

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

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GUIDE TO DESIGNING ASPHALT MIXTURES WITH RECLAIMED ASPHALT PAVEMENT

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**1. PURPOSE**

- 1.1. To establish criteria for designing asphalt mixtures which contain reclaimed asphalt pavement (RAP) and Performance Graded (PG) Binders.
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**2. SCOPE**

- 2.1. This procedure is applicable to all asphalt mixture designs which contain both RAP and PG Binders.
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**3. GENERAL**

- 3.1. This MP does not alter the design specification requirements of the 401 Specification, MP 401.02.22, or MP 401.02.27. It is to be used only as a supplement to the specifications when designing RAP mixtures. It does not affect RAP mixtures which were designed through previously approved methods prior to issuance of this MP.
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**4. REFERENCED DOCUMENTS**

- 4.1. MP 401.02.22 Design Testing of Hot-Mix Asphalt  
4.2. MP 401.02.27 Guide for Contractors Quality Control of Hot-Mix Asphalt
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**5. GUIDELINES**

- 5.1. For purposes of RAP mixture design and production the following shall apply:
- 5.2. The specific gravity of the binder in the RAP shall be assumed equivalent to the specific gravity of the virgin binder, as supplied by the Binder supplier.
- 5.3. The effective specific gravity of the aggregate ( $G_{se}$ ) shall be determined from the RAP material and shall be used as the bulk specific gravity ( $G_{sb}$ ) of the RAP aggregate for calculation purposes. (For greater accuracy, the producer may calculate a binder absorption of their virgin aggregates, utilize that absorption with the  $G_{se}$  of the RAP to calculate an assumed  $G_{sb}$  for the RAP).
- 5.4. RAP content is defined as the percentage of RAP by weight vs total weight of material. Allowable RAP content shall vary based on Base Binder Grade, RAP Fractionation, and Nominal Max Aggregate Size (NMAS) of the mixture as described in Table 1.
- 5.5. Proper stockpile management in accordance with Best Practices for RAP Management as documented by NCHRP report 752, Appendix D, and as discussed in Publication No. FHWA-HRT-11-0-21. These documents can be accessed at the respective links below:

[http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_752.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_752.pdf)  
<http://www.fhwa.dot.gov/publications/research/infrastructure/pavements/11021/11021.pdf>

**TABLE 1 – Maximum RAP by Weight allowable per Mix Type and Fractionation Practices**

	Project Specifies <PG64E-22 Binder				Project Specifies PG64E-22 Binder <sup>(Note 1)</sup>	
	Fractionated RAP		Non-Fractionated RAP		Fractionated RAP	Non- Fractionated RAP
Mix Type NMA S	Project Specified binder	Binder Dump <sup>(Note 3)</sup>	Project Specified binder	Binder Dump <sup>(Note 3)</sup>		
4.75mm <sup>(Note 2)</sup>	15	15	15	15	15	15
9.5mm	25	30	20	25	20	15
12.5mm	25	30	20	25	20	15
19mm	30	35	20	25	25	20
25mm	30	35	20	25	25 <sup>(Note 4)</sup>	20 <sup>(Note 4)</sup>

Note 1 – Binder dumping is not permitted on projects which specify PG64E-22.

Note 2 – RAP material utilized for a 4.75mm mixture for both design and production must be fractionated, scalped, and/or crushed to less than 4.75mm prior to incorporation into the mix.

Note 3 – Binder dump is defined in section 5.6.

Note 4 – 25mm should not normally be specified with PG64E-22

5.6. A binder dump is defined as the reduction of the PG temperature grades by one 6-degree step for both the high and low temperature requirements of the specified PG Binder. For example, if the specified PG Binder for the projects is a PG 64S-22 then the PG Binder used in a RAP design requiring a dump shall be a PG 58S-28. PG64H-22 > PG58H-28.

5.7. For projects specifying PG64S-22 and PG64H-22 binders and mixtures with NMA S greater than or equal to 9.5mm, a contractor may utilize blending charts to exceed the limits of Table 1. Blending chart usage is described in Section 6.0 of this MP shall be used to select the high temperature grade of the virgin asphalt. The low temperature grade shall be at least one grade lower than the binder grade specified for the area where the mix will be used. The binder test data and the blending chart must be submitted along with the mix design package (JMF).

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## 6. EXAMPLE USE OF BLENDING CHART

6.1. The dynamic shear rheometer (DSR) can be used to look at permanent deformation (rutting factor) of the binder, which is governed by limiting  $G^*/\sin d$  at the test temperature. The maximum allowable value of the rutting factor shall be 2.0 kPa. A blending chart, similar to the viscosity blending charts used with viscosity graded asphalts, has been developed which plots  $G^*/\sin d$  on a log-log scale on the y-axis as a replacement test for viscosity. Both the recovered asphalt and the virgin asphalt are tested at the high temperature of the specified binder to be used in the design. The test value  $G^*/\sin d$  for each asphalt is plotted on the chart (the recovered asphalt result on the left and the virgin asphalt on the right) and connected with a straight line. The point on the chart where the plot of  $G^*/\sin d$  intersects the y-axis ( $G^*/\sin d$ , kPa, at test

temperature) at 2.0 kPa is represented on the x-axis (% virgin binder) as the minimum percentage of virgin binder to be used in the RAP design.

- 6.2. The attached example illustrates how the blending chart shall be used. The standard binder for the design in this example is a PG 64S-22. Test measurements for both the recovered asphalt and the virgin binder are taken at 64 °C. Point A on the chart represents the  $G^*/\sin d$  value for the recovered asphalt. Point B represents the  $G^*/\sin d$  test value for the PG 64S-22 binder which has a minimum requirement of 1.0 kPa. The line connecting points A and B intersects the 2.0 kPa rutting factor value at approximately 87% on the x-axis. This means that the minimum amount of virgin asphalt (PG 64S-22) used in the RAP design shall be 87%.
- 6.3. Looking at point C on the example chart, this represents  $G^*/\sin d$  for a PG 58S-28 Binder which has been tested at 64 °C. A PG 58S-28 Binder would normally be tested at 58 °C and would have a minimum  $G^*/\sin d$  value of 1.0 kPa. However, because this material is being used where the required binder is a PG 64S-22, the virgin binder must be tested at 64 °C. The higher test temperature results in a test value of less than 1.0 kPa, as illustrated on the chart attachment. The line connecting points A and C intersects the 2.0 kPa rutting factor value at approximately 75% on the x-axis. This means that the minimum amount of virgin asphalt (PG 58S-28) used in the RAP design shall be 75%.

**Michael  
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MP 401.02.24 Steward – Asphalt Section  
MM:J  
ATTACHMENT

### PG Binder/RAP Blending Chart

