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Standard Specification for A Size 10 × 4–5 Smooth-Tread Friction Test Tire[1]

This standard is issued under the fixed designation E 1844; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the general requirements for a smooth-tread standard tire for measuring tire-pavement friction forces.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 297 Methods for Rubber Products—Chemical Analysis[2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[2]

D 1054 Test Method for Rubber Property—Resilience Using a Rebound Pendulum[2]

D 1765 Classification System for Carbon Blacks Used in Rubber Products[2]

D 2240 Test Method for Rubber Property—Durometer Hardness[2]

D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets[2]

E 867 Terminology Relating to Traveled Surface Characteristics[3]

2.2 *Other Document:*

Griptester—GTSV1 Descriptive Booklet[4]

3. Terminology

3.1 Terminology used in this specification is in accordance with Terminology E 867.

4. Materials and Manufacture

4.1 The individual standard tires shall conform to the design standards of Section 6. Dimensions, weights, and permissible variations are also given in Section 6 and Fig. 1 and Fig. 2.

4.2 Tread compounding, fabric processing, and all tire manufacturing shall be certified to ensure that the specifications are met (see Section 8).

4.3 The markings on the tire, as shown in Fig. 1, shall be molded on the sides of the tire.

4.4 Fig. 1 shows a view of the tread surface and a side view of the tire. Fig. 2 is a typical tire cross-section with critical dimensions identified.

5. Material Requirements

5.1 The compounding requirements for the tread compound are given in Table 1.

5.2 The fabric shall be Nylon, 1260/2 Denier.

NOTE 1—Certain proprietary products have been specified since exact duplication of properties of the finished tire may not be achieved with other similar products. This inclusion does not in any way comprise a recommendation for these proprietary products nor against similar products of other manufacturers, nor does it imply any superiority over any such similar products.

6. Physical Requirements

6.1 The physical and mechanical test requirements of the tread compound are given in Table 2.

7. Construction, Dimensions and Permissible Variations

7.1 *Construction*—The tire shall be size 10 × 4–5, tube type, two plies, nylon cord, and bias construction.

7.2 *Dimensions*—Tread width shall be 51 ± 2.0 mm (2.0 ± 0.08 in.), the tread radius shall be 165 ± 25 mm (6.5 ± 1.0 in.), the cross-sectional width shall be 102 ± 2 mm (4.0 ± 0.08 in.), and the outside diameter at the centerline shall be 258 ± 2 mm (10.15 ± 0.08 in.) when measured on a 89 mm (3.5 in.) wide rim at 138 ± 3 kPa (20 ± 0.5 PSI). See Fig. 2 which shows the inflated dimensions of the new tire.

7.3 *Tread*—The tread surface shall be smooth (blank) without any ribs or grooves. The tread shall have a thickness of 5 mm (0.20 in.) and an undertread thickness of 2 ± 0.5 mm (0.08 ± 0.02 in.) at the tread centerline.

7.4 *Wear Indicators*—There will be two holes molded into the tire tread, 5.0 mm (0.20 in.) deep and 3.2 mm (0.125 in.) in diameter. These two wear-indicators will be spaced 180° apart.

8. Workmanship

8.1 Tires shall be free of defects in workmanship and material.

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[1] This specification is under the jurisdiction of ASTM Committee E-17 on Vehicle-Pavement Systems and is the direct responsibility of Subcommittee E17.24 on Tire and Slider Characteristics.

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[2] *Annual Book of ASTM Standards*, Vol 09.01.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] Available from Findlay-Irvine Ltd., Bog Road, Penicuik, Midlothian EH269BU, Scotland.

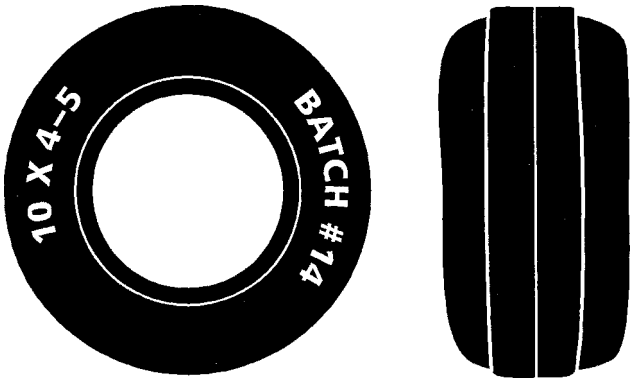

FIG. 1 Molded on Tire: 10 × 4–5 Tread ASTM Batch No.

