Master Specification
Part RD-BP-S2

Supply of Asphalt

September 2024

Government of South Australia
Department for Infrastructure and Transport

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Contents

RD-BP-S2 Supply of Asphalt

1 General

a) This Master Specification Part sets out the requirements for the design, manufacture and supply of hot mix asphalt (HMA), with and without an additive, and warm mix asphalt (WMA) including:

i) the documentation requirements, as set out in section 2;

ii) the requirements for materials, as set out in section 3;

iii) the mix requirements, as set out in section 4;

iv) the requirements for manufacture of mixes, as set out in section 5;

v) the production sampling and testing requirements, as set out in section 6;

vi) the requirements for property variations of production asphalt, as set out in section 7;

vii) the requirements for storage of asphalt, as set out in section 8;

viii) the requirements for delivery of mix, as set out in section 9;

ix) the test procedures, as set out in section 10;

x) the Hold Point requirements, as set section 11; and

xi) the verification requirements and records, as set out in section 12.

b) This Master Specification Part includes the design, manufacture and supply of the following HMA and WMA:

i) coarse dense mix asphalt (AC10 and AC14);

ii) fine dense mix asphalt (FineAC7 and FineAC10);

iii) open graded asphalt (OG10 and OG14); and

iv) stone mastic asphalt (SMA7 and SMA10).

c) The design, manufacture and supply of HMA and WMA must comply with the Reference Documents, including:

i) AGPT Part 4B: Asphalt;

ii) Austroads Test Method AGPT-T191 Extraction of Bituminous Binder from Asphalt;

iii) Austroads Test Method AGPT-T192 Characterisation of the Viscosity of Reclaimed Asphalt Pavement (RAP) Binder using the Dynamic Shear Rheometer (DSR);

iv) Austroads Test Method AGPT-T193 Design Of Bituminous Binder Blends to a Specified Viscosity Value;

v) Austroads Test Method ATM-T231 Deformation Resistance of Asphalt Mixtures by the wheel tracking test;

vi) Austroads Test Method ATM-232 Stripping Potential of Asphalt - Tensile Strength Ratio;

vii) Austroads Test Method AGPT-T234 Asphalt Binder Content (Ignition Oven Method);

viii) Austroads Test Method AGPT-T235 Asphalt Binder Drain-off;

ix) Austroads Test Method AGPT-T236 Asphalt Particle Loss;

x) AS/NZS 1141.8 Methods for sampling and testing aggregates, Method 8: Water-soluble fraction of filler;

xi) AS 1141.11.1 Methods for sampling and testing aggregates, Method 11.1: Particle size distribution - Sieving method;

xii) AS/NZS 1141.17 Methods for sampling and testing aggregates, Method 17: Voids in dry compacted filler;

xiii) AS 1160 Bituminous emulsions for the construction and maintenance of pavements;

xiv) AS 1672.1 Limes and limestones, Part 1: Limes for building;

xv) AS 2150 Asphalt - A guide to good practice;

xvi) AS 2157 Cutback bitumen;

xvii) AS 2008 Bitumen for pavements;

xviii) AS/NZS 2350.8 Methods of testing portland, blended and masonry cements, Method 8: Fineness index by air permeability method;

xix) AS/NZS 2891 Methods of sampling and testing asphalt;

xx) AS 3583.3 Methods of test for supplementary cementitious materials for use with portland cement, Method 3: Determination of loss on ignition;

xxi) ASTM D3549 Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens;

xxii) Australian Asphalt Pavement Association Advisory Note 7 Guide to the heating and storage of binders for sprayed sealing;

xxiii) ISO 3310-1 Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth;

xxiv) ISO 3310-2 Test sieves - Technical requirements and testing - Part 2: Test sieves of perforated metal plate;

xxv) Department Test Procedure TP226 Sampling of Soil, Aggregates and Rocks (available from: https://dit.sa.gov.au/standards/test_procedures);

xxvi) Department Test Procedure TP425 Sampling of Asphalt (available from: https://dit.sa.gov.au/standards/test_procedures);

xxvii) Department Test Procedure TP428 Compaction of Asphalt Test Specimens Using a Gyratory Compactor (available from: https://dit.sa.gov.au/standards/test_procedures);

xxviii) Department Test Procedure TP477 (draft) Flexural Fatigue Test Method (available from: https://dit.sa.gov.au/standards/test_procedures); and

xxix) Department Test Procedure TP664 Extraction of Binder from Asphalt (available from: https://dit.sa.gov.au/standards/test_procedures).

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

a) details of the Contractor’s plant process control system, including the documents required by section 3.1b);

b) a RAP management plan as required by section 3.2b);

c) nominated mix and asphalt mix registration certificates as required by section 4.2b);

d) asphalt mix history (including mix production data) and details of the nominated mobile plant required by section 4.5a);

e) proposed application of C320 asphalt;

f) all details required by Appendix 1: Asphalt inspection test and verification, including the safe storage period for binder in its tank configuration;

g) asphalt mix design together with supporting documentary evidence and laboratory and plant test results for mix and material properties as required by Appendix 2: Assessment and registration of asphalt mix designs;

h) details of the manufacture process of asphalt mixes;

i) details of the asphalt production plant, including company brand, mixing type, capacity, year of manufacturing, functionalities, special abilities, silos, computer control system and production history;

j) the laboratory NATA accreditation certificate, approved tests, and calibration schedule;

k) the process control requirements, which include a description of the flow of materials and the processes carried out on them from input materials to the plant through to delivery of asphalt to the customer. It must incorporate a flow diagram and identification of the key elements of the manufacturing process requiring monitoring, measurement, or verification;

l) the control requirements for aggregates transferred from quarry stockpiles and delivered to an asphalt plant;

m) the control requirements for glass aggregate;

n) the control requirements for RAP transferred from stockpiles and delivered to an asphalt plant;

o) the requirements for labelling of storage bays, silos, and bituminous tanks;

p) the requirements for heating, temperature control and insulation of tanks;

q) the requirements for controlling delivery of binders into the correct tanks;

r) the control requirements for binders, foam, additives, admixtures, fillers, and reclaimed asphalt;

s) the plant calibration and maintenance processes;

t) a description of the characteristics of any hot storage system and its mode of operation;

u) details of the handling, storage, and delivery of asphalt mixture to ensure the minimum of segregation, degradation or binder drain down and that the asphalt remains within the specified temperature range;

v) an Inspection and Test Plan which includes a schedule for monitoring and measuring the performance of the process (as identified in the key process element identification) and products. At a minimum, the ITP must meet the requirements of section 6, section 7 and Appendix 1: Asphalt inspection test and verification;

w) procedures for constant monitoring and statistical analysis of records to verify process capability and product characteristics; and

x) a calibration schedule, which includes daily visual inspection of all equipment and calibration of weighting equipment, admixture dispensers, flow meters, batching or proportioning systems and temperature monitoring equipment. At a minimum, the calibration schedule must meet the requirements of Appendix 1: Asphalt inspection test and verification.

