ROADS AND MARITIME SERVICES (RMS)

QA SPECIFICATION R121

STONE MASTIC ASPHALT

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		Initial issue for trials.	GM, RNIC	13.01.00
Ed 1/Rev 1	1.3, 2.1.3(b).	Minor changes	GM, RNIC	17.08.00
	2.3.1(c), Annx R121/4	Annexure R121/4 changed to Annexure R121/5		
	Annexure R121/4	New annexure listing identified records		
Ed 1/Rev 2	1.3, 2.1.3	RTA 3211 specified for Flyash	GM, RNIC	11.02.03
Ed 2/Rev 0	"Notice"	RTA PO Box and Fax numbers updated.	GM, IC	24.11.09
	Foreword	Foreword, incorporating copyright clause, added		
	Global	Specification reformatted. Text revised to direct imperative style. "Contractor" replaced by "you". "Superintendent" replaced by "Principal". "shall" replaced by "must". Some clauses moved to Annexures. Minor editing to clarify intent.		
	Annex M	Reference documents updated.		
Ed 2/Rev 1	2.1.3	Reference to spec RTA 3054 changed to RTA 3211.	GM, IC	02.11.10
	Annex M	Reference to spec RTA 3054 deleted.		
Ed 3/Rev 0	Global	Clauses rearranged and reworded to improve clarity.	GM, IC	09.07.13
	Guide Notes	Guide notes simplified. Technical Reference Notes deleted.		
	1.1	Reworded to be similar to other asphalt specs.		
Ed 3/Rev 0 (cont'd)	2	Requirement to comply with APRG 18, AS 2150 and AS 2734 removed.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
	2.1.1, 2.1.2	Reference for coarse and fine aggregate requirements changed to spec 3152.		
	2.1.3	New clause on recycled materials added. Subsequent clauses renumbered.		
	2.1.4 (d)	Maximum MBV of filler specified.		
	2.1.5	Use of PMB mandated through deletion of reference to spec 3253.		
	2.1.6 (a)	Material requirements for adhesion agents removed.		
	2.1.6 (c)	Requirements for warm mix asphalt additive added.		
	2.1.7	Option to specify tack coat with 3% SBR deleted.		
	2.2.1 (a)	Requirement for minimum 50% of fine aggregate to be derived from crushed rock removed.		
	Table 121.1	Grading envelopes for SMA10 and SMA14 widened to allow for production tolerances.		
	2.2.1 (c)	Requirements for granulated glass aggregate added.		
	2.2.1 (e)	Upper limit of 1.0% of adhesion agent added.		
	2.2.1 (g)	Requirements for warm mix asphalt additive added.		
	2.2.2	Voids requirements simplified. 80 cycle requirement and 350 cycle, > 2.5% requirement deleted.		
		Test methods changed to RMS tests, and associated requirement for mix volume ratio added.		
	2.2.3	Asphalt moisture content requirement added.		
	2.2.4	Binder drain down requirement added.		
	2.2.5	Deformation resistance requirement added.		
	2.3.1	New subclause. Subsequent subclause renumbered.		
	2.3.2	Retitled “Submission of Nominated Mix Design”.		
		12 month validity period for Hold Point release on mix submission added.		
	2.3.2 (e)	Requirements for warm mix asphalt additive added.		
Ed 3/Rev 0 (cont’d)	2.4.2.2	Added r equirement that actual production values must remain within aggregate grading and binder content limits in Tables 1 and 2.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
	2.4.4	Temperature and time limits on storage of SMA added. Required actions for exceeding storage limit added.		
		Upper limit of 175°C for production temperature added.		
	3.2	Previously clause 3. Subsequent clause 4, 5, etc renumbered to clause 3, 4, etc.		
	3.3	Retitled "Method of Placement".		
		MTV requirements added.		
		Course thickness limits of between 3.0 to 5.0 times nominal mix size added.		
	3.7	Previously clause 4.5. Minimum asphalt laying temperatures tabulated; different requirements for different layer thickness removed.		
	3.8	Previous clause 4.6, retitled "Paving and Compaction Temperatures".		
		Hold Point for submission of details of temperature during delivery and placing added.		
		Provision for use of infrared thermometer added.		
	3.9	Upper limit for tackcoat application rate increased from 0.3 to 0.4 L/m^2.		
		Provision added for reduced application rate of tackcoat due to underlying pavement material such as primerseal or seal.		
		Requirement for tackcoat to be intact at commencement of asphalt placement added.		
	4.1.1	Upper limit of characteristic value of insitu air void content reduced from 9% to 7.0%.		
	4.3	Measurement of ride quality changed from NAASRA counts to IRI.		
		Previous clause 5.4 titled "Skid Resistance" deleted.		
	4.4	Texture depth requirement at time of construction added.		
	5.2	Deductions for Insitu air voids added.		
	Annex B3	Incentives for ride quality added.		
Ed 3/Rev 0 (cont'd)	Annex E	Previous clause 4.8.2 on calculation of characteristic values moved here. Previous combined particle size distribution chart removed.		
	Annex M	Reference documents updated.		

GUIDE NOTES

(Not Part of Contract Document)

Using Specification R121

Specification RMS R121 is a QA specification and the use of QA specifications requires the implementation of a quality management system by the Contractor that meets the quality management system requirements specified in Specification RMS Q. To comply with the intention of government policy as well as RMS R121, Stone mastic asphalt works constructed using RMS R121 require adequate surveillance and audit by the Principal.

RMS R121 requires the RMS Project Manager to select appropriate parameters identified in RMS R121 and nominate them in Annexure R121/A. The Project Manager is also required to select an appropriate version of RMS Q commensurate with the size of the project and the risk to the Principal.

Introduction

Stone mastic asphalt may be referred to by the acronym SMA. It is promoted primarily for use as a surfacing course with relatively high surface texture, low permeability and a high resistance to rutting. The coarse texture tends to reduce the generation of spray during rain periods.

In practice, there is a chance that SMA supplied under this first edition of the specification may be more permeable than expected and pavement designers will need to take this into account. In some cases, the application of a sprayed seal will be warranted prior to placing SMA. Development and/or evolution of the product is expected to continue with a view to minimising permeability and this should eventually lead to the specification of lower air voids limits without unacceptable risk of flushing.

SMA is generally not used lower in the pavement as structural asphalt because of its relatively high cost and lower design stiffness both of which tend to result from a relatively high binder content. Pavement designers are advised to check with RMS Pavement Section in respect of design stiffness for SMA.

SMA is designed with a high proportion of coarse aggregate to generate stone on stone contact between the coarse aggregate particles within the mix with the resulting skeletal voids being partially filled by the mixture of binder and fines (mastic). Thus the inter-particle friction of the coarse aggregate is a significant consideration and care must be taken in the selection of source in terms of shape, fractured faces and particle microtexture.

The mix design and the subsequent production process must ensure that the voids in the coarse aggregate skeleton are sufficient to contain the mastic and the appropriate air voids if performance is to be realised. To achieve this, the aggregate will have good shape and the grading will generally be coarse and gapped in the vicinity of the 2.36 mm and 4.75 mm AS sieves. The quality of aggregate supply must be consistent for the duration of the work and to this end, the use of museum samples (glass containers of the constituents used for mix design purposes) as a surveillance tool is strongly recommended.

The relatively high proportion of binder/mastic requires special attention to be paid to aspects of process if a homogeneous product is to be achieved. These include the possibility of segregation due to insufficient mixing time, binder drainage during haulage, binder segregation during paving/rolling and flushing on opening to traffic.

SMA supplied under this specification is intended to be used as a relatively thin wearing surface and has a service life of approximately 10 years.

