BUREAU OF INDIAN STANDARDS

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भारतीय मानक **मसौदा**

गैसकेट सामग्री के लिए सील योग्य परीक्षण की विधि

(आई एस 7714 का *प्रथम पुनरीक्षण*)

DRAFT *Indian Standard*

METHOD OF SEALABILITY TEST FOR GASKET MATERIALS

(*First Revision* of IS 7714)

ICS 83.140.50

Gasket and Packing Sectional Committee, MED 30	**Last date for receipt of comments: 10 Feb 2025**

FOREWORD
(*Formal clause will be added later*)

This standard was first published in 1975. This standard has been brought out to keep pace with the latest technological developments and international practices. Also, in this revision, the standard has been brought into the latest style and format of Indian Standards, and references, wherever applicable have been updated. BIS certification marking clause has been modified to align with the revised *Bureau of Indian Standards Act*, 2016. The following major modifications have been incorporated in this revision of the standard:

a) The scope has been revised; and
b) Separate tests have been specified for liquid and gas leakage measurements.

This revision covers both liquid leakage measurements and gas leakage measurements. The test methods described in this standard is designed to compare measureable leakage rates and sealing properties of various gasketing materials under controlled conditions. It is intended as a measure of leakage through the gaskets or between the gaskets and the flange faces, or through both. Leakages may also be caused by flange warp, surface finish, stress relaxation, etc. Therefore, the results obtained by this test shall be correlated with actual working conditions.

Assistance has been drawn from the following publications:

ASTM F37- 06	Standard test methods for sealability of gasket materials
ASTM F 104	Standard classification system for non-metallic gasket materials
BS 7531: 2006	Specifications for rubber bonded fibre jointings for industrial and aerospace purposes

The composition of the Committee, responsible for the formulation of this standard is given at Annex (*to be added later*).

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT *Indian Standard*

METHOD OF SEALABILITY TEST FOR GASKET MATERIALS

(*First Revision*)

1 SCOPE

1.1 This standard specifies the test methods to evaluate the sealing properties of compressed fibre gasket sheet and solid form-in-place gasket materials at room temperature.

1.2 This standard specifies two test methods as follows:
a) Test method A for liquid leakage measurements; and
b) Test method B for gas leakage measurements.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No./Other Standards	*Title*
IS 2712 : 2024	Gaskets and packings — Compressed asbestos fibre jointing — Specification (*fourth revision*)
IS 4253 (Part 1) : 2008	Cork composition sheets — Specification Part 1 Plain cork sheets (*second revision*)
IS 4253 (Part 2) : 2008	Cork composition sheets — Specification Part 2 Cork and rubber (*second revision*)
IS 5566 : 2024	Vegetable fibre base jointing material — Specification (*first revision*)
IS 5569 : 2024	Cork and cellulose base jointing material — Specification (*first revision*)
ISO 7322 : 2014	Composition cork — Test methods

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Asbestos — Asbestos is a collective name given to naturally occurring fibrous silicate material. The most commonly used is chrysotile fiber.

3.2 Gasket — Deformable material (or combination of materials) intended to be clamped between flanges to prevent leakage of contained fluid.

4 SUMMARY OF TEST METHODS

The test methods, A and B 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 centre of the annular gasket compressed between the flanges and the specified pressure is applied to the medium.

For liquid sealability test as per test method A, iso-octane is recommended as the test medium unless otherwise specified 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. For gas salability test as per test method B, reference nitrogen gas is recommended and this method indicates a measure of gas leakage through the body of the gasket.

5 APPARATUS

5.1 Test Method A

It uses a test fixture (*see* Fig. 1) by which an external load is transferred into the fixture to produce a compressive force on the gasket specimen.

