

## SECTION 407 - DENSE GRADED ASPHALT

~~##This section cross-references Sections 160, 173, 175, 402, 404, 405, 417, 418, 421, 422, and 801, and these sections should be included in the specification. If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent:~~

### 407.01 GENERAL

This section covers the requirements for the manufacture and placement of dense graded asphalt, including quality of materials, mix design, supply and placing of the asphalt.

The following supplementary VicRoads Standard Sections shall be read in conjunction with this section where mixes other than dense graded asphalt are required:

Stone Mastic Asphalt	Section 404
Regulation Gap Graded Asphalt	Section 405
Open Graded Asphalt	Section 417
High Modulus Asphalt (EME2)	Section 418
High Binder Crumb Rubber Asphalt	Section 421
Light Traffic Crumb Rubber Asphalt	Section 422

If any cold planing is undertaken in association with placing of asphalt, Section 402 shall apply.

### 407.02 STANDARDS

Documents referred to in this section are listed in Table 407.021.

**Table 407.021: Referenced Documents**

Australian Standards	
AS 1141.3.1	Methods for sampling and testing aggregates Sampling - Aggregates
AS 1141.5	Methods for sampling and testing aggregates - Particle density and water absorption of fine aggregate
AS 1141.6.1	Methods for sampling and testing aggregates Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS 1141.6.2	Methods for sampling and testing aggregates Particle density and water absorption of coarse aggregate - Pycnometer method
AS 1141.8	Methods for sampling and testing aggregates - Method 8: Water-soluble fraction of filler
AS 1141.11.1	Methods for sampling and testing aggregates – Particle Size Distribution Sieving Method
AS 1141.15	Methods for sampling and testing aggregates – Flakiness Index
AS 1141.17	Methods for sampling and testing aggregates Voids in dry compacted filler
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289.3.3.1	Methods of testing soils for engineering purposes Soil classification tests - Calculation of the plasticity index of a soil
AS 1672.1	Limes and limestones Limes for building
AS 2008	Bitumen for pavements
AS 2150	Hot mix asphalt - A guide to good practice
AS 2341.2	Determination of dynamic viscosity by vacuum capillary viscometer
AS/NZS 2891.11	Methods of sampling and testing asphalt Degree of particle coating
AS/NZS 2891.3.3	Methods of Sampling and Testing Asphalt: Binder Content and Aggregate Grading - Pressure Filter Method

Table 407.021 continued on next page

**Table 407.021: Referenced Documents (continued)**

<b>Australian Standards</b>	
AS/NZS 2891.7.1	Methods of Sampling and Testing Asphalt – Determination of Maximum Density of Asphalt, Water Displacement Method
AS/NZS 3582.1	Supplementary cementitious materials: Fly ash
AS 3582.2	Supplementary cementitious materials: Slag - Ground granulated blast-furnace
AS 3972	General purpose and blended cements
AS 4489.8.1	Test methods for limes and limestones - Free moisture - Convection oven
<b>Austrroads</b>	
ATS 3110	Austrroads Technical Specification - Supply of Polymer Modified Binders
AGPT/T192	Characterisation of the Viscosity of Reclaimed Asphalt Pavement (RAP) Binder Using the Dynamic Shear Rheometer (DSR)
AGPT/T193	Design of Bituminous Binder Blends to a Specified Viscosity Value
AGPT/T234	Asphalt Binder Content (Ignition Oven Method)
<b>VicRoads</b>	
RC 211.01	Moisture Content of Mixed Asphalt Products
RC 212.01	Recovery of Bituminous Binder from Asphalt for Measurement of Viscosity
RC 370.05	Degradation Factor – Fine Aggregate
RC 372.01	Coarse Aggregate Quality by Visual Assessment
RC 500.01	Registration of Bituminous Mix Designs
RC 500.05	Acceptance of Field Compaction
RC 500.16	Selection of Test Methods for Testing of Materials and Work

Section 175 details the revision dates of the relevant references in this section.

### **407.03 DEFINITIONS**

#### **Added Filler**

A fine material, the majority of which passes the 0.075 mm sieve that forms part of the final aggregate grading and is added to the combined asphalt aggregate derived from crushed rock or other similar material. Typical materials include hydrated lime, fly ash, cement, ground limestone. It excludes the natural component of the combined aggregate passing the 0.075 mm sieve.

#### **Asphalt**

Asphalt is a designed and controlled mixture of coarse and fine aggregates, filler, binder and other additives which is mixed, spread and compacted to a uniform layer while hot.

#### **Asphalt Base Course**

Asphalt base course is that part of an asphalt pavement supporting the intermediate and wearing courses. It rests on the subgrade or pavement subbase.

#### **Asphalt Course**

An asphalt course comprises one or more layers of a single asphalt type.

#### **Asphalt Intermediate Course**

Asphalt intermediate course is that part of the asphalt pavement immediately under the wearing course. It rests on the asphalt base course.

**Asphalt Layer**

An asphalt layer comprises a single uniform application of asphalt placed in a single pass of the paver.

**Asphalt Pavement**

Asphalt pavement comprises the combined thickness of all asphalt courses.

**Asphalt Regulating Course**

Asphalt regulating course is an asphalt course of variable thickness applied to the road surface to adjust the shape prior to the wearing course or any other bituminous surfacing or re-surfacing.

**Asphalt Types (Dense Graded)**

Dense graded mixes are designated by a letter indicating their intended use and key materials. Dense graded asphalt types L, N, V and H series mixes are used for wearing courses, and Type S series mixes are used as structural mixes for intermediate and base courses. A brief description for the various types of dense graded asphalt is shown in Table 407.031.

**Table 407.031: Types of Dense Graded Asphalt**

Mix Designation	Description
L	A light duty Size 7 or 10 wearing course with low air voids and higher binder content for use in very lightly trafficked pavements.
N	A light to medium duty Size 7, 10 or 14 wearing course or regulating course for use in light to moderately trafficked pavements.
H	A heavy duty Size 7, 10 or 14 asphalt wearing course or regulating course for use in most heavily trafficked pavements.
V	A heavy duty Size 10 or 14 asphalt wearing course for heavily trafficked intersections.
HP	A high performance Size 10 or 14 heavy duty wearing course asphalt incorporating a Polymer Modified Binder (PMB) where a high resistance to deformation and flexural cracking is required.
VP	A high performance Size 14 heavy duty wearing course asphalt incorporating a PMB for very heavily trafficked intersections where a high resistance to deformation and flexural cracking is required.
SI	A multi-purpose Size 14 or 20 structural asphalt for intermediate course in heavy duty pavements or base course in medium duty pavements.
SF	A fatigue resistant Size 20 structural base course asphalt for heavy duty asphalt pavements with a total asphalt thickness (excluding Open Graded Asphalt) of at least 175 mm.
SP	A high performance heavy to very heavy duty Size 20 structural intermediate course asphalt incorporating a PMB for high resistance to deformation and flexural cracking.
SS	A very stiff Size 20 structural intermediate course asphalt used to increase pavement deformation resistance and increase mix stiffness for very large scale heavy duty asphalt pavements.

**Asphalt Wearing Course**

Asphalt wearing course is the final part of the pavement upon which the traffic travels except for Open Graded Asphalt (OGA) where the wearing course is the layer beneath the OGA.

**Assigned Polished Stone Value**

The assigned Polished Stone Value (PSV) is a friction rating derived from PSV tests undertaken by the Department of Transport, which is assigned to each source.

**Binder**

Binder is bitumen or polymer modified binder (PMB) used to hold a mixture of aggregates together as a cohesive mass.

**Binder Film Index**

Binder film index is an empirical calculation of theoretical thickness of the binder film around each aggregate particle within the asphalt mix having regard to the aggregate grading, surface area of the aggregates and binder content.

**Bulk Density**

Bulk density is the mass per unit volume of the compacted mix including the air voids.

**Coarse Aggregates**

Coarse aggregates are those retained on the 4.75 mm sieve and higher.

