METHOD OF SAMPLING AND TESTING
MT 334-14
HAMBURG WHEEL-TRACK TESTING OF COMPACTED BITUMINOUS MIXTURES
(*Modified AASHTO T 324*)

1 Scope

1.1 This test method describes a procedure for testing the rutting and moisture-susceptibility of plant mix surfacing (PMS) samples in the Hamburg Wheel-Track Testing Device.

1.2 The method describes the testing of submerged, compacted PMS in a reciprocating rolling-wheel device. This test provides information about the rate of permanent deformation from a moving, concentrated load. This procedure utilizes laboratory compacted specimens or field cores.

1.3 The test method is used to determine the premature failure susceptibility of PMS due to weakness in the aggregate structure, inadequate binder stiffness, or moisture damage. This test method measures the rut depth and number of passes to failure.

1.4 The potential for moisture damage effects are evaluated because the specimens are submerged in temperature-controlled water during loading.

2 Reference Documents

AASHTO

T 166 Bulk Specific Gravity (G_{mb}) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
T 324 Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)

MT Materials Manual

MT 303 Sampling Bituminous Paving Mixtures
MT 321 Determining Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures – "Rice Gravity"
MT 332 Gyratory Compaction of Bituminous Mixtures
MT 335 Linear Kneading Compaction of Plant Mix Surfacing (PMS)

Manufacturer's Operation Manual

For equipment used

3 Summary of Method

3.1 A laboratory-compacted specimen of PMS, a saw-cut slab specimen, or a core taken from a compacted pavement is repetitively loaded using a reciprocating steel wheel. The specimen is submerged in a temperature-controlled water bath at a temperature specified for the binder being used. The deformation of the specimen, caused by the wheel loading, is measured.

3.2 The impression is plotted as a function of the number of wheel passes. An abrupt increase in the rate of deformation coincides with stripping of the asphalt binder from the aggregate in the PMS specimen.

4 Apparatus

Ensure equipment used meets the following requirements:

4.1 *Hamburg Wheel-Track Testing Device* – Electrically powered device capable of moving a steel wheel with a diameter of 203.6 mm and width of 47 mm over a test specimen. The load applied by the wheel is 705 N. The wheel load is maintained at ± 5% for the duration of the test excluding the cycles that are interrupted by stopping the process. The wheel reciprocates over the specimen, with the position varying sinusoidally over time. The wheel makes 52 ± 2 passes across the specimen per minute.

4.2 *Temperature Control System* – Water bath capable of controlling the temperature within ± 2.0ºC over a range of 25 to 70ºC. This bath has a mechanical circulating system to stabilize the water temperature.

4.3 *Impression Measurement System* – Linear Variable Differential Transducer (LVDT) device capable of measuring the depth of the impression of the wheel within 0.5 mm, over a range of at least 0 to 20 mm. The system is mounted to measure the depth of the impression at several points, including the midpoint, in the wheel's path on the specimen. The impression is measured at least every 400 passes of the wheel without stopping the wheel.

4.4 *Wheel Pass Counter* – Device that counts each wheel pass over the specimen. The signal from this counter is coupled to the wheel impression measurement, allowing for the depth to be correlated with the number of wheel passes.

4.5 *Sample Mounting System* – Tray is mounted to the machine so that movement of the specimen is restricted to less than 0.5 mm during testing. The system supports the specimen, allowing for free circulation of water in the bath on all sides of the specimen and tray.

4.6 *Balance* – Balance with a minimum capacity of 15,000 grams, accurate to 0.1 g.

4.7 *Oven* – Forced draft or convection oven.

4.8 *Mixing apparatus* – Bowls, spoon, spatula, etc.

4.9 *Diamond Bladed Saw* – Capable of cutting PMS.

5 Specimen Preparation

5.1 Slabs – Compact and prepare PMS into slabs in accordance with MT 335. Slab thicknesses within a range of 38 to 100 mm can be used. Ensure the slab thickness is at least twice maximum aggregate size.

