



Standard Test Method for Energy Absorbed by a Tire When Deformed by a Slow- Moving Plunger¹

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1. Scope

1.1 This test method covers the determination of tire plunger energy required to completely penetrate the tread area of an inflated tire as indicated by a rupture, loss of inflation pressure, sudden drop in plunger force or bottom-out. The test requires utilization of a laboratory testing machine equipped with a slow-moving plunger which has a hemispherical end.

1.2 This test method is applicable to pneumatic tires for vehicles normally used on the road.

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

2. Referenced Documents

2.1 ASTM Standards:

E 4 Practices for Force Verification of Testing Machines²

E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)³

F 538 Terminology Relating to the Characteristics and Performance of Tires⁴

F 1082 Practice for Tires—Determining Precision for Test Method Standards⁴

3. Terminology

3.1 Definitions:

3.1.1 *groove*, *n*—a void that is relatively narrow compared to its length. (F 538)

3.1.2 *void*, *n*—a volume (in the annular tread band) defined by the lack of rubber; the depth dimension of this volume may vary from point to point in (on) the tread band. (F 538)

3.1.3 *load range*, *n*—a letter designation (A, B, C, D) or, for P-metric tires, standard load (SL) or extra load (XL), used to

identify a given size tire with its load and inflation limits when used in a specific type of service. (F 538)

3.1.4 *load rating* [*M*], *n*—the maximum load a tire is rated to carry for a given usage at a specific cold inflation pressure. (F 538)

3.1.5 *maximum load rating* [*M*], *n*—of a passenger tire, the load rating at the maximum permissible cold inflation pressure for that tire. (F 538)

3.1.6 *bottom out*, *v*—to deform a tire by radial load on the tread until radial movement of the inside surface is stopped by the rim or other tire inside surface. (F 538)

3.1.7 *plunger*, *n*—in tire testing, a cylindrical rod with a hemispherical end. (F 538)

3.1.8 *nominal plunger energy*, $\frac{1}{2}$ [ML^2/T^2], *n*—in tire testing, one half of the product of a peak force (required to rupture the tire structure in tread area) and maximum plunger travel into a tire at the time of rupture. (F 538)

3.1.9 *maximum plunger travel* [*L*], *n*—in tire testing, the relative displacement of tread surface by a plunger, measured from the point of initial contact of the plunger with the tread surface to the point of maximum force at rupture or at the bottom-out point. (F 538)

4. Summary of Test Method

4.1 This test method measures tire plunger energy required to force a cylindrical plunger with a hemispherical end into the tread of the tire to produce a rupture of the carcass.

5. Significance and Use

5.1 This test method establishes a standard procedure of test and provides data that can be related to tire strength, but does not measure tire performance or establish specification or tolerances.

6. Apparatus

6.1 *Testing Machine* that incorporates a cylindrical plunger, which can be forced, at 50 ± 5 mm/min (2.0 ± 0.2 in./min) radially into a tread of a tire, while the force and plunger motion are indicated or recorded.

¹ This test method is under the jurisdiction of ASTM Committee F09 on Tires and is the direct responsibility of Subcommittee F9.30 on Laboratory (Non-Vehicular) Testing.

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² Annual Book of ASTM Standards, Vol 03.01.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Annual Book of ASTM Standards, Vol 09.02.