COFFS HARBOUR CITY COUNCIL

DEVELOPMENT SPECIFICATION
DESIGN

1144 Asphaltic concrete (Roadways)

Version 1 ***01 January 2009***

1144 ASPHALTIC CONCRETE (ROADWAYS)

1 SCOPE

1.1 SCOPE

This worksection covers hot mixed, dense graded, open graded, stone mastic and fine gap graded asphalt for roads and related applications. The areas covered by this worksection include:

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

This section is to be read in conjunction with the Appendix (Schedule of Job Details). Where there is conflict between the requirements of this section and the Appendix, the requirements of the Appendix shall apply.

Asphalt Supplied that is Compliant to NSW RTA - R116 Asphalt (Dense Graded and Open Graded) will also be accepted.

1.2 REFERENCED DOCUMENTS

Documents referenced in this worksection are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

The following documents referred to in this worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0161 Quality (Construction)

1101 Control of traffic

Standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11	Method 11: Particle size distribution by sieving
AS 1141.14	Method 14: Particle shape, by proportional calliper
AS 1141.18	Method 18: Crushed particles in coarse aggregate derived from gravel
AS 1141.22	Method 22: Wet/dry strength variation
AS 1141.42	Method 42: Pendulum friction test
AS 1160	Bituminous emulsions for the construction and maintenance of pavements
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 1672	Limes and Limestones
AS 1672.1	Lime for Buildings
AS 2008	Residual bitumen for pavements
AS 2150	Hot mix asphalt—Guide to good practice
AS 2758	Aggregates and rock for engineering purposes
AS 2758.5	Asphalt aggregates
AS 2891	Methods of sampling and testing asphalt
AS 2891.1	Method 1: Sampling of asphalt
AS 3972	Portland and Blended Cements
AS 3582	Supplementary Cementitious Materials for use with Portland Cement,
AS 3582.1	Fly Ash
AS 3582.2	Slag – Ground Granulated Iron Blast-Furnace.

AS/NZS/ISO 9001Quality Management Systems – Requirements

Other publications

NSW RTA Test Methods

NSW RTA - R116 Asphalt (Dense Graded and Open Graded)

QA Specification 3253 Bitumen for Pavements

Austroads

AP-T41/06	Specification framework for polymer modified binders and multigrade bitumens
AST04	Asphalt binder content (Ignition oven method)
AST05	Sample preparation–compaction of asphalt slabs suitable for characterisation
AST06	Asphalt binder drain-off
AST07	Asphalt particle loss
AST08	Binder film index

AAPA

Advisory note 7 – Guide to the heating and Storage of Binders for Sprayed Sealing and Hot mixed asphalt.

1.3 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in 0161 *Quality (Construction)*.

1.4 ASPHALT MIX TYPES

Mix Types to NSW RTA - R116 Asphalt (Dense Graded and Open Graded).

Otherwise

For the purposes of this worksection dense graded asphalt mixes have been classified in terms of position in the pavement (wearing course or base course) and traffic category (Light, Medium, Heavy and Very Heavy). Where relevant, the same traffic categories shall apply to other mix types. The particular mixes to be used shall be nominated in the Annexure A.

Dense graded hot mix asphalt is also known as asphaltic concrete and designated by the abbreviation 'AC'.

Other mixes are designated:

- Open Graded Asphalt (OGA)
- Ultra Thin Asphalt (UTA)
- Stone Mastic Asphalt (SMA) and
- Fine Gap Graded Asphalt (FGGA).

1.5 TESTING

All testing of properties required by the worksection shall be undertaken in a laboratory registered by the National Association of Testing Authorities (NATA) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian Standard or Austroads *Manual of Test Procedures.*

Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard or Manual provides a choice of procedures, the method to be adopted shall be that endorsed by the relevant State Road Authority in the State in which the work is being undertaken.

1.6 PLANT

All plant shall be registered and insured as appropriate to its use on a public road and shall comply with statutory environmental regulations.

1.7 PROTECTION OF SERVICES AND ROAD FIXTURES

The Contractor shall take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures.

Immediately after the asphalt has been spread the Contractor shall clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

1.8 CONTROL OF TRAFFIC

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work. Any costs incurred as a result of the supply of labour and materials complying with 1101 *Control of traffic* shall be borne by the Contractor.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users.

1.9 WORK RECORDS

Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Appendix B or as per the Contractor's own procedures where equivalent. The Contractor shall complete the Asphalt Work Record, which shall be countersigned by the Superintendent each day as a true record of the work performed. A copy shall be supplied to the Superintendent.

Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.

1.10 PLANT

Contractor to provide

The Contractor shall provide all the plant and equipment and labour necessary for carrying out the work in accordance with this worksection.

Plant to be suitable

All plant and equipment used on the work shall be in accordance with the Contractor's submitted quality documentation and kept in good operating condition.

The Contractor shall not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant shall be registered and insured as appropriate to its use on a public road and shall comply with statutory environmental regulations.

1.11 PROTECTION OF SERVICES AND ROAD FIXTURES

The Contractor shall take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures.

Immediately after the asphalt has been spread the Contractor shall clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

1.12 CONTROL OF TRAFFIC

Provision for traffic

The Contractor shall provide for traffic in accordance with 1101 *Control of traffic* while undertaking the work. Any costs incurred as a result of the supply of labour and materials complying with 1101 *Control of traffic* shall be borne by the Contractor.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

1.13 WORK RECORDS

Asphalt work record

Particulars of the work performed shall be recorded by the Contractor on the Asphalt Work Record attached as Annexure A or as per the Contractor's own procedures where equivalent.

The Contractor shall complete the Asphalt Work Record, which shall be countersigned by the Superintendent each day as a true record of the work performed. A copy shall be supplied to the Superintendent.

Delivery dockets
Delivery dockets stating the mass of each truck load of asphalt shall be attached to the Asphalt Work Record.

2 MATERIALS

Materials to NSW RTA - R116 Asphalt (Dense Graded and Open Graded)
Otherwise

2.1 AGGREGATE

General
All materials shall be obtained from established sources and have established properties. Each individual component of coarse and fine aggregate shall be obtained from the same sources as materials in design of the Job Mix.

Stockpiles of all aggregates from different sources or of different sizes shall be separated.

Where requested, the source of all materials shall be subject to inspection and approval by the Superintendent and only material from a nominated quarry face or location shall be used.

Coarse aggregate
Coarse aggregate is comprised of particles that are retained on the 4.75 mm sieve. Coarse aggregate shall comply with AS 2758.5 with the application of those test properties specified in Tables 2.1, 2.2 and 2.3 as appropriate except that the Superintendent may approve the use of non complying materials from sources of proven performance.

Tables 2.1 and 2.2 provide alternative combinations of hardness and durability and only one combination shall apply. The particular hardness and durability combination to be used shall be selected by the Contractor unless specified in the Schedule of Job Details.

Fine Aggregate
Fine aggregate shall consist of crushed rock particles finer than the 4.75 mm sieve and manufactured from an approved source complying with the requirements of **Coarse aggregate**, clean natural sand, or both.

The fine aggregate shall be clean, hard, durable and free from lumps of clay and other aggregations of fine materials, organic material and any other deleterious material.

Fine aggregate consisting of crushed rock particles shall have a minimum Degradation Factor, Crusher Fines of 60 when tested in accordance with AS 1141.25.3.

Table 2.1 Coarse Aggregate Requirements for Hardness and Durability Based on Los Angeles Abrasion Loss and Unsound and Marginal Stone Content

Test property	**Test value**			
	Heavy/Very Heavy Traffic Mix Types		**Other Mix types**	
Los Angeles Abrasion Loss (% maximum)	Rock type	LA	Rock type	LA
	All	25	Acid Igneous Granitic rocks Others	 35 30
			Intermediate igneous	30
			Basic igneous	30
			Metamorphic	30
			Sedimentary	25
			Dense metallurgical slags	30
Unsound stone content (%)	3 maximum		5 maximum	
Marginal and unsound stone content (%)	8 maximum		10 maximum	

Table 2.2 Coarse Aggregate Requirements for Hardness and Durability Based on Wet Strength and Wet/Dry Strength Variation

Test property	**Test value**	
	Heavy/Very Heavy Traffic Mix Types	**Other Mix types**
Ten Percent Fines Value (Wet) (kN)	150 minimum	100 minimum
Wet/Dry Strength Variation (%)	35 maximum	35 maximum

Table 2.3 Other Coarse Aggregate Requirements

Test property	**Test value**	
	Heavy/Very Heavy Traffic Mix Types	**Other Mix types**
Flakiness Index (% maximum)	25	35
Weak particles (% maximum)	1	1
Water absorption (% maximum)	2	2.5
Polished Stone Value or Polished Aggregate Friction Value of wearing course asphalt	48 minimum	45 minimum

2.2 MINERAL FILLER

Mineral filler is that portion of mineral matter passing a 75 micron sieve, and includes rock dust derived from coarse and fine aggregates used in the production of asphalt in accordance with this worksection, and any other materials added to supplement the quantity and properties of filler in the mix.

