Standard Test Methods for Sealability of Gasket Materials[1]

This standard is issued under the fixed designation F37; 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 These test methods provide a means of evaluating the sealing properties of sheet and solid form-in-place gasket materials at room temperature. Test Method A is restricted to liquid leakage measurements, whereas Test Method B may be used for both liquid and gas leakage measurements.

1.2 These test methods are suitable for evaluating the sealing characteristics of a gasket material under different compressive flange loads. The test method may be used as an acceptance test when the producer and user have agreed to specific test conditions for the following parameters: test medium, internal pressure on medium, and flange load on gasket specimens.

1.3 These test methods use a small-diameter narrow-width gasket as the test specimen under relatively low gasket loads and relatively low pressures. Test Method F2378 is another sealability test method that uses a larger gasket specimen and higher internal pressures and flange loads.

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

1.5 *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.* (For specific hazard or warning statements, or both, see 5.2.11, Section 6, 6.3, 8.2.4, 11.3.2, and 11.4.2.)

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D471 Test Method for Rubber Property—Effect of Liquids

D2000 Classification System for Rubber Products in Automotive Applications

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F38 Test Methods for Creep Relaxation of a Gasket Material

F104 Classification System for Nonmetallic Gasket Materials

F2378 Test Method for Sealability of Sheet, Composite, and Solid Form-in-Place Gasket Materials

2.2 *ANSI Standard:*[3]

B57.1 Compressed Gas Cylinder Valve Outlet and Inlet Connections

2.3 *ASTM Adjuncts:*

Leakage Test Fixtures[4]

3. Summary of Test Methods

3.1 Both test methods utilize a test specimen compressed between the surfaces of two smooth steel flange faces. After the specified flange load is applied, the test medium is introduced into the center of the annular gasket compressed between the flanges and the specified pressure is applied to the medium. For liquid sealability tests (Test Methods A and B), Reference Fuel A (see Test Method D471, Motor Fuel Section of Annex) is recommended and the leakage rate is measured by a change in the level of a sight-glass located in the line upstream from the gasket testing fixture. Nitrogen is the recommended gas for the gas sealability test (Test Method B) and the leakage rate is measured by a change in the level of a water manometer located in the line upstream from the gasket testing fixture.

3.1.1 Test Method A uses a test fixture (Fig. 1) by which an external load is transferred into the fixture to produce a compressive force on the gasket specimen.

3.1.2 Test Method B uses a test fixture (Fig. 2 and Fig. 3) in which the flanges are held within a four-bolt cage that permits loading the flanges at various force levels. The flange load is measured by a transducer held within the cage.

[1] These test methods are under the jurisdiction of ASTM Committee F03 on Gaskets and are the direct responsibility of Subcommittee F03.10 on Composite Gaskets.

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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 American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

[4] Available from ASTM International Headquarters. Order Adjunct No. ADJF0037. Original adjunct produced in 1962.

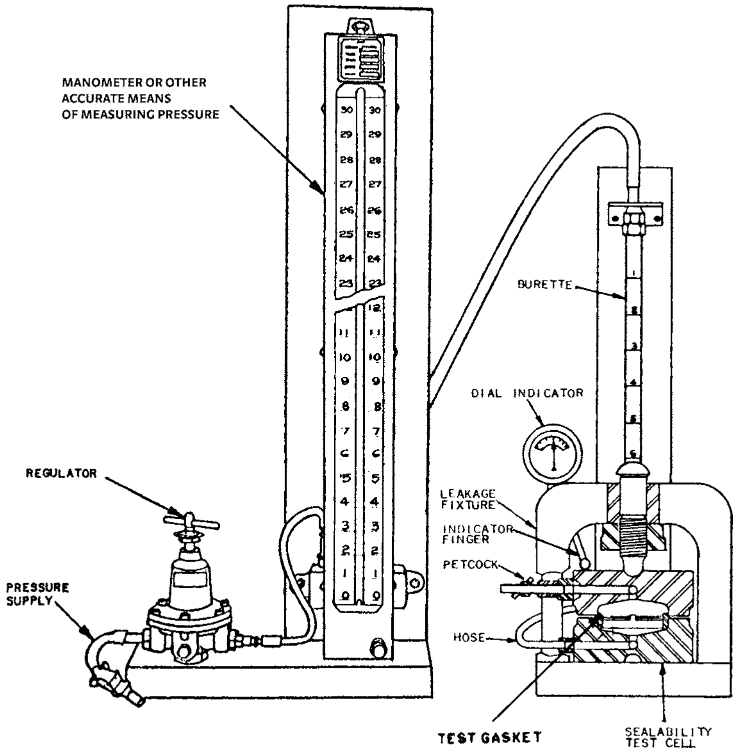

FIG. 1 Test Assembly for Determining Sealability of Gasket Materials by Liquid Leakage Measurements—Test Method A