**Cold Joints**

Cold joints are where asphalt is placed against the exposed edge of an existing asphalt mat, where the existing mat has cooled below 95°C for asphalt containing bitumen and, or less than 110°C for asphalt containing PMBs.

**Compaction Aid**

A chemical additive used to allow compaction of asphalt at low temperatures or improve the workability of mixes.

**Density Ratio**

The percentage ratio of the field bulk density to the assigned bulk density of the approved laboratory mix design.

**Filler**

Filler is the portion of aggregates passing the 0.075 mm sieve. It includes the combined mass of crusher dust, any added recycled fines from the asphalt plant dust extraction filters and any added filler.

**Fine Aggregates**

Fine aggregates are aggregates passing the 4.75 mm sieve and retained on the 0.075 mm sieve.

**Glass Fines**

Glass fines are fine aggregate material generally passing the 4.75 mm AS sieve produced by crushing recycled glass to a cubic shape.

**Hot Joint**

A hot joint is a longitudinal joint between two mats that are generally paved in echelon which are compacted simultaneously before the asphalt edge in both mats has cooled below 95°C for asphalt containing bitumen and 110°C for asphalt containing PMBs.

**Hot Mix Asphalt (HMA)**

Hot Mix Asphalt is asphalt that has been produced at conventional hot mix temperatures, typically above 165°C.

**In situ Air Voids**

In situ air voids represents the air voids in the field compacted mix. It is based on a ratio of field density to maximum density.

**Longitudinal Edge Strip**

A longitudinal edge strip is the area of the asphalt layer within 200 mm of a longitudinal edge of the asphalt layer.

**Maximum Density (Void free density)**

The maximum density is the density that could be achieved in a sample of asphalt if it were possible to compact it to exclude all air voids between coated aggregate particles.

**Natural Sand**

Natural sand is a fine aggregate material passing the 4.75 mm sieve extracted from natural sand deposits.

**Particle Density**

Particle density is the mass of a dry particle of aggregate in air divided by volume of the particle of aggregate excluding permeable voids.

**Placing**

Placing is the spreading and compacting of asphalt, including all necessary ancillary operations.

**Reclaimed Asphalt Pavement (RAP)**

Reclaimed asphalt pavement is asphalt removed from an existing asphalt pavement/plant returns that is re-processed by crushing and/or screening for recycling into new asphalt.

**RAP Level**

RAP level describes the range of RAP contents that can be used in a mix and the associated testing required at each level.

**Registered Mix**

A registered mix is an asphalt mix which has been placed on the VicRoads Asphalt Mix Design Register under a General or Conditional status.

**Rejuvenating Agents**

Rejuvenating agents are materials added to RAP mixes to restore the virgin binder and RAP binder blend viscosity to the required level.

**Warm Mix Asphalt (WMA)**

Warm Mix Asphalt is asphalt which contains an additive, or uses a manufacturing process, that allows the asphalt mix to be produced and placed at temperatures at least 20°C lower than HMA.

**407.04 ASPHALT QUALITY PLAN**

In addition to meeting the requirements of Section 160, the Contractor shall provide an asphalt quality plan that addresses the following requirements:

- sourcing, handling and storage of constituent materials
- RAP Management plan
- asphalt production and process control
- asphalt loading and transportation to minimise segregation and achieve adequate mix temperature on delivery to site
- measuring and recording of pavement temperature, wind speed and weather conditions
- achieving a uniform application of tack coat
- achieving uniform asphalt placement including determination of paving speed and paving plans
- determination of appropriate compaction equipment, number of rollers and rolling patterns required to achieve density
- procedures to maximise density at joints.

**407.05 ADDITIVES**

(a) Warm Mix Additive

The maximum proportion of warm mix additive shall comply with the limits in Table 407.051

**Table 407.051: Maximum Proportion of Warm Mix Additive**

Additive Type	Maximum Proportion by Mass of Binder %
Wax	1.5
Chemical surfactants	1.0
Water (applied directly or in the form of crystals containing water)	3.0

**407.06 AGGREGATES**

(a) General

The combined aggregate mixture shall include coarse aggregate, fine aggregate, filler, and any RAP permitted under Clause 407.12.

(b) Source Materials

Source materials including source rock shall comply with the requirements of Section 801.

(c) Coarse Aggregates

- (i) Coarse aggregates shall be a mixture of separate sized crushed aggregate fractions.
- (ii) The minimum assigned PSV shall comply with the requirements of Section 801.
- (iii) The Flakiness Index of each separate sized coarse aggregate fraction, with a nominal size of 10 mm or larger, when tested in accordance with AS 1141.15, shall comply with Table 407.061.
- (iv) The unsound and marginal rock of each separate sized aggregate fraction excluding any RAP, shall not exceed the relevant percentages specified in Table 407.061 when tested in accordance with RC 372.01.
- (v) The particle density of each separate sized aggregate fraction shall be tested in accordance with AS 1141.6.1 or AS 1141.6.2 and provided by the source quarry.

**Table 407.061: Quality of Coarse Aggregates**

Type of Asphalt	Flakiness Index (%) (max)	Total of Marginal and Unsound Rock (% by mass) (max)	Unsound Rock (% by mass) (max)
H and V Series	35	8	3
L, N, and S Series	35	10	5

(d) Fine Aggregates

- (i) For wearing course mixes fine aggregates shall be a mixture of one or more sands and crushed aggregates which shall be free from lumps and aggregations.
- (ii) The particle density of each separate sized aggregate fraction shall be tested in accordance with AS 1141.5 and provided by the source quarry.

- (iii) Fine crushed aggregate shall comply with the relevant requirements specified in Table 407.062 and tested in accordance with RC 370.05 and AS 1289.3.3.1.

**Table 407.062: Fine Crushed Aggregate Components**

Test Value	
Degradation Factor (min)	Plasticity Index (max)
60	3

Sand extracted from natural sand deposits shall consist of clean, hard, durable grains free from lumps, clay, mica and organic or harmful matter.

Where a washed natural sand is used in the registered mix, the Sand Equivalent Value of any such sand supplied for asphalt production shall not be less than 45.

Where unwashed natural sand is used in the registered mix, the Plasticity Index of any sand supplied for asphalt production shall not be more than 3.

(e) Glass Fines

Glass fines are permitted as a replacement for natural sand but shall be limited to intermediate and base course layers.

Glass fines shall:

- (i) consist of a uniformly graded product, manufactured by crushing recycled glass
- (ii) contain no more than 2% by mass of contaminants such as paper, corks, metals, and other harmful materials; glass shall be primarily container glass and shall not include glass from ceramics, cathode ray tubes, fluorescent light fittings and laboratory glassware.
- (iii) comply with the grading limits specified in Table 407.063 when tested in accordance with AS 1141.11.1
- (iv) be cubical in shape, not sharp edged or elongated.

**Table 407.063: Glass Fines**

Sieve Size AS (mm)	Percentage Passing (by mass)
6.70	100
4.75	97 – 100

**407.07 FILLER**

(a) Dry Compacted Voids

The dry compacted voids for the total combined filler (all filler in the mix including added filler) passing 0.075 mm sieve shall not be less than 38% when tested in accordance with AS 1141.17.

(b) Added Filler

Added filler shall comply with the requirements of Tables 407.071 and 407.072.

If any of the following added fillers are used, they shall comply with the corresponding requirements below:

- (i) hydrated lime complying with AS 1672.1
- (ii) cement kiln dust complying with the requirements of Tables 407.071 and 407.072

- (iii) ground limestone complying with the requirements of Tables 407.071 and 407.072
- (iv) ground granulated blast furnace slag (GGBFS) complying with AS 3582.2 and the requirements of Table 407.072
- (v) portland cement complying with AS 3972 and the requirements of Table 407.072
- (vi) fly ash produced from the combustion of black coal complying with Grade 1 limits in AS/NZS 3582.1.