The total filler component in the combined job mix for medium, heavy and very heavy traffic mix types shall have a value of dry compacted voids in accordance with AS 1141.17 not less than 38%.

Filler shall be consistent in mineral composition and dry compacted air voids. It shall be dry, and free from lumps, clay, organic matter or other material deleterious to asphalt.

Added filler (material not derived from the aggregate components) shall comply with the relevant standards listed in Table 2.4. The Superintendent may approve materials other than those listed in Table 2.4 provided that the Contractor supplies evidence of the quality and effect of the proposed materials on the properties of the asphalt mix. Rock dust that is not derived from the other aggregate components in the mixture may also be used as added filler provided that it is derived from materials that meet the requirements of (**Aggregate)**.

Materials for use as added filler shall meet the test requirements specified in Table 2.6.

Table 2.4 Standards for Materials Used as Added Filler.

Material	Standard (See Note 1)
Hydrated lime	AS 1672.1 Limes and Limestones – Lime for Building
Fly Ash	AS 3582.1 Fly Ash Table 1, Fine Grade.
Cement Kiln Dust	See note 2
Slag	AS 3582.2 Slag – Ground Granulated Iron Blast-Furnace
Ground Limestone	See note 3
Cement	AS 3972 Portland and Blended Cements

1. Provision of test certificates for compliance with the relevant Australian Standard and this specification shall be limited to those tests listed in Table 2.6.
2. Cement kiln dust shall be solid material extracted from the flue gases in the manufacture of Portland cement, having a maximum water soluble fraction of 20% by mass and complying with the grading limits specified in Table 2.5
3. Ground limestone shall consist of rock dust derived from the grinding of sound limestone and complying with the grading limits specified in Table 2.5.

Table 2.5 Grading Limits for Ground Limestone and Cement Kiln Dust Materials for Use as Added Filler

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

Table 2.6 Test Requirements for Materials for Use as Added Filler

Filler type	Test type	Test requirements
All	Grading (AS 0.600 mm, 0.300 mm and 0.075 mm sieves)	Report
All	Voids dry compacted filler	Report
All	Moisture content	3% max.
Fly ash	Loss on ignition	4% max.
Cement kiln dust	Water soluble fraction	20% max.

2.3 BINDER

2.3.1 Bitumen

Standard Classes of bitumen shall comply with the requirements of AS 2008.

Class AR450 bitumen shall comply with the requirements of RTA Specification 3253.

Multigrade bitumen shall comply with the Austroads AP-T41 *Specification framework for polymer modified binders and multigrade bitumens.*

Other Binders

Polymer modified binder shall comply with the Austroads AP-T41 *Specification framework for polymer modified binders and multigrade bitumens.*

Additives

The type and proportion of additives to be used in the mix, other than those specified elsewhere in this worksection, shall be in accordance with an approved specification. An approved specification may be a manufacturer's recommendation, purchaser's specification or as agreed between the parties.

Rejuvenating Agent

Rejuvenating agent, if required in mixes incorporating recycled asphalt, shall be a low volatility oil capable of combining with bitumen to counteract hardening and produce a lower viscosity grade of binder. Rejuvenating agent shall comply with recognised standards for such materials.

2.4 RECLAIMED ASPHALT PAVEMENT

Reclaimed asphalt pavement (RAP) shall be obtained from milling or excavation of existing asphalt. RAP shall be crushed and screened as necessary to ensure a maximum size no greater than the maximum size of asphalt being produced and to achieve a reasonably well graded, free flowing, and consistent product.

RAP shall be free of foreign material such as unbound granular base, broken concrete, crumbed rubber or other contaminants. Asphalt containing tar shall not be used.

RAP shall be placed in separate stockpiles prior to use.

3 MIX DESIGN

Mix Designs to NSW RTA - R116 Asphalt (Dense Graded and Open Graded)

Otherwise

3.1 GENERAL

The Contractor shall provide all mix designs. Where specified, the Contractor's mix design shall be assessed by the Superintendent for compliance with the requirements of this worksection. In such cases, the mix design shall be approved by the Superintendent prior to its use.

The types of mixes shall be as listed in the schedule of job requirements, or as shown on drawings.

3.2 AGGREGATE GRADING AND BINDER CONTENT

Unless otherwise specified, asphalt mixes shall be designed with a target combined aggregate grading (including filler) and binder content complying with the relevant limits given in Tables 3.1, 3.2, 3.3, 3.4 or 3.5. Bitumen content shall be expressed as a percentage by mass of the total mix.

Table 3.1 Dense Graded Asphalt (Medium, Heavy and Very Heavy Traffic Heavy Wearing Course and all Base Course Mix Types)

Sieve Size AS (mm)	**Mix designation**				
	AC10	**AC14**	**AC20**	**AC28**	**AC40**
	Percentage passing sieve size (by mass)				
					100
37.5				100	90–100
26.5			100	90–100	72–87
19.0		100	90–100	73–88	58–76
13.2	100	90–100	71–86	58–76	
9.5	90–100	72–83	58–75	47–67	38–58
6.7	68–82	54–71	46–64	37–58	
4.75	50–70	43–61	37–55	30–50	27–43
2.36	32–51	28–45	24–42	20–37	16–33
1.18	22–40	19–35	15–32	13–28	11–26
0.600	15–30	13–27	10–24	9–22	7–20
0.300	10–22	9–20	7–17	6–16	5–14
0.150	6–14	6–13	4–12	4–10	4–10
0.075	4–7	4–7	3–6	3–6	3–6
Total	100	100	100	100	100
Binder Content (% by mass)	4.5–6.5	4.0–6.0	3.8–5.81	3.5–5.5	3.0–5.0
NOTE: For high fatigue base course mix types, the range of binder content shall be increased by 1 percentage point.					

Table 3.2 Dense Graded Asphalt (Light Traffic Wearing Course Mix Types)

Sieve Size	**Mix designation**

	AC7	**AC10**	**AC14**
	Percentage passing sieve size (by mass)		
19.0			100
13.2		100	90–100
9.5	100	90–100	72–89
6.7	85–100	68–87	54–79
4.75	70–87	50–76	43–69
2.36	44–65	32–57	28–53
1.18	29–48	22–42	19–40
0.600	19–35	15–31	13–30
0.300	12–25	10–23	9–22
0.150	8–16	6–14	6–15
0.075	5–8	4–7	4–7
Total	100	100	100
Binder Content (% by mass)	5.0–7.0	4.5–6.5	4.3–6.3

Table 3.3 Open Graded Asphalt and Ultra Thin Asphalt

Sieve Size AS (mm)	**Mix designation**		
	OGA10	**OGA14**	**UTA10**
	Percentage passing sieve size (by mass)		
19.0		100	
13.2	100	85–100	10
9.5	85–100	45–70	80–100
6.7	35–70	25–45	30–55
4.75	20–45	10–25	20–40
2.36	10–20	7–15	18–36
1.18	6–14	6–12	14–30
0.600	5–10	5–10	10–25
0.300	4–8	4–8	7–20
0.150	3–7	3–7	6–12
0.075	2–5	2–5	4–8
Total	100	100	100
Binder Content (% by mass)	5.0–6.5	4.5–6.0	4.7–5.4

Table 3.4 Stone Mastic Asphalt

Sieve Size AS (mm)	**Mix designation**		
	SMA7	**SMA10**	**SMA14**
	Percentage passing sieve size (by mass)		
19.0			100
13.2		100	90–100
9.5	100	90–100	30–55
6.7	85–100	30–55	20–35
4.75	30–62	20–40	18–30
2.36	20–35	15–28	15–28
1.18	16–28	13–24	13–24
0.600	14–24	12–21	12–21
0.300	12–20	10–18	10–18
0.150	10–16	9–14	9–14

Sieve Size AS (mm)	Mix designation		
	SMA7	SMA10	SMA14
	Percentage passing sieve size (by mass)		
0.075	8–12	8–12	8–12
Total	100	100	100
Binder Content (% by mass)	6.0–7.3	6.0–7.0	5.8–6.8

Table 3.5 Fine Gap Graded Asphalt

Sieve Size AS (mm)	Mix designation	
	FGG7	FGG10
	Percentage passing sieve size (by mass)	
19.0		
13.2		100
9.5	100	85–100
6.7	85–100	60–86
4.75	65–85	55–74
2.36	55–72	50–70
1.18	45–65	45–65
0.600	30–60	30–60
0.300	18–40	18–40
0.150	8–18	8–18
0.075	6–12	5–11
Total	100	100
Binder Content (% by mass)	6.0–7.0	6.0–7.0

3.3 MIX PROPERTIES

General

Asphalt mixes shall comply with the relevant target volumetric design criteria and other properties listed in this clause, provided that alternative design targets may be specified or agreed for particular applications. Laboratory preparation and compaction of asphalt mixes may be undertaken using either gyratory compaction or the Marshall Method. The design criteria shall apply to only one method of compaction. The method of compaction shall be nominated by the Contractor, unless otherwise specified.

