Engineering Construction Specification

C10 Asphaltic (Roadways)

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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide asphalt for roadways and related pavement applications, as documented.

1.2 Precedence

1.2.1 General

Schedule of job details: If there are conflicts between the requirements of this worksection and the **ANNEXURE - SCHEDULE OF JOB DETAILS**, the requirements of the **ANNEXURE - SCHEDULE OF JOB DETAILS** apply.

1.3 Cross references

1.3.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C08 Flexible pavement base and subbase*
- *C09 Sprayed bituminous surfacing*

1.4 Standards

1.4.1 General

Asphalt: To Austroads AGPT04B.
Flexible pavements: To Austroads AGPT02 clause 3.15.
Asphalt pavement surfacing: To Austroads AGPT03 Section 5.

1.5 Interpretation

1.5.1 Abbreviations

General: For the purposes of this worksection the abbreviations given below apply:

- DGA: Dense graded asphalt.
- FGGA: Fine gap graded asphalt.
- ITP: Inspection test plan
- LTA: Light traffic asphalt.
- OGA: Open graded asphalt.
- PAFV: Polished aggregate friction value.
- PMB: Polymer modified binder.
- RAP: Reclaimed asphalt pavement.
- SAMI: Stain Alleviating Membrane Interlayer
- SMA: Stone mastic asphalt.
- UTA: Ultra-thin asphalt.

1.5.2 Definitions

General: For the purpose of this worksection the definitions in Austroads AP-C087 and the following definitions apply:

- Added filler: Mineral matter, suitable for use in asphalt – at least 75% of which is finer than 75 µm and all of which is finer that 600 µm – which is added to the combined aggregate of an asphalt mix. Typical materials include hydrated lime, flyash, cement, cement works flue dust, ground limestone and rock dust other than that which occurs as a natural component of the combined aggregate.
- Anionic bitumen emulsion: A binder material in which the suspended particles are negatively charged.
- Cationic bitumen emulsion: A binder material in which the suspended particles are positively charged.
- Coarse aggregate: A general term for aggregates substantially retained on a sieve of specified size, commonly 4.75 mm.
- Fine aggregate: A general term for aggregate that substantially passes the 4.75 mm.
- Mineral filler: A fine material, the majority of which passes a 75 µm sieve, derived from aggregate or other similar granular material.
- Mix design: The designed portion of constituent materials comprising the type and source of components, target grading, binder content and volumetric properties of the mix.
- Production mix: Mix produced in the plant and delivered to the site in a workable condition suitable for stockpiling, spreading and compaction.

1.6 Tolerances

1.6.1 Level

Each course of asphalt: ± 10 mm.
Wearing course placed against kerb and channel: ≤ 5 mm above the lip of the channel.

1.6.2 Thickness

Average total compacted thickness of the combined asphalt courses: Not less than the documented thickness.
Average thickness of any individual course: Not less than the documented thickness by more than 10%.

1.6.3 Surface shape tolerance table

Layer	**Deviations below 3 m straightedge (mm)**			
	Heavy and very heavy traffic roads		**Medium and light traffic roads**	
Wearing course	5	7	7	10
Intermediate and base	8	12	12	16

1.7 Submissions

1.7.1 Planning Requirements

Testing: Conform to the following:

- All testing of properties required by the worksection is to 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, adopt the method endorsed by the RMS.

Register and Insure Plant: Conform to the following:

- Register and insure all plant as appropriate to its use on a public road. Plant to comply with statutory environmental regulations. This is a HOLD POINT.
- Provide all the plant and equipment and labour necessary for carrying out the work in accordance with this worksection.
- All plant and equipment used on the work is to be suitable and in accordance with the Contractor's submitted quality documentation and kept in good operating condition.
- Do 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. This is a WITNESS POINT.

Protection of services and road fixtures: Conform to the following:

- 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, access chamber covers, bridge or culvert decks, kerbs and other road fixtures, Including driveways and other types of laybacks running off or near the pavement. Immediately after the asphalt has been spread, clean off or remove any waste material and other unsuitable material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent. Waste material to be taken to licenced facility or otherwise directed by the superintendent.

Notification of work: Conform to the following:

- Before commencing site operations, all affected residents and businesses are to be notified. Such notification shall consist of two parts:
    - Part 1: Written notice delivered at least seven days in advance of proposed work; andPart 2: further written or verbal confirmation delivered not less than 24 hours prior to commencement of work.Such notices shall detail:
    - intended date of commencement
    - duration of project;
    - hours of work
    - name of street(s) affected and limits of work;
    - a contact phone number of the site supervisor;
    - description of work;
    - any precautions to be followed by the public.
- A sample of proposed written notification for residents and businesses shall be submitted to the Superintendent for approval prior to use.

Control of Traffic: Conform to the following:

- Provision for traffic: Provide for traffic in accordance with *C03 Control of traffic* while undertaking the work.
- 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.

1.7.2 Execution details

Spreading at low temperatures (less than 5 degree surface temperature): If proposed, submit details of procedures.
Joints: Submit plans showing joints locations.
RAP management plan: Submit a plan with details of procedures for acceptance, processing and material testing.

1.7.3 Products and materials

Mix design: Submit details of the following for each asphalt mix:

- Type and source of constituent materials: Including for aggregates, fillers, binders and binders.
- Proportions of constituent materials used: Including binders, bituminous emulsion content, adhesion agents and additives.
- The combined aggregate particle size distribution as a single grading (not a range).
- Nominal size of the design mix.
- Test certificates: Submit evidence of conformance from a NATA accredited laboratory (for the required test method) for each constituent (aggregates/mineral fillers/binders/additives) including the following:

  Aggregates: Quality and grading.

  Blended aggregates: Proportions of the various sizes, including coarse aggregates.
- Trial mix testing results for review and approval.
- Mixes incorporating more than 30% RAP: Submit mix details including manufacturing plant, quality control procedures, and technical and performance data.
- Fine gap graded asphalt: If alternative particle size distribution is proposed, submit details for approval demonstrating conformance with the volumetric properties in **Design requirements for fine gap graded asphalt mixes table**.

Production mix test results: For each production batch or run of mix from the plant, submit evidence of conformity to the approved mix design and **MIX PROPERTIES** (for the appropriate asphalt type), including for:

- Grading.
- Binder content.
- Maximum density.
- Air voids.
- Laboratory compaction method used.