The quality and surface condition of the existing pavement impacts on the suitability and performance of SMA. Existing pavements with low deflection/curvature, good shape and free of cracking offer the best chance of success.

RMS Project Managers may obtain a general guide and past performance information from RMS Pavement Section. An AAPA Guide to SMA is currently being prepared.

Transport Roads & Maritime Services

NSW GOVERNMENT

QA SPECIFICATION R121

STONE MASTIC ASPHALT

IC-QA-R121

VERSION FOR:
DATE:

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CLAUSE PAGE

FOREWORD

RMS COPYRIGHT AND USE OF THIS DOCUMENT

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REVISIONS TO PREVIOUS VERSION

This document has been revised from RMS Specification R121 Edition 2 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes have been indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

RMS QA SPECIFICATION R121

STONE MASTIC ASPHALT

1 GENERAL

1.1 OVERVIEW

This Specification sets out the requirements for stone mastic asphalt for use as a thin textured single layer wearing course. It is suitable for use on high speed traffic roads, but not in high stress locations such as intersection or roundabouts.

During the first 24 months after the Actual Completion Date:

(a) the asphalt must not ravel, rut, shove, strip or bleed; and

(b) the asphalt for the first 12 months must comply with the surface shape requirements specified in Table R121.8.

1.2 SCOPE

The work to be carried out under this Specification comprises the following:

(a) design of the asphalt mix(es);

(b) supply of materials, production and transport of the asphalt;

(c) preparation and application of tackcoat on the surface on which the asphalt is to be placed;

(d) placement and compaction of asphalt;

(e) all inspection and testing necessary to demonstrate that the quality requirements of this Specification have been achieved.

1.3 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of Annexures that detail additional requirements.

1.3.1 Project Specific Requirements

Project Specific Requirements are shown in Annexure R121/A.

1.3.2 Measurement and Payment and Disposition of Nonconformities

The method of measurement and payment must comply with Annexure R121/B1.

Acceptance of materials and work must be in accordance with Annexure R121/B2.

1.3.3 Schedules of HOLD POINTS and Identified Records

The schedules detailed in Annexure R121/C list the **HOLD POINTS** that must be observed. Refer to Specification RMS Q for definitions of **HOLD POINTS.**

The records listed in Annexure R121/C are **Identified Records** for the purposes of RMS Q Annexure Q/E.

1.3.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements shown in Annexure R121/D and must be implemented.

If the Contract does not require you to implement a PROJECT QUALITY PLAN, the documents listed in Annexure R121/D must be submitted to the Principal for consideration at least 5 working days prior to work commencing and must be implemented.

Include in the PROJECT QUALITY PLAN all manufacturers' recommendations indicated in this Specification.

1.3.5 Requirements for Technical Procedures

Details of calculation for insitu air voids and thickness are shown in Annexure R121/E.

1.3.6 Testing Procedures

Your Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of the item, which must not be less than the frequency specified in Annexure R121/L except where the Principal has approved a reduced frequency of testing as per 5.3.1 of the Specification.

Where a minimum frequency is not specified, nominate an appropriate frequency.

1.3.7 Referenced Documents

Unless otherwise specified or is specifically supplied by the Principal, the applicable issue of a reference document must be the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R121/M.

1.4 DEFINITIONS AND ABBREVIATIONS

1.4.1 Definitions

In this Specification:

(a) the terms "you" and "your" mean "the Contractor" and "the Contractor's" respectively;

(b) the term "stone mastic asphalt" includes "asphalt" and "mix";

Other definitions are in accordance with the Glossary of Austroads Terms.

1.4.2 Abbreviations

The following abbreviations apply to this Specification:

AAPA Australian Asphalt Pavement Association

IRI International Roughness Index

MTV Material Transfer Vehicle

MBV	Methylene Blue Value
NATA	National Association of Testing Authorities
N/A	Not Applicable
PAFV	Polished Aggregate Friction Value
PQP	Project Quality Plan
SMA	Stone mastic asphalt
VMA	Voids in Mineral Aggregate

2 SUPPLY OF SMA

2.1 MATERIALS FOR SMA

All materials used in the manufacture of asphalt must comply with the requirements of this Specification and maintain uniform appearance for the duration of the work.

2.1.1 Coarse Aggregates

Coarse aggregate must comply with Specification RMS 3152.

When aggregates from a specific source or type, or when aggregate with a high PAFV or other special characteristics are specified, 100% of the coarse aggregate in the asphalt must comply with this requirement.

2.1.2 Fine Aggregate

Fine aggregate must comply with Specification RMS 3152.

2.1.3 Recycled Materials

2.1.3.1 Reclaimed Asphalt Pavement (RAP) Material

RAP material is not permitted.

2.1.3.2 Granulated Glass Aggregate

Granulated glass aggregate must comply with Specification RMS 3154

2.1.4 Filler

The total filler in asphalt is the combined fraction of fines produced from the crushing of aggregates and any added filler which passes the 0.075 mm AS sieve.

Filler must meet the following requirements:

(a) Added filler must conform to Specification RMS 3211;

(b) Dry compacted voids content of the total filler fraction in asphalt determined in accordance with AS 1141.17 must be 40% or greater;

(c) Methylene blue value of the total filler in asphalt (excluding hydrated lime) determined in accordance with Test Method RMS T659 must not exceed 10 mg/g.

2.1.5 Binder

The class of binder used in the work must be as specified in Annexure R121/A.

The binder must conform to the requirements of Specification RMS 3252. Provide documentary evidence of the binder compliance for each delivery used in the work.

2.1.6 Additives

(a) Bitumen Adhesion Agent

Bitumen adhesion agent may be added to improve the resistance of the asphalt's propensity to stripping.

(b) Fibre Additive

Use only cellulose fibre as fibre additive.

You may propose an alternative fibre additive for approval by the Principal. Such proposals must be accompanied by documented evidence of the successful use or trial use of such fibre additive under circumstances similar to those which exist under the Contract.

In all cases, attach to your PROJECT QUALITY PLAN the technical specification for the fibre additive and manufacturer's recommendations on the application, handling and incorporation of the fibre additive into the asphalt.

(c) Warm Mix Asphalt Additive

Warm mix asphalt additive may be added to asphalt to reduce the asphalt manufacturing temperature and/or to improve workability during the paving and compaction operations.

2.1.7 Bitumen Emulsion Tackcoat

Bitumen emulsion for use as a tackcoat must be CRS/170-60 complying with AS 1160 unless otherwise approved by the Principal.

2.2 REQUIREMENTS FOR SMA

2.2.1 Proportions of Constituent Materials

The proportions of constituent materials must be as follows:

(a) Combined Particle Size Distribution of Aggregate

The combined particle size distribution of aggregate, when determined in accordance with AS 2891.3.1, must conform to Table R121.1.

Table R121.1 - Combined Particle Size Distribution Limits

AS Sieve Size	**Combined Particle Size Distribution Passing Limits for Nominal Size of Asphalt** (% by mass) **(Asphalt Designation)**	
	10 mm (SMA10)	**14 mm (SMA14)**
26.5 mm	–	–

19.0 mm	–	100
13.2 mm	100	76 – 100
9.50 mm	80 – 100	31 – 64
6.70 mm	31 – 64	16 – 44
4.75 mm	16 – 44	14 – 36
2.36 mm	13 – 31	13 – 31
1.18 mm	11 – 27	11 – 27
0.600 mm	8 – 24	8 – 24
0.300 mm	7 – 21	7 – 21
0.150 mm	8.5 – 16.0	8.0 – 16.0
0.075 mm	7.5 – 12.5	7.5 – 12.5

(b) Binder

In the nominated mix design, the proportion of binder expressed as a percentage by mass of the total mix must comply with the requirements of Table R121.2.

