

SUPERSEDED

Technical Specification

**Transport and Main Roads Specifications
MRTS30 Dense Graded and Open Graded Asphalt**

January 2015

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1 Introduction

This Technical Specification applies to the construction of asphalt pavements and surfacings using dense graded and open graded asphalt.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*. Further definitions are as defined in Table 2.

Table 2 – Definitions of terms

Term	Definition
added filler	A filler component which is independently added to the mix at a specified proportion. It may be an imported filler (e.g. fly ash, hydrated lime) or a reclaimed filler (e.g. baghouse dust).
asphalt mix design registrar	Person(s) nominated by the Deputy Chief Engineer (Pavements, Materials and Geotechnical) to register asphalt mix designs for use on Department of Transport and Main Roads projects.
asphalt supplier registration system	The means by which asphalt manufacturers and paving organisations are registered to supply and lay asphalt on Department of Transport and Main Roads projects.
asphalt supplier registrar	Person(s) nominated by the Deputy Chief Engineer (Pavements, Materials and Geotechnical) to register contractors and/or subcontractors that may supply asphalt to Department of Transport and Main Roads projects.
base layer	Pavement layer, other than a surfacing layer or binder layer, which contributes to the strength of the pavement.
binder layer	An asphalt layer that is placed between an asphalt base layer and an asphalt surfacing layer.
corrector layer	Pavement layer, below the surfacing layer, which restores the geometric profile of an existing pavement prior to construction of an asphalt overlay.
dense graded asphalt	A processed mixture of bituminous binder, aggregate and filler with or without additives, which is mixed, stored, delivered, laid and compacted while hot, in accordance with this Technical Specification. Dense graded asphalt may also be known as asphalt, asphaltic concrete, bituminous concrete, bituminous mix or hot mix.
design binder content	The binder content of the registered mix design.
design grading	The combined aggregate/filler particle size distribution of the registered mix design.
manufacturer	An organisation which has the necessary plant and equipment to manufacture dense graded and open graded asphalt to this Technical Specification.
mix design	The design of an asphalt mix of a particular nominal size, comprising the type and proportions of the constituent materials.

Term	Definition
mix design certificate	A certificate issued by the Department of Transport and Main Roads to a manufacturer confirming that the manufacturer has a registered mix design. It may be either a laboratory verified certificate or a production verified certificate.
mix design registration	Written notification issued by the Department of Transport and Main Roads to a manufacturer registering a mix design.
open graded asphalt	A processed mixture of bituminous binder, aggregate and filler with or without additives, which is mixed, stored, delivered, laid and compacted while hot, in accordance with this Technical Specification. The mixture contains only small amounts of fine material, providing a high percentage of air voids. Open graded asphalt may also be referred to as asphalt, bituminous mix or open graded friction course asphalt.
production asphalt	The open graded or dense graded asphalt, produced at the asphalt plant by the registered manufacturer using the registered mix design, for use in work under the Contract.
production run	A period of continuous asphalt production at the manufacturing plant.
production trial	Production of a mix design that has a laboratory verified certificate by a manufacturer to confirm that the mix design can be manufactured to comply with this Technical Specification.
proposed mix design	A mix design for open graded or dense graded asphalt in a particular nominal size submitted by a manufacturer for registration.
QRS	Quarry Registration System as defined in MRTS50 <i>Specific Quality System Requirements</i> .
reclaimed asphalt pavement (RAP) material	Asphalt which has been milled or excavated from existing asphalt pavements, or returned from job sites.
registered asphalt manufacturer	An organisation which has current Department of Transport and Main Roads registration as an asphalt supplier for asphalt manufacture.
registered asphalt paving organisation	An organisation which has current Department of Transport and Main Roads registration as an asphalt supplier for asphalt paving.
registered asphalt supplier	An organisation which has current Department of Transport and Main Roads registration for asphalt manufacture and/or asphalt paving.
registered mix design	The mix design, of a particular nominal size of open graded or dense graded asphalt, which has been submitted by a manufacturer and registered by the Department of Transport and Main Roads.
roller pass	One pass of both axles of a roller over a specific point in one direction.
small production lot	A production lot consisting of less than 100 tonnes of asphalt.
surfacing layer	Pavement layer which will be directly trafficked by vehicles.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1141.7	Methods for sampling and testing aggregates – Apparent particle density
AS 1141.17	Methods for sampling and testing aggregates – Voids in dry compacted filler

Reference	Title
AS 2891.9.3	Methods of sampling and testing asphalt – Determination of bulk density of compacted asphalt – Mensuration method
AS 2891.11	Methods of sampling and testing asphalt – Degree of particle coating
AS 2891.13.1	Methods of sampling and testing asphalt – Determination of the resilient modulus of asphalt – Indirect tensile method
AS 9001	Quality management systems – Requirements
ASTM C295	Standard Guide for Petrographic Examination of Aggregate for Concrete
TN104	Guidelines for Asphalt Mix Design Assessment, Department of Transport and Main Roads Technical Note

4 Standard test methods

The standard test methods given in Table 4 shall be used in this Technical Specification.

Further details of test numbers and test descriptions are given in Clause 4 of MRTS01 *Introduction to Technical Specifications*.

Table 4 – Standard test methods

Property to be Tested	Test Method Number
General	
Calculation of characteristic value of a lot	Q020
Selection of sampling or test locations (random stratified sampling)	Q050
Sampling of soils, crushed rock and aggregates	Q060
Aggregate	
Particle size distribution	Q103B
Flakiness index	Q201
Polished aggregate friction value	Q203
Wet ten percent fines value	Q205B
Wet/dry strength variation	Q205C
Degradation factor	Q208B
Water absorption	Q214B
Crushed particles	Q215
Weak particles	Q217
Petrographic analysis	ASTM C295
Filler	
Clay index value	Q129
Apparent particle density	AS 1141.7
Voids in dry compacted filler	AS 1141.17

Property to be Tested	Test Method Number
Asphalt	
Sampling of asphalt mix	Q301
Dry coring of bound materials	Q302A
Wet coring of bound materials	Q302B
Preparation of core samples	Q303A
Preparation of asphalt mix from a core sample	Q303B
Permeability of asphalt	Q304A
Assessment of asphalt permeability	Q304B
Marshall stability, flow and stiffness	Q305
Compacted density	Q306A, Q306B, Q306C or AS 2891.9.3, Q306E
Maximum density	Q307A
Binder content and aggregate grading	Q308A, Q308D
Preparation, testing and evaluation of asphalt mix	Q309
Binder drainage	Q310
Voids calculations for compacted asphalt	Q311
Abrasion loss	AG:PT/T236
Relative compaction	Q314
Binder film thickness	Q317
Manufacture of laboratory slabs for wheel tracker testing	Q319
Deformation of asphalt	Q320
Fixed and free binder	Q321
Texture depth	AG:PT/T250
Surface evenness	Q708B, Q708C, Q708D
Three metre straightedge	Q712
Degree of particle coating	AS 2891.11
Resilient modulus	AS 2891.13.1

5 Quality system requirements

5.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are stated in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 5.1.

Table 5.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
7		Assessment of pavement defects	
8.2	1. Asphalt mix design acceptance		Submission of asphalt mix design certificate (seven days)
9	2. Use of Quarry		Submit Quarry Registration Certificate
9			Submit aggregate production procedure
10.4.3.1		Trial of asphalt manufacture	
10.4.3.2			Submission of production trial details (seven days)
10.4.3.4	3. Ability to manufacture registered mix design		
11.3.1			Submission of aggregate testing control charts
11.5			Submission of recurring nonconformances report-production
12.1	4. Acceptance of paving procedure		Submit paving procedures (seven days)
12.2.1.2		Storage of dense graded asphalt	
12.2.2		Loading of delivery vehicles	
12.2.2		Temperature of loaded asphalt	
12.2.4.1.2		Surface preparation	
12.2.4.3	5. Extent of crack filling		
12.2.4.4	6. Extent of strain alleviating fabric strips		
12.2.5		Application of tack coat	
12.2.6.1	7. Paving procedures		
12.2.6.7		Temperature of asphalt discharged to hopper	
12.2.6.8		Temperature of asphalt at commencement of rolling	
12.2.6.12	8. Compaction test results for dense graded asphalt placement trial	Trial of laying operations	
12.2.10	9. Areas for corrector		
12.2.10	10. Tolerance of corrector course		

Clause	Hold Point	Witness Point	Milestone
12.2.12		Cleanliness of road surface prior to opening to traffic	
12.3.3.5	11. Referring overlay design to the Principal		
12.3.4			Submission of recurring non-conformance report-placement
13.4.1		Verification of drying of core samples where Q302B is used	

5.2 Construction procedures

The Contractor shall prepare documented procedures for all construction processes as defined in Clause 6 of MRTS50 *Specific Quality System Requirements*.

Procedures for those activities listed in Table 5.2 shall be submitted to the Administrator in accordance with Clause 6 of MRTS50 *Specific Quality System Requirements*.

Table 5.2 – Construction procedures

Clause	Procedures
9	Aggregate production
12.1	Asphalt pavement construction

5.3 Conformance requirements

The conformance requirements which apply to lots of open graded and dense graded asphalt covered by this Technical Specification are summarised in Clauses 11 and 13.

5.4 Testing frequency

The minimum testing frequencies for work covered by this Technical Specification are stated in Clauses 11.3 and 13.2.

6 Intention of this technical specification

6.1 General

The intention of this Technical Specification in relation to dense graded asphalt and open graded asphalt is described in Clauses 6.2 and 6.3.

It is possible that an asphalt mix can meet the requirements of this Technical Specification but not satisfy its intentions. Where an asphalt mix does not perform in the intended manner, the mix shall still be accepted, provided the specified requirements stated in Clauses 10, 11 and 12 have been met. However, in such cases, the mix design registration status may be reviewed by the Department of Transport and Main Roads in accordance with the Asphalt Supplier Registration System.

6.2 Dense graded asphalt

Dense graded asphalt is a general purpose asphalt which may be used for corrector and surfacing layers as well as structural layers. The intent of this Technical Specification varies according to the mix nominal size:

- a) DG7 mix is intended to be a fine workable mix that is suitable for surface correction and for surfacing very low speed environments such as car parks and bikeways
- b) DG10 and DG14 mixes are intended to be used for corrector, surfacing and structural layers. These mixes shall be relatively rut resistant when used with a binder suitable for the traffic environment and have:
 - i. a life greater than 12 years when placed on a sound pavement
 - ii. an average texture depth above 0.4 mm when placed, and
 - iii. an average permeability of not more than 15 $\mu\text{m/s}$ when initially placed, to minimise moisture damage to the layer and oxidation of the binder during service
- c) DG20 and DG28 mixes are intended to be used as structural layers. These mixes shall be relatively rut resistant when used with a binder suitable for the traffic environment, and have an average permeability of not more than 15 $\mu\text{m/s}$ when initially placed to minimise moisture damage to the layer and oxidation of the binder during service

6.3 Open graded asphalt

Open graded asphalt is intended to be used as a surfacing layer on highways and freeways. The intent of this Technical Specification is to provide OG10 and OG14 mixes that have:

- a) a life greater than eight years when placed on a sound pavement
- b) an average permeability greater than 1000 $\mu\text{m/s}$ (free draining) when new
- c) a noise level which is 2 dBa lower (when new) than dense graded asphalt, and
- d) an average texture depth above 1.1 mm when placed.

7 Contractor responsibilities

The Contractor shall be responsible for the design, production and laying of an asphalt mix which conforms with the requirements of this Technical Specification and, prior to the expiry of the defects liability period, shall not:

- a) have any deviations which exceed 8 mm under a three metre straightedge, and
- b) exhibit ravelling, stripping or bleeding.

Assessment for defects will be the responsibility of the Administrator. **Witness Point**

8 Conditions for manufacture and laying of asphalt

8.1 Asphalt supplier registration

Dense graded and open graded asphalt shall be manufactured and/or placed and compacted only by a registered asphalt supplier. The criteria for registration as an asphalt supplier for asphalt manufacture and for asphalt placement and compaction are detailed in the *Asphalt Supplier Registration System Manual*.

Asphalt supplier registration is generally reviewed every three years or earlier if necessitated by conditions imposed in the terms of registration, or if unsatisfactory performance is reported.