2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

a) weigh notes as required by section 5.2e);

b) the production sampling and testing results as required by section 6;

c) confirmation of delivery, as required by section 6.2d);

d) the test results as required by section 10; and

e) the verification requirements and records as required by section 12.

3 Materials

3.1 Quality of materials

a) The Contractor must develop and implement a process control system which must include the following documents for the asphalt plant:

   i) monthly RAP and asphalt production test results in electronic spreadsheet format;

   ii) audit samples;

   iii) monthly process control charts and invitation to process control meeting; and

   iv) monthly asphalt plant computing data outputs to match with samples being taken.

b) The Contractor must submit the plant process control system developed pursuant to section 3.1a) as part of the Construction Documentation.

c) The Contractor must ensure that materials comply with the following:

   i) binder, flux and cutter must be in accordance with the requirements of RD-BP-S1 “Supply of Bituminous Material”;

   ii) aggregate, sand, recycled glass aggregate, and mineral filler must be in accordance with the requirements of RD-PV-S1 “Supply of Pavement Materials”;

   iii) tack coat must be in accordance with the requirements of AS 1160 Bituminous emulsions for the construction and maintenance of pavements;

   iv) cutback bitumen must be in accordance with the requirements of AS 2157 Cutback bitumen;

   v) hydrated lime filler must be in accordance with the requirements of AS 1672.1 Limes and limestones, Part 1: Limes for building; and

   vi) rejuvenating agent must be in accordance with recognised Reference Documents for such materials (diesel is not a suitable rejuvenating agent). Rejuvenation agents must be fully disclosed for mix assessment including submission of safety data sheets (SDS).

3.2 Reclaimed asphalt pavement material (RAP)

The Contractor must ensure that RAP material complies with the following requirements:

a) RAP must be obtained from milling or excavation of existing asphalt pavements or asphalt plant waste; and

b) for the use of RAP within asphalt mixes, the Contractor must submit as part of the Construction Documentation a RAP management plan meeting the following minimum requirements:

   i) RAP must be crushed and screened as necessary to ensure a maximum size no greater than the maximum size of asphalt being produced and to achieve a well graded, free flowing, and consistent product;

   ii) the processed RAP of each size must be placed in separate stockpiles not exceeding 1,000 t and represent a Work Lot;

   iii) RAP quality must be tested via either:

      A. each Work Lot being tested for binder content, gradings, viscosity and moisture content at a minimum of one test per Work Lot. Test results must be traceable to the asphalt mix containing the RAP; or

B. viscosity testing being carried out on final mix on a regular basis sufficient to demonstrate viscosity is within the target range for binder type targeted (excluding polymer modified binders); and

iv) RAP that has been stockpiled and has bound together in some way must be reprocessed, to ensure that it is in a free flowing state at the time of use.

4 Mix requirements

4.1 General

The Contractor must ensure that mix requirements comply with the requirements of AGPT Part 4B: Asphalt, except as varied by this section 4.

4.2 Nominated mixes

a) The Contractor must ensure that all submissions of nominated mixes are in accordance with Appendix 2: Assessment and registration of asphalt mix designs.

b) The Contractor must submit as part of the Construction Documentation details of each approved asphalt mix and the asphalt mix registration certificates proposed for use (including the propriety product of the additive proposed to be used, pursuant to section 5.4d).

4.3 Compliance of nominated mixes

a) If the Contractor has a current asphalt mix register number and the mix has not been varied in accordance with section 4.4, the Contractor must submit the following as part of the Hold Point submission contemplated by section 4.3b):

i) description of the job mix formula (JMF); and

ii) a copy of the latest asphalt mix design assessment.

b) Submission of the information in section 4.3a) constitutes a **Hold Point**. Production and placement of asphalt must not occur until this Hold Point has been released.

c) The Contractor must monitor the production results of all its registered mixes, and must submit a summary of previous mix production data for the submitted mix which must include:

i) plot of voids verses binder content, max density verses binder content;

ii) summary sheet of JMF data in an electronic spreadsheet format;

iii) process control plots of binder content, max density, production voids and in-situ voids; and

iv) summary of associated non-conformances and dispositions.

d) Where the analysis of the production test data shows that the design air voids target requires a different binder content to the nominated binder content, an alternative mix design must be submitted in accordance with PC-CN3 “Construction Management”.

4.4 Variations to nominated mixes

The Contractor must submit a new nominated mix in compliance with section 4.2 if:

a) the Contractor proposes to vary the proportions of the constituents in a nominated mix;

b) the Contractor proposes to change the source of supply of any constituent; or

c) the asphalt mix register number is withdrawn by the Department.

4.5 Mobile plants

a) The Contractor must submit the asphalt mix history (including mix production data) and details of the nominated mobile asphalt mixing plant as part of the Construction Documentation.

b) Plant settings and mix design parameters must be met before proceeding with the permanent works through production of trial mixes. Submission of trial mix data will constitute a **Hold Point**. The relevant permanent Works must not proceed until the Hold Point has been released.

c) The Contractor must ensure that plant fuel comprises liquefied petroleum gas, liquefied natural gas, petrol or diesel.

