

CAUTION:

This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Material Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Roughness of paper and paperboard, stylus (Emveco-type) method

1. Scope

1.1 This method measures the surface roughness of paper and paperboard used in contact printing processes. It may not be used for tissue or creped paper and may not be suitable for newsprint that is inspected for visual anomalies which cannot be detected with this equipment. The method is not useful for measuring surface waviness.

1.2 This method uses a stylus to mechanically trace the paper surface which differs from methods that relate the rate of air flow leakage to paper roughness.

2. Summary

A skid containing a free-floating stylus rests on the test specimen backed by a smooth anvil. The skid is weighted to keep the specimen flat and also acts as a surface reference plane for the stylus. The test specimen is fed into a drive unit to advance the paper at a controlled traversing speed. As the paper is advanced beneath the skid, the roughness of the specimen causes vertical displacements of the stylus which are recorded at a prescribed interval. The recorded signal is mathematically analysed in such a way that the impact of waviness is minimized and short-span roughness is emphasized.

3. Significance

For printing considerations it is important to analyze the number and steepness of surface asperities occurring over short spans since these are more difficult to transfer ink into as opposed to the longer span wavy features of the paper surface. This method characterizes the abruptness of the paper surface or roughness occurring over 25-250 μm (0.001–0.010 in.) spans which can impact print quality.

4. Definitions

4.1 *Roughness*. The degree to which the surface texture contains short-span or fine irregularities. Roughness can be superimposed on a wavy surface.

4.2 *Waviness*. The degree to which the surface texture contains long-span irregularities or undulations in surface texture.

4.3 *Skid*. A weighted reference surface that houses the stylus and has a radius much larger than the irregularities being measured. Also referred to as the measuring head.

4.4 *Stylus contact force*. The stylus force, acting perpendicular to the test surface when the skid is loaded on the test piece backed by the anvil.

4.5 *Microdeviation*. The average of the squared difference in point-to-point vertical stylus readings. Sensitive to abrupt changes in the surface topography and less sensitive to gradual changes in surface topography. See Appendix A.1 for a mathematical expression.

4.6 *Microaverage*. The mean difference in point-to-point vertical stylus readings. See Appendix A.1 for a mathematical expression.

4.7 *Sample spacing*. The x-axis (the direction in which the specimen is traversed) distance between successive readings.

4.8 *Traversing speed*. The velocity at which the test specimen is advanced past the stylus tip.

4.9 *Evaluation length*. The x-axis (the direction in which the specimen is traversed) distance over which the specimen is traced by the stylus. Mathematically equal to the product of the sample spacing and the number of samples collected.

5. Apparatus

5.1 *Test instrument*¹ having:

5.1.1 *Displacement transducer*: A displacement transducer with a working range of 0.25 mm (0.010 in.) and a linearity of 0.5 % of full range and a resolution of 0.0003 mm (0.00001 in.).

5.1.2 *Stylus Geometry*. Conical stylus with 60° included angle with flat stylus tip with a diameter of 32 ± 5 micrometers (0.00125 ± 0.0002 in.). The tip of the stylus shall be made of a hard and low-friction material (i.e., diamond) and have a smooth surface.

5.1.3 *Stylus contact force*. A stylus force between 5-10 mN (0.001-0.002 lb_f) acting against the test surface over the entire displacement working range.

5.1.4 *Skid*. A skid with a contact diameter of 50 ± 2 mm (1.97 ± 0.08 in.) and a contact force of 4 ± 1 N (0.9 ± 0.2 lb_f) acting uniformly against the test piece and housing the stylus in the center of the skid. The contact surface acting against the test piece shall be made of hard material (i.e., steel or glass). The skid shall have a surface so flat that all points of the skid are within two parallel planes, 0.05 mm (0.002 in.) apart.

5.1.5 *Backing*. An anvil of equal or larger dimension to act as a backing for the skid. The backing is made of a hard material (i.e., steel or glass) having a surface so flat that all points of the skid are within two parallel planes, 0.05 mm (0.002 in.) apart.

5.1.6 *Drive unit*, for advancing the test piece beneath the stylus with constant traversing speed of 10 ± 1 mm/s (0.4 ± 0.04 in./s). The advance of the test piece must be recorded every 0.25 mm (0.010 in.) with an accuracy of at least 0.025 mm (0.001 in.).

5.1.7 *Display* for calibration purposes showing zero and span and a means of adjusting both.

5.1.8 *Computer Interface and Software* to specify control parameters for sample spacing, number of samples, and traversing speed and to output test metrics.

6. Calibration

6.1 *Calibration* is accomplished with certified shims or step height block within the range of 0.025 - 0.250 mm (0.001 - 0.010 in.) accurate to the nearest 0.0025 mm (0.0001 in.).

6.2 *Zero adjustment*. Place a level shim beneath the skid and lower the skid onto the shim and zero the stylus position to read 0 within 0.001 mm (0.00004 in.). The bottom of the skid is the reference plane (datum) for the stylus. Recheck the zero if a span adjustment is made. The anvil should not be used as the surface to zero the stylus since it can wear over time.

6.3 *Span adjustment*. Insert a shim or step height block beneath the skid. Adjust span to read the shim or step height to the certified thickness within 0.0025 mm (0.0001 in.). Recheck the zero, and then recheck span again if the zero setting is adjusted.

¹Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list, available as part of the CD or printed set of Standards, or on the TAPPI website general Standards page