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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.

Ring crush of paperboard (rigid support method)

1. Scope

- 1.1 The ring crush test correlates with edgewise compression strength of paperboard (1,2).
- 1.2 This method is intended for paperboard between 0.28 mm (0.011 in.) and 0.61 mm (0.024 in.) thick. It may be used with less reliability for paperboard as thin as 0.18 mm (0.007 in.) and as thick as 0.76 mm (0.030 in.).

NOTE 1: Caution should be used when testing linerboard less or greater than the specified thickness as the results may be less reliable. For papers thinner than 0.28 mm (0.011 in.), test values may result from a combination of both buckling failure and pure compression. For papers thicker than specified, strain within the sample arising from bending the specimens into a cylinder may impact test results (3,4).

2. Significance

The edgewise compression strength of corrugated board is the principal element in determining the dynamic compression strength of the container made from that board. Fiberboard shipping containers are frequently subjected to loads which are resisted by compression strength, making this property an important measure of the performance characteristics of corrugated board, and useful in controlling the manufacturing process and in measuring the quality of the finished product. Since edgewise compression strength can be estimated by a summation of the ring crush strengths of the liners and medium, this method is useful for the corrugated boxmaker.

3. Summary

A compression force is exerted on a specimen held in ring form in a special sample holder and placed between two platens of a compression machine, by causing the driven platen to approach the rigid platen at a uniform speed until the specimen collapses.

Approved by the Standard Specific Interest Group for this Test Method



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4. Apparatus

4.1 *Compression testing machine*¹ meeting the following requirements:

4.1.1 *Rigid Support Compression Tester*. Two platens, one rigidly supported and the other driven. Each platen shall have a working area of approximately 100 cm² (16 in.²). The platens are to have not more than 0.050 mm (0.002 in.) lateral relative movement, and the rigidly supported platen not more than 0.150 mm (0.006 in.) movement, perpendicular to the surface, within a load range of 0 to 2225 N (0-500 lbf). Within the specimen contact area, each platen shall be flat within 0.0025 mm (0.0001 in.) of the mean platen surface, and the platens shall remain parallel to each other within 1 part in 2000 throughout the test.

4.1.2 A means for moving the driven platen to achieve an initial platen separation of at least 60 mm (2.36 in.). Within a range of platen separation of 0 to 60 mm (0 to 2.36 in.) and within a load range of 0 to 2225 N (0 to 500 lbf), the nominal speed of the driven platen shall be controllable at 12.5 mm ± 0.2 mm (0.50 in. ± 0.008 in.) per minute.

NOTE 2: For convenience, the test machine should be capable of rapid return and automatic, settable positioning.

4.1.3 A capacity of at least 2225 N (500 lbf).

4.1.4 A means of measuring and indicating the maximum load sustained by the test specimen within 2.2 N (0.50 lbf) or 1% error, whichever is greater.

4.1.5 An indicating mechanism that can be checked accurately with dead-weight load, load cell, or proving ring. The accuracy required is 0.5% or 2.2 N (0.5 lbf), whichever is greater.

4.2 *Specimen holder*, having the following characteristics:

4.2.1 The specimen holder will be composed of a circular block having an annular square cut groove, 6.4 ± 0.25 mm (0.25 ± 0.01 in.) deep and 49.3 ± 0.035 mm (1.940 ± 0.001 in.) outside diameter. The bottom of the annular groove is required to be parallel with the base of the block ± 0.01 mm (0.0004 in.), with the sides of the groove at right angles with the base of the block. A branch groove tangent to the annular groove, of the same depth and extending to the edge of the block, is provided to insert the specimen and is not wider than 1.27 mm (0.050 in.) at its entrance to the annular groove.

4.2.2 The center “island” created by the annular groove is removable and replaceable with disks of different diameters so that the width of the groove may be adjusted to be at least 150% but not more than 175% of the nominal caliper of the specimen being tested. Each disk has a central hole to fit a receiving pin central to the annular groove and is free to turn as the specimen is inserted through the branch groove.

4.2.3 Scribe or otherwise mark one point on the perimeter of the annular groove at some distance, at least 12.5 mm (0.5 in.) away from the branch groove. This point will serve as the mark for the ends of the test specimen.

4.3 *Precision die cutter*, capable of accurately cutting the test specimens with clean parallel edges.

5. Sampling

Samples should be selected and gathered in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Products.”

6. Conditioning

Due to possible dimensional changes and the impact of moisture on strength properties, precondition and condition samples prior to cutting test specimens in an atmosphere in accordance with TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp, Handsheets, and Related Products”

7. Preparation of test specimens

7.1 Carefully die-cut test specimens with the felt side (top side) toward the male portion of the die $12.700 + 0.000 - 0.025$ mm ($0.500 + 0.000 - 0.001$ in.) wide, $152.4 + 0.000 - 0.200$ mm ($6.00 + 0.000 - 0.008$ in.) long. Cut so that the long dimension is parallel with the machine direction of the board for CD specimens and the long dimension is

¹ Names 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.