**Table 407.071: Grading Limits for Cement Kiln Dust and Ground Limestone**

Sieve Size (mm)	Percentage Passing by Mass
0.600	100
0.300	95 – 100
0.075	75 – 100

**Table 407.072: Additional Test Requirements for Added Filler**

Added Filler Type	Test	Test Limit (%)
Cement Kiln Dust Ground Limestone GGBFS Portland Cement	Moisture Content <sup>1</sup>	3 (Max)
Cement Kiln Dust	Water Soluble Fraction <sup>2</sup>	20

**Notes on Table 407.072**

- 1. Tested in accordance with AS 4489.8.1
- 2. Tested in accordance with AS 1141.8

**407.08 BITUMINOUS MATERIALS**

(a) General

The Contractor shall comply with the following requirements for supply and handling of bituminous binders:

- (i) material shall be handled in accordance with the manufacturer’s requirements
- (ii) a product quality certificate and test report from the manufacturer shall be obtained for each delivery of material
- (iii) material shall be transported and stored in such a manner to avoid contamination and in accordance with the manufacturer’s recommendations
- (iv) on request a binder sample shall be supplied to the Superintendent Council, from the point of binder manufacture/supply, in accordance with the supplier’s sampling procedures and the labelling requirements of AS 2008 Bitumen for pavements
- (v) for asphalt types with no RAP or those containing RAP in accordance with RAP Level 1 as specified in Table 407.121, the class of binder shall comply with Table 407.081.

**Table 407.081: Class of Binder**

Asphalt Type	Binder Class
L	C170
N	C170 <sup>1</sup> , C320 <sup>2</sup>
H, V, SI and SF	C320
HP, VP and SP	A10E <sup>3</sup>
SS	C600

**Note on Table 407.081**

- 1. For mixes containing C170, up to 20% RAP may be used
- 2. For mixes containing C320, up to 10% RAP may be used
- 3. A10E shall be used unless otherwise specified in Clause 407.30(e).



(b) Bitumen

All bitumen shall comply with AS 2008.

The viscosity of bitumen recovered from a sample of mixed asphalt prior to placement or from the pavement after compaction shall comply with the requirements specified in Table 407.082 and tested at the frequency specified in Table 407.151. Testing shall be in accordance with RC 212.01.

**Table 407.082: Viscosity Range of Bitumen Recovered from Mixed Asphalt**

Class of Bitumen	Viscosity Range at 25°C (kPa.s)		
	Wearing Course	Intermediate Course	Base Course
170	200 - 600	-	-
320	500 - 1600	500 - 2300	500 – 3000
600	-	800 - 5500	800 – 5500

(c) Polymer Modified Binder (PMB)

All PMBs shall comply with the requirements specified in ATS 3110. Where alternative binders have been permitted through the asphalt mix design approval, the binders shall conform to the requirements set out in that asphalt mix approval.

PMBs stored longer than the manufacturer’s recommended holding times shall not be used as a modified binder.

(d) Tack Coat

Tack coat shall consist of a bituminous based binder.

Bitumen emulsion used for tack coating shall be a cationic rapid setting type complying with AS 1160. Emulsion diluted with water shall have a bitumen content of not less than 30%.

Proprietary grades of bituminous tack may also be used where it can be demonstrated they will provide an equivalent or better bond between pavement layers compared to an emulsion tack and can be applied in a uniform distribution at the residual rates specified in Clause 407.19.

Bituminous tack shall contain no more than two parts of cutter or other hydrocarbon solvent.

From 1 July 2022 only trackless tack coat will be permitted.

**HP The Contractor shall submit the details of the trackless tack coat proposed to be used in the works**

**407.09 MIX DESIGN**

All asphalt mixes proposed for use in the works shall be registered in accordance with RC 500.01.

All mix designs registered with Department of Transport are issued a status according to compliance as:

- General** Complies with the requirements of RC 500.01.
- Conditional** Mixes which do not comply in some respects with the requirements of RC 500.01, but which are considered appropriate for use subject to conditions attached to the registration.
- Expired** Previously registered mixes which have exceed the registration period. Details are retained in Department of Transport mix registration system for record purposes.
- Withdrawn** Mixes which are no longer available for use. Details are retained in the Department of Transport mix registration system for record purposes.

**HP All asphalt mixes proposed for use in the works shall have a mix design registered by Department of Transport as ‘General’, unless otherwise approved by the Department of Transport. The registration for all mixes incorporated into the works shall be current at the time of their use. The Contractor shall submit documentation to the Superintendent Council nominating the asphalt mixes to be supplied no less than 7 days prior to their use.**

Approval of a registered mix for use under the Contract does not guarantee the handling properties or performance of the mix nor relieve the Contractor from contractual obligations in regard to rectification of defects.

If a registered mix has unsatisfactory handling or field performance, the Contractor or Superintendent Council may not accept the use of this material. request the mix be de-registered and listed as Withdrawn in accordance with RC 500.04.

#### 407.10 TOLERANCES ON MIX PRODUCTION

The tolerance on the binder content in the mix shall be  $\pm 0.3\%$  of the total mix by mass when tested in accordance with AS/NZS 2891.3.3 or AGPT/T234.

The production tolerances on the registered mix design target grading before compaction shall be as specified in Table 407.101.

**Table 407.101: Production Tolerances for Mix Grading**

Sieve Size AS (mm)	Tolerance on Percentage Passing (by mass)			
	Size 7	Size 10	Size 14	Size 20
37.5	Nil	Nil	Nil	Nil
26.5	Nil	Nil	Nil	Nil
19.0	Nil	Nil	Nil	$\pm 6$
13.2	Nil	Nil	$\pm 6$	$\pm 6$
9.5	Nil	$\pm 6$	$\pm 6$	$\pm 6$
6.70 - 4.75	$\pm 6$	$\pm 6$	$\pm 6$	$\pm 6$
2.36 - 0.600	$\pm 5$	$\pm 5$	$\pm 5$	$\pm 5$
0.300 - 0.150	$\pm 3$	$\pm 3$	$\pm 3$	$\pm 3$
0.075	$\pm 1.0$	$\pm 1.0$	$\pm 1.0$	$\pm 1.0$

#### Notes on Table 407.101

1. Gradings to be undertaken in accordance with AS 2891.3.3 or AGPT/T234.
2. Tolerances apply to all mix types unless otherwise specified in the relevant standard section.
3. If post compaction grading is checked by binder extraction and sieve analysis after placement, the positive tolerances shall be increased by one percentage point.

#### 407.11 PRODUCTION OF ASPHALT

##### (a) Temperatures

The temperature of binder and aggregates at the asphalt plant and the temperature of the asphalt as it is discharged from the asphalt plant shall not exceed the limits specified in Table 407.111. Asphalt manufactured at temperatures in excess of the limits specified in Table 407.111 shall not be used.

**Table 407.111: Maximum Material Storage, Mixing and Asphalt Discharge Temperatures**

Material	Temperature °C (max)
Binder plant storage	185 <sup>1</sup>
Aggregates before binder is added	200
Asphalt at discharge from asphalt plant	175

**Note on Table 407.111**

1. This limit may vary in accordance with the binder supplier's recommendations.

(b) Mixing

The mixing period shall be such that at least 95% of the coarse aggregate particles are fully coated with binder. Where requested by the Superintendent Council, testing for particle coating shall be undertaken in accordance with AS/NZS 2891.11.

After completion of mixing, the moisture content of the mix shall not exceed 0.5% when tested in accordance with RC 211.01.

(c) Hot Storage of Mixed Asphalt

Asphalt types with PMB, C600 and EME binders shall not be stored in hot bins for more than 8 hours prior to use. All other asphalt types shall not be stored in hot bins for more than 18 hours prior to use, unless otherwise approved by the Department of Transport.

(d) Warm Mix Asphalt (WMA)

All mixes shall comply with the requirements of Clause 407.09. The mix identification number for WMA shall include the suffix 'W'.

Production, storage, discharge and compaction temperature ranges for warm mix asphalt shall be included in the Contractor's asphalt quality plan.

