered a hot joint. Hot joints shall be constructed by leaving a 150 mm strip of asphalt unrolled along the free edge until the adjoining lane is placed, and then compacting the unrolled strip simultaneously with the material in the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 80 ºC it shall be considered a warm joint. Warm joints shall be constructed by rolling the full width of the first lane being placed, prior to placing the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has cooled below 80 ºC it shall be considered a cold joint. Asphalt placed against a cold edge should overlap the previous edge by 25 mm to 50 mm. The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

7.8.3. Transverse Joints

Transverse joints shall be offset by not less than 2 m in adjoining paver runs and from layer to layer.

7.9. Surface gritting

Surface gritting should be considered for EME2 layers that will be subject to traffic (other than construction vehicles) in high skid demand and/or high speed locations.

Only the areas nominated by the Superintendent shall be gritted.

A purpose built spreader box shall be used to spread the grit. The spreader box shall be attached to the steel-wheeled roller used to compact the asphalt.

Gritting shall be completed before the surface temperature of the compacted asphalt falls below 70°C. The initial spread rate shall be 0.2 – 0.5 kg/m². After consultation with the Superintendent, the spread rate and temperature range for gritting may be adjusted to ensure an adequate coverage of grit is achieved and the grit is adequately adhered to, and partially coated by, the binder in the asphalt mix.

The grit shall be spread in a uniform manner over the hot asphalt surface to provide an even distribution of grit bonded to the asphalt after rolling is completed. Every attempt shall be made to achieve the required spread pattern on the first spreading pass. Bare or insufficiently covered areas shall be re-treated as soon as possible with a further light spreading run or hand spreading. Overspreading or underspreading shall be avoided.

Prior to the pavement section being opened to traffic, any loose grit material shall be removed from the road surface.

The material used for gritting shall consist of natural sand particles having a grading complying with the requirements shown in Table 7-1 or other material as approved by the Superintendent.

The grit shall be dry, clean, hard, angular, durable, and free from clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

Table 7-1: Grading limits for grit

AS Sieve Size (mm)	Percentage passing by mass
4.75	100
2.36	90 – 100
0.600	0 - 20
0.075	0 - 0.5

8. Production control and construction trial

8.1. General

Where a production and construction trial is specified in the Schedule of Job Details, and not less than two days before the site work is due to commence, all the Contractor's plant and personnel proposed for use on the job shall be subjected to a production and construction trial in the presence of the Superintendent. If more than one asphalt mix is specified, each mix shall be subjected to the trial not less than 24 hours before the proposed commencement of production of that mix.

Asphalt manufactured in the production trial may also be used in the construction trial provided that it meets the requirements of the specification.

8.2. Manufacture

The mixing plant shall be operated at approximately the rate intended for full scale production to produce the 50 to 200 tonne of EME2 required for the trial.

The Contractor shall sample and test the asphalt in accordance with Clause 5.

If the tests on the samples indicate that the asphalt does not conform to the Specification, the Contractor shall make such alterations in the procedures or adjustments to the plant and equipment as necessary to produce asphalt in accordance with this Specification. The mixing trial shall be repeated as necessary until asphalt of the quality specified is being consistently produced.

8.3. Placing compaction and finishing

The Contractor shall subject all of the material transfer, placing, compaction and finishing equipment and operating personnel, proposed for use in the works, to a trial using the construction procedures proposed for the work. The trial shall consist of at least two adjacent

lanes 3 metres wide and at least 50 metres long and shall be constructed in the designated area, in accordance with all the requirements of this Specification, or as directed.

8.4. Testing of trial section

The Contractor shall test the trial section for the finished pavement properties of this Specification. In the event that the tests indicate that the asphalt in the test section does not conform to the specification requirements, the Contractor shall make any necessary adjustments and, if necessary, repeat the production and construction trials, as specified above, until the Superintendent is satisfied that asphalt of uniform quality is being consistently produced, placed, compacted and finished in accordance with the requirements of this Specification.

A hold point shall be designated in the Contractor's Quality System at the conclusion of the trial and the Contractor shall not commence full scale production of any asphalt for the works until the hold point has been released.

9. Finished pavement properties

9.1. Lot size

Compliance testing of asphalt shall be undertaken on a lot basis. A pavement lot shall be an essentially homogeneous and contiguous section of work completed within a shift of production, unless otherwise specified in the Schedule of Job Details

9.2. Level

The level at the top of each course of asphalt shall not differ from the specified level by more than 10 mm. The Contractor shall ensure that the surface shape of the top EME2 layer is such that surface shape requirements for the surfacing can be met.

