



SPECIFICATION 516

CRUMB RUBBER OPEN GRADED ASPHALT

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| REVISION REGISTER | | | |
|---|--|---------------|------------|
| Clause Number | Description of Revision | Authorised By | Issue Date |
| 516.06 & 516.08 | Updated to match all other Main Roads Specifications | BPC | 17/09/2024 |
| 516.02, 516.27.03, 516.32.3 & 516.35 | Inclusion of Ignition Oven WA 730.2 Test Method for production testing and in requirements for mix design submission | | |
| 516.22 & 516.42.4 | Paving Tape details replaced with reference to Specification 511 | | |
| 516.27.03 | Correction of temperature without workability additive | | |
| 516.56 | Clerical – Table Reference rectified | | |
| Whole document | New specification | MME | 16/11/2020 |

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SPECIFICATION 516

CRUMB RUBBER OPEN GRADED ASPHALT

GENERAL

516.01 SCOPE

1. The work under this specification consists of the supply and application of crumb rubber open graded asphalt (hereafter referred to as asphalt) for pavement wearing courses.
2. Details of the location and extent of asphalt work are either summarised at Annexure 516A, or are indicated on the Drawings.
3. The works shall include surface preparation, supply of materials, production, hauling, placing and compaction of asphalt to the areas as shown in the Drawings, or as otherwise directed by the Superintendent, including correction of existing pavement surfaces.

Details

516.02 REFERENCES

1. Australian Standards, Main Roads Western Australia Test Methods, Main Roads Western Australia Standards and Main Roads Western Australia Specifications are referred to in abbreviated form (e.g. AS 1234, MRS 67-08-43 or WA 123). For convenience, the full titles are given below:

Australian Standards

- | | |
|--------------|--|
| AS 1141.11.1 | Particle size distribution – Sieving method |
| AS 1160 | Bituminous emulsions for the construction and maintenance of pavements |
| AS 1672 | Building limes |
| AS 2150 | Hot mix asphalt |

Australian/New Zealand Standards

- | | |
|----------------|-----------------------------|
| AS/NZS 2891.10 | Moisture content of asphalt |
| AS/NZS 2891.11 | Degree of particle coating |

MAIN ROADS Test Methods

- | | |
|----------|--|
| WA 210.1 | Particle Size Distribution of Aggregates |
| WA 212.1 | Aggregate Moisture Content: Convection Oven Method |
| WA 212.2 | Aggregate Moisture Content: Microwave Oven Method |
| WA 313.2 | Surface Profile: Three Metre Straightedge |
| WA 313.4 | Surface Profile: ARRB Profiler |
| WA 701.1 | Sampling and Storage of Asphalt |
| WA 705.1 | Preparation of Asphalt for Testing |

| | |
|----------|--|
| WA 730.1 | Bitumen Content & Particle Size Distribution of Asphalt & Stabilised Soil, Centrifuge Method |
| WA 730.2 | Bitumen Content & Particle Size Distribution of Asphalt Ignition Oven Method |
| WA 731.1 | Stability & Flow of Asphalt: Marshall Method |
| WA 732.2 | Maximum Density of Asphalt: Rice Method |
| WA 733.2 | Bulk Density and Void Content of Asphalt – Vacuum Sealing Method |

Austroads Test Methods

| | |
|------------|--|
| AG:PT/T103 | Pre-treatment and Loss on Heating of Bitumen Multigrade and Polymer Binders (Rolling Thin Film Oven [RTFO] Test) |
| AG:PT/T111 | Handling Viscosity of Polymer Modified Binders (Brookfield Thermosel) |
| AG:PT/T122 | Torsional Recovery of Polymer Modified Binders |
| AG:PT/T131 | Softening Point of Polymer Modified Binders |
| AG:PT/T234 | Asphalt Binder Content (Ignition Oven Method) |

ASTM Test Methods

| | |
|------------------|--|
| ASTM D5329 | Standard Test Methods for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphalt Pavements and Portland Concrete Pavements |
| ASTM D7741/7741M | Standard Test Methods for Measurement of Apparent Viscosity of Asphalt-Rubber or Other Asphalt Binders by Using Rotational Handheld Viscometer |

Southern African Bitumen Association

| | |
|------------------|---|
| Sabita Manual 19 | Guidelines for the design, manufacture and construction of bitumen rubber asphalt wearing courses |
|------------------|---|

MAIN ROADS Specifications

| | |
|-------------------|-------------------------------------|
| Specification 201 | QUALITY MANAGEMENT |
| Specification 511 | MATERIALS FOR BITUMINOUS TREATMENTS |

516.03 DEFINITIONS

1. Unless otherwise detailed in the Contract, the meaning of terms and definitions in this specification are as follows:
 - (a) "Asphalt course" comprises one or more layers of a single asphalt type.
 - (b) "Asphalt layer" comprises a single paving run of uniform asphalt.
 - (c) "Asphalt wearing course" is that part of the pavement upon which the traffic travels including any dense graded asphalt course immediately below a course of open graded asphalt.

Terminology

- (d) "Asphalt pavement" is a pavement, the predominate structural strength of which is provided by asphalt layers.
- (e) "Reclaimed asphalt pavement (RAP)" is the material reclaimed from an asphalt wearing or intermediate course by cold planing and re-processed by crushing and/or screening for recycling into new asphalt.

