T 549 om-01

Coefficients of static and kinetic friction of uncoated writing and printing paper by use of the horizontal plane method

1. Scope

1.1 This method describes a horizontal plane procedure for the determination of the coefficient of static and kinetic friction of paper measured when sliding against itself.

1.2 The horizontal instrument requires some means of movement of the specimen in relation to the surface upon which it rests. The coefficient of friction (COF) is measured directly from the resistance to tangential motion and the applied weight pressing two pieces of paper together.

1.3 Static COF relates to the force required to initiate movement between two surfaces while kinetic COF relates to the force required to cause continuation of the movement at uniform speed.

1.4 An inclined plane method is described in TAPPI T 548, "Coefficient of static friction on uncoated writing and printing paper by use of the inclined plane method" which gives similar results for static COF but it cannot be used for the determination of kinetic COF. The choice of approach depends on the equipment available and the means of measurement.

1.5 The determinations of COF for packaging materials are described in TAPPI T 815, "Coefficient of static friction of corrugated and solid fiberboard (inclined plane method)" and TAPPI T 816, "Coefficient of static friction of corrugated and solid fiberboard (horizontal plane method)." The methods differ in that in testing packaging materials, the two specimens are allowed to slip upon one another three times before the force measurement is determined, while in this method the determination is made on the first slip.

2. Applicable documents

2.1 TAPPI Test Methods: TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product;" TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products;" TAPPI T 409 "Machine Direction of Paper and Paperboard;" TAPPI T 455 "Identification of Wire Side of Paper;" TAPPI T 494 "Tensile Breaking Properties of Paper and Paperboard (Using Constant Rate of Elongation Apparatus)."

2.2 ASTM Standard D 3460 "White Watermarked Bond and Unwatermarked Bond, Mimeograph, Duplicator, and Xerographic Cut-Sized Office Papers."

3. Terminology

3.1   *Friction*, the resisting force that arises when a surface of one substance slides, or tends to slide, over an adjoining surface of itself or another substance. Between surfaces of solids in contact there are two kinds of friction: (1) the resistance opposing the force required to start to move one surface over another, and (2) the resistance opposing the force required to continue moving one surface over another at a constant speed.

3.2   *Coefficient of friction* (COF), the ratio of the frictional force resisting movement of the surface being tested to the force applied normal to that surface (the weight of the material above that surface).

3.3   *Coefficient of static or starting friction*, the ratio of the force resisting initial motion of the surfaces, to the normal force.

3.4   *Coefficient of kinetic or sliding friction*, the ratio of the force required to sustain the uniform relative movement of the surfaces, to the normal force.

4. Summary of method

One specimen of the paper sample is clamped to a horizontal plane surface, the other to a specimen sled. The sled is pulled across the surface, or the plane pulled under the stationary sled and the force required to do so is measured. The coefficients of both static and kinetic friction can be determined.

5. Significance and use

5.1   The coefficient of friction of printing and writing papers is an indicator of the ease with which the top or bottom sheets of a stack of paper will slide across the succeeding sheet, such as occurs on the infeed of a printing press or the sheet transport into a copier machine. A minimum value of coefficient of friction is required to prevent double-feeding of any sheets.

5.2   Since each sheet is removed from the stack only once, a single slide of each pair of specimens is performed and the value recorded.

6. Apparatus (Fig. 1)

6.1   *Horizontal plane and supporting base*, a horizontal plane surface of a smooth, incompressible material - metal, hardwood, plate glass or plastic, having a width at least 25 mm (1 in.) wider than the specimen sled (see 6.2). The plane is mounted on a supporting base provided with means of leveling in two directions. A constant rate-of-motion tester, as described in TAPPI T 494, has also been found suitable. If this type of tester is used, the horizontal plane and supporting base are one and the same.