Information regarding registration status of an asphalt supplier can be obtained from the Asphalt Supplier Registrar at asphaltsupplier@tmr.qld.gov.au

8.2 Mix design registration

Dense graded and open graded asphalt shall be manufactured to a registered mix design.

The registered asphalt manufacturer shall obtain a registered mix design in accordance with Clause 10.

The mix design registration may predate the Contract, provided that it remains current at the time of supply of production asphalt under the Contract.

Alternatively, the asphalt manufacturer may elect to obtain a registered mix design for the relevant nominal size of dense graded or open graded asphalt to be manufactured under the Contract, in accordance with Clause 10, before the date for supply of production asphalt.

At least seven days before production asphalt is required to be produced, the Contractor shall submit to the Administrator the identity and address of the proposed asphalt manufacturer and a copy of the mix design certificate for the mix proposed for the job. **Milestone**

Production asphalt shall not be delivered to the Works until written acceptance of the registered mix design has been obtained from the Administrator. **Hold Point 1**

Unless otherwise stated in Clause 1 of Annexure MRTS30.1, DG10, DG14, DG20 and DG28 mixes with a laboratory verified mix design certificate shall be verified using a production trial which conforms to the requirements of Clause 10.4.3. This trial shall be undertaken in conjunction with the first asphalt production lot incorporated into the Works. DG7 mixes do not require a production trial to be undertaken.

Mix designs having a production verified mix design certificate do not require a production trial to be undertaken.

9 Quarry registration

Coarse aggregate and fine aggregate (other than natural sand) shall be supplied by a quarry registered and operated in accordance with the Transport and Main Roads Quarry Registration System requirements. The current Quarry Registration Certificate shall be submitted to the Administrator at least seven working days before a material's supply or use. **Milestone**

Material from a quarry shall be neither supplied nor used in the Works without written permission of the Administrator. **Hold Point 2**

The Contractor shall notify the Administrator within three days of any change to the Quarry Registration Certificate, including its Testing Frequency Schedule. Hold Point 2 shall be reapplied.

For each quarry that will supply material(s) to be used in the Works, the Contractor shall prepare a construction procedure for aggregate production in accordance with Clause 6 of MRTS50 *Specific Quality System Requirements* and detail the following for each nominated material:

- a) area of the quarry from which the material in the lot will be won
- b) production process and method of winning the material

- c) procedures for stockpile management and traceability as part of lot control and, as applicable, stockpile subplot control, and
- d) quality control procedures.

The construction procedures shall be submitted to the Administrator at least seven days prior to the commencement of aggregate production for the Works. **Milestone**

10 Registered mix design

10.1 Design responsibility

The manufacturer shall be responsible for development of a mix design to comply with the requirements of Clauses 10.2 and 10.3.

10.2 Constituent material requirements

10.2.1 General

The asphalt mix shall incorporate coarse aggregate, fine aggregate, filler, and binder complying with the requirements of Clauses 10.2.2 to 10.2.5. It may also contain an additive complying with the requirements of Clause 10.2.6. Dense graded asphalt may also include RAP material in accordance with Clause 10.2.7. The mix shall be designed in accordance with the requirements stated in Clause 10.3.

10.2.2 Coarse aggregate

Coarse aggregate shall consist of crushed rock or crushed gravel particles 4.75 mm size or larger.

The aggregate shall be clean, hard, angular, durable, and free from laminated particles, clay and other aggregations of fine material, soil, organic matter and any other deleterious material.

The Polished Aggregate Friction Value (PAFV) of the coarse aggregate from each coarse aggregate source (nominal size greater than 5 mm as defined in MRTS22 *Supply of Cover Aggregate*) shall not be less than that stated in Clause 2 of Annexure MRTS30.1. Where no value is nominated in Clause 2 of Annexure MRTS30.1, the minimum PAFV for surfacing layers shall be 45 for dense graded asphalt and 48 for open graded asphalt. Other properties for the combined coarse aggregate shall comply with the requirements of Table 10.2.2. Testing for compliance shall be in accordance with Clause 11.3.1.

For Greenstone material only, non-compliance with the stated maximum Wet/Dry Strength Variation limit shall be accepted, provided that the Ten Percent Fines Value (Wet) is at least 210 kN.

Table 10.2.2 – Coarse aggregate properties

Property	Limit	Dense Graded Asphalt	Open Graded Asphalt
Flakiness index	Maximum	30	25
Wet ten percent fines value (kN)	Minimum	150	175
Wet/dry strength variation (%)	Maximum	35	30
Degradation factor	Minimum	40	45
Water absorption (%)	Maximum	2†	2

Property	Limit	Dense Graded Asphalt	Open Graded Asphalt
Crushed particles (%)	Minimum	80	100
Weak particles (%)	Maximum	1	1

† For aggregate with water absorption between 2% and 2.5%, project-specific approval may be granted provided that, in the opinion of the Administrator, a history of satisfactory performance has been demonstrated and suitable adjustments to the mix properties have been made

10.2.3 Fine aggregate

Fine aggregate shall consist of natural sand particles and/or crushed rock or crushed gravel particles of size smaller than 4.75 mm but larger than 0.075 mm. The source rock of fine aggregate supplied from a quarry source shall comply with the following coarse aggregate requirements stated in Table 10.2.2:

- a) wet ten percent fines value
- b) wet/dry strength variation, and
- c) degradation factor.

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

10.2.4 Filler

Filler shall consist of natural sand particles and/or crushed rock or crushed gravel particles and added filler having a particle size smaller than 0.075 mm.

The combined filler shall be free from lumps, clay, organic matter and any other deleterious material. The combined filler shall exhibit voids (voids in dry compacted filler) not less than that required for the design mix to comply with the lower fixed binder fraction limit stated in Table 10.3.2 or 38%, whichever is the greater. The minimum voids value shall be nominated on the mix design certificate.

The clay index of each individual filler component shall not exceed 2.2. Where a filler component does not comply with this requirement, it shall be accepted provided that:

- a) the combined filler has a clay index not greater than 2.2, and
- b) mix design registration is conditional upon more frequent monitoring of the clay index of that filler component in accordance with the requirements nominated on the mix design certificate.

The added filler content shall be not less than 1.0% by mass of the mix.

For open graded asphalt, added filler shall contain a minimum of 1.0% of hydrated lime by mass of the mix.

10.2.5 Binder

Unless stated otherwise in Clause 3 of Annexure MRTS30.1, the binder to be used shall be Class 320 bitumen for dense graded asphalt and A5S polymer modified binder for open graded asphalt.

Binder shall comply with the requirements of MRTS17 *Bitumen* or MRTS18 *Polymer Modified Binder* as appropriate.

10.2.6 Additive

An additive (for example fibre, wax, anti-stripping agent, water from a mechanical foaming system) may be proposed, provided that full details of the type of additive are provided and the mix design standards of Clause 10.3 are attained.

10.2.7 Reclaimed Asphalt Pavement (RAP) material (dense graded asphalt only)

RAP material may be used in dense graded asphalt non-surface layers which have bitumen binders or multigrade bitumen binders. A maximum RAP content of 15% by mass of mix shall apply.

RAP material shall be processed to a well graded, free flowing and consistent state. Minimum processing shall involve crushing and screening operations to ensure a maximum size no greater than the maximum aggregate size of the asphalt being produced.

RAP material shall not contain tar binder and shall be free of contaminants such as unbound granular base material, concrete, clay, soil, organic matter or any other deleterious material.

Processed RAP material shall be placed in separate stockpiles prior to use. Where RAP material has been stockpiled for some time and is no longer in a free-flowing condition, it shall be reprocessed to ensure that it is free flowing at the time of use.

10.3 Design criteria

10.3.1 Grading

The grading of the combined aggregates and added filler and RAP material aggregates (where applicable) shall be such that it complies with the requirements shown in Table 10.3.1.

For dense graded asphalt, the grading curve shall be smooth and shall not vary from the outer one third of the range between the specified limits for one sieve size to the opposite outer one third of the range between the specified limits for an adjacent sieve size.

Table 10.3.1 – Grading limits for combined aggregate and filler

AS Sieve Size (mm)	Percentage Passing by Mass						
	Asphalt Nominal Size (mm)						
	OG10	OG14	DG7	DG10	DG14	DG20	DG28
37.5							100
26.5						100	90 – 100
19.0		100			100	90 – 100	76 – 90
13.2	100	90 – 100		100	90 – 100	72 – 86	64 – 80
9.50	90 – 100	50 – 70	100	90 – 100	68 – 82	60 – 76	55 – 71
6.70	50 – 70	28 – 42	90 – 100	66 – 80	–	–	–
4.75	28 – 42	16 – 26	68 – 82	46 – 62	42 – 58	41 – 58	40 – 56
2.36	9 – 17	8 – 14	44 – 58	28 – 42	28 – 42	28 – 42	28 – 42
1.18	7 – 13	6 – 11	29 – 41	19 – 31	19 – 31	19 – 31	19 – 31
0.600			22 – 32	13 – 23	13 – 23	13 – 23	13 – 23
0.300	4 – 8	3 – 7	12 – 20	9 – 17	9 – 17	9 – 17	9 – 17
0.150			7 – 13	6 – 11	6 – 11	6 – 11	6 – 11
0.075	1 – 4	1 – 4	4 – 8	4 – 7	4 – 7	4 – 7	4 – 7

10.3.2 Binder content

The binder content of the design mix (including RAP material where applicable) shall comply with the binder requirements of Table 10.3.2.

Table 10.3.2 – Asphalt mix design requirements

Property	Unit	Limit	Value						
			Asphalt Nominal Size (mm)						
			OG10	OG14	DG7	DG10	DG14	DG20	DG28
Effective binder volume	%	Minimum	9.0	8.0	–	10.0	9.5	9.0	8.5
Free binder volume	%	Minimum	6.5	5.5	–	5.5	5.2	5.0	4.5
		Maximum	–	–	–	8.0	7.5	7.0	7.0
Fixed binder fraction	–	Minimum	–	–	0.25	0.30	0.30	0.30	0.30
		Maximum	–	–	0.60	0.60	0.60	0.60	0.60
Binder film thickness	µm	Minimum	15.0	15.0	–	–	–	–	–
Air voids in the compacted mix (silicone sealed)	%	Minimum	13.0	13.0	–	–	–	–	–
Air voids in the compacted mix (mensuration)	%	Minimum	tbr	tbr	–	–	–	–	–
Abrasion loss	%	Maximum	30	30	–	–	–	–	–
Binder drainage	%	Maximum	0.3	0.3	–	–	–	–	–

tbr - To be recorded

10.3.3 Mix properties

10.3.3.1 Open graded asphalt

The manufacturer shall use the Marshall method of design (50 blow) to produce a mix design which complies with the property requirements stated in Table 10.3.2.

10.3.3.2 Dense graded asphalt

The manufacturer shall use the Marshall method of design (50 blow) to produce a mix design which satisfies the property requirements stated in Table 10.3.3.2 for the design mix and for mixes prepared with the maximum permitted variations stated in Table 10.4.2 applied to the grading and binder content.

Table 10.3.3.2 – Dense graded asphalt design requirements

Property	Unit	Limit	Value				
			Asphalt Nominal Size (mm)				
			DG7	DG10	DG14	DG20	DG28
Air voids in the compacted mix (design mix) ^{†1}	%	Minimum	4.9	4.6	4.3	4.1	4.0
		Maximum	5.9	5.6	5.3	5.1	5.0
Stability	kN	Minimum	6.0	7.5	7.5	7.5	7.5
Flow	mm	Minimum	2.0	2.0	2.0	2.0	2.0

Property	Unit	Limit	Value				
			Asphalt Nominal Size (mm)				
			DG7	DG10	DG14	DG20	DG28
Stiffness	kN/mm	Minimum	2.0	2.0	2.0	2.0	2.0
Voids in the mineral aggregate (VMA)	%	Minimum	15.0	14.0	13.0	12.5	12.0
		Maximum	19.0	18.0	17.0	16.5	16.0
Voids filled with binder (VFB)	%	Minimum	58	58	58	58	58
		Maximum	78†2	78†2	78†2	78†2	78†2
Maximum density	t/m ³	–	tbr	tbr	tbr	tbr	tbr

†1 Preparation of test specimens for determining air voids to be carried out using Test Method Q305 and standard Marshall moulds.

