

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
SC01	Scope	Design Traffic Loading	MRTS31 applies to DGA layers used in HILI pavements. Table 2.3-1 in TMR's PDM specifies HILI pavements where the traffic loading will exceed 1000 ESA/lane/day in the first year.	R116 applies to heavy duty DGA used on highways receiving more than 600 heavy vehicles per lane per day. Based on AGPT02/10 Table 7.8, 600 heavy vehicles would impart between 1000 and 1500 ESA.	RMS defines a heavy duty pavement in its AGPT02/10 supplement as one that will receive a design traffic loading of $10^7$ ESA or more during its first 20 years of service.
SC02	Scope	Warm Mixed Asphalt (WMA)	WMA is not mentioned in MRTS31. TMR has issued an advisory note on WMA.	Clause 1.1 of R116 advises that asphalt can be manufactured using warm mix technology.	Does TMR wish to permit the use of WMA in heavy duty pavements?
SC03	Scope	DG14HS	MRTS31, Cl. 6.2 specifies that DG14HS is to be used in wearing courses and binder layers of heavy duty pavements and is intended to have an average permeability less than 15 $\mu$ m/s when first placed.	DG14HS is similar to AC14-A15E. However, RMS generally only specifies AC14-A15E in high shear or very high load situations when it is not desirable to provide a 7mm C170 waterproofing layer below SMA and OGA.	What is TMR's motivation for specifying A5S binder in DG14HS? What does DG14-HS cost relative to AC14-AR450? What DG14HS failure modes have been reported and what caused them?
SC04	Scope	DG14HP	MRTS31, Cl. 6.3 advises that DG14HP is intended for use in free flowing traffic areas in the binder layer and/or in the wearing course of heavy duty pavements and is intended to have an average permeability less than 15 $\mu$ m/s when first placed.	DG14HP is similar to AC14-A15E.	What is TMR's motivation for specifying A5S binder in DG14HP and what failure modes have been reported and what caused them? What does DG14-HP cost relative to AC14-AR450?
SC05	Scope	DG20HM	DG20HM is used in the base course of full depth, composite and deep strength asphalt pavements and is intended to have an average permeability less than 15 $\mu$ m/s when initially placed.	DG20HM is roughly equivalent to AC20-C600. However, C600 binder is rarely used in NSW as C600 binders are difficult to compact at the paving and compaction temperatures specified in R116, Cl. 3.8.	What does DG20HM cost per tonne? What does AC20-AR450 cost per tonne? Have DG20HM failures been reported? What caused those failures? Why is DG20HM susceptible to stripping if its permeability is supposed to be the same as DG14HS/HP?

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SC06	Scope	Defects Liability	<p>MRTS31, Cl. 7 specifies that prior to expiry of the defects liability period, the asphalt shall not exhibit any:</p> <ul style="list-style-type: none"> <li>• Deviations that exceed 8 mm under a three metre straightedge; or,</li> <li>• Ravelling stripping or bleeding</li> </ul>	<p>R116, Cl. 1.1 specifies that during the first 12 months after the Date of Completion:</p> <ul style="list-style-type: none"> <li>• The asphalt must not ravel, rut, shove strip or bleed, and;</li> <li>• Wearing courses must not deviate below a 3m straight edge by more than 6mm where traffic speed <math>\geq</math> 70km/h or 8mm elsewhere.</li> </ul>	<p>Which TMR projects have warranty agreements that require the contractor to warrant the asphalt paving work for longer than 90 days? Did the asphalt supplied to those projects cost more? Was the quality of the asphalt supplied to those projects superior to projects with 90 day defects? Compare HEA asphalt quality with D2G asphalt quality.</p>
SC07	Scope	Homogeneity	<p>MRTS30, Cl. 13.1 specifies that lots shall be “essentially homogeneous”.</p>	<p>R116, Cl. 5.1 specifies that:</p> <ul style="list-style-type: none"> <li>• Asphalt must have a homogeneous appearance.</li> <li>• Non homogeneous asphalt may be accepted by the Principal if the contractor submits technical reasons for its acceptance.</li> </ul>	<p>What is TMR’s definition for homogeneity? Do TMR and suppliers argue about whether or not lots are “essentially homogeneous”?</p>
SC08	Scope	Testing and test methods	<p>MRTS30, Table 4 specifies the test methods that suppliers shall use to design and verify the quality of the mixes that they produce</p>	<p>The test methods that suppliers are required to use to design and verify the quality of the mixes that they produce are specified throughout RMS QA Specification R116.</p>	<p>A subjective comparison of the Q and closest comparable T or AS test methods is provided in</p>

