WI 180308.05

T 825

BALLOT NO. 04-SARG

DRAFT NO. 03

DATE May 16, 2024

WORKING GROUP CHAIR Glenn Rogers

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.

Deleted: Material

Flat crush test of corrugated board (rigid support method)

(Five-year review of Official Method T 825 om-14)

(Changes from Draft 2 shown through strikethroughs/underlines)

1. Scope

The flat crush test (*1*) is a measure of the resistance of the flutes in corrugated board to a crushing force applied perpendicular to the surface of the board under prescribed conditions. The test is satisfactory for single-faced or single wall (double-faced) corrugated board, but not for double-wall or triple-wall corrugated board, because of lateral motion of the central facing or facings. In this method the specimen rests on an essentially rigid support and is tested at a constant deflection rate. See TAPPI T 808 "Flat Crush Test of Corrugated Board" for the procedure in which the specimen rests on a flexing support and is tested at a constant rate of loading. The test methods do not produce similar results.

Approved by the Standard Specific Interest Group for this Test Method
TAPPI

2. Significance

2.1 Flat crush is a measure of the flute rigidity of corrugated board. A high flat crush value indicates a combination of good flute formation and adequate medium strength. Low flat crush can indicate a number of conditions including low medium strength, leaning flutes, and/or crushed flutes. The primary interest of the test is to determine if the medium's contribution to combined board rigidity has been compromised.

3. Apparatus

3.1 *Compression tester* having the following:

3.1.1 A rigidly supported platen and a driven platen, each having a working area of approximately 100 cm^2 (about 15.5 $in.^2$). The platens are required to have not more than 0.050 mm (0.002 in.) lateral 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 4500 *N* (0 to 1000 lbf). Within a 100 cm^2 (15.5 in^2) working area each platen shall be flat within 0.0125 mm (0.0005 in.) and the platens shall remain parallel with each other within 1 part in 2000, or 50 μm/100 mm (0.0005 in./in.) throughout the test. After the platens are checked for parallelism, they may be faced with crocus or emery cloth, free of ridges, by means of double sided tape to prevent slippage. These facings shall be changed after every 2000 tests.

3.1.2 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 4500 *N* (0 to 1000 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.

3.1.3 A capacity of at least 4500 *N* (1000 lbf).

3.1.4 A means for measuring and indicating the maximum load sustained by the test specimen within 2.2 *N* (0.5 lbf).

3.1.5 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.

3.2 *Specimen cutter*, consisting of a device capable of cutting through the corrugated combined board structure without crushing areas at the cut edges. This may be circular, square, or rectangular.

4. Sampling and test specimens

4.1 From each test unit of a sample obtained in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product," select a minimum of 10 specimens free of abnormalities not representative of the combined board. Cut, preferably in circular form, so that each specimen is either 32.3 cm^2 (5.00 $in.^2$), 50.0 cm^2, (7.75 $in.^2$), or 64.5 cm^2 (10.00 $in.^2$) in area, and at least 38 mm (1.5 in.) away from printed matter, scores, and diecuts.

4.1.1 If the specimens are not circular, exercise special care to maintain the desired area accurately.

4.2 Avoid crushing areas at the cut edges, and, where possible, avoid fractional flute counts.

5. Safety precautions

5.1 The circular cutter used to prepare the samples has sharp blades and is often unguarded or improperly guarded. Proper Personal Protection Equipment (PPE) (cut-proof gloves) should be worn at any time one is working around the blades. A warning label should be on each cutter advising of the proper PPE. The motorized cutter blade is moving whenever the unit is powered. Any time the hands reach under to retrieve a sample they are exposed to the blade. The hand driven cutter uses sharp pointed spikes to puncture the board and hold it steady while being cut. These holding spikes, along with the blades, can cause severe injury.

5.2 Care should be taken when changing the flat crush cutter blades. The blades are thin and must be bent around the holder as they are secured. A blade can fracture during this process and send off shards. It is recommended that safety glasses be worn as well as cut-proof gloves during this operation.

6. Procedure

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

6.1.1. Position each specimen centrally on the lower platen. Apply the crushing load to the specimen until the side walls of the corrugations collapse completely. Failure is defined as the maximum load sustained before complete collapse.

