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Technical Association of Pulp and Paper Industry
Tentative Standard Method T 472m-51

Standard Test Method for RING CRUSH OF PAPERBOARD¹

This Standard is issued under the fixed designation D 1164; 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.

1. Scope

1.1 This method covers the measurement of the resistance of paperboard to edgewise compression. It is intended only for paperboard having a thickness not exceeding 0.036 in. (0.9 mm).

2. Significance

2.1 Corrugated and solid fiberboard containers are subject to crushing forces in shipment. This test is used for two purposes in the evaluation of the paperboard to be used as components of such fiberboard containers: (1) to indicate edgewise rigidity of the board so that manufacturing processes may be controlled to secure the desired results, and (2) to indicate the probable crushing resistance of the finished container.

3. Apparatus

3.1 *Compression Machine*—The apparatus shall consist essentially of a compression testing machine having the following:

3.1.1 An upper and a lower platen, one of which may be fixed and the other removable. The surfaces of the platens shall remain smooth, flat, and parallel to each other within 1 part in 2000 throughout the test and shall be so mounted as not to have more than 0.002 in. (0.05 mm) movement in the horizontal direction,

3.1.2 Means for exerting force on a specimen placed between the two platens. This may be accomplished either by causing the movable platen to approach the fixed platen at a uniform speed or applying a constantly increasing pressure against the movable platen without necessarily causing motion thereof until collapse of specimen. In either case, the

force applied to the specimen shall be developed at a rate equivalent to 25 ± 5 lbf (111 ± 22 N)/s when the platens are in contact,

3.1.3 Means for measuring and indicating the applied load within 1 lbf (4.4 N), and

3.1.4 The machine should have a capacity of not less than 300 lbf (1330 N), and the indicating mechanism should be such that it can be accurately checked with dead-weight loads.

3.2 *Specimen Holder*—At the center of the lower platen of the compression testing machine there shall be positioned a specimen holder comprising a circular block having an annular groove cut square, 0.25 ± 0.01 in. (6.4 ± 0.2 mm) deep and 1.94 ± 0.001 in. (49.3 ± 0.03 mm) in outside diameter. The base of the annular groove shall be parallel with the base of the block to ± 0.0005 in. (0.013 mm). A branch groove running from the annular groove to the edge of the block shall be provided to permit insertion of the specimen. The center "island" created by the annular groove may be made removable and replaceable with disks of different diameters so as to vary the width of the groove to provide for varying specimen thicknesses. The disk used for any particular caliper of board shall be of such a diameter that when placed in the block the resulting groove will have a width not less than 150 nor more than 175 percent of the nominal caliper of the specimen being tested. These disks may be provided with a center pin to fit a receiving hole in the center of the block. The disk is then free to turn as the specimen is inserted through the

¹ This method is under the jurisdiction of ASTM Committee D-6 on Paper and Paper Products.
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branch groove. While this is the preferred design, any specimen holder which provides support to both surfaces of the specimen, permits 0.25 in. (6.4 mm) of the specimen to extend above the surface of the holder, and allows insertion without injury to the specimen, is acceptable.

3.3 Cutting Device—A device capable of accurately cutting the specimen to exact dimensions. The edges of the specimen must be clean and sharp and absolutely parallel. The preferred method of accomplishing this is by means of a punch and die, or, lacking this, a card cutter equipped with an adjustable outside guide. Parallelism of the long edges of the specimen shall be such that the width dimension at the opposite ends shall be within 0.0006 in. (0.015 mm) of each other. The length shall be 6 ± 0.005 in. (152 ± 0.13 mm).

4. Test Specimen

4.1 All test specimens shall be 6 in. (152 mm) long and $\frac{1}{2}$ in. (12.7 mm) wide. Those cut with the long dimension perpendicular to the machine direction of the board shall be designated *MD* specimens; those cut with the long dimension parallel to the machine direction of the board shall be designated *CD* or *OD* specimens. At least ten specimens of each of these two directions shall be cut and tested. In cutting the specimens, care shall be exercised to assure that:

4.1.1 The long edges are parallel such that the width at opposite ends shall be within 0.0006 in. (0.015 mm) of each other,

4.1.2 The ends will just abut, and not overlap or leave a gap when placed in the specimen holder,

4.1.3 The long edges are truly parallel (or perpendicular) to the machine direction of the board, and

4.1.4 The long edges are cut clean without wipe or being torn or frayed in any way by poorly functioning cutting equipment.

5. Conditioning

5.1 The test shall be made in an atmosphere conditioned in accordance with Method D 641, Conditioning Paperboard, Fiberboard, and Paperboard Containers for Testing² and after the specimens have reached equilibrium in the specified atmosphere.

6. Procedure

6.1 Insert each specimen in the specimen holder and position at the center between the two platens. When inserting the specimens in the specimen holder, they shall be alternated in such a manner that half of the specimens are tested with the finished surface of the board on the convex side and half with the finished surface on the concave side of the ring.

6.2 Apply the crushing force to the long edges of the specimen ring until the 0.25-in. (6.4-mm) section projecting above the specimen holder has collapsed. Record the maximum load required to cause this collapse. Test at least ten specimens cut from each principal direction of the board.

7. Report

7.1 Report the average load required to crush the sample, in each direction, in pounds to the nearest pound (or newtons to the nearest newton). State whether the crushing force is developed by means of a constant-speed movable platen or by the application of a constantly increasing pressure to the movable platen.

² Annual Book of ASTM Standards, Part 20.

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