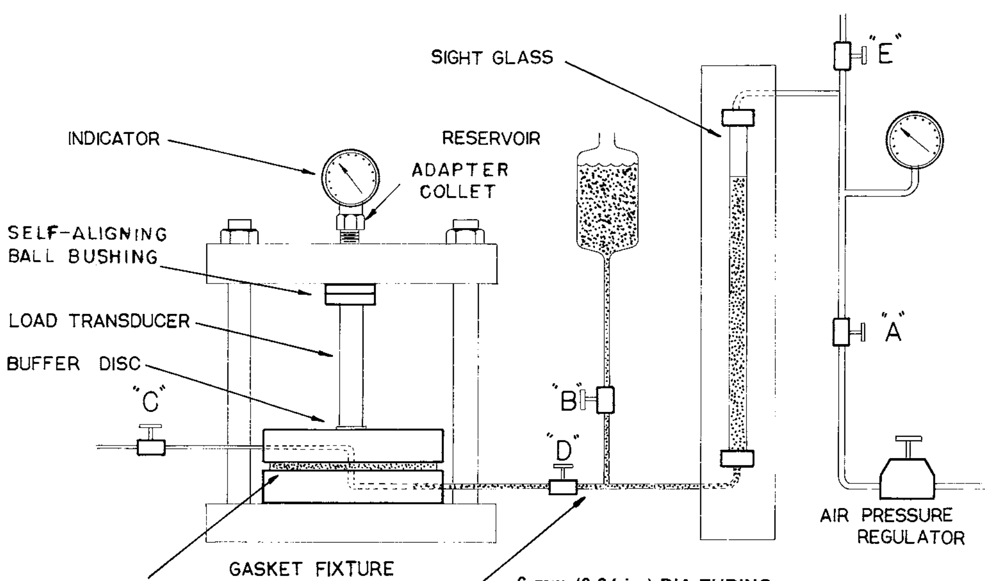

FIG. 2 Test Assembly for Determining Sealability of Gasket Materials by Liquid Leakage Measurements—Test Method B

3.2 Results of the sealability tests are expressed as a leakage rate in millilitres per hour for the test specimen under the specific conditions of the test.

4. Significance and Use

4.1 These test methods are designed to compare gasket materials under controlled conditions and to provide a precise measure of leakage rate.

4.2 These test methods are suitable for measuring leakage rates as high as 6 L/h and as low as 0.3 mL/h. In many cases, "zero" leakage may not be attainable.

4.3 These test methods evaluate leakage rates after time periods that are typically 5 to 30 min under load. Holding a gasket material under load for extended time periods may give different results.