†2 The maximum VFB limit may be increased up to 80, provided the air voids of the tolerance mixes are not less than the values specified in Table 10.4.3.3.3, and the VFB range (which is the difference between the VFB results of the fine grading / high binder content and the coarse gradings / low binder content tolerance mixes) does not exceed 20. A reduced binder content range may apply where compliance with the VFB range cannot be achieved.

tbr To be recorded.

10.3.4 Performance properties (dense graded asphalt only)

10.3.4.1 Mix design performance requirements

The dense graded mix design shall also comply with the performance requirements stated in Table 10.3.4.1.

Table 10.3.4.1 – Asphalt performance requirements

Property	Unit	Limit	Value				
			Asphalt Nominal Size (mm)				
			DG7	DG10	DG14	DG20	DG28
Wheel tracking †1, †2 rut rate rut depth	mm/kC mm	maximum	–	–	0.3	–	–
		maximum	–	–	4.0	–	–
Indirect tensile resilient modulus†3	MPa	–	–	tbr	tbr	tbr	tbr

†1 Testing with Class 320 bitumen as the binder

†2 Test specimens to be prepared in accordance with Q319 to achieve air voids of $5 \pm 1.0\%$.

†3 Test specimens to be prepared in accordance with AS 2891.2.2 using Class 320 bitumen and 120 cycles of gyratory compaction.

tbr To be recorded.

10.3.4.2 Permeability performance requirements

DG14, DG20 and DG28 mix designs which have any point of the target grading that falls on or within the grading envelope limits stated in Table 10.3.4.2 shall be tested for permeability in accordance with Test Methods Q304A and Q304B. Other DG14, DG20 and DG28 mix designs may be tested for permeability in accordance with test methods Q304A and Q304B at the discretion of the Asphalt Mix

Design Registrar where field observations indicate the mix may not comply with the permeability characteristics listed in Clause 6.

When tested, DG14 mix shall have a permeability of not more than 15 $\mu\text{m/s}$ at 7.0% air voids. An increased minimum compaction standard may apply for DG14 mixes where compliance with this permeability requirement cannot be achieved.

When tested, DG20 and DG28 mixes shall have a permeability not more than 15 $\mu\text{m/s}$ at 7.0% air voids or not more than 10 $\mu\text{m/s}$ at 6.0% air voids.

Table 10.3.4.2 – Grading limits for permeability testing

AS Sieve Size (mm)	Percentage Passing By Mass		
	Asphalt Nominal Size (mm)		
	DG14	DG20	DG28
19.0			76 – 79
13.2		72 – 76	64 – 69
9.50	68 – 72	60 – 64	55 – 59
6.70	–	–	–
4.75	42 – 47	41 – 45	40 – 45

10.4 Mix design registration

10.4.1 General

With the exception of DG7, mix design registration is a two-stage process comprising:

- laboratory assessment to verify compliance with the requirements of this Technical Specification, and
- a production trial to verify the capability of the manufacturing plant to produce the laboratory verified mix design.

The mix design registration process is defined in the Asphalt Supplier Registration System.

10.4.2 Laboratory assessment of proposed mix design

To obtain a laboratory verified mix design certificate for a proposed mix design, the manufacturer shall submit the mix design details, test results and samples of the mix design components to the Transport and Main Roads laboratory in accordance with the requirements of the Department of Transport and Main Roads Technical Note Number TN104 – *Guidelines for Asphalt Mix Design Assessment*. Proposed mix designs shall be assessed in accordance with this technical note.

Provided that the manufacturer's design complies with the requirements stated herein, the manufacturer shall be issued with a laboratory verified mix design certificate. This certificate shall include job limits for binder content and grading based on the maximum permitted variations for these properties as stated in Table 10.4.2. This certificate shall also include job limits for maximum density and the combined filler voids.

Table 10.4.2 – Maximum permitted variations from the registered mix design

AS Sieve Size (mm)	Maximum Permitted Variation (% by mass)	
	Dense Graded Asphalt	Open Graded Asphalt
≥ 9.50	± 7	± 6
6.70	± 6	± 5
4.75	± 6	± 4
2.36	± 5	± 3
1.18	± 4	± 3
0.600	± 4	–
0.300	± 3	± 2
0.150	± 2	–
0.075	± 1	± 1
Binder Content (%)	± 0.3†	± 0.3†

† Subject to the approval of the Asphalt Mix Design Registrar during mix design assessment, the maximum permitted variation for binder content may be tightened, but shall not be less than ± 0.2. The applicable binder content variation (job limits) shall be stated on the mix design certificate.

10.4.3 Production trial

10.4.3.1 General

DG7 asphalt does not require a production trial. Unless otherwise stated in Clause 1 of Annexure MRTS30.1, all other mixes with a laboratory verified mix design certificate shall be verified using a production trial of the laboratory verified mix design. **Witness Point**

Mix designs that have a production verified mix design certificate do not require a production trial to be undertaken.

10.4.3.2 Trial details

At least seven days prior to commencement of the production trial, the Contractor shall supply details of the trial to the Administrator and Asphalt Mix Design Registrar, including the date, time, proposed location and tonnage of the trial. **Milestone** The trial may be located in the Works, subject to the approval of the Administrator.

The production trial shall:

- a) adopt the production rate expected to be used for full scale production of the mix and
- b) involve the manufacture of not less than 100 tonnes asphalt.

10.4.3.3 Production trial lot compliance

10.4.3.3.1 Constituent material proportions

The proportions of the constituent materials used in the manufacture of the production trial mix shall comply with the requirements of Table 10.4.3.3.1.

Table 10.4.3.3.1 – Constituent proportion limits for production mix

Constituent	Limit
Coarse Aggregate	For each constituent: $\pm 20\%$ of the proportion on the mix design certificate up to a maximum of $\pm 5\%$ absolute where the constituents come from difference sources, or $\pm 10\%$ absolute where the constituents come from the same source. For the total coarse aggregate proportion (> 5 mm nominal size): $\pm 5\%$ absolute
Fine aggregate	For each constituent: $\pm 20\%$ of the proportion on the mix design certificate up to a maximum of $\pm 5\%$ absolute.
Added filler	For each constituent filler proportion and for the total added filler proportion: $\pm 15\%$ of the proportion on the mix design certificate or $\pm 0.5\%$ absolute, whichever is the greater; except that the proportion of added filler shall not be less than the minimum value specified in Clause 10.2.4.
RAP material	Not greater than the proportion stated on the mix design certificate

Asphalt produced during the production trial shall comprise a production trial lot. A minimum of two samples of mix shall be taken from the production trial lot in accordance with Test Method Q301. The first sample shall be taken from within the first 40% of asphalt produced for the lot, and the second from within the last 40% of asphalt produced for the lot.

10.4.3.3.2 Open graded asphalt

For open graded asphalt, each sample shall be tested in accordance with Test Methods Q307A and Q308A. Provided that the results comply with the job limits on the laboratory verified mix design certificate and the requirements of Table 10.4.3.3.1, the manufacturer will be issued with a production verified mix design certificate.

10.4.3.3.3 Dense graded asphalt

For dense graded asphalt, each sample shall be tested in accordance with Test Methods Q307A, Q308A, Q305 (Marshall compaction only), Q306B and Q311. Provided that each sample taken from the production trial lot complies with the job limits on the laboratory verified mix design certificate and the requirements of Table 10.4.3.3.1 and Table 10.4.3.3.3, the manufacturer will be issued with a production verified mix design certificate. All samples taken and tested shall be reported.

Table 10.4.3.3.3 – Minimum air voids of dense graded production mix

Asphalt Nominal Size (mm)	Minimum Voids (%)
DG7	3.3
DG10	3.1
DG14	2.9
DG20	2.7
DG28	2.6

10.4.3.4 Incorporation of production trial mix into the works

The Contractor may incorporate up to 500 tonnes of production trial asphalt of a stated nominal size into the Works. The test results of the production trial shall be assessed for compliance with the requirements of Clause 10.4.3.3. Provided that the Contractor demonstrates the production trial fully conforms to the requirements of Clause 10.4.3.3, the Administrator shall deem the mix design suitable for incorporation into the Works. **Hold Point 3** If the production trial does not fully conform to the requirements of Clause 10.4.3.3, a further production trial shall be undertaken. Any nonconformances reported in the production trial lot(s) shall be assessed for utilisation of a rejected lot at a reduced level of service in accordance with the Contract.

If the Contractor is not able to supply asphalt which fully conforms to the requirements of Clause 10.4.3.3, the Administrator, subject to a technical assessment of the nonconformances, may direct any further trials to be undertaken offsite at a location nominated by the Contractor. All costs associated with further trials shall be borne by the Contractor.

10.4.3.5 Payment for a production trial

Asphalt manufactured as part of a production trial that is incorporated into the Works shall be paid for in accordance with the provisions of the Contract. All costs of the asphalt manufactured as part of a production trial which is not incorporated into the Works shall be paid for by the Contractor.

11 Constituent materials and production asphalt compliance

11.1 General

Notwithstanding the requirements stated herein for the production asphalt to be manufactured by a registered asphalt supplier, the Contractor shall take full responsibility for the mix design, manufacture, supply and laying of asphalt under the Contract.

Added filler shall be introduced independently at a point in the manufacturing process which ensures thorough mixing with minimal loss of material.

The manufacturer shall not substitute other materials for any of the constituent materials in the registered mix design. Additives shall not be used in the production asphalt unless they are designated constituents of the registered mix design.

The Contractor shall monitor both the production mix air voids and the proportions of the constituents used in the manufacture of the mix. Where changes in constituent materials are such that compliance cannot be consistently achieved within the constituent proportion limits of Table 10.4.3.3.1 or the production mix air voids limits (dense graded asphalt only) of Table 10.4.3.3.3, the Contractor shall notify the Administrator and submit an amended design immediately to the Asphalt Mix Design Registrar for registration.

The Contractor is responsible for carrying out sufficient testing to ensure that all production asphalt complies with the requirements of this Technical Specification. Any binder content and grading tests undertaken by the Contractor in addition to those required to satisfy the compliance requirements of this Technical Specification, shall be reported to the Administrator for assessment of lot compliance.

The manufacturer shall comply with any conditions on the mix design certificate. Such conditions shall take precedence over the requirements of this Technical Specification.

Testing shall be performed in a laboratory which is NATA registered for these tests.

11.2 Charts

The Contractor shall control the uniformity of all asphalt produced for the Works and its conformance with this Technical Specification, using control charts. The minimum requirements for control charts shall be in accordance with the Asphalt Supplier Registration System.

11.3 Conformance requirements

11.3.1 Coarse aggregate

Compliance testing of the coarse aggregate shall be undertaken in accordance with Table 11.3.1-A and Table 11.3.1-B and shall satisfy the requirements of Clause 10.2.2. Testing for each coarse aggregate property shall be as follows:

- a) For flakiness index and weak particles, testing shall be performed on either:
 - i) each nominal size of coarse aggregate used in the registered mix design, or
 - ii) the coarse aggregate, combined in the registered mix design proportions.The latter shall be used where not all of the aggregate nominal sizes comply with the requirements of Table 10.2.2.
- b) For ten percent fines and wet/dry strength variation, testing shall be performed on either:
 - i) the coarse aggregate from each coarse aggregate source used in the registered mix design, or
 - ii) the coarse aggregate, combined in the registered mix design proportions.The latter shall be used where not all of the aggregate nominal sizes comply with the requirements of Table 10.2.2.
- c) For degradation factor, testing shall be performed on the crushed aggregate (including crusher dust), combined in the registered mix design proportions.
- d) For crushed particles, testing shall be performed (where required) on the coarse aggregate, combined in the registered mix design proportions.
- e) For water absorption, testing shall be performed on either:
 - i) the smallest nominal size of coarse aggregate, from each coarse aggregate source, used in the registered mix design, or
 - ii) the coarse aggregate, combined in the registered mix design proportions.The latter shall be used where not all of the coarse aggregate sources comply with the requirements of Table 10.2.2.
- f) For polished aggregate friction value, testing shall be performed on the coarse aggregate from each coarse aggregate source.

