Standard Method of Test for

Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures

AASHTO Designation: T 324-22

Technically Revised: 2022 Editorially Revised: 2022

Technical Subcommittee: 2d, Proportioning of Asphalt–Aggregate Mixtures

AASHTO

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1. SCOPE

1.1. This test method describes a procedure for testing the rutting and moisture-susceptibility of asphalt mixture pavement samples in the Hamburg Wheel-Tracking Device.

1.2. The method describes the testing of a submerged, compacted asphalt mixture in a reciprocating rolling-wheel device. This test provides information about the rate of permanent deformation from a moving, concentrated load. A laboratory compactor has been designed to prepare slab specimens. Also, the Superpave Gyratory Compactor (SGC) has been designed to compact specimens in the laboratory. Alternatively, field cores having a diameter of 150 mm (6 in.), 250 mm (10 in.), or 300 mm (12 in.), or saw-cut slab specimens may be tested.

1.3. The test method is used to determine the premature failure susceptibility of asphalt mixture 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. This test method measures the potential for moisture damage effects because the specimens are submerged in temperature-controlled water during loading.

1.5. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 339/M 339M, Thermometers Used in the Testing of Construction Materials
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

- R 30, Laboratory Conditioning of Asphalt Mixtures
- R 97, Sampling Bituminous Paving Mixtures
- T 166, Bulk Specific Gravity (G_{mb}) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
- T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Hot Mix Asphalt (HMA)
- T 269, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
- T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor

2.2. *ASTM Standards*:

- D6027/D6027M, Standard Practice for Calibrating Linear Displacement Transducers for Geotechnical Purposes
- D8079, Standard Practice for Preparation of Compacted Slab Asphalt Mix Samples Using a Segmented Rolling Compactor
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *International Electrotechnical Commission Standards*:

- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances
- IEC 60751: 2008 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

2.4. *NCHRP Study*:

- NCHRP Report Web-Only Document 219 (NCHRP Project 20-07/Task 361), *Hamburg Wheel-Track Test Equipment Requirements and Improvements to AASHTO T 324*, submitted September 2015. National Cooperative Highway Research Program, Transportation Research Board, Washington, DC, 2016.

3. SIGNIFICANCE AND USE

3.1. This test measures the rutting and moisture susceptibility of an asphalt mixture specimen.

4. SUMMARY OF METHOD

4.1. A laboratory-compacted specimen of asphalt mixture, 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 by the agency. 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 may coincide with stripping of the asphalt binder from the aggregate in the asphalt mixture specimen.

5. APPARATUS

5.1. *Hamburg Wheel-Tracking Device*—An electrically powered machine capable of moving a 203.2 ± 2.0-mm (8 ± 0.08-in.) diameter, 47 ± 0.5-mm (1.85 ± 0.02-in.) wide steel wheel over the center (x and y axes) of the test specimen. The load on the wheel is 703 ± 4.5 N (158.0 ± 1.0 lb). The wheel reciprocates over the specimen, with the position varying sinusoidally over time. A maximum level of deviation from a perfectly sinusoidal wave is defined through the root-mean square error (RMSE), which is calculated as follows:

$$\text{RMSE} = \sqrt{\frac{\sum e_i^2}{n}} \quad (1)$$

where:

e_i = deviation from a pure sinusoidal curve, and

n = number of data points.

The maximum allowable deviation from a sinusoidal wave through the entire track length is set at an RMSE of 2.54 mm (0.1 in.) unless otherwise specified by the agency. The wheel makes 52 ± 2 passes across the specimen per minute. The maximum speed of the wheel, reached at the midpoint of the specimen, is 0.305 ± 0.02 m/s (1 ± 0.066 ft/s).

Note 1—Follow the NCHRP Report or available devices in the market meeting the relevant requirements as proposed in the NCHRP Report to verify the sinusoidal wave requirement of the Hamburg wheel tracking device.

5.2. *Temperature Control System*—A water bath capable of controlling the temperature within ±1.0°C (1.8°F) over a range of 25 to 70°C (77 to 158°F) with a mechanical circulating system stabilizing the temperature within the specimen tank. The thermometer for measuring the temperature of the water bath shall meet the requirements of M 339M/M 339 with a temperature range of at least 20 to 75°C (68 to 167°F), and an accuracy of ±0.25°C (±0.45°F) (see Note 2).