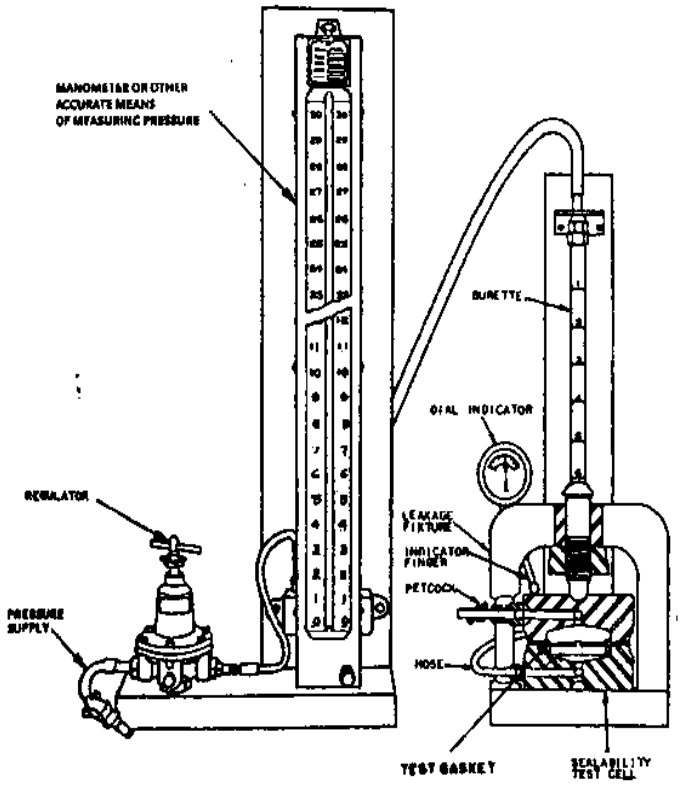


FIG. 1 TEST ASSEMBLY FOR DETERMINING SEALABILITY OF GASKET MATERIALS BY LIQUID LEAKAGE MEASUREMENTS

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).

NOTE — 1 kPa = 0.145 psi

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

5.1.3 *Burette* — 10 ml capacity, graduated in 0.05 ml, with a connection at each end for flexible hose.

5.1.4 *Leakage Test Fixture* — The fixture shall include a suitable dial indicator graduated in 0.025 mm (0.001 in.) and mounted as shown in Fig. 1.

NOTE — 1 mm = 0.039 inch

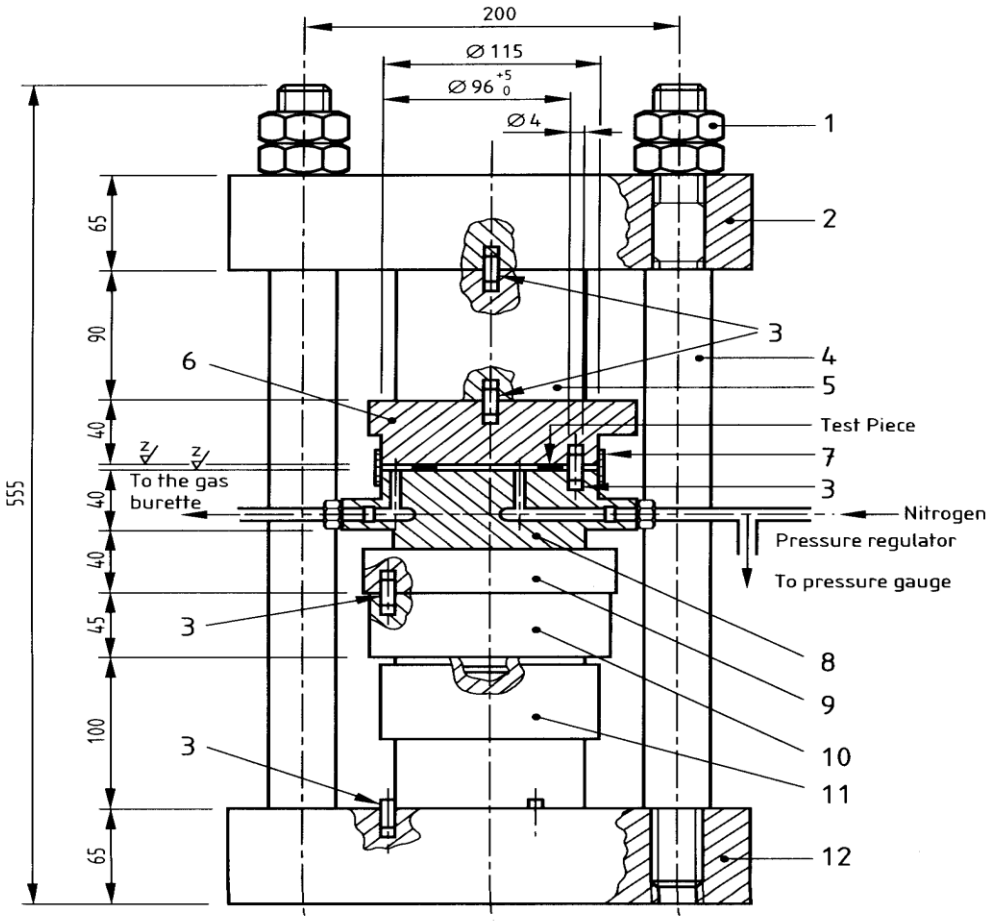
5.1.5 *Petcock* — It is inserted in the upper flange to bleed air from the fixture.

