



Standard Test Methods for Fluid Resistance of Gasket Materials¹

This standard is issued under the fixed designation F146; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope

1.1 These test methods cover the determination of the effect on physical properties of nonmetallic gasketing materials after immersion in test fluids. The types of materials covered are Type 1, Type 2, Type 3, and Type 7 as described in Classification [F104](#). These test methods are not applicable to the testing of vulcanized rubber, a procedure that is described in Test Method [D471](#). It is designed for testing specimens cut from gasketing materials or from finished articles of commerce. These test methods may also be used as a pre-treatment for Multi-Layer Steel, MLS, or Metal Layer Gasket materials adherence testing per Test Method [D3359](#). The pre-treatment of MLS or Metal Layer Gasket materials pertains only as a pre-cursor to the adherence test. Other physical property tests described in this standard are not applicable to MLS or Metal Layer Gasket materials.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are for information only.

1.3 Refer to the current Material Safety Data Sheet (MSDS) and any precautionary labeling provided by the supplier of any materials referred to in these test methods.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

[D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension](#)

¹ These test methods are under the jurisdiction of ASTM Committee [F03](#) on Gaskets and are the direct responsibility of Subcommittee [F03.40](#) on Chemical Test Methods.

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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.

[D471 Test Method for Rubber Property—Effect of Liquids](#)
[D3359 Test Methods for Measuring Adhesion by Tape Test](#)
[E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)
[F36 Test Method for Compressibility and Recovery of Gasket Materials](#)
[F104 Classification System for Nonmetallic Gasket Materials](#)
[F147 Test Method for Flexibility of Non-Metallic Gasket Materials](#)
[F152 Test Methods for Tension Testing of Nonmetallic Gasket Materials](#)

3. Summary of Test Methods

3.1 Appropriate test specimens are subjected to complete immersion in test fluids. After immersing the specimens in the various test fluids, the effect on physical properties is expressed as change in tensile strength, compressibility in softened condition, flexibility, volume change, and thickness and weight changes from the original condition.

4. Significance and Use

4.1 These test methods provide a standardized procedure to measure the effect of immersion in specified fluids under definite conditions of time and temperature. The results of these test methods are not intended to give any direct correlation with service conditions in view of the wide variations in temperature and special uses encountered in gasket applications. The specific test fluids and test conditions outlined were selected as typical for purposes of comparing different materials and can be used as a routine test when agreed upon between the purchaser and the manufacturer.

5. Apparatus

5.1 *Circulating-Hot-Air Ovens*, two, capable of maintaining $100 \pm 1^\circ\text{C}$ ($212 \pm 2^\circ\text{F}$) and $149 \pm 2^\circ\text{C}$ ($300 \pm 3.6^\circ\text{F}$), or aluminum block fitted for use with test tubes, or heating mantle, capable of maintaining $100 \pm 1^\circ\text{C}$ ($212 \pm 2^\circ\text{F}$).

5.2 *Desiccator*, containing anhydrous calcium chloride or silica gel.

5.3 *Analytical Balance*.

TABLE 1 Loads and Pressure

Type	Total Load on Presser Foot (Reference)		Load on Sample	
	N	oz	kPa	psi
1 ^A	2.50	9.0	79.3 ± 6.9	11.5 ± 1.0
2	1.11	4.0	35 ± 6.9	5.1 ± 1.0
3	1.75	6.3	55 ± 6.9	8.0 ± 1.0

^AMaterials of Type 1 and Type 7 that exhibit a minimum thickness increase of 35 % in IRM 903 shall be tested after immersion in any fluid by using a total load on the pressure foot of 0.83 N (3.0 oz) which becomes 26.4 ± 6.9-kPa (3.8 ± 1.0-psi) load on the sample.

5.4 *Thickness Gage*, actuated by dead load weights, having dial graduations of 0.02 mm (0.001 in.) with anvil not less than presser foot diameter of 6.4 ± 0.127 mm (0.252 ± 0.005 in.). Dead weight loads are listed in **Table 1**.

5.5 *Cutting Dies*, appropriate for cutting steel, with sharp edges free from nicks or burrs, in the following sizes:

5.5.1 25.4 by 50.8 mm (1 by 2 in.),

5.5.2 28.6-mm (1.126-in.) diameter, 645.2-mm² (1-in.²) area circular die,

5.5.3 Test Methods **D412**, Die A, 12.7-mm (0.500-in.) width, and

5.5.4 12.7 by 152.4 mm (0.50 by 6 in.).

5.6 *Conditioned Cabinet or Room*, maintained at 21 to 29°C (70 to 85°F) and from 50 to 55 % relative humidity.