9.3. Alignment

The horizontal location of any point on the pavement shall not vary by more than ±50 mm from the corresponding points shown on the documents, except where alignment with an existing pavement structure is necessary, when the new work shall be joined to the existing work or structure in a smooth manner.

9.4. Thickness

The average total compacted thickness of the combined EME2 layers shall be not less than the specified thickness and not be greater than specified thickness + 10 mm. Where confirmation of asphalt thickness is required, it shall be determined by coring to a recognised random sampling plan, based on a minimum of 5 cores per lot

9.5. Density

Bulk density testing shall not be performed on lots of less than 30 tonnes.

The location of each in situ bulk density test shall be chosen by a method of random stratified sampling. For core sample tests, the layer thickness is the mean thickness of the core samples and for nuclear gauge tests, the layer thickness is the nominal thickness. All core holes shall be repaired by an appropriate method that is compatible with the pavement from which cores have been taken.

Density testing shall be carried out as soon as practicable after completion of work. Cores shall be taken in accordance with AS2891.1.2. For cores, the bulk density shall be determined in accordance with AS/NZS 2891.9.2. The bulk density from nuclear gauge tests shall be determined in accordance with AS/NZS 2891.14.2 and AS/NZS 2891.14.3

Relative compaction is the percentage ratio of the in situ bulk density of the compacted asphalt and the reference density of the asphalt of a particular lot. The reference density shall be the mean of the five most recent maximum density measurements determined in accordance with AS/NZS 2891.7.1 of the same mix, provided that:

a. The tests have been completed within the previous 4 weeks.
b. The binder content of samples tested is within ±0.3% of the job mix binder content.
c. There has been no change in the mix components or proportions.

Where 5 tests complying with the above conditions are not available, the Contractor shall carry out a minimum of 5 tests in order to establish the reference bulk density.

The characteristic value of relative compaction is calculated as Mean – K x S where,

Mean = The mean of the relative compaction results

S = The sample standard deviation of the relative compaction results

K = A factor that depends on the number of tests as shown in Table 9.1.

Table 9-1:acceptance constant

Number of Tests or Measurements	Acceptance Constant (K)
6	0.72
7	0.76
8	0.78
9	0.81
10	0.83

The work represented by a lot shall be assessed as the characteristic value of in situ voids where: Characteristic value of in situ air voids (%) = 100 – Characteristic relative compaction.

The maximum characteristic value of in situ air voids shall not exceed 5.5%. The maximum characteristic value for air voids at joints shall not exceed 8.5%.

No minimum air void limit applies.

The density at the joints is not usually tested unless the Superintendent suspects the specified requirements have not been achieved. Where this occurs, the Superintendent may order tests to confirm compliance.

10. Measurement and payment

10.1. General

Payment for tack coat shall be included in payment for asphalt.

Payment for asphalt shall be by mass for quantities determined in accordance with Clause 10.2 or10.3 as appropriate.

Measurement for payment will include all works shown on the plans or as specified but will not include asphalt lost in transit, works not shown on the plans and variations in quantities due to variations in actual thickness exceeding the specified tolerances.

10.2. Measurement by mass

Unless otherwise specified in the Schedule of Job Details, the quantity of asphalt shall be measured by mass.

The quantity of asphalt shall be determined from dockets supplied by the Contractor and issued at a certified weighing system unless measurement by batch weights using certified scales is approved by the Superintendent.

Separate pay items shall be included in the Schedule of Rates for each nominal course thickness and each nominal size and type of asphalt specified.

10.3. Measurement by area and thickness

Where specified in the Schedule of Job Details, the quantity of asphalt shall be determined from measurement of area and thickness.

The area and thickness shall be determined from the dimensions on the plans or as specified for the work being measured.

The density of asphalt in a lot shall be taken as the arithmetic mean of the in situ densities of the lot.

Separate pay items shall be included in the Schedule of Rates for each nominal course thickness and each nominal size and type of asphalt specified.

10.4. Non-complying materials

In the event that the material supplied is not within the tolerances and standards defined for manufacture or placing of asphalt, the Superintendent may direct:

- The removal of non-complying material; or,
- That the reduced service life arising from the non-complying material is offset by reducing payment for the non-complying material by the method defined in the Schedule of Job Details; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service, or,
- The Contractor to propose a “use as is” disposition where the Contractor can substantiate that the non-conformance will have no adverse impact on the life or performance of the pavement.