
Standard Method of Test for

Continuous Measurement of Sideway-Force Friction Number for Highway Pavements

AASHTO Designation: TP 143-21 (2023)¹

First Published: 2021

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Technical Subcommittee: 5a, Pavement Measurement



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1. SCOPE

- 1.1. This test method covers the measurement of the sideway-force friction of paved surfaces using a tire mounted at 20 degrees, herein referred to as the “device.”
- 1.2. This test method utilizes the measurements obtained by a device, containing one freely rotating test wheel angled at 20 degrees to the direction of motion, and operated over a pavement surface at operating speed while the test wheel is under a vertical load. The test equipment has been built onto a number of different vehicle chassis and functions independently of vehicle choice. This method provides data of the sideway-force friction (and other data) along the whole length of the pavement surface being tested. The data are intended for use in comparing certain frictional properties of a pavement relative to those of other pavements or for evaluating changes in these frictional properties of a pavement with the passage of time. The data are insufficient to determine the distance required to stop a vehicle on either a wet or a dry pavement.
- 1.3. The values stated in SI units are to be regarded as standard.
- 1.4. *This standard does not purport to address all of the safety concerns, if any, 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. See also Section 6.*
- 1.5. *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 STANDARDS

- 2.1. AASHTO Standard:
 - < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.2. ISO Standards²:
 - < ISO 23529, Rubber – General Procedures for Preparing and Conditioning Test Pieces for Physical Test Methods

- BS 903-A2/ISO 37, Physical Testing of Rubber. Method for determination of tensile stress-strain properties
- ISO 2781, Rubber, Vulcanized, or Thermoplastic – Determination of Density
- ISO 48, Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)
- ISO 4662, Rubber – Determination of rebound resilience of vulcanizates

2.3.

Other Documents:

- Brittain, S. Speed Correction for SCRIM Survey Machines. Published Project Report PPR587. TRL, Berkshire, United Kingdom, 2011. Formerly Transport Research Laboratory. Available at <https://trl.co.uk/publications/speed-correction-for-scrim-survey-machines>
- Dunsford, A. GripTester Trial - October 2009 Including SCRIM Comparison. Project Report PPR497. Transport Research Laboratory, Berkshire, United Kingdom, August 2010. Available at <https://trl.co.uk/publications/ppr497>
- Highways England. Skidding Resistance. CS 228. In *Design Manual for Roads and Bridges*, Pavement Inspection and Assessment. Highways England, Birmingham, United Kingdom, Revision 1, March 2020. Available at <https://www.standardsforhighways.co.uk/dmr/search/e092f5e5-53a8-43dc-a005-f33ebee845f>
- Hosking, J. R., and G. C. Woodford. Measurement of Skidding Resistance Part III. Factors Affecting SCRIM Measurements. TRRL Report 739. TRL, Berkshire, United Kingdom, 1976. Formerly Transport and Road Research Laboratory. Available at <https://trl.co.uk/publications/lr739>

3. SUMMARY OF TEST METHOD

- 3.1. The device is a self-contained pavement-testing machine that measures sideways-force friction of paved surfaces using a special narrow test wheel. A typical device is illustrated in Figure 1.



Figure 1—Device Wheel Assembly for a Machine with the Wheel in Its Raised Position

- 3.2. A controlled slipping condition is achieved through a freely rotating test wheel mounted mid-machine in line with the wheel path and angled at 20 degrees, pointing towards the center of the vehicle, in the direction of travel³. The test wheel is fitted with a special pneumatic, smooth rubber tire.
- 3.3. When the vehicle is in motion, the test wheel is applied to the pavement surface under a measured vertical load. A controlled flow of water wets the pavement surface immediately in front of the test wheel, so that when the vehicle moves forward, the test wheel rotates, but due to the inclined angle there is slippage in the transverse direction (i.e., in line with the test wheel axle).
- 3.4. The force generated by the resistance to sliding is related to the wet-pavement skid resistance. The ratio of the measured sideway component of force (H) to the measured vertical load (V) multiplied by 100 provides the sideway-force friction number (SFN).
- 3.5. The SFN is affected by the speed of the test vehicle, so testing speed shall be measured on a continuous basis to make the necessary SFN speed correction.
- 3.6. The friction analysis is displayed on the in-cab monitor and can be downloaded to other devices as required by the client for analysis.