516.04 NOT USED

PRODUCTS AND MATERIALS

516.05 SUSTAINABILITY CONSIDERATIONS

1. Materials for road pavements shall be managed under the sustainability hierarchy of REDUCE, REUSE and RECYCLE.
2. Unless defined otherwise, the crumb rubber material described in this specification shall be sourced from end of life tyres or alternative approved sources otherwise destined for landfill. **Reduce**
3. The sourced rubber material shall be processed by shredding and screening for reuse to manufacture crumb rubber modified binder. **Reuse**
4. Asphalt produced with crumb rubber modified binder may be reclaimed by cold planing and used as RAP. **Recycle**

516.06 BITUMINOUS BINDER

1. All binders shall conform to the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS.

TABLE 516.1 BINDER DESIGN PROFILE

| Property | Test Method | Digestion Time | | | | | Maximum (Note 1) |
|---|---------------------------------|----------------|---------|-----------|-----------|-----------|---------------------|
| | | 60 min | 120 min | 240 min | 11 hrs | | |
| Penetration at 4°C, 200g, 60s, pu (minimum) | AS 2341.12 | 15 | - | 15 | 15 | 15 | 15 |
| Resilience at 25°C, % rebound (minimum) | ASTM D5329 | 20 | - | 20 | 20 | 20 | 20 |
| Consistency 6% at 60°C | AGPT/T121 | Report | - | Report | Report | Report | Report |
| Torsional Recovery at 25°C, 30s, % | AGPT/T122 | Report | - | Report | Report | Report | Report |
| Softening Point, °C (minimum) | AGPT/T131 | 55 | - | 55 | 55 | 55 | 55 |
| Viscosity at 175°C | ASTM D7411/ D7741M (Note 2 & 3) | 1.5 – 4.0 | - | 1.5 – 4.0 | 1.5 – 4.0 | 1.5 – 4.0 | 1.5 – 4.0 |
| Viscosity at 175°C | AGPT/T111 | Report | - | Report | Report | Report | Report |

Note 1 – The asphalt manufacturer is to nominate the maximum period of time it intends to store the crumb rubber modified binder beyond 11 hours. The properties of the binder must comply with the table after this period of time.

Note 2 – For the ASTM method the viscometer used shall be a Rion Model VT-04 or VT-06 using the No. 1 rotor. The rotor shall be immersed in the binder to the marked depth for a minimum of 60 seconds to achieve temperature equilibrium. Three measurements shall be taken within a period of 1 minute with the three values not exceeding a range of 1.0 Pa.s. Compliance to be taken as the average of three values.

Note 3 – Main Roads intends to replace the American test method with the Austroads T111 test method when comparative date from each method supports use of the Austroads test method. This is likely to be a short time frame so NATA accreditation for the ASTM test method is not required. Good laboratory practices meeting the requirements of ISO 17025 should be used to calibrate and use the Rion viscometer.

TABLE 516.2 BINDER PROPERTIES AT PRODUCTION

| Property | Test Method | Limits |
|--|-------------------|-------------|
| Penetration at 4°C, 200g, 60s, pu | AS 2341.12 | Minimum 15 |
| Resilience at 25°C, % rebound | ASTM D5329 | Minimum 20 |
| Torsional Recovery at 25°C, 30s, % | AGPT/T122 | Report |
| Softening Point, °C | AGPT/T131 | Minimum 55 |
| Viscosity at alternative temperature, °C | ASTM D7411/D7741M | 1.5 – 4.0 |
| | AGPT/T111 | Report |
| Loss on Heating, % | AGPT/T103 | Maximum 0.6 |
| Compressive Limit at 70°C, 2kg, mm | AGPT/T132 | Minimum 0.2 |

516.07 BITUMEN EMULSION

- Bitumen emulsion to be used as the tack coat during the preparation of the surface prior to the laying of open or dense graded asphalt shall be Cationic Slow Setting emulsion grade CSS/170-60 or Cationic Rapid Setting emulsion grade CRS/170-60, both conforming to AS 1160, mixed 50:50 by volume with water.

516.08 MODIFIED BINDER

- The crumb rubber modified binder shall be Class 170 bitumen with a minimum quantity of 18% crumb rubber by mass of total binder.
- Crumb rubber modified binder shall conform to the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS.
- Prior to the use of the crumb rubber modified binder, the Contractor shall demonstrate compliance with the properties of the binder for each batch used on the Contract. Audit testing undertaken by the Principal shall not be used to demonstrate compliance.**

HOLD POINT

516.09 NOT USED

516.10 AGGREGATE

- Crushed aggregate, including its source rock, and screened or crushed laterite aggregate shall meet the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS. Coarse and fine aggregate used in the manufacture of asphalt shall only consist of crushed rock material.

516.11 MINERAL FILLER

- Mineral filler shall meet the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS. In addition the combined filler being baghouse dust and hydrated lime shall comply with the requirements of Table 516.3.

TABLE 516.3 COMBINED FILLER REQUIREMENTS

| Property | Test Method | Requirement |
|--|----------------|-------------------------|
| Voids in Dry Compacted Filler (%) | AS/NZS 1141.17 | ≥ 28 and ≤ 45 |
| Apparent Density of Filler (t/m ³) | AS/NZS 1141.7 | Report |

- Each added mineral filler shall meet the requirements for particle size distribution (PSD) shown in Table 516.4 when tested in accordance with WA 210.1 or AS 1141.11.1.

Particle Size Distribution

TABLE 516.4 FILLER PARTICLE SIZE DISTRIBUTION

| Sieve Size (mm) | Percentage Passing (by mass) |
|-----------------|------------------------------|
| 0.600 | 100 |
| 0.300 | 95 – 100 |
| 0.075 | 75 – 100 |

516.12 ADHESION AGENT

- Liquid adhesion agents may be used in addition to, but not in place of, the hydrated lime. The adhesion agent shall meet the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS.

516.13 NOT USED

516.14 WARM MIX ADDITIVES

- Warm Mix Additives approved for use are:

(a) Sasobit

(b) Evotherm

516.15 – 516.21 NOT USED

516.22 PAVING TAPE

1. The Paving Tape shall meet the requirements of Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS.

516.23 – 516.26 NOT USED**MIX DESIGN****516.27 OPEN GRADED ASPHALT DESIGN MIX****516.27.01 GENERAL**

1. The asphalt manufacturer shall be responsible for the development of an asphalt mix design and its approval by Main Roads.
2. The asphalt shall incorporate aggregates, binder, filler and adhesion agent to produce an asphalt mix design that satisfies all specified requirements, shall be resistant to segregation during handling and placing, shall have adequate workability to achieve the specified levels of compaction.
3. For the volumetric component of the design the mix shall be compacted using a Marshall hammer with 50 blows on each face in accordance with WA 731.1. *50 blow Marshall*
4. Open graded asphalt shall consist of a mixture of coarse and fine aggregates, hydrated lime, mineral filler, a warm mix additive and crumb rubber modified binder. RAP shall not be used. *Constituents*
5. The design and use of open graded asphalt is only applicable for mix manufactured using granite aggregates from the Perth region. *Perth Aggregates*
6. All tests shall be performed in laboratories accredited with the National Association of Testing Authorities of Australia (NATA) to perform the tests and the results shall be presented on NATA endorsed test reports, unless otherwise specified. *NATA*

516.27.02 DESIGN CRITERIA

1. The aggregate and filler constituents shall be measured to produce a PSD meeting the requirements of Table 516.6. Crumb rubber modified binder, without a warm mix additive, shall be added to the constituents at the target binder content and mixed. The properties of the mixture shall comply with Table 516.5 and Table 516.6.