5.1.6 *Hose* — It is 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 percent. Loading shall range from a minimum of 862 kPa (125 psi) to a maximum of 27.6 Mpa (4 000 psi).

5.2 Test Method B

It uses the test apparatus for sealability as given in Fig. 2. All parts including the test piece are centred relative to each other. Suitable measures are taken to ensure that the test piece is uniformly loaded. The surfaces of the two sealing flanges shall be machined so that the mean roughness (R_z) does not exceed 2 mm.



Key

1	Nut	7	Rubber packing
2	Cross piece	8	Flange
3	Parallel pin	9	Dynamomoter with ball joint
4	Pillar	10	Spacer block
5	Space block	11	Hydraulic press
6	Flange	12	Baseplate

All dimensions are in millimetres.

FIG. 2 TYPICAL LAYOUT OF TEST APPARATUS FOR GAS PERMEABILITY

5.1.1 A good device of applying the external load is a tensile machine. If a tensile machine is not available, any other means of applying a known load is satisfactory. This could be by dead weights, lever arms and weights or hydraulic press by applying a designed ram with a compressed air supply and regulator to control the pressure at a point between 0 kg/cm² to 400 kg/cm².

5.2.2 *Pressure Gauge* — 0 kg/cm^2 to 400 kg/cm² or suitable pressure gauge to read the pressure accurate to 0.5 kg/cm².

5.2.3 *Burette* — A 100 ml capacity burette graduated in 1 ml with a PVC pipe connected towards the left outlet of the tube and the top end is sealed and the bottom end is immersed in a beaker half filled with water.

5.2.4 *Leakage Test Fixture* — The fixture shall include suitable holes for inlet and release of the nitrogen gas in the gasket mounted inside the fixture and this gas shall show the leakages in the burette connected to the same in ml.

5.2.5 *Loading Device* — A suitable means of applying an accurate external load to the leakage test fixture and maintaining the load within one percent of its value shall be used as loading device. The specimen shall be loaded uniformly with a stress of 32 MPa.

6 SIGNIFICANCE AND USE

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

6.2 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.

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

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

7 TEST MEDIUM

7.1 Test Method A

Unless otherwise specified, the test medium shall be iso-octane.

7.2 Test Method B

Unless otherwise specified, the test medium shall be nitrogen gas.

8 TEST SPECIMEN

8.1 Test Method A

When sheet gasket material is to be tested, test specimen shall be die cut so that the edges are flat, clean and free of burrs. If necessary, the test specimen shall be flattened to remove any rollover of the specimen edges generated during the cutting. The size shall be 32.26 to 32.31 mm (1.270 in. to 1.272 in.) in inside diameter and 44.20 to 44.32 mm (1.740 in. to 1.745 in.) in outside diameter. The thickness shall be approximately 0.76 (0.030 in.) unless otherwise agreed between the

manufacturer and the user. The assumed average area of the test specimen is 719.35 mm² (1.115 in.).

8.2 Test Method B

The specimen shall be in an annular form with an outside diameter of 89 mm to 90 mm, width of 19 mm to 20 mm and a thickness of 1.35 mm to 1.65 mm.

8.3 For reporting purposes, measure the thickness of the gasket test specimens with a micrometer (*see* **6.1** of ISO 7322). The test specimens shall be inspected and rejected for surface irregularities, such as scratches, tears and clumps of fibers.

9 CONDITIONING

9.1 Before conducting any test, the specimens shall be conditioned in accordance with their material as given in **9.2** to **9.5**. Asbestos or other inorganic fibre gaskets (*see* IS 2712) shall be conditioned in an oven at (100±2) °C for one hour and allowed to cool to (27±2) °C in a desiccator containing anhydrous calcium chloride. Specimens from asbestos paper and millboard gaskets shall be conditioned in an oven for four hours at (100±2) °C and allowed to cool to (27±2) °C.

9.2 Cork, cork and rubber, and cork and cellular rubber gaskets [*see* IS 4253 (Part 1) and IS 4253 (Part 2)] shall be conditioned at least for 46 h in a controlled humidity room or in a closed chamber with gentle circulation of the air at (27±2) °C and (65±5) percent relative humidity.

9.3 Cellulose or other organic fibre gaskets (*see* IS 5566) and cork and cellulose base jointing material (*see* IS 5569) shall be pre-conditioned for 4 hours at (27±2) °C in a closed chamber, containing anhydrous calcium chloride as a desiccant. The air in the chamber shall be circulated by gentle mechanical circulation of air and conditioned for at least 20 hours at (27±2) °C and (65±5) percent relative humidity.

