WI 210308.01

T 838

DRAFT NO. 02 SARG

DATE October 5, 2021

WORKING GROUP
CHAIRMAN To Be Determined

SUBJECT
CATEGORY
Fiberboard Shipping 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.

Edge crush test using neckdown
(Ten-year review of Classical Method T 838 cm-12)
(No changes to draft. Standard Reaffirmed)

1. Scope

This method describes a procedure for determining the edgewise compressive strength, parallel to the flutes, of a short column of single-, double-, or triple-wall corrugated fiberboard, in a neckdown, non-reinforced, loading edge configuration.

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 relates to the top-to-bottom compressive strength of vertically fluted corrugated fiberboard shipping containers (*1*, *2*). This method may be used for comparing the

edgewise compressive strength of different lots of similar combined boards or for comparing different material combinations (*3*,*4*).

2.2 By narrowing the width of the tested area, this method restricts the area for failure and thus does not evaluate the compressive strength of the specimen as a whole.

3. Apparatus

3.1 *Compression testing machine*[1] 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.) vertical movement, perpendicular to the surface, within a load range of 0 to 2224 N (0 to 500 lbf). Within the specimen contact area, each platen shall be flat to 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 (0.0125 mm/25mm, 0.0005 in./1.00 in.) throughout the test.

3.1.1.1 Within a range of platen separation necessary to cause compression failure of the test specimen, and within a load range of 0 to 2224 N (0 to 500 lbf), the speed of the driven platen shall be controllable at 12.5 ± 0.25 mm (0.50 ± 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 (0.0125 mm/25 mm, 0.0005 in./1.00 in.) throughout the test. The platens are required to have not more than 0.050 mm (0.002 in.) lateral relative movement.

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

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

3.1.4 The tester shall have a capacity of at least 2224 N (500 lbf).

3.1.5 The tester shall have a means for measuring and indicating the maximum load sustained by the test specimen, with an accuracy of 0.5% or better between a measured load of 440 N (100 lb) and the equipment's maximum load. Below this measured load, the accuracy shall be 2.2 N (0.5 lbf), or better.

3.2 *Metal guide blocks,* (Fig. 1). Two are required to align the specimen vertically in the testing machine. The exact dimensions of the block are not critical, but they should have the same thickness (height) so that they support the specimen at the same location on each side (section 8.3). The block set referenced in TAPPI T 811 "Edgewise Compression Strength of Corrugated Fiberboard (Short Column Test)" may be used in this method.

[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.

3.3 A device for cutting specimens that produces clean, parallel and perpendicular edges, within the tolerances specified in 6.1. Opposite edges shall be parallel to each other and perpendicular to adjacent edges.

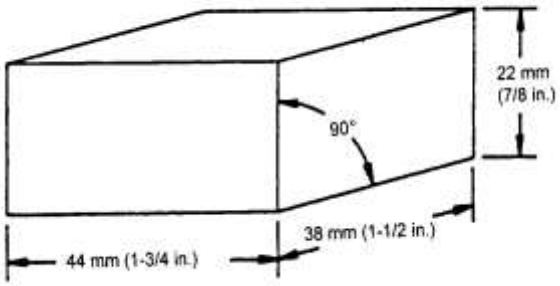

Fig. 1. Metal guide block.

3.3.1 *Knife cutter,* single knife device with guides or, preferably, a twin-knife with guides to cut the test specimens according to the specifications in Section 6.1. The knives must be sharp and of the single-bevel type and arranged in the device so that the unbevelled side is toward the test piece and at 90°. All cuts must be clean and free of excessive fraying.

3.3.2 *Saw,* circular, equipped with a sharp, no-set (hollow-ground or taper-ground is desirable) saw blade. The saw blade shall be 90º to the table supporting the specimen and have the ability to consistently hold the specimen size to ± 0.8 mm (± 0.03 in.)

3.4 *Neckdown cutter,* consisting of a method of cutting a sample 50.8 mm x 50.8 mm (2 in. x 2 in.) into an "hour glass" shape with a narrowed section of 25.4 ± 0.4 mm (1.00 ± 0.015 in.) with tolerances per Section 6.1 (Figure 2). The radius of the semicircular cuts should not be less than 12.7 mm (0.5 in.), the sample tabs must remain 50.8 mm (2 in.) and the narrowed section must meet the above specifications. Take care to insure the hourglass cut is in the center of the specimen. One method is a sample cutter consisting of two single-beveled rotating blades fixed in a holder, with the bevel facing away from the sample.

4. Safety

The thin blades used in many neck down cutters are particularly sharp, and under significant strain when cutting the hour glass shape (*3.4*). Extra care should be taken when cutting specimens for this tests. Safety glasses are recommended.

5. Sampling

Obtain samples in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product."

6. Conditioning

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

7. Test specimens

7.1 Accurately cut 10 representative specimens with a saw or other device to cut clean parallel and perpendicular edges. Cut all specimens 50.8 ± 0.8 mm (2.0 ± 0.031 in.) in both width and height so that the loading edges are parallel to each other and perpendicular to the axis of the flutes (Fig. 2).

7.1.1 If the test specimens are to be taken from corrugated shipping containers, take them from areas away from scorelines, joints, closures, and other damage. Choose specimens that are representative of the materials being tested. For example, if roughly 25% of a box is printed, roughly 25% of the samples should be collected from the printed areas.

7.2 Place each 50.8 mm × 50.8 mm (2 in. × 2 in.) sample in the neckdown cutter and cut the notch in each side of the specimen. Do not cut the loading edges. The sample width at its narrowest point is now 25.4 mm ± 0.4 mm (1.0 ± 0.015 in.).