TABLE 516.5 MARSHALL PROPERTIES (50 BLOW COMPACTION)

| Parameter | Minimum | Maximum |
|----------------------|---------|---------|
| Marshall Stability | 4kN | - |
| Marshall Flow | 2.00 mm | 4.00 mm |
| Air Voids (WA 733.2) | 16.0% | 21.0% |

TABLE 516.6 PARTICLE SIZE DISTRIBUTION AND BINDER CONTENT

| Sieve Size (mm) | Percentage Passing (by mass) |
|---|-------------------------------------|
| 13.20 | 100 |
| 9.50 | 90 – 100 |
| 6.70 | - |
| 4.75 | 30 – 40 |
| 2.36 | 10 – 16 |
| 1.18 | 8 – 14 |
| 0.30 | 4 – 10 |
| 0.075 | 2 – 4 |
| Total Binder Content (by percentage mass of whole mixture) | 5.1% ± 0.3% |
| Hydrated Lime (by percentage mass of total aggregate) | Minimum 1.0% |

516.27.03 MIX DESIGN PROCESS

1. Mixes shall be manufactured in a laboratory to a consistent condition and shall be fully coated with binder. **Manufacture of Mixes**
2. When determining binder content the test shall be adjusted using the following procedure based on Section 4 of Sabita Manual 19 to determine a factor to be applied in calculating the binder content in the asphalt: **Binder Content**
 - (a) Prepare an aggregate blend confirming to the design requirements in the laboratory;
 - (b) Prepare a sample of crumb rubber modified binder;
 - (c) Mix the aggregate blend and crumb rubber modified binder at the target binder content;
 - (d) The time of mixing and mixing procedure shall be consistent and documented;
 - (e) Extract the binder using WA 730.1 or WA 730.2.
 - (f) A factor (f) is calculated as follows:

$$f = \frac{\text{mass of CR binder added to aggregate blend}}{\text{mass of soluble CR binder determined by extraction}}$$

3. Compaction temperature of Marshall specimens is $165 \pm 3^{\circ}\text{C}$ without a warm mix additive in the binder. The bulk density of laboratory prepared specimens shall be determined in accordance with WA 733.2 and the maximum density in accordance with WA 732.2.
4. The temperature for compaction of Marshall specimens when the warm mix additive is added to the binder shall be determined in accordance with the following method.
 - (a) Prepare a laboratory mixture of open graded asphalt without the warm mix additive in the binder, determine the maximum density and compact the mixture at 145°C to prepare Marshall specimens at 50 blows each side. Determine the air voids of a pair of specimens.
 - (b) Prepare a laboratory mixture of open graded asphalt with the warm mix additive in the binder.
 - (c) Determine maximum density in accordance with WA 732.2.
 - (d) Compact Marshall specimens with 50 blows to each face at temperatures of 135°C , 145°C and 155°C in accordance with WA 731.1.
 - (e) Measure the bulk density of each specimen in accordance with WA 733.2 and calculate percentage air voids.
 - (f) Plot percentage air voids versus compaction temperature. Using the air voids determined for the open graded asphalt without the warm mix additive determine the compaction temperature of mix with a warm mix additive to achieve the equivalent air voids. This will be the temperature to compact Marshall specimens during asphalt production.

516.27.04 APPROVAL OF ASPHALT MIX DESIGNS

1. The asphalt manufacturer shall be responsible for submitting the following information to:

Manager Materials Engineering
Materials Engineering Branch
Main Roads Western Australia
5-9 Colin Jamieson Drive
Welshpool WA 6106

- (a) Test report(s) showing that a laboratory prepared mix complies with the properties in Tables 516.5 and 516.6.
- (b) Identification of the manufacturing plant where the asphalt will be produced.
- (c) Test reports showing the latest results for the aggregates and filler to be used against all test properties in Specification 511 MATERIALS FOR BITUMINOUS TREATMENTS.
- (d) Test report(s) showing compliance with the binder properties in Table 516.1 including the maximum period that the crumb rubber modified binder will be stored at the asphalt plant.

- (e) The source of the crumb rubber modified binder to be used in the crumb rubber modified binder and the percentage crumb rubber to be added to the binder.
 - (f) The alternative test temperature for measuring the viscosity of the crumb rubber modified binder including the warm mix additive.
 - (g) The alternative temperature for compaction of Marshall specimens when the crumb rubber modified binder includes the warm mix additive.
2. If all of the requirements of the specification have been met the Materials Engineering Branch of Main Roads will issue a certificate for an Approved Asphalt Mix Design including the following information.
- (a) Identification number of the Approved Asphalt Mix Design.
 - (b) Date of approval.
 - (c) Identification of the asphalt manufacturer.
 - (d) Identification of the manufacturing plant at which the asphalt shall be produced.
 - (e) Source of aggregates to be used for the Approved Asphalt Mix Design.
 - (f) Maximum period of time for use of the crumb rubber modified binder.
 - (g) Source of crumb rubber, percent by mass in the binder and size of the crumb rubber.
 - (h) The warm mix additive to be used and dose rate.
 - (i) The alternative test temperature for measurement of viscosity for compliance testing.
 - (j) The alternative temperature for compaction of Marshall specimens when the crumb rubber modified binder includes the warm mix additive.
3. An Approved Asphalt Mix Design shall have a lifetime of three years. At any time during the period of approval if there has been any change to the details on the mix approval certificate then the mix design process shall be renewed in entirety. If at the end of the approval period there has been no change to the details on the mix approval certificate the asphalt manufacturer shall undertake the following and submit the results for renewal of mix design approval.
- (a) Provide a spreadsheet of all open graded asphalt test results since mix design approval.
 - (b) Prepare a laboratory mix of the crumb rubber modified binder without warm mix additive to demonstrate compliance with all binder properties in Table 516.1 after 60 minutes digestion time and the maximum digestion time.

