ISO 5636-5 Paper and Board — Determination of Air Permeance and Air Resistance (Medium Range) Gurley Method

Description

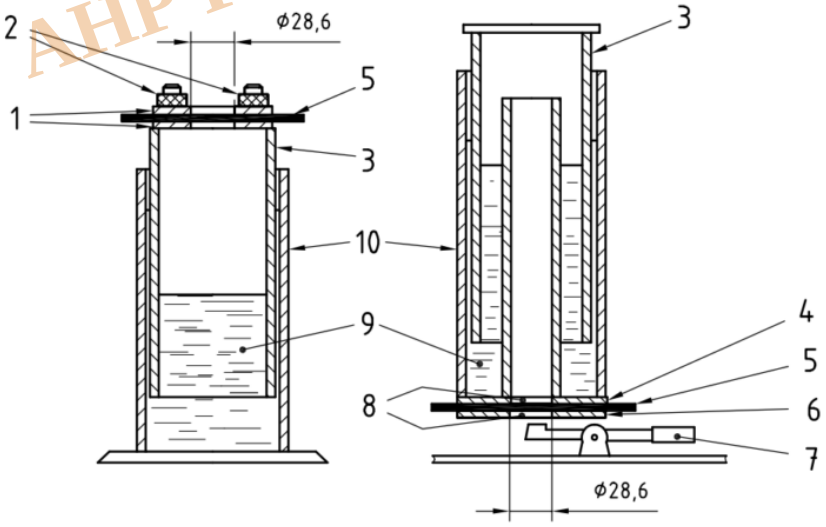
4 Principle

Air is compressed by the weight of a vertical cylinder floating in a liquid. A test piece is in contact with the
compressed air and the cylinder falls steadily as air passes through the test piece. The time for a given volume of air to pass through the test piece is measured and from this the air permeance is calculated.

5 Apparatus and materials

5.1 Air-resistance apparatus (Gurley tester), a diagrammatic sketch of which is shown in Figure 1, consisting of an outer cylinder partly filled with sealing fluid, and an inner cylinder, having an open or closed top, sliding freely in the outer cylinder. Air pressure, provided by the weight of the inner cylinder, is applied to the test piece held between clamping plates in a circular orifice. The clamping plates are at the top if the inner cylinder is open, or at the base of the apparatus if the top of the cylinder is closed. The latter arrangement is preferred (see Annex A). An elastic gasket attached to the clamping plate on the side exposed to the air pressure prevents leakage of air between the surface of the paper and the clamping plate.

Dimensions in millimetres



Key

1	clamping plates and gasket	6	clamping plate
2	knurled nuts	7	loading lever
3	inner cylinder mass 567 g	8	holes for egress of air
4	gasket	9	oil
5	test piece	10	outer cylinder

Figure 1 — Diagrammatic sketch of air-resistance (Gurley) apparatus

The gasket consists of a thin, elastic, oil-resistant, non-oxidizing material, having a smooth surface, a thickness of 0,7 mm to 1,0 mm and a hardness of 50 IRHD to 60 IRHD (International Rubber Hardness Degrees) in accordance with ISO 48. The inside diameter of the gasket is about 28,6 mm and the outside
diameter is about 34,9 mm. The aperture of the gasket is concentrically aligned with the aperture in the clamping plates. To align and protect the gasket in use, it is cemented to a groove machined in the inner
clamping plate. The groove is concentric with the aperture in the opposing plate. Its internal diameter is 28,50 mm ± 0,15 mm and its depth 0,45 mm ± 0,05 mm. Its outside diameter is 35,2 mm ± 0,1 mm for convenience in inserting and attaching the gasket. The gasket when mounted inside the concentric groove defines the measurement area and shall have an inside diameter of 28,6 mm ± 0,1 mm (6,42 cm2 area). The gasket should be changed at regular intervals.
The outer cylinder has a height of 254 mm and an internal diameter of 82,6 mm. The inner surface has three or four bars, not less than 190 mm and not greater than 245,5 mm in length, and 2,4 mm square or 2,4 mm diameter, spaced equidistantly to serve as guides for the inner cylinder.
The inner cylinder is made of aluminium alloy, is graduated in units of 50 ml and has a full-scale reading of at least 300 ml. Some cylinders may have 25 ml graduations between 0 ml and 100 ml markings. The scale markings represent true volumes enclosed within the inner cylinder and, in most instruments, are accurate to within 0,5 %. The exact volume of the inner cylinder may be checked by means of the procedure given in Annex B. The cylinder has a height of 254 mm ± 0,5 mm, an external diameter of 76,2 mm ± 0,5 mm and an internal diameter about 74 mm such that the mass of the cylinder assembly is 567 g ± 0,5 g. The volumes referred to are nominal volumes and should, in principle, be increased by the volume of fluid displaced by the walls of the inner cylinder during the test; in practice, since this error is common to all instruments of this type, it is ignored. For one instrument, the actual volume delivered between the 100 ml and 200 ml marks was measured to be 106 ml.