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CO01	Constituents	Coarse Aggregates	<p>MRTS31, Cl. 10.2.2 specifies that coarse aggregates shall consist of crushed rock or crushed gravel particles 4.75 mm size or larger and comply with the following criteria:</p> <ul style="list-style-type: none"> <li>Flakiness index <math>\leq 30</math></li> <li>Wet strength <math>\geq 150\text{kN}</math></li> <li>Wet/dry strength variation <math>\leq 35\%</math> except for greenstone which may have a wet/dry strength <math>&gt; 35\%</math> provided that its wet strength exceeds <math>210\text{kN}</math></li> <li>Degradation factor <math>\geq 40\%</math></li> <li>Water absorption <math>\leq 2\%</math> (by mass)</li> <li>At least 80% (by mass) of particles shall have 2 or more fractured faces covering at least 50% of the particles' surface area</li> <li>Less than 1% (by number) of particles shall break or deform under finger pressure after overnight soaking</li> <li>PAFV of coarse aggregate shall be at least 48 for wearing courses and not less than 45 for all other DG layers.</li> </ul>	<p>R116, Cl. 2.1.1 specifies that coarse aggregates must conform to RMS Specification 3152 which specifies that coarse aggregates must comply with the following requirements:</p> <ul style="list-style-type: none"> <li>They must consist of clean, dry, hard, tough, sound, crushed rock, gravel or metallurgical slag free from dust, clay, dirt or other deleterious matter</li> <li><math>\leq 25\%</math> by mass may have a length to depth greater than 2:1</li> <li><math>\leq 10\%</math> by mass may have a length to depth greater than 3:1</li> <li><math>\geq 85\%</math> by mass must have at least two fractured faces</li> <li><math>\geq 100\%</math> by mass must have one or more fractured faces.</li> <li>10% Fines Wet strength <math>\geq 150\text{kN}</math></li> <li>Wet/dry strength variation <math>\leq 35\%</math></li> <li>PAFV of coarse aggregates must <math>\geq 48</math> in wearing courses (unless specified otherwise in Annexure 3152/A) and <math>\geq 44</math> in all other DGA courses.</li> <li>Water absorption <math>\leq 2.5\%</math> by mass</li> </ul>	<p>Several of the coarse aggregate requirements specified in RMS Specification 3152 are identical to those specified in MRTS30, Cl. 10.2.2. However, the test methods specified in RMS Specification 3152 are different to those specified in MRTS30, Table 4.</p> <p>It will be necessary to test several aggregate samples via both test method regimes to determine whether aggregates that conform to RMS Specification 3152 also conform to MRTS30, Cl. 10.2.2.</p> <p>RMS's Asphalt Panel Contract specifies in G1, Cl. 12.3 that the PAFV of coarse aggregates <math>\geq 59</math> for high skid resistant asphalts. Situations requiring aggregates with a PAFV <math>\geq 59</math> include curves with poor camber or drainage and approaches to signalised intersections with high speed approaches.</p>

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CO02	Constituents	Fine Aggregates	<p>MRTS31, Cl. 10.2.3 specifies that fine aggregates shall:</p> <ul style="list-style-type: none"> <li>• be clean, hard, durable, and free from clay and other aggregations of fine material, soil organic matter and any other deleterious material</li> <li>• 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</li> <li>• be sourced from rock with a Wet Strength <math>\geq 150\text{kN}</math>, Wet/Dry strength variation <math>\leq 35\%</math> and Degradation factor <math>\geq 40\%</math></li> </ul>	<p>R116, Cl. 2.1.1 specifies that fine aggregates must conform to RTA Specification 3152 which defines fine aggregates as aggregate with a nominal size of 5 mm or less and specifies that fine aggregates must:</p> <ul style="list-style-type: none"> <li>• comprise aggregates and/or clean sands that contain not more than 2.5% bonded particles and/or crusher dust derived from rock with a Wet Strength <math>\geq 150\text{kN}</math> and a Wet/Dry strength variation <math>\leq 35\%</math></li> <li>• Soundness <math>\leq 12\%</math> weighted loss</li> <li>• Water absorption <math>\leq 1.5\%</math> (if quartz sand) or <math>\leq 3\%</math> (if not quartz sand)</li> </ul>	<p>What objective tests are QLD suppliers required to perform to verify that fine aggregates are clean, hard, durable, and free from clay and other aggregations of fine material, soil organic matter and any other deleterious material?</p>

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CO03	Constituents	Combined Filler	<p>MRTS31, Cl. 10.2.4 specifies that fillers shall:</p> <ul style="list-style-type: none"> <li>• have a particle size &lt; 0.075 mm</li> <li>• consist of natural sand particles and/or crushed rock or crushed gravel particles and added filler</li> <li>• be free from lumps, clay, organic matter and other deleterious material</li> <li>• exhibit voids in dry compacted filler not less than 38% or that required for the design mix to contain a fixed binder fraction of at least 30%.</li> <li>• have a clay index <math>\leq 2.2</math></li> <li>• contain at least 1% of added filler</li> </ul>	<p>R116, Cl. 2.1.4 specifies that:</p> <ul style="list-style-type: none"> <li>• Added filler (hydrated lime, flyash, baghouse dust and ground limestone) must conform to Specification RMS 3211</li> <li>• The dry compacted voids content of the total filler fraction determined in accordance with AS 1141.17 must be 40% or greater</li> <li>• The MBV of fines (other than hydrated lime) must not exceed 10mg/g.</li> </ul>	<p>Clay index = the No. of ml of 4.5g/l methylene blue solution absorbed by a gram of sub 75<math>\mu</math>m fines. Is Q129 performed on individual constituent fines or the combined fine fraction?</p>
CO04	Constituents	Binder	<p>MRTS31, Cl. 10.2.5 specifies that DG14HS and DG14HP must contain A5S binder (which approximately equates to binder type A15E) and that DG20HM must contain Class 600.</p>	<p>The class of binder is user specified in R116 Annexure R116/A. TD2006/04 mandates the use of AR450 binder in asphalt that is not expected to be subjected to very high performance demands.</p>	<p>Ask RMS when and where it has used C600 and whether it is aware that refiners may be oxy-blasting C320 bitumen to increase its viscosity and penetration to comply with AR450?</p>

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CO05	Constituents	RAP	<p>MRTS31, Cl. 10.2.7 specifies that RAP incorporated into asphalt shall:</p> <ul style="list-style-type: none"> <li>• be well graded, free flowing and consistent</li> <li>• be crushed and screened to ensure a maximum size no greater than the maximum aggregate size of the asphalt being produced</li> <li>• not contain tar binder</li> <li>• be free of contaminants such as unbound granular base material, concrete, clay, soil, organic matter or any other deleterious material</li> </ul>	<p>R116, Cl. 2.1.3.1 requires RAP to comply with Specification RMS 3153, which specifies that RAP must comply with the following requirements:</p> <ul style="list-style-type: none"> <li>• it must be sourced totally from asphalt and must not contain any foreign materials such as road base, concrete, coal tar, plastics, brick, timber, scrap rubber etc. and must be free from dust, clay, dirt or other deleterious matter</li> <li>• its aggregates must conform to the requirements of Tables 3152.1 and 3152.2 of RMS 3152</li> <li>• 100% must pass the 26.5mm sieve</li> <li>• Be free flowing with consistent particle size distribution and comply with the tolerances specified in Table 3152.3 of RMS 3152</li> <li>• minimal fracture of aggregate particles</li> <li>• it must be quality assured with the ITP nominating a frequency of testing not less than the minimum specified Annexure 3153/L.</li> </ul>	<p>Does TMR require suppliers to perform any tests to verify that RAP conforms to MRTS31, Cl. 10.2.7?</p>