Dense Graded Asphalt

Dense graded asphalt mixes shall comply with the volumetric design criteria listed in either Tables 3.6 or 3.7 and the Voids Mineral Aggregate (VMA) requirements listed in Table 3.8.

All mixes shall be designed to have a minimum effective binder film index of 7.5 microns with the exception of high fatigue base that shall have a minimum effective design binder film index of 10 microns.

Open Graded Asphalt

Open graded asphalt mixes shall comply with the volumetric (Level 1) design criteria listed in Table 3.9.

Open graded asphalt shall comply with the Asphalt Particle Loss values listed in Table 3.10.

OGA and UTA shall have a maximum binder drain-off test value, at 170°C, of 0.3% by mass except that a lower value of test temperature may be applied where that temperature will not be exceeded during manufacture and transport of the asphalt.

Stone Mastic Asphalt

Stone mastic asphalt mixes shall comply with the volumetric design criteria listed in Table 3.11.

SMA shall contain a minimum of 0.3% by mass of cellulose or acrylic fibre or a minimum of 0.5% by mass of mineral fibre.

SMA shall have a maximum binder drain-off test value, at 170°C, of 0.3% by mass.

Fine Gap Graded Asphalt

Fine gap graded asphalt mixes shall comply with the volumetric (Level 1) design criteria given in Table 3.12.

Table 3.6 Design Requirements for Dense Graded Asphalt Mixes Prepared Using Gyratory Compaction

Mix Type		**Laboratory Compaction Level (cycles)**	**Design Air Voids* - target (%)**	**Air Voids at 250 cycles - min (%)**
Traffic Category	**Application**			
Light	Wearing and base	50	4.0	–
Medium	Wearing and base	80	4.0	–
	High fatigue base	80	3.0	–
Heavy	Wearing and base	120	4.0	–
	High fatigue base	80	3.0	–
Very Heavy	Wearing and base	120	5.0	2.0
* Binder content can only be measured to the nearest +/–0.1% by mass and hence design voids may vary slightly from the target value.				

Table 3.7 Design Requirements for Dense Graded Asphalt Mixes Compacted by the Marshall Method (50 Blow Compaction1)

Mix Type		**Design Air Voids- target (%)**	**Stability - min (kN)**	**Flow (mm)**
Traffic Category	**Application**			
Light	Wearing and base	4.0	5.5	2–4
Medium	Wearing and base	5.0	6.5	2–4
	High fatigue base	3.0	6.5	2–4
Heavy	Wearing and base	5.0	6.5	2–4
	High fatigue base	3.0	6.5	2–4
Very Heavy	Wearing and base	6.0	7.0	2–4

Notes:
1. Where 75 blow Marshall compaction is used, the air voids targets shall be reduced by 1 percentage point.
2. Where 35 blow Marshall compaction is used, the air voids targets shall be increased by 1 percentage point.
3. Binder content can only be measured to the nearest +/- 0.1% by mass and hence design voids may vary slightly from the target value.

Table 3.8 Voids Mineral Aggregate (VMA)

Mix Nominal Size (mm)	**VMA (% minimum)**		
	Gyratory Compaction	**Marshall Compaction (50 blow1)**	
		Heavy/Very Heavy Traffic Wearing Course Mixes	**Other Mix Types**
7	17	–	17
10	16	17	16
14	15	16	15
20	14	–	14
28	13	–	13
40	12	–	12

Note:
1. Where 75 blow Marshall compaction is used, the VMA targets shall be reduced by 1 percentage point.

Table 3.9 Level 1 Design Requirements for Open Graded Asphalt Mixes

Mix Type /Traffic Category	Laboratory Compaction		Air Voids
	Gyratory (cycles)	Marshall (blows)	
OGA Light/Medium	80	50	18–23
OGA Heavy/ Very Heavy	80	50	20–25
UTA	No specified requirement		

Table 3.10 Asphalt Particle Loss

Mix Type /Traffic Category	Asphalt Particle Loss – maximum (%)	
	Unconditioned	Moisture conditioned
OGA Light/Medium	25	30
OGA Heavy/ Very Heavy	20	35
UTA	No specified requirement	

Table 3.11 Design Requirements for Stone Mastic Asphalt Mixes

Mix Type		Laboratory compaction		Design Air Voids – target (%)	VMA – minimum (%)
Size (mm)	Traffic Category	Gyratory (cycles)	Marshall (blows)		
7	Light/Medium	80	50	4.0	19
10	Light/Medium	80	50	4.0	18
10	Heavy/Very Heavy	120	75	4.0	17
14	Heavy/Very Heavy	120	75	4.0	16

Table 3.12 Design Requirements for Fine Gap Graded Asphalt Mixes

Traffic Category	Laboratory compaction		Design Air Voids – target (%)
	Gyratory (cycles)	Marshall (blows)	
Light	50	35	4.0

3.4 DESIGN OF ASPHALT MIXES INCORPORATING RECLAIMED ASPHALT PAVEMENT (RAP)

General

Separate mix designs shall be prepared for all mixes containing RAP. Binder in RAP shall be included as binder in the total mix. Alterations to the proportion of RAP shall constitute a design change.

Mixes shall generally comply with the design and manufacture requirements specified elsewhere in this worksection with the additional requirements specified in **Reclaimed asphalt pavement** and the following sub-clauses.

Asphalt mixes containing not more than 15% of RAP by mass of total mix

Unless otherwise specified, RAP in proportions up to 15% by mass of the total mix shall be permitted in all dense graded asphalt mixes.

Asphalt mixes containing more than 15% but not more than 30% of RAP by mass of total mix

RAP in proportions greater than 15%, but not exceeding 30%, may be used in dense graded asphalt mixes except for Heavy and Very Heavy Duty Wearing Course Mixes, mixes containing polymer modified binder, or where excluded in the Schedule of Job Details. In addition to the requirements specified in **Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP)**, allowance may be made for increase in binder stiffness due to hardened binder in RAP by adoption of bitumen binder one class lower in viscosity than that otherwise specified.

Asphalt mixes containing more than 30% of RAP

Asphalt mixes containing more than 30% of RAP shall only be accepted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures to ensure consistent production of hot mix asphalt of a standard not less than that otherwise specified.

3.5 APPROVAL OF JOB MIX

General

Where approval of the job mix is required by the Superintendent, the Contractor shall provide the information listed in Table 3.13 at least seven (7) days prior to commencement of production.

Each mix design shall be identified by a unique number system allocated by the Contractor or Superintendent in accordance with the accepted practice of the Principal and shall be designated the Job Mix.

Submission of Samples

Where specified in the Schedule of Job Details, or on request by the Superintendent, the Contractor shall provide samples of the constituent materials used in the proposed mix design. The samples shall be provided at the Contractor's expense and delivered to the address specified in the Schedule of Job Details. The quantity of samples shall be in accordance with Table 3.14, or as directed by the Superintendent.

Approval to Use Previously Designed Mix

The Superintendent may accept a Job Mix used by the Contractor under other Contracts for the supply of asphalt of the particular type and nominal size specified subject to the following conditions:

- The project work is undertaken within a two-year period of mix design work for the Job Mix.
- The type, quality and sources of all constituent materials remain unchanged.
- The proportions of aggregates and filler are not varied by more than 20% of the proportion of that component in the original Job Mix.
- The in-service performance of the Job Mix materials has been satisfactory.