(e) Assigned Maximum Density

The Assigned Maximum Density of an asphalt mix for a lot shall be the mean maximum density of the days production from the plant that supplied the asphalt mix to that lot. Maximum density shall be measured in accordance with AS/NZS 2891.7.1

Should a single maximum density result for the production mix vary by more than  $\pm 35 \text{ kg/m}^3$  of its 6-point rolling average then a check design on the mix volumetrics shall be completed.

Where the check design indicates a significant change to volumetric properties, a re-design shall be undertaken.

**407.12 ASPHALT INCORPORATING RAP**

(a) General Requirements

No RAP shall be added to mixes containing Polymer Modified or EME2 binders.

RAP may be added to other asphalt types subject to the following:

- (i) the requirements of Clause 407.13 are met
- (ii) the RAP content by mass does not exceed the limits shown in Table 407.121 at the designated RAP level
- (iii) for mixes registered at RAP Level 2, RAP binder characterisation and binder blend viscosity adjustments are undertaken in accordance with Clause 407.13(e).

**Table 407.121: Permitted RAP Content**

Asphalt Type	Permitted RAP Content (% by mass)	
	RAP Level 1	RAP Level 2
L	Up to 25	-
N	Up to 10 <sup>1</sup> Up to 20 <sup>2</sup>	-
H	Up to 15	16 to 20
SI, SS	Up to 15	16 to 30
V	Up to 10	11 to 15
SF	Up to 15	16 to 40

**Notes on Table 407.121**

1. For Type N mixes using C320 binder
2. For Type N mixes using C170 binder

**407.13 RAP MANAGEMENT**

The Contractor shall have a detailed Department of Transport approved RAP management plan and inspection and test plan which at a minimum addresses the following areas:

(a) RAP Stockpile Management

- (i) RAP sourcing and inspection: RAP shall only consist of plant returns and milled or excavated asphalt. RAP shall be free of foreign material such as granular base, concrete, brick, geotextiles, tar or other contaminants.
- (ii) RAP processing: RAP materials used for asphalt production shall be processed by blending, crushing and screening to produce a material that is free flowing and homogenous. Processes to manage RAP which are sourced from plant returns and rejected loads shall be outlined.  
Processed RAP that has segregated or formed lumps shall be re-processed and re-tested for grading.
- (iii) RAP stockpiling: RAP shall be transported and stored to minimise the impact of moisture and prevent compaction, segregation and contamination from other material sources including virgin aggregates, other processed RAP lots and unprocessed RAP.  
RAP shall be stored in a manner that ensures materials removed are representative of the cross section of the processed RAP stockpile.  
Processed RAP shall be stockpiled in lots not exceeding 1000 tonnes. Each lot shall be clearly identified and marked including its testing status.  
Once the processed RAP stockpile has been assessed for compliance there shall be no more processed RAP added to that stockpile.

(b) RAP Sampling and Testing

- (i) Sampling: Stockpiles shall be sampled in accordance with AS 1141.3.1.
- (ii) General Testing: RAP shall be tested for moisture content, grading, and binder content at the frequency specified in Table 407.151.  
The Contractor shall outline the method that will be used to monitor aggregate density.
- (iii) RAP Binder Viscosity Characterisation: For mixes registered at RAP Level 2, characterisation of the viscosity of the RAP lot binder shall be undertaken in accordance with AGPT/T192, at the frequency specified in Table 407.151.
- (iv) The RAP management plan shall include grading, binder content and recovered binder viscosity results for three separate samples from a 1000 tonnes lot produced within 3 months of the submission date of the RAP Management plan.

(c) RAP Process Control

The Contractor shall have documented processes to monitor and manage fluctuations in the aggregate density, moisture content, grading, binder content and binder viscosity of the RAP lot to ensure that the requirements of the specification are met.

- (i) RAP Grading and binder content: A target grading and binder content shall be established for each RAP component. RAP shall be then produced within the tolerances outlined in Table 407.131.
- (ii) RAP Moisture content: The maximum moisture content acceptable for an individual asphalt plant shall be nominated by the Contractor.
- (iii) RAP compliance data: The Contractor shall maintain an ongoing system of process control demonstrated by data that shows the RAP processing facility is able to produce RAP to the requirements of the specification and the Contractor's quality plan. This analysis shall be based on 25 continuous data points for asphalt manufacturers seeking registration of mixes at RAP Level 1 and 50 continuous data points for asphalt manufacturers seeking registration of mixes at RAP Level 2.
- (iv) Allowable deviation from tolerances: the number of test results which constitute a non-conformance for binder content and on each individual sieve for grading that are outside of the permitted tolerances are outlined in Table 407.131.

**Table 407.131: RAP Grading and Binder Tolerances**

Description	Tolerance	Allowable number of results outside of tolerance
Passing 26.5 mm sieve and larger	± 10	1 out of 5 consecutive results
Passing 4.75 mm to 19.0 mm sieve	± 8	1 out of 5 consecutive results
Passing 1.18 mm and 2.36 mm	± 6	1 out of 5 consecutive results
Passing 0.300 mm and 0.600 mm	± 5	1 out of 5 consecutive results
Passing 0.150 mm	± 3	1 out of 5 consecutive results
Passing 0.075 mm	± 2	1 out of 10 consecutive results
Binder Content (%)	± 0.5	1 out of 10 consecutive results

(d) RAP Traceability

Each RAP lot shall be traceable through to asphalt production.

(e) RAP Binder Blend Viscosity

For RAP Level 2 mixes the blend of virgin and RAP binder shall be designed to have a viscosity at 60°C that falls within the viscosity range in Table 407.132 for the binder specified in the nominated mix type. The components of the binder blend shall be determined according to AGPT/T193.

To achieve the targeted binder blend viscosity in the asphalt mix, the Contractor may use a virgin binder class one grade lower than that specified in Table 407.081.

The viscosity of the virgin binder class used in the binder blend calculation may be determined using either AGPT/T192 or AS 2341.2.

**Table 407.132: Binder blend Viscosity Range for the Specified Binder Class**

Specified Binder Class	Binder Blend Viscosity Range (Pa.s @ 60°C)
C170	170 – 240
C320	320 – 500
C600	600 – 880

(f) Asphalt Plant Capability

Evidence shall be provided that the manufacturing process allows for the controlled addition and mixing of RAP into a plant that has been specifically designed to produce the registered mixes, as governed by the plant manufacturer’s specification.

At the asphalt plant the processed RAP shall be stored in stockpiles or cold aggregate storage bins that are covered with a permanent roof and protected from the direction of prevailing weather by permanent walls.

Heating of materials shall be undertaken in such a way to prevent damage to the RAP and virgin binder, but which will ensure binder in the processed RAP is activated. The difference in temperatures between the binder and the aggregate (including RAP) shall be maintained so that it does not exceed 30°C.

**HP No asphalt containing RAP shall be supplied until the Department of Transport approved RAP Management Plan has been submitted at least 14 days prior to the asphalt works commencing and approval to proceed is given by the Superintendent Council.**

**407.14 RED ASPHALT**

Where the works include the provision of red asphalt at the sites as listed in Clause 407.30(j) red asphalt shall conform to the following:

(a) Mix Design and Registration

Mixes shall be designed and registered as per the requirements of Clause 407.09.

(b) Aggregate

Further to Clause 407.06 pink coarse aggregate for the red asphalt shall be obtained from the quarry sources included in Table 407.141.

**Table 407.141: Allowable Sources of Pink Aggregate**

Source Name	Location
Granite Rock Quarry	Bairnsdale, Victoria
Bald Hills Quarry	Holbrook, NSW

Alternative aggregate sources may be considered by the Department of Transport depending on the aggregate meeting the requirements of Section 801, and the ability of the aggregate to provide red coloured asphalt to the satisfaction of the Superintendent.

(c) Binder

The binder for the red asphalt shall be that specified for the mix type as per Clause 407.08.

(d) Red Oxide Pigment

A minimum of 1% by mass of the binder of red oxide shall be used to colour the binder. Other pigments may be considered by the Superintendent.