1.7.4 Records

Daily works record: Contractor to submit records for countersigning with the following:

- **ANNEXURE – ASPHALT WORK RECORD**, completed each day of the work performed.
- Asphalt delivery dockets: Indicate the time and date of mixing, registration or delivery truck fleet number and mass of each truck load.
- After finishing each asphalt pavement course:
  - Provide survey certificate demonstrating compliance with surface level and thickness requirements.
  - Provide inspection record verifying compliance with surface finish, shape, alignment and width requirements.

- Provide lot diagram updated to show bounds of lots.
- Provide lot register updated to record: Lot numbers, Delivery docket numbers, Lot volumes and Number of tests required for lot and specified test compliance criteria.

- Review of test results:
  - Provide test certificates verifying compliance with specified compaction requirements.
- Lot package closures: Provide lot package closure certificates confirming for the work lots covered by this ITP:
  - Confirm all inspections have been completed.
  - Confirm all tests have been completed and the results recorded on the lot record.
  - Confirm all non-conformances have been notified.
  - Confirm that non-conformances that have not been closed are recorded in the defects register.
  - Confirm that all changes to design details have been reviewed and approved in accordance with requirements, and these have been recorded and certified on a marked up copy of the relevant drawings (interim as built drawings) with a reference to the applicable design change notice or survey certificate.
  - Confirm that the complete set of construction records and as built drawings are accessible on-line.
  - Confirm that the lot package has been closed.

1.7.5 Tests

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES.**
Frequency of sampling: Submit proposal to vary frequency to correct non-conformance.

1.7.6 Variations

Approved mix design: Submit details, of proposed changes to the approved mix design, including its method of production, constituent material supply source, and alterations to RAP content, if applicable.

1.8 Inspections

1.8.1 Notice

General: Give notice so that inspection may be made of the following:

- Production plant and trucks: Asphalt production and delivery equipment before start of production mix and delivery to site.
- Sprayer calibration: Before start of spraying.
- Mobile equipment: Equipment condition before using.
- Surface preparation: Completed surface preparation, including repair of surface defects.
- Base gravel: Confirm that the base gravel has been prepared and approved for sealing.
- Spreading and compaction: Completed surfacing.

2 Pre-construction planning

2.1 Road occupancy

2.1.1 Road occupancy licensing

Requirement: Before commencement, obtain a road occupancy license for local roads for the area of work from the appropriate road/local government authority.

- Roads shared by the state road authority: Obtain occupancy from the Roads and Maritime Services.

2.2 Plant and equipment

2.2.1 Plant

Operation: Conform to statutory environmental regulations.

3 Materials

3.1 Aggregates

3.1.1 Properties and source

Properties and assessment: To Austroads AGPT04J.
Material source: Obtain each individual component of coarse and fine aggregates from the same sources as materials in the approved mix design.

3.1.2 Coarse aggregates

- Properties: To AS 2758.5 and the **Other coarse aggregate requirements table**.

3.1.3 Other coarse aggregate properties table

Test property	**Test value**	
	Heavy/very heavy traffic mix types	**Other mix types**
Shape testing: (See note 1) • Particle shape 2:1 ratio or • Flakiness Index	 25 25	 35 35
Weak particles (% maximum) (See note 2)	1	1
Water absorption (% maximum)	2.5	2.5
Polished stone value or polished aggregate friction value of wearing course asphalt	48 minimum	44 minimum
Notes: 1. Select only one type of shape test to be performed. 2. Weak particles test not required if unsound stone content is tested.		

3.1.4 Fine aggregates

Properties: Clean, hard, durable and free from lumps of clay and other aggregations of fine materials, organic material and other deleterious materials.
Soundness tested to AS C08.24: ≤ 12% weighted loss.

3.1.5 Mineral fillers

Properties: Added filler consistent in mineral composition; dry; and free from lumps, clay, organic matter or other materials deleterious to asphalt.

3.1.6 Added filler materials table

Material	Property[(1)]
Hydrated lime	To AS 1672.1
Fly ash	To AS/NZS 3582.1
Cement kiln dust	Solid material extracted from the flue gases in the manufacture of Portland cement, with maximum water soluble fraction of 20% (by mass) and conforms to the **Grading limits for ground limestone and cement kiln dust filler materials table**.
Slag	To AS 3582.2
Ground limestone	Rock dust derived from ground limestone conforming to the **Grading limits for ground limestone and cement kiln dust filler materials table**.
Cement	To AS 3972
Notes: 1. Provide test certificates verifying conformance, tested to the **Combined filler materials tests table**. 2. Rock dust not derived from the other aggregate components in the mixture: May be used as added filler if they are derived from materials that conform to **AGGREGATES**. 3. Where the AS indicates Loss on Ignition testing this is not required for fillers used in asphalt.	

3.1.7 Grading limits for ground limestone and cement kiln dust filler materials table

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

3.1.8 Combined filler material tests table

Filler type	Test type	Test property
All	Voids dry compacted filler	≥ 38%
All	Moisture content	Maximum 2%

3.2 Binders

3.2.1 Bitumen

Bituminous binders: To Austroads AGPT04F.
Classification and properties of bitumen: To AS 2008.

3.2.2 Other binders

Polymer modified binders: To Austroads AG:PT/T190 Table 5.2.

3.2.3 Additives

Type and proportion: To the manufacturer's recommendations.

3.2.4 Warm mix asphalt additives

Application: If required to reduce the asphalt manufacturing temperature and/or to improve workability during paving and compaction.

3.2.5 Rejuvenating agents

Mixes incorporating recycled asphalt: If rejuvenating agents are require, include an agent of with low volatility oil, capable of combining with bitumen to counteract hardening and to produce a binder with lower viscosity.

3.3 Reclaimed asphalt pavement

3.3.1 Properties and manufacturing

Reclaimed asphalt pavement (RAP): Provide materials derived from milling or excavating existing asphalt with the following properties:

- Crushed and screened to provide the required grade and size.
- Maximum size: Not greater than the mix size being produced.
- Material texture: Well graded, free flowing, and consistent product as detailed in the manufacturer's RAP management plan.
- Contaminants: Free of foreign material such as unbound granular base, broken concrete, crumbed rubber or other contaminants.
- Asphalt containing tar: Do not use.

Stockpiling: Place in designated stockpiles before use.

3.4 Testing

3.4.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

3.5 Mix design - general

3.5.1 Asphalt mixes

Mix types: Select from the following mixes based on particle size distribution to **ANNEXURE - SCHEDULE OF JOB DETAILS**:

- Dense graded asphalt (DGA), also called asphaltic concrete (AC).
- Stone mastic asphalt (SMA).
- Open graded asphalt (OGA).
- Fine gap graded asphalt (FGGA).
- Light traffic asphalt (LTA).
- Ultra-thin asphalt (UTA).

