



Designation: D 1329 – 88 (Reapproved 1998)

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
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Standard Test Method for Evaluating Rubber Property—Retraction at Lower Temperatures (TR Test)¹

This standard is issued under the fixed designation D 1329; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method describes a temperature-retraction procedure for rapid evaluation of crystallization effects and for comparing viscoelastic properties of rubber and rubber-like materials at low temperatures. This test method is useful when employed in conjunction with other low-temperature tests for selection of materials suitable for low-temperature service.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information 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 832 Practice for Rubber Conditioning for Low-Temperature Testing²

D 4483 Practice for Determining Precision for Test Method Standards in the Rubber and Carbon Black Industries²

3. Summary of Test Method

3.1 This test method is carried out by (1) elongating the specimen, (2) locking it in the elongated condition, (3) freezing it to a state of reduced elasticity, (4) releasing the frozen specimen and allowing it to retract freely while raising the temperature at a uniform rate, (5) measuring the length of the specimen at regular temperature intervals while it is retracting, and (6) computing the percentage retraction at these temperatures from the data obtained. In practice, the temperatures

corresponding to 10 % and 70 % retraction are of particular importance, and are designated as TR10 and TR70, respectively.

4. Significance and Use

4.1 The difference between the temperature at which a vulcanizate retracts 10 % (TR10) and the temperature at which a vulcanizate retracts 70 % (TR70) increases as the tendency to crystallize increases.

4.2 TR70 correlates with low-temperature compression set.

4.3 TR10 has been found to correlate with brittle points in vulcanizates based on polymers of similar type.

4.4 In general, the retraction rate is believed to correlate with low-temperature flexibility of both crystallizable and noncrystallizable rubbers.

5. Apparatus

5.1 *Specimen Rack*, designed to maintain a slight tension on the specimen of 7 to 21 kPa (1 to 3 psi), and to permit it to be stretched and anchored at any elongation desired up to a maximum to 350 %. Means of measuring the length of the specimen at any time during the test within an accuracy of ± 1 mm (± 0.04 in.) shall be provided. The rack may be designed to hold a number of specimens at the same time.

5.2 *Insulated Cooling Bath*, equipped with stirrer, thermometer, and an immersion heater. A rheostat shall be included in the heater circuit. A suitable thermocouple-potentiometer measuring system may be substituted for the thermometer.

5.3 *Temperature Measurement*, may be conducted in one of two ways: (a) a typical glass thermometer with appropriate range and sensitivity ($\pm 1^\circ\text{C}$ ($\pm 2^\circ\text{F}$)); or (b) a more modern thermocouple or resistive element, electronic temperature measuring system, accurate to $\pm 1^\circ\text{C}$.

5.4 *Liquid Coolant*, which does not attack the test specimen under the conditions of the test. Methanol cooled with dry ice is satisfactory for most samples. Gaseous media may be employed as the coolant when the design of the apparatus is such that tests using it will duplicate those obtained with the standard liquid media.

¹ This test method is under the jurisdiction of ASTM Committee D-11 on Rubber and is the direct responsibility of Subcommittee D11.14 on Time and Temperature Dependent Properties.

Current edition approved April 29, 1988. Published June 1988. Originally published as D 1329 – 54T. Last previous edition D 1329 – 86.

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