Table 11.3.1-A – Maximum lot size for coarse aggregate source rock tests (minimum of one test per lot)

Property	Test Method	Maximum Lot Size ¹ (tonnes of coarse aggregate)		
		Normal	Reduced	Tightened
Petrographic analysis	ASTM C295	Testing Frequency shall be in accordance with Clause 8.1.1 of MRTS50 <i>Specific Quality System Requirements</i>		
Wet ten percent fines value	Q205B			
Wet/dry strength variation	Q205C			
Water absorption	Q214B			
Degradation factor	Q208			
Polished aggregate friction value (PAFV)	Q203			

1. Lot sizes are based on total throughput of plant and can be over consecutive Queensland Department of Transport and Main Roads projects.

Table 11.3.1-B – Maximum lot size for coarse aggregate product tests (minimum of one test per lot)

Property	Test Method	Maximum Lot Size ¹ (tonnes of coarse aggregate)		
		Normal	Reduced	Tightened
Flakiness index	Q201	2,500	5,000	1,000
Crushed particles ²	Q215	10,000	20,000	5,000
Weak particles	Q217	2,500	5,000	1,000

1. Lot sizes are based on total throughput of plant and can be over consecutive Queensland Department of Transport and Main Roads projects.
2. Testing only required where aggregate is obtained from other than a blasted face in a quarry.

The frequency for compliance testing shall initially be undertaken at the normal level. This may change in accordance with the following criteria:

- a) after no nonconformances have occurred in four consecutive lots, a reduced level may be applied
- b) when a nonconformance has been detected, a tightened level shall be applied, and
- c) in a tightened testing regime when no nonconformances have occurred in two consecutive lots, a normal level may be applied.

To demonstrate compliance with the testing requirements in Table 11.3.1, the Contractor shall provide aggregate testing control charts to the Administrator:

- a) prior to commencement of asphalt paving **Milestone** and

- b) as evidence of compliance throughout the project.

The control charts shall be in accordance with the requirements of the *Asphalt Supplier Registration System*.

11.3.2 Fine aggregate

Compliance testing of the fine aggregate shall be undertaken for the following properties where the fine aggregate source differs from the coarse aggregate source:

- a) ten percent fines value (wet)
- b) wet/dry strength variation, and
- c) degradation factor.

Testing of these properties for this purpose shall be performed on coarse aggregate from the fine aggregate source at the frequencies specified in Table 11.3.2.

Table 11.3.2 – Maximum lot size (minimum of one test per lot)

Property	Test Method	Maximum Lot Size (tonnes of fine aggregate)
Petrographic analysis	ASTM C295	Testing Frequency shall be in accordance with Clause 8.1.1 of MRTS50 <i>Specific Quality System Requirements</i>
Wet ten percent fines value	Q205B	
Wet/dry strength variation	Q205C	
Degradation factor	Q208B	

Compliance testing of the fine aggregate is not required where:

- a) the fine aggregate is obtained from a natural sand source, or
- b) the fine aggregate is obtained from the same source as the coarse aggregate.

11.3.3 Combined filler

Samples for compliance testing of the combined filler shall be prepared using the individual filler proportions determined from the mix design certificate. Each sample shall be tested for clay index and voids (voids in dry compacted filler). The minimum testing frequency shall be three monthly for clay index and monthly for voids, unless otherwise stated on the mix design certificate. The combined filler shall have a clay index not greater than 2.2 and voids not less than that nominated on the mix design certificate.

11.3.4 Binder

11.3.4.1 Sampling and testing by the manufacturer

Bitumen and polymer modified binder testing by the manufacturer shall be undertaken in accordance with the requirements of MRTS17 *Bitumen* or MRTS18 *Polymer Modified Binder*, as appropriate.

11.3.4.2 Sampling and testing at site

Bitumen and polymer modified binder delivered to the asphalt plant shall be sampled from the asphalt plant storage tank and tested for compliance in accordance with the requirements of MRTS17 *Bitumen* or MRTS18 *Polymer Modified Binder*, as appropriate.

11.3.5 Asphalt mix

11.3.5.1 Lot sizes

A production lot shall be a portion of production asphalt of the same nominal size manufactured and supplied from the same plant to the same registered mix design, and of not greater than one day's production. Where daily production exceeds 500 tonnes, the maximum lot size shall be half of the daily production. Where the daily production is less than 100 tonnes, the lot shall be classified as a small production lot. A production lot may be used for construction of one or more pavement lots.

11.3.5.2 Sampling and testing

Compliance testing of the production asphalt shall be undertaken for each lot.

Samples for compliance testing shall be taken from fresh production asphalt at the asphalt plant. Two samples shall be taken from each production lot in accordance with Test Method Q301. The first sample shall be taken from within the first 40% of asphalt produced for the lot and the second from within the last 40% of asphalt produced for the lot. These samples shall be deemed to be representative of the asphalt in the lot. For small production lots, at least one sample shall be taken to represent the asphalt within the lot.

Each sample of production asphalt shall be tested for grading, binder content and maximum density in accordance with Test Methods Q308A and Q307A, and preliminary results shall be reported to the Administrator not more than one working day after production.

The Administrator may select samples from trucks within the work site for audit testing. Sampling shall be undertaken in the presence of the Contractor and in accordance with all relevant Workplace Health and Safety requirements. Core samples may also be taken from the compacted pavement to authenticate production mix test results. However, the job limits on the mix design certificate cannot be applied to core sample results.

11.3.5.3 Assessment

Each sample of production asphalt shall be assessed for compliance with the design grading, design binder content and the maximum density of the registered mix design.

The grading and binder content and maximum density shall lie within the job limits on the mix design certificate.

11.4 Characterisation testing (dense graded asphalt only)

Testing of the production mix air voids shall be undertaken by the Contractor to confirm the volumetric characteristics of the production mix. The Contractor shall monitor the test results against the stated requirements and report the results to the Administrator. Although air voids testing shall not be used for assessing the compliance of the production mix with this Technical Specification on a lot by lot basis, the Administrator may use the results as part of the assessment for accepting nonconforming lots at a reduced level of service.

Two samples of production asphalt, taken at the same time as samples for compliance testing, shall be used to determine the air voids of the mix for each production lot. At least two test specimens shall be prepared from each sample for this purpose in accordance with Clause 5 of Test Method Q305.

The air voids within each test specimen shall be determined in accordance with Test Methods Q306B or Q306C and Q311 using the maximum density obtained for the corresponding sample. The average air voids for each sample shall be assessed against the requirements of Table 10.4.3.3.3. Corrective action shall be undertaken when there is a recurring nonconformance as defined in Clause 11.5.

Preliminary results for average voids shall be reported to the Administrator not more than one working day after production.

11.5 Recurring nonconformance – production

A nonconformance is considered recurring when more than five out of the most recent 20 tests have the same nonconformance.

The Contractor shall submit a nonconformance report for each of the following recurring nonconformances: **Milestone**

- a) binder content repeatedly above the upper job limit or repeatedly below the lower job limit stated on the mix design certificate
- b) grading repeatedly above the upper job limit or repeatedly below the job limit stated on the mix design certificate for a particular sieve
- c) maximum density repeatedly above the job limit or repeatedly below the job limit nominated on the mix design certificate, and
- d) for dense graded asphalt, air voids lower than the specified minimum in Table 10.4.3.3.3.

The nonconformance report shall detail the actions previously undertaken to prevent a recurrence of the nonconformance and reasons for these actions being ineffective. The Contractor shall also detail what further actions will be taken to rectify the recurring nonconformance. The Contractor shall also submit a copy of the nonconformance report and a summary of the conformance reports for all preceding lots to the Administrator and the Asphalt Mix Design Registrar. If the recurring nonconformance persists at a frequency greater than one in four lots, the registration status of the mix design may be reviewed under the requirements of the Asphalt Supplier Registration System.

11.6 Performance reporting

Within 14 days of the Certificate of Practical Completion being issued, the Administrator shall issue a preliminary Asphalt Supplier Performance Report, in accordance with the requirements of the Asphalt Supplier Registration System, to the Contractor and Registered Asphalt Supplier for review. The Contractor and Registered Asphalt Supplier shall provide comment and advise the Administrator in writing within 14 days as to the factual accuracy of the preliminary Asphalt Supplier Performance Report. The Administrator shall consider and incorporate the Contractor and Registered Asphalt Supplier's comments (where appropriate) into the report and submit the final Asphalt Supplier Performance Report to the Asphalt Supplier Registrar not more than 60 days after the Date of Practical Completion for the project. The Administrator shall also send a copy of the final Asphalt Supplier Performance Report to the Contractor and Registered Asphalt Supplier.

Where the Contractor and/or Registered Asphalt Supplier do not agree with the content of the final Asphalt Supplier Performance Report, the Contractor and/or Registered Asphalt Supplier may submit

separate reports to the Asphalt Supplier Registrar not more than 90 days after the Date of Practical Completion for the project.

An Asphalt Supplier Performance Report is not required for a project or program of works that involves less than 2000 tonnes of asphalt.

12 Construction

12.1 Construction procedure

At least seven days prior to commencement of paving, the Contractor shall submit the identity and address of the registered asphalt supplier (where not the Contractor) and the procedure for paving operations detailing at least the following: **Milestone**

- a) laying program and rolling pattern
- b) details of any required placement trial, and
- c) inspection and test plan.

Paving operations shall not commence until the procedure is accepted by the Administrator.

Hold Point 4

12.2 Process requirements

12.2.1 Storage of asphalt

12.2.1.1 Open graded asphalt

Open graded asphalt shall be loaded into delivery vehicles as soon as practical and under no circumstances shall be stored for longer than four hours.

12.2.1.2 Dense graded asphalt

Dense graded asphalt may be stored prior to delivery to the Works, provided that the following requirements are observed: **Witness Point**

- a) the asphalt is consigned to, deposited in and discharged from the storage bin in a manner which prevents segregation of the asphalt,
- b) the storage bins are adequately insulated and/or heated so as to maintain an essentially uniform temperature between 135°C and 175°C throughout the stored asphalt for mixes with bitumen binders, and between 140°C and 185°C for mixes with polymer modified binders. Where an additive is a constituent material in the registered mix design, these storage temperatures may be varied, subject to the approval of the Administrator,
- c) the storage time does not exceed 48 hours, and
- d) the temperature of the asphalt is checked immediately after discharge into delivery vehicles.

12.2.2 Loading of delivery vehicles

12.2.2.1 General

The loading of asphalt into the delivery vehicles shall be carried out in a manner which effectively prevents segregation of the asphalt. **Witness Point**

There shall be no foaming or other evidence of moisture content in the asphalt greater than 0.5% by mass. The loaded asphalt shall, on visual inspection, appear uniform in texture, with all particles

completely covered with binder. Where the Administrator suspects the aggregate and filler particles are not fully coated or the asphalt mix contains excessive moisture, the Administrator may order tests to confirm the degree of particle coating or moisture content of the asphalt. The degree of particle coating of the production asphalt shall not be less than 99% when tested in accordance with AS 2891.11. The moisture content of production asphalt shall be determined by drying a sample of fresh asphalt in an oven for a period of three hours at a temperature between 105°C and 110°C. The moisture content shall be determined as the mass loss expressed as a percentage of the initial sample mass.

The temperature of asphalt loaded into the first two delivery vehicles from each production run shall be measured. Provided these temperatures comply with the specification requirements, the frequency of subsequent temperature measurements may be reduced thereafter to hourly. If a nonconformance is detected, each truck load following the nonconformance shall be measured until four consecutive delivery loads comply with the temperature requirements specified in Clauses 12.2.2.2 and 12.2.2.3. The frequency of subsequent tests may be reduced thereafter to hourly.

Loaded asphalt which does not comply with the requirements of this Clause and Clauses 12.2.2.2 and 12.2.2.3, as appropriate, shall not be delivered to the Works.

12.2.2.2 Dense graded asphalt loading temperature

For dense graded asphalt, the temperature of the loaded asphalt shall not exceed 175°C for mixes with bitumen binders, and 185°C for mixes with polymer modified binders. **Witness Point** Where an additive is a constituent material in the registered mix design, the maximum temperature of the loaded asphalt may be varied, subject to the approval of the Administrator.