Certificate

Renewal

516.27.05 USE OF ASPHALT MIX DESIGN

1. The Contractor shall provide proof to the Superintendent that the asphalt mix design has been approved by the Principal before any asphalt is manufactured in accordance with that Approved Asphalt Mix Design and placed in the Works.

HOLD POINT

516.28 – 516.29 NOT USED

MANUFACTURE AND TRANSPORT

516.30 CRUMB RUBBER MODIFIED BINDER

1. During manufacture of the crumb rubber modified binder the crumb rubber and bitumen are to be thoroughly mixed prior to the beginning of the reaction period. Mixing shall then continue with a reaction period of at least 1 hour. Crumb rubber floating on the surface or agglomeration of crumb rubber is evidence of insufficient mixing.
2. At the asphalt plant the crumb rubber modified binder shall be stored in a vertical insulated tank heated electrically or by hot oil. The tank shall have continuously operated stirrers to keep the crumb rubber in suspension.
3. The binder shall be stored at a temperature between 165°C to 190°C. If during the first ten hours after completion of the reaction period the temperature of the binder drops below 165°C the binder may be reheated to the required temperature of 165°C to 190°C. The binder shall not be held at a temperature between 165°C to 190°C for more than 10 hours after completion of the reaction period. Binder that is to be used at a time beyond 10 hours after completion of the reaction period shall be cooled to a temperature below 165°C and reheated when needed. Binder shall only be reheated once. Binder shall be used within the time limit nominated by the asphalt supplier with the binder profile.
4. For each batch of binder the Contractor shall provide the following information:
 - (a) The source, grade and quantity of bitumen used;
 - (b) The crumb rubber content expressed as percent by weight of total binder;
 - (c) Times and dates of addition of the crumb rubber;
 - (d) A continuous record of temperature of the binder against time for each batch beginning at the time of addition of the crumb rubber and until the load has been completely used.
5. Immediately prior to use of the crumb rubber modified binder for asphalt production a sample shall be taken from the binder storage tank and tested for viscosity at the temperature that was nominated with the binder profile, as specified at 516.06. The viscosity shall comply with the requirements of Table 516.7.

TABLE 516.7 VISCOSITY AT PRODUCTION

| Property | Test Method | Requirement |
|--|--------------------------|--------------------|
| Viscosity at nominated alternative temperature | ASTM D7741/D7741M (Note) | 1.5 – 4.0 Pa.s |

Note – Main Roads intends to replace the American test method with the Austroads T111 test method when comparative date from each method supports use of the Austroads test method. This is likely to be a short time frame so NATA accreditation for the ASTM test method is not required. Good laboratory practices meeting the requirements of ISO 17025 should be used to calibrate and use the Rion viscometer.

516.31 MIXING PLANT

- Asphalt shall be manufactured in a central mixing plant by either, batch mixing, continuous mixing or drum mixing. All mixing plant and equipment and associated facilities shall conform to the requirements of AS 2150 and shall be such as to prevent segregation of the asphalt at all stages. **Plant**
- A sampling cock shall be installed in the inlet pipe between the road tanker and binder storage tanks. An additional sampling cock shall be installed for sampling at the time of asphalt production between the binder tank and the mixing chamber to facilitate the sampling of any binder being used for asphalt production. **Binder Sampling Cocks**
- For the verification of weights or proportions and character of materials and determination of temperatures used in the preparation of the asphalt, the Superintendent shall have access at any time to all parts of the plant subject to safety considerations.

516.32 MANUFACTURE OF ASPHALT

- The quantities of coarse and fine aggregates, mineral filler, adhesion agent and binder shall be accurately and positively controlled to produce the asphalt specified for use in the Works. **Control**
- The mixing process shall be such as to produce a uniform distribution of aggregate sizes and a uniform coating of binder on 100% of aggregate particles when tested in accordance with AS/NZS 2891.11. **Mixing**
- The particle size distribution and the percentage of binder shall be within the limits as specified in Table 516.6 for open graded asphalt when tested in accordance with WA 730.1 or WA 730.2. **Particle Size Distribution**
- The air voids, stability and flow shall be in accordance with Table 516.5 for open graded asphalt when tested in accordance with WA 731.1 and 733.2. **Marshall Properties**
- The moisture content of the asphalt at the completion of the mixing process shall not be greater than 0.15% by mass when measured in accordance with AS/NZS 2891.10. **Moisture Content**
- In a batch mixer the volume of material shall be limited to an amount allowing the paddle tips to be seen when passing through the top vertical position during mixing. **Volume of Material**

7. The temperature of the mixed asphalt shall be measured and recorded at the discharge point of the pugmill or mixing drum. The temperature of the asphalt shall not exceed 165°C unless otherwise directed by the Superintendent.

**Temperature at
Discharge
Point**

516.33 – 516.34 NOT USED

516.35 TESTING

1. The asphalt producer shall provide and maintain at a suitable location at the site of the mixing plant for the duration of the Contract a suitably equipped air conditioned testing laboratory accredited by NATA to perform the following tests:

**Testing
Laboratory**

WA 210.1, 212.1 or 212.2, 701.1, 705.1, 730.1, WA 730.2, 731.1, 732.2, 733.2, AS/NZS 2891.10, AS/NZS 2891.11 where applicable. A Rion viscometer shall be available at the mixing plant laboratory to test for binder viscosity in accordance with ASTM D7741/D7741M but NATA accreditation for this method is not mandatory.