4.6 Wearing course

a) The Contractor must ensure that all wearing course layers contain at least 1% added hydrated lime.

b) For the purposes of section 4.6a), a levelling course that is trafficked more than 20 days is deemed to be a wearing course.

c) The Contractor must ensure that the design of wearing course asphalt mixes satisfies the requirements of RD-BP-D4 “Surface Characteristics of Flexible Pavements”.

4.7 Coarse dense mix asphalt

a) The Contractor must ensure that the mix properties for the design and production control of coarse dense mix asphalt satisfies the requirements of Table RD-BP-S2 4-1.

b) The Contractor must ensure that:

i) the grading envelopes meet the requirements of Table RD-BP-S2 4-2; and

ii) production tolerances on grading and binder content comply with AS 2150 Asphalt - A guide to good practice.

Table RD-BP-S2 4-1 Mix properties of coarse dense mix asphalt

Characteristic		Gyratory cycle no.	AC10	AC14	AC14HB
Nominal mix sieve size (mm)			9.5	13.2	13.2
Design and production air voids target (%)	Medium duty(1)	80	4.0	4.0	2.5
	Light duty(1)	50	4.0	4.0	-
Production air voids	Tolerance (%)		Target ±1.5	Target ±1.5	Target ±1.5
Binder film index (µm) - minimum	Medium duty(1)	80	8.5	8.5	10.0
	Light duty	50	9.5	9.5	-

Table notes:
(1) Medium and light duty refers to Austroads definitions for number of gyratory gyropac cycles, not extent of traffic loading.

Table RD-BP-S2 4-2 Coarse dense mix grading envelopes(1)

Sieve	AC10		AC14 and AC14HB	
	Max	Min	Max	Min
19			100	100
13.2	100	100	92	80
9.5	92	80	83	67
6.7	82	66	70	54
4.75	70	52	60	43
2.36	48	34	42	28
1.18	34	21	30	19
0.6	24	14	21	12
0.3	17	8	16	7
0.15	11	5	10	6
0.075	7	4	6	3

Table notes:
(1) Aggregate gradings with percentage passing sieve size (mm), in accordance with ISO 3310-1 Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth and ISO 3310-2 Test sieves - Technical requirements and testing - Part 2: Test sieves of perforated metal plate.

4.8 Fine dense mix asphalt

a) The Contractor must ensure that mix properties for design and production control of fine dense mix asphalt meets the requirements of Table RD-BP-S2 4-3.

b) The Contractor must ensure that:

i) grading envelopes of fine dense mix asphalt meet the requirements of Table RD-BP-S2 4-4; and

ii) production tolerances on grading and binder content comply with AS 2150 Asphalt - A guide to good practice.

Table RD-BP-S2 4-3 Mix properties of fine dense mix asphalt

Characteristic	Fine AC7	Fine AC10
Light duty design (gyratory cycles)	50 cycles	50 cycles
Nominal mix sieve size (mm)	6.7	9.5
Minimum binder content (%)	6.0	5.7
Design and production air voids target (%)	4.0	4.0
Production air voids tolerance (%)	Target ±1.5	Target ±1.5
Target in-situ voids (%) (refer to RD-BP-C3 “Construction of Asphalt Pavement”)	2.0 - 6.0	2.5 - 7.0
Binder film index (µm) minimum	8.0	8.0

Table RD-BP-S2 4-4 Mix grading envelopes of fine dense mix asphalt(1)

Sieve	Fine AC7		Fine AC10	
	Max	Min	Max	Min
13.2				100
9.5		100	100	90
6.7	100	90	90	75
4.75	90	75	77	63
2.36	65	51	56	43
1.18	47	35	41	30
0.6	33	23	29	20
0.3	22	15	20	13
0.15	14	9	13	8
0.075	8	5	8	5

Table notes:
(1) Aggregate gradings with percentage passing sieve size (mm), in accordance with ISO 3310-1 Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth and ISO 3310-2 Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate.

4.9 Coarse / fine dense mix asphalt including RAP

Where RAP is incorporated into coarse/fine dense mix asphalt, the Contractor must ensure that:

a) dense mix asphalt incorporating RAP meets the design requirements of section 4.7 or section 4.8 and Table RD-BP-S2 4-5;

b) for asphalt mixes with higher than 10% RAP incorporation, additional design components of binder rejuvenation are used including:

   i) extracting the RAP binder to determine binder content and viscosity;

   ii) ensuring the resilient modulus of RAP mixes to be the same as equivalent virgin mixes in accordance with Table RD-BP-S2 14-2. Testing frequency is one test (a pair of production pat per sample) per 10 production samples per mix;

   iii) ensuring that the rejuvenating agent is a softer grade bitumen and low volatility oil (if required) capable of combining with bitumen to counteract hardening and produce a lower viscosity grade of binder; and

   iv) no added binder or rejuvenation is required for asphalt mixes with 10% RAP or less added; and

c) asphalt mixes with standard binder types reflect the design viscosity recommended. For mixes including added binder from RAP, softer binder class and or rejuvenator may be required to achieve the target viscosity.

Table RD-BP-S2 4-5 RAP Incorporation into asphalt mix

Wearing course		Other layers	
RAP content incorporation limits			
Coarse dense mix	Fine dense mix	Non-PMB binder	PMB binder
≤10%	≤20%(1)(2)	≤50%(1)(2)	≤20%(1)(2)

Table notes:

(1) For asphalt mixes with 10% or greater (5% increments) RAP content in the total mix, the actual percentage added must be approved by the Principal.

(2) Rejuvenation requirement:

a) rejuvenator not required if RAP ≤10%; and

b) rejuvenator required if RAP >10%.

4.10 Coarse / fine dense mix asphalt including recycled crushed glass (RCG)

Where RCG is incorporated into the coarse/fine dense mix asphalt, the Contractor must ensure that:

a) it meets the design requirements of section 4.7 or section 4.8;

b) where incorporated in asphalt the mix must:

i) be a quarry sand substitute (or blend); and

ii) comply with the requirements of RD-PV-S1 “Supply of Pavement Materials”;

c) for wearing course mixes, the proportion of RCG in the total mix must not exceed 2.5%; and

d) for all layers except wearing course, the proportion of RCG in the total mix must not exceed 10%.