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CO06	Constituents	Granulated Glass Aggregate	MRTS31, Cl. 10.2 does not permit recycled materials other than RAP to be incorporated into DG14HS, DG14HP or DG20HM mixes.	R116, Cl. 2.1.3.2 requires granulated glass aggregates to comply with RMS Specification 3154, which specifies that such aggregates must have: <ul style="list-style-type: none"> <li>a maximum nominal particle size <math>\leq</math> 5 mm</li> <li>a particle size distribution envelope within the nominated particle size distribution envelope</li> <li>a water absorption <math>\leq</math> 1%</li> <li>Be quality assured with the ITP nominating a frequency of testing not less than the minimum specified Annexure 3154/L</li> </ul>	Is DTMR willing to permit granulated glass that conforms to RMS Specification 3154 and/or MRTS31, Cl. 10.2.3 to be incorporated into DG14HS, DG14HP or DG20HM mixes?
CO07	Constituents	Bituminous Emulsion	MRTS31, Cl. 12 specifies that bituminous emulsion used in tack coats shall comply with the requirements of MRTS21	R116, Cl. 2.1.7 specifies that tack coats must comprise CRS/170-60 complying with AS 1160 unless approved otherwise.	Does DTMR allow suppliers to nominate any bituminous emulsion that complies with the requirements of MRTS21?
MD01	Mix Design	Mix Approval	MRTS31, Cl. 10.4 specifies that mixes shall be registered in accordance with MRTS30, Cl. 10.4 and that the design mixes shall also comply with MRTS31, Table 10.4.	R116, Cl. 2.3.1 specifies that evidence that the mix conforms to R116 must be submitted at least 7 days before the mix is proposed to be placed. The mix design is approved or rejected by Principal based solely upon the information submitted.	RMS's asphalt panel contract obliges AOS to register compliant mix designs for 12 months based on test results submitted by suppliers Does TMR intend to continue to test mixes at the tolerance limits prior to registering mixes?

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MD02	Mix Design	Design Criteria	MRTS31, Cl. 10.3.1 specifies the criteria in Clause 10.3.1 and 10.3.2 of MRTS30 and Clauses 10.3.2 and 10.3.3 of MRTS31 shall be adopted to design DG14HS, DG14HP and DG20HM mixes subject to the binder limits quoted in Item MD04.	<p>The mix design criteria specified in R116, Cl. 2.2 include mass proportional limits on:</p> <ul style="list-style-type: none"> <li>• Binder content (refer Item MD04)</li> <li>• Mix Grading (refer Item MD05)</li> <li>• RAP (refer Item MD12)</li> <li>• Granulated Glass (max. 2.5%)</li> <li>• Hydrated Lime (min. 1.5%)</li> <li>• Adhesion Agent (max. 1.0%)</li> <li>• Wax in WMA (Max. 2%)</li> </ul>	If TMR adopts RMS's mix design criteria, it may pay more for the asphalt that it procures as R116, Cl. 2.2 yields denser mixes that typically contain up to 1.5% more binder by volume and fewer air voids.



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MD03	Mix Design	Methodology	MRTS31, Cl. 10.3.2 specifies that manufacturers shall use the Marshall method to produce mixes that meet the volumetric, stiffness, stability and flow requirements specified in MRTS31, Table 10.3.2. MRTS31, Cl. 10.3.3.1 specifies that mixes shall also comply with the performance requirements in Table 10.3.3.1 which, inter alia, requires the void content of mixes to be determined in accordance with TMR test method Q322 after 250 cycles.	R116 Cl. 2.2.2 specifies that the nominated mix must be compacted in accordance with T662 (using a gyratory compactor) and the following mix properties determined: <ul style="list-style-type: none"> <li>air voids after 120 and 350 cycles in accordance AS 2891.7.3, AS 2891.8 and AS 2891.9.2</li> <li>the binder to filler ratio in accordance with AS 2891.3.1</li> <li>voids in mineral aggregate at 120 cycles of compaction, AS 2891.7.3, AS 2891.8 and AS 2891.9.2</li> <li>binder film index in accordance with Test Method Austroads AG:PT/T237 or AS 2891.8</li> </ul>	Does TMR wish to continue to design mixes using the 50 blow Marshall method or adopt RMS's approach or introduce the Servopac as its preferred compaction method?
MD04	Mix Design	Binder Content	MRTS31, Cl. 10.3.1 specifies that DG14HS and DG14HP mixes shall have an effective binder volume between 10.0% and 11.5%. While the volumetric limits in MRTS31, Table 10.3.2 effectively limit DG20HM effective binder volume content to between 7.4% and 12.4%.	R116, Table R116.2 specifies that the targeted binder content of 14mm DGA must be between 4.8 and 6.2% by mass which approximately equates to an effective binder content of between 10% and 13% by volume based on typical coarse and fine aggregate and filler volumetric ratios and bulk densities and aggregate binder absorption values.	AC14 mixes containing more than may not conform to the criteria specified in MRTS31, Cl. 10.3.1.