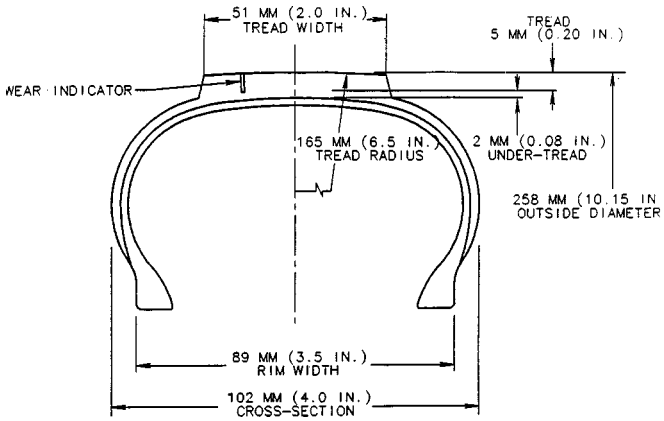

FIG. 2 Tire Section—Inflated Dimensions

TABLE 1 Compounding of Tread Rubber[A]

Material	Parts by Mass
SBR 1714[B]	89.38
CB1252[C]	48.12
N347[D]	75.00
High-Aromatic Oil	9.00
Zinc Oxide	3.00
Stearic Acid	2.00
Santoflex 13[E]	2.00
Paraffin Wax	2.00
Santocure NS[F]	1.10
DPG[G]	0.10
Sulfur	1.80

[A] See Practice D 3182.
[B] Styrene-butadiene rubber (23.5 % styrene) 37.5 parts of high-aromatic oil.
[C] Cis-polybutadiene with 37.5 parts of high-aromatic oil or equivalent.
[D] N347 Carbon Black, see Classification D 1765.
[E] Dimethyl butylphenyl phenylenediamine.
[F] Butyl benzothiazole sulfenamide.
[G] Diphenyl guanidine.

9. Test Methods

9.1 For information on the following, refer to the ASTM standards listed.

9.1.1 *Tensile Sheet Cure*—Practice D 3182.

9.1.2 *Modulus (300 %)*—Test Methods D 412.

9.1.3 *Tensile Sheet Durometer*—Test Method D 2240, using a Type A Shore Durometer.

9.1.4 *Restored Energy (Rebound or Resilience)*—Test Method D 1054.

9.1.5 *Specific Gravity*—Test Method D 297.

9.1.6 *Tensile Strength*—Test Methods D 412.

TABLE 2 Physical Properties of Tread Compound

Tensile Sheet Cure, min at 300°F (149°C)	30
300 % modulus, psi (MPa) (Test Methods D 412)	800 ± 200 (5.5 ± 1.4)
Tensile sheet durometer (Test Method D 2240)	58 ± 2
Restored energy (rebound or resilience) (Test Method D 1054)	46± 2
Specific gravity (Methods D 297)	1.13 ± 0.02
Tensile strength, min psi (MPa) (Test Methods D 412)	2000 (13.8)
Elongation, min % (Test Methods D 412)	500
Tire tread durometer (Test Method D 2240)	58 ± 2

9.1.7 *Elongation*—Test Methods D 412.

9.1.8 *Tire Tread Durometer*—Test Method D 2240, in addition to the following specific procedures:

9.1.8.1 Use a Type A Durometer. A12.7 mm (0.5 in.) diameter presser foot, a sure code XAHAF is recommended.

9.1.8.2 The Durometer shall be calibrated at a reading of 60 hardness.

9.1.8.3 Condition the tire and durometer to equilibrium at 23 ± 2°C (73.4 ± 3.6°F) before determining tread hardness.

9.1.8.4 Determine the tire tread hardness by averaging at least one set of six readings. A set should consist of readings taken at approximately equally spaced intervals around the tread circumference.

9.1.8.5 Apply the presser foot to the tire tread as rapidly as possible without shock, keeping the foot parallel to the tread surface. Apply just sufficient pressure to obtain firm contact between the presser foot and tire tread surface. Read the durometer scale within 1 s after the presser foot is in contact with the tread, but after initial maximum transient which may occur immediately after contact is made.

