T 810 om-98
SUGGESTED METHOD – 1966
OFFICIAL TEST METHOD – 1980
REVISED – 1985
REVISED – 1992
REVISED – 1998

Bursting strength of corrugated and solid fiberboard

1. Scope

This method describes the procedure for measuring the bursting strength of single wall and double wall corrugated and solid fiberboard. It is not designed to be used for the bursting strength of paper (TAPPI T 403 "Bursting Strength of Paper"), paperboard and linerboard (TAPPI T 807 "Bursting Strength of Paperboard and Linerboard"), or triple wall corrugated board.

2. Significance

The bursting strength of combined board is primarily an indication of the character of the materials used in manufacturing a fiberboard box and has value in this respect. Bursting strength of combined board is an optional requirement of the various carrier regulations for shipping containers. The bursting strength of the component paperboard is an important control test in the paperboard mill since the conformity of the finished container is generally controlled by the bursting strength of the paperboard. Triple-wall corrugated board cannot be tested suitably by the bursting method. Testing of double-wall board is of questionable accuracy since it is rarely possible to get sufficiently simultaneous bursts of the multiple facings. The test is simple and rapid to execute, but it must be recognized that it is subject to serious errors if instrument, diaphragm, and gages are not properly maintained or if improper procedures are used (*1, 2, 3*).

3. Apparatus

3.1 *Bursting tester*[1], consisting of the following:

3.1.1 Means for clamping the test specimen between two annular, plane surfaces having fine concentric tool marks to minimize slippage. The upper clamping platen (clamping ring) has a minimum diameter of 95.3 mm (3.75 in.), a minimum thickness of 9.53 mm (0.375 in.), and a circular opening of 31.50 ± 0.03 mm (1.240 ± 0.001 in.) diameter. The lower edge of the opening (side in contact with the board) has a 0.64 mm (0.025 in.) radius. The lower clamping surface (diaphragm plate) has a thickness of 5.56 ± 0.08 mm (0.219 ± 0.003 in.) with an opening 31.50 ± 0.03 mm (1.240 ± 0.001 in.) in diameter and an overall diameter at least as large as the upper clamping plate.. The upper edge of the opening (in contact with the board) has a 0.41 mm ± 0.1 mm (0.016 ± 0.004 in.) radius and the lower edge of the opening (in contact with the rubber diaphragm) has a radius of 3.1 ± 0.1 mm (0.122 ± 0.004 in.) to prevent cutting the rubber when pressure is applied. The upper clamping ring is connected to the clamping mechanism through a swivel joint to

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

facilitate an even clamping pressure. The openings in the two clamping plates are required to be concentric to within 0.13 mm (0.0051 in.) and their clamping faces flat and parallel (see T 807 Appendix A.1.1).

3.1.2 A molded (disk-shaped) diaphragm requiring a pressure of not less than 160 kPa nor more than 210 kPa (not less than 23 psi nor more than 30 psi) to distend it to a height of 9.53 mm (0.375 in.) above the diaphragm plate (see T 807, Appendix A.1.2.)

3.1.3 Means of forcing liquid into the pressure chamber below the diaphragm at a steady rate of 170 ± 16 mL/min (0.045 ± 0.004 gal/min). This pressure shall be generated by a motor-driven piston forcing a liquid (glycerin) into the pressure chamber of the apparatus (see T 807, Appendix A.1.3).

3.1.4 A Bourdon pressure gage of the maximum reading or the lazy hand type. The scale should have a radius of 47.6 mm (1.875 in.) with graduations extending over a minimum arc of 270° indicating bursting pressure in kPa or psi, with an accuracy of 0.5% of full scale, and have sufficient capacity so that all readings can be maintained in the middle half of the scale. In its operating position, have the gage inclined between horizontal and not over 30° from the horizontal. When more than one gage is mounted on a single apparatus, only the gage on which the measurement is being made is open to the hydraulic system so as not to reduce the rate of distention of the sample.

3.1.5 As an alternate to 3.1.4, a pressure transducer with suitable signal processing circuitry to display the maximum bursting pressure may be used provided it gives comparable results.

3.1.6 Electronic instruments are now available that automate and speed up the testing procedure. These instruments must maintain the critical elements of 3.1.1 through 3.1.3.

NOTE 1: Care should be taken when comparing results between bourdon tube and electronic measuring systems. Differences in test results can arise due to differences in system expansibility and speed of data acquisition.

3.1.7 Vernier caliper with micrometer gage to measure penetration of the upper clamping platen into the board.

4. Calibration

4.1 Calibrate apparatus as per Instrument Manufacturers specifications.

4.2 Appendix A.1 of TAPPI T 807 describes a calibration procedure for one manufacturers apparatus.

5. Sampling and test specimens

5.1 *Solid fiberboard*

5.1.1 From each test unit obtained in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product," prepare five specimens at least 305 × 305 mm (12 × 12 in.). If the dimensions of each sheet of the test unit are too small, then use specimens no less than 102 mm (4 in.) wide and of sufficient length or number to permit a total of 20 bursts.

5.2 *Corrugated board*

5.2.1 From each test unit obtained in accordance with T 400, prepare five specimens at least 305 × 305 mm (12 × 12 in.). If size does not permit this, take specimens no less than 152 mm (6 in.) wide and of sufficient length or number to permit a total of 20 bursts.

6. Conditioning

Condition all specimens prior to testing and conduct tests in an atmosphere in accordance with TAPPI T 402 "Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products."

7. Procedure

7.1 *Solid fiberboard*

7.1.1 Insert the specimen between the clamping ring and diaphragm plate, then apply a clamping pressure of 690 kPa (100 psi) either manually, pneumatically, or hydraulically and verify the pressure applied to the specimen. The specimen must not slip during the test.

