
Standard Method of Test for

Determining Rutting Susceptibility of Asphalt Mixtures Using the Asphalt Pavement Analyzer (APA)

AASHTO Designation: T 340-23¹

Technically Revised: 2023

Editorially Revised: 2023

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

**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This method describes a procedure for testing the rutting susceptibility of asphalt mixtures using the Asphalt Pavement Analyzer (APA).
- 1.2. Annex A1 contains procedures for calibration checks for several APA components and related equipment.
- 1.3. Appendix X1 presents specifications for, and discussion concerning, several options for APA testing parameters often employed by APA users.
- 1.4. The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.
- 1.5. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all 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:*
 - < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - < R 97, Sampling Asphalt 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 Asphalt Mixtures

- < 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 Standard:*

- < E1, Standard Specification for ASTM Liquid-in-Glass Thermometers

3. APPARATUS

- 3.1. *APA*—A thermostatically controlled device designed to test the rutting susceptibility of asphalt mixtures by applying repetitive linear loads to compacted test specimens through pressurized hoses via wheels.
- 3.1.1. The APA shall be thermostatically controlled to maintain the test temperature and conditioning chamber at any set point between 4 and 72°C (40 and 160°F) within 1°C (2°F).
- 3.1.2. The APA shall be capable of independently applying loads up to 578 N (130 lbf) to the wheels. The loads shall be calibrated to the specified test load by an external-force transducer.
- 3.1.3. The APA shall be capable of adjusting the pressure in the test hoses and maintaining up to 862 kPa (125 psi) in the test hoses.
- 3.1.4. The APA shall be capable of testing four or six cylindrical specimens using a two-wheel or three-wheel APA, respectively.
- 3.1.5. The test molds shall be rectangular in shape, be composed of ultra-high-molecular-weight (UHMW) polyethylene, fit snugly within the testing position in the APA testing chamber, and contain two holes in which to insert the specimens. The dimensions of each hole shall be 150 ± 2.0 mm (5.91 ± 0.08 in.) in diameter by 75.0 ± 2.0 mm (2.95 ± 0.08 in.) tall.
- 3.1.6. The APA shall have a programmable master cycle counter that can be preset to the desired number of cycles for a test. The APA shall be capable of automatically stopping the test at the completion of the programmed number of cycles.
- 3.1.7. The test hoses shall be composed of a nylon tube with high-tensile textile cord reinforcement and a synthetic rubber cover. The nominal inside diameter of the hoses shall be 19.0 mm (0.75 in.); the nominal outside diameter of the hoses shall be 29.5 mm (1.16 in.). The maximum working pressure (WP) of the hoses shall be 5.17 MPa (750 psi). The hoses should be replaced when any of the outer rubber casing exhibits significant wear. Follow the APA manufacturer's instructions for the technique on replacing hoses.
- Note 1**—A Gates 77B Paint Spray and Chemical hose has been found to be satisfactory. This hose is available from the Gates Corporation (Product No. 3207-0296).
- 3.1.8. When electing to manually measure rut depths, a rut depth measurement template is required. This template shall be machined aluminum plate [approximately 31.7 to 38.1 mm (1.25 to 1.50 in.) thick] and have the following dimensions: 400.0 mm (15.75 in.) long by 152.4 mm (6 in.) wide. The rut depth measurement template shall contain five openings, spaced along the length of the template, in which the ruts are measured. The locations of the openings on the template will coincide with the locations utilized by the automatic measurement system. Each of the five openings shall be approximately 11 mm (0.43 in.) wide.
- Note 2**—Manual rut depth measurements on specimens that are rutted significantly may result in erroneous data. The rut depth measurement template may rest on the displaced material rather than on the test mold. In these cases, the rut depth measurement template should be modified with a

channel removed from the bottom side of the template in order to span the displaced material and ensure that the template rests on the test mold.

- 3.1.9. The APA shall be calibrated in accordance with Annex A1.
- 3.2. Ovens for maintaining temperature of plant-produced asphalt mixtures and preheating specimens.
- 3.3. *Compaction Device and Molds:*
 - 3.3.1. Superpave gyratory compactor (SGC) and compaction molds conforming to T 312, or
 - 3.3.2. Vibratory compactor and compaction molds.
 - 3.3.2.1. *Vibratory Compactor*—A steel-frame device mounted on noise-absorbing isolators and supports that utilizes adjustable vibratory compression forces to consolidate and compact asphalt mixtures to produce cylindrical specimens for further testing. The device shall be timer-controlled and capable of compacting the specimens to a specified height and extracting the specimens after compaction. The vibratory compactor shall have a control panel separate from the compaction unit. The panel shall contain a mode switch to control specimen compaction and extraction and a timer to control the compaction-time cycle.
 - 3.3.2.2. The compaction molds used for specimens produced in the vibratory compactor shall be composed of steel with the following dimensions:
 - < Inside diameter of 149.9 ± 0.5 mm (5.90 ± 0.02 in.),
 - < Inside height of 133.4 ± 0.5 mm (5.25 ± 0.02 in.),
 - < Overall height of 152.7 ± 0.5 mm (6.01 ± 0.02 in.),
 - < Wall thickness of 7.81 ± 0.5 mm (0.31 ± 0.02 in.), and
 - < Bottom plate diameter of 149.0 ± 0.5 mm (5.87 ± 0.02 in.).