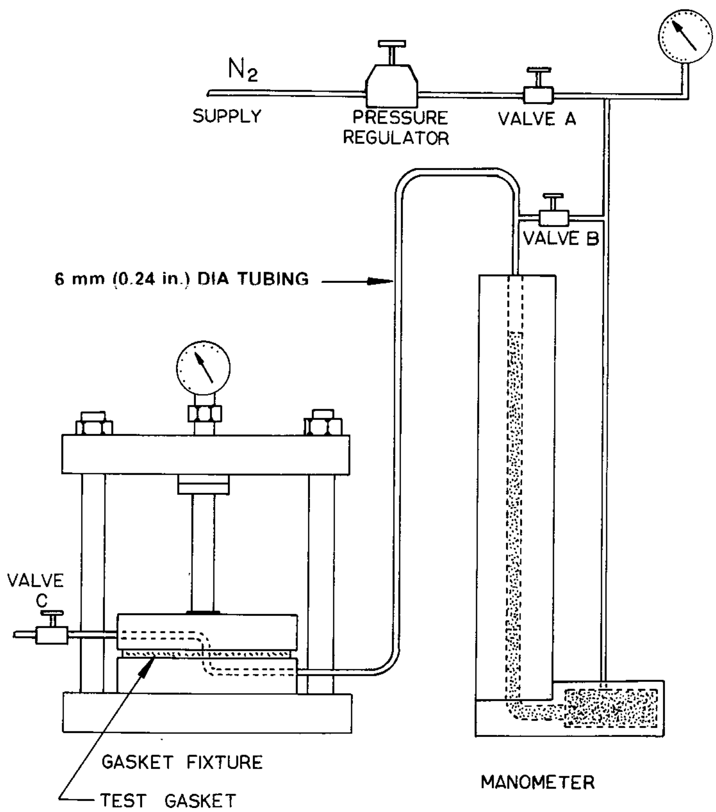

FIG. 3 Test Assembly for Determining Sealability of Gasket Materials by Gas Leakage Measurements—Test Method B

4.4 If the fluid being used in the test causes changes, such as swelling, in the gasket material, then unpredictable results may be obtained.

5. Apparatus

5.1 *Test Method A:*

5.1.1 *Compressed Air Supply and Regulator*—A source of compressed air with a suitable regulator to control the pressure at a point between 0 and 101.4 kPa (14.7 psi).

5.1.2 *Manometer or Pressure Gauge*—A 101.4-kPa (14.7-psi) manometer or suitable pressure gauge to read the pressure to the nearest 0.67 kPa (0.1 psi).

5.1.3 *Buret,* 10-mL capacity, graduated in 0.05 mL, with a connection at each end for flexible hose.

5.1.4 *Leakage Test Fixture,* including a suitable dial indicator graduated in 0.025 mm (0.001 in.) and mounted as shown in Fig. 1. (See 2.3.)

5.1.5 *Petcock,* inserted in the upper flange to bleed air from the fixture.

5.1.6 *Hose,* flexible, suitable to withstand the pressure and liquid specified for the test being run. Piping the system with rigid copper or stainless steel tubing may result in less variation during testing.

5.1.7 *Loading Device*—A suitable means of applying an accurate external load to the leakage test fixture and of maintaining the load within ±1.0 %. Loading shall range from a minimum of 862 kPa (125 psi) to a maximum of 27.6 MPa (4000 psi).

5.2 *Test Method B:*

5.2.1 *Nitrogen Supply Cylinder and Pressure Regulator*—A cylinder of dry nitrogen with a suitable regulator to control the outlet pressure.

5.2.2 *Pressure Gauge,* suitable for measuring 690-kPa (100-psig) pressure precisely. A114-mm (4.5-in.) diameter Bourdon-type gauge with scale calibrated in 3.4-kPa (0.5-psig) graduations is recommended.[5,6]

5.2.3 *Test Fixture Cage,* consisting of top and bottom platens and four threaded studs with nuts, in accordance with Fig. 2 and Fig. 3.[6,7] Orient the fixture cage base horizontally and use a bubble level on the cage top platen to improve alignment of the top and bottom platen during compression of the gasket.

5.2.4 *Test Fixture Flanges,* an upper and a lower, that support the gasket being tested. The surface finish shall be 0.41 to 0.82 µm (16 to 32 µin.) Ra.

5.2.5 *Load Transducer Assembly,* consisting of a calibrated load transducer, the diameter of which is dependent upon the load range desired (Note 1); an indicator rod that projects up

[5] The sole source of supply of the apparatus (1900 Series, 200 psi pressure range) known to the committee at this time is U.S. Gauge Division, PO Box 152, Sellersville, PA 18960.

[6] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[7] The sole source of supply of the apparatus known to the committee at this time is Metal Samples Co., Inc., Route 1, PO Box 152, Munford, AL 36268.

the center of the transducer; a self-aligning ball bushing[6,8] that fits on the load transducer; and a precision dial indicator (50 mm (2 in.) in diameter and a total range of 0.152 mm (0.006 in.), with scale divisions of 0.013 mm (0.0005 in.))[6,9] for measuring the deflection of the transducer.