Table 3.13 Information to be Submitted by Contractor for Approval of Job Mix

Item	Information
1	Details of constituent materials required under this Specification including aggregates, filler, binder, additives (if used) and source of materials
2	The nominated grading, binder content, design air voids and proportion of each component in the mix
3	Test results verifying constituent material properties and test results of trial mixes made at varying binder contents to arrive at the design mix
4	Test results in accordance with the design requirements specified in Mix properties.
5	The following test results performed on a batch of each mix proposed to be used, and produced from the mixing plant from which the asphalt is to be supplied: - Grading - Binder Content - Maximum density - Air voids at laboratory design compaction level

Table 3.14 Sample Quantities of Constituent Materials

Material	Sample Quantity
Each coarse and fine aggregate component	50 kg
RAP (if used)	50 kg
Added Mineral Filler	5 kg
Binder	8 litres
Additives	As appropriate

4 MANUFACTURE AND STORAGE

4.1 GENERAL

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

4.2 STORAGE OF RAW MATERIALS

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

- Aggregates shall be handled and stored in such a manner as to prevent contamination and avoid segregation.
- Filler shall be handled and stored in such a manner as to keep it dry and free flowing at all times. Where more than one type of filler is to be used, each shall be handled and stored separately.
- Additives, including cellulose or mineral fibre, shall be protected from moisture or contamination. Materials that have become wet shall not be used.
- Binder tanks for heating and storage of binder shall be thermostatically controlled and each shall be fitted with a thermometer that is located so that the temperature can be read conveniently.

A sampling cock shall be provided in the outlet pipe from each tank.

Bitumen binder shall not be heated to more than 185°C. Multigrade and Polymer Modified binders shall not be heated or stored contrary to the temperature and time combinations specified by the manufacturer's written instructions.

4.3 MIXING TEMPERATURES

Temperature of bitumen and aggregates at the mixing plant, and the temperature of asphalt as it is discharged from the asphalt plant, shall not exceed the limits specified in Table 4.1.

Table 4.1 Mixing temperatures

Material	**Maximum Temperature (°C)**
Class 170, Class 320, Class AR450 Bitumen delivered into mixer	165
Class 600 Bitumen delivered into mixer	175
Aggregates before mixing with binder	200
Asphalt at discharge from asphalt plant	1751
Note: 1. The maximum temperature of open graded asphalt shall not exceed that determined from the asphalt binder drain-off test, if applicable.	

4.4 MOISTURE CONTENT

After completion of mixing the moisture content of the mix shall not exceed 0.5%.

4.5 PRODUCTION TOLERANCES

Production tolerances on grading and binder content shall comply with Table 4.2.

Table 4.2 Production Tolerances

Description	**Maximum Tolerance on Job Mix Percentage**
Grading: Sieve size one size larger than nominal size	Nil
4.75 mm sieve and larger	± 7
2.36 mm sieve	± 5
1.18 mm sieve	± 5
0.600 mm sieve	± 4
0.300 mm sieve	± 4
0.150 mm sieve	± 2.5
0.075 mm sieve	± 1.5
Binder Content: Percent by mass	± 0.3

4.6 STORAGE OF MIXED ASPHALT

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

- The mix is consigned to and deposited in the storage bins in such a manner as to minimise segregation.
- The storage bin shall be insulated.
- The method of discharge shall be such as to minimise segregation. Any caked or segregated portions of mix shall be discarded.
- Asphalt with polymer modified binders shall not be stored in plant silos for a period longer than eight hours or that recommended by the manufacturer of the polymer modified binder.
- Open graded asphalt and stone mastic asphalt shall not be stored in plant silos for periods in excess of four hours.
- The total time of storage shall be limited to 24 hours unless otherwise approved.

4.7 MANUFACTURE OF STONE MASTIC ASPHALT

The following particular requirements shall apply to the production of stone mastic asphalt:

- Filler systems shall be designed or modified to provide for the appropriate quantity of added filler. In drum mix plants, loss of filler shall be minimised by feeding direct into the mixer alongside addition of binder.
- Fibre shall be added in a manner that ensures good dispersion of fibres, avoids loss of fibre through dust collection systems and avoids damage to fibre by overheating.
- Mixing times shall be increased, where necessary, to ensure adequate dispersal and mixing of fibre.

4.8 ASPHALT MIXES INCORPORATING RECLAIMED ASPHALT PAVEMENT (RAP)

RAP shall only be used from stockpiles that have been tested for consistency in grading and binder content with materials used in mix design.

In batch mixing plants, the RAP shall be either:

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

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

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

5 SAMPLING AND TESTING OF ASPHALT PRODUCTION

5.1 GENERAL

The Contractor shall arrange for all relevant testing.

Samples from asphalt production shall be randomly selected (random sampling) by a recognised statistical technique from fresh production asphalt at the asphalt plant. Samples shall not be mixed. In addition, each loaded truck shall be visually inspected for segregation, uncoated particles, excess bitumen or overheating, before dispatch from the plant.

Production asphalt shall be tested for the following:

- Grading
- Binder content
- Maximum density
- Temperature.

5.2 FREQUENCY OF SAMPLING AND TESTING

Frequency of sampling and testing shall be not less than that shown in Tables 5.1 and 5.2. Table 5.1 provides for two levels of minimum frequency. The reduced frequency may only be adopted where the process is demonstrated to be under statistical control as specified in **Process control**.

Where a non-conformance occurs in any test requirement, the frequency of sampling and testing for that particular property shall be increased to the normal level until conforming results have been obtained on five consecutive samples.

Table 5.1 Frequency of Sampling and Testing of Production Asphalt

Test	Normal Minimum Frequency	Reduced Minimum Frequency
Grading	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Binder Content	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Maximum density	One test per 300 t of asphalt plant production	One test per 500 t of asphalt plant production
Temperature	Each loaded truck	Lesser of each loaded truck or one per 15 minutes

Table 5.2 Frequency of Testing of Component Materials

Test	Minimum Frequency
Los Angeles Abrasion (where applicable)	3 Monthly
Unsound and marginal stone content (where applicable)	3 Monthly
Wet Strength (where applicable)	3 Monthly
Wet/Dry Variation (where applicable)	3 Monthly
Flakiness index of coarse aggregate	Monthly
Dry compacted voids of combined filler	Monthly
Added filler (Tables 2.2.2 and 2.2.3)	Certification of each delivery
Binder viscosity	Certification of each delivery
RAP grading and binder content	One test per 500 t of RAP

5.3 PROCESS CONTROL

The Contractor shall implement suitable measures for control of the asphalt process. Process control measures may include the use of statistical process control charts for some, or all, of the tests required in **Frequency of sampling and testing** and suitable decision rules for determining that the process is under statistical control and therefore subject to reduced minimum frequency of test.

Elements of the process control system that incorporate the application of statistical process control shall be included in the Contractor's Quality Plan.

6 DELIVERY

6.1 GENERAL

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

- The inside of vehicle bodies shall be kept clean and coated with a thin film of an appropriate release agent to prevent asphalt sticking to the body of the vehicle. Care shall be taken to remove surplus release agent before loading asphalt into the vehicle.

- After loading with asphalt, the body of the vehicle shall be covered to prevent contamination and reduce the rate of cooling of the mix.
- Where the length of the haul or the weather is such that the temperature of the asphalt may drop below a suitable placing temperature, or where excessive local cooling of the mix may occur, the vehicles shall be suitably insulated.

7 PLACING

7.1 PREPARATION OF SURFACE

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

7.2 PROTECTION OF SERVICES

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

7.3 PRIMING

Where specified separately, crushed rock and gravel pavements shall be primed.

7.4 TACK COATING

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

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

Unless otherwise directed, tack coat shall be applied to provide a uniform application rate of residual binder of between 0.10 L/m^2 and 0.20 L/m^2.

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

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

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

When placing ultra-thin surfacing materials, and unless otherwise specified or directed, the tack coating procedure shall be modified to provide a bond coat consisting of 0.9 L/m^2 (total) of 62% binder content polymer modified bitumen emulsion. Bitumen emulsion application rates of more than 0.5 L/m^2 shall be applied through a spray bar mounted directly on the asphalt paver, immediately ahead of the spreading of asphalt.

7.5 SPREADING

General

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

Ambient Conditions for Placing

The surface on which the asphalt is to be placed shall be essentially dry and free from free-standing water.

Asphalt shall not be placed when the pavement surface temperature is less than 5°C.

