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Roughness of paper and paperboard (Print-surf method)

1. Scope

This method measures the roughness of paper and paperboard under conditions intended to simulate the nip pressures and backing substrates found in printing processes. It is applicable to coated and uncoated papers and paperboards which are intended to be printed by contacting printing processes. The measuring principle, that of determining the resistance to flow of air between the test surface and a metal band in contact with it, is similar to that employed in TAPPI Test Method T 538 om-96 “Roughness of Paper and Paperboard (Sheffield Method).” The major difference between this and other air leak methods is that the metal band dimensions, clamp pressures and composition of the measuring nip are all intended to simulate printing process conditions.

2. Summary

The measuring head, which carries a circular metal measuring land surrounded by concentric guard lands is pressed against the specimen, which is supported by a resilient backing surface consisting of lithographic blanket or other material designed to simulate backing materials used in printing processes. Air under pressure is led into the gap between one of the guard lands and the measuring land and the rate of flow between the edge of the measuring land and the specimen is measured.

3. Significance

Surface roughness is a significant factor in determining the printability of papers and paperboards. By measuring roughness under conditions approximating letterpress, litho and gravure printing processes this method yields information relevant to the performance of the product during printing. The results of the test are expressed directly as an average value of roughness in micrometers, which in many cases correlates better with printability than other comparable methods. In some cases, it is possible to relate average roughness to ink film thickness, thus providing guidance on setting printing conditions.

Approved by the Standard Specific Interest Group for this Test Method



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4. Definition

4.1 *Print-surf roughness.* The mean gap between a sheet of paper or board and a flat circular land pressed against it under specified conditions. The mean gap is expressed as the cube root mean cube gap calculated as prescribed in Appendix A.1

4.2 *Print-surf compressibility, K.* The percentage decrease in surface roughness when measurements are made consecutively at two of the standard clamping pressures specified in this method. The surface compressibility, K, can be defined mathematically by the equation:

$$K = 100 (G_1 - G_2)/G_1$$

Where G_1 and G_2 are the surface roughness values obtained at the two clamping pressures, with G_1 being the lower pressure.

5. Apparatus

5.1 *Air supply.* A source of clean air, free of oil and water droplets, at a steady pressure within the range 300 kPa (43 lb/in.²) to 600 kPa (86 lb/in.²). If the instrument is not provided with internal air filters the provision of an external oil mist filter having an effective screening efficiency of 99.99% at 0.5 mm particle size is recommended.

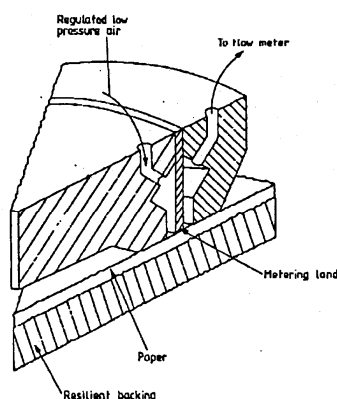


Fig. 1: The sensing head sectioned on two radii.

5.2 *Sensing head.* A circular head of the form shown in Figs. 1 and 2, consisting of steel lands, which have coplanar, polished surfaces. The center or measuring land shall be $51.0 \mu\text{m} \pm 1.5 \mu\text{m}$ wide and have an effective length of $98.0 \pm 0.5 \text{ mm}$. The two guard lands shall each be at least $1000 \mu\text{m}$ wide at any point and the radial distance between them at any point shall be $152 \mu\text{m} \pm 10 \mu\text{m}$. The measuring land shall be centered between them to within $\pm 10 \mu\text{m}$. The lands shall be fixed in an airtight mounting constructed so that air can be passed into the gap between the inner guard land and the measuring land and exhausted from the gap between the measuring land and the outer guard land. A spring loaded protective collar may be fitted outside the guard lands. The measuring head should be readily detachable for cleaning and so should be constructed in such a way that an airtight seal between the head and the air inlet and outlet ports may be easily formed and maintained. In most commercially available instruments the back of the head is ground and lapped to mate with an air manifold.