4.11 Open graded asphalt (OGA)

The Contractor must ensure that the following requirements are satisfied with respect to OGA:

a) mix properties for the design and production control must comply with Table RD-BP-S2 4-6;

b) the grading envelopes must comply with Table RD-BP-S2 4-7;

c) production tolerances on grading and binder content must comply with the requirements of AS 2150 Asphalt - A guide to good practice;

d) the design and production must be to medium duty category (80 gyratory cycles);

e) binder type must be A15E;

f) cellulose fibres may be added to reduce binder drain down;

g) RAP content is not permitted; and

h) RCG content is not permitted.

Table RD-BP-S2 4-6 Mix properties of OGA

Characteristic	OG10	OG14
Nominal mix sieve size (mm)	9.5	13.2
Hydrated lime (%) - minimum	1.0	1.0
Design air voids target (%)	20	20
Production air voids tolerance (%)	18 - 23	18 - 23
Binder content target (% by mass)	5.6	5.3

Table RD-BP-S2 4-7 Mix grading envelopes(1)

Sieve	OG10		OG14	
	Max	Min	Max	Min
19			100	100
13.2	100	100	100	85
9.5	100	85	70	45
6.7	65	35	45	25
4.75	45	20	25	10
2.36	20	10	15	7
1.18	14	6	12	6
0.6	10	5	10	5
0.3	8	4	8	4
0.15	7	3	7	3
0.075	5	2	5	2

Table notes:
(1) Aggregate gradings with percentage passing sieve size (mm), in accordance with ISO 3310-1 Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth and ISO 3310-2 Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate.

4.12 Stone mastic asphalt (SMA)

The Contractor must ensure that the following requirements are satisfied with respect to SMA:

a) mix properties for the design and production control must meet the requirements of Table RD-BP-S2 4-8;

b) the grading envelopes must meet the requirements of Table RD-BP-S2 4-9;

c) production tolerances on grading and binder content must comply with the requirements of AS 2150 Asphalt - A guide to good practice;

d) the design and production must be to medium duty category (80 gyratory cycles);

e) binder type to be A5E, with A15E suitable for light to medium duty traffic subject to approval during the asphalt mix certification process;

f) minimum of 0.3% (by mass) cellulose fibre to reduce binder drain down must be added and the nominated mix submission must include details of the filler, fibre type and source;

g) RAP content is not permitted; and

h) RCG content is not permitted.

Table RD-BP-S2 4-8 Mix properties of SMA

Characteristic	SMA07	SMA10
Nominal mix sieve size (mm)	6.7	9.5
Hydrated lime (%) - minimum	1.0	1.0
Design air voids target (%)	3.5	3.5
Production air voids tolerance (%)	2.0 - 5.5	2.0 - 5.5
Binder content target (% by mass)	7.0	6.5
Binder film index (BFI) (µm) - minimum	-	9.0

Table RD-BP-S2 4-9 Mix grading envelopes(1)

Sieve	SMA7		SMA10	
	Max	Min	Max	Min
13.2				100
9.5		100	100	90
6.7	100	85	55	30
4.75	62	30	40	20
2.36	35	20	28	15
1.18	28	16	24	13
0.6	24	14	21	12
0.3	20	12	18	10
0.15	16	10	14	9
0.075	12	8	12	8

Table notes:
(1) Aggregate gradings with percentage passing sieve size (mm), in accordance with ISO 3310-1 Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth and ISO 3310-2 Test sieves — Technical requirements and testing — Part 2: Test sieves of perforated metal plate.

4.13 Job mix formula (JMF)

The nominated job mix formula submitted by the Contractor pursuant to section 4.3a)i) will be assessed by the Department for compliance with the requirements of this Master Specification Part. An asphalt mix design assessment will be supplied to the Contractor and will incorporate:

a) mix register number;

b) production grading tolerances; and

c) a JMF comprising of combined grading, binder content, max density, bulk density, design target air voids, binder film thickness, RAP percentage, and resilient modulus.

5 Manufacture of mixes

5.1 General

a) The Contractor must ensure that mixes are manufactured to replicate the JMF in accordance with the requirements of AS 2150 Asphalt - A guide to good practice.

b) The Contractor must ensure that mixes do not exhibit drainage of the binder or contain less than 95% of aggregate particles that are not fully coated with binder as determined in accordance with AS 2891.11 Methods of sampling and testing asphalt - Degree of particle coating.

c) The Contractor must ensure that asphalt is manufactured so that its properties comply with the requirements specified in section 12.

5.2 Manufacturing controls

The Contractor must ensure that the following manufacturing controls are satisfied:

a) plant temperatures and mixing times must be maintained in a range sufficient to ensure a homogenous mix without causing deleterious effects to the binder through overheating and within the manufacturer specifications as detailed in Australian Asphalt Pavement Association Advisory Note 7 Guide to the heating and storage of binders for sprayed sealing;

b) the binder temperature used for storage or transport must not exceed the values shown against the binder class indicated in Table RD-BP-S1 5-1;

c) the maxima stated in Table RD-BP-S1 5-1 may be increased by up to 10°C when additives such as polymers or scrap rubber are incorporated in the binder;

d) spray temperature of the binder into a pugmill type environment must be such as to minimise oxidation or drainage of the binder; and

e) the temperature of the mix delivered into each truck during loading at the asphalt plant must be recorded on the weigh note and included as part of the Quality Management Records.

Table RD-BP-S1 5-1 Maximum binder temperature

Binder class	Max temperature (°C)
170	180
320	185

5.3 Manufacture of mixes including RAP

a) In batch mixing plants, the Contractor must ensure that the RAP is either:

i) metered into the asphalt plant after heating and drying of aggregates;

ii) added directly to the weigh hopper with other aggregate materials, for each batch; or

iii) weighed separately and added direct to the pugmill.

b) If necessary, the Contractor must ensure that the batch mixing time is increased to ensure adequate heat transfer and dispersion of RAP.

c) In drum mixing plants, the Contractor must ensure that RAP is protected from excessive temperatures by a combination of entry point to drum and shielding from direct flame contact.