Wearing course asphalt shall not be placed when the pavement surface temperature is less than 10°C except that placing at lower temperatures may be permitted subject to agreement on procedures used to compensate for rapid cooling of asphalt materials.

Layer Thickness

Asphalt shall be spread in layers at the compacted thickness shown on the drawings, or as specified.

Level Control

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

Spreading

Asphalt shall be spread without tearing or segregation.

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

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

7.6 COMPACTION

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

Pneumatic tyred rollers shall not be used in the compaction of open graded asphalt and stone mastic asphalt. The method of compaction of open graded and stone mastic asphalt shall avoid damage to aggregate or drawing of binder to the surface of stone mastic asphalt. Generally no more than two vibratory passes using high frequency and low amplitude shall be applied.

7.7 JOINTS

General

Joints shall be provided as follows:

- Longitudinally, if the width of the pavement is such that more than one paving run is necessary.
- Transversely, after the completion of a day's paving operations, or where a delay in paving operation allows asphalt to cool and adversely affect placing, and elsewhere if a break in a longitudinal run is required.
- The location of joints shall be planned before work commences.
- The number of joints shall be minimised by adopting good asphalt paving practices.
- All joints shall be well constructed and comply with the shape requirements specified in **Measurement and payment**.

Longitudinal Joints

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

Where asphalt is placed against the edge of a preceding lane that has not cooled below 100°C it shall be considered a hot joint. Hot joints shall be constructed by leaving a 150 mm strip of asphalt unrolled along the free edge until the adjoining lane is placed, and then compacting the unrolled strip simultaneously with the material in the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has not cooled below 60°C it shall be considered a warm joint. Warm joints shall be constructed by rolling the full width of the first lane being placed, prior to placing the adjoining lane.

Where asphalt is placed against the edge of a preceding lane that has cooled below 60°C it shall be considered a cold joint. Asphalt placed against a cold edge should overlap the previous edge by 25 mm to 50 mm. The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

Transverse Joints

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

8 FINISHED PAVEMENT PROPERTIES

8.1 LEVEL

The level at the top of each course of asphalt shall not differ from the specified level by more than 10 mm, except that where asphalt is placed against kerb and channel, the surface at the edge of the wearing course shall be flush with, or not more than 5 mm above, the lip of the channel, unless otherwise specified or shown on the Drawings.

8.2 ALIGNMENT

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

8.3 THICKNESS

The average total compacted thickness of the combined asphalt courses shall be not less than the specified thickness. The average thickness of any individual course shall be not less than the specified thickness by more than 10%. Where confirmation of asphalt thickness is required, it shall be determined by coring to a recognised random sampling plan.

8.4 SHAPE

Surface

No point on the finished surface shall deviate below a 3 m straightedge, measured between any two points, by more than the tolerances specified in Table 8.1.

Table 8.1 Permissible tolerances in surface shape

Layer	**Deviations below 3 m straightedge, mm**					
	Freeways and Highways With High Speed Traffic		**Heavy and Very heavy Traffic Roads**		**Medium and Light Traffic Roads**	
	Parallel to centreline	**Transverse to centreline**	**Parallel to centreline**	**Transverse to centreline**	**Parallel to centreline**	**Transverse to centreline**
Wearing course	3	5	5	7	7	10
Inter-mediate and base	6	10	8	12	12	16

Ride Quality

Where ride quality is specified in the Schedule of Job Details it shall be determined from the average of three replica runs with a calibrated roughness car, laser profiler or ARRB TR Walking Profiler.

Each lane shall be divided into homogenous sections 100 m long. Any length less than 100 m shall be included with the section immediately preceding it and an average roughness determined for the section. Start and finish joints of the entire work, and bridge expansion joints, shall not be included in any section.

Roundabouts shall not be measured under **Shape**.

8.5 DENSITY

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

Density testing shall not be performed on lots of less than 30 t, layers with a nominal thickness less than 30 mm, layers with a nominal thickness less than 2.5 times the nominal mix size, or open graded asphalt.

The location of each insitu density test shall be chosen by a method of random stratified sampling. For core sample tests, the layer thickness is the mean thickness of the core samples and for nuclear and

impedance density gauge tests, the layer thickness is the nominal thickness. All core holes shall be repaired by an appropriate method that is compatible with the pavement from which cores have been taken.

Density testing shall be carried out as soon as practicable after completion of work.

Relative compaction is the percentage ratio of the insitu density of the compacted asphalt and the reference density of the asphalt of a particular lot. The reference density shall be the mean of the five most recent maximum density measurements of the same mix, provided that:

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

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

The characteristic value of relative compaction is calculated as (Mean – KS)

where:

Mean = The mean of the relative compaction results.

S = The sample standard deviation of the relative compaction results.

K = A factor that depends on the number of tests as shown in Table 8.2.

Table 8.2 Acceptance Constant

Number of Tests or Measurements	Acceptance Constant (K)
6	0.719
7	0.755
8	0.783
9	0.808
10	0.828

The work represented by a lot shall be assessed as the characteristic value of insitu voids where:

Characteristic value of insitu air voids (%) = 100 – Characteristic relative compaction.

The value of characteristic voids shall comply with the maximum characteristic values specified in Tables 8.3 and 8.4.

Table 8.3 Characteristic Value of Insitu Air Voids for Wearing Course Asphalt

Asphalt Type and Thickness (mm)	Maximum Characteristic Value (%)
All heavy and very heavy traffic asphalt wearing courses	8
Medium traffic wearing course.	9
Light traffic wearing course	7

Table 8.4 Characteristic Value of Insitu Air Voids for Base Asphalt

Asphalt Type and Thickness (mm)	Maximum Characteristic Value (%)
Heavy and very heavy traffic mixes in layers ≤ 40 mm	8
Medium and light traffic mixes in layers ≤ 40 mm	9
Heavy and very heavy traffic (except high fatigue base) mixes in layers > 40 mm	7
Medium and light traffic mixes in layers > 40 mm	8
High fatigue base	6

9 MEASUREMENT AND PAYMENT

9.1 GENERAL

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

Payment for asphalt shall be by mass for quantities determined in accordance with **Measurement by mass** or **Measurement by area and thickness** as appropriate.

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

9.2 MEASUREMENT BY MASS

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

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

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

9.3 MEASUREMENT BY AREA AND THICKNESS

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

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

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

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

9.4 NON COMPLYING MATERIALS

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

- That the reduced service life arising from the non complying material is offset by reducing payment for the non complying material by the method defined in the Schedule of Job Details; or,
- The removal of non complying material; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.

10 ANNEXURE A

10.1 SCHEDULE OF JOB DETAILS

Asphalt mix requirements
(Quality, Binder, Aggregate grading and binder content, Mix properties)

Item	Layer/Course	Asphalt Mix Type/ Traffic Category	Binder Class/Type	Nominal Size	Layer Thickness

Measurement and payment
(**Measurement and payment**)
Measurement and payment shall be by: Mass/ Area and Thickness
Any Special Job Requirements listed below shall be additional separate Payment Items
Special job requirements (Optional)
Special Design Criteria: [complete/delete]

Approval of Job Mix: [complete/delete]

Submission of Samples: [complete/delete]

Method of level Control: [complete/delete]

Measurement of Ride Quality: [complete/delete]

Density Testing: [complete/delete]

Non Complying Materials: [complete/delete]

Removal of Thermoplastic or Other Line Marking: [complete/delete]

Additional Pavement Preparation: [complete/delete]

Other: [complete/delete]

11 ANNEXURE B – ASPHALT WORK RECORD

CLIENT:

Date: _____ Contract No:_____ Work Location: _____km to: _____ km

Road Name: _____ Supplier: _____ From: _____towards: _____
(Crossroad or landmark)

Road No: _____ Job No: _____ PMS/MMS Segment Numbers: _____

Plan No: _____ Mix Type: _____ New Surfacing ☐ Resurfacing ☐ Existing Surface Type: _____

Delivery								Paving										Remarks
Load No.	Time			Truck Reg'd No.	Docket No.	Net Mass (t)	Mix Temp Ex paver ℃	Chainage		Paved Width (m)	Direction with or against chainage	Dist. from left edge to centre of run (m)	Thickness (mm)	Layer			Sample No. & Lot Size (tonnes) if sampled	Weather Work Stoppages, Start & Finish etc.
	Depot Plant	Arrive Job	Depart Job					From	To					1st	2nd	3rd		

Remarks: _____

Penciller: _____ Sampling by: _____ Superintendent's Representative: _____ (Signature) Contractor's Representative: _____ (Signature)

Affiliation: _____ Affiliation: _____

12 ANNEXURE C

NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

12.1 SCOPE AND GENERAL

Scope: The specification has been prepared for the manufacture, supply and placing of dense graded hot mix asphalt (also referred to as asphaltic concrete or AC), open graded asphalt (OGA), stone mastic asphalt (SMA) and fine gap graded asphalt (FGGA) for roadworks and related applications. Different criteria apply to quality of components and asphalt mix design according to the application. The nominal size and types of mixes to be used should be specified in the Schedule of Job Details.