4. PREPARATION OF TEST SPECIMENS

- 4.1. *Number and Dimensions of Test Specimens*—Four cylindrical specimens for the two-wheel APA and six cylindrical specimens for the three-wheel APA, 150 mm (5.91 in.) in diameter by 75 ± 2 mm (3.0 ± 0.1 in.) tall.
- 4.2. *Roadway Core Specimens:*
 - 4.2.1. Roadway core specimens shall be 140 to 152 mm (5.5 to 6.0 in.) in diameter and a minimum of 50 mm (2 in.) tall with all surfaces of the perimeter perpendicular to the surface of the core within 5 mm (0.2 in.). Cores taller than the desired height shall be trimmed with a saw to a height of 75 ± 2 mm (3.0 ± 0.1 in.). For cores with diameters between 140 and 152 mm (5.5 and 6.0 in.) or heights between 50 and 73 mm (2.0 and 2.9 in.), plaster of paris or comparable material may be used to achieve the proper testing height of 75 ± 2 mm (3.0 ± 0.1 in.) and to ensure that specimens with small diameters fit snugly within the testing mold. Testing shall be conducted on the uncut face of the core.
- 4.3. *Plant-Produced Asphalt Mixtures:*
 - 4.3.1. Samples of plant-produced asphalt mixtures shall be obtained in accordance with R 97. Asphalt mixture samples shall be reduced to the appropriate test size and compacted while the asphalt mixture is within the compaction temperature range as determined by the specifying agency. Reheating of loose plant asphalt mixtures should be avoided.

- 4.3.2. When using an SGC, compact specimens conforming to the dimensional requirements of Section 4.1 to 7.0 ± 0.5 percent air voids in accordance with T 312.
- 4.3.3. When using a vibratory compactor, compact specimens conforming to the dimensional requirements of Section 4.1 to 7.0 ± 0.5 percent air voids in accordance with the following procedure:
 - 4.3.3.1. Attach and level the appropriate compaction head to the vibrating assembly in accordance with the manufacturer's instructions. Verify that the compaction head is correctly attached and arranged to produce a specimen of the desired height. Check the position of the compaction head against the specimen mold in accordance with the manufacturer's instructions.
 - 4.3.3.2. Adjust the compaction force and vibration time settings in accordance with the manufacturer's instructions.
 - 4.3.3.3. Heat and charge the specimen mold in accordance with the manufacturer's instructions.
 - 4.3.3.4. Operate the vibratory compactor in order to compact and extrude the specimen in accordance with the manufacturer's instructions.
- 4.3.4. Compacted specimens should remain at room temperature, approximately 25°C (77°F), to allow the entire specimen to cool, for a minimum of 3 h.
- 4.4. *Laboratory-Prepared Asphalt Mixtures:*
 - 4.4.1. Prepare the ingredient materials and mix the asphalt mixture specimens in accordance with T 312.
 - 4.4.2. When using an SGC, compact specimens conforming to the dimensional requirements of Section 4.1 to 7.0 ± 0.5 percent air voids in accordance with T 312.
 - 4.4.3. When using a vibratory compactor, compact specimens conforming to the dimensional requirements of Section 4.1 to 7.0 ± 0.5 percent air voids in accordance with the procedure given in Sections 4.3.3.1 through 4.3.3.4.
 - 4.4.4. Compacted specimens should remain at room temperature, approximately 25°C (77°F), to allow the entire specimen to cool, for a minimum of 3 h.

5. DETERMINING THE AIR VOID CONTENT

- 5.1. Determine the bulk specific gravity of the asphalt mixture specimens in accordance with T 166. In the case of sawn specimens as described in Section 4.2.1, determine the bulk specific gravity of the specimens after sawing.
- 5.2. Determine the maximum specific gravity of the loose asphalt mixture in accordance with T 209.
- 5.3. Determine the air void content of the asphalt mixture specimens in accordance with T 269.

6. SELECTING THE TEST TEMPERATURE

- 6.1. The test temperature shall be set to the high temperature of the standard Superpave performance-graded (PG) binder identified by the specifying agency for the project for which the asphalt mixture is intended. For circumstances where the high-temperature binder grade has been increased, the APA test temperature will remain at the standard PG binder high temperature.