WI 12030803

T 841

DRAFT NO. 3

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WORKING GROUP CHAIRMAN Ben Frank

SUBJECT Fiberboard Shipping
CATEGORY Container Testing

RELATED METHODS See "Additional Information"

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.

Edgewise compressive strength of corrugated fiberboard using the Morris method (short column test) (Proposed withdrawal of T 841 cm-03)

1. Scope

1.1 This method describes procedures for determining the edgewise compressive strength, parallel to the flutes, of a short column of single wall and double wall corrugated fiberboard.

1.2 The method includes procedures for cutting the test specimen (saw cutting and knife cutting), one procedure for specimen support (Morris specimen holder), and two procedures for applying the compressive force (constant strain rate, or constant load rate). Studies have shown that any combination of these procedures will yield similar test results.

2. Significance

2.1 Research has shown that the edgewise compressive strength of specimens with flutes vertical, in combination with the flexural stiffness of the combined board and box dimensions, relates to the top-to-bottom compressive strength of vertically fluted corrugated fiberboard shipping containers (*1*,*2*).

2.2 This method may also be used for comparing the edgewise compressive strength of different lots of similar combined boards or for comparing different material combinations (*3*,*4*). Values are typically 7-15% less than values found using TAPPI T 811.

3. Apparatus[1]

3.1 *Compression testing machine* meeting the requirements of either 3.1.1, or 3.1.2, 3.1.3, 3.1.4, and 3.1.5.

3.1.1 *Rigid support compression tester*, two platens, one rigidly supported and the other driven. Each platen shall have a working area of approximately 100 cm^2 (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 at least 0 to 2224 N (0-500 lbf). Within a 100 cm^2 (16 $in.^2$) working 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 (.0125 mm/25 mm, .0005 in./1.00 in.) throughout the test.

3.1.1.1 Within a range of platen separations necessary to cause compressive failure of the test specimen, and within a load range of at least 0 to 2224 N (0-500 lbf), the speed of the driven platen shall be controllable at 12.5 ± .25 mm (0.49 ± 0.01 in.) per minute. (For convenience, the test machine should be capable of rapid return and automatic, settable positioning).

3.1.2 *Flexible beam compression tester*, two platens, one flexible beam supported and the other driven. Each platen shall have a working area of approximately 100 cm^2 (16 $in.^2$). 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. The platens are required to have not more than 0.05 mm (0.002 in.) lateral relative movement.

3.1.2.1 Within a range of platen separations necessary to cause compressive failure of the specimen, and within a load range of at least 0 to 2224 N (0-500 lbf), the speed of the driven platen shall be controlled so that the rate of force increase (without considering specimen deformation) is 111 ± 22 N/s (25 ± 5 lbf/s).

3.1.3 The driven platen shall be moveable to achieve an initial platen separation of at least 60 mm (2.36 in.).

3.1.4 A capacity of at least 2224 N (500 lbf).

3.1.5 A means for measuring and indicating the maximum load sustained by the test specimen with an accuracy of 0.5% of that load or 2.2 N (0.5 lbf), whichever is greater.

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[1] Names of suppliers of testing equipment and materials for this method may be found on the Test Equipment Suppliers list in the set of TAPPI Test Methods, or may be available from the TAPPI Quality and Standards Department.

3.1.6 A means such as a saw or other device for cutting specimens having clean, parallel and perpendicular edges within the tolerances specified in 6.2 and 6.3. Opposite edges shall be parallel to each other and perpendicular to adjacent edges.

3.1.6.1 *Knife cutter*, single knife device with guides or, a twin-knife device with guides to cut the test pieces according to the specifications in Section 6. The knives must be sharp and arranged in the device so that it/they are at 90° ± 3° to the specimen's surface.

3.1.6.2 *Saw*, circular, equipped with a sharp, no-set (hollow ground or taper ground) saw blade. The saw blade shall be 90° ± 3° to the table supporting the specimen, and have the ability to consistently hold specimen size to ± .8 mm (± .03 in.).

3.2 *Test fixture*, (Figs. 1 and 2) consisting of:

3.2.1 *Specimen holders*, constructed from plexiglass or metal, of suitable size for the compression tester platens, and attached to the upper and lower platens. The critical feature of these holders is the 6.0 ± .25 mm (.24 in. ± .01 in.) thickness of the holding platens tapered with a 50° ± 3° angle face from the top to the bottom of the groove. One side of the groove is fixed, with the other side being on a slide adjustment to handle various caliper dimension combined board grades. The specimen holders are shown in Figs. 1 and 2.

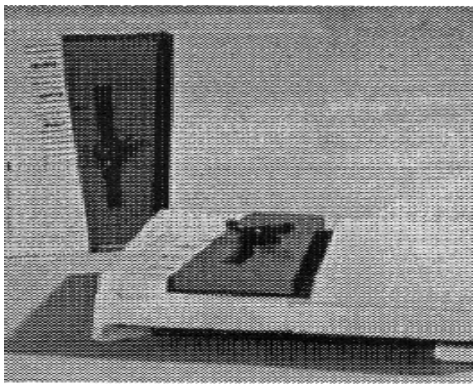

Fig. 1. Specimen holders

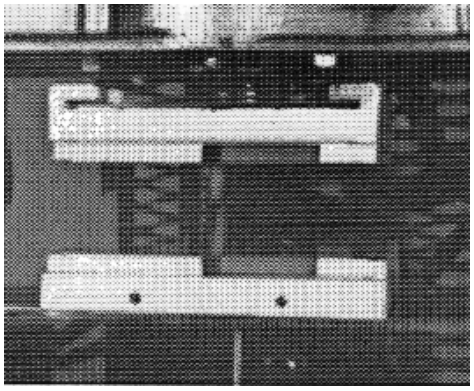

Fig. 2. Specimen holders.

