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Bursting strength of linerboard

1. Scope and summary

1.1 This method describes a procedure for measuring the bursting strength of linerboard using a disk shaped diaphragm. Basis weights for this method should be 98 g/m² (20#/MSF) and higher. The minimum burst should be 350 kPa (51 psi). This method may also be used to test paperboard.

1.1.1 A specimen is clamped between two platens with circular openings in their centers. An expandable diaphragm is distended through the lower platen by means of hydraulic pressure until the specimen ruptures. The maximum hydraulic pressure when the specimen ruptures is recorded.

1.2 For the bursting strength of paper with basis weights below 98 g/m², use TAPPI T 403 "Bursting Strength of Paper." For corrugated combined board, see TAPPI T 810 "Bursting Strength of Corrugated Board."

2. Significance

The bursting strength test of linerboard (and paperboard) is a composite measure of certain properties of the sheet structure, principally tensile strength and elongation. In general, bursting strength is dependent on the type, proportion, preparation, and amount of fibers present in the sheet and on their formation, internal sizing, and, to some degree, the surface treatment. While bursting strength is an empirical property, this test, in combination with grammage (basis weight), serves to define some "standard grades" in commerce. The bursting strength relates to sidewall puncture of the finished combined board and has been shown to be important in mixed load LTL types of shipments. See TAPPI T 810 for testing burst on combined board and boxes.

3. Apparatus

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

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.

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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 diameter of approximately 95.3 mm (3.75 in.), with a circular opening 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 an opening 31.50 ± 0.03 mm (1.240 ± 0.001 in.) in diameter and an outer diameter greater than or equal to the upper platen. The upper edge of the opening (in contact with the board) has a 0.40-mm (0.016-in.) radius and the lower edge of the opening (in contact with the rubber diaphragm) has a radius of 3.18 mm (0.125 in.) to prevent cutting the rubber when pressure is applied.

3.1.2 The upper clamping ring is connected to the clamping mechanism through a swivel joint to 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 must be flat and parallel (see Appendix A.1.1).

3.1.3 A molded (disk-shaped) diaphragm requiring a pressure of at least 160 kPa but not more than 210 kPa (at least 23 psi but not more than 30 psi) to distend it to a height of 9.53 mm (0.375 in.) above the diaphragm plate (see Appendix A.1.2.). Diaphragms that require more pressure to distend may lead to artificially high readings.

3.1.4 Means of forcing liquid into the pressure chamber below the diaphragm at a steady rate of 170 ± 15 mL/min (5.75 ± 0.5 oz/min). This pressure is generated by a motor driven piston, rotary pump, or other suitable method for forcing a hydraulic fluid into the pressure chamber of the apparatus (see Appendix A.1.3).

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

3.1.6 Calibrate the gauges before initial use and frequently enough to ensure their specified accuracy (weekly or monthly as needed, or before using if they have been idle for a month or more). Calibrate the gauges while inclined at the same angle as used during a test. During calibration, apply the pressure so that the rate of travel of the needle is similar to that when actually testing the board. If a gauge is accidentally subjected to a pressure beyond its capacity, recalibrate it before it is again used (see Appendix A.1.4).

3.1.7 As an alternative to 3.1.5, a pressure transducer with equivalent accuracy and suitable signal processing circuitry to display the maximum bursting pressure may be used provided it gives comparable results.

4. Sampling and test specimens

From each test unit obtained in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product,” select 10 or more specimens, each with areas at least 100×100 mm (4×4 in.), preferably larger.

5. Conditioning

Condition the specimens and make the tests in the conditioning and testing atmosphere specified in TAPPI T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products.”

6. Procedure

6.1 Clamp specimen uniformly so that no slippage is visible during or after test. On units with automatic clamping devices, a minimum clamping pressure of 690 kPa (100 psi) is recommended. For linerboard with bursting strength above 2000 kPa (290 psi) a minimum clamping pressure of 1000 kPa (145 psi) is recommended to assure meeting the no-slip condition. Note that clamping pressure = gauge pressure $\times$ (area of piston/area of clamp). See Appendix B for an example of this calculation.

NOTE 1: Using excessive clamping pressures may lead to lower burst results mostly due to damage at the clamping site. If the recommended clamping pressure is insufficient to prevent slipping, perform additional testing to identify the lowest clamping pressure required to restrain the sample.