The intended use of the materials may also involve the application of different construction requirements and these should also be nominated in the Schedule of Job Details. Guidelines for the application of such requirements are given in the notes to the relevant worksection clauses.

Careful consideration of the Schedule of Job Details is required to ensure that asphalt is fit for purpose, of the appropriate type and quality, and provided in a cost effective manner.

The terms used in the worksection guidelines are generally consistent with AS 2124, and include Principal, Superintendent, and Superintendent's Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Quality: The quality requirements of **Quality (Scope and General)** are design to apply the AUS-SPEC quality system requirements.

The following paragraphs may be substituted if desired:

'The Contractor shall establish, implement and maintain a Quality System in accordance with this worksection and the requirements of AS/NZS ISO 9001(Int), or a recognised equivalent.'

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

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor's Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

12.2 MATERIALS

Aggregate

The worksection refers to AS 2758.5, which requires the user to select from a number of options for determination of aggregate durability. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards are applied on a State by State basis as follows:

- Soundness based on Los Angeles Abrasion and Unsound Stone Content (Table 2.1) – Victoria and Western Australia.
- Soundness based on Ten Percent Fines Value and Wet/Dry Strength Variation (Table 2.2) – All other States.

Minimum values of polishing resistance (PSV or PAFV) are provided as default values for general application. Surface friction requirements will vary according to the risks associated with operating environment or particular sites, which will also influence the choice of type of asphalt mix and other design factors associated with surface texture. Availability may also be a consideration. This may lead to the adoption of higher or lower minimum polishing values for some applications.

Mineral Filler

Some asphalt specifications show confusion over the role and specification of filler in asphalt mixes. By strict definition, filler is that mineral matter passing the 75 micron sieve and includes filler sized particles derived from aggregates as well as added fine materials such as lime, fly ash, etc. In practice, materials used as added filler are comprised predominately of particles smaller than

75 microns but may also contain a proportion of coarser particles. Tests applied to added filler materials apply to the complete sample, not just that portion passing the 75 micron sieve.

Binder

A guide to selection of binder type is provided in the notes to **Mix design**.

Reclaimed Asphalt Pavement (RAP)

A guide to the application of design and manufacturing requirements for RAP in asphalt is provided in the notes to **Mix design**.

12.3 MIX DESIGN

General

Gyratory compaction enables ready selection of different compaction levels to match expected service conditions as well as being able to simulate long term heavy traffic loadings by extended compaction. Gyratory compaction is also considered to achieve particle alignment that is a better representation of field compaction of asphalt. The specification also provides for the use of Marshall compaction where that method of compaction is preferred. It is important that only one set of criteria are applied, either Marshall or gyratory compaction. In due course it is expected that gyratory compaction will become more common than Marshall.

The mechanical properties of Marshall 'Stability' and 'Flow' do not directly measure fundamental properties but provide empirical relationships that have been found to correlate with asphalt mixes that provide suitable levels of field performance.

Several relatively new performance-based design criteria have been developed through the national research programs of AAPA, Austroads and ARRB Transport Research. The outcome of that research program has been published as Austroads Pavement Research Group Report No. 18 - Selection and Design of Asphalt Mixes: Australian Provisional Guide. The provisional status of the Guide reflects the tentative nature of aspects of the performance criteria and are not included here as the Provisional Guide is the subject of a review in 2006/07.

Aggregate Grading and Binder Content

The aggregate grading and binder content ranges shown in Tables 3.1, 3.2, 3.3, 3.4 and 3.5 of the worksection are targets for design purposes. Application of production tolerances may result in actual production being outside those limits. Table 3.1 restricts the proportion of finer materials in order to provide good texture for dense graded wearing course mixes for medium and heavy traffic and increased deformation resistance in heavier trafficked applications. Table 3.2 allows increased proportions of finer materials in dense graded mixes for all lesser trafficked applications.

The Superintendent may approve the use of asphalt mixes with a design target outside the ranges shown where it can be shown that all the other performance requirements can be adequately met.

Mix Properties - Selection of Mix Type, Binder Type, and Layer Thickness

The principal factors influencing the performance characteristics of asphalt mixes are the selection and quality of components, the volumetric properties of the mix (nominal size, grading, binder content and voids relationships) and the layer thickness.

The worksection provides for different criteria for aggregate quality and voids relationships for dense graded mixes based on traffic categories. A guide to selection of traffic category is shown in the Table C1 below. The relevant traffic category should be nominated in the Schedule of Job Details.

The mix type, nominal mix size, binder type and layer thickness should also be nominated in the Schedule of Job Details.

For most wearing course and structural asphalt applications, dense graded asphalt mix types are used. Other mix types are used as wearing course to provide particular surface characteristics for particular applications as follows:

- Open graded asphalt is used as a porous wearing course to reduce water spray and tyre noise levels on freeways and other high speed roads.
- Ultra thin asphalt (UTA) is a specialty asphalt mix for placing in thin layers (12–15 mm compacted thickness). It uses a modified grading to improve resistance to surface shearing forces, which reduces porosity but still provides coarse textured surface. UTA must be placed in conjunction with a heavy tack coat (see notes to Section 7.3), sprayed seal or strain alleviating membrane interlayer (SAMI) to ensure strong bond to underlying surface.

- Stone mastic asphalt (SMA) is used to provide good surface texture and good deformation resistance on heavily trafficked roads. Smaller nominal sizes can also be used as a durable, well-textured surface in lightly trafficked applications.
- Fine gap graded asphalt (FGGA) provides a very fine textured surface in a mix that can be readily compacted to low air voids thereby providing good durability in lightly trafficked pavements. The grading envelope for FGGA provides for a wide choice of grading target but there is a design intent to produce a gap grading with limited intermediate sized aggregate fractions as described in Chapter 6 of APRG 18. While the grading and binder content produces a more workable mix, it can be more susceptible to deformation and is not appropriate for heavily trafficked or highly stressed areas.

A detailed guide to selection of different wearing course asphalt mixes for particular surface characteristics is provided in Austroads *Guide to selection of road surfacings*.

The nominal size may be determined as a function of the layer thickness or the layer thickness selected on the basis of the nominal size required for a particular application. A guide to selection of layer thickness and nominal size is shown in Table C2.

Guides to selection of binder types for dense graded wearing and base course applications are shown in Tables C3 and C4. Not all binder types may be available in all locations and AR450 has only recently been introduced in NSW. Modified binders require delivery in minimum quantities and special handling and storage requirements. The specification of modified binders may, therefore, not be practical for small projects or remote locations. Before specifying a particular binder, the designer should ascertain the availability in the project location.

It should be noted that the design air voids targets for gyratory compaction of dense graded mixes are different to those for Marshall compaction. The limits for gyratory compaction are based on different compactive effort (cycles) for different traffic applications. The design air void targets for Marshall compaction provide the option of varying compactive effort for different traffic levels, or choosing different air voids targets based on a single 50-blow compactive effort. The use of 50-blow compaction enables mixes of different applications and voids targets to be selected from the one set of laboratory test data. If mixes are to be designed for different Marshall compactive effort, the target air voids and VMA should be reduced by up to 1% for 75-blow compaction and increased by up to 1% for 35-blow compaction. Where different design air voids criteria are required, a special clause should be inserted in the schedule of details.

Table C1 Guide to Traffic Category

Indicative Traffic Volume		**Traffic Category**	
Commercial vehicles/lane/day	**Structural design level**	**Free flowing vehicles**	**Stop/start OR climbing lane OR slow moving**
< 100	< 5x105 ESAs	Light	Medium
100–500	5x105–5x106 ESAs	Medium	Heavy
500–1000	5x106–2x107 ESAs	Heavy	Very Heavy
> 1000	> 2x107 ESAs	Very heavy	Very Heavy

Table C2 Guide to selection of nominal size of dense graded mixes

Nominal size (mm)	**Typical Layer thickness (mm)**	**Typical Use**
5	15–20	Very thin surfacing layer with fine surface texture. May not be available in all locations
7	25–30	Commonly used for surfacing residential streets and foot traffic areas where thin layers and fine surface texture are required.
10	30-45	General purpose wearing course in light and medium traffic applications
14	40–55	Wearing course mix for heavier traffic applications. Also some intermediate course applications depending on layer thickness
20	60-90	General purpose base and intermediate course mix for wide range of use.