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MD05	Mix Design	Combined Grading	MRTS31, Cl. 10.3.1 specifies that the grading of the combined mineral aggregates and added filler and RAP material aggregates shall comply with MRTS30, Table 10.3.1.	R116, Cl. 2.2.1(a) specifies that combined grading of asphalt aggregates, when determined in accordance with AS 2891.3.1, must conform to Table R116.1.	The grading envelopes specified in MRTS30, Table 10.3.1 are slightly narrower than those specified in Table R116.1. RMS permits finer 14mm mixes and coarser 20mm mixes than TMR.
MD06	Mix Design	% passing 75 micron	MRTS31, Cl. 10.3.1 specifies that 4% to 7% of aggregates in DG14HS, DG14HP and DG20HM design mixes shall pass the 75 micron sieve when tested in accordance with TMR test method Q103B.	R116, Cl. 2.2.1(a) specifies that 2% to 8% of aggregates in AC14 and AC20 nominated mixes shall pass the 75 micron sieve when tested in accordance with AS2891.3.1.	R116, Cl. 2.2.2 effectively limits the aggregate fraction passing the 75 micron sieve to between 3% and 8%.
MD08	Mix Design	Hydrated Lime Content	MRTS31, Cl. 10.2.4 specifies that DG14HS, DG14HP and DG20HM shall contain not less than 1.0% by mass of hydrated lime complying with AS1672.1 which requires the lime to contain $\geq 65\%$ Ca(OH) <sub>2</sub> .	R116, Cl. 2.2.1(c) specifies that asphalts must contain not less than 1.5% by mass of hydrated lime complying with Specification RMS 3211 which requires the lime to contain $\geq 80\%$ Ca(OH) <sub>2</sub> .	RMS effectively requires its asphalt to contain at least 1.2% Ca(OH) <sub>2</sub> . While TMR requires at least 0.65% Ca(OH) <sub>2</sub> . Have there been any reports of heavy duty asphalt layers stripping in QLD?
MD09	Mix Design	Mix Properties	MRTS31, Cl. 10.3.2 requires the design mix to comply with Table 10.3.2 when prepared at each end of the tolerance limits specified in MRTS30, Table 10.4.2.	R116, Cl. 2.3.1 specifies that the nominated and trial mixes meet the requirements of R116 Cl. 2.1 and 2.2. Nominated mixes are not tested at their tolerance limits in NSW.	TMR's mix design test results are manually recorded on lab sheets. How does RMS record submitted nominated mix lab test results?

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MD10	Mix Design	Mix Permeability	MRTS31, Cl. 10.3.3.2.2 specifies that the permeability of DG14HS, DG14HP and DG20HM mixes shall be less than 15µm/s at 7% air voids and less than 10µm/s at 6% air voids.	R116 does not specify an upper permeability limit for heavy duty asphalts.	Ask RMS why there is no permeability requirement in R116. Why are DG20 layers “particularly prone to moisture ingress <sup>1</sup> ”? Have any Q304A tests been done on HD DGA cores?
MD11	Mix Design	Minimum air voids	MRTS31, Table 10.3.3.1 specifies that DG14HS shall have an air void content of at least 2% at 250 cycles.	R116, Cl. 2.2.2 (a)(ii) specifies that nominated mixes must contain at least 2% air voids at 350 cycles.	What is the typical range of minimum air voids contents for DG14HP and DG20HM? Why has RMS chosen to determine refusal air voids at 350 cycles?
MD12	Mix Design	Recycled Asphalt Pavement (RAP)	MRTS31, Cl. 10.2.7 permits a maximum of 15% RAP to be incorporated into non wearing course asphalt layers.	R116, Cl. 2.2(c) permits up to 20% RAP in wearing courses and up to 40% RAP in other courses (refer R116, Table R116.3).	Allowing suppliers to increase RAP content should lower asphalt prices.
MD13	Mix Design	Moisture Sensitivity	MRTS31, Table 10.3.3.1 specifies that Q315 tests on DG14HS, DG14HP and DG20HM shall return a TSR ≥ 80.	R116, Cl. 2.2.4 specifies that the Tensile Strength Ratio (TSR) must be at least 80% and the average tensile strength of the freeze/thaw group ≥ 600 kPa.	Does T660 return a similar result to Q315?
MD14	Mix Design	Voids in the mineral aggregate (VMA)	MRTS31, Table 10.3.2 specifies that the VMA of design mixes shall be between: <ul style="list-style-type: none"> <li>13.5% and 17.5% (DG14HS)</li> <li>13% and 17% (DG14HP)</li> <li>12.5% and 16.5% (DG20HM)</li> </ul>	VMA is determined at 120 cycles. Table R116.4 specifies that: <ul style="list-style-type: none"> <li>AC14 shall have a VMA ≥ 15%</li> <li>AC20 shall have a VMA ≥ 14%</li> </ul>	What percentage of registered DG14 and DG20 mixes have a VMA < 15% and 14%? Ask RMS why requires VMA to exceed 15% for AC14 and 14% for AC20%.

<sup>1</sup>This statement is made in Section 3.5 of TMR's PDM

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MD15	Mix Design	Voids filled with binder (VFB)	MRTS31, Table 10.3.2 specifies that DG20HM VFB shall be 58% to 78%.	R116 does not specify VFB.	Ask RMS why it doesn't specify VFB. What is the VFB requirement for DG14HS and DG14HP?
MD16	Mix Design	Binder film thickness	MRTS31 does not specify binder film thickness.	R116, Cl. 2.2.2(d) specifies that binder film thickness must exceed 7.5 microns and be determined in accordance with AS2891.8	What is the range of binder film thicknesses for registered DG14HS, DG14HP and DG20HM mixes?
MD17	Mix Design	Filler to Binder Ratio (FBR)	MRTS31 does not specify a permissible range for the ratio of filler to binder.	R116, Cl. 2.2.2 specifies that filler to binder mass ratio must be between 0.8 and 1.2.	Section 3.6 of AGPT04B/07 advises that the ratio by mass of filler to binder is generally between 0.6 and 1.2.
MD18	Mix Design	Mix Flow, Stability & Stiffness	MRTS31, Table 10.3.2 specifies that the flow, stability and stiffness shall be at least 7kN, 2mm and 2kN/mm respectively	R116 does not specify minimum values for these properties.	Ask RMS why it doesn't require suppliers to demonstrate mix stability, flow or stiffness.
MD19	Mix Design	Flexural Modulus	MRTS31, Table 10.3.3.1 specifies that the modulus of DG20HM shall be at least 5000MPa when tested in accordance with AS2891.2.2 at 5% air voids.	An AS2891.13.1 resilient modulus test is only performed if it is specified in Annexure R116/A. R116 does not specify a minimum modulus for AC20.	RMS uses the modulus to check that the mix modulus is consistent with the modulus adopted by the designer.
MD20	Mix Design	Deformation (rut) resistance	MRTS31, Table 10.3.3.1 specifies that the maximum rutting rate of DG14HS, DG14HP slabs manufactured in accordance with Q319 and tested in accordance with Q210 shall not exceed 1mm per 1000 cycles and twice that amount for DG20HM.	R116, Cl. 2.2.6 specifies that the rut depth of WMA and DGA containing more than 20% RAP must be determined in accordance with Austroads test method AG:PT/T231 or if specified in Annexure R116/A but does not specify a maximum rut depth or rate.	Does MRTS31 or MRTS30 specify the test method to be used to determine wheel tracker rut rate? Is the wheel tracker test performed on wet or dry asphalt? Ask RMS for wheel track test results on AC20-C600 and AC14-A15E.