12.2.2.3 Open graded asphalt loading temperature

For open graded asphalt, the temperature of the loaded asphalt shall not exceed 150°C for mixes with bitumen binders, and 175°C for mixes with polymer modified binders. **Witness Point** Where an additive is a constituent material in the registered mix design, the maximum temperature of the loaded asphalt may be varied, subject to the approval of the Administrator.

12.2.3 Delivery of asphalt to the works

The asphalt shall be delivered to the Works in vehicles equipped with leak-proof, spill-proof, metal tipping trays.

Prior to loading, the inside surfaces of the tipping tray shall be cleaned to remove all foreign matter and then coated with a thin film of a release agent to prevent adhesion of the asphalt to the tray surfaces. Diesel or other hydrocarbon solvents shall not be used as a release agent.

The load shall be covered with a heavy cover, made from canvas or similar material, to minimise heat loss and provide protection against wetting by rain or other contamination.

Delivery shall be undertaken as expeditiously as possible. If the asphalt is transported over long distances or if the ambient air temperature is low, the tipping tray shall be suitably insulated to further minimise heat loss. Unless otherwise approved by the Administrator, asphalt shall not be discharged from the delivery vehicles onto the prepared surface or similar stratum, and subsequently loaded into the paver or material transfer vehicle.

The load-carrying capacity of delivery vehicles shall be not less than six tonnes. All loads of asphalt shall be in accordance with the legal load limit of the vehicle.

The asphalt shall be delivered at a rate which, as far as is practicable, permits continuous operation of the paver.

Delivery vehicles shall be fitted with a suitable tail gate or mechanical device which allows adequate control of the discharge of the asphalt into the receiving hopper of the material transfer vehicle or paver.

The alignment of the paver shall not be adversely affected by the delivery operation.

Asphalt that has spilled at the point of transfer from delivery vehicles to the material transfer vehicle, or at the receiving hopper of the paver, shall be immediately removed from the Works.

All deliveries of asphalt shall be accompanied by the following documentation:

- a) a docket from a certified weighbridge, stating the mass of asphalt in the delivery vehicle, and
- b) a docket from the asphalt plant identifying the delivery vehicle, and stating the time of loading of the asphalt and the temperature of the asphalt at the time of loading.

A copy of all dockets shall be provided to the Administrator. Alternatively, printed output records from calibrated load cells at the load out bins of the production plant may be provided to the Administrator.

12.2.4 Preparation of the existing surface

12.2.4.1 General

The Contractor shall carry out the preparation work detailed in Clauses 12.2.4.2 to 12.2.4.5 on existing surfaces on or against which the asphalt is to be placed. **Witness Point**

12.2.4.2 Preparation

The surface of the pavement base/bridge deck or existing substrate shall be dry, and shall be thoroughly swept using a rotary broom to remove any loose material or other deleterious material which may be present. Any deleterious material which still adheres to the surface after sweeping shall be removed by other means.

In addition to and following mechanical sweeping:

- a) areas of oil or fuel spillage shall be cleaned with detergent, flushed with clean water and allowed to dry prior to application of the tack coat, and
- b) cracks, joints or holes in the pavement/bridge deck shall be rectified as stated in Clause 12.2.4.3.

Frames for manhole covers, gully gratings, kerbs and other structures shall have the joint surfaces cleaned free of any extraneous material.

12.2.4.3 Crack filling

In the areas shown in the Drawings or stated in Clause 4 of Annexure MRTS30.1, cracks greater than 2 mm wide shall be filled prior to placement of any corrector layer, overlay or pavement layer.

The Contractor shall mark out, in the presence of the Administrator, the extent of crack filling to be carried out. **Hold Point 5**

Prior to filling of cracks, the existing cracks shall be cleaned.

Cracks shall be filled level with the surrounding surface with a polymer modified sealant approved by the Administrator.

12.2.4.4 Strain alleviating fabric strips

In the areas shown on the Drawings or stated in Clause 5 of Annexure MRTS30.1, strain alleviating fabric strips shall be applied to existing cracks prior to placement of any corrector layer, overlay or pavement layer.

The contractor shall mark out, in the presence of the Administrator, the extent of the strain alleviating fabric strips to be applied. **Hold Point 6**

Strain alleviating fabric strips shall be non-woven polyester fabric precoated with a rubberised bitumen adhesive base.

Prior to application of the fabric strips, the existing surface shall be swept clean and shall be free of dust, grit, surface moisture and vegetation and any cracks or joints greater than 2 mm in width shall be filled in accordance with the requirements of Clause 12.2.4.3.

The surface to which the strain alleviating fabric is to be applied shall be sprayed with a bituminous emulsion tack coat at a rate of 0.25 litres/m², unless otherwise directed by the Administrator.

Alternatively, a proprietary primer which is recommended by the strain alleviating fabric manufacturer may be used as an alternative to the bituminous emulsion tack coat.

The fabric strips shall be laid to cover a minimum width of 250 mm (nominally 125 mm on each side of the crack).

Placement of the fabric shall be carried out only under the following conditions:

- a) the pavement temperature is not less than 15°C and rain is not likely to fall prior to completing the installation, and
- b) the pavement surface is clean and absolutely dry.

Joints in the fabric shall be overlapped in accordance with the manufacturer's recommendations.

After placement, the fabric shall be rolled with at least one pass of a pneumatic-tyred roller to ensure proper adhesion. The fabric shall be placed free of wrinkles or creases.

Traffic shall not be permitted to traverse the fabric for at least 20 minutes after rolling.

Prior to placing the asphalt, the normal application of bitumen emulsion tack coat shall be applied over the strain alleviating fabric in accordance with Clause 12.2.5.

12.2.4.5 Joining new work to existing work and existing structures

Existing asphalt pavements shall be cut back to provide the following:

- a) a vertical surface at the joint line against which the new asphalt is to be placed and
- b) a longitudinal taper such that the minimum layer thickness is as stated in Clause 12.2.6.5.

Asphalt shall be compacted and neatly finished adjacent to existing structures.

12.2.5 Tack coating

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

Tack coating of existing surfaces on or against which the asphalt is to be laid shall be carried out as follows:

- a) After surface preparation and immediately prior to placing the asphalt, the surface shall be uniformly covered with a fine sprayed coat of bituminous emulsion at the application rate given in Clause 6 of Annexure MRTS30.1. The bituminous emulsion shall be allowed to break and harden prior to laying the asphalt. **Witness Point**
- b) Bituminous emulsion shall comply with the requirements of MRTS21 *Bituminous Emulsion*.
- c) Warming of bituminous emulsion to not more than the manufacturer's recommended maximum temperature and/or dilution of the bituminous emulsion with water may be undertaken in order to facilitate spraying.
- d) Vehicles employed to spray the bituminous emulsion shall be in good mechanical order and shall be fitted with a spray bar and a calibrated dip stick.
- e) Hand spraying shall be carried out only in areas where it is impractical to employ a spray bar, and
- f) Protective boards and/or covers shall be employed as necessary to prevent overspray beyond surfaces to be tack coated.

The contents of the bituminous emulsion tank shall be measured with a dip-stick at appropriate intervals to determine the spray rate of the tack coat, having due regard to the dilution of the emulsion.

Tack coating shall not be carried out where asphalt is to be placed on or against a strain alleviating membrane interlayer.

If the pavement structure consists of a number of layers of asphalt and if the elapsed time between the construction of the pavement layers does not exceed one day, tack coating of the surfaces between the layers is not required unless otherwise directed by the Administrator. If the elapsed time exceeds one day, tack coating of the surfaces between the layers shall be carried out at no cost to the Principal.

Under no circumstances shall a tack coated surface be opened to public traffic.

12.2.6 Laying of asphalt

12.2.6.1 General

With the exception of those operations defined in Clause 12.2.6.9, self-propelled mechanical pavers shall be employed to lay the asphalt.

Paving operations shall not commence until:

- a) the laying program has been accepted by the Administrator
- b) the preparation of the existing surface is acceptable to the Administrator
- c) preliminary production and construction compliance test results for the underlying pavement lot(s), where applicable, have been supplied to the Administrator and conform in all respects to this Technical Specification, or have been accepted by the Administrator for utilisation of a rejected lot at a reduced level of service, and
- d) all recurring nonconformances identified in preceding asphalt lots have been addressed by the Contractor to the satisfaction of the Administrator.

The Contractor shall allow not less than one working day for the Administrator to review the nonconformance report associated with a recurring nonconformance prior to release of the hold point.

Hold Point 7

12.2.6.2 Indicative conformance

Where multiple layers of asphalt are placed during one day's construction, the Administrator may approve the use of Indicative Conformance procedures for testing and/or analysis of production and construction compliance testing. The purpose of Indicative Conformance is to allow work to progress prior to the minimum time-frames required for testing and/or analysis to demonstrate conformance.

An Indicative Conformance Report for the lot may be submitted before the following testing and/or analysis is completed:

- a) binder content and grading of the production mix
- b) maximum density of the production mix
- c) relative compaction of the compacted asphalt, and
- d) geometrics of the compacted asphalt.

Where the Contractor is seeking Indicative Conformance, a separate Indicative Conformance Report shall be prepared by the Contractor for each lot. Each report shall contain:

- a) a statement acknowledging the test results are not yet available for confirmation of conformance, and
- b) a statement accepting risk of the lot, and subsequent overlying lots, being rejected if the work subsequently fails to comply with the stated requirements.

The conformance report shall be processed as soon as possible, with preliminary test results supplied to the Administrator within the time-frame nominated in Clauses 11.3.5.2, 11.4 and 13.1.

Notwithstanding Indicative Conformance being achieved, the lot shall still be subject to assessment in accordance with Clauses 11, 12 and 13.

12.2.6.3 Use of a material transfer vehicle

A material transfer vehicle shall be used in conjunction with the asphalt paving machine where stated in Clause 7 of Annexure MRTS30.1. If so stated, the material transfer vehicle shall be used for placing all asphalt except for areas to be paved at ramps, tapers, turning lanes, roundabouts of radius less than 50 m and other areas approved to be excluded by the Administrator.

The material transfer vehicle shall be a self-propelled, self-steering machine which shall receive hot asphalt materials from delivery vehicles, and remix and deliver those materials to an asphalt paving machine without touching or bumping the asphalt paving machine.

The material transfer vehicle shall be equipped with:

- a) a receiving hopper compatible with normal delivery vehicles
- b) conveyor mechanisms and anti-segregation devices for remixing hot asphalt materials
- c) conveyor mechanisms capable of delivering re-mixed asphalt materials to a paving machine at a minimum rate to suit the paver capacity and asphalt work being carried out
- d) a minimum storage capacity of 15 tonnes, and

- e) sufficient motor horsepower to operate with full loads on grades up to 6% and to travel in tandem with an asphalt paving machine, whether directly in front or at an offset position.

Where asphalt paving shall be across structures, the Contractor shall control the gross mass of the material transfer vehicle to any maximum permissible loadings as set out in Clause 8 of Annexure MRTS30.1.

When a material transfer vehicle is used, the paver hopper shall be fitted with a mass flow hopper insert or enclosed by other means to prevent asphalt from falling out of the front of the paver during paving operations. The Contractor shall maintain sufficient head of material in the paver hopper to avoid segregation of the mix. Material which has fallen from the receiving hopper of a materials transfer vehicle or from the receiving hopper of the paver shall be removed from the Works.

12.2.6.4 Paver capacity

Mechanical pavers shall be capable of laying at least 30 tonnes of asphalt per hour, unless approved otherwise by the Administrator [**Refer to Hold Point 4**]

12.2.6.5 Layer thickness limits

The target thickness of each layer chosen to suit the construction process and the thickness of the compacted asphalt layer as stated in the Contract shall be within the limits given in Table 12.2.6.5. In situations where a single nominal size asphalt mix is stated for multiple layers of base asphalt, the target layer thickness of DG14 and DG20 may be increased to up to five times the nominal size for that particular asphalt mix, subject to the approval of the Administrator. Prior to the Administrator approving an increase in the layer thickness above the limits stated in Table 12.2.6.5, the Contractor shall undertake a placement trial in accordance with the requirements of Clause 12.2.6.12 at the target thickness proposed.