Nominal size (mm)	Typical Layer thickness (mm)	Typical Use
28	85-120	Base and intermediate course but less commonly used than 20 mm. Control of segregation can sometimes be an issue.
40	120–160	Occasionally used as heavy duty base. Control of segregation can be a significant issue.

Table C3 Selection of binder type for dense graded wearing course applications

Traffic Category	Binder Class/Type	Recommended use
Light	320 or 450	Residential streets, car parks and foot traffic
	AR450	Alternative to 320, particularly in warmer climates
Medium	320 or AR450	Normal conditions and lower traffic ranges, particularly in cooler conditions
	320 or AR450	Good general purpose mix for wide range of applications
Heavy	320 or AR450	General purpose mix for heavily trafficked applications.
	600, AR450, Multigrade or PMB	Higher performance mixes for more critical traffic applications or where elastomeric polymers are required to improve flexibility. Stiffer binders require strong, stiff base.
Very Heavy	320 or AR450	Heavily trafficked intersections and slow moving traffic
	600, AR450, Multigrade or PMB	Special applications such as very heavily trafficked intersections and heavy-duty industrial pavements.

Table C4 Selection of binder type for dense graded intermediate and base course applications

Traffic Category	Binder Class/Type	Recommended use
Light and Medium	320	General purpose mixes for cooler conditions
	320 or AR450	General purpose mixes for most light and medium traffic applications
Medium/ Heavy (high fatigue base)	320 or AR450	Special high bitumen content sub-base layer providing high fatigue resistance. To avoid rutting, this mix should not be used within 125 mm of surface. The layer thickness should not generally exceed 70 mm or one third of the structural pavement depth.
Heavy	320 or AR450	General purpose mix for heavy traffic applications.
	600	High stiffness base for use in heavy duty pavements.
Very Heavy	320, 450, 600, Multigrade or PMB	Special applications such as heavy-duty industrial pavements and hard standing areas.

Table C4 Selection of binder type for other mix types

Mix Type	Traffic Category	Binder Class/Type	Recommended use
Open Graded Asphalt	Light or Medium	320 or 450	Wearing course on light to medium trafficked roads where low levels of noise and water spray are required.
	Heavy or Very Heavy	PMB	Wearing course on Freeways and other heavily trafficked roads where low levels of noise and water spray are required.
Stone Mastic Asphalt	Light or medium	320 or 450	Wearing course for light and medium trafficked roads where well textured mix is required.
	Heavy or Very Heavy	320, 450 or Multigrade	Wearing course for heavily trafficked roads providing high levels of texture and rut resistance.

Mix Type	Traffic Category	Binder Class/Type	Recommended use
	Very Heavy (Special applications)	PMB	Enhanced wearing course performance in heavily trafficked applications.
Fine Gap Graded Asphalt	Light	320 or 450	Fine textured, durable wearing course for use in residential streets, pedestrian areas, and other light traffic applications

Design and Manufacture of Asphalt Mixes Incorporating Reclaimed Asphalt Pavement (RAP)

As a general rule, no special requirements need apply to the use of RAP in hot mix asphalt where the percentage of RAP does not exceed 15% of the total mix, provided that separate designs are prepared for such mixes, the proportions used in manufacture are not substantially altered from that used in design, and that the Quality Plan includes a reasonable management plan for monitoring incoming RAP materials.

Where RAP is to be added in proportions greater than 15%, but not more than 30% of the total mix, the use of bitumen binder of one class softer than that otherwise specified will generally provide suitable compensation for the influence of hardened binder in the RAP and produce asphalt mixes of comparable stiffness, fatigue resistance and deformation resistance to mixes manufactured with virgin materials.

Alternative procedures include the use of rejuvenators or a softer class of binder tailored to tests on actual penetration or viscosity of binders recovered from stockpiled RAP materials. The latter approach is appropriate where it is believed that accurate prediction of binder stiffness is critical to the long term performance of the asphalt, e.g. Heavy traffic base applications and Very Heavy traffic base and wearing course applications. A further option is to accept the material without adjustment to the grade of fresh binder. In such cases the asphalt may have slightly higher flexural stiffness that could reduce fatigue resistance in thin surfacing applications when the proportion of RAP approaches 25 or 30%.

The specifier may also restrict use of more than 15% RAP to particular mix types or project applications. Mixes that are not permitted to contain more than 15% RAP should be listed in the Schedule of Job Details. The use of RAP in proportions greater than 15% should not be allowed where polymer modified binders are specified but should be satisfactory for use with multigrade binder and most applications with standard classes of bitumen binder.

The use of RAP in proportions greater than 30% of the total mix should only be permitted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures. Manufacture should only be carried out in asphalt plants specifically designed to handle such proportions of RAP without overheating and damage to binder in the RAP or new mix. The quality plan should indicate the procedures for monitoring the consistency of grading and binder properties of incoming RAP materials, the use of softer binders or rejuvenating agents to achieve a binder of comparable performance to that otherwise specified, and testing to validate the properties of the manufactured asphalt.

A guide to blending of binders or rejuvenating agents to achieve a target binder viscosity is provided in *the Austroads Asphalt Recycling Guide (AP-44/97) and Austroads Framework Specifications for Asphalt Recycling (AP-T02).* Caution must be used in determining targets for blending of binders as fresh binder or rejuvenator may not be fully combined with the aged binder during the asphalt manufacture process. Consequently, mix performance characteristics imparted by binder stiffness, particularly fatigue and rutting resistance, may be somewhat intermediate between that of the fresh binder and that predicted from the stiffness or viscosity calculated or determined by extraction and testing of the blended binder.

12.4 MANUFACTURE AND STORAGE

Guidance for binder storage and mixing temperatures may be obtained by reference to AAPA *Advisory Note 7: Guide to the Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt.* The length of time that manufactured asphalt may be held in hot storage bins will vary according to the type of mix, type of binder and construction of storage bins. Maximum storage times (24 h) are generally applicable to standard dense graded asphalt mixes, standard bitumen binder and well insulated bins that may also include supplementary heating. Shorter storage periods apply to high binder content mixes, polymer modified binders and poorly insulated bins. Additional guidelines

for storage of polymer modified binders at elevated temperatures may be provided by the manufacturers of polymer modified binders. Other potential deleterious influences of extended storage may be assessed by monitoring mix temperature variation and segregation.

The addition of fibre to stone mastic asphalt is generally undertaken by one of the following alternative methods:

- Addition of loose or pelletised fibre direct to the pugmill of a batch mixer in meltable pressed packs
- Metering of loose or pelletised fibre direct to pugmill of batch mixing plant
- Metering of pelletised fibre through system designed for addition of RAP to drum mixing plant.
- Metering of loose or pelletised fibre direct to drum mixing plant through line that merges fibre with binder at point of addition to aggregates.

12.5 SAMPLING AND TESTING OF ASPHALT PRODUCTION

General

The purpose of inspection and testing is to provide reasonable assurance to the purchaser that the quality of component materials comply with the standards specified, and that the manufactured asphalt is in accordance with the designated job mix design.

Manufacturing compliance may be assessed at two levels:

- Verification that the job mix has been replicated, i.e. use of conforming components and combination in the design proportions to achieve the job mix grading and binder content.
- Verification that the design targets have been met, i.e. testing of compacted samples for volumetric properties and other specified properties.

For many applications, compliance with the job mix grading and binder content is adequate. If production is controlled within the tolerances specified, it is neither necessary nor cost effective to perform further testing for conformity to mix design criteria as a routine measure of quality. In fact, the variability inherent in such sampling and testing may lead to misleading interpretation of quality variation where no such variation really exists.

Where confirmation of volumetric properties is required, an additional clause should be inserted to require compaction of samples taken from production to be compacted using the same procedures as that specified for the design of the relevant mix. The sampling frequency should be the same as that applied to testing of grading and binder content and the tolerance on air voids should be ± 1.5% of the design target.