Asphalt courses: Provide the following asphalt in the pavement structure:

- Wearing or surface course.
- Intermediate course.
- Base course.

- Regulating, levelling or corrective course.

Dense graded asphalt mixes: Provide mix appropriate to the pavement traffic classification required in **ANNEXURE - SCHEDULE OF JOB DETAILS**.

3.6 Mix design - aggregate grading and binder content

3.6.1 General

Combined aggregate grading (including filler) and binder content: To the limits appropriate for the wearing course and asphalt mix type.

3.6.2 Dense graded asphalt (DGA) - Medium, heavy and very heavy traffic wearing course and base course mix table

AS sieve size (mm)	**Mix designation**				
	DGA10[(1)]	**DGA14**[(1)]	**DGA20**[(1)]	**DGA28**[(1)]	**DGA40**[(1)]
	Percentage passing by mass				
53.0	–	–	–	–	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 – 83	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
Binder content (% by mass)[(2)]	5.2 – 6.5	4.8 – 6.0	4.5 – 5.8	4.3 – 5.5	4.0 – 5.0
Notes: 1. Mix designation: Nominal mix size. 2. Bitumen content: Expressed as a percentage of the total mix by mass. 3. For high fatigue base course mix types, increase the range of binder content by 0.5% to 1%.					

3.6.3 Dense graded asphalt (DGA) - Light traffic wearing course mix table

AS sieve size (mm)	**Mix designation**			
	DGA5[1]	**DGA7**[1]	**DGA10**[1]	**DGA14**[1]
	Percentage passing by mass			
19.0	–	–	–	100
13.2	–	–	100	90 – 100
9.5	100	100	90 – 100	72 – 89
6.7	98 – 100	85 – 100	68 – 87	54 – 79
4.75	85 – 100	70 – 87	50 – 76	43 – 69
2.36	55 – 75	44 – 65	32 – 57	28 – 53
1.18	38 – 57	29 – 48	22 – 42	19 – 40
0.600	20 – 43	19 – 35	15 – 31	13 – 30
0.300	15 – 28	12 – 25	10 – 23	9 – 22
0.150	8 – 18	8 – 16	6 – 14	6 – 15
0.075	4 – 11	5 – 8	4 – 7	4 – 7
Binder content (% by mass)[2]	6.5 –7.5	6.0 –7.5	5.5 – 6.5	5.0 –6.0
Notes: 1. Mix designation: Nominal mix size. 2. Bitumen content: Expressed as a percentage of the total mix by mass.				

3.6.4 Open graded asphalt (OGA) mix table

AS sieve size (mm)	**Mix designation**	
	OGA10[1]	**OGA14**[1]
	Percentage passing by mass	
19.0	–	100
13.2	100	85 – 100
9.5	85 – 100	45 – 70
6.7	35 – 65	25 – 45
4.75	20 – 45	10 – 25
2.36	10 – 20	7 – 15
1.18	6 – 14	6 – 12
0.075	2 – 5	2 – 5
Binder content (% by mass)[2]	5.0 – 6.5	4.5 – 6.0
Notes: 1. Mix designation: Nominal mix size. 2. Bitumen content: Expressed as a percentage of the total mix by mass.		

3.6.5 Stone mastic asphalt (SMA) mix table

AS sieve size (mm)	**Mix designation**		
	SMA7[1]	**SMA10**[1]	**SMA14**[1]
	Percentage passing 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
0.075	8 – 12	8 – 12	8 – 12
Binder content (% by mass)[2]	6.0 – 7.3	6.0 – 7.0	5.8 – 6.8

Notes:

- Mix designation: Nominal mix size.
- Bitumen content: Expressed as a percentage of the total mix by mass.

3.6.6 Fine gap graded asphalt (FGGA) mix table

AS sieve size (mm)	**Mix designation**	
	FGG7[1]	**FGG10**[1]
	Percentage passing by mass	
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
Binder content (% by mass)[2]	6.0 – 7.0	6.0 – 7.0

Notes:

1. Mix designation: Nominal mix size.
2. Bitumen content: Expressed as a percentage of the total mix by mass.
3. Alternative particle size distribution: Do not use without approval.

3.7 Mix properties - general

3.7.1 Design criteria

Asphalt mix sampling and compaction: Use the gyratory compaction or the Marshall Method.

3.8 Mix properties - dense graded asphalt

3.8.1 Mix design criteria

Volumetric design criteria: To either of the following:

- **Dense graded asphalt (DGA) mixes prepared using gyratory compaction table**.
- **Dense graded asphalt (DGA) mixes compacted by the Marshall Method (50 blow compaction) table**.

Voids mineral aggregate (VMA): To the **Voids mineral aggregate (VMA) table**.
Minimum effective binder film index:

- High fatigue base mix: 0.01 mm.
- All other mixes: 0.0075 mm.

3.8.2 Dense graded asphalt (DGA) mixes prepared using gyratory compaction table

Mix type		**Laboratory compaction level (cycles)**	**Air voids (%)**	**Minimum air voids at 250 cycles (%)**
Traffic classification	**Application**			
Light	Wearing and base	50	3.0 – 7.0	–
Medium	Wearing and base	80	3.0 – 7.0	–
	High fatigue base	80	2.0 – 4.0	–
Heavy	Wearing and base	120	3.0 – 7.0	–
	High fatigue base	80	2.0 – 4.0	–
Very heavy	Wearing and base	120	3.0 – 7.0	2.0

3.8.3 Dense graded asphalt (DGA) mixes compacted by the Marshall Method (50 blow compaction(1)) table

Mix type		**Air voids (%)**	**Minimum stability (kN)**	**Flow (mm)**
Traffic classification	**Application**			
Light	Wearing and base	3.0 – 7.0	5.5	2 – 4
Medium	Wearing and base	4.0 – 7.0	6.5	2 – 4
	High fatigue base	2.0 – 4.0	6.5	2 – 4
Heavy	Wearing and base	3.0 – 7.0	6.5	2 – 4
	High fatigue base	2.0 – 4.0	6.5	2 – 4
Very heavy	Wearing and base	3.0 – 7.0	7.0	2 – 4

Notes:
1. Where 75 blow Marshall compaction is used, reduce the air voids range by 1% .
2. Where 35 blow Marshall compaction is used, increase the air voids range by 1% .

