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T 826

DRAFT NO. 4 - SARG

DATE May 18, 2021

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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.

Short span compressive strength of containerboard

(Five-year review of T 826 om-13)

(revisions from Draft 3 incorporated)

1. Scope

1.1 This method describes a procedure for determining the compressive resistance of containerboard.

1.2 This method is intended for containerboard having a span-to-thickness ratio of 5 or less. This is equivalent to a grammage of between approximately 100 g/m^2 (20 lb/1000 ft^2) (*1*) and 440 g/m^2 (90 lb/1000 ft^2).

2. Significance

The edgewise compressive strength of corrugated board is one of the most important properties governing the compressive strength of corrugated containers. Research has shown that the cross directional short span compressive strengths of linerboard and medium can be used to predict the compressive strength of corrugated board and, hence, the box compressive strength (*1-3*). For example, summations of the compressive strengths of the components correlate very well with the combined board edgewise compressive strength.

3. Summary

A test specimen, 15 mm wide (0.59 in.), is held between two clamps, 0.70 mm (0.028 in.) apart. The clamps are forced towards each other until a compressive failure occurs. The maximum force causing failure is measured.

4. Apparatus

4.1 *Compression tester*, having the following:

4.1.1 Two clamps for holding a test specimen 15 mm (0.59 in.) wide (Fig. 1). Each clamp has a stationary and a movable jaw. The clamps shall be 30 mm (1.18 in.) deep and have a surface of high friction, for example, a sand-blasted surface. The clamps shall grip the test specimen firmly over its full width. The stationary jaws shall be on the same side of the test specimen. The clamping surfaces of the movable jaws shall be in the same plane and parallel to those of the stationary jaws (see Appendix A).

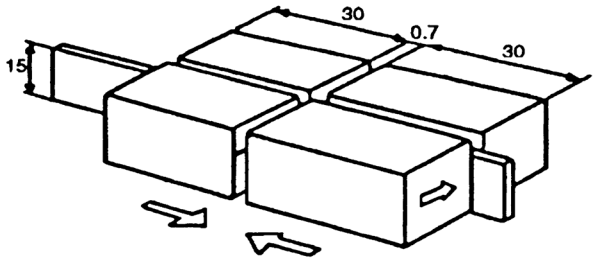

Fig. 1. Clamping arrangement all measurements in mm *(4)*.

4.1.2 The clamps shall be able to grip the test specimen with a constant clamping force of 2300 ± 500 *N* (517 ± 112 lb). A means for indicating the relative force exerted by the clamps shall be available.

NOTE 1: In 2019 a study was performed by ABB on six different paper materials to understand the impact of clamping pressure on compression strength. The clamping pressure range from 1700 N (405 lb) to 2800 N (629 lb) produced no changes in measured strength above the level of variation in the material. This study is archived with TAPPI and available upon request.

4.1.3 At the start of the test, the free span between the clamps shall be 0.70 ± 0.05 mm (0.028 ± 0.002 in.). After the test is started, the clamps shall move toward each other at a speed of 3 ± 1 mm/min (0.12 ± 0.04 in./min), the deformation of the load cell being considered.

4.1.4 A means for measuring and indicating the maximum load sustained by the specimen which can accurately be checked with dead weight loads or equivalent means. The accuracy required is ± 1% of the test reading when this is within 10 - 100% of the full scale range.

4.2 *Cutting device*, capable of accurately cutting the specimen to a width of 15 ± 0.1 mm (0.59 ± 0.004 in.) and a convenient length, usually about 150 mm (6 in.). A precision die-type cutter is preferred.

5. Sampling

From each test unit obtained in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product.”

6. Conditioning

Due to possible dimensional changes and the impact of moisture on strength properties, precondition in 10-35% RH and 22-40°C (72-104°F) and then condition in atmosphere 50.0% ± 2.0% RH and 23.0 ± 1.0°C (73.4 ± 1.8°F). Follow TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets and Related Products”

7. Preparation of test specimens

7.1 Carefully cut specimens in the form of strips at least 70 mm (2.8 in.) in length and with a width of 15 ± 0.1 mm (0.59 ± 0.004 in.). Cut the specimen so that the long direction is parallel to the cross-machine direction, (CD). (Although cross direction (CD) measurements are the basis for edge crush and box compression predictive formulas, machine direction (MD) measurements can also be taken using the same method). In cutting the specimens take care to ensure that:

7.1.1 The long edges are parallel to each other, such that the widths at opposite ends are within 0.1 mm (0.004 in.) of each other.

7.1.2 The edges are cleanly cut, without tears or frays

7.2 This test, like all other tests depending on resistance to compression, is very sensitive to change in the moisture content of the test specimen. A 1 % change in the moisture content can give up to 8 % change in the compression strength. Handle the test specimens carefully and never touch the compressive zone with bare hands. Keep the test specimens away from moisture, heat, direct illumination, expiration air and other conditions that may change their moisture content. Ensure that the clamps are not exposed to heat from lamps, motors, etc.