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PR01	Production	Constituent fractions	MRTS31, Cl. 11 specifies that the material constituent fractions shall not vary by more than the limits specified in MRTS30, Table 10.4.3.3.1 which permits 20% variation in aggregate fraction and 15% filler variation	R116, Cl. 2.4.2.1 specifies that constituents must not vary by more than 10% except for added filler which must not vary by more than 15%.	What percentage of mixes supplied to TMR jobs do not comply with these requirements?
PR02	Production	Mix compliance testing frequency	MRST31, Cl. 11 specifies that two samples from each production lot less than 500 tonnes shall be assessed for compliance with the design grading, binder content and maximum density limits on the laboratory verified mix design certificate and that at least four samples must be tested when the daily production exceeds 500 tonnes.	R116, Annexure R116/L specifies four samples must be tested for compliance with binder content, grading, FBR, VMA and moisture content per daily production run that does exceeds 600 tonnes and that when the daily production exceeds 600 tonnes, the testing frequency shall be one test per 200 tonnes or part thereof.	RMS requires the same No. of mix compliance tests to be performed as TMR when the daily production is between 501 tonnes and 800 tonnes and one additional sample to be tested per 200 tonnes (or part thereof) when the daily production exceeds 800 tonnes.
PR03	Production	Air voids monitoring	<p>MRTS31, Cl. 11 specifies that the average of the 5 most recent production mix air voids shall exceed:</p> <ul style="list-style-type: none"> <li>• 3% for DG14HS</li> <li>• 2.5% for DG14HP</li> <li>• 2.6% for DG20HM</li> </ul> <p>MRTS31, Cl. 11 specifies that production mix air voids shall also be monitored but shall not be used for assessing compliance.</p>	R116 Table R116/L.3 specifies that the air void content of mix compacted at 120 cycles must be determined per 200 tonnes of production when > 600 tonnes is laid per shift. R116 Table R116/L.3 also specifies that refusal air voids must be determined at 350 cycles on at least one sample per lot.	<p>What happens if the five most recent production mix air voids is less than the value in MRTS31, Table 10.4?</p> <p>Ask RMS what it does when laboratory air voids are out of tolerance.</p>

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

## Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
PR04	Production	Characterisation testing	MRTS31, Cl. 11 specifies that a full suite of characterisation tests shall be performed on each 15,000 tonnes of mix produced. These test are also not used for compliance	R116 Annexure R116/L specifies that binder content, combined PSD, VMA and air voids at 120 cycles must be determined once per 200 tonnes when more than 600 tonnes is delivered per shift.	Are the results of characterisation tests reported to TMR? What does TMR do if the characterisation test results reveal non-compliance? Ask RMS the same questions.
PR05	Production	Particle Size Distribution (PSD)	MRTS31, Cl. 10.3.1 specifies that the design mix grading shall comply with the PSD in MRTS30, Table 10.3.1. MRTS31, Cl. 10.4 specifies that the PSD limits of registered mixes shall be based on the tolerances MRTS30, Table 10.4.2.	The nominated mix PSD must be within the overall PSD limits specified in R116, Table R116.1. Production mixes must not vary from the nominated mix PSD by more than the tolerances in R116, Table R116.5.	Compare TMR and RMS's PSD limits with the PSD recommended in AGPT04B-07, Table A7. Under what circumstances does TMR accept mixes who's PSD does not comply with MRTS30, Table 10.4.2?
PR06	Production	Manufacturing requirements	MRTS31, Cl. 8 specifies that asphalt manufacture shall be by an approved asphalt supplier as detailed in TMRs <i>Asphalt Supplier Registration System</i>	R116, Cl. 2.4.3 specifies that the manufacturing process must produce asphalt that consistently conforms to R116.	RMS does not require asphalt manufacturers to be registered. However, RMS do require asphalt pavers to be prequalified.
PR07	Production	Manufacturing temperature	TMRs Asphalt Supplier Registration System does not specify manufacturing temperatures	R116, Cl. 2.4.5 specifies that asphalt temperatures must not exceed 175°C.	High mixing temperatures can result in oxidation of the binder.
PR08	Production	Aggregate temperature	TMRs Asphalt Supplier Registration System does not specify the maximum aggregate temperature	R116, Cl. 2.4.5 specifies that the difference in temperature between binder and aggregate must not exceed 30°C at the point of mixing.	Overheating aggregates may cause them to crack and may cause binder to boil and flash esp. if the aggregates are hotter than 250°C.