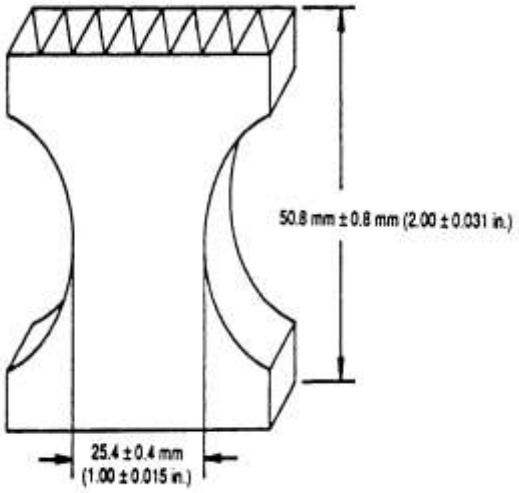

Fig. 2. Sample cut into "hourglass" shape.

8. Procedure

8.1 Perform all tests in the conditioning atmosphere.

8.2 Measure the width at narrowest point nominal 25.4 mm (1 in.) of each specimen to the nearest 0.4 mm (0.016 in.).

8.3 Center the specimen on the bottom platen. Place a guide block on each side of the specimen centrally located relative to it so the flutes are held perpendicular to the platen. Zero the tester.

8.4 Apply a compressive force to the specimen. When the load on the specimen is between 22 and 67 N (5 and 15 lbf), move both guide blocks away from specimen and without altering the platen movement rate, continue to apply pressure until the specimen fails.

8.5 Record the maximum load (N or lbf).

9. Report

9.1 For each test specimen, report:

9.1.1 Maximum load to cause failure in kN/m or lbf/in.

9.1.2 Whether or not specimen exhibited a valid failure. A failure is defined as valid when the catastrophic failure (buckling) occurs in the narrowed section.

9.2 For each test unit, report:

9.2.1 Average maximum load from valid tests in N or lbf.

9.2.2 Average maximum load per unit width for valid tests, calculated from average maximum load and specimen width at narrowest point (kN/m or lbf/in.).

9.2.3 Standard deviation among valid determinations (kN/mm or lbf/in.).

9.2.4 Number of valid test determinations.

9.2.5 A description of material tested.

9.2.6 A statement that the test was conducted in compliance with this procedure or a description of any deviations.

9.2.7 A statement on what type of cutter was used to produce the 50.8 mm × 50.8 mm (2 in. × 2 in.) sample and the method of necking.

10. Precision

The following estimates of repeatability and reproducibility are based on data from CTS-TAPPI Interlaboratory Program from 2001 and 2002. The material on which these data are based were 10 (ten) grades of C flute corrugated board with various weight combinations including, 36-26-36, 42-26-42 and 69-26-69. Only participants who reported following TAPPI T 838 pm-95 version of this method were included. The precision estimates are based on 10 determinations per lab, per material.

Repeatability (within a lab) = 6%

Reproducibility (between Laboratories) = 18%

Repeatability and reproducibility are estimates of the maximum difference (at 95%), which should be expected when comparing test results for materials similar to those described above under similar test conditions. These estimates may not be valid for different materials or testing conditions.

11. Keywords

Corrugated boards, Fiberboards, Edge crush resistance, Compression tests, Compressivity

12. Additional Information

12.1 Effective date of issue: To be assigned.

12.2 Related methods, using different specimen dimensions and/or geometry, include but are not limited to: TAPPI T 811, TAPPI T 839, FEFCO Test Method No. 8, ISO 3037, and ISO 13821. The procedures in those methods will not, necessarily, yield the same results as this method (*6, 7, 8*). This method differs from the other methods in that a necked down sample is used.

12.3 The current test method has undergone multiple revisions since its initial inception.

12.3.1 In the 2006 revision, the definitions of tester accuracy (Section 3.1.5) and sampling method (6.1.1) were revised to bring them in line with the other ECT test methods. References to nonexistent organizations, test methods, or sections of test methods were removed.

12.3.2 In 2012, other minor revisions and corrections were made. Due to the limited use but historical value of this method, the designation was changed to a Classical Method.

Literature cited

1. McKee, R. C., Gander, J. W., and Wachuta, J. R., "Edgewise Compression Strength of Corrugated Board," *Paperboard Packaging* **46** (11): 70 (1961).
2. McKee, R. C., Gander, J. W., and Wachuta, J. R., "Compression Strength Formula for Corrugated Boxes," *Paperboard Packaging* **48** (8): 149 (1963).
3. Maltenfort, G. G., "Compression Strength of Corrugated," *Paperboard Packaging* **48** (8): 160 (1963).
4. Moody, R. C., "Edgewise Compressive Strength of Corrugated Fiberboard as Determined by Local Instability," U.S. Forest Service Research Paper FPL 46 (December 1965).
5. Moody, R. C., and Koning, J. W., Jr., "Effect of Loading Rate on the Edgewise Compressive Strength of Corrugated Fiberboard," U. S. Forest Service Research Note FPL-0121 (April 1966).

6. Koning, J. W., Jr., "Comparison of Two Specimen Shapes for Short Column Test of Corrugated Fiberboard," U. S. Forest Service Research Note FPL-0109 (October 1965).
7. Koning, J. W., Jr., "A Short Column Crush Test of Corrugated Fiberboard," *Tappi* **47** (3): 134 (1964).
8. Frank, B., "Which ECT," *Corrugating International*, August 2003.

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