10. Precision and Bias

10.1 Precision standards are currently under development.

11. Certification

11.1 Tires are to be inflated and measured prior to shipment. Upon request, the manufacturer shall furnish the purchaser with certification that the test tire meets this specification.

11.2 The Annex to this specification suggests a test procedure for determining the reliability, performance and consistency of the tires.

11.3 All tires under certification shall be subject to the manufacturers normal variation.

12. Packaging and Preservation

12.1 Tires should be stored in a dry area, at a temperature not exceeding 32.2°C (90°F) and in subdued light. Tires must not be stored near electric motors, welders, or other ozone generating equipment.

13. Recommendations for Tire Use and Operational Requirements

13.1 The tire was designed for measuring tire-pavement friction forces only and was not designed for any other use or service.

13.2 A new tire break-in sufficient to only remove the glossy tread surface is recommended before using the tire for testing. This break-in time will vary with pavement surface condition, speed, and test tire operating mode, but is normally 5–11 km (3–7 miles).

13.3 The inflation pressure used in the test tire shall be 138 ± 3 kPa (20 ± 0.5 PSI) measured at ambient temperature (cold). The maximum permitted inflation is 275 kPa (40 PSI).

13.4 The recommended static test load on the test tire shall be 21 kg (46 lbs).

13.5 When any irregular wear or damage results from the testing or when the wear indicators are no longer visible, the use of the tire as a standard friction test tire shall be discontinued.

NOTE 2—**Caution:** The measured friction number may be influenced by tire age or tread hardness, or both. The magnitude of this dependence has not been exactly determined, but aging which has increased tread hardness to 65 will influence the resultant friction forces on some types of pavements.

14. Keywords

14.1 friction test tire; size 10 ±, 4–5

ANNEX

(Mandatory Information)

A1. SUGGESTED PROCEDURE FOR TESTING AND DOCUMENTING MEASURING TIRES

A1.1 Introduction

A1.1.1 The purpose of this procedure is to ensure that all measuring tires give friction readings which match the "standard." This standard is defined in terms of a reference measuring tire or calibration tire.

A1.1.2 For continuity, there shall be three calibration tires: two in active use and one master calibration tire held in reserve for calibration tire testing. These tires are selected from those that have passed the standard procedure for testing with particularly stringent conditions (see paragraph A1.4 below).

A1.1.3 The three current calibration tires must undergo the monthly cross-check set out in section A1.5 below.

A1.1.4 All tires must be manufactured from the rubber compound defined in Specifications E 1551, E 501, and E 524.

A1.2 Incoming Goods Inspection

A1.2.1 On receipt of a batch of tires from the manufacturer, every tire must be visually examined for a batch number, rubber formulation stamp, and physical imperfections. Tires failing visual inspection must be returned to the manufacturer.

A1.2.2 Tires which have passed visual inspection must be marked in bright metallic paint with an individual serial number showing the type of tire, batch number, and tire number. For example, A-08-21. These numbers must be entered in the tire log book which will subsequently show the date of test, whether it passed or failed, and (when appropriate) to where it was dispatched.

A1.3 Running in of New Tires

A1.3.1 The tires, together with their inner tubes, must be mounted on rims and inflated to 138 ± 3 kPa (20 ± 1 psi) and then run-in on a friction tester. The mileage required depends on the temperature and moisture on the road surface at the time and varies from 5 to 11 km (3 to 7 miles), at 50 to 65 kmH (30–40 mph). The tire must be considered "run-in" when the central molding flash is no longer visible.

A1.4 Test Procedure

A1.4.1 The mounted and run-in tires must be road-tested for accuracy of their friction readings, according to the following procedure:

A1.4.1.1 *Test Conditions*—The test must be made according to the following rules:

A1.4.1.1.1 Tires must be tested within nine months of manufacture and hardness recorded.

A1.4.1.1.2 All tires must be inflated to 138 ± 3 kPa (20 ± 1 psi).

A1.4.1.1.3 All tires must travel at least 1 km (0.6 mile) before entering the test section, and for the last 200 metres (220 yds), the surface must be wetted so that the surface is covered with at least 0.5 mm (.02 in.) of water.

A1.4.1.1.4 A properly calibrated friction tester must be used. Comparisons must only be made between runs carried out using the same friction tester.

A1.4.1.1.5 Comparisons must only be made between runs carried out on the same day and under the same conditions of road state, moisture and temperature. If the ambient temperature changes more than 5°C (9°F) or if precipitation conditions change, the procedure must be restarted.