Compacted samples may also be assessed for other design properties such as Marshall Stability and flow or resilient modulus. The Marshall test properties should meet the specified design criteria.

The manufacturer should not rely solely on the sampling and testing done for compliance purposes as the measures of process quality control. The worksection provides an incentive to the manufacturer to undertake suitable measures to improve the level of conformity and consistency of manufactured product by reducing the frequency of testing for compliance purposes where the manufacturer is using a suitable statistical process control system and where the results of compliance tests show an appropriate level of consistency in meeting the worksection requirements.

A guide to statistical process control systems is provided in AAPA *Implementation Guide IG-3: Asphalt Plant Process Control Guide*. Further guidance to the application of statistical techniques is provided in AS 3940 *Quality control – Guide to the use of control charts* including Cusum techniques and AS 3942 *Quality control – Variables charts – Guide*.

A typical statistical process control system that would be suitable for this application is one that incorporates the following elements:

Process control charts for the compliance tests for grading (one sieve below mix nominal size, 2.36 mm and 0.075 mm sieves), binder content, and maximum density.

Process charts should show:

- Actual individual sample test results plotted against the target value and specified tolerances.
- Five point rolling mean, with the target value, warning and control limits.
- Five point rolling range (the maximum of five points)

Corrective action should be taken when any of the following occur:

- One point lies outside the control limits

- Two out of three points lie outside the warning limits. Investigation of possible assignable causes, and need for corrective action, should be undertaken if:
- Five consecutive points in the rolling mean are above or below the target
- Five consecutive increasing points occur in the range
- Two out of three points lie outside the warning limits

The use of statistical process control measures are strongly encouraged as a means of reducing the uncertainties associated with interpretation of test results from single samples. The use of risk assessment procedures to define where variation may occur is also recommended.

12.6 DELIVERY

The rate of delivery should be matched to paving output to maintain consistent spreading to achieve good ride quality and uniform compaction and to avoid unnecessary delays in spreading operations and loaded asphalt being held on site for long periods.

Asphalt should arrive on site at a suitable temperature for spreading. The actual temperature will depend on mix type, layer thickness, ambient conditions and equipment available for compaction. Generally, compaction should be completed before the mix temperature falls below about 90°C (slightly higher for modified binders). A guide to temperature of dense graded asphalt mixes, at the time of spreading, to provide adequate time for compaction using typical equipment, is shown in

Table C6 Asphalt Spreading Temperatures (Dense Graded Asphalt)

Road surface temperature1 (°C)	**Minimum mix temperature2 (°C)**			**Range of mix temperature3 (°C)**
	Thickness of layer, mm			
	<30	**30 – 40**	**41 – 100**	**>100**
5 – 10	See note 4	See note 4	145	135 – 150
10 – 15	150	145	140	130 – 145
15 – 25	150	145	135	125 – 140
> 25	150	145	130	120 – 135

Notes:
1. Surface temperature should be generally that applicable to the coolest area of the pavements, e.g., shade areas, if applicable.
2. Mix temperatures apply to Classes 170, 320 and AR450 bitumen binder. Use of Class 600, Multigrade, or PMBs may require minimum temperatures 5°C to 10°C higher than those shown.
3. Maximum temperatures apply when placing thick layers, to avoid excessive displacement under rolling.
4. Placing asphalt in thin layers under cool conditions may adversely affect the result due to the increased difficulty in achieving proper compaction, effective joints and good surface finish. Additional attention should be paid to issues of mix workability, asphalt temperature, compaction techniques and any influence from additional cooling due to wind or moisture.
5. Placing of asphalt over a previous layer that has not cooled below about 65°C requires special consideration and mix temperatures should be adjusted accordingly.

12.7 PLACING

Preparation of Surface

Road surfaces must be clean to ensure good bond between new asphalt and the existing surface.

Priming

Crushed rock and gravel surfaces should be primed with a suitable application of primer, prior to placing asphalt, particularly where the total thickness of asphalt is 50 mm or less. Priming the surface assists in:

- Achieving a strong bond between asphalt and granular layers.
- Reducing the permeability of the surface of the granular layer.
- Stabilising the pavement moisture content and assisting in the curing of cement stabilised layers.
- Preserving the integrity of the granular surface after completion of preparation and before placing asphalt.

If priming is required, it must be included as a separate worksection and schedule item.

Tack Coating

Tack coating for normal asphalt applications comprises a light application of bitumen emulsion to ensure adequate adhesion between layers. The placing of ultra thin asphalt is a specialty process that requires a higher application rate of tack coat (up to 0.9 L/m^2) to increase the surface bond. The type of bitumen emulsion used in such applications generally contains a polymer modifier and must be placed with a special integrated paving machine that sprays tack coat immediately ahead of depositing asphalt so that the tack coat is not damaged by spreading equipment.

The type of bitumen emulsion for normal applications should suit the conditions of use. Generally, rapid setting cationic emulsion is used in cooler regions where damp conditions may be encountered. In warmer or drier conditions, slower setting cationic emulsions and anionic emulsions may combine easier handling with satisfactory performance. Bitumen emulsion used for tack coating may be diluted with water to assist uniform coverage, provided that the residual binder application rate is achieved.

Tack coating is generally not necessary when placing over clean, freshly applied primed surfaces or newly placed, untrafficked asphalt.

Spreading

The specification provides for asphalt to be placed when pavement surface temperatures are as low as 5°C. Placing in cool conditions increases the difficulty in obtaining good standards of work and, where practicable, work involving thin layers (40 mm or less) or PMB binders should be programmed to be done when such conditions are less likely to occur.

The selection and use of automatic level control for asphalt paving should normally be determined by the Contractor, taking into account the applicability to site conditions and the geometric requirements of the finished result. The use of automatic level controls will usually only be applicable to larger jobs and heavier traffic. The Schedule of Job Details provides for specification of particular level control devices, if required.

Compaction

Selection of compaction equipment is the responsibility of the Contractor, provided that it is capable of achieving the required standards of compacted density, surface shape and finish.

Joints

Joints are the weakest part of the pavement. Cold joints should be minimised by planning of works to achieve a minimum number of construction joints and, where practicable, maximum use of hot or warm joints.

12.8 FINISHED PAVEMENT PROPERTIES

For general asphalt work, the application of shape standards as specified in **Shape**, together with the use of good placing practices as outlined in the notes to **Placing**, should provide adequate surface smoothness and ride quality.

The standard of ride quality that can be achieved will depend on the roughness of the surface on which the asphalt layer is to be placed, and the extent of shape correction and additional asphalt layers that may be applied prior to the final layer. Ride quality will also be influenced by restrictions such as intersecting streets, road fixtures (e.g., manholes), and the need to match kerb and channel. Specifiers should avoid potential conflicts in requirements by simultaneously trying to control thickness, level and ride quality.

Achievement of specified densities will depend upon the provision of a stiff base and a workable mix.

12.9 MEASUREMENT AND PAYMENT

Payment is normally on the basis of mass determined from an approved weighing system. Alternatively, on new works where asphalt is being placed to a specified thickness, the mass may be determined on the basis of measured area, thickness and density.

Additional clauses may also be inserted to apply a scheduled rate of reduction in payment for failure to comply with manufacturing targets, compacted density and ride quality requirements to compensate for reduced service life.

Annex A – Schedule of job details

A1 ASPHALT MIX REQUIREMENTS: See **Quality**, **Binder**, **Aggregate grading and binder content**, **Mix properties**. Insert type/traffic category of mix, binder type, nominal size and thickness, where applicable.

A2 MEASUREMENT AND PAYMENT: See **Measurement and payment**. Indicate the method of measurement applicable.

A3 SPECIAL JOB REQUIREMENTS: Where required, special clauses should be prepared and inserted in the schedule of job details for the following.

- Special Design Criteria: See **Mix properties**. Insert any special design requirements, if applicable.
- Use of Reclaimed Asphalt Pavement (RAP): See **Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP)**. Insert any particular conditions or restrictions to mix types or applications of RAP in asphalt.
- Submission of Samples: See **Approval of job mix**. Insert details for delivery of samples (if relevant).
- Automatic Paver Level Control: See **Tack coating**. Insert any special requirements for use of automatic paver control, if applicable.
- Measurement of Ride Quality: See **Non complying materials**. Insert special requirements for measurement of ride quality, if applicable. A separate schedule item should be provided for the cost of testing, where testing is to be provided by the Contractor.
- Non Complying Materials: See **Non complying materials**. Insert special requirements for payment for non complying materials, if applicable.