8. Procedure

8.1 Test the specimens in an atmosphere in accordance with TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products.”

8.2 Insert the test specimen in the machine and actuate the clamps so that the prescribed pressure is applied and there is minimal slippage. Avoid handling the specimen in the test area with bare fingers because compressive strength tests are sensitive to the moisture content of the containerboard under test.

8.3 Operate the machine to apply a compressive load to the specimen and record the maximum compressive load.

8.4 Multiple tests can be run on each strip but do not test any area of the strip that has been compressed by the clamping jaws.

8.5 A minimum of 10 tests should be run.

9. Report

9.1 Report the CD test results (each an average of 10 determinations of maximum compressive force per unit area width) in kilonewtons per meter (or in pounds force per inch) to three significant figures.

NOTE 2: Results in kilonewtons per meter may be converted to pounds force per inch by dividing by 0.17513.

9.2 Report the standard deviation of the CD compressive loads.

9.3 Include, for a complete report, the number of determinations.

10. Precision

10.1 Repeatability (within a laboratory) = 6.5%.

10.2 Reproducibility (between laboratories) = 14%.

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

10.4 These estimates of repeatability and reproducibility listed above are based on data from the CTS Containerboard Interlaboratory Programs from testing conducted in 2007 and 2008. The data included 11 rounds of testing on 4 grades of containerboard as shown in the chart below. The precision estimates are based on 20 determinations per test result (this method defines the result as average of 10 determinations) and 1 test result per lab for each round of testing with an average of between 9 and 40 laboratories reporting for each round and grade. Only laboratories that reported performing the testing in accordance with this method and using adhering standard conditioning atmospheres were included in the calculations.

Table 1. Data table

Material	*Mean*	*Repeatability r and %r*		*Reproducibility R and %R*		*Labs Included*
26lb medium	14.4	0.91	6.3 %	1.32	9.1 %	9
36lb linerboard	21.0	1.42	6.8 %	3.12	14.8 %	39
42lb linerboard	24.6	1.79	7.3 %	3.60	14.6 %	39
42lb linerboard	27.5	1.60	5.8 %	4.47	16.2 %	39
69lb linerboard	39.0	2.26	5.8 %	4.61	11.8 %	36

Results listed in pounds force per inch.

11. Keywords

Containerboards, Compression strength, Corrugated boxes

12. Additional information

12.1 Effective date of issue: to be assigned.

12.2 This method is technically similar to ISO 9895:2008

12.3 The 2008 revision of this method updated the precision statement with current data and removed confusion regarding different measures of repeatability and reproducibility gathered from differently structured data sets.

12.4. The 2019 revision of this method didn't have any technical changes from the 2008 revision. The importance of pre-conditioning and conditioning of the samples was described better.

Appendix A. Specifications for the clamps *(4,5)*

A.1 The four jaw edges in contact with the test specimens in the 0.7 mm (0.0276 in.) span shall not be blunted. The difference in the free span at the top and bottom of the jaws shall be less than 0.03 mm (0.001 in.).

A.2 Those parts of the two surfaces of the stationary jaws that grip the test piece close to the free span shall lie between two parallel planes, 0.01 mm (0.0004 in.) apart. All points of the two surfaces, 30 mm (1.18 in.) in each direction from the free span, shall lie between two parallel planes, 0.2 mm (0.008 in.) apart (Fig. 2).

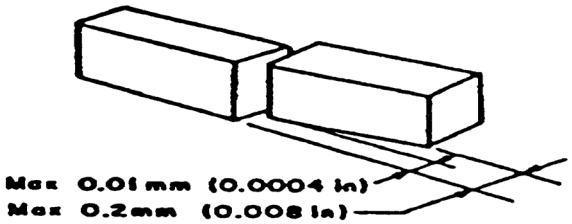

Fig. 2 Specification for the maximum permissible departure from vertical alignment of the clamps *(4)*.

A.3 All points of the bottom surfaces of the jaws shall lie between two parallel planes 0.1 mm (0.004 in.) apart (Fig. 3).

A.4 If jaw alignment is other than specified, between tester correlation will be poor (*5*).

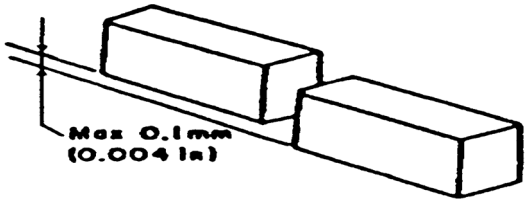

Fig. 3 Specifications for the maximum permissible departure from parallelism of the clamping surfaces (*4*).

Literature cited

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5. McNown, W. J., *Tappi Journal* **75** (1): 83 (1992).

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