NOTE 1—Load transducers of various sizes will provide different load ranges. A transducer with a shaft diameter of 8.10 mm (0.319 in.) will deflect 0.025 mm/4.45 kN (0.001 in./1000 lbf). A transducer with a shaft diameter of 11.0 mm (0.433 in.) will deflect 0.025 mm/8.90 kN (0.001 in./2000 lbf). A deflection of 0.076 mm (0.003 in.) should not be exceeded, or damage to the test fixture may result.

5.2.6 *Steel Buffer Disk*—This disk of annealed steel prevents the hardened-steel transducer from damaging the top of the flange.

5.2.7 *Adapter Collet*—The adapter collet is used to attach the dial indicator to the threaded end of the load transducer. When attached properly, the indicating member on the load transducer contacts the actuating button on the dial indicator.

NOTE 2—Depending on the exact equipment used, sometimes the adapter collet used in Test Methods F38, Test Method B, can be used with this fixture.

5.2.8 *Manometer*—A standard Meriam-type 101.4-kPa (14.7-psi) manometer suitable for use with water and suitable for 2.07-MPa (300-psig) pressure. The scale shall be calibrated with 1.0-mm (0.04-in.) graduations.

5.2.9 *Sight Glass and Reservoir*—The liquid testing procedure requires a liquid reservoir that may be any metal container of approximately 1500-cm^3 (100-in.^{3}) capacity that can be piped into the system and conveniently filled. A sight-glass made from 2.07-MPa (300-psig) boiler-gauge glass tubing is used for observing the fluid level. A piece of 16-mm (0.625-in.) outside diameter glass tubing approximately 280- mm (11-in.) long has proven satisfactory. This glass gauge shall be assembled with appropriate fittings and a stand. The scale used with the gauge shall be calibrated with 1.0-mm (0.04-in.) graduations. If desired, the manometer described in 5.2.8 can be used as a sight-glass (see 9.2).

5.2.10 *Tubing, Fittings, and Valves*—Suitable high-pressure flexible tubing and either flare or compression adapter fittings may be used. Piping the system with rigid copper or stainless steel tubing may result in less variation during testing. Small hand valves shall be used where indicated. The tubing connecting the manometer or sight-glass to the test fixture shall be of small bore to reduce the internal volume. Capillary tubing with a 1.6-mm (0.0625-in.) inside diameter is suggested.

5.2.11 *Laboratory Stress-Strain Equipment*—Suitable tension equipment with calibrated load cell to produce and measure a force required for a given deflection of the transducer tube. The tension equipment shall have an accuracy of ±5 % of the load value read. (**Warning—**The maximum force that can be safely applied to the equipment is 44.48 kN (10 000 lb).)

5.2.12 Prepare some type of holding fixture to hold the bottom platen of the test fixture cage when the nuts at the top are tightened.

6. Hazards

6.1 Normal safety practices required for operating pressure equipment shall be observed by the personnel conducting the tests.

6.2 A suitably mounted, transparent safety shield shall be used as a barrier between the operator and the pressurized glass tubing.

6.3 All components of the system must be designed to safely accommodate a maximum working pressure of 1.03 MPa (150 psig), in order to satisfy the requirements of the user and ensure the safety of the operator. (**Warning—**The maximum force that can be safely applied to the equipment is 44.48 kN (10 000 lb).)

6.4 Care shall be exercised to ensure proper support of nitrogen gas cylinders and pressure regulators used for operating pressure control in accordance with ANSI Standard B57.1. Full details are also included in the *Handbook of Compressed Gases.*[10]

7. Test Specimens

7.1 *Preparation of Test Specimens for Test Method A:*

7.1.1 When sheet gasket material (see Classification F104) is to be tested, test specimens shall be die-cut so that the edges are flat, clean, and free of burrs. If necessary the test specimens shall be flattened to remove any rollover of the specimen edges generated during die cutting. The size shall be 32.26 to 32.31 mm (1.270 to 1.272 in.) in inside diameter and 44.20 to 44.32 mm (1.740 to 1.745 in.) in outside diameter. The thickness shall be approximately 0.76 mm (0.030 in.) unless otherwise agreed upon between the producer and user. The assumed average area of this test specimen is 719.35 mm^2 (1.115 in.^{2}).

7.1.2 For reporting purposes, measure the thickness of the gasket test specimens with a micrometer in accordance with Classification F104.