Table R121.2 – Binder Content

Nominal Size of Asphalt (Asphalt Designation)	**10 mm (SMA10)**	**14 mm (SMA14)**
Binder Content (% by mass of total mix)	6.2 – 7.2	6.0 – 7.0

Note: The specified binder content range is applicable to commonly used natural sources of asphalt aggregates and sands for a known range of densities. If you propose to use constituents of substantially different density, then for the nominated design mix and use of the mix in the works, you may propose a nonconforming binder content subject to the approval of the Principal. You must demonstrate that the volumetric proportions are consistent with the intent of the Specification.

Determine the binder content in accordance with AS 2891.3.1.

(c) Granulated Glass Aggregate

The proportion of granulated glass aggregate in SMA must not exceed 2.5% by mass of the total mix.

(d) Hydrated Lime

The amount of hydrated lime in SMA must not be less than 1.5%, by mass of total aggregate.

(e) Adhesion Agent

Asphalt may contain bitumen adhesion agent not exceeding 1.0% by mass of the binder.

(f) Fibre Additive

Nominate the amount of fibre in the mix, which must not be less than 0.3% by mass of the total mix.

(g) Warm Mix Asphalt Additive

The maximum proportion of additive must comply with Table R121.3.

Table R121.3 – Maximum Proportion of Additive in Warm Mix Asphalt

Additive	Maximum Proportion
Wax	2.0% by mass of binder
Surfactants	Nominated by Contractor
Water (either directly, or in the form of water containing crystals)	0.06% by mass of the total mix

2.2.2 Volumetric Characteristics

For all asphalt mixes:

(a) The air voids in laboratory compacted briquettes must be:

(i) ≥ 3.0% and ≤ 6.0% when determined in accordance with Test Method RMS T662 at 120 cycles of compaction, AS 2891.7.1 or AS 2891.7.3, AS 2891.8 and AS 2891.9.2;

and

(ii) ≥ 2.0% when determined in accordance with Test Method RMS T662 at 350 cycles of compaction, AS 2891.7.1 or AS 2891.7.3, AS 2891.8 and AS 2891.9.2.

(b) The mix volume ratio when determined in accordance with Test Method RMS T646 must be < 1.0. For the purpose of T662, apply 120 cycles of gyratory compaction.

2.2.3 Moisture Content

For all mixes produced in a drum plant, the moisture content must be < 0.5% by mass of the total mix when determined in accordance with Test Method RMS T660.

2.2.4 Binder Drain Down

The binder drain down when determined in accordance with Test Method RMS T648 must be less than 0.3% after 4 hours at the maximum nominated production temperature.

2.2.5 Deformation Resistance

The rut depth, when determined in accordance with Austroads AG:PT/T231, must not be greater than 2.5 mm.

2.3 NOMINATED MIXES

2.3.1 Nominated Mix Design

The submitted nominated mix design is:

(i) materials specific, and substitution of constituent materials during production is not permitted;

(ii) design specific, and variation to the design nominated mix submission is not permitted;

(iii) asphalt plant specific, and, except for component maintenance, changes in the components, configuration and/or location of the plant is not permitted;

(iv) contract specific, and release of the Nominated Mix Hold Point under another contract is not applicable to this contract.

For each new establishment of a mobile asphalt plant, a full nominated mix submission is required.

2.3.2 Submission of Nominated Mix Design

Unless specified otherwise, all asphalt and binder tests relating to the submission must be carried out within a one month period prior to the date of submission to the Principal. All other tests relating to the submission must be carried out within a 6 month period prior to the date of submission to the Principal. All phases of any particular test must be performed at the same laboratory.

Submit to the Principal one nominated mix design for each asphalt mix specified in Annexure R121/A. The nominated mix design submission must include the following details:

(**a) Constituent Materials**

(i) Coarse and fine aggregates: source, geological type.

Aggregate of different type or quality from the same quarry face or within a quarry will be regarded as a different source.

(ii) Added filler: type, grade and source.

(iii) Binder: source, class or grade.

(iv) Recycled materials: recycled glass granulate, the type, source and manufacturer's recommendations.

(v) Additives: type, source, trade name and manufacturer's recommendations.

(b) Mix Design

(i) Proportion of each constituent by percentage of mass of total mix.

(ii) For each nominated mix design, the nominated values and allowable tolerances, where required, for each requirement for the asphalt specified in Clause 2.2.

(iii) Graphical representation of the nominated combined particle size distribution with control points as required by the limits of Table R121.1 and the production tolerances in accordance with Table R121.4.

(iv) Type and identification number of the asphalt mixing plant.

(v) Temperature range at which the asphalt is to be manufactured.

(c) Production Trial

All production trial tests on each nominated mix must be from one trial batch. The tests on the constituent materials must represent the materials used in this trial batch.

(d) Signed Statement

A signed statement certifying that each nominated and production trial mix including all constituents meet the requirements of Clauses 2.1 and 2.2. The statement must include NATA endorsed test results for all specified tests. Attach a copy of your completed verification checklist.

(e) Warm Mix Asphalt Additives

When using warm mix asphalt additives, provide details of the additive in the nominated mix design submission. Include evidence acceptable to the Principal that the additive is designed and has proven performance for the purpose described in this Specification.

The nominated mix design will be rejected if the nature, intended purpose and dosage of the warm mix asphalt additive are not clear in your nominated mix design submission.

Clearly state in your submission:

(i) any proposed amendments to the mix design procedure, operational processes and/or test methods as a result of the inclusion of a warm mix asphalt additive; and

(ii) the classification of the warm mix asphalt additive.

HOLD POINT	
Process Held:	Placing of the nominated mix(es).
Submission Details:	Documents as detailed in 2.3.2 at least 7 working days before each asphalt mix is proposed to be used.
Release of Hold Point:	The Principal will consider the submitted documents, prior to authorising the release of the Hold Point. This Hold Point release is valid for a maximum period of 12 months.

2.4 PRODUCTION OF ASPHALT

2.4.1 Method of Production

Your adopted method of production must:

(a) control the process and target the nominated mix design, and

(b) supply a homogeneous and consistent product at the nominated manufacturing temperature.

2.4.2 Production Tolerances

2.4.2.1 Proportions of Constituents

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

(a) the proportion of each constituent, with the exception of added filler, is not varied by more than 10% of the value nominated, and

(b) the proportion of each added filler is not varied by more than 15% of the value nominated.

2.4.2.2 Combined Particle Size Distribution and Binder Content

The actual combined particle size distribution and actual binder content may vary from the nominated value within the limits shown in Table R121.4, provided that the actual values also remain within the limits of Tables R121.1 and R121.2 respectively.

Table R121.4 – Production Tolerances

Description	Tolerance
Permissible variation to nominated combined particle size distribution during production (% by mass of total aggregate, AS 2891.3.1) for each mix size:	
Passing 4.75 mm AS sieve and larger	± 7
Passing 2.36 mm and 1.18 mm	± 5
Passing 0.600 mm and 0.300 mm	± 4
Passing 0.150 mm	± 2.5
Passing 0.075 mm	± 1.5
Permissible variation to the nominated binder content during production (% by mass of total mix, AS 2891.3.1)	± 0.3

2.4.3 Asphalt Manufacturing Plant

Operate the asphalt manufacturing plant with adequate production process controls to produce asphalt of a consistent quality and conforming to the requirements of this Specification. The production control system must produce auditable records of key process parameters including individual aggregate and filler feed rates/batch masses, binder application rate/batch mass and various process temperatures.