4. SIGNIFICANCE AND USE

- 4.1. The knowledge of sideway-force friction serves as an additional tool in characterizing pavement surfaces. Sideway-force friction data alone may be of limited value in determining the suitability of paving materials or finishing techniques. However, when used in conjunction with other physical and chemical tests, the sideway-force friction may contribute valuable information about the interaction of tires and the pavement surface.
- 4.2. The values measured with the equipment and procedures stated herein do not necessarily agree or correlate directly with those obtained by other paved surface friction measuring methods.

5. APPARATUS

- 5.1. *The test equipment shall include the following features:*
- 5.1.1. Test wheel assembly,
- 5.1.2. Test tire,
- 5.1.3. Water supply and flow control mechanism, and
- 5.1.4. Electronic recorder and measurement control system.
- 5.2. *Test Wheel Assembly:*
- 5.2.1. The test wheel assembly is mounted on a frame within the wheelbase of the vehicle. The two vertical shafts are attached to the frame and position the test wheel assembly in the appropriate wheel path.
- 5.2.2. The assembly shall be free to move vertically when the test wheel is in contact with the surface (to minimize the effects of vehicle chassis movements).

- 5.2.2.1. The test wheel assembly shall be comprised of a back plate for location on the vertical shafts, a swinging arm, hub, test wheel and tire, and electrical load cells to measure the horizontal (i.e., perpendicular to the test wheel) and vertical loads.
- 5.2.2.2. A single damper/spring suspension unit is also included.
- 5.2.3. The static wheel load of the test wheel assembly shall be 200 ± 1 kg (440 ± 2 lb). The vertical plane of the test wheel is to be set at 20 ± 1.0 degrees to the line of the chassis. This angle is known as the “slip angle.”
- 5.2.4. A mechanism shall be provided for raising and lowering the test wheel assembly to and from the ground.
- 5.3. *Test Tire*—The test tire shall be tubed, size 3.00/20 in., pneumatic, of natural rubber, and without tread (smooth).
- 5.3.1. The tire compound shall conform to the physical properties listed in Table 1. Tires shall be individually tested by the supplier and each tire marked with the rebound resilience result at the temperature tested.

Table 1—Physical Properties of Tire Tread Compound

Property	Test Method	Value
Tensile Sheet Cure, Min. at 298°F (148°C)	ISO 23529	50
Specific Gravity, kg/m ³	ISO 2781	1.12 ± 0.01
Tire Tread Hardness, IRHD°	ISO 48	62 ± 3
Tensile strength, min psi	BS 903-A2/ISO 37	2700
300% Modulus, psi	BS 903-A2/ISO 37	1800 ± 150
Elongation at Break, min %	BS 903-A2/ISO 37	400
Lupke Rebound Resilience, R %	ISO 4662	40–49

- 5.3.2. Figure 2a is a schematic of a typical tire cross section, along with several important dimensions. Figure 2b is an oblique view of the tire. Inflate the tire to a pressure of 350 ± 20 kPa ($50 \text{ psi} \pm 3 \text{ psi}$) when measured at 20°C (68°F) ambient air temperature. If measured at a different temperature, the tire pressure shall be equivalent to the pressure at the specified temperature. In practice, other pressure values will apply at other temperatures.
- 5.3.3. New test tires shall be conditioned by using them to test at least 5 km (3 mi) before any test results are recorded.
- 5.3.4. Date stamp all tires and mark each one indelibly with a unique reference number. Each tire is marked with a wear indicator to indicate wear of 3 mm (0.12 in.). Do not use a tire that has worn down to the wear-indicator level or if otherwise damaged. Do not use a tire that is more than 2 yr old. Tires shall be stored in a cool, dry environment away from direct sunlight, in such a way that prevents damage or distortion.