7.1.3 The test specimens shall be inspected and rejected for surface irregularities, such as scratches, tears, and clumps of fibers.

7.2 *Preparation of Test Specimens for Test Method B:*

7.2.1 *Sheet Gasket Material (see Classification F104):*

7.2.1.1 Test specimens shall be die-cut so that the edges are flat, clean, and free of burrs. If necessary the test specimens shall be flattened to remove any rollover of the specimen edges generated during die cutting. They shall be of circular construction having concentric inside and outside diameters such that they fit the sealability test cell. The thickness shall be approximately 0.76 mm (0.030 in.) unless otherwise agreed upon between the producer and user.

7.2.1.2 For reporting purposes, measure the thickness of the gasket specimens with a micrometer in accordance with Classification F104.

[8] The sole source of supply of the apparatus (Model 6SF10) known to the committee at this time is The Timken Company (Torrington Company), 1835 Dueber Ave. SW, Canton, OH 44706-0932.

[9] The sole source of supply of the apparatus (No. 25209) known to the committee at this time is The L.S. Starrett Company, Athol, MA.

[10] Available from the Compressed Gas Association, Inc., 500 Fifth Ave., New York, NY 10110.

7.2.2 *Types 4 and 5 Form-In-Place Gasket Material (see Classification F104)*—A 122-mm (4.8-in.) long piece of standard size material, between 4.76 and 6.35-mm (0.1875 and 0.250-in.) nominal size or width, shall be formed into a circle of 38-mm (1.5-in.) mean diameter. The ends of the Type 4 material shall be so laid as to have a 6.35 ± 1.59-mm (0.25 ± 0.0625-in.) overlap to complete the seal. The Type 5 material shall have an overlap of 1.59 ± 0.79 mm (0.0625 ± 0.0313 in.) to complete the seal.

7.2.3 The test specimens shall be inspected, and surface irregularities such as scratches and tears shall be cause for rejection.

8. Preparation of Apparatus

8.1 *Test Method A:*

8.1.1 Prior to running any tests, check the setup for leaks. For Test Method A, this is accomplished by inserting in the fixture a rubber gasket cut from an approximately 3.2-mm (0.12-in.) thick rubber compound conforming to Grade BG 515 in accordance with Classification D2000. Adjust the external flange pressure to 862 kPa (125 psi) and the internal pressure of the test liquid to 101.4 kPa (14.7 psi). The system shall be free of leaks when held for 15 min under these conditions.

8.2 *Test Method B:*

8.2.1 Maintain a light film of oil on the various parts of the apparatus, including the cage nuts and washers, and the transducer self-aligning ball bushing.

8.2.2 Clean the exposed surfaces of the top and bottom flanges of the test fixture so that all residue from previous tests is removed. Before each test, inspect the flange for nicks or scratches.

8.2.3 By trial and error, determine the best fit for the studs and the top and bottom platens. Once the optimum assembly has been established, mark the studs and top and bottom platens, and maintain them in the same relationship to each other.

8.2.4 Assemble the equipment and connect the appropriate tubing and valves in accordance with Fig. 2 and Fig. 3. Construct the sight-glass and reservoir shown in Fig. 2 as one assembly. Then, in use, either this assembly or the manometer may be inserted into the line leading from the pressure gauge to the gasket test fixture. In most instances, it will be simpler and more convenient to use the assemblies in accordance with Fig. 2 and Fig. 3. However, if desired, the piping can be modified so that both the liquid and gas tests can be run using one manometer assembled with the appropriate piping. (**Warning—**The maximum force that can be safely applied to the equipment is 44.48 kN (10 000 lb).)

8.2.5 For Test Method B, check the setup for leakage as follows: Disconnect the line leading to the gasket test fixture and plug it. This will permit running an initial leak test on the valves, manometer, and tubing section of the equipment by pressurizing only them. Then, assemble the equipment in the normal manner, and run a final leak test using a rubber gasket cut from an approximately 3.2-mm (0.12-in.) thick rubber compound conforming to Grade BG 515 in accordance with Classification D2000 and a flange load in excess of 6.984 MPa (1000 psi). This condition should give essentially no leakage (less than 0.005 mL/min). Run the equipment leakage check for several hours so that a highly precise leakage measurement can be obtained in subsequent measurements.

