



Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomer— Determination of Force Decay (Stress Relaxation) in Compression¹

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1. Scope

1.1 This standard specifies two methods for determining the decrease in counterforce exerted by a test specimen of vulcanized rubber or thermoplastic elastomer which has been compressed at a constant deformation under specified conditions of time and temperature.

1.2 This document was developed based on testing in air and liquids.

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:*²

D573 Test Method for Rubber—Deterioration in an Air Oven

D1349 Practice for Rubber—Standard Conditions for Testing

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D3767 Practice for Rubber—Measurement of Dimensions

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.10 on Physical Testing.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.1 *Compressive Stress, n* —the time-dependent force necessary to maintain a constant compressive strain, divided by the original cross-sectional area over which the force is applied.

3.1.2 *Force Decay, n* —the decrease in stress which has occurred after a specified time-interval, during application of a constant deformation, expressed as a percentage of the stress at the commencement of that time-interval. (Stress relaxation is a synonym.)

4. Summary of Test Method

4.1 *Method A*—The test specimen is compressed at the test temperature, and it is maintained at this temperature throughout the test period, all force measurements being made at the test temperature.

4.2 *Method B*—The test specimen compression and the initial measurement of the counterforce take place at $23 \pm 2^\circ\text{C}$ ($73 \pm 4^\circ\text{F}$); the test specimen is then stored in a chamber controlled at the test temperature, but it is removed from the chamber for each of the subsequent force measurements, which are made at $23 \pm 2^\circ\text{C}$ ($73 \pm 4^\circ\text{F}$).

4.3 The two methods, A and B, of carrying out the measurement do not give the same values of force decay and comparison of values obtained from the two methods must be avoided. The method selected for use depends on the purpose of the test. Thus, for fundamental studies and in applications where sealing at elevated temperatures is a problem, method A may be preferred, and in applications where temperature cycling from normal to an elevated temperature is a problem, method B may be preferred.

5. Significance and Use

5.1 When a constant strain is imposed on rubber, the force necessary to maintain that strain is not constant but decreases with time; this phenomenon is called force decay (stress relaxation). Conversely, when rubber is subjected to a constant stress, an increase in the deformation takes place in time; this behavior is called creep. These phenomena are of practical significance in rubber articles, such as seals and gaskets.