Table 12.2.6.5 – Layer thickness limits

Asphalt Mix Nominal Size (mm)	Compacted Layer Thickness (mm)					
	Corrector Layer		Base Layer		Surfacing or Binder Layer	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
OG10					25	35
OG14					35	45
DG7	–	–	–	–	20† ¹	30† ¹
DG10	25	50	–	–	30† ²	40† ²
DG14	35	70	40	60† ³	45	60
DG20	50	100	50	80† ³	50† ¹	80† ¹
DG28	–	–	70	110	† ¹	† ¹

†¹ Not recommended for use as a final road surfacing layer

†² Not recommended for motorways or roads with a speed limit of 100 km/h or greater

†³ The layer thickness may be increased to 5 times the nominal size, subject to the approval of the Administrator

12.2.6.6 Weather restrictions

The surface on which the asphalt is to be placed shall be essentially dry and free of any surface water. Asphalt shall not be placed during periods of rain. Any asphalt placed during rain shall be removed from the Works and replaced with fresh asphalt unless otherwise determined by the Administrator.

Compaction of thin layers of asphalt is adversely affected by low pavement temperatures. If the pavement temperature is less than the minimum pavement temperatures given in Table 12.2.6.6, the Contractor shall develop and implement project-specific construction procedures to minimise the impact of these conditions at the site. These procedures shall include the supply and use of at least one additional roller and/or increasing the asphalt discharge temperature (not exceeding the maximum discharge temperature stated in Clause 12.2.6.7) and/or increasing the rolling temperature. If the characteristic value of relative compaction stated in Clause 12.3.1 and the minimum discharge and rolling temperatures are not achieved under these conditions, no further asphalt shall be placed.

Nonconformance

Table 12.2.6.6 – Minimum surface temperature for asphalt placement

Target Layer Thickness (mm)	Minimum Surface Temperature for Asphalt Placement (°C)	
	All binders other than A0.6S, A5S and A10S Polymer Modified Binders	A0.6S, A5S and A10S Polymer Modified Binders
25	25	† ¹
30	20	† ¹
35	10	35
40	0	20
45	0	10
≥ 50	0	0

†¹ Specific procedures and an additional roller required regardless of pavement temperature

12.2.6.7 Discharge temperature

The minimum temperature of the asphalt at the time of discharge into the receiving hopper of the paver shall be as stated in Table 12.2.6.7. **Witness Point** Where an additive is a constituent material in the registered mix design, the minimum discharge temperature may be varied, subject to the approval of the Administrator.

Reheating of the delivered asphalt shall not be permitted.

Table 12.2.6.7 – Minimum asphalt discharge temperature

Asphalt Type	Layer Thickness (mm)	Minimum Temperature (°C)	
		All binders other than A0.6S, A5S and A10S Polymer Modified Binders	A0.6S, A5S and A10S Polymer Modified Binders
Dense Graded Asphalt	≤ 40	135	145
	> 40	125	135
Open Graded Asphalt	≤ 45	110	135

12.2.6.8 Paver operation

Laying of the asphalt shall commence immediately following discharge of the asphalt into the receiving hopper. The operating speed of the paver shall be so adjusted that, as far as is practicable, continuous laying of the asphalt is achieved without stoppages.

The paver screed shall not be left in contact with the previously laid asphalt for prolonged periods while the paver awaits delivery of asphalt. At no time shall the temperature of the asphalt prior to rolling fall below the minimum temperature stated in Clause 12.2.7.2. **Witness Point**

The asphalt shall not be allowed to segregate or to accumulate along the sides of the receiving hopper.

The finished mat shall have a uniform appearance, with no evidence of segregation or surface irregularities.

The method of paver level control shall be as given in Clause 9 of Annexure MRTS30.1. If no method is given in Clause 9 of Annexure MRTS30.1, the Contractor shall provide an adequate method of level control for the work. Unless automatic control actuated by a computerised layer thickness device is being used, a matching shoe attachment shall be employed when the asphalt is being laid to match the level of previously constructed work.

If any irregularity in the laying of the asphalt occurs, operation of the paver shall cease until the cause of the irregularity is identified and corrective procedures applied. If, however, the irregularity is of a minor nature and is confined to isolated areas on the surface of the laid asphalt, then, provided that the surface has not cooled below the temperature stated in Table 12.2.7.2, operation of the paver may continue and the affected areas shall be corrected by hand-spreading methods.

12.2.6.9 Hand spreading

Hand spreading of the asphalt shall be confined to correcting of minor surface irregularities, and working on or very close to drainage channels, in tapers and in other areas normally inaccessible to pavers.

In the correction of minor surface irregularities, a thin layer of fresh asphalt shall be placed over the affected areas, spread evenly using board rakes, and rolled immediately.

In areas where hand-spreading operations are required, the asphalt shall be taken directly from the receiving hopper (or other approved location), immediately distributed into place using shovels, and spread to the required loose depth using metal rakes or board rakes (lutes).

Loose stones shall be removed from the surface prior to rolling.

General broadcasting of the asphalt from shovels shall not occur.

12.2.6.10 Removal prior to rolling

Any asphalt which, prior to rolling, has cooled to a temperature lower than that stated in Clause 12.2.7.2, and does not meet the minimum compaction requirements, or exhibits an irregularity which cannot be satisfactorily corrected, shall be removed from the Works and replaced with fresh asphalt.

12.2.6.11 Laying program and rolling pattern

Prior to commencement of the work, the Contractor shall submit to the Administrator a laying program and rolling pattern which shall be used for laying operations and shall achieve the requirements of this Technical Specification **[Refer to Hold Point 4]** The laying program shall ensure that:

- a) the main paving runs are laid first
- b) the longitudinal joints are parallel to the pavement centreline
- c) the longitudinal joints are located away from the traffic wheel paths, and
- d) where practical, longitudinal joints are located under proposed line marking.

The rolling pattern shall be maintained for the whole of the laying program, or until such time as a subsequent trial run establishes an alternative pattern. The rolling pattern, including the number of passes of the rollers, shall not be varied without advising the Administrator.

12.2.6.12 Placement trial

12.2.6.12.1 General

Where specified in Clause 10 of Annexure MRTS30.1, a trial of the laying operations shall be carried out prior to commencement of the work. **Witness Point**

12.2.6.12.2 Dense graded asphalt placement trial

The trial section shall be located within the site and shall be not less than 1000 m². The trial shall determine:

- a) the adequacy or otherwise of the construction plant for the work
- b) the rolling pattern and the number of passes of the rollers required to produce an acceptable compacted layer, and
- c) the adequacy of the joint compaction procedure.

The Contractor shall carry out compaction tests along the trial run, in accordance with Clause 13, in order to determine the degree of compaction attained **Hold Point 8** If the trial does not conform to the requirements of this Technical Specification, a further trial shall be undertaken.

12.2.6.12.3 Open graded asphalt placement trial

A placement trial shall be undertaken for each open graded asphalt mix incorporated into the Works. The trial section shall be located within the site and shall be not less than 1000 m². The trial shall determine the following:

- a) the adequacy or otherwise of the construction plant for the work, and
- b) the assigned compacted density of the asphalt mix.

The minimum number of rolling passes shall be as specified in Clause 12.2.7.3.1. If the trial does not conform to the requirements of this Technical Specification, a further trial shall be undertaken.

The assigned compacted density of the asphalt layer shall be determined using the following formula:

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

where:

- D = the assigned compacted density of an open graded asphalt mix, in tonnes per cubic metre.
- T_C = average thickness of cores extracted from the pavement lot, in millimetres.
- M = the mass of asphalt in the pavement lot, in tonnes.
- A = area of the pavement lot, in square metres.

The frequency of the core testing shall not be less than that specified in Table 13.2 for layer thickness (cores extracted from the compacted layer).

12.2.7 Compaction

12.2.7.1 Rollers

12.2.7.1.1 Dense graded asphalt

Compaction of dense graded asphalt shall be achieved using approved steel-wheeled rollers, vibratory rollers and pneumatic-tyred rollers.

12.2.7.1.2 Open graded asphalt

Compaction of open graded asphalt shall be achieved using approved steel-wheeled rollers of minimum static weight of 6 tonnes. However, pneumatic-tyred rollers may be used for two complete passes only in the final rolling. Vibratory rolling shall not be used.

12.2.7.2 Rolling temperatures

The minimum temperature of the asphalt at the time of commencement of rolling shall be as detailed in Table 12.2.7.2. Where an additive is a constituent material in the registered mix design, the minimum rolling temperature may be varied, subject to the approval of the Administrator.

Table 12.2.7.2 – Minimum asphalt temperature at commencement of rolling

Asphalt Type	Layer Thickness (mm)	Minimum Temperature (°C)	
		All binders other than A0.6S, A5S and A10S Polymer Modified Binders	A0.6S, A5S and A10S Polymer Modified Binders
Dense Graded Asphalt	≤ 40	115	125
	> 40	105	115
Open Graded Asphalt	≤ 45	110	120

If the temperature of the asphalt is such that ridges or other irregularities form due to horizontal displacement of the asphalt under the action of the roller, the rolling operation shall cease until such time as the asphalt has cooled sufficiently to allow rolling to proceed without these deficiencies forming.

12.2.7.3 Rolling technique

12.2.7.3.1 Open graded asphalt

These requirements for open graded asphalt are intended to provide sufficient compactive effort to ensure interlocking of the material without fracturing the aggregate.

Rolling shall commence as soon as practicable after the laying of the asphalt, consistent with the temperature limitations detailed in Clause 12.2.7.2. A minimum of five passes of the steel-wheeled roller shall be completed within 20 minutes of discharge of the open graded asphalt into the paver receiving hopper. Vibratory rolling shall not be used.

Tyre pressures on pneumatic-tyred rollers shall be maintained within the roller manufacturer's recommended limits.

Transverse joints, longitudinal joints and edges shall be rolled first, in sequential order. Rolling shall then proceed longitudinally along the pavement using the approved pattern, as stated in Clauses 12.2.6.11 and 12.2.6.12.3.

Care shall be taken to ensure that the rolling is delayed sufficiently to minimise displacement of the asphalt, but not sufficiently to allow the asphalt to cool below the minimum rolling temperatures stated in Clause 12.2.7.2.

Steel-wheeled rollers shall be operated at a steady speed not exceeding 5 km/h. Pneumatic-tyred rollers shall operate at a maximum speed of 15 km/h. Care shall be taken to avoid abrupt stops and starts which displace partially compacted asphalt.

The Contractor shall ensure no adverse displacement or cracking of the asphalt occurs during rolling operations.

Rollers shall not remain stationary on the newly compacted asphalt until the temperature of the compacted surface falls below 60°C.

12.2.7.3.2 Dense graded asphalt

Rolling shall commence as soon as practicable after the laying of the asphalt, consistent with the temperature limitations detailed in Clause 12.2.7.2.

The first (breakdown) pass of the roller shall be undertaken using a steel-wheeled roller or a vibratory roller with the vibrator disengaged, unless otherwise approved by the Administrator. The driving wheels shall lead during the first pass.

Except for corrector layers, intermediate rolling shall be undertaken using a pneumatic-tyred roller or a vibratory roller. Intermediate rolling of corrector layers shall be undertaken using a pneumatic-tyred roller.

Final rolling shall be undertaken using a steel-wheeled roller or a vibratory roller.

Tyre pressures on pneumatic-tyred rollers shall be maintained within the roller manufacturer's recommended limits.

Transverse joints, longitudinal joints and edges shall be rolled first, in sequential order. Rolling shall then proceed longitudinally along the pavement.

For layers which have greater than 75 mm compacted thickness, the first (breakdown) pass shall commence approximately 300 mm in from the unsupported edge and progress inwards. The outer

300 mm zone shall then be compacted by advancing outwards from the edge of the first pass towards the unsupported edge in 100 mm increments.

When carrying out this operation, care shall be taken to ensure that the rolling is delayed sufficiently to minimise displacement of the asphalt, but not sufficiently to allow the asphalt to cool below the minimum rolling temperatures stated in Clause 12.2.7.2.