3.8.4 Voids mineral aggregate (VMA) table

Mix nominal size (mm)	VMA (% minimum)		
	Gyratory compaction	Marshall compaction (50 blow[1])	
		Heavy/very heavy traffic wearing course mixes	Other mix types<
7	16	–	16
10	16	16	16
14	15	15	15
20	14	–	14
28	13	–	13
40	12	–	12
Note: 1. Where 75 blow Marshall compaction is used, reduce the VMA by 1% .			

3.9 Mix properties - open graded asphalt

3.9.1 Mix design criteria

Volumetric design criteria: To the **Level 1 open graded asphalt mixes table**.
Asphalt particle loss: To the **Asphalt particle loss table**.
OGA maximum binder drain-off test value at 160°C: 0.3% by mass. A lower test temperature may be applied if the temperature is unlikely to be exceeded during manufacture and transportation.

3.9.2 Level 1 Open graded asphalt (OGA) mix table

Mix type/Traffic classification	Laboratory compaction		Air voids (%)
	Gyratory (cycles)	Marshall (blows)	
OGA	80	50	20 – 25

3.9.3 Asphalt particle loss table

Mix type/Traffic classification	Maximum asphalt particle loss (%) to AGPT/T236	
	Unconditioned	Moisture conditioned
OGA	20	35

3.10 Mix properties - fine gap graded asphalt

3.10.1 Mix design criteria

Volumetric design criteria: To the **Fine gap graded asphalt mixestable**.

3.10.2 Fine gap graded asphalt mixes table

Traffic classification	Laboratory compaction		Air voids (%)
	Gyratory (cycles)	Marshall (blows)	
Light	80	50	3.0 – 5.0

3.11 Mix properties – Light traffic asphalt

3.11.1 Mix design criteria

Volumetric design criteria: To the **Light traffic asphalt mix table**.

3.11.2 Light traffic asphalt mix table

Traffic classification	Laboratory compaction		Air voids (%)
	Gyratory (cycles)	Marshall (blows)	
Light	80	50	3.0 – 5.0

3.12 Mix properties – asphalt mixes incorporating (RAP)

3.12.1 Mix design criteria

Mixes containing RAP: Design mixes in conformance with the following:

- Prepare separate mix designs for mixes containing RAP.
- Binder in RAP: Include as binder in the total mix.
- RAP content in dense graded asphalt mixes generally: Maximum 15% of the total mix by mass.
- 15% to 30% of RAP content: 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 not allowed in the **ANNEXURE - SCHEDULE OF JOB DETAILS**. If required, allow for bitumen binder one class lower than the required viscosity if there is an increase in binder stiffness from hardening of binder in the RAP.

3.13 High Friction Asphalt mixes

- High Friction Asphalt mixes are preferred at intersections and roundabouts

4 Execution

4.1 Mix design

4.1.1 Mix design requirements

Design limits: Design a mix that conforms to **MATERIALS** for approval.
Identification: Identify each mix design by a unique numbering system acceptable to the Principal.
Non-conforming mixes: Revise and retest mixes that do not conform to **MATERIALS**.
Previously designed mixes: These may be acceptable if it conforms to all the following requirements:

- **MATERIALS**.
- The work is undertaken within a two year period of the date of testing in the mix design report.
- The type, quality and source of all constituent materials remain unchanged.

- The proportions of aggregates and filler do not vary by more than 20% of the proportion of that constituent material in the original mix design.

4.1.2 Mix design approval

Trial mix testing: Prepare minimum 6 samples for testing at the coarse and fine limits of the particle size distribution (PSD) in a laboratory.
Approval procedure: Provide mix design details to **SUBMISSION**, **Products and materials** and trial mix testing results demonstrating that the design mix conforms to the requirements of this worksection over the range of PSD and binder content limits.
Testing: By an accredited laboratory and test results presented in an endorsed test report.
Non-conforming mix design: Revise and retest.

4.1.3 Mix design currency

Period of mix currency: Mix designs may be current for a period of up to two years where no substantial change has occurred for the source and quality of the constituent materials.

4.2 Production mix

4.2.1 Sampling and testing of asphalt production

Production mix testing: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES.**
Sampling: Prepare samples from fresh production asphalt at the asphalt plant to AS/NZS 2891.1.1. Do not mix samples. Visually inspect each loaded truck on a random basis for segregation, uncoated particles, excess bitumen or overheating, before dispatch from the plant.

4.2.2 Sampling and testing frequency

Frequency of production asphalt testing: To the **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**

4.2.3 Process control

Process control measures: Develop, document and implement suitable measures for controlling the asphalt production process. Process control measures may include the following:

- The use of statistical process control charts for some or all of the tests required.
- Rules for determining the process is under statistical control and subject to reduced testing frequency.

4.2.4 Production tolerances on for aggregate grading and binder content table

AS sieve size (mm)/property	**Maximum permitted variations from the approved mix design (% by mass)**
Grading: Sieve size one size larger than nominal size	Nil
26.5 mm sieve or larger	± 7
4.75 to 19.0 mm sieve inclusive	± 7
1.18 to 2.36 mm sieve inclusive	± 5
0.300 to 0.600 mm sieve inclusive	± 4
0.150 mm sieve	± 2.5
0.075 mm sieve	± 1.5

AS sieve size (mm)/property	Maximum permitted variations from the approved mix design (% by mass)
Binder content: Percent by mass of total mix	± 0.3
Notes: 1. Source: AS 2150 Table 11.	

4.3 Construction Plant and equipment

4.3.1 General

Plant operating condition: Make sure all plant and equipment used on the work is suitable, conforms to the contractor's submitted quality documentation and kept in good operating condition.
Operation: Conform to statutory environmental regulations.
Faulty plant or equipment: Do not use faulty plant or equipment that may affect the product quality or operational safety.

4.4 Manufacture and storage

4.4.1 Asphalt manufacturing plant

Plant condition: Sound design and construction, capable of consistently producing the required asphalt mixes at a rate suitable for smooth, continuous asphalt placing.

4.4.2 Storage of raw materials

Storage: Store raw materials at the mixing site in sufficient quantities to allow continuous production, and effective sampling and testing before use.
Facilities for handling materials: Handle and store as follows:

- Aggregates: Prevent contamination and segregation. Allow for separate stockpiles of aggregates from different sources or of different sizes.
- Fillers: Keep dry and free flowing at all times. Separate fillers of different types.
- Additives, including cellulose or mineral fibres: Protect from moisture or contamination. Do not use wet materials.
- Binders: In thermostatically controlled binder tanks, each fitted with a thermometer that is located where it can be read conveniently and to allow for sampling of binders.

