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Standard Test Method for COEFFICIENT OF STATIC FRICTION OF CORRUGATED AND SOLID FIBERBOARD (HORIZONTAL PLANE METHOD)[1]

This standard is issued under the fixed designation D 3247; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the coefficient of static friction of corrugated and solid fiberboard or of the materials used to make such board.

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 is measured directly from the resistance to that force and the applied weight.

1.3 An inclined plane method is described in Test Method D 3248. Either method gives essentially equivalent results. The choice of approach depends on the equipment available and the means of measurement.

1.4 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Applicable Documents

2.1 *ASTM Standards:*

D 585 Method of Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Product[2]

D 685 Method of Conditioning Paper and Paper Products for Testing[2]

D 2534 Test Method for Coefficient of Kinetic Friction for Wax Coatings[3]

D 3248 Test Method for Coefficient of Static Friction of Corrugated and Solid Fiberboard (Inclined Plane Method)[2]

2.2 *Special Technical Publication:*

STP 335 Manual for Conducting an Interlaboratory Study of a Test Method[4]

3. Significance and Use

3.1 The coefficient of friction of corrugated and solid fiberboard indicates how containers made from that board will perform in many critical applications. A high coefficient of friction of one surface of board to itself means that containers having that surface will tend to resist sliding in unit loads. A low coefficient may indicate potential problems with the containers slipping from the load.

3.2 The coefficient of friction test is empirical. It describes the condition of that surface at the moment of test. This may or may not relate to the condition of the surface in use. Nevertheless, the test results are useful in determining the properties of the surface tested. Its condition will depend upon the historical treatment of the surface. Because the previous history is unknown, measurement is not made until the third slide. Experience has shown that variability is greatly reduced after the second slide.

4. Definitions

4.1 *coefficient of friction*—the ratio of the frictional force resisting movement of the surface being tested to the force applied normal to that

[1] This test method is under the jurisdiction of ASTM Committee D-10 on Packaging and is the direct responsibility of Subcommittee D10.17 on Paper and Paperboard Products.

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[2] *Annual Book of ASTM Standards*, Vol 15.09.

[3] *Annual Book of ASTM Standards*, Vol 05.02.

[4] Available from ASTM Headquarters, 1916 Race St., Philadelphia, PA 19103.

surface (the weight of the material above that surface).

4.2 *kinetic coefficient*—the ratio of the force resisting motion of the surface once the motion is in progress.

NOTE 1—Kinetic coefficient is not determined in this method (Appendix XI).

4.3 *static coefficient*—the ratio of the force resisting initial motion of the surface.

5. Apparatus (Fig. 1)

5.1 *Instrument Table*—A horizontal plane surface of a smooth incompressible material (metal, hard wood, plate glass, or plastic), having a width at least 1 in. (25 mm) wider than the test sled (5.2) with means of leveling it in two directions. The base serves as a support for the rest of the mechanism. When placed on a solid support, the instrument must be free of vibration.

5.2 *Sled*, or specimen block, having a bottom area of at least 3 in.^{2} (20 cm^2) smoothly finished to exert a pressure of 0.50 ± 0.25 psi (3.44 ± 1.72 kPa) on the horizontal surface. A sled 2.5 by 2.5 in (62.5 by 62.5 mm) weighing 3 lb (1.36 kg) has been found to be satisfactory. Means are provided for clamping the specimen to the block, also for fastening the sled to the force measuring device.

5.3 *Mechanical Power Unit*—Means for moving the specimen block horizontally along the instrument table or the horizontal table under the specimen block at a speed of 6.0 ± 1.0 in./min. (2.54 ± 0.42 mm/s). This unit must not transmit vibration to the instrument table. The unit is connected to the sled or table with some kind of inelastic linkage.

5.4 *Measuring Device*—Means for measuring the force required to move or restrain the specimen block to the nearest 0.01 lb (5 g).

6. Test Specimens

6.1 From each test unit of a sample obtained in accordance with Method D 585, cut five specimens (see 6.3 for size). Carefully mark each specimen with its machine direction, on a place that will not be the actual test area. For corrugated board this will be perpendicular to the direction of the flutes.

6.2 Cut and orient the specimens as follows:

6.2.1 If the specimens are from a container, carefully cut them from a flap area of the container. It is usually desirable to test a flap area since this is the area that normally comes in contact with the next container in pallet loads.

6.2.2 Paper is anisotropic and the coefficient of friction is particularly so. Care must be taken in making the test to orient the surfaces to each other just as they will be oriented in actual use. Therefore, if the layers of containers are to be alternated in palletization, the coefficient should be measured with one surface MD (machine direction) and the other CD (cross-machine direction).

6.2.3 If it is of interest to know how the container will perform on packaging machinery or be retained by conveyors, floors, shelves, etc., measure the coefficient between a sample of the paperboard and the material from which the conveyor or floor or shelf is made.

6.2.4 If there is no known relationship to use conditions, cut the test specimens so that the measurements will be made with both parts oriented in the CD direction.

6.3 Each specimen consists of two sheets. Cut the smaller sheet to fit the size of the sled allowing for excess material if it is to be clamped. It is suggested that the specimen be scored with a suitable instrument and folded to conform to the sled base. Cut the larger sheet at least 1 in. (25 mm) larger in width than the test surface of the sled, and sufficient in length to fit the horizontal table, also allowing for material to be clamped. For some instruments it may be necessary to separate the outer facing of the board from the medium and inner facing or from the filler in order to clamp onto the sled or block.

NOTE 2—Take care not to touch the test area since skin oils, pencil marks, etc. can affect the test results.

7. Conditioning

7.1 Precondition, condition and test the specimens in an atmosphere in accordance with Method D 685.

7.2 With a clean cloth or tissue lightly wipe the test surface to remove any loose fibers or debris which may be present.

8. Procedure

8.1 Place the instrument upon a solid and vibration-free base or table and level it.

8.2 If necessary, adjust the force gage to zero.

8.3 Place the longer specimen on the table top and clamp the end of the sheet farthest from the measuring device in the sheet clamp.