9. Calibration of Equipment—Test Method B

9.1 Calibrate the transducer assembly using appropriate laboratory stress-strain equipment to measure the amount of force required for a given deflection of the transducer tube. Obtain various test points throughout the anticipated range of use of the transducer. In most cases, the performance of the transducer is such that one calibration value for the stress-strain relationship can be used throughout the entire range. For example, an 8.10-mm (0.319-in.) diameter transducer tube will have a calibration factor of approximately 4.45 kN/0.025 mm (1000 lb load/0.001 in.) of deflection.

9.2 Calibrate the manometer with water. First, fill the well completely with water and plug the connection. Note the manometer reading and then add additional water to the manometer tube at the top from a laboratory buret. The amount of water required for a given change in reading on the manometer can be established by the precise measurement available from the laboratory buret. Calibrate the sight-glass in a similar manner.

10. Conditioning

10.1 *Test Methods A and B:*

10.1.1 Condition all types of the test specimens, except Type 4, in an atmosphere of 50 to 55 % relative humidity for 24 h prior to use. If a humidity cabinet with gentle air circulation is not available, then place a tray containing a saturated solution of magnesium nitrate $[Mg(NO_3)_2\ 6H_2O]$ in the conditioning chamber at room temperature to provide the required relative humidity. Remove test specimens from the chamber one at a time, as required, for testing.

10.1.2 Type 4 materials shall not be conditioned.

11. Procedure

11.1 The temperature of the test shall be 21 to 30°C (70 to 85°F) unless otherwise specified. Evaluation of materials at temperatures other than ambient must take note of the many temperature effects on the test media, test fixture, and material under evaluation.

11.2 *Test Method A—Liquid Leakage:*

11.2.1 Install the test specimen in the leakage test fixture.

11.2.2 Place the assembled test fixture in the device for applying the external load, and apply the prescribed load gradually within 20 s. Maintain this load for 1 min.

NOTE 3—Proper seating between the load pin and test cell can be ensured by rotating the test cell by hand while hand-tightening the lock nut.

NOTE 4—External pressure on the specimen shall be 3.45 MPa (500 psi) unless otherwise specified by the user of the material being tested. The fixture can be used from approximately 862 kPa (125 psi) to approximately 27.6 MPa (4000 psi).

NOTE 5—Since the upper and lower gasket flanges each have an annular size of 32.89 by 43.69 mm (1.295 by 1.720 in.), the actual gasket flange contact area computes to 645.16 mm^2 (1.0 $in.^2$). Therefore, when equating external flange pressure, actual contact area should be used and not specimen surface area.

11.2.3 Set the dial indicator at 0.00 mm (0.000 in.) and tighten the knurled nut in the test fixture to maintain this zero reading within ±0.013 mm (±0.0005 in.) as the external load is removed.

11.2.4 Place the loaded test cell and fixture in the buret stand (Fig. 1). With the bleeder valve on the test cell slightly open, fill the buret tube with the Reference Fuel A and bleed the air from the system.

11.2.5 After 3 min from the lockup in 11.2.3, which includes the time required for the step described in 11.2.4, apply the specified pressure to the test liquid (Note 6). The variation in pressure during the test shall not exceed ±5 mm (±0.2 in.) of the manometer reading. Check for leaks at all connections.

NOTE 6—The internal pressure on the test liquid shall be 101.4 kPa (14.7 psi) unless otherwise specified by the user of the material being tested.

11.2.6 After the pressure has been applied to the test liquid for 5 min and no leakage has been detected at any of the connecting joints in the system, read the buret and record the liquid level to the nearest 0.01 mL; label this as the initial reading. Continue to read and record the liquid level at time intervals until an insignificant change (0.05 mL) in readings is obtained. Then calculate the average volume change for the last three successive time intervals and the average leakage rate in millilitres per hour.

11.3 *Test Method B—Liquid Leakage:*

11.3.1 Place the test specimen centrally on the bottom flange. Set the top flange in place, using caution to line it up with the bottom flange. Position the flanges centrally in the cage assembly. Assemble the transducer, self-aligning ball bushing, adapter collet, and dial indicator. Mount this assembly on the top platen and set the top platen in place on the four studs. Insert the steel buffer disk between the transducer and the top flange. Zero the reading of the dial indicator.