Implement a documented procedure for the management and control of the moisture content of each aggregate material. The moisture content must be determined at least daily, and the asphalt manufacturing plant must be adjusted accordingly.

The asphalt manufacturing plant must have sufficient capacity, and be able to supply asphalt for the continuous operation of the paver.

2.4.4 Storage and Handling

(a) Binder

Heating and storage of binder must comply with the temperature and time limits set out in Advisory Note 7 published by the Australian Asphalt Pavement Association.

Provide details in your PROJECT QUALITY PLAN of the procedures for the acquisition, storage and handling of binder which identify and prevent segregation and/or contamination of the binder.

At the asphalt manufacturing plant, binder supplied in accordance with Specification RMS 3252 must be recirculated in delivery and/or storage tanks to a uniform consistency immediately prior to use in the manufacturing process.

(b) Asphalt

The asphalt must not be retained in hot storage silos for longer than 4 hours. Asphalt stored for more than 4 hours must be sub-Lotted and tested for binder content in accordance with AS2891.3.1, in addition to the sampling frequency in Annexure R121/L. Results for binder content must be within the submitted nominated mix production tolerances.

2.4.5 Manufacturing Temperatures

Control the temperatures of constituent materials in response to suitable thermometer elements placed in the flow of materials from the drier, and in the binder storage system or binder supply line. Thermometer registrations must be readable and accurate to within ± 2°C.

The difference in temperature between binder and aggregate must not exceed 30°C at the point of mixing.

Measure and record the temperature of the asphalt when:

(a) the asphalt leaves the pugmill or mixing drum; or

(b) the asphalt discharges from the hot storage bin(s); or

(c) in the trucks prior to leaving the plant.

The dispatch temperature of the asphalt must facilitate the specified density in the finished product. Project specific process temperatures and the frequency of recording must be detailed in your PROJECT QUALITY PLAN.

The temperature of asphalt must not at any time in the process exceed 175°C.

2.4.6 Sampling

Asphalt samples are to be taken in accordance with AS 2891.1.1 at the frequency specified in Annexure R121/L.

2.5 TRANSPORT OF ASPHALT

The transport of asphalt must be in accordance with the requirements in AS 2150.

State in your PROJECT QUALITY PLAN the method of application and control of release agent to ensure a uniform, light coating of the vehicle's tray without ponding of surplus release agent.

Facilitate the continuous operation of the paving train by:

(a) providing and allocating sufficient transport capacity; and

(b) ensuring efficient on-site management of asphalt deliveries.

3 PLACING ASPHALT

3.1 GENERAL

Your method of placing and finishing asphalt must:

(a) produce a homogeneous product with a tightly bound surface;

(b) achieve a uniform bond to the surface below; and

(c) achieve the finished pavement properties, specified in Clause 4, within the specified tolerances.

Do not induce rapid cooling in the asphalt by the application of water at any stage in the process, including preparation for trafficking.

3.2 PREPARATION OF PAVEMENT

Prior to placing asphalt, prepare the surface to be paved in accordance with the requirements in AS 2150, including the removal of raised extruded thermoplastic road markings and raised pavement markers.

3.3 METHOD OF PLACEMENT

The asphalt is to be placed by a self-propelled paving machine equipped and operated with automatic thickness control and automatic joint matching facility.

Hand placement of asphalt is only permitted for minor corrections of the existing surface and in areas where placement with a paving machine is impractical.

State in your PROJECT QUALITY PLAN the method of achieving conforming compaction including roller type, number of passes and rolling pattern.

If specified in Annexure R121/A, a Material Transfer Vehicle (MTV) must be used in your paving operations. The MTV must be a self propelled machine with independent controls which will receive asphalt from delivery vehicles, store, remix and transfer the asphalt to the paving machine without contact and be equipped with:

(a) a receiving hopper compatible with delivery vehicles;

(b) conveying mechanisms and anti-segregation devices for remixing asphalt;

(c) conveying mechanisms capable of delivering asphalt to the paver at a minimum rate to suit the paving output;

(d) a minimum nominal on-board storage capacity of 15 tonnes;

(e) an additional holding bin in the paving machine hopper; and

(f) sufficient power output from the motor to operate with full load on grades up to 6% and travel in tandem with the paver, either directly in front or in an offset position.

If specified in Annexure R121/A, place the asphalt by echelon paving using a minimum of two paving machines operating continuously in tandem. The paving run layout must be such that the hot joint is located to minimise cold joints within the trafficked carriageway, unless otherwise approved by the Principal.

3.4 PROTECTION OF WORK

Provide for traffic in accordance with the requirements of Specification RMS G10 while undertaking the work.

Protect the work until the required thickness of asphalt has been placed, compacted and cooled sufficiently to carry traffic without damage to the work.

3.5 PROTECTION OF SERVICES AND ROAD FIXTURES

Do not allow asphalt or other material used on the work from entering or adhering to grates, hydrants or valve boxes, service covers, bridge joints and other road fixtures. Immediately after the asphalt has been placed, clean and remove all waste asphalt from the affected services and road fixtures.

3.6 COURSE AND LAYER THICKNESSES

A course of asphalt must comprise one layer only.

The course thickness must be within the limits of 3.0 to 5.0 times the nominal mix size.

3.7 PAVEMENT TEMPERATURE AND WEATHER CONDITIONS

Measure and record the pavement surface temperature and wind velocity at the point of asphalt placing. Document the method of measurement and recording in your PROJECT QUALITY PLAN.

Do not commence or continue placing asphalt, unless the pavement surface temperature complies with the requirements in Table R121.5.

Table R121.5 – Minimum Asphalt Laying Temperature

Wind Speed (km/h)	Minimum Pavement Surface Temperatures (°C)
0 – 5	13 and rising
6 – 10	20
11 – 15	25
> 15	30

Note: Wind speed should remain constant over a period of 15 minute.

Do not place tackcoat and/or asphalt when the pavement surface is wet and/or when rain is imminent.

3.8 PAVING AND COMPACTION TEMPERATURES

Your PROJECT QUALITY PLAN must document the temperatures at which the asphalt is placed and compacted to achieve the insitu air void requirements specified in 4.1.1

HOLD POINT

Process Held:	Placing of the nominated mix (including placement trial).
Submission Details:	Nominate in writing: (a) the minimum temperature at which asphalt is to be delivered to the paver; and (b) the minimum temperature at which initial compaction of the asphalt is to commence; and (c) the method of temperature measurement.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

Do not incorporate asphalt that exhibits a temperature variation into the Works unless it has been remixed to a consistent and adequate temperature for compaction.

Measure and monitor paving and compaction temperatures as described in your PROJECT QUALITY PLAN with a hand held or machine mounted infrared thermometer readable and accurate to ± 2°C at the discharge point from a tipper truck or at the distribution auger on the paver.

Carry out verification of the accuracy of the infrared thermometer and determine the correlation factor daily at the commencement of work, and at any other time at the request of the Principal.

3.9 TACKCOAT

Prior to applying the tackcoat, the existing surface must be clean, dry and free from loose material.

Apply the tackcoat evenly at a rate of between 0.15 and 0.40 litres of residual bitumen per square metre so that it is effectively bonded to the surface. For joints and chases, double the application rate. Nominate in writing to the Principal your proposed tackcoat application rate prior to applying the tackcoat.

You may propose in writing to the Principal a reduced application rate for the tackcoat due to the existing underlying pavement material. Your proposal must be supported by examples of previous cases where this has been done, including location and insitu material types and the current pavement performance.

Provide to the Principal a daily record with your endorsement, of the average tackcoat application rate applied to each Lot. Report the tackcoat application rate in terms of residual bitumen and state the percentage dilution of the tackcoat used during spraying.