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

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Low

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High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
PR09	Production	Binder Temperature	TMRs Asphalt Supplier Registration System does not specify maximum binder temperatures	R116, Cl. 2.4.4 specifies that binders must be stored at temperatures and time limits in AAPA Advisory Note 7	<p>AAPA Advisory Note 7 recommends that:</p> <ul style="list-style-type: none"> <li>AR450 may be stored at 140°C to 165°C for up to 14 days</li> <li>C600 may be stored at 160°C to 180°C for up to 14 days</li> <li>A15E binders may be stored at 160°C to 180°C for up to 4 days.</li> </ul>
PR10	Production	Storage temperatures	<p>MRTS30, Cl. 12.2.1.2(b) specifies that:</p> <ul style="list-style-type: none"> <li>DG20HM shall be stored in insulated bins maintained a uniform between 135°C and 175°C for not more than 48 hours.</li> <li>DG14HS and DG14HP shall be stored in insulated bins maintained at a uniform temperature between 140°C and 180°C for not more than 48 hours.</li> </ul>	<p>R116, Cl. 2.4.4 specifies that:</p> <ul style="list-style-type: none"> <li>Asphalts that do not contain RAP may be stored in heated bins for longer than 24 hours as long as oxidation suppression systems are used.</li> <li>Mixes that contain RAP may be retained in a purpose designed storage system which has been demonstrated to cause no deterioration in the stored asphalt for a period not exceeding 24 hours.</li> </ul>	<p>Ask AAPA how many of its members employ oxidation suppression systems.</p>
PR11	Production	Loading temperature	MRTS30, Cl. 12.2.2 permits DGA containing bitumen binders and PMB to be respectively loaded at 175°C and 185°C.	Loading temperature is not specified but logically it will not be higher than the maximum permitted storage temperature.	Ask RMS why it has limited asphalt temperatures to 175°C.

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

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High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
CO01	Construction	Production trial	MRTS31 does not require suppliers to carry out a mix manufacturing and placement trial.	<p>R116, Cl. 3.11 specifies that when a placement trial is specified in Annexure R116/A:</p> <ul style="list-style-type: none"> <li>All relevant tests results on the trial must be submitted prior to placing any more of that mix</li> <li>A new trial must be implemented in the event of a trial non-conformance.</li> </ul>	<p>Ask RMS what percentage of R116/A annexures specify that a placement trial must be carried out.</p> <p>Does TMR wish to revise MRTS31 to require asphalt suppliers to manufacture and place trial mixes to demonstrate their ability to produce conforming asphalt?</p>
CO02	Construction	Compliance testing frequency	MRTS31, Cl. 13 specifies that compliance tests shall be performed on placed asphalt in accordance with MRTS30, Table 13.2 which specifies that one relative density (RC) tests shall be performed per 400m <sup>2</sup> when the lot size exceeds 2800m <sup>2</sup> .	Table R116/L.5 specifies the compliance tests that must be performed on placed asphalt. Table R116/L.5 specifies that insitu air voids must be determined every 1,000m <sup>2</sup> when the lot size exceeds 10,000m <sup>2</sup> .	Compliance testing adds to the cost of producing and placing asphalt. Under what circumstances is TMR willing to reduce the frequency of construction compliance testing?



# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

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High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
CO03	Construction	Insitu air voids	<p>MRTS31, Cl. 12 effectively specifies that other than at joints:</p> <ul style="list-style-type: none"> <li>DG14HS layers shall contain 3% to 7.5% air voids.</li> <li>DG14HP layers with a thickness <math>\geq 50</math>mm shall contain 3% to 7% air voids.</li> <li>DG14HP layers that are 40mm to 50mm thick shall contain 3% to 8% air voids.</li> <li>DG20HM layers that are thicker than 50mm shall contain 2% to 7% air voids.</li> </ul>	<p>R116, Table R116.6 specifies that:</p> <ul style="list-style-type: none"> <li>The upper characteristic insitu air voids must be <math>\leq 7\%</math> for layers thicker than 50mm and <math>\leq 8\%</math> when 30 to 50mm thick.</li> <li>The lower characteristic insitu air voids of asphalt layers <math>&gt; 30</math>mm thick must exceed 3%.</li> <li>The air voids content of asphalt layers less than 30mm thick is not tested.</li> </ul> <p>Table R116/L.5 specifies that insitu air voids tests must be carried out at the frequencies specified in Q L3.1 (e.g. one per 2000m<sup>2</sup> when the plan area of the lot exceeds 10,000m<sup>2</sup>).</p>	<p>Maximum characteristic insitu air voids = 100% - minimum characteristic RC.</p> <p>Ask RMS what percentage of placed asphalt conforms to R116, Table R116.6.</p> <p>Air voids content and asphalt performance are negatively correlated. Does TMR have any asphalt performance versus air voids content data that Hyder could review?</p> <p>Is TMR willing to adopt the same upper characteristic insitu air voids contents as specified in Table R116.6?</p>
CO04	Construction	Roughness	<p>Maximum roughness count is specified in MRTS30.1, Cl. 16.</p>	<p>R116, Cl. 4.5.2 specifies when the scope specifies ride quality that:</p> <ul style="list-style-type: none"> <li>The IRI of each lot of asphalt must not exceed 1.56.</li> <li>The IRI of a single layer of asphalt placed on pavement constructed by others must not exceed the greater of 0.2 plus 60% of the IRI of the road prior to placing the asphalt layer and 1.56.</li> </ul>	<p>Why has TMR adopted roughness counts? Why has RMS adopted IRI?</p>

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

Minimal

Low

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High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
CO05	Construction	Relative Compaction	<p>MRTS31, Cl. 12 specifies that:</p> <ul style="list-style-type: none"> <li>The maximum characteristic relative compaction of DG14HS and DG14HP layers shall not exceed 97%.</li> <li>The maximum characteristic relative compaction of DG20HM shall not exceed 98%.</li> <li>The minimum characteristic relative compaction of DG14HS shall be 92.5%</li> <li>The minimum characteristic relative compaction of DG14HP &amp; DG20HM 50mm or more thick shall be 93%</li> <li>The minimum characteristic relative compaction of DG14HP layers 40mm to 50mm thick shall be 92%</li> </ul>	R1 16 does not require relative density to be reported.	<p>Ask RMS why R1 16 focuses on the insitu air void content of placed asphalt rather than relative density.</p> <p>Does TMR wish to continue to indirectly control insitu air voids by specifying limits on minimum and maximum characteristic relative compaction?</p>