Note 2—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E879 thermistor thermometer; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometer, Class A; or IEC 60751: 2008 Pt-100 RTD platinum resistance thermometer, Class AA.

5.2.1. *Impression Measurement System*—A linear displacement transducer (LDT) device capable of measuring the depth of the impression (rut) of the wheel to within 0.15 mm (0.006 in.), over a minimum range of 0 to 20 mm (0 to 0.8 in.). The system shall measure the depth of the impression at a minimum at the following locations along the track length: –114 (–4.5), –91 (–3.6), –69 (–2.7), –46 (–1.8), –23 (–0.9), 0 (0), +23 (+0.9), +46 (+1.8), +69 (+2.7), +91 (+3.6), and +114 (+4.5) mm (in.) with zero being the midpoint of the track unless otherwise specified by the agency. The midpoint of the track shall be marked by the manufacturer. The system measures the rut depth, without stopping the wheel, at least every 20 passes. Rut depth is expressed as a function of the wheel passes. The device will also disengage if the average LDT displacement (read from the micro-control unit, not the screen) is 40.90 mm (1.6 in.) or greater for an individual specimen. Note that the screen readout subtracts the initial LDT reading from the total displacement.

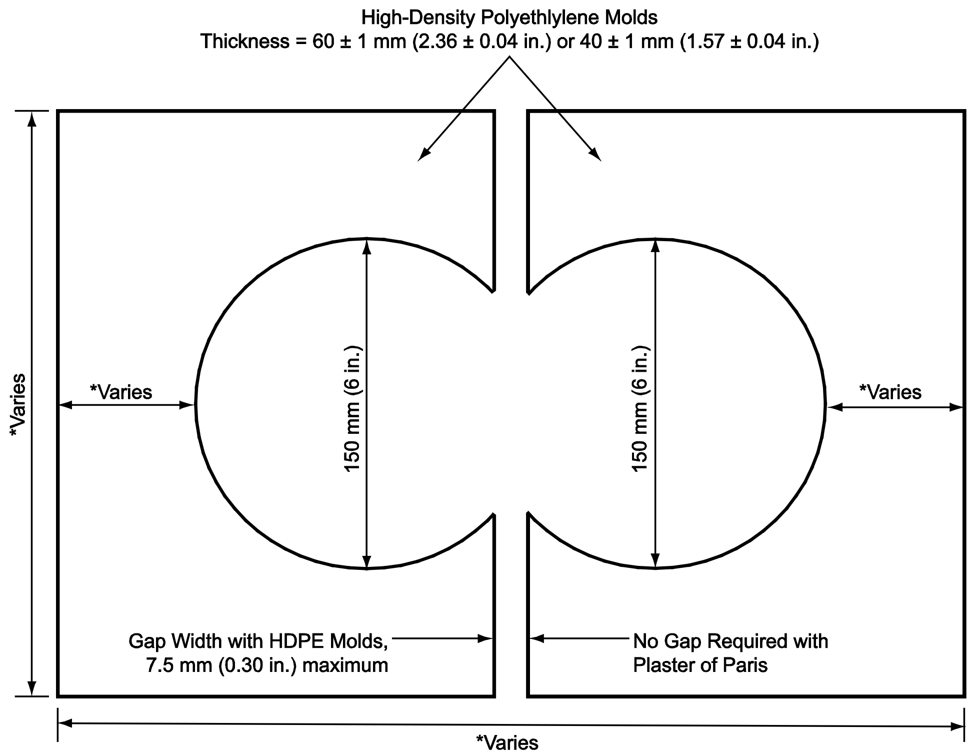
Note 3—The locations of the deformation readings should be verified experimentally using the aluminum apparatus presented in Appendix X2. The maximum allowable RMSE at the 11 pre-set locations after taking into account the effect of curvature of the aluminum apparatus discussed in the NCHRP Report is 1.27 mm (0.05 in).

