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BALLOT NO. _____ 02 - SARG _____

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DATE _____ November 03, 2026 _____

WORKING GROUP

CHAIR _____ Benjamin Frank _____

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 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.

Flat Crush of Corrugating Medium (CMT Test)

(Early review of Official Method T 809 om-22)
(Changes from Draft 1 Incorporated)

1. Scope

This method describes a procedure for measuring the crushing resistance of a laboratory fluted strip of corrugating medium using rigid platen test equipment, and provides a means of estimating, in the laboratory, the potential flat crush resistance of a corrugated board.

2. Significance

Rigidity of the fluted structure, one of the essential characteristics of corrugated board and flat crush resistance (T 825), is necessary to prevent crushing of the flute structure on the corrugator and other converting equipment. The corrugating medium test (CMT) permits the evaluation of the crush resistance of corrugating medium before it is fabricated into combined board, and by consideration of the flat crush of the corrugated board produced may act as a basis for judgment of fabrication efficiency.

3.5.1 The surface of the platens shall be provided with some means to prevent slippage of the test piece during compression, for example, by means of a matte finish or being faced with crocus cloth or its equivalent, adhered free of ridges and maintaining parallel surfaces.

4. Conditioning

Precondition and condition the material to be tested following TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets and Related Products.”

5. Test specimens

From each test unit accurately cut at least 10 specimens. Cut the test specimens 12.7 ± 0.1 mm (0.5 ± 0.004 in.) $\times$ 150 to 160 mm (6 to 6.3 in.) on the die cutter. Assure that the longer dimension is in the machine direction of the medium.

6. Procedure

6.1 Arrange all equipment and supplies to facilitate completing operations in the specified time (see 10.3).

6.2 Perform the fluting operation only after the specimens have reached equilibrium with the specified atmosphere. Heat the fluting rolls to $177 \pm 8^\circ\text{C}$ ($350 \pm 15^\circ\text{F}$) as shown by the temperature indicator.

6.2.1 Feed the specimen into the guide slot of the fluter, so that the bottom edge of the specimen rides flat on the hot plate.

6.2.2 Place the fluted specimen, which emerges on the other side, on the corrugated rack, so that a portion of the specimen is resting on the flat surface at each end of the rack. Place the comb over the fluted specimen, so that it is held firmly into the flutes of the rack, making certain that the specimen is bottomed uniformly in each of the flutes. Exercise care in handling the comb to avoid dropping it. A rolling motion of the comb as it is placed on the specimen aids in forming the specimen onto the rack.

6.2.3 Holding the specimen firmly in the rack, place a 130 mm (5 in.) strip of at least 15 mm (0.59 in.) wide pressure sensitive tape, adhesive side down, on the exposed flute tips and stroke down firmly. [If more than 10 flutes are formed, crush the extra flute(s)]. Carefully, slip the comb out of the flutes without damage to the specimen. Then, lift the resulting 10-flute strip straight up from the rack by the edges of the tape to avoid damaging the flutes.

6.3 Place the specimen on the lower platen of the compression tester, flutes facing up. Apply compressive force to the specimen at a rate of 12.50 ± 0.25 mm (0.50 ± 0.01 inches) per minute recording the peak load.

6.3.1 The function of the matt or crocus cloth surface on the platen is to prevent leaning failures due to slippage of the specimen.

6.3.2 Observe the test in progress and the compressed flutes after compressing each test strip to identify leaning flutes or other abnormal compression patterns as these often result in lower compression values.

6.4 Perform all of these operations using the same technique and speed for each specimen. Test the specimen immediately after fluting so that the time from complete emergence of the specimen from the fluter to the initial application of the crushing force is no more than 15 s.

NOTE 2: Failure to maintain the 10-15 s range may result in low or erratic results. See also 10.2.

7. Report

Include the following in the report: (1) the average medium flat crush value of 10 determinations, to the nearest 5 *N* (1 lbf); (2) the standard deviation of test values; (3) the type of compression tester used; and (4) any leaning flutes or other abnormal compression patterns.