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
CO06	Construction	Layer thickness	<ul style="list-style-type: none"> <li>DG14HS and DG14HP layers overlying asphalt shall be 50 to 60mm thick.</li> <li>DG14HP binder layers on concrete may be 40mm to 60mm thick.</li> <li>DG20 HM layers shall be 50 to 80mm thick but may be laid up to 100mm thick subject to approval.</li> <li>The average thickness of asphalt layers shall be within 5mm of target thickness.</li> <li>The thickness of asphalt layers shall be within 10mm of its target thickness.</li> </ul>	R116, Cl. 3.6.1 specifies that the thickness of asphalt layers must be between 3 and 5 times the nominal mix size. R116 Table R116.7 specifies layer thickness tolerances.	<p>NCHRP Project 9-27 found that asphalt with a compacted thickness between 3 and 5 times the nominal mix size had fewer air voids and outperformed asphalt layers with a compacted thickness outside that range (refer NCHRP Report 531).</p> <p>Does TMR wish to specify the same layer thicknesses as those in R116, Cl. 3.6.1?</p>
CO07	Construction	Minimum texture depth	MRTS30.1, Cl. 11 advises that until TMR releases its macrotexture and microtexture policy, there is no minimum texture depth requirement.	Not specified in R116.	RMS acknowledges that DGA typically has a texture depth less than 0.6mm and is unsuitable as a wearing course on roads signposted above 80km/h.
CO08	Construction	Pavement temperature and weather	The minimum paving temperature is specified in MRTS30, Table 12.2.6.5. Asphalt shall not be placed while it is raining and the road surface is required to be dry.	R116, Cl. 3.7 specifies that at zero wind speed, pavement temperature must be $\geq 10^{\circ}\text{C}$ when laying $< 20\text{mm}$ mixes with standard binder and $15^{\circ}\text{C}$ for PMB mixes. $20\text{mm}$ mixes containing standard binder must be paved on surfaces $\geq 5^{\circ}\text{C}$ . Minimum temperatures increase by $5^{\circ}\text{C}$ per $5\text{km/h}$ wind speed. Asphalt cannot be laid on wet surfaces or if rain is imminent.	Ask RMS whether contractors report non-conformances to R116, Cl. 3.7 and whether asphalts that do not conform to R116, Cl. 3.7 are rejected.

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

## Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
CO09	Construction	Paving and compaction temperature	MRTS31, Cl. 12 specifies that the minimum asphalt temperature at the commencement of rolling shall be that specified in MRTS30, Table 12.2.7.2	R116, Cl. 3.8 specifies that the paving and compaction temperature must be consistent with AGPT04B/07 which does not specify a minimum paving temperature.	What does TMR do if the asphalt temperature at the commencement of rolling is less than that specified in MRTS30, Table 12.2.7.2?
CO10	Construction	Tack Coats	MRTS31, Cl. 12 specifies that the application rate shall be that specified in MRTS30.1, Cl. 6 which states that tack coat spray rate is typically 0.05 to 0.2 litres/m <sup>2</sup> of residual bitumen.	R116, Cl. 3.9 specifies that a residual binder application rate of between 0.15 and 0.3 litres/m <sup>2</sup> and double that amount at chases and joints.	Does TMR wish to increase the tack coat application rate to that specified in R116, Cl. 3.9?
CO11	Construction	Joints	Jointing requirements are specified in MRTS30, Cl. 12.8 which specifies, inter alia, that joints must be staggered by at least 100mm except at crowns.	Jointing requirements are specified in R116, Cl. 3.10. Longitudinal and transverse joints must be at least 150mm and 1m apart respectively.	Does a 100mm joint stagger preclude water infiltration through joints?
CO12	Construction	Plant and equipment	MRTS31, Cl. 12 specifies that approved rollers shall be used, pavers shall have a capacity of 30 tonnes per hour and an MTV shall be used if specified in MRTS30.1.	R116, Cl. 3.3 permits the contractor to nominate in what plant and equipment he will use. An MTV must be used unless specified otherwise in Annexure R116/A.	These requirements are effectively identical
CO13	Construction	Surface shape	MRTS30, Cl. 12.2.3.2 (c) specifies that the maximum deviation below a 3m straight edge shall not exceed 5mm.	R116, Table R116.9 specifies that the maximum deviation below a straight edge must not exceed 3mm on through carriageways with a traffic speed ≥ 70km/h.	R116, Table R116.9 is more stringent than MRTS30, Cl. 12.2.3.2 (c).
CO14	Construction	Ride Quality	MRTS30, Cl. 12.3.3.5 specifies that the road roughness count rate not exceed 60% of the road roughness count rate prior to overlay + 5	R116, Cl. 4.5.2 specifies that the IRI of each lot must neither exceed 1.56 m/km nor 60% of the IRI prior to overlay + 0.2.	Ask RMS why it has opted to specify roughness in IRI.