9.4 If a mechanical means of maintaining (65±5) percent relative humidity is not available, a tray containing a saturated solution of reagent grade magnesium nitrate [$Mg(NO_3)2.6H_2O$] shall be placed in the chamber to provide the required relative humidity. In all cases where testing is conducted outside the area of specified humidity, specimens shall be removed from the chamber one at a time as needed.

9.5 Unless otherwise specified, test shall be conducted at room temperature that is (27±2) °C.

10 TEST PREPARATION

Test specimens are stored for atleast 48 h at (50 ± 6) percent relative humidity at (23 ± 2) °C.

10.1 Preparation of the Apparatus

10.1.1 *Test Method A*

Prior to running any tests, check the setup for leaks. For this test, it is accomplished by inserting in the fixture a rubber gasket cut from an approximately 3.2 mm (0.12 inch) thick rubber compound conforming to nitrile butadiene rubber (NBR) polymers, urethanes with swell 40 percent max at 100 ^{o}C, durometer hardness of 50±5 and tensile strength of 15 MPa. 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.

10.1.2 *Test Method B*

Check the setup for leakages as follows:

10.1.2.1 Disconnect the line leading to the gasket test fixture and plug it. This will permit running and initial leak test on the valves, pressure gauge and the tubing section of the equipment by pressurizing only them. Then, assemble the equipment in the normal manner, and fill the burette with water and adjust the level to one of the nos. identified on the burette so that the leakage can be measured. Connect the line while measuring the leakage after 2 h of supply of the gas in the leakage test apparatus.

10.1.2.2 If a mechanical means of maintaining (65 ± 5) percent relative humidity is not available, a tray containing a saturated solution of reagent grade magnesium nitrate [Mg $(NO_3)2.6H_2O$] shall be placed in the chamber to provide the required relative humidity. In all cases where testing is conducted outside the area of specified humidity, specimens shall be removed from the chamber one at a time as needed.

11 TEST PROCEDURE

11.1 Test Method A

11.1.1 Install the test specimen in the leakage test fixture. 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 — 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).

11.1.2 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.

11.1.3 Place the loaded test cell and fixture in the burette stand (Fig. 1) with the bleeder valve on the test cell slightly open, fill the burette tube with the reference iso-octane and bleed the air from the system.

11.1.4 After 3 min from the lockup in **11.1.2**, which includes the time required for the step described in **11.1.3**, apply the specified pressure to the test liquid (*see* **10.1**). 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. 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.

11.1.5 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 burette 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 milliliters per hour.

11.2 Test Method B

11.2.1 Assemble and centre the fixture in the device for loading the specimen.

11.2.2 The specimen shall be removed from the conditioning chamber and assembled in the leakage test fixture. Place a 0.05 mm thick ring of polythene film, of the same dimensions as the specimen on both sides of the specimen. Centre the specimen and film between the compression plates after the plates have been carefully cleaned.

11.2.3 Gradually apply an external load of 32 MPa in 20 s. This load shall be maintained throughout the test.

11.2.4 After 10 min during which time the tightness of the gas leakage measuring device is to be checked, introduce nitrogen gas inside the ring. Ensure the pressure increase is uniform and the final internal pressure is (40 ± 1) bar. Hold the pressure of (40 ± 1) bar for 4 min.

NOTE — 1 bar = 10 000 Pa

11.2.5 The loaded test specimen and the fixture shall be connected to the burette stand available with the bleeder valve on the test specimen. The burette tube shall be filled with water and the air from the system shall be allowed to bleed. After a further 2 h measure the quantity of gas escaping for a period of 10 min.

11.2.6 The liquid level in burette shall be recorded to the nearest 1 ml. This shall be taken as the initial reading. The final reading shall be recorded after two hours for a period of ten minutes. The average difference for three successive readings shall then be calculated for a leakage observed by reduction in the measuring device per 120 min and shall be expressed as ml/min.

12 CALCULATIONS

12.1 Test Method A

The leakage of liquid is calculated as follows:

Convert the average differences for the last three successive time intervals to a leakage rate expressed in ml/h.

12.2 Test Method B

The leakage of gas is calculated as follows:

Leakage observed by reduction in the measuring device per 120 min.

12.3 Retest

If any sample fails to comply with the requirements related to this leakage test for a particular grade, two further samples shall be selected from the same manufacturing run for retesting. If either of the retest samples fails the test, the whole manufacturing run of the material shall be deemed not to comply with the standards.

13 TEST REPORT

The report shall include the following:

a) Type of material tested;
b) Specimen thickness;
c) Average leakage of the three consecutive tests shall be used to determine the average reading;
d) Average leakage in ml/min; and
e) All the specimens tested shall show a leakage rate of ≤ 3 ml/min.