

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
CONTRACT ADMINISTRATION DIVISION

MATERIALS PROCEDURE

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COMPACTION TESTING OF HOT-MIX ASPHALT PAVEMENTS

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1.0 PURPOSE

1.1 The purpose of this procedure is to establish the test methods for quality control testing by the Contractor and verification testing by the Division.

2.0 SCOPE

2.1 This procedure is applicable for all items of hot-mix asphalt pavements requiring compaction testing.

3.0 DEFINITIONS

3.1 Quality Control Testing – Testing conducted by the Contractor to monitor and control the production of their product.

3.2 Verification Testing – Testing conducted by the Division to determine specification compliance.

4.0 APPLICABLE DOCUMENTS

AASHTO R11  
MP 712.21.26

5.0 EQUIPMENT

5.1 Nuclear density gauges of the backscatter type.

5.2 One measuring tape of approximately 50 feet (20 meters).

5.3 Lime or other suitable material to mark test sites.

5.4 Dry mortar sand.

5.5 Supply of T401 or T407 data sheets.

## 6.0 ROUNDING OF DATA

6.1 Test data must be rounded according to AASHTO R11.

6.2 Test data and calculations are rounded to the following nearest significant digit.

Station Number	1 ft (0.1 m)
Offset	1 ft (0.1 m)
Wet Density	0.1 lb/ft <sup>3</sup> (1 kg/m <sup>3</sup> )
Target Density	0.1 lb/ft <sup>3</sup> (1 kg/m <sup>3</sup> )
Lift Thickness Compacted	0.25 inch (1 mm)
Relative Density	1 %
Average Relative Density	1 %
Average Wet Density	0.1 lb/ft <sup>3</sup> (1 kg/m <sup>3</sup> )

## 7.0 STANDARDIZATION OF NUCLEAR GAUGE

7.1 Warm up the gauge in accordance with the manufacturer's recommendations.

7.2 Standardization must be performed away from metal and other objects.

7.3 Clean the top of the standard block and the bottom of the gauge with a cloth.

7.4 Make sure the gauge is turned the correct way on the block.

7.5 After making the necessary adjustments on the gauge for standardization, take a four minute count for density.

7.6 Compare the standard count to the manufacturer's standard count. The standard count must be within  $\pm 2\%$  from the manufacturer's standard.

7.7 If the gauge is not within the specified tolerance, repeat the standardization. If the gauge will not standardize after four attempts, there is probably something wrong with the gauge. There may be electronics problems, the gauge needs calibrated, or a stability check needs to be performed. Do not use a gauge for testing if it will not standardize.

- 7.8 A gauge must be standardized before testing and at least every four hours during testing.
- 8.0 COMPARISON OF GAUGES
- 8.1 The gauge used for the Contractor's quality control testing should be compared with the gauge used for the Division's verification testing.
- 8.2 Standardize both gauges according to 7.1 through 7.8.
- 8.3 Place the aluminum plate provided by the Division on the standard block used for verification testing. Place the standard block on material weighing a minimum of 110 lb/ft<sup>3</sup> (1762 kg/m<sup>3</sup>). The block must not be near metal or other objects during testing and must not be moved. Keep the gauges separated a minimum of 30 feet (9.1 meters) during testing.
- 8.4 Take 5 one minute wet density readings with each gauge in the backscatter position. The gauges are to be oriented on the block the same as for standardization.
- 8.5 Record the wet density readings exactly as shown on the gauge. The range of the five readings shall not exceed 1.5 lb/ft<sup>3</sup> (24 kg/m<sup>3</sup>). If the readings exceed this range, perform a new set of five readings. A gauge should not be used if the repeatability of the gauge is not within this range.
- 8.6 Average the five readings for each gauge. The gauges are considered similar if the averages of the readings are within 3 lb/ft<sup>3</sup> (48 kg/m<sup>3</sup>).
- 8.7 The density readings for verification testing will not be adjusted to compensate for any differences in readings between gauges.
- 9.0 QUALITY CONTROL TESTING
- 9.1 Record the test data on a T401 form.
- 9.2 Divide the LOT into five equal sublots.
- 9.3 Randomly locate a test site within each subplot according to MP 712.21.26.
- 9.4 Check each test site to determine if there are surface voids. Fill the voids with dry mortar sand. Avoid a build-up of fines on the surface to no more than 0.1 inch (3 mm).

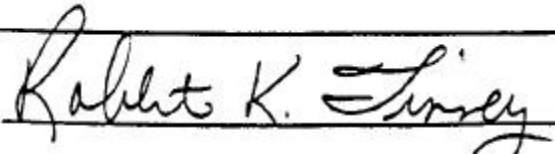
- 9.5 Take a one minute wet density reading on each test site.
- 9.6 Perform the calculations on the Division approved form.
- 9.7 Compare the relative densities to the specification requirements.
- 9.8 The results of the quality control tests should be used by the Contractor to judge if the LOT will meet specifications when verification tests are performed by the Division. Corrective measures are to be taken to bring the LOT into specifications if the quality control tests indicate that a nonconformance situation exists.
- 10.0 LOT-BY-LOT DIVISION VERIFICATION TESTING
- 10.1 Once the Contractor offers a LOT of material to the Division for testing, verification testing will be performed to determine compliance to the specifications.
- 10.2 Randomly locate a test site within the LOT according to MP 712.21.26.
- 10.3 Check each test site to determine if there are surface voids. Fill the voids with dry mortar sand. Avoid a build-up of fines on the surface to no more than 0.1 inch (3 mm).
- 10.4 Take a one minute wet density reading in the backscatter position.
- 10.5 Perform the calculations on the T401 form.
- 10.6 Compare the percent relative density to the specification range. If the value is within the range, the LOT is accepted for density.
- 10.7 When the percent relative density is outside the specification range, divide the LOT into five equal sublots and randomly locate a test site in each subplot according to MP 712.21.26.
- 10.8 Take a wet density reading at each test site.
- 10.9 Average the five wet densities.
- 10.10 Calculate the percent relative density.
- 10.11 The LOT would be acceptable if the average relative density falls within the specification range. A nonconformance situation exists if the value is outside the range.

