



Designation: D471 – 16a (Reapproved 2021)

Standard Test Method for Rubber Property—Effect of Liquids¹

This standard is issued under the fixed designation D471; 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 covers the required procedures to evaluate the comparative ability of rubber and rubber-like compositions to withstand the effect of liquids. It is designed for testing: (1) specimens of vulcanized rubber cut from standard sheets (see Practice D3182), (2) specimens cut from fabric coated with vulcanized rubber (see Test Methods D751), or (3) finished articles of commerce (see Practice D3183). This test method is not applicable to the testing of cellular rubbers, porous compositions, and compressed sheet packing, except as described in 12.2.2.

1.2 Periodically, it is necessary to produce a new lot of an IRM oil to replace the dwindling supply of the current product. The Chairman of the subcommittee shall have the authority to approve the production of a replacement lot. Once produced, the technical data of the new lot shall be presented, in a comparative fashion, to that of the existing lot and balloted upon by the membership of the D11.15 subcommittee and, either subsequently or concurrently, balloted upon by the membership of the D11 main committee for approval to release the new lot for distribution.

1.3 In the event that an IRM oil becomes unavailable for distribution due to depletion, the Chairman of the subcommittee shall have the authority to approve production of a new lot and, after a meeting of the task group, regularly scheduled, or not, to release a quantity of the product for distribution sufficient enough only to address a backlog. Once the backlog is addressed, the process described in 1.2 shall be followed.

1.4 ASTM Oils No. 2 and No. 3, formerly used in this test method as standard test liquids, are no longer commercially available and in 1993 were replaced with IRM 902 and IRM 903, respectively (see Appendix X1 for details).

1.5 ASTM No. 1 Oil, previously used in this test method as a standard test liquid, is no longer commercially available and

in 2005 was replaced with IRM 901; refer to Table 1 and Appendix X3 for details.

1.6 ASTM No. 5 Oil was accepted into Specification D5900 as an industry reference material in 2010 and designated as IRM 905. The composition, and properties of this immersion oil were not changed and the data in Table 1 remains current. Refer to Appendix X4 for other details.

1.7 The specifications and properties listed in Table 1 for IRM 901, IRM 902, IRM 903, and IRM 905 are also maintained in Specification D5900.

1.7.1 The subcommittee responsible for maintaining Test Method D471, presently D11.15, shall review the data in Specification D5900 to ensure that it is identical to that which appears in Test Method D471. This shall be accomplished at the time of the 5 year review or more frequently when necessary.

1.8 Historical, technical, and background information regarding the conversion from ASTM No. 1, ASTM No. 2, and ASTM No. 3 Oils to IRM 901, IRM 902, and IRM 903 immersion oils is maintained in Practice D5964.

1.8.1 The subcommittee responsible for maintaining Test Method D471, presently D11.15, shall review the data in Practice D5964 to ensure that it is identical to that which appears in Test Method D471. This shall be accomplished at the time of the 5 year review or more frequently when necessary.

1.9 This test method includes the following:

Change in Mass (after immersion)	Section 11
Change in Volume (after immersion)	Section 12
Dimensional-Change Method for Water-Insoluble Liquids and Mixed Liquids	Section 13
Change in Mass with Liquid on One Surface Only	Section 14
Determining Mass of Soluble Matter Extracted by the Liquid	Section 15
Change in Tensile Strength, Elongation and Hardness (after immersion)	Section 16
Change in Breaking Resistance, Burst Strength, Tear Strength and Adhesion for Coated Fabrics	Section 17
Calculation (of test results)	Section 18

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

1.11 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.15 on Degradation Tests.

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TABLE 1 Specifications and Typical Properties of IRM Reference Oils

Property	IRM 901 ^A	IRM 902	IRM 903	IRM 905	ASTM Method
<i>Specified Properties:</i>					
Aniline Point, °C (°F)	124 ± 1 (255 ± 2)	93 ± 3 (199 ± 5)	70 ± 1 (158 ± 2)	115 ± 1 (239 ± 2)	D611
Kinematic Viscosity (mm ² /s [cSt])					
38°C (100°F)		...	31.9–34.1	...	D445
99°C (210°F)	18.12–20.34	19.2–21.5	...	10.8–11.9	D445
Gravity, API, 16°C (60°F)	28.8 ± 1	19.0–21.0	21.0–23.0	...	D287
Viscosity-Gravity Constant	0.790–0.805	0.860–0.870	0.875–0.885	...	D2501
Flash Point COC, °C (°F)	243(469) min	232 (450) min	163 (325) min	243 (469) min	D92
Naphthenics, C _N (%)	27 (avg)	35 min	40 min	...	D2140
Paraffinics, C _P (%)	65 min	50 max	45 max	...	D2140
<i>Typical Properties:</i>					
Pour Point, °C (°F)	–12 (10)	–15 (5)	–42.8 (–45)	–15 (5)	D97
ASTM Color	L 3.5	L 2.0	L 0.5	L 1.0	D1500
Refractive Index	1.4848	1.5083	1.5004	1.4808	D1747
UV Absorbance, 260 nm	0.8	1.43	1.43	...	D2008
Aromatics, C _A (%)	3	10	12	4	D2140

^A Refer to [Appendix X3. Table X3.1](#) reflects the differences in the properties between ASTM No. 1 Oil and IRM 901 for reference purposes.

TABLE 2 IRM 901 – 2012 Batch Test Results

Property	Method	2005 Batch COA	2005 Batch Current	2012 Sample Data				2012 Batch Average
Viscosity, cSt @ 99°C	D445	19.58	19.5	18.8 18.8	18.7 18.8	18.8 18.9	18.7 18.7	18.8
Gravity, API @ 16°C	D287	28.6	28.9	28.9 28.9	28.9 28.9	28.8 28.9	28.9 28.9	28.9
Flash Point COC, °C	D92	287	313	306 299	289 303	292 294	288 294	296
Aniline Point, °C	D611	123.8	124.7	124.8 124.8	124.8 124.8	124.7 124.9	124.3 124.6	124.5
Viscosity-Gravity Constant	D2501	0.796	0.798	0.799 0.799	0.799 0.799	0.800 0.799	0.799 0.799	0.799
Naphthenics, C _N %	D2140	—	24	26 26	26 26	27 27	28 29	27
Paraffinics, C _P %	D2140	70	72	71 71	71 71	69 71	70 70	71

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.

1.12 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

D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester

D97 Test Method for Pour Point of Petroleum Products

D287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

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.