5.3. *Wheel Pass Counter*—A non-contacting solenoid that counts each wheel pass over the specimen. The signal from this counter is coupled to the wheel impression measurement, allowing for the rut depth to be expressed as a function of the wheel passes.

5.4. *Slab Specimen Mounting System*—A stainless steel tray that is mounted rigidly to the machine. The mounting system must restrict shifting of the specimen to within 0.5 mm (0.02 in.) during testing and must suspend the specimen to provide a minimum of 20 mm (0.8 in.) of free circulating water on all sides of the mounting system.

5.5. *Cylindrical Specimen Mounting System*—An assembly consisting of two high-density polyethylene (HDPE) molds or plaster of Paris, in accordance with Section 8 to secure the specimen (as shown in Figures 1 and 2), placed on a stainless steel tray that is mounted rigidly to the machine. This mounting system must restrict shifting of the specimen to within 0.5 mm (0.02 in.) during testing and must suspend the specimen to provide a minimum of 20 mm (0.8 in.) of free circulating water on all sides of the mounting system.

Figure 1—Cylindrical Specimen Mounting System



* Dimension may vary depending on manufacturer.

Figure 2—Schematic of Cylindrical Specimen Mounting System

5.6. *Linear Kneading Compactor*—A hydraulic-powered unit that uses a series of vertically aligned steel plates to compact molded asphalt mixtures into flat, rectangular slabs of predetermined thickness and density.

5.7. *Balance*—Of 12 000-g capacity, accurate to 0.1 g.

5.8. *Ovens*—For heating aggregate and asphalt binders to their appropriate mixing temperature. Oven(s) for heating shall be properly standardized and capable of operation at the temperatures required, between 100 to 175°C (212 to 347°F), within ±5°C (±9°F), as corrected, if necessary, by calibration. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer for measuring the temperature of materials shall meet the requirements of M 339M/M 339 with a temperature range of at least 140 to 175°C (284 to 347°F), and an accuracy of ± 1.25°C (±2.25°F) (see Note 4).

Note 4—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Special Class; or IEC 60584 thermocouple thermometer, Type T, Class 1.

5.9. *Superpave Gyratory Compactor (SGC)*—And molds conforming to T 312.

5.10. Bowls, spoon, spatula, etc.

6. SPECIMEN PREPARATION

6.1. *Number of Test Specimens*—Prepare two test specimens for each test, either slab specimens or cylinders.

6.2. *Laboratory-Produced Asphalt Mixture*:

6.2.1. Batch mixture proportions in accordance with the desired job mix formula.

6.2.2. Use the mixing temperature at which the asphalt binder achieves a viscosity of 170 ± 20 cSt. For modified asphalt binders, use the mixing temperature recommended by the binder manufacturer.

6.2.3. Dry-mix the aggregates and mineral admixture (if used) first, then add the correct percentage of asphalt binder. Mix the materials to coat all aggregates thoroughly. (Wet-mix the aggregates if using a lime slurry or other wet material.)

6.2.4. Condition test samples at the appropriate compaction temperature in accordance with the short-term conditioning procedure for mechanical properties in R 30.

6.2.5. Use the compaction temperature at which the asphalt binder achieves a viscosity of 280 ± 30 cSt. For modified asphalt binders, use the compaction temperature recommended by the binder manufacturer.

6.2.6. *Laboratory Compaction of Specimens*—Compact either slab specimens or SGC cylindrical specimens.

6.2.6.1. *Compacting Slab Specimens*—Heat molds and tools to compaction temperature. Compact slab specimens 320 mm (12.5 in.) long and 260 mm (10.25 in.) wide using a Linear Kneading Compactor (or equivalent such as a compactor meeting ASTM D8079). Specimen thickness must be at least twice the nominal maximum aggregate size, generally yielding a specimen 38 to 100 mm (1.5 to 4 in.) thick. Allow compacted slab specimens to cool at normal room temperature on a clean, flat surface until cool to the touch.

6.2.6.2. *Compacting SGC Cylindrical Specimens*—Compact two 150-mm (6-in.) diameter specimens in accordance with T 312. Specimen thickness must be at least twice the nominal maximum aggregate size, generally yielding a specimen 38 to 100 mm (1.5 to 4 in.) thick. Allow compacted specimens to cool at normal room temperature on a clean, flat surface until cool to the touch.

