METHOD OF SAMPLING AND TESTING
MT 334-17
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) specimens 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- or field laboratory-compacted specimens, field saw-cut slabs, 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 specimens are submerged in temperature-controlled water during loading to evaluate the potential for moisture damage effects.

2 Reference Documents

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

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 Bituminous Mixtures

Manufacturer's Operation Manual
For equipment used

3 Terminology

3.1 *Specimen*

Any of the following are considered specimens under this test method.

3.1.1 Laboratory-compacted slab

3.1.2 Two (2) paired laboratory-compacted gyratory pucks

3.1.3 Two (2) paired field laboratory-compacted gyratory pucks

3.1.4 Field core, 10" core or two (2) paired 6" cores

3.1.5 Field saw-cut slab

3.2 Mix Design Verification Test

A Mix Design Verification test will consist of evaluating two specimens with the Hamburg Wheel-Tracking Device and averaging the results.

3.3 Field Production Verification Test

A Field Production Verification test will consist of the evaluation of one specimen with the Hamburg Wheel-Tracking Device.

4 Summary of Method

4.1 A laboratory- or field laboratory-compacted specimen of PMS, a core(s) taken from compacted pavement, or a saw-cut slab specimen 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.

4.2 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.

5 Apparatus

Ensure equipment used meets the following requirements:

5.1 *Hamburg Wheel-Track Testing Device* – Electrically powered device capable of moving a steel wheel with a diameter of 203.2 ± 2.0 mm (8 ± 0.08 in.) and width of 47 mm (1.85 in) over a test specimen. The load applied by the wheel is 705 ± 4.5 N (158 ± 1.0 lb.). 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.

5.2 *Temperature Control System* – Water bath capable of controlling the temperature within ± 2.0ºC over a range of 25 to 70ºC (77 to 158ºF). This bath should have a mechanical circulating system to stabilize the water temperature.

5.3 *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.

5.4 *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.

5.5 *Slab Specimen Mounting System* – A tray that is mounted to the machine so that movement of the specimen is restricted to less than 0.5 mm (0.02 in.) during testing. Plaster of paris may be used to rigidly mount specimen in tray. The system supports the specimen, allowing for free circulation of water in the bath on all sides of the specimen and tray.

5.6 *Cylindrical Specimen Mounting System* – An assembly consisting of two high-density polyethylene (HDPE) molds or plaster of paris to hold the gyratory pucks or cores, placed in a tray that is mounted to the machine so that movement of the specimen is restricted to less than 0.5 mm (0.02 in.) during testing. The system supports the specimen, allowing for free circulation of water in the bath on all sides of the specimen and tray.

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

5.8 *Oven* – Thermostatically-controlled forced draft or convection oven.

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

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

6 Specimen Preparation

6.1 *Number of Specimens* – Produce at least two (2) specimens for a Mix Design Verification test and one (1) specimen for a Field Production Verification test.

6.2 *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 material.

6.3 *Laboratory-Compacted Slabs* – Prepare PMS and compact into slabs in accordance with MT 335. Slab thicknesses should be within a range of 38 to 100 mm. Ensure the slab thickness is at least twice maximum aggregate size. Determine the air void content of the slab.

6.4 *Gyratory-Compacted Specimens* – Prepare PMS as necessary and compact into gyratory pucks in accordance with MT 332. Determine the air void content of the gyratory pucks. Mark the compacted face of each gyratory puck and cut to height if necessary by removing the uncompacted face (Note 1). Cut each puck 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. Mount the two cut pucks so that the chords are together and the wheel rolls on the uncut faces of the pucks (see Note 2). The wheel path should follow the diameter of each half of the specimen through the center of the chords. A tolerance of ± 5 mm offset from the center is allowed.

Note 1 - When using the Pine Brovold Gyratory Compactor (Model AFGB1) the compacted face is the bottom face as the puck sits in the compactor so the puck must be flipped after extraction in order to mark the compacted face.

Note 2 – Take care when loading the specimen so it is level to the surface of the mold. Trim the specimen if it is too tall or shim it up if it is too short (support with bedding sand or plaster as needed).

6.5 *Determine Air Void Content* – Determine the air void content of the compacted slab and gyratory compacted pucks in accordance with MT 335 and MT 332, respectively. The recommended target air void content is 7.0 ± 1.0 percent for laboratory-compacted slabs and 7.0 ± 0.5 percent for laboratory-compacted gyratory pucks. The air void content of field laboratory specimens will vary.

6.6 Field Cores – One (1) – 10" core or two (2) – 6" cores. Cut field cores with an appropriately sized diameter bit. Remove 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.

7 Procedure

7.1 Place specimens in mounting systems. Use plaster of paris to rigidly mount specimens (i.e., 10" cores) that don't fit in the HDPE molds or trays.

7.2 Position the frame holding the specimen 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, appropriate water temperature based on binder grade (see Table 1), stroke length, speed and any other variables described in the procedure. Enter the number of test passes required by the specification.

Table 1

Binder Grade	Test Temperature
70-28	133°F (56°C)
64-22 and 64-28	122°F (50°C)
58-28	111°F (44°C)

7.3 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 45 minutes, the initial passes of the loaded wheel occur; this establishes zero. The wheel-tracking device shuts off when the test completes the specified number of passes, when the test has achieved the maximum impression depth established in the specification, or when the set maximum standard deviation has been reached. The testing device software automatically saves the test data file.

7.4 Photograph the tested specimen before removing specimen mounting tray, if possible; otherwise photograph the specimen after removing the mounting trays. Remove the specimen mounting tray(s) containing the specimen(s). Remove the specimen from the mounting tray and 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. Remove particles that have settled to the bottom of the baths. Lubricate moving parts in accordance with manufacturer’s recommendations. Do not use solvents to clean the water bath.

7.5 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 Field Production Verification test consists of a single specimen. A Mix Design Verification test is the average of two or more specimens. If two Mix Design Verification specimens vary by more than 6 mm 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.

8 Report

8.1 Ensure the report of the results contains the following information.

Sample, Compaction, and Run Dates
Project Number
Project Name
Tester/Technician
Binder Content
Contract Binder Grade
SiteManager Sample ID
Sample Type (Start-up; Target-set, Out-of-broadband, etc.; Informational Use Only)
Rice Gravity
Density
% Air Voids (include % Air Voids for each gyratory puck used in the specimen)
Other Comments

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