Steel-wheeled rollers and vibratory rollers shall be operated at a steady speed not exceeding 5 km/h. Pneumatic-tyred rollers shall operate at a speed of approximately 2.5 km/h for the first pass, increasing in speed by 2.5 km/h for each subsequent pass, up to a maximum speed of 15 km/h.

Care shall be taken to avoid abrupt stops and starts which displace partially compacted asphalt.

The Contractor shall ensure no adverse displacement or cracking of the asphalt occurs during rolling operations. Vibratory rollers shall have the vibrator disengaged during any change in direction of movement of the roller, and while the roller is stationary.

Rollers shall not remain stationary on the newly compacted asphalt until the temperature of the compacted surface falls below 60°C.

12.2.7.4 Tamping of asphalt

Mechanical tamping (other than that provided by the operation of the paver) and hand tamping of the asphalt shall be employed only in those locations which are either inaccessible to or prohibited to rollers.

12.2.8 Joints

12.2.8.1 General

The laying program stated in Clause 12.2.6.11 shall be such as to keep the number of joints, transverse and longitudinal, to a minimum.

Joints shall be provided as follows:

- a) transversely, after the completion of a day's paving operations or where a delay in the laying operation allows the previously laid asphalt to cool below the minimum rolling temperature stated in Clause 12.2.7.2, and
- b) longitudinally, if the width of the pavement is such that more than one paving run is necessary.

In multiple layer work, the joints in successive layers shall be offset by at least 100 mm, except for longitudinal joints on a crowned pavement.

12.2.8.2 Longitudinal joints

12.2.8.2.1 Hot joints

Where job planning and weather conditions permit the placement of a lane before the temperature of the edge of the preceding lane has dropped below 100°C, the joint may be treated as a hot joint.

Hot longitudinal joints shall be constructed by the use of one of the following:

- a) two spreaders operating 'in echelon', or
- b) leaving a 150 mm wide strip of asphalt mix unrolled along the free edge of each lane until after the adjoining lane has been placed.

The unrolled strip of asphalt mix shall be compacted simultaneously with the material in the adjoining lane. Rolling shall commence before the temperature of the asphalt along the edge of the first-placed lane has fallen below 100°C. After placing the adjacent lane, the initial pass with the rollers shall overlap the previously placed lane by at least 150 mm.

12.2.8.2 Cold joints

Where a hot joint is not feasible, the joint shall be formed using either of the following methods:

- a) Prior to placing the adjoining lane, the edge of the mat shall be cut back, using a cutting wheel, profiler or jack hammer, a sufficient distance to ensure the joint compaction standard in Table 12.3.1.2-A is achieved.
- b) Prior to placing the adjoining lane and the temperature of the mat falling below 100°C, the edge of the mat shall be compacted using an edge compactor.

Dense graded and open graded asphalt edge faces shall be sprayed with a uniform thin coat of bituminous emulsion tack coat in accordance with Clause 12.2.5 before the adjoining asphalt is placed. Waste material from cutting back of cold joints shall be replaced by the Contractor at no cost to the Principal.

12.2.8.3 Transverse joints

Transverse joints shall be generally at right angles to the direction of placing and shall be cut to a straight vertical face for the full depth of the course.

Before making transverse joints, areas at the end of the run which are rough or too low shall be determined by checking longitudinally with a straightedge and removed. The joint shall be cut using a cutting wheel, profiler or jackhammer and the cut material removed and discarded. Cutting using a diamond saw shall not be permitted. Waste material resulting from cutting back to form a transverse joint shall be replaced by the Contractor at no cost to the Principal.

The face of the joint shall be sprayed uniformly with a coat of bituminous emulsion tack coat in accordance with Clause 12.2.5.

The joint shall be made using the paver positioned on the joint such that the hot asphalt is spread against the face of the joint for the full width of the lane and to the required predetermined uncompacted thickness.

In the breakdown rolling of the transverse joint, the roller shall operate parallel with the transverse joint overlapping approximately 50 mm to 100 mm onto the freshly placed material and shall apply not more than two passes. Each successive pass shall overlap a small distance onto the fresh material until the full width of the roller bears on the fresh material. Breakdown rolling shall then continue as normal.

The asphalt in the completed joint shall conform to the required density, surface smoothness and levels stated herein.

12.2.8.4 Joint placement technique

The adjoining run shall be laid with the uncompacted asphalt overlapping the previously laid run by between 25 mm and 75 mm. Prior to rolling, the overlapping material shall be pushed back to the line of the joint to form a ridge along the edge of the newly laid asphalt. Care shall be taken to remove and discard from the Works excessive amounts of the overlapping material and any segregated material before rolling commences.

Excess asphalt shall not be spread across the mat.

If adjoining lanes are laid simultaneously using two or more pavers operating 'in echelon', the loose depths of the laid asphalt shall match exactly along the joint.

Where asphalt is placed over a strain alleviating membrane interlayer, longitudinal joints shall be formed using edge compactors and other joints shall be formed by cutting back broken material or other deformities to the extent that the previously laid asphalt complies with the stated requirements for compaction and geometric tolerances as stated in Clause 12.3.3.

12.2.9 Temporary ramps

If, at the end of a day's laying operations, traffic is required to run on the new asphalt work, the Contractor shall provide temporary asphalt ramps down to the level of the adjacent road surface.

Ramps shall be constructed using impervious cloth, sand or other materials over the underlying surface, and shall be shaped so as to provide safe passage for traffic at the posted speed limit.

Prior to laying the adjoining run, the asphalt ramp shall be cut back to form a transverse joint, as detailed in Clause 12.2.8.3, without breaking the waterproof seal provided by any underlying strain alleviating membrane or sprayed seal coat. If any area of the underlying waterproof seal is damaged, it shall be repaired before being covered with asphalt. Repairs may be carried out using bituminous emulsion with fine aggregate or bituminous emulsion with fine asphalt.

12.2.10 Surface correction

A corrector layer shall be used to correct any irregularities in an existing surface and/or modify the shape of an existing surface.

Any surface depressions greater than 25 mm in depth and any uneven surface shall be brought to the general level of the surrounding pavement/deck surface. Where a corrector layer is used to modify the shape of an existing surface, the layer shall be laid to the reduced levels and/or shape stated in the Contract.

The Contractor shall mark out, in the presence of the Administrator, the areas where the corrector layer is to be applied and shall not lay the corrector layer prior to receiving acceptance of the proposed areas from the Administrator. **Hold Point 9**

A rolling pattern shall be established to achieve the required standard of compaction and this rolling pattern shall be used on all areas of corrector.

The tolerance on the surface of the corrector layer shall be ± 10 mm. **Hold Point 10**

12.2.11 Surface finish

The surface of any asphalt layer shall have a uniform and homogenous appearance and shall contain no cracked, segregated, corrugated, bony or fatty sections. If part of a lot is segregated or contains surface irregularities, the lot shall be subdivided. The segregated sub-lot shall be subject to further testing, and the remainder shall be assessed as a new lot. If in the opinion of the Administrator the whole lot is segregated, it shall be subject to further testing. Lots and sub-lots subject to further testing shall be rejected if they fail to meet the minimum requirements for compaction and surface texture as set out in Clauses 12.3.1 and 12.3.2, and Clause 11 of Annexure MRTS30.1. The minimum testing frequency for surface texture shall be 1 test per 50 m².

12.2.12 Clean up

Prior to being opened to traffic, the Contractor shall clean the surface of all pavements to be trafficked, including shoulders, so that the pavement is free from all loose material. **Witness Point**

Upon completion of the asphalt works, all excess materials, including cut-offs from temporary ramps and joints, shall be removed from the site and disposed of in a manner which complies with environmental requirements in force at the time of such disposal.

12.2.13 Opening to traffic

Asphalt shall be given sufficient time to cool prior to trafficking. If the Contractor allows the asphalt to be trafficked before it has cooled to less than 65°C, the trafficked surface shall be tested for deviation from a straightedge in accordance with Test Method Q712 not less than 24 hours after trafficking commences. The shape of the asphalt surface which has been subjected to early trafficking shall be rectified by the Contractor if the deviation from a straightedge is greater 10 mm for a non-wearing course or 5 mm for a wearing course. The rectification treatment proposed by the Contractor shall be approved by the Administrator prior to implementation.

12.2.14 Exposure of structural layers to weather

DG20 binder and base layers and DG28 base layers, compacted to a minimum characteristic value of relative compaction of less than 93.0%, shall be covered by the next layer of asphalt or sprayed seal within 10 calendar days of placement.

12.2.15 Trafficking of asphalt

This clause applies to all vehicular road traffic, other than traffic used to construct the layers of asphalt.

Layers of asphalt, other than the surfacing layer, may be trafficked during construction of the pavement provided that:

- a) the Polished Aggregate Friction Value of the coarse aggregate used in the layer to be trafficked complies with the requirements of Clause 10.2.2
- b) the proposed trafficking arrangements do not reduce the life of the pavement, and
- c) the proposed trafficking arrangements do not cause ravelling of the trafficked asphalt surface.

12.3 Product standards

12.3.1 Compaction standards

12.3.1.1 Open graded asphalt

Compaction shall be deemed to have been achieved upon verification of compliance with Clause 12.2.7.3.1.

12.3.1.2 Dense graded asphalt

Minimum and maximum characteristic values of relative compaction shall be calculated in accordance with Clause 13.4.1.

The minimum characteristic value of relative compaction shall be not less than the value stated in Table 12.3.1.2.

The maximum characteristic value of relative compaction shall be not more than the value stated in Table 12.3.1.2.

The average value of relative compaction for corrector layers and joints shall be not less than the value stated in Table 12.3.1.2.

Pavement lots that do not conform to the joint compaction requirement shall be accepted, provided the Contractor takes the necessary action to prevent recurrence of the non-compliance and states, on the nonconformance report, what action is to be taken. Recurring nonconformances to this requirement shall be assessed in accordance with the Contract.

Table 12.3.1.2 – Compaction standard

Asphalt Mix Nominal Size (mm)	Surfacing, Binder and Base Layers		Corrector Layers	Joints
	Characteristic Value (%)		Average Value (%)	Average Value (%)
	Minimum	Maximum	Minimum	Minimum
DG7	90.0	97.0	–	–
DG10	90.0	97.0	90.0	88.0
DG14	92.0 (91.0†)	97.0	92.0 (91.0†)	90.0
DG20	93.0	98.0	93.0	90.0
DG28	93.0	98.0	–	90.0

† For target compacted layer thickness < 50 mm

12.3.2 Texture depth

For asphalt layers subject to traffic, the average texture depth within a pavement lot shall not be less than that stated in Clause 11 of Annexure MRTS30.1. Pavement lots that do not conform to the texture depth requirement may be accepted subject to the approval of the Administrator, provided that the Contractor takes the necessary action to prevent recurrence of the non-compliance and states, on the nonconformance report, what action is to be taken. Recurring nonconformances to this requirement shall be assessed in accordance with the Contract.

12.3.3 Geometrics

12.3.3.1 General

There are three primary vertical tolerance controls and one primary horizontal tolerance control for asphalt pavements.

Primary vertical tolerance controls include reduced level, thickness and deviation from a straightedge in accordance with Clause 12.3.3.2. Unless otherwise stated in Clause 12 of Annexure MRTS30.1, vertical tolerance controls shall be as follows:

- a) binder and base layers – reduced level control shall apply and
- b) surfacing layers – thickness control shall apply.

The requirement for deviation from a straightedge stated in Clause 12.3.3.2 and horizontal tolerances stated in Clause 12.3.3.3 shall apply for all asphalt layers.

The pavement shall be constructed so as not to depart from the relevant widths, lengths, shapes and reduced levels or thicknesses stated in the Contract by more than the tolerances listed in Clauses 12.3.3.2 and 12.3.3.3. The widths and reduced levels, if relevant, of the surface of layers, other than the final layer, shall be calculated using the widths, reduced levels and shapes for the completed pavement as shown on the Drawings, and the depth of the layers within the pavement.

12.3.3.2 Primary vertical tolerances

a) Reduced Level

A primary tolerance of ± 10 mm shall apply to any point on the surface of any layer.

b) Thickness

The average thickness of the compacted layer shall be determined using the following formula –

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

where:

T_A = average thickness of compacted layer, in millimetres.

