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Internal bond strength of paperboard (z-direction tensile)

1. Scope and summary

1.1 This method describes a procedure for measuring the internal fiber bond strength (z-direction tensile strength) of paperboard using an instrument that subjects a normal separation force to a 6.45-cm² (1-in.²) specimen.

1.2 The procedure consists of applying double (two-sided) coated, pressure-sensitive tape to both sides of a test specimen. The specimen is then placed between two platens and compressed uniformly over the entire specimen surface area. Uniform tension is then applied over the entire test area in a direction perpendicular to the plane of the sample (z-direction) to affect a separation.

1.3 The test is intended for paperboards and some papers which have internal fiber bond strength (cohesive strength) lower than the adhesive bond strength of the tape to the specimen and/or test platens. The material from which the platens are made will affect the adhesive strength between platen and tape. The selection of tape may also affect test results. These effects may be seen as tape failures or in some cases higher test values caused by adhesive migrating into sample. The adhesive bond strength of the tape is critical to reproducible test results. New batches of tape should be tested for consistent bond strength. Bond strength can be tested by performing peel tests on standard test plates, or by testing a stable reference sample.

1.4 Test results by this method do not correlate with TAPPI T 569 “Internal bond strength (Scott type)” measurements. TAPPI T 569 uses a pendulum that impacts the top inside surface of a platen at a high speed causing it to rotate and split the paper specimen.

2. Significance

2.1 The internal bond strength of paperboard provides an indication of expected performance, e.g., strength of board in relation to glue bonding at carton side seams, and possible delamination on scoring, or use of high tack coatings.

2.2 This method has also been found useful for the evaluation of coated fine papers.

2.3 The results must be interpreted according to each user's requirement and to each end use.

Approved by the Standard Specific Interest Group for this Test Method



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3. Apparatus

3.1 *Tensile-compression tester, z-direction*¹, having:

3.1.1 A force measuring system with a minimum capacity of 900 N (200 lbf) with a minimum resolution of 0.25% of full scale and an accuracy of at least 1% of full scale.

3.1.2 A $6.45 \pm 0.05 \text{ cm}^2$ (1 in.²) test platen area. Testers are supplied with a 6.45 cm² platen on one side and a larger platen on the other. This larger platen reduces the potential for edge effect errors caused by small misalignments of upper and lower platens.

3.1.3 A means of insuring platen parallelism. A self adjusting (swivel) mount for one of the tester platens is one means of insuring this criterion is met.

3.1.4 A test cycle consisting of a compression stroke, a dwell time (to assure an adequate tape bond between the sample and tester platens), and a tension stroke (which causes the splitting of the test material, leaving a portion of the material on each of the tester platens).

NOTE 1: The data acquisition rate of the tensile-compression tester is a critical factor to its ability to capture accurate peak force values. Tests conducted with this method have a break time of approximately 150 to 300millescond so it is the responsibility of the instrument manufacturer to take care in the design to provide an adequate sample rate to capture the peak force with sufficient accuracy.

3.2 *Double (two-sided) coated, pressure-sensitive tape, 50 mm (2 in.) wide.*

NOTE 2: The brand of tape or the strength characteristics cannot be named here, because manufactures constantly change formulations and properties. The adhesion of the tape to the paper must be stronger than the internal bonding of the sample. This can be verified by examining the sample after testing and verifying that the tape did not separate from the sample or the platen. Strength properties of the tapes are affected with ageing and storage so the manufacture's recommendations must be followed to ensure accurate test results.

3.3 *Paper cutter.*

4. Calibration

4.1 Check the accuracy and linearity of the tensile compression tester by the manufacturer's suggested methods using dead weights or a traceable force gauge.

NOTE 3: If dead weight calibration is to be used to check the force gauge, extreme care and caution should be observed when balancing weights. A falling weight is dangerous.

NOTE 4: If recalibration (other than resetting zero) is required, consult the manufacturer's equipment specifications.

5. Sampling and test specimens

5.1 Obtain samples in accordance with TAPPI T 400 "Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product."

5.2 From each sample, cut five specimens at least 50 × 50 mm (2 × 2 in.), free from folds, wrinkles, or other abnormalities.

NOTE 5: Handle the specimens only by the edges, to minimize samples exposure to contaminants that may affect test results. Do not bend or flex the specimens in any manner or damage the edges.

6. Procedure

6.1 Precondition, condition, and 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."

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