- 11.0 ROLLERPASS COMPACTION PROCEDURE
- 11.1 When the total new pavement thickness is limited, the specifications may require that compaction testing will be performed in accordance with the following rollerpass procedure.
- 11.2 At the beginning of the work, a test section shall be constructed with a length of 100 feet (30 meters) and the width of the paving operation except in restricted areas. If the 100 feet (30 meters) length cannot be obtained, then the test section shall be the maximum obtainable length.
- 11.3 If there is a concern that the existing pavement conditions may cause difficulty in obtaining the specified density requirement then the Division will either monitor or conduct density testing of the existing pavement before the test section is constructed. Five randomly located wet density tests will be conducted within the test section area and the results will be recorded on a T401 form. Additional testing may also be conducted on other sections of the existing pavement if it is considered necessary for later evaluation.
- 11.4 To determine the number of roller passes for lift thicknesses of less than 1.5 inches (38 mm), immediately after placement start the rolling operation on the test section and continue this process until the mat temperature reaches 175 °F (80 °C). If the mat begins to show signs of distress (such as excessive surface aggregate breakage or mat cracking) before reaching 175 °F (80 °C), then discontinue rolling and record the number of roller passes completed before the stress signs occurred. The mat temperature may be lowered to 165 °F (74 °C) if the contractor can demonstrate through the test section that additional densification can be achieved at this lower temperature without causing any pavement distress.
- 11.5 If the lift thickness is 1.5 inches (38 mm) or greater, the rolling operation may be stopped at 200 °F (93 °C) to conduct density testing as per Section 11.7. If additional rolling is needed then continue as per Section 11.4. If the air temperature is below 60 °F (16 °C), the rolling operation should not be halted until the mat temperature reaches 175 °F (80 °C) unless the distress signs described in Section 11.4 occur. Project conditions may require the Engineer to determine the proper rolling application for lift thicknesses of 1.5 inches (38 mm) or greater.
- 11.6 The Division will either conduct or closely monitor all density testing on the test section.

- 11.7 Divide the test section into two equal sublots and randomly locate a test site within each according to MP 712.21.26. Take a wet density reading on each subplot using the procedure described in Section 10.3 and 10.4. Determine the average wet density obtained from the two sublots and use this average to calculate the relative density of the test section. Record all rollerpass density test data on a T407 form.
- 11.8 If the relative density of the test section is within 92 – 96 % of the maximum density of the approved mix design, or the maximum density established by the most recent plant mix formula verification, then density has been achieved and the number of roller passes has been established for the remainder of the project.
- 11.9 If the relative density of the test section is above 96 % the Division will make a visual evaluation of the mat and the mixture to look for any appearance of excessive asphalt or an extremely fine mix which may result in over compaction. A review of any density test results obtained from the existing pavement will be made to determine if the existing pavement density was significantly higher than the target density of the mix. The Division will determine whether additional test sections are needed or that the pavement is compacted to the satisfaction of the Engineer with the established number of roller passes. If it is later determined, through the Contractor's daily quality control testing, that the mix had an air void content below 2.5% then proper adjustments shall be made to the mix to bring the air voids back into the allowable tolerance limits. The Division may require the Contractor to establish a new test section if such mix adjustments are required.
- 11.10 If the relative density of the test section is below 92 %, then a new test section shall be established and the Contractor shall make adjustments to his rolling operation in an attempt to achieve a higher density level before the mat temperature reaches 175 °F (80 °C).
- 11.11 If the density requirement is not met after two consecutive test sections are completed, the Division will determine whether additional test sections are needed or that the pavement is compacted to the satisfaction of the Engineer with the established number of roller passes. To help with this decision, an evaluation will be made of the existing pavement condition and any density test results obtained prior to construction of the test section will be reviewed. If it is later determined, through the Contractor's daily quality control testing, that the mix had an air void content above 5.5% then proper adjustments shall be made to the mix to bring the air voids back into the allowable tolerance limits. The Division may require the Contractor to establish a new test section if such mix adjustments are required.

- 11.12 The established number of roller passes shall continue for the remainder of the project unless the Division determines that weather conditions or changes in the condition of the existing roadway are affecting the rolling operation. Under such circumstances, the Division may request that a new roller pattern be established through a new test section.
- 11.13 The designated number of roller passes shall continue to be completed before the mat temperature falls below 175 °F (80 °C) unless the conditions of Section 11.4 have been established.
- 11.14 The Contractor shall designate a person to monitor and document the number of roller passes and the mat temperature through the duration of the project.

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