5.4 Manufacture of asphalt with additive or foaming technique

a) Where approved on the mix registration certificate, the Contractor may use an additive or foaming technique to manufacture:

i) at standard temperatures but air and pavement placement temperatures are reduced in accordance with the requirements of RD-BP-C3 “Construction of Asphalt Pavement”;

ii) at standard temperatures but time until placement is extended and mix placement temperature reduced (HMA); or

iii) asphalt at lower temperatures (WMA).

b) Where placement temperature is reduced, the Contractor must ensure that compaction requirements are still be in accordance with the requirements of RD-BP-C3 “Construction of Asphalt Pavement”.

c) The Contractor must provide the testing temperature of gyratory compaction when additives or foaming technique are used in accordance with the requirements of:

i) Department Test Procedure TP425 Sampling of Asphalt; and

ii) AS 2891.2.2 Methods of sampling and testing asphalt, Part 2.2: Sample preparation - Compaction of asphalt test specimens using a gyratory compactor.

d) The propriety product of the additive used must be fully disclosed by the Contractor as part of the Construction Documentation in accordance with section 4.2.

6 Production sampling and testing

6.1 General

a) The Contractor must conduct sampling and testing of asphalt and binder for control and verification purposes during manufacture.

b) The Contractor must ensure that, for fine dense mixes meeting the requirements in this Master Specification Part, the sample rate is one per Work Lot (the Work Lot must not exceed a day's production).

c) The Contractor must ensure that, for coarse dense mixes, SMA and OGA meeting the requirements of this Master Specification Part, the sample rate must be in accordance with Table RD-BP-S2 6-1.

d) The Contractor must ensure that the following tests and calculations are performed and reported on each production sample:

i) combined grading;

ii) binder content - various test methods allowed, with AS2891.3.3 Methods of sampling and testing asphalt binder content and aggregate grading - Pressure filter method to be used in any auditing or dispute resolution;

iii) maximum density;

iv) bulk density;

v) air voids; and

vi) binder film index (BFI).

e) Test results and calculations of production mix must be provided as part of the Quality Management Records within 24 hours of the relevant sampling and testing being carried out.

Table RD-BP-S2 6-1 Asphalt sampling and testing frequency

Sampling and testing frequency	Fixed asphalt plant and approved(1) process control (t)	Fixed asphalt plant without approved(1) process control (t)	Mobile asphalt plant (t)
1	50 - 200	50 - 150	0 - 30
2	Additional sample / test each 300 t >200	151 - 300	31 - 100
3		301 - 500	101 - 250
4		Additional sample / test each 300 t >500	251 - 400
5			Additional sample / test each 300 t >400

Table notes:
(1) As documented in asphalt mix design assessment.

6.2 Audit samples

a) The Contractor must provide audit samples using the Department's random selection template for product auditing purposes in accordance MAT-PC063 "Random Sample Template" for the following:

i) asphalt: from each production mix sample, the Contractor must provide a single sample (6 L tin) of a minimum 11 kg asphalt for retention by the Principal. These samples may be used for product auditing purposes. The Contractor must submit asphalt audit samples using random sample template (selection rate of 1 in 4 or otherwise as directed);

ii) asphalt for performance testing: the Contractor must combine all audit samples per mix type that are not required for other auditing purposes, and prepare bulk samples for performance testing. All production reports for each audit must remain with the bulk sample;

iii) residual bitumen: the Contractor must provide one sample per type per delivery (minimum of 1 L) for product auditing purposes. Audit samples are not required where a Department arrangement exists; and

iv) PMBs: the Contractor must provide one sample per type per delivery (minimum of 1 L) for product auditing purposes.

b) All samples must be delivered to the Principal's nominated facility at a minimum of monthly intervals, or as requested by the Principal. The Contractor may dispose of remaining random asphalt samples after a minimum of 30 days from the date of sampling.

c) All samples must be a minimum of 11 kg and clearly labelled on the side of the container in clear indelible ink or paper sticker and must include:

i) materials;

ii) mix type;

iii) sample number;

iv) date of sampling; and

v) asphalt mix design register number and project name.

d) The samples will be stored at the Department's expense. The Contractor must provide documentation to confirm that the samples have been received at the Principal's nominated facility, and submit this as part of the Quality Management Records with the relevant Works Lot. All samples must be clearly marked and traceable to the relevant Work Lot in accordance with the requirements of PC-QA1 "Quality Management Requirements" or PC-QA2 "Quality Management Requirements for Major Projects" (as applicable).

7 Property variations of production asphalt

a) In replicating the JMF properties, the Contractor must ensure that the production mix variations do not exceed the limits shown in AS 2150 Asphalt - A guide to good practice.

b) The Contractor must ensure that variations of the production air voids from the design air voids targets do not exceed the limits of production air voids tolerance in:

i) Table RD-BP-S2 4-1;

ii) Table RD-BP-S2 4-3;

iii) Table RD-BP-S2 4-6; and

iv) Table RD-BP-S2 4-8.

c) The Contractor must ensure that the moisture content of production asphalt is less than 0.2%.

8 Storage of asphalt

The Contractor must ensure that asphalt is stored in accordance with the requirements of AS 2150 Asphalt - A guide to good practice.

9 Delivery of mix

The Contractor must ensure that the delivery of asphalt mix complies with the following requirements:

a) asphalt mix must be transported to site in a manner which does not result in a deterioration of the properties of the mix or contamination of the mix;

b) transport operations must be arranged in a manner which ensures continuous placing of asphalt;

c) if haulage distance is measured for the purpose of payment in the Contract Documents, the haulage distance must be calculated from the nominated asphalt plant which is closest to the work site, regardless of whether it is sourced from any other plant for any reason (including breakdown); and

d) the haulage distance includes the loaded trip only and excludes the return trip.

10 Test procedures

a) The Contractor must use the test procedures detailed in Table RD-BP-S2 10-1 to verify conformance with the requirements of this Master Specification Part.

b) Results of the testing undertaken pursuant to section 10a) must be provided as part of the Quality Management Records.