2. The laboratory shall be equipped with all testing equipment necessary to perform these tests. The asphalt producer shall operate and maintain the equipment in good condition in accordance with NATA requirements.

**Testing
Equipment**

3. Asphalt and mineral filler shall be tested for the properties and at the testing frequency shown in Table 516.8.

**Testing
Requirements**

TABLE 516.8 ASPHALT AND FILLER TESTING FREQUENCY

| Property | Test Method | Minimum Testing Frequency | | |
|--|----------------------|---|---|--|
| Binder Content and PSD (Note 1) | WA 730.1 or WA 730.2 | <ul style="list-style-type: none"> • Up to 50 tonnes • Up to 150 tonnes • Up to 350 tonnes • Up to 550 tonnes | 1 test 2 tests 3 tests 4 tests | |
| Maximum Density | WA 732.2 | | | |
| Air Voids | WA 733.2 | | | |
| Stability and Flow | WA 731.1 | | | |
| Moisture Content | AS/NZS 2891.10 | 1 test with initial production in first shift and then once per week | | |
| Uniform Coating of Binder | AS/NZS 2891.11 | 1 test with initial production in first shift and then once per week | | |
| Voids in Dry Compacted Filler (%) | AS 1141.17 | 1 test with initial production in first shift and then once per week | | |
| Apparent Density of Filler (t/m ³) | AS 1141.7 | | | |
| PSD of Filler | AS 1141.11.1 | | | |

Note 1 – when determining binder content the test result shall be adjusted by the f factor described in Clause 516.27.03.

- | | |
|--|---------------------------------|
| 4. Asphalt shall be sampled in accordance with WA 701.1 with samples tested immediately they are taken. The number of tests undertaken shall be evenly spread across the entire period of production within a shift. | Sample Testing Frequency |
| 5. The first sample of asphalt in a shift shall be taken from the first 50 tonnes of asphalt manufactured in the shift. | First Sample |
| 6. If the result of a test sample does not conform to any specified requirements another sample of asphalt shall be taken immediately and tested immediately for a full test. | |
| 7. Results of testing shall be reported on a NATA endorsed test report within 24 hours of a sample being taken. The testing laboratory shall send all results directly to, amongst others, the Contractor, the Superintendent and the Main Roads Materials Engineering Branch mailbox (email MEBAsphaltreports@mainroads.wa.gov.au). | Reporting |

516.36 NON-CONFORMANCE

- | | |
|---|-------------------|
| 1. A hold point will apply when any mix test result indicating a non-conformance occurs. This hold point shall also apply to a mix produced prior to the non-conforming test result, but which has not been placed. | HOLD POINT |
|---|-------------------|

516.37 TRANSPORT

- | | |
|--|-----------------------------|
| 1. The asphalt shall be transported from the asphalt plant to the Works in metal bodied trucks or trailers previously cleaned of all foreign materials. In long distance haul situations the asphalt should be transported in insulated vehicles sufficient to ensure arrival of the asphalt on site in a conforming condition. | Vehicle Type |
| 2. The temperature of the asphalt in each truck load and each trailer load shall be measured using a calibrated digital probe thermometer before the truck leaves the site of the asphalt manufacturing plant. The thermometer shall have a digital display readable to 1°C and have a measurement of uncertainty of not more than 3°C. Infrared thermometers shall not be used to measure temperature. The temperature shall comply with the requirements of Clause 516.32.7. | Temperature in Truck |
| 3. The temperature of the asphalt shall be recorded on a printout showing date, time and asphalt temperature for each truck load and each trailer load of mix dispatched. The printout shall be provided with the load delivery docket. | Temperature Record |
| 4. Each load shall be covered with suitable material of sufficient size to prevent loss of heat from the mixture. | Heat Loss |
| 5. The asphalt shall be delivered at a uniform rate within the capacity of the placing and compacting plant. | Delivery Rate |

516.38 – 516.40 NOT USED

PLACING OF ASPHALT

516.41 GENERAL

1. Prior to commencing asphalting, the Contractor shall submit to the Superintendent the proposed number and widths of asphalt runs, and the proposed joint layout. **HOLD POINT**
2. Asphalt shall not be placed if the truck delivery docket does not include a printout of the date, time and temperature of asphalt when the truck was dispatched.
3. Asphalt shall be delivered to the work site at temperatures as follows:
 - (a) Open graded asphalt with warm mix additive 145°C to 160°C.**Delivery Temperatures**
4. If a delay occurs of more than 30 minutes between successive truck deliveries to the paver, the paver shall be moved clear of the laid asphalt and a proper transverse joint formed. **Delays**
5. Prior to commencing each day's operations, and also after any delay exceeding half an hour during the day, the screed shall be preheated for at least 15 minutes in order to eliminate drag marks and imperfections in the finished mat. **Screed to be Preheated**
6. All kerbs, gullies, grates and other structures shall be protected at all times from damage or defacement by asphalt placement works and the site shall be left in a clean and tidy condition. **Damage**

516.42 SURFACE PREPARATION

1. Prior to the placement of asphalt, the Contractor shall carry out preparation work as detailed in the following clauses.
2. The Contractor shall sweep all road surfaces on which asphalt is to be placed under this contract to a clean condition with no appreciable amounts of loose materials or any other foreign matter remaining. Loose surface material against kerbing shall be removed by handwork if necessary. The surface to be paved shall be dry. **Sweeping**
3. Where the surface to be covered is asphalt, all depressions more than 20mm deep shall be filled with a nominal 10 mm or 14 mm dense graded asphalt and shall be screeded or raked and then compacted to similar density as the remainder of the surface to be paved. **Surface Correction**
4. Where paving tape is shown in asphalt drawings the tape shall be applied to a surface that is clean, dry and all loose material has been removed beyond the width of the tape to be applied. Joins of the tape shall be overlapped and any air bubbles or creases in the tape shall be cut and flattened. **Paving Tape**

516.43 EQUIPMENT

1. The asphalt must be placed by a self-propelled paver equipped with the ability to be operated with automatic thickness control and automatic joint matching facility. The paver must be equipped with a ski or laser control **Requirements**

system and crossfall controller to maintain levels, and also suitable sensing equipment to provide longitudinal joint matching. It shall further be equipped with a vibrating or tamping screed capable of achieving 85% of final compaction.