NOTE 1: Normally, a preliminary end point occurs when the tips of the corrugation flatten on one or both sides of the specimen. This should not be confused with the final end point when the corrugations collapse completely. The threshold setting on the compression tester may be set to a level above the preliminary end point so the machine does not look for failure until after that point. If the collapse of the corrugations is so gradual that no such peak load is distinctly registered, note this fact. In this case, adjusting the yield deflection percentage (sensitivity) down may alleviate the problem. If not, watch each test to determine the peak load. Maximum crush load is often near total collapse of the flutes. A strip chart recorder connected to the load cell output will aid in the determination of the correct endpoint of the test. Some machines have the ability to record the loads seen over a specific travel distance and report the maximum load.

7. Report

7.1 Report the flat crush test results, in kilopascals (kPa) or pounds force per square in., (psi) as the average of ten determinations, to three significant figures (1 psi = 6.895 kPa).

7.1.1 To get the flat crush value in kPa (psi), divide the maximum force by the area of the sample.

7.2 Include for a complete report:

7.2.1 The standard deviation.

7.2.2 The total number of specimens tested.

7.2.3 The number of specimens exhibiting rolling failure which is an irregular skewed pattern or leaning type of collapse of the flutes.

7.2.4 The model and type of testing machine used.

7.2.5 Indicate the flute size and type. Flute counts can vary significantly for a given contour.

8. Precision

8.1 The following estimates of precision are based on an interlaboratory study with three grades of combined board that had flat crush strengths ranging between 207 kPa (30 psi) and 276 kPa (40 psi), which were tested using replicates in 7 different laboratories.

Repeatability (within a laboratory) = 38 kPa (5.5 psi).
Reproducibility (between laboratories) = 66 kPa (9.6 psi).

NOTE 2: CTS determined in 1995 and reaffirmed in 2003 that there was no convincing evidence that variation in this test increases with increasing strength of the material being tested, so the expression of the variation is best described by a fixed unit and not by a percentage.

8.2 Repeatability and reproducibility are estimates of the maximum difference that should be expected when comparing replicate measurements for materials similar to those used in round robin of testing.

8.3 Round robin testing was performed on three samples of C-fluted board with the following liner and medium combinations:

A. 52-26-52
B. 42-33-42
C. 42-26-33

The summary of the data collected and analyzed by Collaborative Testing Services has been placed on file at TAPPI.

9. Keywords

Flat crush tests, Corrugated board, Compression tests

10. Additional information

10.1 Effective date of issue: To be assigned.

10.2 An important relationship exists between CMT and Flat crush. The statistical link previously reported between the two tests when using flexible beam testers (see T809 99 om) has not been rigorously explored nor confirmed using fixed platen testers.

10.3 Related methods: APPITA P 429 "Flat Crush Resistance of Corrugated Board," Technical Association of the Australian and New Zealand Pulp and Paper Industry, Parkville, Australia; PAPTAC D.20 "Flat Crush Test of Corrugated Board," Canadian Pulp and Paper Association, Montreal, Canada; ISO 3035 "Determination of Flat Crush Resistance " Single-Faced and Single-Wall Corrugated Fiberboard," International Organization for Standardization, Geneva, Switzerland; SCAN P-32 "Flat Crush Resistance of Corrugated Fiberboard," Scandinavian Pulp, Paper, and Board Testing Committee, Stockholm, Sweden.

10.4 Revision history:

10.4.1 The 2013 revision of this method moved the safety precautions earlier in the document and made minor editorial corrections to the text. The 2023 revision of this method includes adding clarification language to 10.4.1, deleting language in the previous 10.2 that discussed the relationship between Flat Crush and CMT using flexible beam testers and adding the language above in 10.2 noting that a relationship between Flat Crush and CMT using rigid support testers has not been rigorously explored nor confirmed.

Deleted: 2

Deleted: 3

Deleted: 3

Literature cited

1. Nelson, H. G., and Maltenfort, G. G., report of TAPPI Flat Crush Study, *TAPPI* **44** (9): 614 (1961).

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

■