Table RD-BP-S2 10-1 Test procedures

Test	Test procedure
Sampling of raw materials: aggregates and processed RAP	Department Test Procedure TP226 Sampling of Soil, Aggregates and Rocks
Sampling of raw materials: bitumen and polymer modified binder (PMBs)	AS 2008 Bitumen for pavements
Sampling of raw materials: mineral filler	Department Test Procedure TP226 Sampling of Soil, Aggregates and Rocks
Sampling of asphalt	Department Test Procedure TP425 Sampling of Asphalt and AS2891.1.1 Methods of sampling and testing asphalt - Part 1.1: Sampling Loose asphalt
Compaction of asphalt test specimens using a gyratory compactor	Department Test Procedure TP428 Compaction of Asphalt Test Specimens Using a Gyratory Compactor
Determination of the maximum density of asphalt - Water displacement method (duplicate sample testing not required)	AS 2891.7.1 Methods of sampling and testing asphalt Determination of maximum density of asphalt - Water displacement method
Bulk density of compacted asphalt specimens: presaturation method for dense graded and SMA	AS 2891.9.2 Methods of sampling and testing asphalt Determination of bulk density of compacted asphalt - Presaturation method
Bulk density of compacted asphalt specimens: mensuration method for OGA and porous mixes	AS 2891.9.3 Methods of sampling and testing asphalt Determination of bulk density of compacted asphalt - Mensuration method
Measurement of thickness or height of compacted asphalt	ASTM D3549 Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens
Voids - calculation	AS 2891.8 Methods of sampling and testing asphalt Voids and volumetric properties of compacted asphalt mixes
Binder film index - calculation	AS 2891.8 Methods of sampling and testing asphalt Voids and volumetric properties of compacted asphalt mixes
Binder content - pressure filtration method	AS 2891.3.3 Methods of sampling and testing asphalt Binder content and aggregate grading - Pressure filter method
Binder content - reflux method	AS 2891.3.1 Methods of sampling and testing asphalt
Binder content - centrifugal extraction	AS 2891.3.2 Methods of sampling and testing asphalt Binder content and aggregate grading - Centrifugal extraction method
Binder content - ignition oven	Austroads Test Method AGPT-T234 Asphalt Binder Content (Ignition Oven Method)
Stripping potential of asphalt - tensile strength ratio (TSR)	ATM-232-22 Stripping Potential of Asphalt - Tensile Strength Ratio
Extractions of bituminous binder from asphalt	Austroads Test Method AGPT-T191 Extraction of Bituminous Binder from Asphalt
Design of bituminous binder blends to a specified viscosity value	Austroads Test Method AGPT-T193 Design Of Bituminous Binder Blends to a Specified Viscosity Value

Test	Test procedure
Characterisation of the viscosity of RAP binder using the shear rheometer (DSR) asphalt binder viscosity	Austroads Test Method AGPT-T192 Characterisation of the Viscosity of Reclaimed Asphalt Pavement (RAP) Binder using the Dynamic Shear Rheometer (DSR) Department Test Procedure Department Test Procedure TP664 Extraction of Binder from Asphalt
Asphalt particle loss	Austroads Test Method AGPT-T236 Asphalt Particle Loss
Asphalt binder drain-off	Austroads Test Method AGPT-T235 Asphalt Binder Drain-off
Particle size distribution by dry sieving	AS 1141.11.1 Methods for sampling and testing aggregates, Method 11.1: Particle size distribution — Sieving method
Voids in dry compacted fillers	AS/NZS 1141.17 Methods for sampling and testing aggregates, Method 17: Voids in dry compacted filler
Moisture content	AS/NZS 2891.10 Methods of sampling and testing asphalt Moisture content of asphalt
Specific surface	AS/NZS 2350.8 Methods of testing portland, blended and masonry cements, Method 8: Fineness index by air permeability method
Loss on ignition AS 3583.3 Methods of test for supplementary cementitious materials for use with portland cement Determination of loss on ignition (Reconfirmed 2016), water soluble fraction of filler	AS/NZS 1141.8 Methods for sampling and testing aggregates, Method 8: Water-soluble fraction of filler
Deformation resistance of asphalt mixtures by the wheel tracking test	Austroads Test Method ATM-T231 Deformation Resistance of Asphalt Mixtures by the wheel tracking test
Fatigue life of compacted bituminous mixes subject to repeated flexural bending	Department Test Procedure TP477 (draft) Flexural Fatigue Test Method
Determination of the resilient modulus of asphalt - Indirect tensile method	AS/NZS 2891.13.1 Methods of sampling and testing asphalt Determination of the resilient modulus of asphalt - Indirect tensile method

11 Hold Points

Table RD-BP-S2 11-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table RD-BP-S2 11-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
4.3b)	Submission of JMF documentation and information	Documentation	15 Business Days review
4.5b)	Submission of trial mix data from a mobile plant	Documentation	20 Business Days review

12 Verification requirements and records

12.1 Test records and verification for asphalt mix design initial assessment

The Contractor must undertake the testing specified in Table RD-BP-S2 14-4 and must supply written verification with their initial mix registration submission in accordance with Appendix 2: Assessment and registration of asphalt mix designs.

12.2 Test records and verification for plant production

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table RD-BP-S2 12-1 have been complied with.

Table RD-BP-S2 12-1 Plant production testing

Subject	Property	Frequency	Acceptable limits
Manufacturing controls	Temperature at manufacture	Each truckload	Refer section 5.2
Production sampling and testing	Binder content and combined grading	Refer section 6.1	Refer section 4 and asphalt mix design assessment
Production sampling and testing	Bulk density	Refer section 6.1	Report only
Production sampling and testing	Absorption of compacted specimens	Refer section 6.1	≤ 2.0% for AC20 ≤ 1.0% for SMA
Production sampling and testing	Maximum density	Refer section 6.1	Report only
Production sampling and testing	Voids on compacted specimens	Refer section 6.1	Refer section 4 and asphalt mix design assessment
Production sampling and testing	Binder film index (1)	Refer section 6.1	Refer section 4

Table notes:
(1) Absorption for RAP component assumed to be zero.