The Contractor shall provide coloured asphalt samples for approval by the Superintendent and these shall be used as the reference to assess the colour of the completed mat. Asphalt samples shall be treated to remove the binder film from the surface aggregate.

**407.15 FREQUENCY OF INSPECTION AND TESTING**

The frequency of inspection and testing shall not be less than that shown in Table 407.151.

The test frequency for Grading, Degradation Factor, Plasticity Index, Sand Equivalent and Particle Density may be halved where the most recent ten successive test results meet the specified requirements. If any subsequent test result fails, another test shall be immediately undertaken. If the second test fails, the test frequency shall revert to that specified in Table 407.151 and shall not return to half the test frequency until a further ten successive test results comply with the specified requirements.

**Table 407.151 Frequency of Inspection and Testing**

Checks Required	Minimum Frequency
<b>Aggregates and Fillers</b>	
Particle size distribution of each aggregate and sand component	Certification of compliance against asphalt manufacturers nominated particle size distribution is received for each delivery to the asphalt plant.
Particle size distribution glass fines	1000 tonnes
Unsound and marginal rock content	On each day, one per 500 tonnes or part thereof
Degradation Factor of fine aggregate components	2 500 tonnes
Plasticity Index of fine aggregate and natural sand supplied as unwashed sand	2 500 tonnes
Sand Equivalent of natural sand supplied as washed sand	2 500 tonnes
Flakiness Index of coarse aggregate 10 mm and larger	2 500 tonnes
Particle Density of all coarse and fine aggregate components	10 000 tonnes
Added fillers	2 500 tonnes
<b>Binders</b>	
Compliance against AS 2008 for bitumen	Certification of specification compliance for each delivery of bitumen supplied to the asphalt plant.  Testing of viscosity at 60°C, at weekly intervals where bitumen has been stored above 150 °C for more than 28 days without the storage tank being topped up by more than 50% of its capacity.  In cases where two or more bitumen classes are blended together at the asphalt plant, a viscosity test at 60°C shall be undertaken prior to use.
Compliance against ATS 3110 for PMBs	Certification of specification compliance for each delivery of PMB supplied to the asphalt plant.
<b>RAP</b>	
RAP Levels 1 and 2: Grading, Binder Content, & Moisture content	One set of tests on a representative sample of RAP for each 500 tonnes of RAP.
RAP Level 2 mixes: RAP binder viscosity characterisation	One test on representative sample of RAP for each 1000 tonnes lot of RAP.
<b>Asphalt</b>	
Scrutiny for segregation, uncoated particles, separated binder, excess binder or overheating before dispatch from the plant	Each loaded truck.
Degree of particle coating	As directed by <del>the Superintendent</del> Council
Temperature of asphalt before dispatch from the plant	Each loaded truck or at intervals of 15 minutes if more than one truck is dispatched in 15 minutes.
Binder Content and Full Sieve Analysis of Asphalt (full extraction test)	On each production day: One test per 250 tonnes or part thereof of the asphalt plant production on a representative sample taken from a delivery truck.
Maximum Density	On each production day
Viscosity of Recovered Bitumen at 25 °C	<del>As directed by the Superintendent</del> – the The average of three tests where any asphalt mix containing unmodified bitumen is reasonably suspected of being over-heated or over-mixed.

The Contractor shall make available all completed work sheets, checklists and test reports for inspection at the asphalt plant.

**407.16 RATE OF DELIVERY**

Asphalt shall be placed at a rate that matches the plant and asphalt delivery capacity and ensures continual paving.

**407.17 AMBIENT CONDITIONS FOR PLACING**

(a) General Requirements

The surface on which asphalt is to be placed shall be essentially dry and free from surface water. Asphalt shall not be placed when the pavement surface is wet, or rain is imminent.

Asphalt shall not be placed when the majority of the area to be paved has a surface temperature less than that detailed in Table 407.171.

**Table 407.171: Minimum Pavement Temperatures Prior to Laying Asphalt**

Asphalt Type	Intermediate or Base Courses	Wearing Course
C170, C320	5°C	10°C
C600, PMBs	10°C	15°C

(b) Cold Weather Placement

Where approved by the ~~Superintendent~~ Council placement of dense graded asphalt in layers 35 mm or greater may take place at pavement temperatures up to 5°C below the minimum temperatures specified in Table 407.171 provided that the:

- (i) The asphalt manufacturer agrees that the requirements of the specification can be met.
- (ii) Asphalt is produced using a warm mix technology based on a wax or chemical surfactant as a compaction aid. Evidence shall be supplied of the ability of the process to facilitate compaction at lower temperatures.
- (iii) Prevailing wind speeds are less than 30 km/h.
- (iv) Asphalt is transported using insulated/heated or double skinned delivery trucks with tight fitting covers.
- (v) Minimum temperature of asphalt at the time of discharge into the paver is 145°C for asphalt containing PMBs and 135°C for other mixes.
- (vi) Minimum temperature of the asphalt mat at completion of initial breakdown rolling is 110°C for PMBs and 95°C for other binders.
- (vii) Additional density testing is undertaken for lots greater than 2,000 m<sup>2</sup>. The lot shall be split into two equal sub-lots, representing the first 50% of the lot laid and the last 50% of the lot laid. Compaction testing as per Clause 407.27 shall be undertaken on each sub-lot.
- (viii) A job specific inspection and Test Plan ITP is developed which addresses the modified procedures to be used.
- (ix) Contractor personnel are present full time on site to specifically monitor and manage the cold weather paving process.

~~The Superintendent~~ Council may require a placement trial as detailed in Clause 407.22 to demonstrate that the Contractor’s cold weather placement procedures will meet the requirements of this specification.



## (c) Cold Weather Placement Management Plan

The cold weather placement management plan shall include as a minimum:

- (i) Monitoring frequency of pavement temperature, asphalt temperature at discharge into paver and mat temperature after initial rolling.
- (ii) Measures to mitigate risk during the construction process including but not limited to:
  - a. Asphalt delivery – planning to avoid delays and use of the quickest route to the site, enough trucks to allow continuous paving and avoiding trucks waiting for lengthy periods.
  - b. Paving – determination of paving width and speed to match roller capacity, measurement of mix temperature prior to discharge, use of material transfer vehicles where practical and a process to cease works where pavement temperatures fall below the minimum requirement.
  - c. Compaction - modified rolling procedures, additional rollers for surfacing mixes, use of joint compaction devices, monitoring of compaction and mat temperature during laying.
- (iii) Quality Records
  - a. Monitoring of the above measures including method of measurement and frequency of testing.

HP

**Prior to commencing cold weather placement of asphalt, the Contractor shall submit a job specific cold weather placement management plan to the Superintendent Council for review.**

~~The Superintendent Council may prohibit cold weather placement at any stage during the works where the Superintendent Council has deemed that the Contractor has not adopted satisfactory measures or demonstrated satisfactory implementation of the cold weather placement plan.~~

#### 407.18 SURFACE PREPARATION AND RAISING OR LOWERING OF MANHOLE AND VALVE COVERS

Prior to tack coating and placing of asphalt, the Contractor shall remove all loose and deleterious material and sweep clean the area upon which asphalt is to be placed.

Where specified in Clause 407.30(d), all manhole and valve covers shall be raised or lowered to the new surface level. Where directed by ~~the Superintendent Council~~ temporary ramping around each cover shall be provided and removed in accordance with the requirements of Clause 407.21(f).

#### 407.19 APPLICATION OF TACK COAT

A tack coat shall be applied to all asphalt, concrete or sprayed seals on which asphalt is to be placed.

The tack coat shall achieve an effective bond between the asphalt and the underlying layer.

The application rate for the tack coat shall be 0.15 to 0.30 L/m<sup>2</sup> of residual bitumen (except for joints and chases where rates shall be doubled).

The tack coat shall be:

- applied only to a clean, essentially dry surface, free from surface water
- applied uniformly over the entire road surface
- intact at the time of placing the asphalt.