M = the mass of asphalt in the pavement lot, in tonnes.

D = the average compacted density of the pavement lot, in tonnes per cubic metre.

A = area of the pavement lot, in square metres.

The average compacted density for a dense graded asphalt pavement lot shall be determined from the relative compaction test results for the lot. The average compacted density for an open graded asphalt pavement lot shall be assumed to be the assigned compacted density determined from the placement trial.

The average thickness of the compacted layer shall be within ± 5 mm of the target thickness.

The thickness of each layer at any point, excluding any corrector layer, shall lie within the tolerances given in Table 12.3.3.2.

In addition to the above, the total thickness of the constructed asphalt pavement shall be within ± 10 mm of the target total thickness.

Table 12.3.3.2 – Layer thickness tolerances at any point

Asphalt Mix Nominal Size (mm)	Layer Thickness Tolerances at any Point (mm)
OG10	-5, +10
OG14	-5, +10
DG7	± 5
DG10	± 5
DG14	± 7
DG20	± 10
DG28	± 10

c) Deviation from a Straightedge

The deviation from a three metre long straightedge placed anywhere on the surface of a layer in accordance with Test Method Q712 shall not exceed 5 mm, due allowance being made for design shape, where relevant.

12.3.3.3 Horizontal tolerances

The horizontal location of any point on the pavement shall not differ by more than ± 50 mm from the corresponding point shown in the Contract, or as calculated in accordance with Clause 12.3.3.1, except for the following situation. Where alignment of the pavement with an existing road or other existing road structure is necessary, the new work shall be joined to the existing work in a smooth manner as shown on the Drawings.

12.3.3.4 Additional tolerance – new work and overlays with full length/full width correction or profiling

The additional tolerance, as stated below, shall apply to the asphalt pavement lots in the final asphalt pavement layer of work other than single layer asphalt pavement overlays.

The surface evenness of the asphalt pavement layer shall be such as to provide a road roughness count rate not exceeding the road roughness R_s , as stated in Clause 13.1 of Annexure MRTS30.1. Where not stated in Clause 13.1 of Annexure MRTS30.1, R_s shall not exceed 50 counts per kilometre.

12.3.3.5 Additional tolerance – single layer overlays

The additional tolerance, as stated below, shall only apply to the asphalt pavement lots for single layer asphalt pavement overlays without a nominal full length corrector layer or nominal full length profiling. The surface evenness of the asphalt pavement layer shall be such as to provide a road roughness count rate not exceeding the stated required counts per kilometre, R_s , as calculated by the following formula:

$$R_s = R_p \times 0.6 + 5$$

where:

R_s = stated required road roughness count rate, and

R_p = road roughness count rate prior to overlay.

Unless nominated otherwise in Clause 13.2 of Annexure MRTS30.1, R_p shall be taken as the value obtained by the Principal prior to and within 30 days of the Contractor commencing work on the asphalt overlay. Where R_p is greater than 85, single layer overlays shall not be used without correction or profiling. This design is to be referred to the Principal. **Hold Point 11**

Where the value of R_s is calculated to be less than 50, R_s shall be taken as 50 counts per kilometre.

Costs associated with the measurement of surface evenness prior to the asphalt overlay shall be borne by the Principal. Costs associated with the measurement of surface evenness after the completion of the asphalt overlay shall be borne by the Contractor.

12.3.4 Recurring nonconformance - placement

A nonconformance is considered recurring when more than five out of the most recent 20 lots have the same nonconformance.

The Contractor shall submit a nonconformance report for each of the following recurring nonconformances **Milestone**:

- a) minimum characteristic value of relative compaction less than that stated in Table 12.3.1.2
- b) average joint relative compaction less than that stated in Table 12.3.1.2, and
- c) average texture depth less than that stated in Clause 12.3.2.

The nonconformance report shall detail the actions previously undertaken to prevent a recurrence of the nonconformance and reasons for these actions being ineffective. The Contractor shall also submit a copy of the nonconformance report and a summary of the conformance reports for all preceding lots to the Administrator and Asphalt Mix Design Registrar. If the recurring nonconformance persists at a frequency greater than one on four lots, the registration status of the mix design may be reviewed under the requirements of the Asphalt Supplier Registration System.

13 Construction compliance testing

13.1 General

The Contractor is responsible for carrying out sufficient testing to ensure that all asphalt pavement and surfacing constructed under the Contract complies with the requirements of this Technical Specification.

The process requirements shall be checked for compliance with the stated requirements during and after the construction operation, as relevant.

Compliance testing of the pavement shall be undertaken for each lot and shall include the testing of all joints relevant to the lot (as required). A pavement lot shall be a section of completed asphalt pavement of the same mix design, which is essentially homogeneous and has been constructed under essentially uniform conditions. Pavement lot size shall be no greater than one day's construction in a single layer.

Preliminary construction compliance test results for relative compaction shall be reported to the Administrator not more than three working days after placing the asphalt.

13.2 Testing frequency

The minimum testing frequency for work covered by this Technical Specification shall be as listed in Table 13.2.

Where the pavement lot corresponds to a small production lot, the minimum number of tests for relative compaction (dense graded asphalt only) and texture depth may be varied, subject to the approval of the Administrator.

Table 13.2 – Minimum testing frequency

Conformance Requirement	Minimum Test Frequency		Minimum Number of Tests	
	Dense Graded Asphalt	Open Graded Asphalt	Dense Graded Asphalt	Open Graded Asphalt
Relative compaction Q306A, Q306B, Q306C and Q314, or	1 test per 400 m ²	–	7 per lot	–

Conformance Requirement	Minimum Test Frequency		Minimum Number of Tests	
	Dense Graded Asphalt	Open Graded Asphalt	Dense Graded Asphalt	Open Graded Asphalt
Q306E and Q314	1 test per 200 m ²	–	10 per lot	–
Texture depth of road surfacing AG:PT/T250	1 test per 400 m ²	–	7 per lot	–
Relative compaction – longitudinal joints (during placement trial, refer Clause 13.4.4.) Q306C and Q314	1 test per 500 m	-	2 per joint	-
Relative compaction - transverse joints (during placement trial, refer Clause 13.4.4) Q306C and Q314	–	–	1 per 5 joints	–
Horizontal geometry	1 test per 50 m	1 test per 50 m	–	–
Deviations from a straightedge	1 test per 20 m	1 test per 20 m	–	–
Reduced levels at shoulder edges and lane centreline(s) on the cross section (where applicable)	1 test per 20 m	1 test per 20 m	–	–
Layer thickness (where applicable) – a) Probing of the uncompacted layer at 3 points on the cross section or b) Cores extracted from the compacted layer	1 test per 20 m 1 test per 400 m ²	1 test per 20 m 1 test per 400 m ²	– 7 per lot	– 7 per lot

13.3 Geometrics

The geometric tolerances, except for surface evenness, shall be checked at regular intervals not greater than those stated in Table 13.2.

The thickness of the layer (where applicable) shall be determined by one of the following methods:

- a) extracting cores from the compacted layer and measuring the thickness of the cores, or
- b) probing and measuring the thickness of the uncompacted layer.

When probing is used, the thickness of the compacted layer at a specific location shall be determined as follows:

$$T_T = \frac{T_A}{U_A} \times U_T$$

where:

- T_T = compacted layer thickness at a specific test location, in millimetres.
- T_A = average thickness of the compacted layer (as determined in Clause 12.3.3.2), in millimetres.
- U_T = uncompacted layer thickness at a specific location, in millimetres.
- U_A = average thickness of the uncompacted layer to achieve T_A above, in millimetres.

13.4 Compaction (*dense graded asphalt only*)

13.4.1 General

The compaction standard for a lot shall be represented by the characteristic value of relative compaction. The characteristic value of relative compaction shall be calculated in accordance with Q020, using the individual relative compaction results from each lot.

Relative compaction is the percentage ratio of the in situ density of the compacted asphalt and the representative maximum density of the pavement lot.

The in situ density of the compacted asphalt pavement shall be determined by one of the following methods:

- a) nuclear gauge in accordance with Test Method Q306E, or
- b) core sampling in accordance with Test Methods Q302A or Q302B, Q303A and Q306A, Q306B or Q306C.

For core sampling, Test Method Q306A/Q306B shall normally be used, but Test Method Q306C shall be the reference method. Test Method Q306A/Q306B shall not be used for core samples taken from joints or areas within the pavement which are coarsely segregated or suspected of being coarsely segregated or poorly compacted. If core sampling cannot be undertaken using Test Method Q302A, Q302B may be used, subject to the Contractor providing evidence to the Administrator that the core samples have been dried to constant mass prior to density measurement. **Witness Point**

For layer thickness less than 50 mm, insitu density shall be determined by core sampling and/or thin layer nuclear gauge only.

Testing for in situ density shall be carried out as soon as possible after final rolling and, where possible, prior to trafficking. If density testing is carried out after two days of trafficking, the test sites shall be selected away from the trafficked wheel paths.

The representative maximum density for a pavement lot shall be the arithmetic mean of the individual maximum densities obtained for the production lots comprising the pavement lot.

If in the opinion of the Administrator, the representative maximum density is not applicable to the mix in the lot, the relative compaction at each tested location in the lot shall be determined using the

individual maximum density of the mix at each location obtained by core sampling, preparation and testing in accordance with Test Methods Q302A, Q303A, Q303B and Q307A.

13.4.2 Surfacing, binder and base layers

The location of each in situ density test shall be chosen using random stratified sampling in accordance with Test Method Q050, but no test site shall be within 150 mm of a joint or free edge.

In the calculation of the characteristic value of relative compaction from core sampling, core samples of thickness below the minimum layer thickness stated in Table 12.2.6.5 minus the tolerance value stated in Clause 12.3.3.2 shall be tested and reported, but the density results shall not be used for calculation of the characteristic value of relative compaction. Additional cores shall be taken where necessary to ensure compliance with the minimum number of tests stated in Table 13.2.

13.4.3 Corrector layers

The compaction standard for a lot shall be represented by the average value of relative compaction.

Coring for compaction testing shall only be used at locations where the layer thickness is equal to or greater than the minimum layer thickness for the nominal size of asphalt as stated in Clause 12.2.6.5.

The location of each in situ density test shall be chosen using random stratified sampling in accordance with Test Method Q050, but no test site shall be within 150 mm of a joint or free edge.

In the calculation of the average value of relative compaction from core sampling, core samples of thickness below the minimum layer thickness stated in Table 12.2.6.5 minus the tolerance value stated in Clause 12.3.3.2 shall be tested and reported, but the density results shall not be used for calculation of the average value of relative compaction. Additional cores shall be taken where necessary to ensure compliance with the minimum number of tests stated in Table 13.2.

13.4.4 Joints

Compaction testing of joints is only required during the placement trial to confirm the joint compaction process.

Where the Administrator suspects that the stated joint compaction standard has not been achieved, audit testing may be undertaken as stated in MRTS50 *Specific Quality System Requirements*.

The compaction requirement for joints within a pavement lot shall be represented by the average value of relative compaction.

In situ density testing shall be performed using core sampling, and the location of each density test shall be chosen using random sampling in accordance with Test Method Q050. Where the mix on either side of the joint belongs to the same pavement lot, the core sample shall span the joint and not be located to one side of the line of the joint. Where the mix on either side of the joint belongs to a different pavement lot, the core sample shall be taken from within the relevant pavement lot so that it abuts the joint. Joint testing shall only be undertaken where coring equipment can be safely located within the work site in accordance with the requirements of the *Manual of Uniform Traffic Control Devices*.

Compacted density testing shall be carried out using Test Method Q306C.

13.5 Surface texture

Texture depth testing shall only be undertaken on the final surfacing layer and pavement layers subject to public traffic. The location of each texture depth test shall be chosen using random stratified sampling in accordance with Test Method Q050.

13.6 Surface evenness of final surfacing layer

The surface evenness shall be measured by road roughness using Test Methods Q708B, Q708C or Q708D.

The minimum length of a lot for this test shall be 100 m and the maximum length of a lot shall be 500 m.

14 Supplementary requirements

The requirements of MRTS30 *Dense Graded and Open Graded Asphalt* are varied by the supplementary requirements given in Clause 14 of Annexure MRTS30.1

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