8. Precision

8.1 The following estimates of repeatability and reproducibility are based on results from the CTS Containerboard Interlaboratory Program. The data was drawn from flat crush results from 53 laboratories for two different samples of 26 lb. corrugating medium. The testing was conducted in both 2002 and 2005. Only participants who reported using rigid-platen type instruments and adhering to TAPPI conditioning requirements were included in the calculation of the precision estimates. The precision estimates are based on one test result per lab, per material

Repeatability (within a laboratory) = 5 %, 10 specimens/average

Reproducibility (between laboratories) = 11 %, 10 specimens/average

8.2 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, in accordance with the definitions of these terms in TAPPI T 1200 "Interlaboratory Evaluation of Test Methods to Determine TAPPI Repeatability and Reproducibility." These estimates may not be valid for different materials or testing conditions.

9. Keywords

Corrugating medium, Flat crush tests, Corrugated boards, Compressibility, Compression strength

10. Additional information

10.1 Effective date of issue: To Be Assigned

10.2 Related Methods: ISO 7263-1 is similar to this method and includes the possibility for testing the strip after fluting following reconditioning in the lab environment. In this approach, after lifting the composite test piece from the rack, let it condition in the testing atmosphere for 32.5 ± 2.5 min (30 to 35 min) before placing on the lower platen of the compression apparatus, and test it for its flat crush resistance according to the procedure in 6.2. ISO 7263-2 is similar to ISO 7263-1 but uses B-flute corrugating rolls in the fluter.

10.3 For the most reliable and repeatable results in the present method, specimen preparation must be maintained within the 10-15 s time limit specified. This is the time interval from the discharge of the fluted specimen from the fluter to the initial application of force in the compression tester. Extended time between fluting and compressing allows the sample specimen to absorb moisture from the environment and can result in lower test values. To accomplish testing in this time period, the following suggestions have been found convenient:

10.3.1 The compression tester should be equipped with an automatic stop or limit switch to control the initial clearance between the platens to a minimum, convenient for insertion of the specimen.

10.3.2 Mount the test equipment on the laboratory bench top, so that it is in a convenient position. For a right handed tester this would be: left to right facing the equipment, fluter, comb and rack, and compression tester with approximately 250 mm (10 in.) spacing between units.

10.3.3 Precut tape strips to proper length and adhere one end lightly to edge of bench.

10.3.4 Insert medium specimen into fluter with left hand.

10.3.5 Pick up comb with left hand.

10.3.6 Remove fluted specimen from fluter with right hand and place specimen on rack.

10.3.7 Holding comb in left hand, securely position fluted medium in rack.

10.3.8 Apply tape with right hand, using thumb to crush additional flutes at each end of the 10 flute test strip.

10.3.9 Remove comb carefully from taped specimen with left hand, holding specimen in reach with right hand.

10.3.10 Use right hand to insert specimen into compression tester plates.

NOTE 3: For a left-handed tester, much of the above procedure would be reversed.

10.3.11 Start compression tester with left hand on switch or use foot pedal if unit is so equipped.

10.3.12 Return compression tester platens to initial position at completion of test.

10.4 Limited prior work found no difference in the CMT values found using a flexible beam or rigid platen instrument. However, meaningful differences have been observed in flat crush testing using the two instruments. The difference likely arises from the difference in area covered on the curved area of the flexible beam instrument and the resulting unevenly applied forces on the larger flat crush specimen.

10.4.1 Several studies (7,9,10) generated formulae connecting CMT values using a flexible beam instrument and flat crush values using a flexible beam instrument. Equations from these studies reflecting a reasonably linear correlation between CMT and combined board flat crush were incorporated into this method through the 1990s. While many in the industry found the relationship useful to set CMT specifications and to check "efficiency" of the corrugator process (roll wear, etc.), it cannot be applied to present test equipment. No similar studies have been done for the current generation of load-cell instruments; while the relationship is highly likely to remain linear, it is unlikely that the constants from the earlier work correctly describe the relationship on current equipment. If such a relationship were developed for the rigid platen equipment, it might similarly be useful in setting minimum CMT specifications.