6.3. *Field-Produced Asphalt Mixture—Loose Mix*:

6.3.1. Obtain a sample of asphalt mixture in accordance with R 97.

6.3.2. *Laboratory Compaction of Specimens*—Compact either slab specimens or SGC cylindrical specimens in accordance with Section 6.2.6.

6.4. *Field-Produced Asphalt Mixture—Field Compacted (Core/Slab Specimen)*:

6.4.1. *Cutting Field Cores or Field Slab Specimens*—Field cores or field slab specimens consist of wet saw-cut compacted specimens taken from asphalt mixture pavements. Cut field cores 300 mm (12 in.), 250 mm (10 in.), or 150 mm (6 in.) in diameter. Cut field slab specimens approximately 260 mm (10.25 in.) wide by 320 mm (12.5 in.) long. Use a slab specimen thickness of 38 to 100 mm (1.5 to 4 in.). The height of a field core or field slab specimen is typically 38 mm (1.5 in.), but may be adjusted to fit the specimen mounting system by wet saw-cutting. Cut field cores in accordance with Section 6.4.2.

Note 5—Take care to load the sample so it is level to the surface of the mold. Trim the sample if it is too tall, or use shims if it is too short (supporting with plaster if needed). Calibrate the down pressure from the wheel to be 703 ± 4.5 N (158.0 ± 1.0 lb) at the center, level to the top of the mold position. Even a small change in elevation will change the down pressure significantly.

6.4.2. *Cutting SGC Cylindrical Specimens and Field Cores*—Cut specimens after they have cooled to room temperature using a wet or dry saw. Saw the specimens along equal secant lines (or chords) such that when joined together in the molds, there is no space between the cut edges. The amount of material sawed from the SGC cylindrical specimens may vary to achieve a gap width no greater than 7.5 mm (0.3 in.) between the molds.

Note 6—To cut specimens consistently may require the use of a jig.

7. DETERMINING AIR VOID CONTENT

7.1. Determine the bulk specific gravity of the specimens in accordance with T 166.

7.2. Determine the maximum specific gravity of the mixture in accordance with T 209.

7.3. Determine the air void content of the specimens in accordance with T 269. The recommended target air void content is 7.0 ± 0.5 percent for laboratory-compacted SGC cylindrical specimens and 7.0 ± 1.0 percent for laboratory-compacted slab specimens. Field specimens may be tested at the air void content at which they are obtained.

8. PROCEDURE

8.1. *Slab and Large Field Core Specimen Mounting*—Use plaster of Paris to rigidly mount the 300 mm (12 in.), 250 mm (10 in.), or slab specimens in the mounting trays. Mix the plaster at approximately a 1:1 ratio of plaster to water. Pour the plaster to a height equal to that of the specimen to fill the air space between the specimen and the sides of the mounting tray. The slab specimen will be in direct contact with the mounting tray; however, plaster may flow underneath the specimen. If the thickness of the Slab or Large Field Core Specimen is the same as the height of the mounting tray, the plaster underneath the specimen must not exceed 2 mm (0.08 in.). If the thickness of the Slab or Large Field Core Specimen is less than the height of the mounting tray, plaster and/or shims from aluminum, HDPE, or other suitable material shall be used underneath the specimen as necessary to bring the top of the specimen level with the top of the mounting tray and to prevent any movement of the specimen in the mounting tray during testing. Allow the plaster at least 1 h to set. If using other mounting material, it should be able to withstand 890 N (200 lb) of load without cracking.