2. Where the use of a material transfer vehicle (MTV) is specified at Annexure 516B or elsewhere the MTV shall be a self-propelled machine capable of receiving asphalt from delivery trucks and transferring the asphalt to the paver without any contact with the paver. The paver must be fitted with a bin in its hopper to transfer asphalt directly to the feed conveyor of the paver.

Material Transfer Vehicle

516.44 TACK COAT

1. A tack coat using the dilute emulsion shall be applied to the prepared surface at the rate to obtain a rate of residual bitumen of 0.15 to 0.25 L/m². The tack coat shall be sprayed in a uniform film over the entire road surface.
2. No asphalt shall be placed on the tack coat until the emulsion has broken and the water has substantially evaporated.
3. The Superintendent may direct the pavement area ahead of the paver to be resprayed and may specify the time to be allowed between the spraying of tack coat and the placing of asphalt. However, this area shall not exceed the requirements for half a day's placing of asphalt.
4. The tack coat shall be applied with care to reduce the possibility of concrete kerbs, driveways and footpaths being sprayed with bitumen. Any such contamination shall be removed by the Contractor at no cost to the Principal.

Composition

Respraying

Contamination

516.45 NOT USED

516.46 WEATHER CONDITIONS

1. Asphalt placement shall not commence or continue upon a surface which is not clean and dry, and only when the pavement temperature meets the requirements shown in Table 516.9 and rain is not imminent.

Pavement Temperature

TABLE 516.9 PAVEMENT TEMPERATURES FOR PLACEMENT

| Minimum pavement temperature when wind speed < 20 km/hr | Minimum pavement temperature when wind speed ≥ 20 km/hr |
|---|---|
| 15°C | 20°C |

2. The Superintendent may, if the weather or surface conditions are considered to be unsuitable, instruct the Contractor to cease laying operations. Any materials laid after this instruction is given will not be paid for and are to be removed at no cost to the Principal.

516.47 JOINTS

1. The number and extent of joints in asphalt layers shall be kept to a minimum and the paving pattern shall be designed accordingly in advance of the work. **Paving Pattern**
2. The main paving runs shall be laid first and any smaller or irregular adjacent areas later so that they can be matched to the main run.
3. Each joint shall be neat, thoroughly compacted, and have a surface finish equal in quality to that of the surrounding asphalt layer. **Surface Finish**
4. Where the edge of the previously laid work has become distorted it shall be cut back a sufficient distance to provide the true cross section. **Edges**

516.48 LONGITUDINAL JOINTS

1. Longitudinal joints shall be continuous and parallel to the pavement centreline. Joints in successive layers shall be offset by at least 150 mm. Joints shall be located away from traffic wheel tracks. Where possible, joints in wearing courses shall be located beneath traffic line marking. The end of the previous run shall be lightly tack coated before the paving of the adjacent run proceeds. **Position**
2. Temporary longitudinal ramps shall be provided for any asphalt course that has not been completed to the full carriageway width and is subjected to traffic. These ramps shall be cut back before the adjacent lane is laid. **Temporary Ramps**

516.49 TRANSVERSE JOINTS

1. Transverse joints shall be at right angles to the direction of paving. They should be staggered by at least one (1) metre between successive layers and between adjacent runs. **Position**
2. The end of the previous run shall be lightly tack coated before the paving of the next run proceeds. **Tack Coat**
3. Temporary transverse ramps shall be provided where traffic is to use the newly laid work prior to a run being completed. These ramps shall be cut back before the next run is laid. **Temporary Ramps**

516.50 TERMINAL JOINTS

1. Terminal joints between the new and existing surfaces shall be formed by ramping with a nominal 5 mm dense graded asphalt mix. The ramp shall extend over a sufficient distance to provide a slope of at least 1:100.

516.51 ASPHALT CONSTRUCTION DRAWINGS

1. Unless otherwise specified details for transverse joints, longitudinal joints and profiles shall be in accordance with the asphalt construction drawings available on the Main Roads website as listed in Table 516.10.

TABLE 516.10 LIST OF ASPHALT CONSTRUCTION DRAWINGS

| Drawing Number | Title |
|----------------|--|
| 201331-0031 | Pavement Series – Typical details full depth asphalt transverse joints |
| 201331-0032 | Pavement Series – Typical details Granular transverse joints |
| 201331-0033 | Pavement Series – Typical details full depth asphalt longitudinal joints and profile |
| 201331-0035 | Wearing Course Series – Typical details OGA/DGA transverse joints |
| 201331-0036 | Wearing Course Series – Typical details DGA transverse joints |
| 201331-0037 | Wearing Course Series – Typical details SMA transverse joints |
| 201331-0038 | Wearing Course Series – Typical details longitudinal joints |

516.52 – 516.53 NOT USED**516.54 COMPACTION**

1. Self-propelled vibrating steel wheel rollers, each of mass not less than eight (8) tonnes, capable of varying the amplitude and/or frequency of vibration shall be used. All rollers shall be fitted with reticulation to water wheels to prevent pick up of asphalt and be fitted with scrapers to clean the wheels. **Equipment**
2. Unless otherwise directed by the Superintendent rolling shall commence immediately after placing and compacting with the vibrating or tamping screed. The rolling shall start longitudinally at the sides and proceed towards the centre of the pavement, overlapping on successive passes by at least 150 mm. Successive passes of the roller shall be of slightly different lengths.
3. Roller speed shall be uniform. Stops and starts shall be controlled so that displacement (shoving) of the asphalt mix does not occur when changing direction. Any shoving occurring as a result of changing direction, or from any other cause, shall be corrected at once by the use of rakes and of fresh asphalt when required. **Roller Stop/Starts**
4. To prevent adhesion of asphalt to the roller, all wheels shall be kept properly moistened but excess of water shall be avoided. **Moistened Wheels**
5. Vibratory compaction shall be discontinued in areas where it is considered such vibrations could cause damage to adjacent buildings or structures. Under these conditions, initial compaction of the asphalt shall be achieved using the self-propelled static steel wheeled rollers of appropriate mass to meet the compaction requirements in Clause 516.55. **Vibratory Compaction**
6. The Contractor shall ensure the protection of services and property from deterioration or damage due to the works. **Protection**
7. Rollers shall be kept in continuous operation as much as practicable and in such a manner that all parts of the pavement receive substantially equal compaction. In the event of a delay in the laying operation, rolling is to be **Continuous Operations**