Heating binders: Do not heat bitumen binder to more than 185°C. Conform to the manufacturer's recommendations for temperature and time combinations for heating and storing multigrade and polymer modified binders.

4.4.3 Mixing temperature

Temperature of bitumen and aggregates: Not more than the temperature limits in the **Mixing temperatures table** at the mixing plant and when discharged from the plant.

4.4.4 Mixing temperatures table

Material	Maximum temperature (°C)
Class 170, Class 320 Bitumen delivered into mixer	165
Class 450, Class 600 Bitumen delivered into mixer	175
Asphalt at discharge from asphalt plant	175(1)
Note: 1. Maximum temperature of open graded asphalt: Not more than that determined from the asphalt	

Material	Maximum temperature (°C)
binder drain-off test.	

4.4.5 Moisture content

Maximum moisture content: 0.5% after completion of mixing.

4.4.6 Storage of mixed asphalt

Asphalt storage before delivery: If required, conform to the following:

- Store the mix in insulated bins to minimise segregation and prevent localised cooling and overheating if heating is required to maintain a uniform temperature throughout the body of mix.
- Discharging: Use a method that minimises segregation. Discard any caked or segregated portions of mix.
- Asphalt with polymer modified binders: Do not store in plant silos for more than 8 hours and to the manufacturer's recommendations.
- Open graded asphalt and stone mastic asphalt: Do not store in plant silos for more than four hours.
- Total time of storage: Not more than 24 hours without approval.

4.4.7 Asphalt mixes incorporating reclaimed asphalt pavement (RAP)

RAP materials: Use RAP from stockpiles that have been tested for grading and binder content and is consistent with the materials used in the approved mix design.
Batch mixing plants: Incorporate the RAP by one of the following methods:

- Meter into the asphalt plant after heating and drying of aggregates.
- Add directly to the weigh hopper with the other aggregate materials, for each batch.
- Weigh separately and add directly to the pugmill.

Batch mixing time: If necessary, increase mixing time to allow adequate heat transfer and dispersion of RAP.
Drum mix plants: Protect RAP from excessive temperatures at drum entry point and shield from direct flame contact.
High Friction Asphalt mixes are preferred at intersections and roundabouts

4.5 Delivery

4.5.1 Transportation

Requirement: Transport asphalt as follows:

- Vehicle body: Keep the inside of vehicle bodies clean and coat with a thin film of an appropriate release agent to prevent asphalt sticking to the body. Remove surplus release agent before loading asphalt into the vehicle.
- Protection: After loading with asphalt, cover the vehicle body to prevent contamination and reduce the mix cooling rate.
- Vehicle insulation: Insulate vehicles if the haul length or weather condition may cause the asphalt temperature to drop below the required placing temperature, or where excessive local cooling of the mix may occur.
- Transportation operation: Program so that operations allow for continuous placing of asphalt.

Asphalt work records

Asphalt work record: Particulars of the work performed are to be recorded by the Contractor on the Asphalt Work Record attached as Annexure or as per the Contractor's own procedures where equivalent. Complete the Asphalt Work Record, which is to be countersigned by the Superintendent each day as a true record of the work performed. Supply a copy to the Superintendent. This is a HOLD POINT.

Requirement: Record the details of the work performed each day. Include delivery dockets stating the mass of each truck load to Annexure Asphalt Work Record.

4.6 Placing

4.6.1 Surface preparation

Requirement: Clear surface of deleterious material before tack coating and placing asphalt.

Where required, sweep clean the area on which asphalt is to be placed. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent.

Rectification: The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's cleaning activities. Affected areas designated by the Superintendent shall be removed and reinstated with fresh asphalt. The cost of repairing such damage shall be borne by the Contractor.

4.6.2 Protection of services and fixtures adjacent to surfacing area

Protection: 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, access chamber covers, bridges, or culvert decks, kerbs and other road fixtures.

Cleaning: Immediately after spreading the asphalt, clean off and remove any residual materials from services and road fixtures, including surrounding structures and paths/driveways

4.6.3 Priming

Requirement: Prime seal is required to *C09 Sprayed bituminous surfacing.*

4.6.4 Tack coating

Application: Apply tack coat to the cleaned surfacing area before placing asphalt as follows:

- Tack coat material: Use a bitumen emulsion that conforms to AS 1160, at a breaking rate suitable to for the climatic and surface conditions so that the coating surface is fully broken, free of surface water and intact before spreading asphalt.
- Application rate of residual binder: Apply at a uniform rate in accordance with the mix design.
- Application method: Apply tack coat by spray bar fitted to a mechanical sprayer. Use hand spraying only in areas where it is impracticable to use a spray bar.
- Protection of adjacent works: Protect kerbs, channels, adjoining structures, traffic and parked vehicles from tack coat spray.

Tack coat omission: Coating may be omitted if spreading asphalt over clean, freshly placed asphalt, or over a clean primed surface.

Ultra-thin surfacing materials application rate: Nominate application rate of tack coat and modify the tack coating procedure to suit.

- Application rates more than 0.5 L/m2: Apply through a spray bar mounted directly on the asphalt paver, immediately ahead of the spreading of asphalt.

4.6.5 Asphalt spreading temperatures (for DGA) table

Road surface temperature (°C) [1]	**Minimum mix temperature (°C)**[2]			**Range of mix temperature (°C)**[3]
	< 30 mm[4]	**30 – 40 mm**[4]	**41 – 100 mm**[4]	**> 100 mm**[4]
5 – 10	See note 5	See note 5	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. Generally applicable to the coolest area of the pavements, e.g. shade areas.
2. Applicable to Classes 170, 320 and 450 bitumen binders. If using Class 600, multigrade, or PMBs, allow for temperatures 5 to 10°C higher than those shown.
3. Maximum temperatures apply when placing thick layers, to avoid excessive displacement under rolling.
4. Layer thickness.
5. If placing asphalt in thin layers under cool conditions is required, consider mix workability, asphalt temperature, compaction techniques and any other factor that may cause cooling from wind or moisture as this may adversely affect the ability to achieve proper compaction, joints and surface finish quality.
6. If placing of asphalt over a previous layer that has not cooled below about 65°C, adjust mix temperatures.
7. If warm mix asphalt (WMA) is used, the temperatures required can be reduced by 25°C to 30°C up to layer thicknesses of 100 mm. The minimum temperature of WMA for layer thicknesses of over 100 mm may be reduced by up to 15°C.