8.2. *SGC Cylindrical and Field Core Specimen Mounting*—Rigidly mount the 150-mm [5.91-in.] or 152-mm [6-in.] diameter samples in the mounting tray using HDPE molds meeting the dimensions outlined in Figure 2 or use plaster of Paris. For HDPE molds, place the molds in the mounting tray and insert the cut specimens in the molds. Shim the molds in the mounting tray as necessary. Secure the molds into the mounting tray. If plaster of Paris is used, pour the plaster to a height equal to that of the specimen to fill the air space between the specimen and the sides of the mounting tray. The specimen will be in direct contact with the mounting tray; however, plaster may flow underneath the specimen. For SGC Cylindrical Specimens the plaster underneath the specimen must not exceed 2 mm (0.08 in.) in thickness. For Field Core Specimens plaster and/or shims from aluminum, HDPE, or other suitable material shall be used underneath the specimen as necessary to bring the top of the specimen level with the top of the HDPE molds and to prevent any movement of the specimen in the molds during testing. Allow the plaster at least 1 h to set.

Note 7—Cores drilled with a 152-mm [6-in.] drill bit may not fit in the 150-mm [5.91-in.] HDPE mold and may require further trimming and mounting in plaster of Paris.

8.3. Place the mounting tray(s) with the test specimens into the device. Adjust the height of the specimen tray as recommended by the manufacturer, and secure by hand-tightening the bolts.

8.4. Turn the testing device and all components on.

8.5. Start the software used to communicate with the testing device.

8.6. Enter the pertinent project information and testing configuration requirements.

8.6.1. Select the test temperature based on the applicable specifications.

8.6.2. Select the maximum allowable rut depth based on the applicable specifications.

8.6.3. Select the maximum number of passes based on the applicable specifications.

8.6.4. Enter a start delay of 45 min to precondition the test specimens. The temperature of the specimens in the mounting tray will be the test temperature selected in Section 8.6.1 on completion of this preconditioning period.

8.7. Proceed to Section 8.8 to operate the testing device in "Auto" mode. Proceed to Section 8.9 to operate the testing device in "Manual" mode.

Note 8—Perform the test in "Auto" mode for testing devices manufactured in the United States later than 1998, where software will automatically open and close the valves to fill and drain the water bath. Perform the test in "Manual" mode for devices made available to the United States prior to 1998.

8.8. *Performing the Test in Auto Mode*:

8.8.1. Adjust the height of the LDT in accordance with the manufacturer's recommendations.

Note 9—The LDT for each steel wheel is automatically zeroed at the start of the test. The software will display a zero at the start of the test.

8.8.2. If using cylindrical specimens, lower the wheels onto the edge of the test specimens such that a majority of the wheel is in contact with the HDPE molds in the mounting tray. If using slabs, lower the wheels onto the specimen no more than 5 min prior to the beginning of the test. In either case, the sample must not be submerged longer than 60 ± 5 min prior to starting the test. This includes the conditioning time.

8.8.3. Start the test by selecting the "Start" button of the testing device software.

Note 10—The start delay time or preconditioning time will start after the water heats to the test temperature selected in Section 8.6.1.

8.8.4. The wheel-tracking device will stop when 20,000 passes have occurred, when some other predetermined number of passes has occurred, or when the test has achieved the maximum impression depth established in Section 8.6.2. The testing device software automatically saves the test data file.

8.8.5. Raise the wheel(s) and remove the specimen mounting tray(s) and rutted specimens.

8.8.6. Proceed to Section 8.10.

8.9. *Performing the Test in Manual Mode*:

8.9.1. Close the drain valve(s) and fill the water bath of the wheel-tracking device with water until the float device(s) raises to a horizontal position.

Note 11—Adjust the amount of hot and cold water if necessary, as the water temperature may vary.

8.9.2. Precondition the test specimens in the water bath for 45 min after the water has reached the selected test temperature. Do not place the sample in the conditioning bath more than 60 ± 5 min prior to beginning the test. This includes the preconditioning time.

8.9.3. Lower the wheels onto the specimens after the test specimens have preconditioned at the selected test temperature for 45 min. For machines that start automatically after the selected preconditioning time, it is allowable to lower the wheels before the preconditioning cycle. The wheel must not be in contact with the specimen for more than 5 min prior to starting the wheel.

8.9.4. Ensure the micro-control unit's LDT reads between 10 and 18 mm (0.4 and 0.7 in.). Adjust the LDT height to obtain this reading. Loosen the two screws on the LDT mount and slide the LDT up or down to the desired height. Tighten the screws.