7.1.2 Apply the bursting pressure by forcing the piston forward until the diaphragm ruptures the specimen. Record the maximum pressure registered.

7.1.3 Allot a minimum area of 102 x 102 mm (4 × 4 in.) for each burst to prevent the clamping areas from overlapping. Make an equal number of bursts from each side of the specimen. Arrange that no more than one burst from

each side of the specimen falls in the same line of machine formation. Make no test on areas containing wrinkles, creases, or other obvious imperfections. Make a minimum of 6 bursts on each 305 × 305 mm (12 × 12 in.) specimen and a maximum of 10 bursts to determine the average bursting strength of the material tested.

7.2 *Corrugated board*

7.2.1 Insert the specimen between the clamping ring and the diaphragm plate. Apply a clamping pressure so that the top compression ring moves into the board to a depth as follows: "A" flute 2.08 ± 0.05 mm (0.082 ± 0.002 in.); "B" flute 0.81 ± *0.05 mm* (0.032 ± 0.002 in.); "C" flute 1.62 ± 0.05 mm (0.062 ± 0.002 in.) and for Double Wall 3.05 ± 0.07 mm (0.12 ± 0.003 in.). The specimen must not slip during the test. Apply the bursting pressure by forcing the piston forward until the diaphragm ruptures the specimen. Record the maximum pressure registered.

NOTE 2: On some testers equipped with a clamping wheel this corresponds to: "A" flute 3/4 turn; "B" flute 1/4 turn; "C" flute ½ turn and double wall 1 turn. Due to the surface and frictional characteristics of the board, the penetration depth to prevent slippage could vary by +1/4 of a turn. If the tester is equipped with a hand wheel, pneumatic or hydraulic loading system adjust clamping pressure so that the sample will just slip between the clamping rings, measure the distance between the yoke and top clamping ring (see Fig. 1), and adjust the pressure to get the specified penetration depth. There should be no slipping during the test, if slippage does occur increase the penetration depth.

7.2.2 On corrugated board a minimum area of 152 × 152 mm (6 × 6 in.) is required for each burst. A maximum of four bursts, two from each direction, is therefore made on each 930 cm^2 (1 ft^2) specimen. A margin of at least 25 mm (1 in.) is left between the periphery of the clamping ring and the edge of the specimen. Locate the bursts so that not more than one burst from each direction is made in line with the same corrugation. Make a minimum of 20 bursts.

NOTE 3: On testers with adjustable clamp pressure (pneumatic or hydraulic) the following alternative clamp procedure can be used. Determine the clamping force required to collapse the flutes of the test material. Reduce the clamp pressure by 35 kPa (5 psi) to run the burst tests.

NOTE 4: Occasionally a "double pop" may occur on some corrugated materials. These results should be included in the report and labeled as double pops.

8. Report

For each test unit report the average of the test determinations in kilopascals (or in $lb/in.^2$ equivalent to kPa/6.89) to three significant figures.

NOTE 5: For purposes of determining compliance with the optional carrier classification requirements, Uniform Freight Classification Rule 41 and National Motor Freight Classification Item 222 specify a minimum bursting test rather than an average of the test determinations. These rules state, in effect, that only one burst (out of the six prescribed) is permitted to fall below the minimum test required. Board failing to pass the foregoing will be accepted if, in a retest consisting of 24 bursts, not over 4 bursts fall below the minimum test required.

9. Precision

9.1 Repeatability (within a laboratory) = 5.7%

9.2 Reproducibility (between laboratories) = 13.5%

9.3 The above values were obtained using test results, each an average of 20 determinations among 12 laboratories on 6 different corrugated combinations. The interlaboratory study was conducted in accordance with TAPPI T 1200 "Interlaboratory Evaluation of Test Methods Used with Paper and Board Products" by the Fibre Box Association Technical Committee, 1971-2.

10. Keywords

Corrugated boards, Fiber boards, Burst strength.

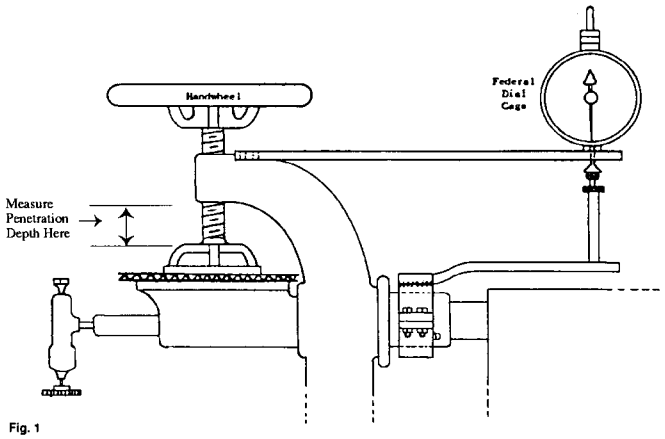

Fig. 1

11. Additional information

11.1 Effective date of issue: February 23, 1998.

11.2 Related methods: ASTM D 2738 (technically identical); Australian and New Zealand, APPITA P 438 (specifies clamping pressure) ISO 2759 (specifies crushing flutes).

References

1. Institute of Paper Chemistry, "A Method for Determining the Bursting Strength (Mullen) of Paperboard and Paperboard Products," *Fiber Containers* (Feb. 1948).
2. McKee, R. C., Root, C. H., and Ayers, L. R., "Instrumental and Operational Variables Influencing Bursting Strength Results," *Fiber Containers* (May, June, and July 1948).
3. Pitman, G. A., "Problems of Entrapped Air in Mullen Testers," *Fiber Containers* (Nov. 1955).

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Technical Operations Manager. ■