5.7 *Test Tubes*, with 38-mm (1.50-in.) outside diameters and 305-mm (12-in.) overall lengths,³ fitted with aluminum foil-covered compressible stoppers.

5.8 *Immersion Containers*, of configuration required to accommodate specimen sizes.

5.9 *Boiling Flask with Reflux Condenser*, of configuration required to accordance specimen sizes.

5.10 *Light-Metal Wire Screens*, sized to fit within immersion containers (5.8).

5.11 *Watchglass or Ground-Glass Tared Weighing Bottle*.

5.12 *Immersion Fluids*—ASTM Oil No. 1⁴ (IRM 901),⁵ IRM 903,⁶ ASTM Fuel B, distilled water, ethylene glycol, propylene glycol, and other test fluids as needed.

³ Suitable test tubes of this size were obtained from Edwin H. Benz Co., 703 Maplehurst Rd., Providence, RI 02908-5398 and are available from most scientific supply houses.

⁴ ASTM Oil No. 1 was available from Penreco, 4426 E. Washington Blvd., Los Angeles, CA 90028; ASTM Fuel A and ASTM Fuel B are available from Chevron Phillips Co., 10001 Six Pines Drive, The Woodlands, TX 77380. Refer to Test Method **D471** for further information regarding immersion test fluids.

⁵ ASTM Oil No. 1 was used for original interlaboratory testing and has since been replaced with IRM 901 as approved by ASTM Committee D04-11. Users may continue to use ASTM Oil No. 1 but should be aware that IRM 901 from R.E. Carrol, Inc., P.O. Box 5806, Trenton, NJ 08638 is the commercially available replacement going forward.

⁶ IRM 903 is available from R. E. Carrol, Inc., P. O. Box 5806, Trenton, NJ 08638. The user should be aware that results may differ. ASTM Oil No. 3 is no longer commercially available due to potential health risks associated with its use. IRM 903 has been approved by Committee D-11 as a replacement for ASTM Oil No. 3.

TABLE 2 Properties, Characteristics and Test Methods

Type of Material	Physical Property	Fluid ⁶	Test Duration, h	Temperature, °C (°F)
1, 7	Compressibility	IRM 903	5	149 (300)
	Tensile strength	IRM 903	5	149 (300)
	Thickness increase	ASTM Fuel B	5	21 to 29 (70 to 85)
	Weight increase	IRM 903	5	149 (300)
2	Flexibility	ASTM Oil No. 1 (IRM 901)	70	100 (212)
	Volume change	ASTM Oil No. 1 (IRM 901)	70	100 (212)
	Volume change	IRM 903	70	100 (212)
	Volume change	ASTM Fuel B	22	21 to 29 (70 to 85)
3	Weight change	ASTM Fuel B	22	21 to 29 (70 to 85)
		IRM 903	22	21 to 29 (70 to 85)
		distilled water	22	21 to 29 (70 to 85)
	Thickness increase	ASTM Fuel B	22	21 to 29 (70 to 85)
		IRM 903	22	21 to 29 (70 to 85)
		distilled water	22	21 to 29 (70 to 85)

5.13 *Absorbent Paper*, rapid qualitative-type or similar absorptive texture.⁷

6. Test Specimens

6.1 Specimens to be tested shall be cleanly die-cut so as to be flat, clean, and free of projecting fibers, fillers, particulates, etc.

6.1.1 Specimens for immersion in liquids for change in thickness, weight, or volume shall be single-ply with 25.4 by 50.8-mm (1 by 2-in.) dimensions or 28.6-mm (1.126-in.) diameter disks.

6.1.2 Specimens for loss of tensile strength in test fluids shall be of Die A or alternative as permitted in Test Methods **F152**.

6.1.3 Specimens for compressibility measurement after immersion in test fluids shall be 645.2 mm² (1 in.²) in circular square-inch disks plied in number in accordance with Test Method **F36**.

6.1.4 Specimens for flexibility after immersion in test fluids shall be 12.7 by 152.4 mm (0.5 by 6 in.) by single thickness.

7. Temperature of Test Measurement

7.1 Conduct all measurements on test specimens that are set at a temperature of 21 to 29°C (70 to 85°F).

8. Conditioning

8.1 Prior to testing, the user should condition specimens as specified in Classification **F104**.

9. Procedure

9.1 Conduct tests in accordance with **Table 2** or otherwise agreed upon between the producer and the user. These test methods are applicable to ethylene glycol, propylene glycol, commercial coolants and blends with water thereof (see **Note 1**), distilled water, and other commercial oils and fuels. The

⁷ Whatman Filter Paper No. 4 has demonstrated proper absorptive character for oils and is recommended to obtain repeatable results.