5.2 Sealing fluid, oil having a density of 860 kg/m3 ± 30 kg/m3 (0,86 g/cm3 ± 0,03 g/cm3), a viscosity of 16 cP to 19 cP at 20 °C in accordance with ISO 3104, and a flash point of at least 135 °C. (The change in
specification of the oil viscosity from that of a kinematic viscosity of 10 mm2/s to 13 mm2/s at 38 °C is based on the typical physical properties of lightweight paraffin oils.)
5.3 Ancillary equipment, stopwatch, or electric timer to be accurate to within 0,5 % at all levels and capable of being read to the nearest 0,2 s.

6 Sampling

Sampling is not included in this International Standard. If the mean quality of a lot is to be determined, sampling shall be in accordance with ISO 186. If the tests are made on another type of sample, make sure
that the test pieces taken are representative of the sample received.

7 Conditioning

Condition the sample in accordance with ISO 187.

8 Preparation of test pieces

One test piece cut from each of ten specimens is normally sufficient (but see 10.3).
Where the clamping plates of the apparatus are at the top of the inner cylinder, a convenient test-piece size is 50 mm × 120 mm; for apparatus having the clamp in the base, a 50 mm square is adequate.

9 Procedure

9.1 Determination
Carry out the test in the same atmospheric conditions as used to condition the sample.
Place the instrument on a level surface so that the cylinders are vertical. Check the oil level in the outer cylinder to make certain it is at a depth of about 120 mm as indicated by a ring marked on the inner surface of the cylinder.
For an instrument having the clamp in the base, raise the inner cylinder until its rim is supported by the catch, clamp the test piece between the clamping plates, release the catch and then lower the inner cylinder until it floats.
For instruments with the clamp in the base; and, for those papers where surface air leakage or leakage through the sheet may be a problem, the clamping force should be controlled to ensure repeatability. The
clamping force should be repeatable and set at a minimum force of 150 N.
For an instrument having the clamp in the top of the inner cylinder, raise the inner cylinder with one hand, clamp the test piece with the other, then lower the inner cylinder and allow it to float in the oil. Alternatively, see hereafter, the inner cylinder may be removed, the test piece clamped, and the inner cylinder lowered gently into the outer cylinder.
NOTE The proper procedure is to tighten the knurled nuts alternately so that the clamping pressure will be the same on both sides. If only one nut at a time is tightened, the clamp will not bear evenly on the test piece and air leakage will probably occur.
If the alternative procedure is used, it should be carried out very carefully to avoid spillage of oil on the test piece, reduction in volume of oil and contamination of the oil.
Once the cylinder attains steady movement, measure the time, in seconds, required for the first two consecutive 50 ml scale markings to pass the rim of the outer cylinder. The time shall be measured with the following precision:

? up to 60 s: to the nearest 0,2 s;
? greater than 60 s: to the nearest 1 s.
For relatively impermeable papers and boards, the reading may be taken at the end of the first 50 ml interval.
With very open or porous papers, a larger volume of air may be timed. If a steady movement of the inner
cylinder is not attained before the zero mark is reached, timing may be started at the 50 ml mark.
If a volume other than 100 ml is measured, calculate the time t based on 100 ml.
It is essential to avoid vibration of the apparatus, as this increases the rate of air displacement.

10 Expression of results
10.1 Calculate the air permeance, to two significant figures, from the formula:

$$P = \frac{135,3}{t}$$

where
P is the air permeance, in micrometres per pascal second;
t is the mean time, in seconds, for the passage of 100 ml of air (as measured on the volume marks on the cylinder).
This formula is based on a mean pressure difference of 1,22 kPa and a test area of 6,42 cm2 and an actual
volume of 106 ml of air passing through the test specimen measured at room pressure.
NOTE Due to the testing principle of this method, the actual pressure in the instrument decreases as the cylinder descents into the oil and the actual volumes passing through the test piece are slightly greater than the scale volumes. In practice, since these errors are common to all instruments of this type, they are ignored.
It should be observed that there is a systematic error of around 6 % when comparisons are made with results achieved by other methods described in ISO 5636-1.
10.2 If the standard deviation is required, calculate this from the replicate time measurements and correct to micrometres per pascal second using the formula in 10.1.
10.3 If the mean air permeances measured on the two sides are significantly different and if this difference is required to be shown in the test report, ten tests are required for each face. The results shall then be reported separately.
10.4 If the air resistance is required, this shall be reported as “Air resistance (Gurley)” in seconds and is the
time, t, obtained in 10.1. Report values to two significant figures.

Air Permeance Tester – Gurley Method

- According to ISO 5636-5
- Graduated column for volume reading
- Stopwatch included
- Sample grip in bottom side

Category

1. Equipment for Standards
2. Standards