

**METHODS OF SAMPLING AND TESTING**  
**MT 334-11**  
**METHOD OF TEST FOR HAMBURG WHEEL-TRACK TESTING**  
**OF COMPACTED BITUMINOUS MIXTURES**

**1 Scope:**

- 1.1 Use this test method to determine the susceptibility of bituminous mixtures to moisture damage. Measured properties are impression depth measurements, number of passes at the stripping inflection point, and number of passes to failure.

**2 Reference Documents:**

**2.1 MT Manual:**

- MT 303 Method of Sampling Bituminous Paving Mixtures
- MT 314 Bulk Specific Gravity of Compacted Bituminous Mixtures
- MT 321 Maximum Specific Gravity of Bituminous Mixtures
- MT 332 Gyrotory Compaction of Bituminous Mixtures
- MT 335 Linear Kneading Compaction of Bituminous Mixtures
- Manufacturer's Operation Manual for equipment used

**3 Apparatus:**

- 3.1 *Wheel-tracking Device* - An electrically powered device capable of moving a steel wheel with a diameter of 203.6 mm (8 in.) and width of 47 mm (1.85 in.) over a test specimen.
- 3.1.1 The load applied by the wheel is 705 N (158 lbs.). The wheel load is maintained  $\pm 5\%$  for the duration of the test excluding the cycles that are interrupted by stopping the process.
- 3.1.2 The wheel unidirectionally travels approximately 52 passes across the slab per minute.
- 3.2 Temperature Control System: A water bath capable of controlling the temperature within  $\pm 2.0^\circ\text{C}$  over a range of ambient temperature to  $70^\circ\text{C}$ . This bath has a mechanical circulating system to stabilize the water temperature.
- 3.3 *Impression Measurement System* - A Linear Variable Differential Transducer (LVDT) device capable of measuring the depth of the impression of the wheel within 0.5 mm, over a minimum range of 20 mm. The system shall be mounted to measure the depth of the impression at several points in the path of the wheel and at the midpoint of the wheel's path on the slab. The impression is measured at intervals within 10 to 400 passes of the wheel without stopping the wheel.
- 3.4 *Wheel Pass Counter* - A device that counts each wheel pass over the slab. 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.
- 3.5 *Sample Mounting System* - A tray is mounted to the machine so that movement of the sample is restricted to less than 0.5 mm during testing. The system supports the sample, allowing for free circulation in the water bath on all sides of the sample.

#### 4 Sample:

4.1 *Field Samples* - Samples for testing should have a thickness that is more than three times the nominal maximum aggregate size.

4.1.1 Slabs -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<sub>mm</sub>) x 0.93. **Mass for sample = sample volume x 1 gm/cm<sup>3</sup> x G<sub>mm</sub> x 0.93**

Compact and prepare plant mix into slabs using MT 335 Linear Kneading Compaction of Bituminous Mixtures. The slab thickness of 38 mm to 100 mm can be used. The slab thickness shall be at least twice maximum aggregate size.

4.2 *Field Compacted Gyratory Samples* - Two gyratory samples produced to the same requirements are paired and tested or a sample of 115 mm may be cut to yield two samples that are 55 mm in height. The gyratory specimens are fabricated with air voids in the range of N design. The design target air voids (VTM) for all current bituminous mixtures is 3.4% - 4.0%. Each sample is cut to fit the form. The height is adjusted and each sample is cut on a chord that is at least 35 mm longer than the width of the test wheel and parallel to the vertical axis of the specimen. The two samples are mounted so that the chords are together and the wheel rolls on the uncut faces of the specimens. 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.

4.2.1 *Gyratory Specimens* - The height of a compacted gyratory specimen is 115 mm ± 5 mm and the diameter is 150 mm. Compact each specimen to N design with the number of gyrations shown on the mix design. Field compacted samples produced to specification parameters are used. Using a diamond saw cut two specimens the same height.

4.3 *Ten Inch Cores* - Cut field cores with a bit with a nominal 10-inch diameter. Complete the preparation of the cores for testing by removing the bottom lift/s of plant mix to achieve a height of two and one-half inches to four inches. Separate the plant mix lifts by chilling the core and splitting the sample on the lift line with a metal wedge. The wedge is successively placed at points on the lift line around the circumference of the specimen and tapped with a hammer. The core will cleanly cleave on the lift line. An alternative is to cut the core with a diamond saw at the desired point, taking care to orient the cut perpendicular to the axis of the vertical core.

4.4 *Laboratory Produced Mix* - Before mixing bituminous mixtures for testing, all of the pans and implements should be "battered". Heat materials to be mixed in a laboratory to the mixing temperature range in a forced draft or convection oven. Do not overheat the samples.

#### 5 Procedure:

5.1 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. Insure that the setting of the machine is the same as those required for the specification. These are wheel force, temperature of environment, stroke length, speed and any other variables described in the procedure. Enter the number of test passes required by the specification.

5.2 Lower the wheel onto the slab and fill the wheel-tracker with water. When the water has been at test temperature for 30 minutes, make ten passes with the loaded wheel. See Note 1. This establishes zero. Record the amount of impression of the specimen at intervals of 10 to 400 cycles until the test sequence is complete. If the impression exceeds the preset limit, the test will conclude and the cycles to failure will be reported. If the specimen cycles the number of times required by the contract and does not reach the impression depth defined as failure, record the impression depth at the conclusion of the testing.

*Note 1 – The PG binder will be tested 14 °C below the Average 7-day Maximum Pavement Design Temperature as shown in the chart below:*

<i>GRADE</i>	<i>TEST TEMPERATURE</i>
<i>70 - 28</i>	<i>56°C</i>
<i>64 - 28</i>	<i>50°C</i>
<i>58 - 28</i>	<i>44°C</i>

**6 Report:**

- 6.1 The report for the results of testing samples using the wheel tracker must contain the following information:
  - 6.1.1 Cover Sheet: Date Sampled, Project Number, Project Name, Binder Content (how %AC was obtained), Binder Grade, Sample Type
  - 6.1.2 Configuration Settings: Conditioning Time, Maximum Number of Passes, Wheel Travel, Force Setting, Water Temperature, Average Final Impression, Sample Frequency, Graph (number of passes on the x-axis and impression depth on the y-axis).
- 6.2 Report the Average Final Impression determined by the software as the Hamburg test result. The average impression of each run is determined by averaging the middle seven points from the data given by the software (eliminated the first two and the last two). If multiple tests of the same sample are run, report the average as the Hamburg test result.

**7 Calibration / Equipment Verification Procedure:**

- 7.1 Verify that the water bath temperature is within 1.0°C of the temperature readout.
- 7.2 Verify that the LVDT height is within 0.1 mm at each height tested with each of three calibration blocks that span the range of the test or use an LVDT calibration program and apparatus.
- 7.3 Verify the accuracy of the force application to the specimens within 2 kilograms.