The tackcoat must be intact at the commencement of asphalt placement.

3.10 JOINTS

Describe in your PROJECT QUALITY PLAN the procedure for the construction of joints. Your procedure must maximise joint density and include mechanised edge compaction or mechanised edge trimming. Hand tamping of edges is permitted where the use of a machine is impractical. Do not spread excess material resulting from hand preparation of edges on the surface of the work.

Remove all loose, cracked and/or boney material at the edge of a paved mat prior to placing the adjacent mat. Do not incorporate asphalt resulting from clean-up of process trimmings in the work.

Finish each joint with a smooth, planar surface coinciding with the surface of the rest of the mat and satisfying the surface shape requirements specified in Clause 4.3.

Longitudinal joints must be:

(a) offset by 150 mm from the joint in the underlying layers;

(b) located within 150 mm of the line of change in crossfall;

(c) coincident with final traffic markings, unless otherwise approved by the Principal.

Transverse joints must be:

(i) located at a minimum of 25 m apart;

(ii) offset by a minimum of 1 m from the joint in the underlying layer;

(iii) formed at the commencement of each paving run;

(iv) formed when a delay in paving causes asphalt temperature to fall below the initial compaction temperature nominated in Clause 3.8.

3.11 PLACEMENT TRIAL

If specified in Annexure R121/A and prior to commencing work, carry out a separate placement trial using the plant and personnel proposed for the work for each nominated mix.

Each placement trial must be located remote from the work, unless otherwise approved by the Principal. The size of the placement trial must be limited to one production shift.

Design the trial to implement all the procedures described in your PROJECT QUALITY PLAN and demonstrate conformity with the Specification in respect of:

(a) homogeneity;

(b) insitu air voids;

(c) course thickness;

(d) texture depth;

(e) surface shape;

(f) surface gritting application, where specified;

(g) joint quality; and

(h) ride quality, where specified.

HOLD POINT

Process Held:	Placing of the nominated mix
Submission Details:	Verification checklist and all relevant test results from the placement trial demonstrating conformance to the Specification at least 3 working days prior to further placing of your nominated mix on the work.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

In the event of nonconformities in the placement trial, or when the Principal determines that a previous trial is not representative of the materials, asphalt mix proportions, temperature, plant, rate of output and/or method of placement, a new trial must be implemented.

Where a placement trial forms part of the work, manage all nonconformities in respect of materials, process and finished pavement properties in accordance with Clause 5.

3.12 TEMPORARY RAMPS AND TIE-INS TO EXISTING PAVEMENT AND STRUCTURES

Temporary ramps at joints for safe trafficking of the work, must be constructed either by placement of dense grade asphalt complying with Specification RMS R116, or by cold milling of the existing or new asphalt layer to form the ramp.

The length and grade of temporary ramps must be equivalent to those specified for treatment at edges and structures described in Specification R101.

Construct permanent tie-ins to existing pavement by placement of dense grade asphalt complying with Specification R116.

4 FINISHED PAVEMENT PROPERTIES

4.1 INSITU AIR VOIDS

4.1.1 Requirements for Insitu Air Voids

Each layer of asphalt must be uniformly compacted to achieve the specified characteristic values of insitu air voids.

The asphalt must have a dense appearance with the cut or cored faces of samples exhibiting few, if any, surface voids.

Do not test asphalt layers less than or equal to 30mm nominated thickness for insitu air voids.

The characteristic values of insitu air voids for the Lot must comply with Table R121.6.

Table R121.6 – Insitu Air Voids Standard

Limits for Characteristic Values of Insitu Air Voids
V_L = 3.0% and V_U = 7.0%

Note: V_L is the lower limit of characteristic value of insitu air voids and V_U is the upper limit of characteristic value of insitu air voids.

4.1.2 Determination of Insitu Air Voids

Carry out compaction control on Lots using statistical techniques as specified in RMS Q.

The calculation for determining the insitu air voids is set out in Annexure R121/E. Determine the bulk density either from cores in accordance with AS 2891.9.2 or from nuclear density measurements taken in accordance with AS 2891.14.2 and using the calibrated procedure described in AS 2891.14.3. Use only one of these methods to calculate the bulk density.

Cores must be taken in accordance with AS 2891.1.2. Determine the layer thickness prior to trimming of cores. Trimming must not reduce the core layer thickness by more than 5 mm.

Do not use the nuclear density method when steel reinforcement exists within 300 mm of the surface of the layer.

The reference density for the purpose of insitu air voids calculations is the mean maximum density of the Lot where the individual values are determined in accordance with AS 2891.7.1 or AS 2891.7.3.

Determine the air voids for:

(a) every change in underlying pavement material and layering within 300 mm of the surface of the layer being measured; and

(b) every change in nominated mix and specified layer thickness.

4.2 COURSE THICKNESS

4.2.1 Requirements for Course Thickness

The specified course thickness is detailed in Annexure R121/A.

(a) Where finished surface levels are not specified

Comply with either of the following:

(i) Where the SMA is placed over an existing pavement constructed by others, the average compacted course thickness for each Lot must not be less than the specified course thickness or greater than the specified course thickness plus the tolerance specified in Table R121.7 for the nominal size of asphalt.

OR

(ii) Where the SMA is placed over one or more layers placed by you, the Lot is deemed to be conforming if the lower characteristic value of thickness (T_L) for the Lot is not less than the specified course thickness as shown on the Drawings or specified in Annexure R121/A and the upper characteristic value of thickness (T_U) for the Lot is not more than the specified course thickness plus the tolerance specified in Table R121.7 for the nominal size of the asphalt.

Table R121.7 – Allowable Tolerances for Course Thickness

Nominal Size of Asphalt (mm) **(Asphalt Designation)**	**Tolerance** (mm)
10 (SMA10)	+ 6
14 (SMA14)	+ 8

(b) Where finished surface levels are specified

Control the course thickness by maintaining the design levels and the surface shape requirements specified in Clause 4.3, provided that:

(i) The average compacted course thickness of each Lot calculated from surveys must be consistent with the average compacted course thickness of the respective Lot determined from cores. Include in your PROJECT QUALITY PLAN, the statistical technique for verifying the consistency of the results.

(ii) The average compacted course thickness of each Lot of the wearing course is within 10% of the specified course thickness.

4.2.2 Determination of Course Thickness

Determine the characteristic values and average value of thickness of the Lot on the basis of statistical techniques as specified in Specification RMS Q on cores taken in accordance with AS 2891.1.2 where:

(a) core layer thickness is determined prior to trimming of the core;

(b) the core diameter can be less than 95 mm;

(c) the test specimen may comprise more than one layer.

The calculation of the upper and lower characteristic values of thickness for the Lot is shown in Annexure R121/E2.

4.3 SURFACE SHAPE

4.3.1 Determination of Surface Shape

Determine and report the surface shape in accordance with Test Method RMS T183.

The maximum Lot size must be in accordance with RMS Q and extended to include the adjacent longitudinal joints, transverse joints and tie-ins. Carry out testing at the frequency specified in Table R121/L.5 of Annexure R121/L.

4.3.2 Requirement for Surface Shape

The surface of the course including longitudinal and transverse joints must not pond water.

The surface shape of the course within the traffic lane must not deviate from the bottom of a straightedge laid in any direction by more than the tolerances specified in Table R121.8. Where the deviations from a straightedge for an existing surface exceed 10 mm, carry out rectification of those areas before the new asphalt is placed, unless directed otherwise by the Principal.

Correct any nonconformities before testing ride quality.