Photographic evidence that includes an identifiable landmark relevant to the lot, shall be supplied to show that tack has been applied uniformly over the lot.

Before asphalt is placed, sufficient time shall be allowed for emulsion based tack coats to break.

Any tack coat not covered by asphalt shall be covered with clean grit or sand before the road is opened to traffic.

Where asphalt is to be spread over a clean, un-trafficked, freshly laid asphalt, over a clean primed surface, or on a granular material where the overall asphalt depth is 150mm or greater the Contractor may omit the tack coat.

**407.20 DELIVERY OF ASPHALT**

## (a) General

Delivery of asphalt shall only be made during the hours listed for possession of site.

Asphalt delivered to the site, which is segregated, has been overheated, is too cold, contains separated binder, uncoated particles or which does not comply with the Specification shall be removed from the site.

## (b) Delivery Dockets

Delivery docket shall show:

- (i) name of supplier and location of plant
- (ii) docket number
- (iii) name of user
- (iv) project name and location ~~(or contract number)~~
- (v) registered number or fleet number of the vehicle
- (vi) date and time of loading
- (vii) mix or product identifier traceable to the mix registration number
- (viii) size and type of asphalt
- (ix) empty and loaded mass of the vehicle, or the total of the electronically measured batch weights printed on the docket
- (x) class of binder, and proprietary name of modified binder
- (xi) temperature of load at the asphalt plant when dispatched.

~~Where asphalt is scheduled for measurement by mass, a copy of the delivery docket for each load shall be provided at the point of delivery or delivered to the Superintendent at the end of each shift.~~

~~Where asphalt is measured by other means and for Lump Sum Contracts, the Contractor shall make delivery docket available for inspection on request by the Superintendent Council.~~

**407.21 JOINTS AND JUNCTIONS**

## (a) General

The location of all joints shall be planned before work commences to achieve the specified offsets between layers and the final position of joints in the wearing course.

The number of joints shall be minimised by adopting good asphalt paving practices. If requested by ~~the Superintendent Council~~, the Contractor shall produce drawings showing the location of longitudinal joints of asphalt layers in respect to the traffic lane lines.

All joints shall be well bonded and sealed and the surface across the joint shall meet the requirements of Clause 407.29

All cold joints and abutting concrete edges shall be tack coated as per Clause 407.19.

Where cold joints are constructed, any loose or poorly compacted existing asphalt on the exposed edge shall be trimmed back to produce a face of fully compacted asphalt along the exposed edge before fresh asphalt is placed.

## (b) Transverse Joints

All transverse joints shall be offset from layer to layer by not less than 2 m.

(c) Longitudinal Joints

- (i) Longitudinal joints in the wearing course shall coincide with the location of intended traffic lane lines.
- (ii) Longitudinal joints in intermediate and base courses shall be offset from layer to layer by not less than 150 mm and shall be within 300 mm of the traffic lane line or the centre of traffic lane. Where new pavement abuts an existing full depth asphalt pavement, the existing pavement shall be removed in steps to achieve an offset from layer to layer of not less than 150 mm.

At the wearing surface where the new and existing pavement join, a hot applied bituminous crack sealant shall be applied.

- (iii) Longitudinal joints shall be parallel to the traffic lanes.

Subject to approval by the ~~Superintendent~~ Council, a longitudinal joint in the wearing course may be located up to 150 mm from the traffic lane line, or 150 mm from the centre of a traffic lane.

(d) Joints Against a Granular Pavement

Asphalt joints against a granular pavement shall not be offset between layers but shall form a vertical flush joint.

A tack coat as per Clause 407.19 shall be applied to the vertical surface of the existing pavement.

At the wearing surface where the new and existing pavement join, a hot applied bituminous crack sealant shall be applied.

(e) Junctions at Limits of Work

At junctions where the new asphalt mat is required to match the level of existing pavement surface at the limits of work, chases shall be cut into the existing pavement by cold planing as specified in Section 402.

The chase shall be cut by removal of a wedge of asphalt tapering from zero to a depth of 2.5 times the nominal size of the asphalt from the existing pavement to the minimum length as follows:

- (i) at side streets and median openings – 600 mm
- (ii) on through carriageways with a speed limit of 80 km/h or less – 3 m
- (iii) on through carriageways with a speed limit of more than 80 km/h – 6 m.

(f) Treatment of Exposed Edges under Traffic

On completion of each day's work and prior to opening to traffic, the following treatment of exposed edges shall be adopted for asphalt work.

- (i) Longitudinal Edges

All longitudinal joints within the trafficked area shall be matched up between paver runs except for a short section required to achieve the minimum offset between transverse joints, unless otherwise approved by the ~~Superintendent~~ Council. Any exposed longitudinal edges within the trafficked area shall be ramped down at a slope of not steeper than 5 horizontal to 1 vertical by constructing a temporary wedge of dense graded or cold mixed asphalt. In unusual situations such as the sudden onset of inclement weather, a longer length of longitudinal joint may be exposed provided it is ramped down as specified and appropriately signed.

(ii) Transverse Edges

At the end of the paving run in the transverse direction, the new asphalt mat shall be squared up to a straight line and ramped down by constructing a temporary wedge of dense graded or cold mixed asphalt. Temporary ramping shall not be steeper than shown in Table 407.211.

**Table 407.211: Maximum Grade of Temporary Ramping**

Posted Speed Limit (km/h)	Maximum Ramp Grade (Horizontal to Vertical)
40	20 to 1
60	30 to 1
80	40 to 1
> 80	50 to 1

(iii) Removal of Temporary Ramping

Before commencement of each day's work, all temporary ramping shall be removed by cutting back along a straight line to expose a vertical face of fully compacted asphalt at the specified layer depth.

**407.22 PLACEMENT TRIAL**

Where specified in Clause 407.30(h), the mix, plant, procedures and personnel proposed for the placement of asphalt shall be subjected to a placement trial conforming with the following:

- (a) each mix nominated shall be subjected to a separate placement trial
- (b) each placement trial may be located within the Works
- (c) the size of each placement trial shall be limited to one lot.

The Contractor shall design the trial to implement all the procedures described in the Contractor's quality plan and demonstrate conformance with the Specification.

The Contractor shall submit a copy of the completed inspection and test plan and all relevant test results and records from the placement trial. Prior to further placement ~~the Superintendent~~ Council shall review the outcomes of the placement trial for approval.

In the event of a nonconformance in the placement trial, or when ~~the Superintendent~~ Council determines that a previous trial is not representative of the materials, asphalt mix proportions, asphalt temperature, ambient condition, plant and method of placement, a new trial shall be undertaken prior to placement resuming.

**407.23 COMMENCEMENT OF PLACEMENT**

**HP** The placement of asphalt on the sub-base or granular base for a new pavement or for an overlay of an existing bituminous surfaced pavement shall not commence until approval to proceed is obtained from ~~the Superintendent~~ Council.

**407.24 REGULATING COURSE**

A regulating course of asphalt of the type and size specified shall be placed for correction of longitudinal and transverse pavement shape so that the resulting surface is parallel with the finished surface.

#### 407.25 PAVING OF ASPHALT

(a) General

Asphalt shall be spread in layers at the compacted thicknesses shown on the drawings or specified.

(b) Level Control

Asphalt paver screed levels shall be controlled by a suitable combination of manual and automatic controls operating from fixed or moving references.

(c) Spreading by Paver

All asphalt shall be spread with a purpose designed asphalt paving machine to form a uniformly smooth asphalt mat complying with the requirements of Clause 407.29 without segregation, tearing or gouging. In areas that are not accessible by a paver placement of asphalt by other means is permitted.

The width of a single paving run shall not exceed 6 metres unless paving in echelon is proposed or procedures are in place to ensure that a uniform asphalt layer free of segregation can be achieved.

The Contractor shall conduct spreading operations to ensure that the paver speed matches the rate of supply so that stoppages are minimised.

If the paver is required to stop and asphalt in front of the screed cools to below 120°C, a transverse joint shall be constructed.