8.9.5. Start the test.

8.9.6. The wheel-tracking device will stop when 20,000 passes have occurred, when some other predetermined number of passes has occurred, or when the test has achieved the maximum impression depth established in Section 8.6.2.

8.9.7. Open the valve(s) beneath the tanks and drain the water bath. Raise the wheel(s) and remove the specimen mounting tray(s) and rutted specimens.

8.10. Clean the water bath, heating coils, wheels, and temperature probe with water and scouring pads or per the manufacturer's recommendations. Use a wet-dry vacuum to remove particles that have settled to the bottom of the baths. Clean the filter element and spacers after every test or per the manufacturer's recommendations. Do not use solvents to clean the water bath.

8.11. Turn the wheels after each test, so the same section of the wheel surface is not in contact with the test specimen from test to test. This rotation will provide for even wear over the entire wheel. The test should operate with a smooth movement across the test specimen.

9. CALCULATIONS

9.1. For the purposes of this method, a "test" is defined as:

a) Two 320-mm (12.5-in.) long by 260-mm (10.25-in.) wide slab specimens, two 250-mm (10-in.) core specimens, or two 300-mm (12-in.) core specimens representing similar material run in the Hamburg Wheel-Tracking Device simultaneously; or

b) Four 150-mm (6-in.) diameter specimens grouped in pairs (1 and 1a) representing similar material run in the Hamburg Wheel-Tracking Device simultaneously.

The test results will be reported as the average value of both specimens (a) or both pairs of specimens (b).

9.2. The maximum rut depth shall be calculated based on the average rut depth for the five middle deformation locations (i.e., located at –46 (–1.8), –23 (–0.9), 0, +23 (+0.9), and +46 (+1.8) mm (in.)) or other suitable method as specified by the agency. Plot the rut depth versus number of passes for each test for each deformation location. Figure 3 shows a typical plot of the output produced by the Hamburg Wheel-Tracking Device. From this plot, obtain the following values:

- slope and intercept of the first steady-state portion of the curve, and
- slope and intercept of the second steady-state portion of the curve.

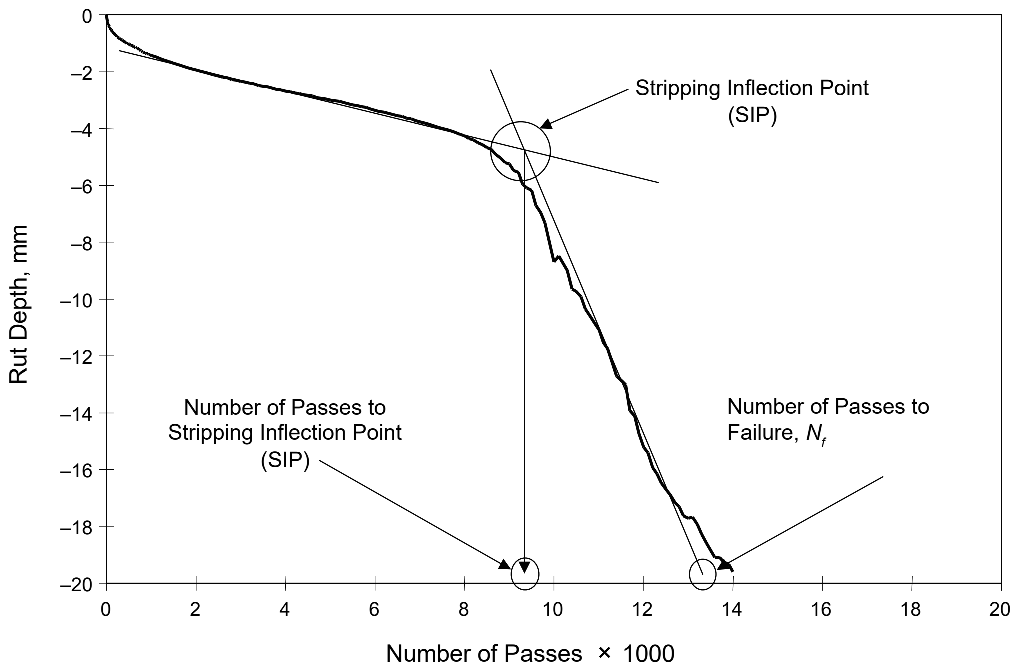


Figure 3—Hamburg Curve with Test Parameters

9.3. Calculate the following test parameters, all expressed in "Passes."

$$\text{stripping inflection point (SIP)} = \frac{\text{intercept (second portion)} - \text{intercept (first portion)}}{\text{slope (first portion)} - \text{slope (second portion)}} \qquad (1)$$

where:

Failure rut depth is the specified maximum allowable rut depth for the test.