Table R121.8 – Maximum Deviation From Straightedge Placed Within Traffic Lane (mm)

Wearing Course	Ramps, Roundabouts and Through Carriageway < 70 kph Speed Zone	Through Carriageway ≥ 70 kph Speed Zone
At Actual Completion	5 mm	3 mm
12 months after Date	8 mm	6 mm

4.4 RIDE QUALITY

4.4.1 Determination of Ride Quality

If specified in Annexure R121/A, determine the ride quality from measurements of the longitudinal profile taken by a vehicular laser profilometer, where the ride quality is the International Roughness Index (IRI_S) determined in accordance with Test Method RMS T188 and the Lot is a section within the test lane as defined in the Test Method.

Develop an Inspection and Test Plan (ITP) for ride quality that meets the requirements of the Specification. Define the Lots and the start and end locations for testing in your ITP.

Supply the Principal with copies of the RMS Accreditation Certificates for each vehicular laser profilometer driver and operator proposed for use in the Works.

4.4.2 Requirement for Ride Quality

The surface of the wearing course must have a smooth longitudinal profile, and

(a) when construction of the underlying pavement forms part of the contract; or

(b) when asphalt is placed on any corrective course over a pavement constructed by others; or

(c) when the scope of work targets a ride quality.

the ride quality of each Lot must not exceed an IRI_S of 1.56 m/km.

When asphalt is placed over pavement constructed by others, the ride quality of each Lot must not exceed the IRI_{Sa} values determined as follows:

$IRI_{Sa} = 0.2 + (0.6 \times IRI_{Sb})$, or 1.56 m/km, whichever is the greater.

where: IRI_{Sa} is the Lane IRI after placing the asphalt layer (m/km)

IRI_{Sb} is the Lane IRI before placing the asphalt layer (m/km)

When asphalt is placed over a pavement constructed by others, determine and report the ride quality of the existing surface prior to the work. The Lots of the existing surface selected must coincide with the Lots of the finished work.

4.5 TEXTURE DEPTH

At the time of construction, the texture depth when determined in accordance with Test Method RMS T240 must be equal to or greater than 1.0 mm.

5 CONFORMITY

Verify conformity with the Specification by sampling and testing, and providing records of process control.

5.1 HOMOGENEITY

All asphalt must be homogenous in appearance.

Areas of asphalt that exhibit segregation, cracking, ravelling, bony or fatty material, or have been damaged during construction must be rectified or replaced.

Any proposal by you that the Principal accepts non-homogeneous and/or segregated material or work must be in writing and must show:

(a) technical reasons for acceptance;

(b) compliance with the Specification; and

(c) sub-Lotting that minimises performance risk to the surface and structure of the pavement.

5.2 SAMPLING

Nominate all sampling locations, frequencies and test methods in your PROJECT QUALITY PLAN.

In addition to the requirements of RMS Q Annexure Q/L, and unless otherwise specified or agreed with the Principal, boundaries of sub-Lots represented by a single tested sample are deemed to be the midpoints in production between the sample points for the purpose of B2 in Annexure R121/B of this Specification.

When the Principal requests loose asphalt samples for testing, you must riffle and/or quarter the samples.

All samples, including core samples, must be delivered in sealed and labelled containers.

5.3 TESTING

5.3.1 Minimum Frequency of Testing

The minimum frequency of testing is specified in Annexure R121/L. Nominate an appropriate frequency where a minimum frequency of testing is not specified.

You may propose in writing to the Principal that a reduced minimum frequency of testing be accepted in accordance with RMS Q. Your proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics.

In the event of a nonconformity, a reduced frequency of testing must revert immediately back to the specified minimum frequency of testing. You can request a further reduction in the minimum frequency of testing when you can demonstrate again by statistical analysis that you have gained a consistent process capability and product characteristics.

5.3.2 Maximum Lot Size

The maximum Lot size must conform to RMS Q.

5.3.3 Time for Submission of Test Results

Complete and report to the Principal:

(i) the tests for binder content, combined particle size distribution and air voids in laboratory compacted mix within one working day of laying the asphalt.

(ii) the results for insitu air voids, course thickness and course shape within three working days of placing the asphalt.

5.4 PROCESS CONTROL

You must employ a capable process and implement process control in accordance with or exceeding the requirements of Australian Asphalt Pavement Association Implementation Guide IG-3.

5.5 NONCONFORMITIES

If a Lot fails to conform to the Specification, such failure must constitute a nonconformity under the Contract.

If the nonconformity is not accepted in accordance with Annexure R121/B2, rectify or replace the Lot.

ANNEXURE R121/A – PROJECT SPECIFIC REQUIREMENTS

The requirements below apply to the following pavement types in the project:

Insert in the table below the SMA to be used.

Use multiple copies to cater for different pavement designs within the same project.

Course	**Nominal Size of Asphalt** (mm)	**Class of Binder** (1) (Clause 2.1.5)	**Specified Course Thickness** (mm) (3.6, 4.2.1)
Wearing			

Note (1)**:** Default class of binder to be used is Class A15E.

	Description	**Requirement**
3.3	Material Transfer Vehicle required:	Yes / No *
3.3	Paving in echelon required:	Yes / No *
3.11	Placement trial required:	Yes / No *
4.4.2	Measurement of ride quality of pavement required:	
	- Existing pavement	Yes / No *
	- Finished pavement	Yes / No *

* Delete as applicable

Measure the following pay items by area (refer Annexure R121/B): *(List pay items)*

Other Project Specific Requirements: *(List requirements)*

ANNEXURE R121/B – MEASUREMENT AND PAYMENT

B1 MEASUREMENT AND PAYMENT

Payment for the activities associated with completing the work detailed in this Specification in accordance with the following Pay Items.

A lump sum price for any of these items will not be accepted.

Where an item of work required is not specifically covered by the measurement and payment descriptions for the pay items in the Schedule, due allowance must be made in one or more of the other pay items to allow for this item of work at the time of tendering.

Measurement and payment of asphalt is made on the basis of either mass or area as follows:

(a) Measurement by Mass

Unless specified otherwise in Annexure R121/A, the quantity of asphalt must be measured by mass and the unit of measurement must be a tonne.

The Principal may approve measurement by batch weights using certified scales certified scales, the quantity of asphalt in place in the final work must be mutually agreed using the RMS Contract Quantity Agreement Sheet using the tally of the weigh bridge dockets of delivered asphalt less the quantity of asphalt which is not incorporated in the Works.

Truck weighbridge dockets must be issued at a weighbridge certified by the NSW Office of Fair Trading and collected at the point of delivery.

(b) Measurement by Area

If specified in Annexure R121/A, the quantity of asphalt is measured by area and the unit of measurement is the square metre.

The area is to be determined from the dimensions shown on the Drawings or as specified for the work in Annexure R121/A.

The measurement of tackcoat sprayed is based on the quantity of residual bitumen. The unit of measurement is the litre determined from sprayer tanker dippings.

Pay Item R121P1 - Supply and Application of Tackcoat (Including Preparation of Surface)

Unless specified otherwise in Annexure R121/A, the quantity of tackcoat used in the work is determined by volume and the unit of measurement is a litre of residual bitumen.

The volume must be determined by multiplying the nominated application rate of residual bitumen by the specified area of the road surface to be tackcoated.

Tackcoat applied to faces of joints, kerbs and other structures is deemed to be included in the rate.

Pay Item R121P2 - Stone Mastic Asphalt in Wearing Course

R121P2.1 10 mm Nominal Size

R121P2.2 14 mm Nominal Size

Pay Item R121P3 - Incentives and Deductions in accordance with Annexure R121/B

R121P3.1 All deductions as per Table R121/B.1 and B.2

R121P3.2 All incentives (Table R121/B.3)

Incentives and deductions under this pay item are not subject to rise and fall adjustments.