4.6.6 Spreading

Placing: Place asphalt with a self-propelling paving machine except where the use of a paver is impracticable.
Ambient conditions for placing: Place asphalt in the following conditions:

- Surfacing area: Dry and free from standing water.
- Surface temperature: Minimum 5°C.
- Pavement surface temperature for placing wearing course asphalt: Minimum 10°C. If placing at lower temperatures is required, obtain approval of procedures for compensating rapid cooling of asphalt materials.

Layer thickness: To the **Asphalt mix requirements table**.
Level control: To the **ANNEXURE - SCHEDULE OF JOB DETAILS**. If no method is documented, apply suitable automatic or manual screed level controls using an averaging beam or electronic device.
Spreading: Spread asphalt without tearing or segregation, in conformance with the following:

- Paving speed: Match the paving machine speed to the supply rate so that the number of paving stops is minimised.
- Paving stops: Do not leave the paving machine stationary for prolonged periods where the screed box is in contact with the previously placed asphalt or if there is loose asphalt in front of the screed.

4.6.7 Adjoining existing work

New work adjoining to existing work or structure: Align the horizontal location of any point on the pavement with the existing pavement structure.

4.6.8 Compaction

Timing: Uniformly compact asphalt on each layer as soon as the asphalt has cooled sufficiently to support the rollers without displacement.
Rollers: Use suitable sized steel wheeled or vibratory rollers and pneumatic tyred rollers to achieve compaction.
Open graded and stone mastic asphalt: Compact asphalt as follows:

- Do not use pneumatic tyred rollers.
- Use a method that does not damage to the aggregates or draws binder to the surface of stone mastic asphalt.
- Apply maximum 2 vibratory passes using high frequency and low amplitude.

4.6.9 Joints

Joint location: Plan the joint locations before work commences and provide joints as follows:

- Longitudinal joints: Provide if the width of the pavement requires more than one paving run.
- Transverse joints:
- At the completion of each day's paving operations.
- Where a delay in paving operation may cause the asphalt to cool and adversely affect placing.
- If a break in a longitudinal run is required.
- Minimise the number of joints.
- Shape requirements: To the Surface shape tolerance table.
- Longitudinal joints: Locate joints as follows:
- Align joints in the wearing course with traffic lane linemarkings.
- Offset joints from layer to layer by minimum 150 mm, provided that no joint is placed directly below a trafficked wheel path.

Transverse joints: Offset joints by minimum 2 m in adjoining paving runs and from layer to layer.
Hot joints: If placing asphalt against the edge of a preceding lane that has not cooled below 100°C, construct hot joints by leaving a 150 mm strip of asphalt unrolled along the free edge until the adjoining lane is placed. Compact the unrolled strip simultaneously with the material in the adjoining lane.
Warm joints: If placing asphalt against the edge of a preceding lane that has not cooled below 60°C, construct warm joints by rolling the full width of the first lane being placed, before placing the adjoining lane.
Cold joints: If placing asphalt against the edge of a preceding lane that has cooled below 60°C, construct cold joints by:

- Overlapping the previous edge by 25 to 50 mm.
- Pushing back the overlap using lutes, immediately after spreading, forming a slight ridge that is compacted with the steel wheel roller.

4.7 Finished pavement properties

4.7.1 Dimensions and levels

Requirement: Provide finished pavement to level, alignment, thickness and shape to **TOLERANCES**.

4.7.2 Density assessment

Lot conformance: Assess the lot characteristic value of in situ air voids.
Characteristic value of in situ air voids: Calculate the upper (V_u) and lower (V_L) characteristic values of in situ air voids of the lot as follows:
$V_L = \bar{a} - ks$
$V_u = \bar{a} + ks$
where:
$\bar{a}$ = arithmetic mean of the in situ air voids expressed as percentage for the lot.
s = standard deviation of the air voids expressed as percentage for the lot.
k = factor that depends on the number of tests as documented in **Acceptance constant table**.

$$a = \left(\frac{MD - BD}{MD} \right) \times 100\%$$

and
MD = mean maximum density of the production lot to AS 2891.7.1 or AS/NZS 2891.7.3.
BD = bulk density of the lot to AS/NZS 2891.9.2 for cores or AS/NZS 2891.14.2 and AS/NZS 2891.14.3 for nuclear density gauge.

4.7.3 Characteristic value of in situ air voids for wearing course asphalt table

Asphalt type and thickness (mm)	Upper limit characteristic value (%)	Lower limit characteristic value (%)
All heavy and very heavy traffic asphalt wearing courses	8	3
Medium traffic wearing course	8	3
Light traffic wearing course	7	3

4.7.4 Characteristic value of in situ air voids for base asphalt table

Asphalt type and thickness (mm)	Upper limit characteristic value (%)	Lower limit characteristic value (%)
All heavy and very heavy traffic asphalt wearing courses	8	3
Medium traffic wearing course	8	3
Light traffic wearing course	7	3

4.7.5 Acceptance constant table

Number of tests or measurements	Acceptance constant (k)
3	0.52
4	0.62
5	0.67
6	0.72
7	0.75
8	0.78
9	0.81
10 - 14	0.83
15 - 19	0.90
20	0.95

4.7.6 Ride quality

Council may request roughness testing results following installation.
Surface wearing course longitudinal profile: Maximum 40 to 50 NAASRA roughness counts or 1.6 to 2.0 International Roughness Index (IRI_s).

4.8 Field Testing for placing and finished pavement

4.8.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.
Frequency of in situ asphalt testing: To **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

4.8.2 Dimensions and levels

Course position: Determine using the following method:

- Levels: Survey.
- Alignment: Survey.

Thickness: If confirmation of asphalt thickness is required, determine it by coring to a recognised random sampling plan.

- Coring of asphalt: To AS 2891.1.2. Determine layer thickness before trimming of cores. Do not trim cores by more than 5 mm.

4.8.3 Density testing

Timing: Perform testing as soon as practicable after completion of work.
Location: Choose the location of each in situ density test by a method of random stratified sampling.
Layer thickness: Allow as follows:

- For core sample tests: The layer thickness is the mean thickness of the core samples.
- For nuclear and impedance density gauge tests: The layer thickness is the nominal thickness.

Core holes: Repair all holes using a method compatible with the pavement from which cores have been taken.
Restrictions: Do not perform density testing on the following:

- Lots less than 30 t.

- Layers with a nominal thickness equal to or less than 30 mm.
- Layers with a nominal thickness less than 2.5 times the nominal mix size, or open graded asphalt.

Bulk density: Determine from either of the following methods:

- Presaturation method: To AS/NZS 2891.9.2.
- Nuclear density measurement: To AS/NZS 2891.14.2 using the calibrated procedure described in AS/NZS 2891.14.3.