Note 12—The specifying agency may choose to define a "test" as an individual slab or core specimen or as a pair of specimens as defined in Section 9.1.

10. REPORT

10.1. *The report may include the following parameters*:

10.1.1. Asphalt mixture production (field or lab);

10.1.2. Compaction method (slab or SGC cylindrical specimen);

10.1.3. Number of passes at maximum impression;

10.1.4. Maximum impression;

10.1.5. Test temperature;

10.1.6. Specimen(s) air voids;

10.1.7. Type and amount of anti-stripping additive used;

10.1.8. Creep slope;

10.1.9. Strip slope; and

10.1.10. Stripping inflection point.

11. PRECISION AND BIAS

11.1. Work is underway to develop precision and bias statements for this standard.

12. KEYWORDS

12.1. Compacted asphalt mixture; moisture-susceptibility; rutting; wheel-track testing.

ANNEX A—EVALUATING HAMBURG WHEEL DIMENSIONS

(Mandatory Information)

A1. SCOPE

A1.1. This Annex covers the evaluation of the steel wheel as a check for compliance with the requirements outlined in Section 5.1. Measurements of the wheel's diameter and width, as well as visual inspection of critical surface conditions, are included.

Minimum frequency of this evaluation is 12 months.

A2. APPARATUS

A2.1. *Measurement Instrument (Calipers or Micrometer)*—With appropriate range and a minimum resolution of 0.1 mm (0.004 in.). The measurement instrument shall be standardized annually.

A3. PROCEDURE FOR MEASURING THE DIAMETER OF THE HAMBURG WHEEL

A3.1. *Perform a visual inspection of the wheel*: The wheel shall be free of residue and deep gouges. Identify any wear that may be visible on the wheel.

A3.2. Determine the maximum diameter of the wheel by measuring it at several locations. Place a removable mark at the maximum diameter position. Record the maximum diameter to the nearest 0.1 mm (0.004 in.).

A3.3. Measure the diameter at a 90-degree orientation to the maximum diameter. Record this diameter to the nearest 0.1 mm (0.004 in.).

A3.4. Each individual diameter measurement shall be compared to the specified range and given a pass/fail rating. If any of the individual measurements are assigned a "fail" rating, the wheel is considered to be out of conformance and shall not be used.

A4. PROCEDURE FOR MEASURING THE WIDTH OF THE HAMBURG WHEEL

A4.1. *Perform a visual inspection of the wheel loading surface*: The edge shall be free of residue and deep gouges. Identify any wear that may be visible on the edge of the wheel.

A4.2. Determine the maximum width of the wheel by measuring it at several locations. Place a removable mark at this position. Record the maximum width to the nearest 0.1 mm (0.004 in.).

A4.3. Measure the width at a 90-degree, 180-degree, and 270-degree orientation to the maximum width. Record each width to the nearest 0.1 mm (0.004 in.).

A4.4. Each individual width measurement shall be compared to the specified range and given a pass/fail rating. If any of the individual measurements is assigned a "fail" rating, the wheel is considered to be out of conformance and shall not be used.

A5. INSPECTION REPORT

A5.1. *Record and report the following information*:

A5.2. Name of evaluator;

A5.3. Date;

A5.4. Equipment owner;

A5.5. Location of evaluation;

A5.6. Hamburg Wheel-Tracker model;

A5.7. Diameter measurements of the wheel to the nearest 0.1 mm (0.004 in.);

A5.8. Width of the loading surface of the wheel to the nearest 0.1 mm (0.004 in.).

APPENDIXES

(Nonmandatory Information)

X1. MAINTENANCE

X1.1. Grease all of the grease fittings with fresh grease every 20 tests (not to exceed 2 months) per the manufacturer's recommendations.