B2 DISPOSITION OF NONCONFORMITIES

B2.1 General

If the nonconformity is not acceptable in accordance with Annexure R121/B2.2, the nonconforming material must be replaced or the nonconforming section of work must be either replaced or corrected.

The cost of rectifying nonconformities, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, must be borne by you. Materials removed from the site by you must be replaced with materials that conform to this Specification.

B2.2 Acceptance of Nonconformities

You may propose in writing to the Principal that pre-determined dispositions be applied to nonconformities in the following properties:

(a) Combined particle size distribution and binder content in asphalt

(b) Insitu Air Voids

(c) Ride quality.

Deductions apply to the schedule rate for the quantity of asphalt represented by the test sample and must be recorded against Pay Item R121P3.1.

B2.2.1 Combined Particle Size Distribution and Binder Content

Deductions in accordance with Table R121/B.1 must be applied to accepted nonconformities in combined particle size distribution and binder content provided that:

(a) For any individual sieve size and the binder content, nonconformities greater than twice the production tolerance specified in Table R121.4 must not be accepted, and

(b) Deductions are cumulative and nonconformities must not be accepted if combined deductions exceed 20%.

Table R121/B.1 – Deductions for Combined Particle Size Distribution and Binder Content

	% by which nonconformity exceeds production tolerance (Clause 2.4.2)	**Deductions** (in % of schedule rate)
Combined Particle Size Distribution Element	**(% by mass of total aggregate)**	
Pass 13.2 mm AS sieve	Each 2 or part thereof	1
Pass 9.50 mm AS sieve	Each 2 or part thereof	1
Pass 6.70 mm AS sieve	Each 2 or part thereof	1
Pass 4.75 mm AS sieve	Each 2 or part thereof	1
Pass 2.36 mm AS sieve	Each 1 or part thereof	1
Pass 1.18 mm AS sieve	Each 1 or part thereof	1
Pass 0.600 mm AS sieve	Each 1 or part thereof	1
Pass 0.300 mm AS sieve	Each 1 or part thereof	2
Pass 0.150 mm AS sieve	Each 0.5 or part thereof	2
Pass 0.075 mm AS sieve	Each 0.5 or part thereof	2
Binder Content	**(% by mass of total asphalt mix)**	
SMA10 or SMA14	Each 0.1 or part thereof	3

B2.2.2 Insitu Air Voids

Deductions in accordance with Table R121/B.2 must be applied to accepted nonconformities in excess of the upper characteristic insitu air voids provided that, nonconformities must not be accepted when the upper characteristic insitu air voids exceeds the specified limit by more than 2.0 %.

Table R121/B.2 – Deductions for Nonconforming Insitu Air Voids

Insitu air voids outside of specified limit V_U by	**Deduction** (in per cent of value of Lot)
< 0.5%	2.5 %
0.5% – 1.0%	15 %
1.1% – 1.5%	25%
1.6% – 2.0%	50%
> 2.0%	Reject

B2.2.3 Ride quality

Deductions in accordance with Table R121/B.3 must be applied to accepted nonconformities in ride quality provided that, nonconformities must not be accepted when the ride quality exceeds the specified limit by more than 0.80 m/km.

Table R121/B.3 - Deductions for Ride Quality

Ride quality in excess of specified limit by (m/km)	**Deduction** (in per cent of value of Lot)
< 0.25	2
0.25 – 0.43	4
0.44 – 0.61	8
0.62 – 0.80	16

B3 INCENTIVES

It may be proposed in writing to the Principal that pre-determined incentives be applied in accordance with Table R121/B.4 to the Ride Quality of the asphalt wearing course, provided that:

(a) the Lot conforms to all requirements of this Specification, and

(b) for all three adjacent Lots in all directions, the ride quality is conforming.

Table R121/B.4 - Incentives for Ride Quality

Ride quality below specified limit by (m/km)	**Incentive (in per cent of the value of the Lot)**
< 0.44	0
0.44 – 0.61	1
0.62 – 0.80	2
> 0.80	3

Incentives apply to the schedule rate for the quantity of asphalt represented by the test sample and must be recorded against Pay Item R121P3.2.

ANNEXURE R121/C – SCHEDULES OF HOLD POINTS, AND IDENTIFIED RECORDS

Refer to 1.3.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Process Held
2.3.1	Submission of nominated mix design details
3.8	Submission of paving and compaction temperature details to achieve conformity
3.11	Submission of verification checklists and test results from placement trial

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of RMS Q Annexure Q/E.

Clause	Description of the Identified Record
1.3.4	Project specific Project Quality Plan
2.1.5	Documentary evidence of binder conformity for each delivery
2.1.6	Documentary evidence of fibre additive to be used
2.3.1	Documents as detailed for each nominated asphalt mix
2.3.1	Documents as detailed for proprietary information
2.4.3, 2.4.5	Asphalt manufacturing process parameters including process temperatures
2.5	Method of application and control of release agent
3.7	Pavement temperatures and weather conditions
3.8	Asphalt temperature at which initial compaction will be commenced
3.9	Notification of proposed application rates for tackcoat
3.9	Daily record of average tackcoat application rate in each Lot
3.11	Verification checklist and all listed test reports of trial section for each combination of materials, mix proportions, equipment, rate of paving and methods for placement, compaction and finishing
4.3.1	The location and frequency of straightedge measurements including testing at longitudinal and transverse joints
5.3.1	Test reports of all specified properties and characteristics at the minimum frequency of testing

ANNEXURE R121/D – PLANNING DOCUMENTS

Refer to 1.3.4. The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. Review the requirements of this Specification and others included in the Contract to determine additional documentation requirements.

Clause	Planning Documents
1.3.4	Manufacturer's written recommendations
2.1	For each constituent material, Lot/stockpile sizes, method of defining each Lot and allocating a unique Lot Number
	Procurement, handling and storage of each constituent material
	Nominated particle size distribution and tolerances for each constituent aggregate
2.1.6	Proposed fibre additive
2.3.1	Development and authorisation of the nominated mix submission
2.4	Method of defining each Lot and allocating a unique Lot Number
	Calibration of the asphalt manufacturing plant, including all weigh scales, flowmeters and thermometers
	Process control, including plant operating instructions, key temperature targets and records, and response to process control charts
	Acquisition, storage and handling of binder, including identification and prevention of segregation and/or contamination
	Control of plant feed proportions, including regular checks on grading and moisture content
	Daily asphalt manufacturing plan to ensure timely and uninterrupted progress on site
	Storage and handling of binder
2.5	Loading, delivery and unloading procedures that maintain adequate mix temperature and do not interrupt progress of the paving train.
3	For each paving and related activity, method of defining each Lot and allocating a unique Lot Number
	Calibration of all thermometers and other measuring equipment
	Process control for surface preparation, tackcoating, placing, joint construction, compaction and cleanup, including plant operating instructions, key temperature targets and records, patterns for paving and compaction operations, and process monitoring
3.3	Allocation of appropriate plant and equipment, including backup in case of breakdown
	Rolling pattern including roller type and number of passes
3.6	Nominated layer thicknesses where these have not been specified by the Principal
3.7	Method of measurement and recording of pavement temperatures and weather conditions
3.8	Paving and compaction temperature

Clause	Planning Documents
3.10	Joint construction procedure
3.11	Design, execution and quality verification of a placement trial
4.1	Compaction
4.2.1	Requirements for course thickness
4.2.2	Determination of course thickness
5.1, 5.2 & 5.3	Inspection and test plan, including methods and frequencies of sampling, methods and frequencies of testing, verification checklists, and timeframe for submission of test results

ANNEXURE R121/E – CALCULATIONS

E1 CALCULATION OF CHARACTERISTIC VALUES OF INSITU AIR VOIDS

Calculate the upper (V_U) and lower (V_L) characteristic values of insitu air voids of the Lot as follows:

$V_U = \bar{a} + ks$ $V_L = \bar{a} - ks$

where: s = the standard deviation of sub-Lot air voids expressed as a percentage

k = value stated in RMS Q Annexure Q/L L3.2

$\bar{a}$ = the arithmetic mean of insitu air voids expressed as a percentage for all sub-Lots

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

MD = mean maximum density of the Lot determined in accordance with AS2891.7.1 or AS2891.7.3

BD = bulk density of the sub-Lot determined in accordance with

(i) AS2891.9.2 for cores

(ii) AS 2891.14.2 and AS 2891.14.3 for nuclear density gauge

Round and report the values of V_U and V_L to the nearest 0.1%.

