Designation: D4289 – 21

Standard Test Method for Elastomer Compatibility of Lubricating Greases and Fluids[1]

This standard is issued under the fixed designation D4289; 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 U.S. Department of Defense.

1. Scope*

1.1 This test method evaluates the compatibility of lubricating greases and fluids with coupons cut from standard elastomer sheets (Practice D3182). Compatibility is evaluated by determining the changes in volume and Durometer A hardness that occur when elastomer coupons are totally immersed in a lubricant sample for 70 h or for a duration as required by the lubricant specification at either 100 °C or 150 °C or at a test temperature as required by the lubricant specification.

1.1.1 Some lubricant specifications may require different elastomers or test conditions, such as longer durations or lower or higher temperatures. In such instances, the repeatability and reproducibility values stated in Section 12 do not apply, and the user and supplier should agree on acceptable limits of precision.

NOTE 1—The scope of this test method now includes the evaluation of the elastomer compatibility of both lubricating fluids and greases. Testing of fluids was not included in Test Method D4289–95 and earlier versions.

1.2 This test method can also be used as a guide to evaluate the compatibility of greases with rubber products not in standard sheet form (Practice D3183).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3.1 *Exception*—When listed, Durometer A units shall be regarded as the 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see 8.4 – 8.6.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D217 Test Methods for Cone Penetration of Lubricating Grease

D297 Test Methods for Rubber Products—Chemical Analysis

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D471 Test Method for Rubber Property—Effect of Liquids

D1193 Specification for Reagent Water

D2240 Test Method for Rubber Property—Durometer Hardness

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

D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4950 Classification and Specification for Automotive Service Greases

2.2 *Federal Standards:*[3]

Federal Test Method Standard 791C, Method 3603.5, Swelling of Synthetic Rubbers

2.3 *U.S. Air Force Specifications:*[4]

USAF-539 Specification Bulletin for Standard Elastomer Stocks

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.G0.01 on Chemical and General Laboratory Tests.

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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] Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[4] USAF-539 is obsolete, but reproductions have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1165.

***A Summary of Changes section appears at the end of this standard**

2.4 *SAE Standards:*[5]

AMS 3217A Standard Elastomer Stocks—Test Slabs

AMS 3217/2C Test Slabs, Acrylonitrile Butadiene (NBR-L)—Low Acrylonitrile, 65–75

AMS 3217/3B Test Slabs, Chloroprene (CR)—65–75

NOTE 2—USAF-539 was specified in Test Method D4289–94 and earlier versions. This specification is obsolete and has been replaced by SAE Standard AMS 3217A. USAF-539 NBR-L was replaced by SAE AMS 3217/2C (NBR-L), which is virtually identical. USAF-539 CR has been replaced by the similar, but not identical, SAE AMS 3217/3B (CR). Elastomer sheets prepared to this latter specification are not known or expected to provide test results identical with those of the USAF-539 counterpart.

NOTE 3—With respect to elastomer AMS 3217/2A, the elastomer specification was superseded by AMS 3217/2B. Per SAE, the elastomers are identical, however, the synthetic lubricant immersion fluid used to reference the elastomer has been exchanged from ARM-200 to AMS 3021. Reference fluid AMS 3021 better represents current market aviation fluids.

NOTE 4—With respect to elastomer AMS 3217/2B, the elastomer is no longer being made by the original supplier and has been superseded by AMS 3217/2C. Limited testing of the new material compared with AMS 3217/2B material appears to show no bias but more in-depth evaluation is impossible due to lack of the older material.

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175.

3.1.2 *elastomer, n*—a natural or synthetic polymer having the rubber-like property of substantially recovering its size and shape after removal of a deforming force.

3.1.3 *hardness, n—of an elastomer*, the resistance to deformation or indentation.

3.1.3.1 *Discussion*—In this test method the hardness of an elastomer is measured with a Shore Durometer A (see Test Method D2240).

3.1.4 *lubricant, n*—any material interposed between two surfaces that reduces the friction or wear, or both, between them. **D4175**

3.1.5 *lubricating grease, n*—a semifluid to solid product of a dispersion of a thickener in a liquid lubricant.

3.1.5.1 *Discussion*—The dispersion of the thickener forms a two-phase system and immobilizes the liquid lubricant by surface tension and other physical forces. Other ingredients imparting special properties are often included. **D217**

3.1.6 *relative density, n*—the ratio of the density of a material at temperature, t_1, to the density of water at a reference temperature, t_2.

3.1.6.1 *Discussion*—In this test method relative density is determined with the temperature of the elastomer and water being equal and within the range from 20 °C to 25 °C, and the temperature correction for the density of water is not applied. The term, *relative density*, replaces the synonymous, deprecated term, *specific gravity*, used in some earlier editions of this test method.

3.1.7 *thickener, n—in a lubricating grease*, a substance composed of finely divided particles dispersed in a liquid lubricant to form the product's structure.

3.1.7.1 *Discussion*—The thickener can be fibers (such as various metallic soaps) or plates or spheres (such as certain non-soap thickeners) which are insoluble or, at most, only very slightly soluble in the liquid lubricant. The general requirements are that the solid particles be extremely small, uniformly dispersed, and capable of forming a relatively stable, gel-like structure with the liquid lubricant. **D217**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *coupon, n*—a test piece of specified dimensions cut from standard elastomer sheets. **D3182**

3.3 *Symbols:*

3.3.1 Symbols used in the calculation of hardness change (see Eq 1 in 10.1):

ΔH = hardness change, Durometer A units,
H_i = initial hardness, Durometer A units,
H_f = final hardness, Durometer A units.

3.3.2 Symbols used in the calculation of relative density (see Eq 2 in 10.2) and volume change (see Eq 3 in 10.3):

RD = relative density,
ΔV = volume change, %,
$M1$ = initial mass of coupon in air, g,
$M2$ = initial mass of coupon and hanger wire in water less mass of hanger wire partially submerged in water, g,
$M3$ = final mass of coupon in air, g,
$M4$ = final mass of coupon and hanger wire in water less mass of hanger wire partially submerged in water, g.

4. Summary of Test Method

4.1 This test method provides procedures for exposing test specimens to the influence of lubricating greases and fluids under defined conditions of temperature and time as required by the lubricant specification. The resulting deterioration is determined by measuring the changes in physical properties, such as hardness, and changes in volume, before and after immersion in the test lubricant.

5. Significance and Use

5.1 Measurement of the changes in the volume and hardness of an elastomer that occur from immersion in a lubricating grease or fluid provides a means for evaluating relative compatibility. Much of this test method was derived from procedures described in Test Method D471 and Federal Test Method 791C/3603.5. In contrast to these two test methods, which emphasize the evaluation of rubber and rubber-like compounds, Test Method D4289 was developed specifically to evaluate lubricating greases and fluids, especially those used in automotive applications, although the test method can be applied to lubricants used in industrial applications as well. Excepting the Shore Durometer A, this test method requires no specialized, rubber-testing equipment. Virtually all other equipment and supplies specified in the procedure are stock items in lubricants laboratories.

5.2 The volume and hardness-change values determined by this test method do not duplicate similar changes that occur in

[5] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.