11.3.2 Establish the transducer deflection required to produce the compressive force necessary for the test being conducted. A flange load of 3.45 MPa (500 psi) shall be used unless otherwise specified by the user. Tighten the nuts while maintaining the top platen in a horizontal position and the transducer in a vertical position. The self-aligning ball bushing will compensate for small variations in orientation. Tighten the nuts in a clockwise direction. Try to apply about half the load on the first round of tightening and the remaining load on the second or third round of tightening. Tightening the nuts must be completed within a maximum time of 1 min. Tap the bottom platen lightly to make sure an accurate reading is obtained on the dial indicator. (**Warning—**Once a given flange load has been applied, do not loosen the nuts to obtain a lower load value.)

11.3.3 With the sight-glass filled with Reference Fuel A and Valves B and E closed (Fig. 2), open Valves A, D, and C. The supply pressure shall be from an air line or nitrogen cylinder. An internal pressure on the test liquid shall be 101.4 kPa (14.7 psi) unless otherwise specified by the user of the material being tested. Permit the fluid to fill the cavity inside the test fixture while bleeding air out through Valve C. Bleed a small amount of fluid out through Valve C, and then close this valve. Refill the sight-glass as required by closing Valves A and D and bleeding the pressure out of the sight-glass by opening Valve E. With this valve open, open Valve B, permitting fluid from the reservoir to flow into the sight-glass. After the desired level is attained, close Valves B and E, and open Valves A and D.

11.3.4 After supplying the liquid pressure to the gasket, wait 2 min. Begin the leakage rate measurement by noting the change in level of the sight-glass using a suitable timer with a precision of 1 s. The time period chosen should be suitable for the desired degree of measurement precision for the leakage rate obtained. Suggested time periods for various leak rates are given in Table 1. Make a series of leak rate measurements until the leakage rate becomes constant to the desired degree. Due to the greater time required for liquid to penetrate the pores of the gasket, the leak rate will change for a much longer period of time when running liquid leakage tests than when running gas leakage tests. With very low leak rates, several hours may be required to attain a constant leakage rate. Unless otherwise specified, it is recommended that low leak rates be measured after a period of 30 min to 1 h.

11.3.5 When a test is complete, close Valves A and D. Open Valves E and C to release the pressure within the system. Then disassemble the test fixture and remove the gasket specimen.

11.3.6 Evaluate at least three specimens to obtain the proper precision.

11.4 *Test Method B—Gas Leakage:*

11.4.1 Place the test specimen centrally on the bottom flange. Set the top flange in place, using caution to line it up with the bottom flange. Position the flanges centrally in the cage assembly. Assemble the transducer, self-aligning ball bushing, adapter collet, and dial indicator. Mount this assembly on the top platen and set the top platen in place on the four studs. Insert the steel buffer disk between the transducer and the top flange. Zero the reading of the dial indicator.

11.4.2 Establish the transducer deflection required to produce the compressive force necessary for the test being conducted. The flange load shall be agreed upon between the producer and the user with said flange load included in the report. If the flange load is not specified, 20.7 MPa (3000 psi) shall be used and reported. Tighten the nuts while maintaining the top platen in a horizontal position and the transducer in a vertical position. The self-aligning ball bushing will compensate for small variations in orientation. Tighten the nuts in a clockwise direction. Try to apply about half the load on the first round of tightening and the remaining load on the second or third round of tightening. Tightening the nuts must be completed within a maximum time of 1 min. Tap the bottom platen lightly to make sure an accurate reading is obtained on the dial

TABLE 1 Duration of Gas Leakage Test

Leak Rate, mL/min	Time Period, min
Over 15	0.2
1–15	1
0.2–1.0	3
0.05–0.2	10
0.01–0.05	30
0.005–0.01	60

indicator. (**Warning—**Once a given flange load has been applied, do not loosen the nuts to obtain a lower load value.)

11.4.3 With Valve B open and Valve C closed, open Valve A and adjust the gas pressure to the desired level of internal pressure. The internal gas pressure shall be 206.9 kPa (30 psi) unless otherwise specified by the user of the material being tested. The pressure regulator shall be adjusted carefully so that the pressure is held as close to the desired level as possible. Wait 2 min for the relaxation of the gasket and the leakage rate conditions to come to equilibrium. Then close Valve B and measure the leakage rate by noting the change in level of the manometer using a suitable timer with a precision of 1 s.