| | |
|---|---|
| carried out as close as practicable to the paving machine. Rollers shall not be parked on work carried out the same day. | |
| 8. A sufficient number of rollers shall be available on site commensurate with the rate of supply of asphalt and the output of the paving machine. | Number of Rollers |
| 9. All joints must be filled and edges adjacent to kerbing and such other hand work as may be necessary must be rolled with a suitable pedestrian type roller. | Joints |
| 10. Finish rolling shall be carried out while the material is still warm enough for the removal of tyre marks. | Finish Rolling |
| 11. At places not accessible to the roller, thorough compaction must be ensured by means of hot tampers and at all joints with structures the surface mixture must be effectively sealed. | Hot Tampers |
| 516.55 DENSITY REQUIREMENTS | |
| 1. The Characteristic Percent Marshall Density (Compaction) for any lot shall be deemed to be conforming if it attains a value of 93% or greater. | Marshall Density |
| 2. Density shall be calculated on the basis of the results of tests of core samples of asphalt sampled from an asphalt layer, after laying and compaction, in accordance with WA 701.1. The density of the samples shall be determined in accordance with WA 733.2 and expressed as a percentage of the mean Marshall Density of all asphalt results from the same production shift in accordance with WA 731.1 and WA 733.2. | |
| 3. Core samples shall be taken within 24 hours of placement of a lot of asphalt. Results of testing shall be reported on a NATA endorsed test report within 48 hours of the core samples being taken. The testing laboratory shall send all density results directly to, amongst others, the Contractor, the Superintendent and to the Main Roads Materials Engineering Branch mailbox (email MEBAsphaltreports@mainroads.wa.gov.au). | Testing and Reporting of Results |
| 4. Where any lot of asphalt work is deemed non-conforming the Contractor shall apply remedial action in accordance with the procedures contained in Specification 201 QUALITY MANAGEMENT, and the lot shall be removed and replaced with fresh asphalt and retested. Removal shall be carried out so as not to damage the underlying layers or any road furniture such as gully gratings. Any such damage shall be repaired at no cost to the Principal. | Non-conformance |
| 516.56 SURFACE REQUIREMENTS | |
| 1. The surface of the compacted asphalt shall be smooth and true to the specified crown and grades, be of uniform appearance, free of dragged areas, cracks, open textured patches and roller or paver marks. Any section of asphalt that is loose or broken, mixed with dirt or other impurities, or is in any way defective, shall be removed and replaced. | |
| 2. When using the 3 metre straightedge, in accordance with WA 313.2, the shape of the compacted asphalt shall be deemed to be conforming when the maximum deviation from a 3 metre straightedge, placed in any position | Shape: 3 metre Straightedge |

on the surface of a layer does not exceed the limits specified in Table 516.11. A 3 metre straightedge shall be provided with each paver.

3. When using the ARRB TR Walking Profiler, in accordance with WA 313.4, the shape of the compacted asphalt shall be deemed to be conforming when the maximum deviation, measured in any direction and within any 3m long section of the surface does not exceed the limits specified in Table 516.11.

Shape: ARRB Profiler

TABLE 516.11 SURFACE SHAPE

| Direction of Measurement | Maximum Deviation | Maximum rate of Change of Deviation |
|--------------------------|-------------------|-------------------------------------|
| Longitudinal | 3 mm | 1.0 mm per 240 mm |
| Transverse | 5 mm | 1.0 mm per 240 mm |

4. For construction works, the upper surface of the compacted asphalt shall be within 5 mm of the final design levels. For construction work the mean thickness of the compacted asphalt layers shall be within 5 mm of the specified thickness. On resurfacing works, the thickness of any core sample shall be within 5 mm of the specified thickness. The thickness shall be determined from the thickness of core samples taken for compaction testing, measured in accordance with WA 705.1.

Level and Thickness

5. The plan location of the outer edge of the asphalt shall be within +25 mm of its true location and the rate of change of the edge from its true plan position shall not exceed 1 in 40.

Position

6. The Contractor shall test for compliance with the specified lines, levels, thickness and surface finish immediately after initial compaction. Any variations shall be corrected by removing or adding materials as may be necessary. Rolling shall then be continued as specified. After final rolling out, the smoothness of the course shall be checked again.

Compliance

7. Where work is deemed non-conforming the Contractor shall apply remedial action in accordance with the procedures contained in Specification 201 QUALITY MANAGEMENT, and the lot shall be removed and replaced with fresh asphalt and retested.

Non-conformance

516.57 OPENING FINISHED WORKS TO TRAFFIC

1. Prior to opening the finished asphalt surface to traffic, the Contractor shall certify to the Superintendent that the final road surface is completed in accordance with the Specification, and that the works are properly delineated and safe for public use.

HOLD POINT

516.58 – 516.80 NOT USED

AS-BUILT AND HANDOVER REQUIREMENTS

516.81 – 516.90 NOT USED

CONTRACT SPECIFIC REQUIREMENTS

516.91 – 516.99 NOT USED

ANNEXURE 516A

SCHEDULE OF WORKS

(Insert appropriate details of all asphalt treatments: for Main Roads Policy, refer Guidance Note 1. Supplement with drawings, diagrams, etc. where necessary.)