10.5 Recent work exploring hardness, the first peak in the load curve of a CMT or Flat Crush test, provides additional insight into this method.

10.6 Revisions

10.6.1 The 2025 revision corrected the flute depth inch measurement to match the mm measurement specified and updated the time to complete the test to no more than 15 seconds.

10.6.2 The 2022 revision incorporated editorial corrections and emphasized that this method applies to fixed platen compression test equipment.

10.6.3 In the 2016 revision of the method, references to use of a flexible beam tester were moved to the Additional Information section, and other minor edits were made to correct language usage.

Appendix A: Calibration of the medium fluter

A.1 *Fluting rolls (Horizontal roll type)*. Uniform meshing of fluting rolls can be checked by the use of National Cash Register Tape - CB white NCR paper and CR green tinted NC paper C2R. A 12.7-mm (0.5-in.)-wide strip of each type of paper is run through the fluting rolls. The pressure pattern will appear on the green tinted strip. The pressure lines should be uniform and extend the full 12.7 mm (0.5-in.) width of the strip. If there is more impression at the top or bottom of the rolls, they are not in the same plane. This means that the heating plate has warped, is worn unevenly, or the bearings are worn. In any case, the fluter should go back to the manufacturer for repair.

A.1.1 The rolls should ride flat on the heating plate. If the drive roll is not flat on the heating plate, loosen the collar directly above the bottom bearing housing and tap the roll lightly until it is lying flat. It may be necessary to loosen the bottom bearing also. Make this adjustment only when the fluter is up to normal operating temperature. When the roll is flat, tighten all bolts and set screws. Remove driven roll by taking out the center bolt and lifting the roll up by bolts inserted in the thread holes provided. Inspect the heating plate for wear of chrome plating. If worn, a new heating plate should be installed by the manufacturer. The roll can also be inspected for smoothness and wear on the bottom. The spring-loaded post slide can be checked for freeness of movement and lubricated with powdered graphite, if necessary. When the roll is replaced, powdered graphite should be added to the lubricating hole while the roll is turning. Graphite should be added until the grooves under the roll are completely filled. The same holds true for the drive roll.

A.2 *Spring force*. The bar at the front end of the heating plate (on older model fluters) which holds the spring in place can be removed and the spring taken out. By placing the spring upright in the compression tester and applying force until the gage reads 100 N (22.5 lbf), the length of the spring at that point can be determined.

A.2.1 The distance from the edge of the heating plate to the base of the slide block should correspond to the spring length at 100 N (22.5 lbf) force. Make the measurement with the driven roll in proper contact with the drive roll.

A.2.2 On newer model fluters the spring is under the heating plate and applies force to the roll by leverage so that the spring exerts only 50 N (11.25 lbf) of force to give 100 N (22.5 lbf) on the roll. This can be checked by the method above, or by pulling the roll back with another spring scale, or by pulling back with a spring scale at the point on the lever where the main spring is located.

A.3 *Temperature*. The temperature of the fluting rolls should be $177 \pm 8^{\circ}\text{C}$ ($350^{\circ}\text{F} \pm 15^{\circ}\text{F}$), as checked by a pyrometer or thermocouple. Bring the rolls up to temperature with the cover in place. When the plate and rolls are up to temperature as indicated by the amber light going out, remove the cover and take the temperature of the rolls as near the flute tips as possible. Do this while the fluting rolls are in motion. If the temperature is not correct, adjust the thermostat to bring the rolls to the correct temperature and make a new mark at 177°C (350°F). If the temperature cannot be adjusted, check the heating element under the hot plate with a continuity tester. A new heating element may have to be installed by the manufacturer.

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