X2. CALIBRATION/EQUIPMENT VERIFICATION

X2.1. Verify the water bath temperature is within ±1.0°C (1.8°F) of the temperature readout from the testing device or software every 6 months. Measure the water bath temperature at four locations per the manufacturer's recommendations. Average the four measurements and report this as the water bath verification temperature.

X2.2. Verify the LDT calibration in accordance with ASTM D6027/D6027M or per the manufacturer's recommendations.

X2.3. Verify the load from the wheel loading assembly at the level of the initial height of the test per the manufacturer's recommendations to be 703 ± 4.5 N (158.0 ± 1.0 lb). A calibrated load cell, accurate to 0.4 N (0.1 lb) is sufficient for this check. Align the center of the load cell with the middle of the wheel width as well as the center axis of the wheel.

X2.4. Verify that the wheel is reciprocating on the test sample at 52 ± 2 passes per min.

X2.5. Verify that rut measurements are obtained at the 11 pre-set locations defined in Section 5.2.1. The aluminum apparatus presented in Figure X1.1 should be used.

X2.6. The wheel position varying sinusoidally over time shall be verified to have a maximum RMSE of 2.54 mm (0.1 in) unless otherwise specified by the agency from a perfectly sinusoidal wave.

Table X1.1—Offset Values for Displacement Readings

Position (in.)	Position (mm)	Offset (mm
–4.5	–114	0.79
–3.6	–91	0.50
–2.7	–69	0.28
–1.8	–46	0.13
–0.9	–23	0.03
0.0	0	0.00
0.9	23	0.03
1.8	46	0.13
2.7	69	0.28
3.6	91	0.50
4.5	114	0.79

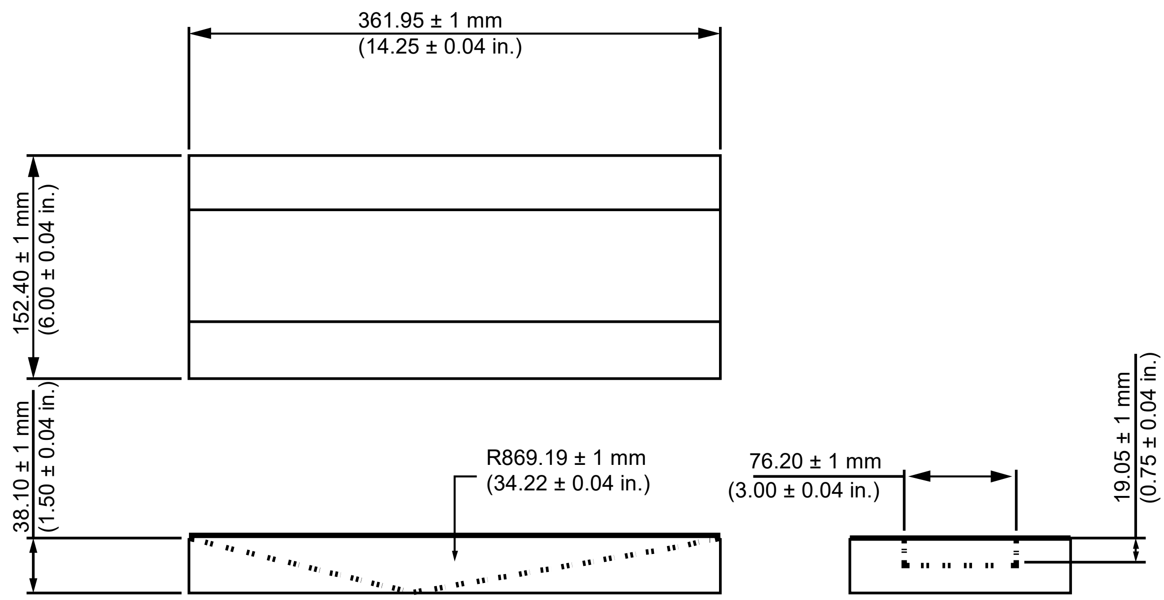


Figure X1.1—Details of the Metal Specimen