Contents

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Contents (continued)

Abrasion Testing (Taber Abrasion Tester)

Return to Table of Contents

This method determines the resistance of surfaces of paper and paperboard to the action of abrasion, either wet or dry, by measuring abrasion loss. Abrasion loss is quite complex and involves many factors including fiber type, material structure, and any additives or bonding agents used. Surface sizing may increase abrasion resistance. By combining abrasion test results with actual end use results, it is possible to predict usefulness and suitability of a product for a particular application.

The instrument consists of a horizontal turntable with a center clamp, which revolves at 70 to 75 rpm, and which holds the test specimen. Two weighted, special abrasive-embedded rubber wheels rotate freely on the surface of the specimen. The specifics of the abrasion test are given in TAPPI test method T476 or ASTM D3884.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Appearance Testing (Image Expert)

Return to Table of Contents

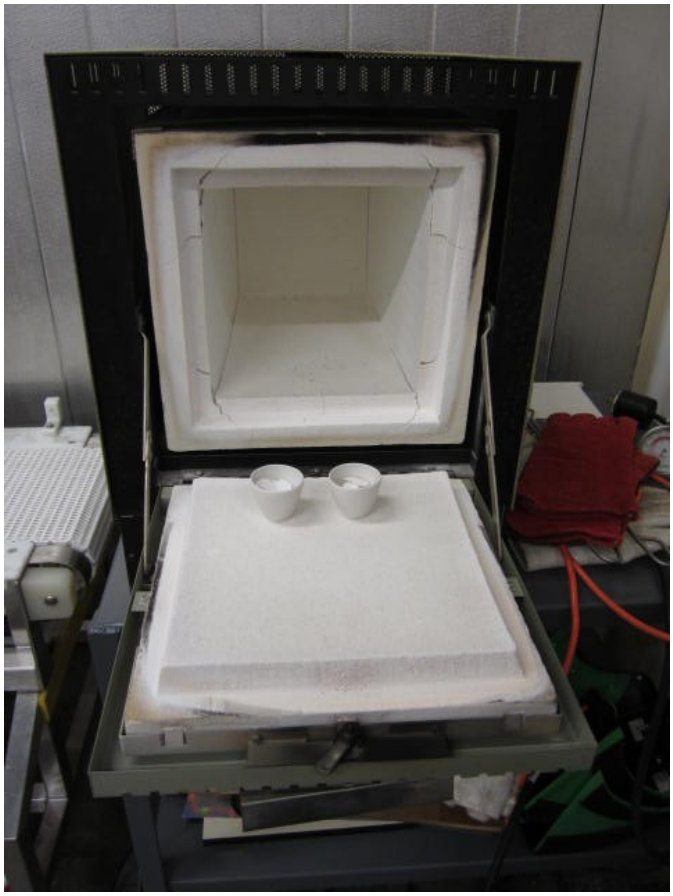
We measure the relative appearance of paper and board with an ImageXpert system. Achieving a uniform surface appearance can be particularly difficult when manufacturing coated grades. The degree of non-uniformity (mottle) present on the coated surface depends both on coating coverage and the opacity of the applied coating or coatings. The data collected by our image analysis system correlates well with the visual ranking of a variety of coated board samples.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Ash

Return to Table of Contents

A muffle furnace is used to determine the ash content of paper or board. We follow TAPPI test methods T-211 (525 °C) and T-413 (900°C). A weighed sample is placed in a crucible and the sample is ashed at either 525°C or 900°C. The sample is removed from the muffle furnace and the weight of ash determined. If the coating formulation is known, the amount of ash present can be used to determine coat weight.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Barcode Evaluation

