

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
CONTRACT ADMINISTRATION DIVISION

MATERIALS PROCEDURE

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GUIDE TO DESIGNING HOT-MIX ASPHALT WITH RECYCLED ASPHALT  
PAVEMENT

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1.0 PURPOSE

- 1.1 To establish criteria for designing hot-mix asphalt (HMA) which contains recycled asphalt pavement (RAP) and Performance Graded (PG) Binders.

2.0 SCOPE

- 2.1 This procedure is applicable to all hot-mix asphalt designs which contain both RAP and PG Binders.

3.0 GENERAL

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

4.0 APPLICABLE DOCUMENTS

- 4.1 MP 401.02.22

5.0 GUIDELINES

- 5.1 The following guidelines shall apply to all new mix designs which incorporate RAP with PG Binders.
- 5.2 For design purposes, the specific gravity of the virgin PG Binder shall be used as the specific gravity of the asphalt binder in the RAP. Also, the effective specific gravity of the aggregate in the RAP shall be determined and used as the bulk specific gravity of the RAP aggregate for calculation purposes.

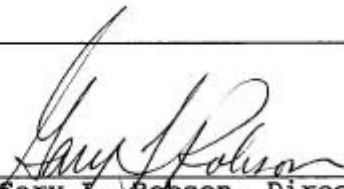
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- 5.3 If the amount of RAP in the mix is equal to or less than 15 percent, then the selected PG Binder to be used as the virgin asphalt shall be the same as the specified PG Binder for the region where the mix will be used. For example, if the specified PG Binder for the region is a PG 64-22 then the PG Binder used in the RAP design shall be a PG 64-22.
- 5.4 If the amount of RAP in the mix is 16 to 25 percent, then the selected PG Binder to be used as the virgin asphalt shall be one grade below both the high and low temperature grade of the specified PG Binder for the region where the mix will be used. For example, if the specified PG Binder for the region is a PG 64-22 then the PG Binder used in the RAP design shall be a PG 58-28.
- 5.5 If the amount of RAP in the mix is more than 25 percent, then the blending chart 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.

## 6.0 EXAMPLE USE OF BLENDING CHART

- 6.1 The dynamic shear rheometer can be used to look at permanent deformation (rutting factor) of the binder, which is governed by limiting  $G^*/\sin \delta$  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  $G^*/\sin \delta$  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  $G^*/\sin \delta$  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  $G^*/\sin \delta$  intersects the y-axis ( $G^*/\sin \delta$ , 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 64-22. Test measurements for both the recovered asphalt and the virgin binder are taken at 64 °C. Point A on the chart represents the  $G^*/\sin \delta$  value for the recovered asphalt. Point B represents the  $G^*/\sin \delta$  test value for the PG 64-22 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 64-22) that must be used in the RAP design will be 87%.

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- 6.3 Now look at point C on the example chart. This point represents  $G^*/\sin \delta$  for a PG 58-28 Binder which has been tested at 64 °C. A PG 58-28 Binder would normally be tested at 58 °C and would have a minimum  $G^*/\sin \delta$  value of 1.0 kPa. However, because we are using this material where the required binder is a PG 64-22, 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 58-28) that must be used in the RAP design will be 75%.

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Gary L. Robson, Director  
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Attachment

# PG Binder/RAP Blending Chart

MP 401.02.24  
Attachment 1