A1.4.1.1.6 Test runs must be made on a 1 km (0.6 mile) length of straight road, surfaced with hot-rolled-asphalt. Each one third of each side of this test length must be regarded as a separate test section.

A1.4.2 *Calculation of Calibration Friction Numbers*

A1.4.2.1 Because testing is carried out on surfaces whose friction characteristics are not constant, the first stage of the testing procedure must always be to obtain a current set of friction numbers for the six test sections used.

A1.4.2.2 With a calibration tire mounted, a run covering all six test sections (that is, an outward and return run) must be made and the average friction number for each section calculated. This double run must be repeated, and the average friction number for each section calculated again.

A1.4.2.3 By this means, two average friction numbers will have been obtained for each of the six sections. These two average friction numbers should differ by no more than 0.03.

A1.4.2.4 If this condition is met, a calibration friction number for each section must be formed by averaging the two averages for that section.

A1.4.2.5 If this condition is not met, the double run must again be carried out until two double runs are obtained which do satisfy the condition.

A1.4.3 *Acceptance Criteria for Production Tires*

A1.4.3.1 With the new tire mounted, a run covering three of the test sections must be made and the average friction number for each section calculated. If the friction number for each of the three sections is within 0.02 of the calibration average, the tire is passed.

A1.4.3.2 If at least one of the average friction numbers is not within 0.02 of the calibration average but each of the average friction numbers is within 0.03 of the calibration average, then a return run must be made; if the friction number for each section is again within 0.03 of the calibration average, the tire is passed.

A1.4.3.3 If the reading for one section has to be discarded (because of obstruction or contamination) a return run is made; five readings which are within 0.03 of the calibration average allow the tire to be passed.

A1.4.4 *Acceptance criteria for calibration tires*:

A1.4.4.1 The calculation of the six calibration friction numbers described in A1.4.2 must be carried out using the master calibration tire.

A1.4.4.2 With the new tire mounted, a run covering three of the test sections must be made and the average friction number for each section calculated. If the friction number for each of the three sections is within 0.01 of the calibration average, the tire is passed.

A1.4.4.3 If the friction number for each of the three sections is only within 0.02 of the calibration average, a return run is made; if the friction number for each section is again within 0.02 of the calibration average, the tire is passed.

A1.5 Checks on the Calibration Tires

A1.5.1 The life of a master calibration tire in that role must not exceed six months, or if hardness exceeds 62.

A1.5.2 The life of an active calibration tire in that role must not exceed eighteen months, or if the hardness exceeds 62.

A1.5.3 At least bi-monthly, each of the two active calibration tires must be tested against the master calibration tire as defined in paragraphs A1.4.4.1-A1.4.4.3.

A1.5.4 A calibration tire which fails this cross check, is too old for its role or exceeds 62 hardness, must be replaced.

A1.5.5 A replacement for a master calibration tire must be a new tire.

A1.6 Recording of Results

A1.6.1 Details of all tests are to be recorded in the Friction Tester Log book in the same detail as tests for Friction Testers, under the following headings:

A1.6.1.1 Date
A1.6.1.2 Location
A1.6.1.3 Friction Tester No.
A1.6.1.4 Tire No.
A1.6.1.5 Speed
A1.6.1.6 Distance
A1.6.1.7 Friction Numbers
A1.6.1.8 Remarks
A1.6.1.9 Pass/Fail
A1.6.1.10 Tester's signature

A1.6.2 The results of the test are to be entered in the Tire Log book (see A1.2.2).

A1.6.3 A green *TESTED* sticker initialed and dated is to be applied to all tires which have met the requirements of this annex. A tire which has passed as a calibration tire and is to be adopted as such must be given an additional marking in metallic paint CAL-A-*n*, where *n* is a serial number.

A1.6.4 Production tires which have passed these tests, are to be stored in the bin kept solely for this category of material. Calibration tires mounted, are to be stored in the bin kept solely for this class of material.

A1.6.5 Production tires which have passed these tests shall be supplied to customers accompanied by a release certificate.

A1.6.6 A red *REJECTED* sticker initialed and dated is to be applied to all tires which have failed to meet the requirements of these tests and on both sides of the tire the word FAILED must be written in metallic paint, without obscuring the tire number.

A1.6.7 Failed tires must be returned to the stores failed inspection area.