3.2.2 *Groove positioning bar*. A 100 mm x 25 mm x 5 mm (4.0 in. x 1.0 in. x 0.2 in.) machined brass bar or some other means must be used to obtain vertical alignment of the fixed sides and horizontal parallelism of platen grooves when attaching holder jigs to compression tester platens.

4. Sampling

Samples shall be obtained in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product."

5. Conditioning

Precondition and condition the sample in accordance with TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products."

6. Test specimens

6.1 From each test unit accurately cut at least ten specimens (Rule 41 only six specimens are required) with the knife or circular saw to cut clean, parallel, and perpendicular edges. If the test specimens are to be taken from corrugated shipping containers, they should be taken from areas away from scorelines, joints, and closures. Specimens should not be taken from obviously damaged areas and areas not representative of the container as a whole.

6.2 The width edges shall be parallel to each other and perpendicular to the axis of the flutes. Cut specimens to a width of 50.8 ± 0.8 mm (2.00 ± 0.03 in.).

6.3 Specimens to be tested using this procedure shall be cut to a height 50.8 ± 0.8 mm (2.00 ± 0.03 in.) for A, B, and C-flute and for all single and double wall board.

7. Procedure

7.1 Perform all tests in the conditioning atmosphere.

7.2 The rate of platen movement required for a flexible beam compression machine has been determined to be 111 ± 22 N/s (25 ± 5 lbf/s). Record the platen movement rate actually used. On most machines this rate of platen movement will be 13-51 mm (0.5 - 2.0 in.) per minute depending on the load range at the beam.

7.3 The rate of platen movement for each rigid support compression machine should be set to 12.5 ± .25 mm (0.49 ± 0.01 in.) per minute.

7.4 *Adjusting the groove width.* The width of the holder grooves must be set according to the thickness or caliper of the board being tested. Once the width is set for a given sample, all specimens from the same lot are run at this width setting. Ordinarily, successive samples from different lots having the same flute and board combinations can be made at the same setting, but this should be verified for each sample lot. Changes in board construction, fabrication

quality, or holder damage will necessitate resetting the groove width. A properly adjusted width will produce test failure breaks in specimen area between holders rather than the top or bottom edge at or within the thickness of the holder plate. To set the groove width, raise the upper platen until a test specimen can be freely placed vertically between the platens. Adjust the width of the lower groove until the sample is held at approximately mid-depth when resting in the groove under its own weight. Using the slide index scale, adjust the upper groove to the same width as this lower groove.

7.5 *Test sequence*. Adjust the distance between platens, using mechanical limit stop if available, so that the test specimen can be easily inserted into both grooves simultaneously without using force. Center the specimen within the length of the groove. Start the tester and apply force until specimen crush failure occurs. Record the load at failure. Note any unusual failure modes such as liner delamination, adhesive bond failure, etc. A valid test is when one or both liners have buckled in the center portion of the specimen. It is recommended to discard test values on specimens which fail in "bending."

7.6 Record the maximum load (newton or pounds-force), the specimen width, and whether or not the specimen exhibited a valid failure.

8. Report

8.1 For each test unit, report:

8.1.1 Average maximum load per unit width for valid tests calculated from average maximum load from sample lot (10 samples or 6 for Rule 41) and specimen width (kilonewtons per meter or pounds-force per in.).

8.1.2 Standard deviation among valid determinations (kilonewtons per meter or pounds-force per in.).

8.1.3 Number of valid test determinations.

8.1.4 A description of material tested.

8.1.5 A statement that the test was conducted in compliance with this test method and a description of any deviations.

9. Precision

9.1 For the maximum expected difference between two test results, each of which is the average of 10 test determinations.

Repeatability (within a laboratory) = 5%.

Reproducibility (between laboratories) = unknown.

In accordance with the definitions of these terms in TAPPI T 1200 "Interlaboratory Evaluation of Test Methods to Determine TAPPI Repeatability and Reproducibility."

9.2 Reproducibility is not known as data is only available or obtainable from one converter lab.

10. Keywords

Corrugated boards, Edge crush resistance

11. Additional information

11.1 Effective date of issue: to be assigned.

11.2 This method is to provide a routine control procedure for measuring edgewise compressive strength of corrugated fiberboard.

11.3 The combined board edge compression strength is a function of the edge compression strength of the linerboard and medium materials plus a structural component resulting from the fabricating process. In contrast to TAPPI T 811 "Edgewise Compression Strength of Corrugated Fiberboard,"wax end treated method, this procedure specifies the same 50.8 mm (2.00 in.) specimen column height for A, B, and C flutes single wall and double wall. The additional column height for the more frequently used B and C flute boards places additional stress on the combined board fabrication quality component in the edge compression test procedure. Flute formation and the medium flat crush strength (z-direction board properties) become more significant in their contribution to the measured combined board edge compression strength value. Typically comparative values are 7-15% less than values of TAPPI T 811. However, using the standard IPC-McKee estimating equations, experience and data indicate improved reliability of container compression strength predicted versus observed test values obtained when evaluating production runs from the box plant reflecting the normal variation in plant fabricating quality.

References

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Appendix A: Calibration

A.1 *Crush Tester*. Calibrate the flexible beam instrument in accordance with TAPPI TIP 0304-20 (Calibration of Flexible Beam Crush Tester). Calibrate the rigid support instrument in accordance with the manufacturer's instructions.

A.1.1 Periodic calibration must be performed to assure test results are accurate. The test instrument's accuracy must be certified periodically (minimum of once per year).

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department. ■