E2 CALCULATION OF CHARACTERISTIC VALUE OF THICKNESS

Calculate the upper (T_U) and lower (T_L) characteristic values of thickness for the Lot as follows:

$T_U = \bar{x} + ks$ $T_L = \bar{x} - ks$

where: s = the standard deviation of sub-Lot attribute test results

k = value stated in RMS Q Annexure Q/L L3.2

x = the average height of a core (mm) based on measurements taken at four equidistant points at the circumference of the core.

$\bar{x}$ = the arithmetic mean of attribute test results for all sub-Lots

(Note: $\bar{x}$, x and s are in mm and T is rounded to the nearest whole millimetre.)

ANNEXURES R121/F TO R121/K – (NOT USED)

ANNEXURE R121/L – MINIMUM FREQUENCY OF TESTING

The minimum frequency of testing of the materials, production, placing and finished pavement are listed in Tables R121/L.1 to R121/L.5.

Table R121/L.1 - Minimum Frequency of Testing of Asphalt

Quantity of Asphalt Supplied in Each Shift	Minimum Frequency of Testing
Less than 100 tonnes	One per 50 tonnes or part thereof
101 to 300 tonnes	One per 100 tonnes or part thereof
301 to 600 tonnes	One per 150 tonnes or part thereof
Over 600 tonnes	One per 200 tonnes or part thereof

Note: A "shift" must be continuous work not exceeding a period of 12 hours.

Table R121/L.2 – Constituents

Clause	Constituent	Minimum Frequency of Testing [(2)]
2.1.1	Coarse Aggregate	As per RMS 3152
2.1.2	Fine Aggregate	As per RMS 3152
2.1.3	Granulated Glass Aggregate	As per RMS 3154
2.1.4	Filler	As per RMS 3211
2.1.5	Binder	As per RMS 3252
2.1.7	Bitumen Emulsion Tackcoat	As per AS 1160

Notes:

(1) The nominated mix design submission must also include complying test results for each specified characteristic of each constituent.

(2) The minimum frequency of testing must be in accordance with the specific RMS Test Method or Australian Standard.

Table R121/L.3 – Asphalt Production

Clause	Characteristic	Test Method / Procedure	Minimum Frequency of Testing
2.1.4	Filler in asphalt – Dry compacted voids	AS 1141.17	One test with each nominated mix submission
2.1.4	Filler in asphalt – Methylene blue value	RMS T659	One test with each nominated mix submission
2.2.1	Binder content	AS 2891.3.1	As per Table R121/L.1
2.2.1	Combined particle size distribution	AS 2891.3.1	As per Table R121/L.1
2.2.2	Air voids in laboratory compacted mix (120 cycles)	T662 AS2891.7.1 or AS 2891.7.3, AS 2891.8, AS 2891.9.2	As per Table R121/L.1
2.2.3	Moisture content	RMS T660	One per mix type per shift
2.2.6	Deformation resistance	AG:PT/T231	One test with each nominated mix submission.
2.4.5	Production temperature of asphalt	Your documented procedure	As specified in PQP
2.4.5	Dispatch temperature of asphalt	Your documented procedure	Each delivered load

Table R121/L.4 – Asphalt Placing

Clause	Characteristic	Test Method / Procedure	Minimum Frequency of Testing
3.7	Pavement temperature	Your documented procedure	1 measurement every 2 hours
3.7	Wind velocity	Your documented procedure	1 measurement every 2 hours
3.8	Temperature at initial compaction	Your documented procedure	Each delivered load
3.9	Tackcoat application rate	Your documented procedure	Each paving Lot
5.1	Homogeneity	Visual assessment	Each paving Lot

Table R121/L.5 – Finished Pavement Properties

Clause	Characteristic	Clause / Test Method	Minimum Frequency of Testing
4.1	Insitu air voids	Clause 4.1.2	As specified for relative compaction > 100.0 in RMS Q L3.1
4.2	Course thickness	Clause 4.2.2	As specified for relative compaction > 100.0 in RMS Q L3.1
4.3	Surface shape	RMS T183	**(a) Within lane:** one measurement in longitudinal direction and 1 measurement in transverse direction every 60 m^2 **(b) Longitudinal joint excluding crowns:** one measurement per 10 lineal metres **(c) Transverse joint:** one measurement in each wheel path in each lane except at the boundaries of the contract
4.4	Ride quality	RMS T188	Each Lot as defined in Test Method RMS T188
4.5	Texture depth	RMS T240	1 test per 100 m of traffic lane length or part there of.

ANNEXURE R121/M – REFERENCED DOCUMENTS

Refer to 1.2.4.

RMS Specifications

RMS G10	Traffic Management
RMS Q	Quality Management System
RMS R101	Cold Milling of Road Pavement Materials
RMS R116	Heavy Duty Dense Grade Asphalt
RMS 3152	Aggregates for Asphalt
RMS 3154	Granulated Glass Aggregate
RMS 3211	Cements, Binders and Fillers
RMS 3252	Polymer Modified Binder
RMS 3259	Bitumen Adhesion Agent (for Bitumen)
RMS 3269	Bitumen Adhesion Agent (for Polymer modified bitumen)

RMS Test Methods

RMS T183	Surface Deviation using a Straightedge
RMS T188	Project Ride Quality (Vehicular Laser Profiler)
RMS T230	Resistance to Stripping of Aggregates and Binders
RMS T240	Road Surface Texture Depth
RMS T646	Mix Volume Ratio (Dry Mix)
RMS T648	Static Binder Drainage Test
RMS T659	Methylene Blue Value of Road Construction Material
RMS T660	Moisture Content of Bituminous Mixes (Mass Loss Method)
RMS T662	Compaction of Asphalt Test Specimens (Using a Gyratory Compactor)

Australian Standards

AS 1160	Bituminous emulsions for construction and maintenance of pavements
AS 2008	Residual bitumen for pavements

Australian Standard Test Methods

AS 1141.17	Voids in dry compacted filler
AS 1141.50	Resistance to stripping of cover aggregates from binders
AS 2891.1.1	Sampling – Loose asphalt
AS 2891.1.2	Sampling – Coring Method
AS 2891.3.1	Bitumen content and aggregate grading – Reflux method
AS 2891.7.1	Determination of maximum density of asphalt – Water displacement method

AS 2891.7.3	Determination of maximum density of asphalt – Methylated spirit displacement
AS 2891.8	Voids and density relationships for compacted asphalt mixes.
AS 2891.9.2	Determination of bulk density of compacted asphalt – Presaturation method

AUSTROADS Test Methods

AG:PT/T231	Deformation Resistance of Asphalt Mixtures by the Wheel Tracking Test

AAPA Documents

Advisory Note 7	Guide to the Selection, Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt
IG-3	Asphalt Plant Process Control Guide