For asphalt work carried out on a road to be opened for traffic at the completion of work each day, each layer of asphalt shall cover the full width of the trafficked area. The requirements of Clause 407.21(f) shall be followed in respect of the treatment required for exposed edges.

(d) Spreading by Hand

Hand spreading shall only be used for small areas where it is not practical to use a paver.

(e) ~~Echelon Paving~~

~~Where specified in Clause 407.30(g) two or more pavers in echelon shall be used in locations where a full carriageway wider than 6 m is available clear of traffic.~~

~~When paving in echelon the longitudinal joints shall be constructed as hot joints.~~

#### 407.26 COMPACTION

Asphalt shall be uniformly compacted to the standards specified in Clause 407.27. Compaction shall not commence until the asphalt has cooled sufficiently to support the rollers without undue displacement.

Vibratory rolling shall not be used to compact asphalt on bridge decks.

#### 407.27 REQUIREMENTS FOR TESTING AND ACCEPTANCE OF COMPACTION

(a) General

Work shall be tested and accepted for compaction on either a test lot basis as provided in Clause 407.27(b) or on an approved procedural basis as provided in Clause 407.27(c).

Where the total quantity of the particular size and/or type of asphalt supplied under the contract exceeds 300 tonnes, compaction shall be tested and accepted on a test lot basis.

Acceptance of compaction for all other asphalt work may be on a procedural basis.

(b) Testing and Acceptance of Compaction on a Lot Basis

(i) Test requirements

The density of extracted cores for the purposes of determining the bulk density for acceptance purposes or to check or assign offsets to a nuclear gauge shall be undertaken in accordance with RC 500.05 and RC 500.16.

A lot presented for testing shall consist of an asphalt layer which is placed in one shift under uniform conditions and is essentially homogeneous in respect to placement methods, materials and appearance.

Sites for density testing for acceptance of the lot (excluding longitudinal edge strips) shall be selected on a random basis as per RC 500.16 provided that no site shall be selected within 200 mm of a joint constructed against a cold edge.

For lots exceeding 500 m<sup>2</sup> density testing of the longitudinal edge strips for wearing courses shall be undertaken and results reported and submitted separately. Sites for this testing shall be selected as follows:

- The length of all the longitudinal edge strips within a lot shall be added and treated as a continuous length. Six test sites shall be selected so that they are evenly spaced along this length.
- Sites shall not be located within 2 m of a transverse joint.
- Where density is measured using a nuclear gauge, testing shall be undertaken so that the gauge is parallel to the direction of paving and the centre of the nuclear gauge shall be located within  $\pm 50$  mm of the centre of the longitudinal edge strip at the selected test location.

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 nominated layer thickness.

The assigned maximum density of the asphalt shall be determined in accordance with Clause 407.11(e).

(ii) Lot size

For lots with an area less than 50 m<sup>2</sup> acceptance of compaction shall be based on procedures outlined in the contractor's asphalt quality plan.

Lots between 50 and 500 m<sup>2</sup>, the test procedure specified for small areas in Section 173.04 shall apply.

For lots greater than 500 m<sup>2</sup> compaction shall be assessed using the characteristic value of density ratio. Asphalt Density Ratio is defined as the percentage ratio of the characteristic field bulk density to the assigned bulk density of the approved laboratory mix design.

(iii) Characteristic Density Ratio Calculation

The characteristic field bulk density ratio is the calculated value of  $\bar{x} - 0.92S$  for six tests per lot where  $\bar{x}$  and S are respectively the mean and standard deviation of the individual density ratio test values for the lot.

(iv) Compaction requirements

The work (excluding longitudinal edge strips) represented by a lot of six tests shall be assessed as shown in Table 407.271.

**Table 407.271: Limits for Characteristic Density Ratio (Six Tests)**

For layers less than 50 mm thick		For layers 50 mm thick or greater	
Characteristic Value of the Density Ratio (Rc)	Assessment	Characteristic Value of the Density Ratio (Rc)	Assessment
95.0% or more	Accept lot subject to no other nonconformances raised for the lot.	96.0% or more	Accept lot subject to no other nonconformances raised for the lot.
94.9% to 93.0%	Lot may be accepted at a reduced rate calculated by $P = 15 R_c - 1325$	95.9% to 94.0%	Lot may be accepted at a reduced rate calculated by $P = 15 R_c - 1340$
92.9% or less	Remove and replace asphalt	93.9% or less	Remove and replace asphalt

Notes: (Rc) is the Characteristic Value of the density ratio for the lot and (P) is the percentage of the relevant scheduled rate to be paid which shall not be greater than 100%.

Where the Contract is a lump sum Contract the relevant scheduled rate will be that shown in the 'Rates for Variation Purposes' schedule accompanying the lump sum tender. If no such rate is provided a variation will be considered in accordance with the General Conditions of Contract.

The Characteristic Value of the Density Ratio determined for the longitudinal edge strips within the lot shall be submitted for report only.

Where one or more individual core thicknesses are less than the relevant values shown in Table 407.272, they shall be discarded, and the acceptance assessment modified in accordance with Table 407.273 provided that there remain at least four test values.

**Table 407.272: Minimum Thickness of Cores Extracted from the Pavement**

Size of Asphalt	Individual Core Thickness (mm) min
7	20
10	25
14	35
20	50

**Table 407.273: Mean Density Ratio (less than six cores)**

For layers less than 50 mm thickness		For layers 50 mm thickness or greater	
Mean Value of the Density Ratio (Rm)	Assessment	Mean Value of the Density Ratio (Rm)	Assessment
96.5% or more	Accept lot subject to no other nonconformances raised for the lot.	97.0% or more	Accept lot subject to no other nonconformances raised for the lot.
94.5% to 96.4%	Lot may be accepted at a reduced rate calculated by $P = 15 R_m - 1348$	95.0% to 96.9%	Lot may be accepted at a reduced rate calculated by $P = 15 R_m - 1355$
94.4% or less	Remove and replace	94.9% or less	Remove and replace

(Rm) is the mean of the individual density ratios for the lot and (P) is the percentage of the relevant scheduled rate to be paid which shall not be greater than 100%.

(v) In situ Air Voids and Characteristic In situ Air Voids

In situ Air Voids and Characteristic In situ Air Voids shall be reported for each lot.

Percentage In situ Air Voids is defined as the ratio of In-situ Air Voids to the Maximum Density of asphalt. Percentage In situ Air Voids represents the Air Voids of the compacted asphalt as placed onsite, and shall be determined as follows:

$$\text{In situ Air Voids} = \frac{\text{Assigned Maximum density} - \text{field bulk density}}{\text{Assigned Maximum density}} \times 100$$

The Characteristic Value of In situ Air Voids is the calculated value of  $\bar{x} + 0.92S$  for six tests per lot where  $\bar{x}$  and S are the mean and standard deviation of the individual In situ Air Void test values for the lot, respectively.

(c) Acceptance of Compaction on a Procedural Basis

Where a procedural basis is to be used, the Contractor is required to develop a compaction procedure that has been validated against density testing for the mix placed. Acceptance of work for compaction shall be based on the adoption of these approved placing procedures and a density test check plan that provides for a minimum test frequency of 5% of relevant lots to be tested. The test check plan shall provide for additional testing to demonstrate correction of non-conformance. Placing procedures shall be in accordance with AS 2150.

**407.28 TRAFFICKING OF ASPHALT AND PAVING OF MULTIPLE LAYERS**

Trafficking of asphalt or placement of asphalt over freshly laid asphalt layer is not permitted unless the majority of the asphalt has a surface temperature lower than that specified in Table 407.281.

**Table 407.281: Maximum surface temperature of mixes before trafficking or placement**

Mix Type	Maximum Surface Temperature (°C)
SF	50

Where trafficking results in deformation of the asphalt, further trafficking shall cease until such time that the asphalt has adequately cooled to allow trafficking without further damage.