Maximum density: To AS 2891.7.1 or AS/NZS 2891.7.3.

Reference density: To AS/NZS 2891.14.5 calculate as the mean maximum density of the lot, for the purpose of in situ air voids calculations.

4.8.4 Completion tests

Surface shape: Deviation from 3 m straightedge test.

5 Annexures

5.1 Annexures - 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 or	Dist. from left to edge	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_____ Contractor's_____

Representative: (Signature) Representative: (Signature)

Affiliation: _____ Affiliation: _____

5.2 Annexure - Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C10-HP01	SUBMISSIONS, Products and materials Mix design – Type and source of constituent materials; Test certificates	H	Documentation on material type, source and test certificates as evidence of conformance for each constituent.	10 days before starting production mix	Production of mix
C10-HP02	SUBMISSIONS, Products and materials Mix design	H	Samples, documentation and test certificates verifying the mix design meets the project requirements.	10 days before starting production mix	Production of mix
C10-HP03	SUBMISSIONS, Tests Production mix	H	Test certificates.	7 days before ordering materials	Ordering and delivery of material
C10-WP04	INSPECTIONS, Notice Production plant and trucks	W	Asphalt production and delivery equipment condition	1 day before starting production mix	Asphalt production
C10-WP05	INSPECTIONS, Notice Sprayer calibration	W	Spraying equipment condition	1 day before spreading	Primer spraying
C10-WP06	INSPECTIONS, Notice Mobile equipment	W	Equipment condition	1 day before using equipment	Asphalt production and primer spraying
C10-WP07	SUBMISSIONS, Records Daily work records	W	Completed **ANNEXURE – ASPHALT WORK RECORD**. Delivery dockets.	On the day of delivery	Asphalt supply
C10-WP08	INSPECTIONS Asphalt delivery. Asphalt finishing. Asphalt tests	W	QA documentation of delivery, finishing, and testing	7 days before finishing processes such as linemarking and RPM's	**ASPHALT WORK RECORDS**
C10-HP09	SUBMISSIONS,	H	If required, details of	1 day before	Placing/

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
	Execution details Spreading at low temperatures		proposed procedures.	spreading	spreading
C10-HP10	SUBMISSIONS, Execution details Joints	H	Plan of joint locations.	7 day before placing	Placing/ spreading
C10-HP11	INSPECTIONS, Notice Surface preparation	H	Completed surface preparation, including repair of surface defects. Confirm base gravel is approved for surfacing to commence	7 days before placing	Placing/ spreading. For development inspections book through "MyInspect".
C10-HP12	INSPECTIONS, Notice Spreading and compaction	H	Completed surfacing.	2 days after compaction	The next lot or application of pavement marking. For development inspections book through "MyInspect".
C10-WP13	INSPECTIONS, Notice Non-conforming sections	W	Completed replacement and rectification of non-conforming sections.	1 day before the inspection	Linemarking application and opening to traffic
C10-HP14	SUBMISSIONS, Work as Executed Drawings and Road Asset Attribute Schedules	H	Submit certified drawings and schedules	2 weeks after placement of road surfacing	Prior to Subdivison Certificate/Occupation Certificate
	*H = Hold Point, W = Witness Point				

5.3 Annexure – Maximum lot sizes and minimum test frequencies table

5.3.1 Frequency of sampling and testing of constituent materials

Activity	Material properties	Maximum lot size	Minimum test frequency	Test method/Conformance assessment
Material supply	Coarse and fine aggregates Grading	1 week's production	1 per week	AS C08.11.1

Activity	Material properties	Maximum lot size	Minimum test frequency	Test method/Conformance assessment
	Coarse aggregates			
	Los Angeles Abrasion (where applicable)	1 contract	1 per contract or change in materials or 6 monthly	AS C08.23
	Unsound and marginal stone content (where applicable)		or 6 monthly	AS C08.30.1
	Wet strength (Where applicable)		or 6 monthly	
	Wet/dry variation (Where applicable)		or 6 monthly	
	Weak particles		or 6 monthly	AS C08.32
	PAFV		or 12 monthly	AS C08.40, AS C08.41 or AS C08.42
	Water absorption and density		or 6 monthly or change in materials	AS C08.6.1 or AS C08.6.2
	Shape testing of coarse aggregate • Particle shape 2:1 ratio • Flakiness Index		or 6 monthly or change in materials	AS C08.14 or AS C08.15
	Fine aggregates			
	Soundness	1 contract	1 per contract or change in materials	AS C08.24
	Combined filler			
	Voids in dry compacted filler	1 contract or 1 month's production	1 per contract or 1 per month	AS/NZS C08.17
	Added mineral filler			
	Grading	Each production batch	1 per batch or 12 monthly	AS C08.11.1
	Voids in dry compacted filler			AS/NZS C08.17
	Moisture content			AS 4489.8.1
	Binder			

Activity	Material properties	Maximum lot size	Minimum test frequency	Test method/Conformance assessment
	Bitumen	Each production batch	AS 1160 Table A1	AS 1160 Table A1
	PMB		Austroads AG:PT/T190 Table 5.2	Austroads AG:PT/T190 Table 5.2
	RAP			
	Grading	1 stockpile	1 per stockpile	AS/NZS 2891.3.1, AS/NZS 2891.3.2 or AS/NZS 2891.3.3
	Binder content	1 contract	1 per contract or change in materials	
	Mix properties			
Mix design	Approval of mix and NATA endorsed certification – supplier's documentary evidence and certification	1 contract	1 per mix	**MATERIALS**

5.3.2 Frequency of sampling and testing of production of asphalt table

Activity	Key quality verification requirements	Normal minimum frequency	Test method
Asphalt production	Grading	One test per 300 t of asphalt plant production	AS/NZS 2891.3.1
	Binder content	One test per 300 t of asphalt plant production	AS/NZS 2891.3.1
	Binder film index	One test per 300 t of asphalt plant production	Austroads AG:PT/T237
	Temperature	Each loaded truck or as indicated on the plant control system	
Laboratory compacted dense graded asphalt (DGA) - Voids and VMA	Marshall stability and flow (50 blows)	One test per 300 t of asphalt plant production	AS/NZS 2891.5
	Voids in mix (50 blows)	One test per 300 t of asphalt plant production	AS/NZS 2891.8
	Gyropac (80 cycles)	One test per 300 t of asphalt plant production	AS/NZS 2891.2.2 AS 2891.7.1 or AS/NZS 2891.7.3 AS/NZS 2891.9.2 AS/NZS 2891.8
	Gyropac (120 cycles)	One test per 300 t of asphalt plant production	AS/NZS 2891.2.2 AS 2891.7.1 or AS/NZS 2891.7.3 AS/NZS 2891.9.2 AS/NZS 2891.8
	Gyropac (250 cycles)	One test per 300 t of asphalt plant production	AS/NZS 2891.2.2 AS 2891.7.1 or AS/NZS 2891.7.3 AS/NZS 2891.9.2 AS/NZS 2891.8
Laboratory compacted open graded asphalt (OGA)	Voids: Gyropac (80 cycles)	One test per 300 t of asphalt plant production	AS/NZS 2891.2.2 AS/NZS 2891.7.3 AS/NZS 2891.9.3 AS/NZS 2891.8
	Asphalt particle loss	One test per 300 t of asphalt plant production	Austroads AG:PT/T236
Laboratory compacted	Voids: Gyropac (120	One test per 300 t of	AS/NZS 2891.2.2