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
DI01	Disposition	PSD & binder	<p>MRS31, Cl. 3 specifies that:</p> <ul style="list-style-type: none"> <li>The maximum cumulative deduction due to PSD and binder content defects is 20%.</li> <li>Mix with more than 6 defects shall be removed and replaced.</li> </ul>	<p>RMS rejects lots with PSD and/or binder content departures more than twice the production tolerances specified in Table R116.5 or if the cumulative deductions for same exceed 20%. (refer R116, Cl. B2.2.1)</p>	<p>What does TMR do if the PSD or binder content is outside the "job limits on the laboratory verified mix design certificate"?</p>
DI02	Disposition	Insitu air voids/ Relative Compaction	<p>MRS31 Cl. 3 specifies that a lot with minimum characteristic relative compaction &lt; 88% shall not be utilised for a reduced level of service.</p> <p>The deductions in MRTS31, Table 10.3.3.2 apply to lots with a minimum characteristic value of relative compaction less than 92%.</p> <p>The deductions in MRS31, Table 3 apply to lots with a minimum characteristic value of relative compaction between 88% and 92%.</p>	<p>R116, Cl. B2.2.2 specifies that:</p> <ul style="list-style-type: none"> <li>Lots with an upper characteristic air voids content (<math>V_u</math>) greater than 1.5% must be removed and compacted</li> <li>A deduction of 50% will be applied when <math>V_u</math> exceeds the upper limit in R116, Table R116 by 1.1% to 1.5%.</li> <li>A deduction of 30% will be applied when <math>V_u</math> exceeds the upper limit in R116, Table R116 by 0.5% to 1%.</li> <li>A deduction of 5% will be applied when <math>V_u</math> exceeds the upper limit in R116, Table R116 by less than 0.5%.</li> </ul>	<p>What percentage of non-conforming DGA mix is accepted by TMR and RMS. What percentage is removed and replaced with compliant mix?</p>

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
DI03	Disposition	Moisture Sensitivity	Neither MRS30 nor MRS31 specifies acceptance criteria for mix that do not conform to MRST31, Cl.	R116, Cl. B2.2.3 specifies: <ul style="list-style-type: none"> <li>criteria for acceptance of mix with a TSR &lt;80%</li> <li>hotmixed asphalt with a TSR &lt; 70% will not be accepted when the air voids in the laboratory compacted mix are nonconforming</li> </ul>	Ask TMR whether it accepts or rejects mix that does not conform to
DI04	Disposition	Homogeneity	MRTS, Cl. 13 specifies that asphalt lots shall be “essentially homogenous” but does not specify criteria for rejection of non-homogenous lots.	R116, Cl. 5.1 specifies that areas that exhibit segregation, cracking, ravelling, bony or fatty material or have been damaged during construction must be replaced.	Ask RMS what percentage of DGA production is replaced because it exhibits segregation, cracking, ravelling, bony or fatty material.
DI05	Disposition	Filler/Binder Ratio	MRS31 does not specify mix acceptance or rejection criteria for Filler/Binder Ratio (FBR)	R116, Cl. B2.2.4 specifies that mix that does not conform to R116, Cl. 2.2.2: <ul style="list-style-type: none"> <li>will be accepted subject to meeting the requirements in Table R116/B.4</li> <li>must be rejected when the binder content and/or the percentage of aggregate passing 0.075 mm AS Sieve are individually nonconforming and/or individual test results exceed the design Filler/Binder Ratio of the nominated mix by more than 0.4.</li> </ul>	Ask TMR whether it wishes to specify FBR in MRTS31 so that it can incorporate the dispositions in R116, Cl. B2.2.4 into MRS31.

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

## Cost Saving Opportunity Rating

Minimal

Low

Medium

High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
IN01	Incentives	Roughness	MRS31, Cl. 4 specifies that contractors shall receive up to 4% incentive payment if they achieve a lower roughness count less than that specified in MRTS30.1, Cl. 16.	Contractors receive up to 3% incentive payment if IRI is 0.8 or more below the specified level.	TMR pays slightly more for exceptionally smooth asphalt.
QS01	Quality System	Work Planning Documentation	<p>MRTS31, Cl. 5 specifies that the quality systems requirements that apply to asphalt supply include:</p> <ul style="list-style-type: none"> <li>The hold points, witness points and milestones in MRTS30, Table 5.1</li> <li>Procedures for all construction processes referenced in MRTS31</li> <li>The conformance requirements specified in MRTS31, Cl. 11 and 13.</li> <li>The testing requirements specified in MRTS31, Cl. 11.3 and 13.2</li> </ul>	R116, Cl. 1.3.4 specifies that the project quality plan must include the documents listed in Annexure R116/D and that these must be submitted to the principal at least 5 working days prior to commencing work.	
EN01	Engineering Design	Waterproofing seal	TMR PDM, Section 3.5 specifies that 1.2 litres/m <sup>2</sup> of S4.5S polymer modified binder seal covered with 10mm aggregate seal must be provided beneath all asphalt surface layers in pavements where the layer beneath the surface layer is also asphalt.	RMS TD 2003/05 specifies that a C170 seal covered with 7mm aggregate must be provided below OGA and SMA wearing surfaces unless the the asphalt layer immediately below the wraing course is either AC10 or AC14 with an insitu air voids content between 3% and 6%.	<p>Does the absence of a waterproofing seal at high horizontal shear locations result in the binder layer stripping?</p> <p>RMS does not require a water proofing seal on AC14-A15E binder layers or below DGA wearing courses.</p>

# HEAVY DUTY DENSE GRADED ASPHALT TECHNICAL REQUIREMENTS

Cost Saving Opportunity Rating Minimal Low Medium High

Item	Process	Parameter	TMR Requirement	RMS Requirement	Comments/Questions
EN02	Engineering Design	Binder layers	TMR PDM, Table 2.3-2 specifies that all HILI pavements must have a DG14HS binder layer under asphalt wearing courses unless the layer beneath the wearing course is concrete.	RMS does not require an AC14-A15E binder layer to be provided below densely graded asphalt wearing courses.	RMS TD 2003/05 specifies that an AC10 or an AC14 layer must be provided below SMA and OGA wearing courses.
EN03	Engineering Design	Binder types	MRTS31 specifies that DG14HS layers must contain A5S binder.	TD2006/04 mandates the use of AR450 binder in asphalt procured after August 2006 and instructs that "Class AR450 is to replace Class AR320 and, as such, does not substitute for multigrade and polymer modified binders in applications with very high performance demands".	RMS believes that asphalts containing A15E binder are not prone to stripping. Accordingly, RMS does not require a waterproofing seal to be provided below an OGA or SMA wearing course foudfnd on an AC14-A15E binder layer.