**407.29 SURFACE FINISH AND CONFORMITY WITH DRAWINGS**

(a) General

For all asphalt works the following requirements shall apply for conformance with shape, location, alignment and width.

(i) Surface Finish

The finished surface of any asphalt course shall be of uniform appearance, free of dragged areas, cracks, open textured patches and roller marks.

(ii) Kerb and Channel

Where asphalt is placed against kerb and channel the surface at the edge of the wearing course shall be either flush with or not more than 5 mm above the lip of the channel.



(iii) Shape

No point on the finished surface of the wearing course shall lie more than 4 mm below a 3 m straight edge laid either parallel to the centreline of the pavement or, except on crowned sections, at right angles to the centreline. For intermediate and base course layers, the distance below the straight edge shall not exceed 6 mm and 10 mm respectively.

(iv) Alignment

Where asphalt pavement is not placed against a concrete edging, the edge of asphalt layers shall not be more than 50 mm inside nor more than 100 mm outside, the designed offset from centreline or design line. Within these tolerances, the rate of change of offset of the edge of layer shall not be greater than 25 mm in 10 m.

(v) Width

Where asphalt pavement is not placed against a concrete edging, the width of asphalt layers shall not be less than the design or specified width of layer by more than 50 mm or greater than the design or specified width by more than 100 mm. The average width over any 300 m shall not be less than the design or specified width.

(b) Conformity with Drawings for New Pavements and Major Pavement Rehabilitation Projects

For pavement works where design drawings show the finished surface level and thickness of each pavement course, the surface level of each asphalt course shall be measured in accordance with the requirements of Section 173. Every test lot shall meet either a Scale A, B or C requirement as specified in Clause 407.30(b).

Unless otherwise specified in Clause 407.30(f), the maximum lot size for measurement and assessment of surface level shall be 4,000 m<sup>2</sup>.

(i) Scale A and B Surface Level Requirements

- a. Each level measurement shall be taken at random locations over the area of the lot in accordance with the relevant Test Method and the number of measurements taken within each lot shall not be less than the number specified in Table 407.292.
- b. The mean surface level and the variation in surface level for the base, intermediate and wearing courses within each lot shall meet the requirements of Table 407.293.

**Table 407.292: Minimum Number of Level Measurements per Lot**

Scale of Surface Level Measurement	Minimum Number of Measurements Per Lot
Scale A	80
Scale B	40

**Table 407.293 Mean Surface Level Tolerances for the Sub-base and Pavement Courses**

Scale of Surface Level Measurement	Granular or Cement Treated Subbase		Asphalt Layers	
	$\bar{x}$ Range (mm)	Max. S (mm)	$\bar{x}$ Range (mm)	Max. S (mm)
Scale A	+4 to -8	8	± 5	8
Scale B	+6 to -12	13	± 8	10

**Notes on Table 407.293**

$\bar{x}$  is the mean value of all level readings taken in the lot (a negative value designates a measured departure below the design level and positive value designates a surface level above the design level)

S is the standard deviation of all level readings taken in the lot.

For Scale A and Scale B level requirements, the Superintendent may agree to accept a lot which does not conform with the limits of Table 407.293 at a reduced payment, in accordance with Table 407.294. The value of the lot of work shall be calculated from the unit rates for pavement construction as specified in Clause 407.30(c).

Where the surface level tolerances exceed the allowable variation in Table 407.294 rectification of the surface levels shall be undertaken

**HP** ~~Rectification of surface levels shall not commence until approval to proceed is obtained from the Superintendent.~~

**Table 407.294: Payment Deduction for Surface Level**

Variation	Payment reduction
<b>Mean (<math>\bar{x}</math>)</b> outside the specified limit up to a maximum of 25% of the limit	8% plus 4% reduction for each 1 mm the mean value extends outside the tabulated limit
<b>Standard Deviation (S)</b> exceeding the specified limit up to a maximum of 35% of the limit	8% plus 4% reduction for each 1 mm the Standard Deviation extends outside the tabulated limit

**Note to Table 407.294**

If both ( $\bar{x}$ ) and (S) vary by more than the specified limit, the payment reduction shall be the sum of the payment reductions for both ( $\bar{x}$ ) and (S).

(ii) Scale C Surface Level and Thickness Requirements

Surface level and thickness measurements shall be taken in accordance with the procedure specified in Section 173.

The level of the top of each asphalt course shall not differ from the specified level by more than 15 mm for intermediate and base courses and 10 mm for wearing course.

Where a uniform thickness of new asphalt pavement construction is specified, the mean thickness of a lot of asphalt shall not be less than the combined thickness of all asphalt courses specified in Clause 407.30 or shown on the drawings. For the purpose of this clause, the maximum lot size shall not be more than 4,000 m<sup>2</sup> of pavement area.

(c) Asphalt Overlays

Where a minimum average or nominal thickness of overlay is specified, and no existing pavement or finished levels are available, the average thickness of the overlay shall be calculated by:

$$T = \frac{M}{D \times A} \times 1000$$

Where:

T is the thickness of overlay in millimetres

A is the area of the job in square metres

D is the mean field density of placed asphalt in tonnes/m<sup>3</sup>

M is the mass of asphalt used in tonnes

The average thickness of the overlay shall not be less than the specified thickness.

407.30 SCHEDULES OF DETAILS

**REFER TO DRAWINGS**

~~\*\*\* (a) Asphalt Requirements (Clause 407.09)~~

Course	Layer	Nominal Size of Asphalt (mm)	Type of Asphalt	Specified Layer Thickness (mm)
Wearing and Regulation	Open Graded (Section 417)	##:	##:	##:
	Wearing	##:	##:	##:
	Regulation	##:	##:	##:
Intermediate	Intermediate 1	##:	##:	##:
	Intermediate 2	##:	##:	##:
	Intermediate 3	##:	##:	##:
Base		##:	##:	##:
Combined Thickness of Asphalt Pavement (less the Open Graded Asphalt Layer)				##:

~~\*\*\* (b) Scale of Level/Thickness Control (Clause 407.29)~~

Road Name	Location	Scale for Level/Thickness Control
##:		

Note to Table: Scale A shall be used unless otherwise approved by the Superintendent.

~~\*\*\* (c) Basis for Determining the Value of the Lot to be used for Price Deduction for Departure from Specified Density Requirements and Surface Level (Clauses 407.27 and 407.29).~~

Location	Layer	Unit Price \$/m <sup>2</sup>
##:	##:	##:

- \*\*\* (d) ~~Schedule of Any Manhole and Valve Covers~~ within the works to be Raised or Lowered to the New Finished Level Prior to Asphalt Overlay

<del>Location or Chainage</del>	<del>Direction or Carriageway</del>	<del>Lane</del>	<b>Cover Type (Manhole or Valve)</b>
<del>###:</del>			

- (e) Polymer Modified Binder if ~~different to~~ shall be Class A10E unless otherwise shown on the drawings (Clauses 407.08) ~~###[strikethrough if 'default' Class A10E is to be used]:~~

\*\*\* ~~The class of PMB required in the ###: course shall be Grade ###:.~~

- (f) ~~Maximum Size of Test Lots if different to 4,000 m<sup>2</sup> (Clause 407.29b(ii)) ###[strikethrough if the maximum lot size is to be 4,000 m<sup>2</sup>]:~~

\*\*\* The maximum size of test lot for assessment of compaction under Clause 407.27 and if applicable, compliance drawings under Clause 407.29 shall be 4,000 m<sup>2</sup>.

- (g) ~~Paving in Echelon (Clause 407.25(e))~~

\*\*\* ~~Two pavers in echelon shall be used on the through carriageways from ###: to ###:~~

- (h) ~~A placement trial is required for mix type ## (strikethrough if a placement trial is not required)~~

- (i) ~~Joint testing required over 10% of lots with a minimum of 1 lot ## (strikethrough if not required).~~

- (j) Locations where red asphalt to be placed **REFER TO DRAWINGS**

<del>Location or Chainage</del>	<del>Direction or Carriageway</del>	<del>Lanes</del>
<del>###:</del>		