13 Appendix 1: Asphalt inspection test and verification

Table RD-BP-S2 13-1 Plant inspection schedule

Control Area	Inspection / test	Purpose	Frequency
Cold feed bins	As set out in the Construction Documentation	To ensure correct feeding of plant	a) On installation. b) As set out in the Construction Documentation.
Dryer drum	As set out in the Construction Documentation	To ensure correct heating and drying of aggregates	As set out in the Construction Documentation
Hot feed bins	As set out in the Construction Documentation	To ensure correct batching	As set out in the Construction Documentation
Binder	Tank temperature penetration or softening point	To check storage temperature. To check for binder hardening(1)	a) Daily b) In case of doubt
Additive silos	As set out in the Construction Documentation	To ensure correct feed rates for additives	As set out in the Construction Documentation
Mixed asphalt	Temperature	To ensure temperature conforms	Every batch or continuously

Table notes:
(1) Binder can harden during storage, particularly when circulated. The Construction Documentation should state the “safe” storage period for binder in its tank configuration and require testing if that period is exceeded without fresh deliveries. In the absence of other information, a period of 2 weeks should be adopted.

Table RD-BP-S2 13-2 Inspection and test frequencies for additives(1)

Inspection / test	Purpose	Frequency
Appropriate tests to determine intrinsic properties	To confirm characteristics of product or check compliance with this Master Specification Part	a) Source approval prior to initial use b) As stated in the Construction Documentation
Inspection of delivery ticket	To check that consignment is as ordered and from the correct source	Each delivery
Organoleptic check of consignment	For comparison with normal appearance	Each delivery, if practicable, otherwise in accordance with the Construction Documentation

Table notes:
(1) This table may include the results of tests and inspections by the additive supplier as part of the process control system.

14 Appendix 2: Assessment and registration of asphalt mix designs

14.1 Submission

a) The Contractor must submit the asphalt mix design together with supporting documentary evidence and laboratory and plant test results for mix and material properties in accordance with section 4.2.

b) For the purposes of section 14.1a), the following details of nominated mix must be submitted:

   i) constituent materials:

      A. aggregates - source, geological type;

      B. added mineral filler - type, source;

      C. binder - source, class or grade;

      D. bitumen adhesion agent - name, type, source, SDS; and

      E. relevant test results verifying material properties for the mentioned materials; and

   ii) mix design:

      A. design mix maximum density;

      B. nominated combined aggregate grading and binder content;

      C. test results of the properties in tables of section 4 of each nominated mix;

      D. details of mixing plant location, description capacity, history and any relevant information;

      E. test results of representative material of each nominated mix produced by the mixing plant from which the asphalt is to be supplied; and

      F. manufacturer's instructions of any additive, including submission of SDS.

c) Testing must be carried out on representative material of each nominated mix progressively of:

   i) laboratory prepared mix; and

   ii) plant prepared mix from which the asphalt is to be applied.

d) When requested, the Contractor must submit a sample of 100 kg of loose asphalt of the nominated mix for verification of performance testing undertaken by the Department.

Table RD-BP-S2 14-1 Testing requirements

Characteristic[1]	FineAC7	FineAC10	AC10	SMA7	SMA10	AC14	OG10	OG14
Gyropac gyratory compaction								
Raw aggregate grading - individual sizes (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total aggregates, sand and fillers absorption (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mix design proportions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Combined gradings (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maximum density (t/m3)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Voids (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Binder content (%)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Binder film thickness (µm)	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Tensile strength ratio[3] (%)	Yes	Yes	Yes	No	No	Yes	No	No
RAP (%) and viscosity treatments	Yes	Yes	Yes	No	No	Yes	No	No
Viscosity (pa.s)[2]	Yes	Yes	Yes	No	No	Yes	No	No

Table notes:
(1) Including asphalt dense mixes containing RAP and WMA.
(2) For asphalt dense mixes containing RAP in accordance section 4.9.
(3) Tensile strength ratio testing must be added to laboratory mix design for mobile plants and must exceed 75%.

14.2 Nominated mix performance test requirements

The Contractor must conduct testing on plant produced mix upon receipt of asphalt mix design assessment in accordance with Table RD-BP-S2 14-2 and Table RD-BP-S2 14-3.

Table RD-BP-S2 14-2 Nominated mixes - Mix performance test properties[1][2]

Asphalt mix characteristic		Wheel tracking	Flexural fatigue TP477	Flexural modulus TP477	Resilient modulus[1]
No.	Mix type (including RAP and WMA)	Austroads Test Method ATM-T231 Deformation Resistance of Asphalt Mixtures by the wheel tracking test (mm)	Minimum micro strain- at 1 million cycles[3]	At 25°C and 10 Hz (MPa)	AS2891.13.1 Methods of sampling and testing asphalt Determination of the resilient modulus of asphalt - Indirect tensile method (MPa) ±1,000 MPa
1	AC10M320	3.0 ≤ WT ≤ 6.0	180 µε	-	4,800 MPa
2	AC14M320	3.0 ≤ WT ≤ 6.0	170 µε	-	4,600 MPa
3	AC14M320H	≥6.0	200 µε	-	5,000 MPa
4	AC10L5E	≤3.0	265 µε	-	4,300 MPa
5	AC10M15E	≤4.0	330 µε	-	2,400 MPa
6	AC14M15E	≤4.0	310 µε	-	2,500 MPa
7	AC10M5E	≤2.0	225 µε	-	6,500 MPa
8	AC14M5E	≤2.0	200 µε	-	6,600 MPa
9	SMA7M15E	-	-	-	-
10	SMA10M15E	≤3.0	350 µε	-	2,000 MPa
11	SMA10M5E	≤3.0	250 µε	-	5,000 MPa

Asphalt mix characteristic	Wheel tracking	Flexural fatigue TP477	Flexural modulus TP477	Resilient modulus[(1)]

Table notes:
(1) Minimum testing frequency (per calendar year). The Contractor must carry out performance testing if the total asphalt amount is greater than 5,000 t per mix per calendar year and for special asphalt mixes including SMA10 or as requested by the Department. The Contractor must also carry out additional performance testing for every 20,000 t per mix per calendar year.
(2) Test results are for the Department's engineers only, are report only, and values given are provided as a guide.
(3) Final strain value must be reported as peak to neutral axis.