11.4.4 Measure the leak rate for three time periods and record the leak rate results. To obtain the best accuracy within the limitations of the equipment, the time period of the test should be varied according to the leak rate, as suggested in Table 1.

12. Calculation

12.1 *Test Method A*—Convert the average differences for the last three successive time intervals to a leakage rate expressed in millilitres per hour.

12.2 *Test Method B*—Obtain the leakage rate by multiplying the recorded change in readings on the sight-glass or manometer scale by the calibration factor to obtain the millilitres leaked. This leakage amount divided by the time interval in minutes gives the leakage rate expressed in millilitres per minute, which should be converted to and reported in millilitres per hour.

13. Report

13.1 Report the following information:

13.1.1 Identification of the sample material, including thickness.

13.1.2 Test Method used: A or B.

13.1.3 Medium used for test and internal pressure exerted upon it.

13.1.4 Number of specimens tested at each respective flange pressure.

13.1.5 Leakage rates measured at respective stated flange pressure.

13.1.6 Average leakage rate in mL/h for all specimens tested with one set of conditions.

TABLE 2 Precision Data (Reproducibility) for Test Method A

Material	Compressive Force, MPa (psi)	Mean, mL/h	Standard Deviation
A	2.8 (400)	32.20	10.60
B	2.1 (300)	2.49	2.68
C	6.3 (900)	47.70	28.20
D	3.4 (500)	2.30	1.80
E	10.3 (1500)	2.00	1.30

13.1.7 The test report shall also include the ambient temperature and the duration of the leakage test.

14. Precision and Bias[11]

14.1 *Precision for Test Method A—Liquid Leakage:*

14.1.1 *Reproducibility for Test Method A:*

14.1.1.1 The inherent variability (estimated standard deviation), *s*, for Test Method A as established by interlaboratory testing is given in Table 2 for the conditions cited using Reference Fuel A and a pressure of 0.103 MPa (15 psi).

14.1.1.2 The averages of *n* determinations on a single lot of material as determined by two laboratories may be considered to be in agreement unless the averages differ by more than 2 mL/h, or as agreed upon between the producer and user.

14.2 *Precision for Test Method B—Liquid and Gas Leakage:*

14.2.1 *Reproducibility for Test Method B*—Table 3 shows the between-laboratory precision data obtained in a three-member interlaboratory test based on a single material at three levels of flange pressure using Reference Fuel A and dry nitrogen gas at 0.21-MPa (30-psi) internal pressure. These data were calculated in accordance with Practice E691.

14.3 *Bias*—Since there is no accepted reference material suitable for determining the bias of the procedures in Test Methods F37 for measuring sealability of gasket materials, no statement on bias is available.

15. Keywords

15.1 flange; fluid; gas; gasket materials; leakage; manometer; pressure; sealability

[11] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F03-1007.

TABLE 3 Precision Data (Reproducibility) for Test Method B

Compressive Force		Mean, mL/h	Within Laboratory Standard Deviation	Between Laboratory Standard Deviation	Coefficient of Variation	
MPa	psi				Within Laboratory	Between Laboratory
		Material A—Nitrogen Gas				
4.4	600	0.687	0.04	0.14	9.5	22.6
6.9	1000	0.273	0.07	0.11	15.3	42.8
17.2	2500	0.0449	0.0082	0.233	18.3	55.0
		Reference Fuel A				
4.4	600	0.00848	0.0044	0.0040	52.5	70.2
6.9	1000	0.00970	0.0046	0.0071	46.6	86.7
17.2	2500	0.00301	0.0008	0.0042	25.0	137.8
		Material B—Nitrogen Gas				
4.4	600	11.47	0.062	5.69	5.4	49.9
6.9	1000	6.49	1.87	3.11	28.8	55.9
17.2	2500	2.24	0.78	0.98	34.9	56.0
		Reference Fuel A				
4.4	600	0.169	0.0321	0.0298	19.0	26.0
6.9	1000	0.122	0.0158	0.0320	12.9	29.1
17.2	2500	0.030	0.0065	0.0127	21.9	47.9