Activity	Key quality verification requirements	Normal minimum frequency	Test method
stone mastic asphalt (SMA)	cycles)	asphalt plant production	AS 2891.7.1 or AS/NZS 2891.7.3 AS/NZS 2891.9.2 AS/NZS 2891.8
Laboratory compacted fine gap graded asphalt (FGGA)	Voids in mix (50 blows)	One test per 300 t of asphalt plant production	AS/NZS 2891.8
	Voids: Gyropac (80 cycles)	One test per 300 t of asphalt plant production	AS/NZS 2891.2.2 AS/NZS 2891.7.3 AS/NZS 2891.8 AS/NZS 2891.9.3

5.3.3 Frequency of sampling and testing of finished asphalt properties table

Activity	Characteristics	Maximum lot size	Minimum test frequency	Test method/Conformance assessment
Placing and compaction	Course position	1 day's laying	One survey point per 25 m^2	Survey
	Compacted course thickness	1 day's laying	One core per 500 m^2 with minimum 5 per lot	Average thickness of coring to AS 2891.1.2
	In situ air voids for DGA, FGG, SMA	1 day's laying	One core per 500 m^2 with minimum 5 per lot	AS/NZS 2891.9.2 or AS/NZS 2891.14.2
	Density ratio and percentage of air voids of in situ compacted asphalt < 40 mm	1 day's laying	One core per 500 m^2 with minimum 5 per lot	AS/NZS 2891.14.5
	Surface shape	1 day's laying	10 per 200 m lane length or part thereof	3 m straightedge
	Ride quality	1 day's laying	10 per 200 m lane length or part thereof	T188

5.4 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS C08		Methods for sampling and testing aggregates
AS C08.6.1	2000	Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS C08.6.2	1996	Particle density and water absorption of coarse aggregate – Pycnometer
AS C08.8	2014	Water soluble fraction of filler
AS C08.11.1	2009	Particle size distribution - Sieving method
AS C08.14	2007	Particle shape, by proportional caliper
AS C08.15	1999	Flakiness index
AS/NZS C08.17	2014	Voids in dry compacted filler
AS C08.22	2008	Wet/dry strength variations
AS C08.23	2009	Los Angeles value
AS C08.30.1	2009	Coarse aggregate quality by visual comparison
AS C08.32	2008	Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS C08.40	2017	Polished aggregate friction value - Vertical road-wheel machine
AS C08.41	2017	Polished aggregate friction value - Horizontal bed machine
AS C08.42	2017	Pendulum friction test
AS 1160	1996	Bitumen emulsions for construction and maintenance of pavements
AS 1672		Limes and limestones
AS 1672.1	1997	Limes for building
AS 2008	2013	Bitumen for pavements
AS 2150	2005	Hot mix asphalt - a guide to good practice
AS 2758		Aggregates and rock for engineering purposes
AS 2758.5	2009	Coarse asphalt aggregates
AS/NZS 2891		Methods of sampling and testing asphalt
AS/NZS 2891.1.1	2013	Sampling - Loose asphalt
AS 2891.1.2	2008	Sampling - Coring method
AS/NZS 2891.2.2	2014	Sample preparation - Compaction of asphalt test specimens using a gyratory compactor
AS/NZS 2891.3.1	2013	Bitumen content and aggregate grading - Reflux method
AS/NZS 2891.3.2	2013	Binder content and aggregate grading - Centrifugal extraction method
AS/NZS 2891.3.3	2013	Bitumen content and aggregate grading - Pressure filter method
AS/NZS 2891.5	2015	Compaction of asphalt by Marshall method and determination of stability and flow - Marshall procedure
AS 2891.7.1	2015	Determination of maximum density of asphalt - Water displacement method
AS/NZS 2891.7.3	2014	Determination of maximum density of asphalt - Methylated spirits displacement
AS/NZS 2891.8	2014	Voids and density relationships for compacted asphalt mixes
AS/NZS 2891.9.2	2014	Determination of bulk density of compacted asphalt – Presaturation method

AS/NZS 2891.9.3	2014	Determination of bulk density of compacted asphalt - Mensuration method
AS/NZS 2891.14.2	2013	Field density tests - Determination of field density of compacted asphalt using a nuclear thin-layer density gauge
AS/NZS 2891.14.3	2013	Calibration of nuclear thin-layer density guage using standard blocks
AS/NZS 2891.14.5	2014	Field density tests - Density ratio and percentage air voids of compacted asphalt
AS/NZS 3582		Supplementary cementitious materials
AS/NZS 3582.1	2016	Fly ash
AS 3582.2	2016	Slag - Ground granulated blast-furnace
AS 3972	2010	General purpose and blended cements
AS 4489		Test methods for limes and limestones
AS 4489.8.1	1997	Free moisture - Convection oven
AAPA	2004	National Asphalt Specification
Austroads AGPT		Guide to pavement technology
Austroads AGPT02	2012	Pavement structural design
Austroads AGPT03	2009	Pavement surfacings
Austroads AGPT04B	2014	Asphalt
Austroads AGPT04E	2009	Recycled materials
Austroads AGPT04F	2017	Bituminous binders
Austroads AGPT04J	2008	Aggregates and source rock
Austroads AG:PT/T190	2014	Specification framework for polymer modified binders
Austroads AG:PT/T236	2005	Asphalt Particle Loss
Austroads AG:PT/T237	2005	Binder Film Index
Austroads AP-C087	2015	Austroads glossary of terms
Austroads AP-T41	2006	Specification framework for polymer modified binders and multigrade bitumens

RMS Test Methods	
QA Specification R116	Heavy Duty Dense Graded Asphalt
QA Specification 3253	Bitumen for pavements.