5.1.1 The formula for the volume of a slab is as follows: length x width x thickness. The amount of material to batch for each slab with 7% ± 1% air voids is determined by multiplying the sample length x width x thickness in cubic centimeters by the sample's maximum specific gravity (G_{mm}) x 0.93. Mass for sample = sample volume x 1 gm/cm^3 x G_{mm} x 0.93

5.2 Gyratory Specimens – Two gyratory specimens produced to the same requirements are cut to height, paired, and tested or a single specimen may be cut in half to yield two specimens. Each sample is cut on a chord that is 35 to 45 mm longer than the width of the test wheel and parallel to the vertical axis of the specimen. The two specimens are mounted so that the chords are together and the wheel rolls on the uncut faces of the specimens (see Note 1). The wheel path follows the diameter of each half of the sample through the center of the chords. A tolerance of ± 5 mm offset from the center is allowed. Using a diamond saw, cut two specimens the same height.

Note 1 – Take care when loading the sample so it is level to the surface of the mold. Trim the sample if it is too tall or shim it up if it is too short (support with plaster if needed).

5.3 Ten Inch Cores – Use a nominal 10-inch diameter bit to cut field cores. Complete the preparation of the cores for testing by removing the bottom lift(s) of PMS to achieve the desired height between 38 to 100 mm. Cut the core with a diamond saw at the desired point, taking care to orient the cut parallel to the surface being tested.

5.4 Laboratory Produced Mix – Before mixing bituminous mixtures for testing, "butter" all of the pans and implements. Heat materials to the mixing temperature range in a forced draft or convection oven. Do not overheat the samples.

6 Procedure

6.1 Position the frame holding the sample into the wheel-tracker so that the loading arm of the wheel is approximately horizontal when it rests on the slab. Ensure that the frame is securely fastened. Confirm that the settings of the machine are the same as those required for the specification. These settings include wheel force, water temperature (see note 2), stroke length, speed and any other variables described in the procedure. Enter the number of test passes required by the specification.

Note 2 – Test the PG binder in accordance with the chart below:

GRADE	TEST TEMPERATURE
70 - 28	133°F (56°C)
64-22 and 64 - 28	122°F (50°C)
58 - 28	111°F (44°C)

6.2 Lower the wheel onto the slab. Select the "Start" button of the testing device software. When the specimen has been preconditioned in the water at the test temperature, for 30 minutes, ten passes with the loaded wheel occur. This establishes zero. The wheel-tracking device shuts off when the test completes the specified number of passes or when the test has achieved the maximum impression depth established in the specification. The testing device software automatically saves the test data file.

6.3 Raise the wheel(s) and photograph the tested specimen. Remove the specimen mounting tray(s) containing the specimen(s). Once specimen(s) have been removed, thoroughly clean the mounting tray(s). Clean the water bath, heating coils, wheels, filter element, spacers, and temperature probe in accordance with manufacturer's recommendations. If no manufacturer's recommendation exists, use water and scouring pads. Use a wet-dry vacuum to remove particles that have settled to the bottom of the baths. Lubricate moving parts after every test or in accordance with manufacturer's recommendations. Do not use solvents to clean the water bath.

7 Report

7.1 Ensure the report for the results of testing samples using the wheel-tracking device contains the following information:

7.1.1 Cover Sheet:

Sample, Compaction, and Run Dates
Project Number
Project Name
Binder Content
Binder Grade
SiteManager Sample ID
Sample Type
Other Comments

7.1.2 Configuration Settings:

Conditioning Time
Velocity
Maximum Allowed Passes
Maximum Allowed Depth
Sample Frequency
Data Points
Wheel Travel
Acceleration
Water Temperature
Force Setting
Average Final Impression
Graph (number of passes on the x-axis and impression depth on the y-axis)

7.2 Report the Average Final Impression determined by the software as the Hamburg Wheel-Tracking Device test result. Determine the average impression of each run by averaging the middle seven points from the data given by the software (eliminating the first two data points and the last two data points). A Production test is considered a single specimen. A Mix Design Verification test is the average of two or more specimens. If two Mix Design Verification tests vary by more than 6mm with one passing test result and one failing test result, prepare two more test specimens and re-run. The reported result will be the average of all four or more individual specimen test results.