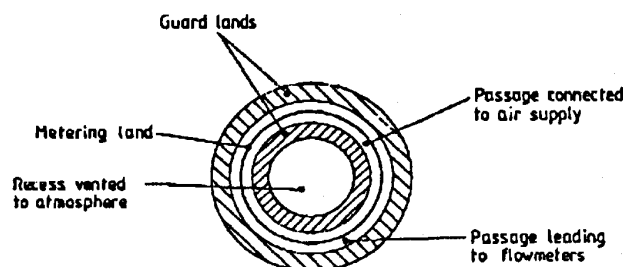


Fig. 2: Plan of the measuring and guard lands of the sensing head.

5.3 *Sensing head air pressure regulator.* The sensing head shall be supplied with air regulated at a known differential pressure. In instruments employing variable area flowmeters and following the original Parker design the differential pressure across the measuring land and flowmeters is specified as 6.2 ± 0.1 kPa or 19.6 ± 0.1 kPa. Later instruments employing electronic flow measurement techniques may require different differential pressure settings and tolerances.

5.4 *Resilient backings.* Two types of resilient backings are normally available for use in pressing the test piece against the sensing head. The backings are in the form of disks, at least $10\text{ }\mu\text{m}$ greater in diameter than the outside diameter of the guard land.

5.4.1 *Soft backing.* Consisting of a rubber offset printing blanket composed of a layer of synthetic rubber at least $600\text{ }\mu\text{m}$ thick, bonded to a fabric backing giving an overall thickness of at least $2000\text{ }\mu\text{m} \pm 200\text{ }\mu\text{m}$. The apparent hardness of the complete backing is 83 ± 6 IRHD (international rubber hardness degrees).

5.4.2 *Hard backing.* A composite consisting of a layer of polyester film bonded at its periphery to cork, offset blanket or similar material. There is a small exhaust hole in the center of the polyester disk to prevent the entrapment of air between the disk and the cork. The apparent hardness of the assembly is 95 ± 2 IRHD.

5.5 *Backing holders.* Rigid disks, each recessed to accommodate a resilient backing disk. The design and construction of the holder must be such that the applied clamping pressure is transmitted to the test piece.

NOTE 1: It has been observed that high stiffness papers and boards can react negatively with the flat metal backing holder and cause erroneously high roughness results. This problem can be solved by using a modified backing holder which relieves those areas of the backing holder not directly below the measuring land, as shown in Fig. 3.

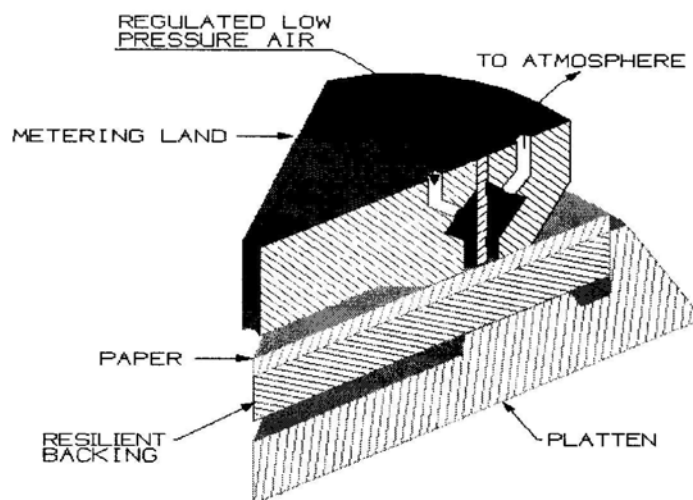


Fig. 3. Modified backing holder.

The resilient backing should be secured to the holder by a suitable means, e.g. double-sided adhesive tape.

5.6 *Clamping mechanism,* allowing clamping of the test piece between the backing and the sensing head during the measurement cycle. The clamping system should allow the selection of either of the following three clamping pressures; 490 ± 30 kPa, 980 ± 30 kPa or 1960 ± 30 kPa.