Table RD-BP-S2 14-3 Nominated mixes - Testing requirements

Characteristic[(1)]	FineAC7	FineAC10	AC10	SMA7	SMA10	AC14	OG10	OG14
Gyropac gyratory compaction								
Tensile strength ratio (TSR) (%)	No	No	Yes	Yes	No	No	No	No
Slab compaction								
Resilient modulus	No	No	Yes	Yes	Yes	Yes	No	No
Flexural fatigue and modulus	No	No	Yes	Yes	Yes	Yes	No	No
Wheel tracking	No	No	Yes	Yes	Yes	Yes	No	No

Table notes:
(1) Including asphalt dense mixes containing RAP and WMA.

14.3 Asphalt mix design assessment progression

a) The following general stages apply to an asphalt mix design:

   i) laboratory assessment;

   ii) plant production assessment;

   iii) performance testing assessment; and

   iv) field inspection (for surface course mixes).

b) On an ongoing basis, the following applies to an asphalt mix design:

   i) plant production assessment including process control monitoring; and

   ii) performance testing on a minimum yearly basis.

c) If at any stage the Department deems a mix to be unsatisfactory, the registration may be withdrawn as indicated in section 4.4.

14.4 Laboratory assessment

a) The laboratory mix design must incorporate the requirements of section 4, including the following minimum requirements:

   i) design grading curve based on raw aggregate gradings;

   ii) 5 point binder content verses voids laboratory analysis (washout binder content not required) using standard bitumen;

   iii) determination of design binder content at required target air voids;

   iv) provision of all section 4.13 requirements; and

   v) plant trial of mix to verify aggregate gradings and design binder content.

b) The Contractor must undertake the testing specified in this Master Specification Part and Table RD-BP-S2 14-4, and submit the mix design together with supporting documentary evidence and laboratory and plant test results for mix and material properties as per section 4.2.

c) The Department will compare the mix design and test results submitted with the requirements contained in:

i) RD-PV-S1 “Supply of Pavement Materials”;

ii) RD-BP-S2 “Supply of Asphalt”;

iii) AS 2150 Asphalt - A guide to good practice; and

iv) AGPT Part 4B: Asphalt.

Table RD-BP-S2 14-4 Initial mix design testing

Subject	Property	Frequency	Acceptable limits
Materials for asphalt	Binder, flux and cutter	Refer section 3.1	Refer section 3.1
Materials for asphalt	Aggregate, sands and mineral filler	Refer section 3.1	Refer section 3.1
Materials for asphalt	Hydrated lime	Refer section 3.1	Refer section 3.1
RAP material	Binder content (wash out) and grading	Refer section 3.2	Report only
RAP material	Asphalt binder viscosity	Refer section 3.2	Report only
RAP material	Moisture content	Refer section 3.2	Report only
Mix requirements	Total absorption by combined agg.	Refer Appendix 2: Assessment and registration of asphalt mix designs	Report only
Mix requirements	Mix design proportions	Refer Appendix 2: Assessment and registration of asphalt mix designs	Report only
Mix requirements	Binder content and combined grading	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2 and 4.3 and asphalt mix design assessment
Mix requirements	Bulk density	Refer Appendix 2: Assessment and registration of asphalt mix designs	Report only
Mix requirements	Absorption of compacted specimens	Refer Table RD-BP-S2 10-1	≤ 2.0% for AC14 ≤ 1.0% for SMA
Mix requirements	Maximum density	Refer Appendix 2: Assessment and registration of asphalt mix designs	Report only
Mix requirements	Voids on compacted specimens	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2 and 4.3 and asphalt mix design assessment
Mix requirements	Void in mineral aggregate (VMA)	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2
Mix requirements	Tensile strength ratio (TSR)	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2
Mix requirements	Binder film index (BFI)	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2

Subject	Property	Frequency	Acceptable limits
Mix requirements	Resilient modulus	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.2
Mix requirements	Viscosity of the binder of the combined mix containing RAP	Refer Appendix 2: Assessment and registration of asphalt mix designs	Refer section 4.3

14.5 Plant production assessment

a) The Contractor must submit all production test data as part of the Construction Documentation and the following analysis to demonstrate:

   i) sieve data is within the design grading curve envelope;

   ii) binder content and air voids meet the nominated binder content; and

   iii) constructed pavement air voids confirm mix design suitability.

b) When satisfied that the mix meets the specified requirements, the Department will note the summary of test results and give notice for performance testing via the asphalt mix design assessment.

14.6 Initial performance testing assessment

The Contractor must undertake performance testing on the nominated mix and submit performance test results as part of the Construction Documentation.

14.7 Regular mix design assessment

a) The Contractor must submit asphalt plant production test data and material test data to the Department to support the nominated mix.

b) The Contractor must demonstrate to the Department the following:

   i) the average air voids determined from production tests per mix are within ± 0.2% from target for 25 consecutive discrete samples; and

   ii) the average binder content determined from production tests per mix must not be lower than 0.05% from the nominated binder content for 25 consecutive discrete samples.

14.8 Regular performance testing assessment

Performance testing must be undertaken in accordance with Table RD-BP-S2 14-2 and Table RD-BP-S2 14-3 and submit them to the Department.

14.9 Registration

a) The Department will maintain a register of assessed asphalt mixes.

b) The Department will not issue additional mix register numbers if asphalt mixes are equal or less than 10% RAP incorporation, or WMA additives or foaming technique are used.

c) The “Mix Design Assessment” will consist of 5 pages, with a summary page that can be issued to the client. The registered mix number will be in this format: **AASSDBBBZ-CCC-TXXX**, where:

   i) AA = Mix Type;

   ii) SS = Nominal Mix Size (mm);

   iii) D = Duty Type;

   iv) B = Binder Type;

v) Z = additional suffix, e.g. L for hydrated lime, G for RCG, R for regular, H for high binder, and for inclusion of RAP, each 5% is given a number (1 to 9 for 5% through 45%);

vi) CCC = Contractor's name and plant; and

vii) TXXX = sequential number for each mix combination, beginning at T001.