ANNEXURE 516B

SPECIFIC CONTRACT REQUIREMENTS

1. MATERIAL TRANSFER VEHICLE

A material transfer vehicle is required to be used for the following layers:

| Location | Yes | No |
|----------|-----|----|
| | | |
| | | |
| | | |
| | | |

2. ECHELON PAVING

Echelon paving is required to be used for the following areas:

| Location | Yes | No |
|----------|-----|----|
| | | |
| | | |
| | | |
| | | |

GUIDANCE NOTES

FOR REFERENCE ONLY – DELETE GUIDANCE NOTES FROM FINAL DOCUMENT

1. All edits to this specification are to be made using track changes, to clearly show added/deleted text.
 2. If **all** information relating to a clause is deleted, the clause number should be retained and the words "**NOT USED**" should be inserted.
 3. The proposed document with tracked changes must be submitted to the Project Manager for review, prior to finalising the document.
 4. Once the Project Manager's review is complete, accept all changes in the document, turn off track changes and refresh the Table of Contents.
 5. The Custodian of this specification is Bituminous Products Consultant.
-

1. GUIDANCE ON THE USE OF WEARING COURSE ASPHALT

- 1.1 Main Roads document number 6706-04-154 Guide for Surfacing Type Selection provides guidance on the use of various types of asphalt surfacings in different scenarios and speed zones.

2. 10mm OPEN GRADED ASPHALT

- 2.1 For new construction or reconstruction works granite open graded asphalt shall be used for both the trafficked lanes and the break down lane or shoulder. Red coloured granite open graded asphalt shall not be used for any application.

3. USE OF A MATERIAL TRANSFER VEHICLE

- 3.1 The requirement to use an MTV has to be specified at Annexure 516B. MTVs facilitate continuous paving by having a truck come in contact with the MTV to empty its load whilst asphalt is transferred into the paver by conveyor. Removing contact between a truck and paver overcomes bumps from the stop/start of the paver and reduces the likelihood of mix segregation near the end of a truckload. The outcome is more uniform temperature of the asphalt which will result in improved and more uniform compaction, improved ride and less incidence of segregated areas of asphalt.

MTVs are not suited to all asphalting applications as shown below. Where an MTV must be used includes:

- On a project where there will be high daily production outputs of asphalt, e.g. widening of Tonkin and Leach Highways near Perth Airport (Gateway WA Project).
- Where there are long paving runs, e.g. Kwinana Fwy widening Roe to Armadale and Armadale to Russell.
- Where improved ride quality is required, e.g. Great Eastern Hwy from Graham Farmer Fwy to Tonkin Hwy (City East Alliance).

- Where asphalt is to be placed in adverse weather conditions such as low temperatures or strong winds, e.g. winter paving.
- When paving thin layers of asphalt containing a polymer modified binder.

MTVs may not be suited for the following scenarios:

- On a project where there will be small daily production outputs of asphalt, e.g. small minor improvement works.
- Where there are confined spaces.
- Small areas of widening such as intersection channelisation including short turn pockets.

4. MINOR WORKS CONTRACTS

4.1 Where this document is used in a Minor Works Contract with wearing course asphalt as the sole or primary work required, Authors should ensure that the following specifications are also included in the tender documentation:

- (a) Specification 100 GENERAL REQUIREMENTS
- (b) Specification 604 PAVEMENT MARKINGS (if required)

4.2 Contract Specific Requirements – include any details provided or required by the Principal, such as:

- (a) Setting Out information
- (b) Working Hours and Days (if not already included in the tender document)
- (c) Surface Preparation – e.g. normally sweeping only, but may include localised surface correction requirements
- (d) Record Forms – to include any required details of proof and origin of asphalt supply, etc.

Insert appropriate Annexures and reference to Annexures to suit in conjunction with these additional provisions.

CONTRACT SPECIFIC REQUIREMENTS

The following clauses are to be placed under the CONTRACT SPECIFIC REQUIREMENTS, as required. After inserting the clause, change the clause number and heading to style “H2 SP” so it appears in the Table of Contents.

XXX.XX SUB-HEADING (H2 SP)

- | | |
|--------------------------------|------|
| 1. Insert text (Main Table SP) | XXXX |
| 2. Insert text (Main Table SP) | |

XXX.XX SUB-HEADING (H2 SP)

- | | |
|--------------------------------|--|
| 1. Insert text (Main Table SP) | |
| 2. Insert text (Main Table SP) | |

AMENDMENT CHECKLIST

Specification No. **516** Title: **CRUMB RUBBER OPEN GRADED ASPHALT** Revision No: _____

Project Manager: _____ Signature: _____ Date: _____

Checked by: _____ Signature: _____ Date: _____

Contract No: _____ Contract Name: _____

| ITEM | DESCRIPTION | SIGN OFF |
|--|---|----------|
| <i>Note: All changes/amendments must be shown in tracked changes until approved.</i> | | |
| 1. | Project Manager has reviewed the specification and identified additions and amendments. | |
| 2. | Standard clauses amended? MUST SEEK approval from the Specification Custodian. | |
| 3. | Any unlisted materials/products proposed and approved by the Project Manager? If "Yes" provide details at 16. | |
| 4. | Deleted clauses shown as " NOT USED ". | |
| 5. | Ensure appropriate INSPECTION AND TESTING parameters are included in Specification 201 (test methods, minimum testing frequencies verified). | |
| 6. | AS-BUILT AND HANDOVER requirements addressed. | |
| 7. | CONTRACT SPECIFIC REQUIREMENTS addressed? Contract specific materials, products, clauses added? (refer Specification Guidance Notes). | |
| 8. | ANNEXURES completed (refer Specification Guidance Notes). | |
| 9. | Estimates Manager has approved changes to SMM . | |
| 10. | Project Manager certifies completed specification reflects intent of the design. | |
| 11. | Independent verification of completed specification arranged by Project Manager. | |
| 12. | Project Manager's review completed. | |
| 13. | SPECIFICATION GUIDANCE NOTES deleted. | |
| 14. | TABLE OF CONTENTS updated. | |
| 15. | FOOTER updated with Document No., Contract No. and Contract Name. | |
| 16. | Supporting information prepared and submitted to Project Manager. | |

Additional information or further action:

Signed: _____ (*Project Manager*) Date: _____