Return to Table of Contents

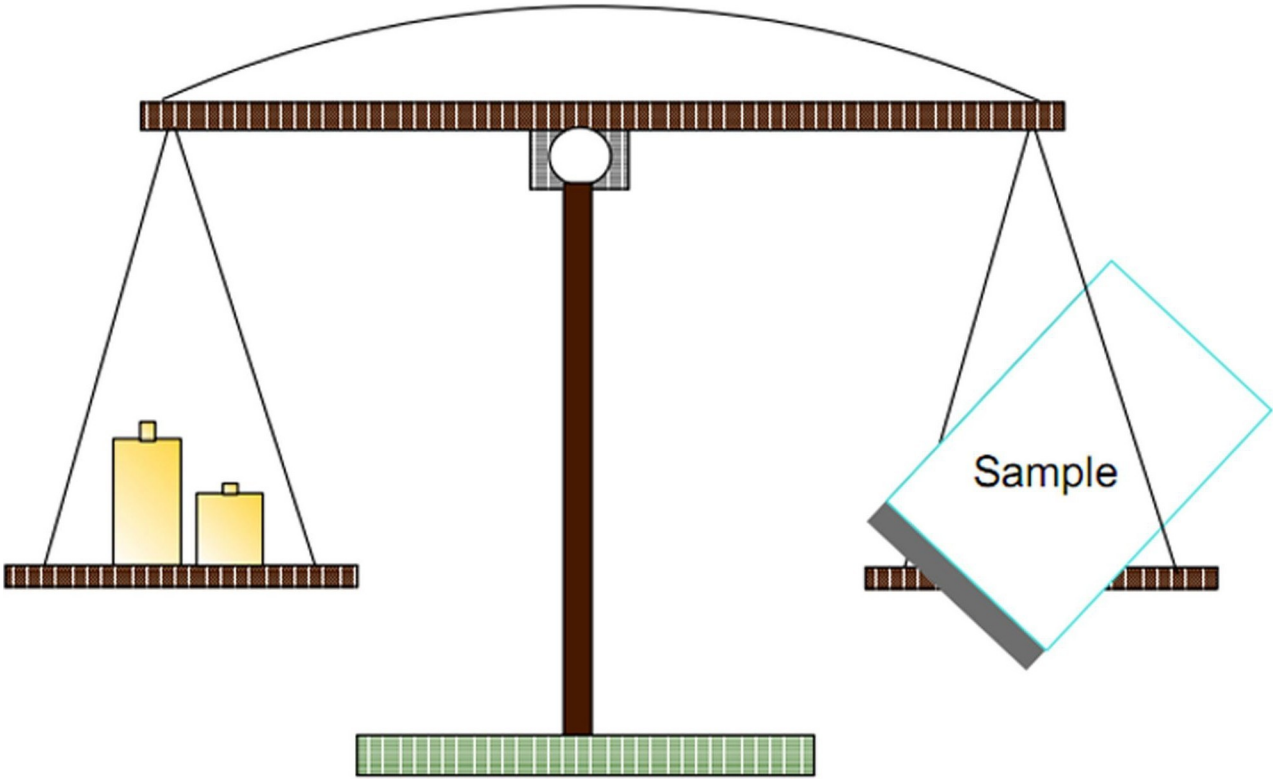
We use a Omron Microscan 9510 Desktop Barcode Verifier (formerly LVS Integra 9510) to test the quality of printed barcode readability. This device is able to test both 1D and 2 D barcodes and can be used to compare the relative readability of barcodes printed on substrates of different colors or brightness. The instrument is compatible with 27 different application standards. Barcode grading can be by reporting all ISO/IEC parameters individually, or can be reduce to an overall pass/fail summary of these parameters. The barcode reader can also be used to measure the readability of barcodes that have had exposed to various physical and/or chemical environments. This provides a means for rating the durability of barcodes on different substrates under different exposures.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Basis Weight

Return to Table of Contents

The weight of a specified area of paper or paperboard is defined as the "basis weight". There are a number of weights and areas used for specifying basis weight. Examples include pounds per 1,000 square feet (lb/1000ft^2, sometimes referred to as lb/MSF) which is usually used for unbleached boards. Pounds per 3,000 square feet (lb/3000ft^2, sometimes referred to as lb/3MSF), is the weight of a ream (500 sheets) of paper or paperboard of size 24 inches by 36 inches (2 feet x 3 feet). The metric measure of weight, "grammage", is expressed as grams per square meter (g/m^2, sometimes referred to as gsm). When the basis weight of a combined board product is reported, the weight is that of the entire product, including all components. We determine basis weight according to TAPPI Test Method T410.

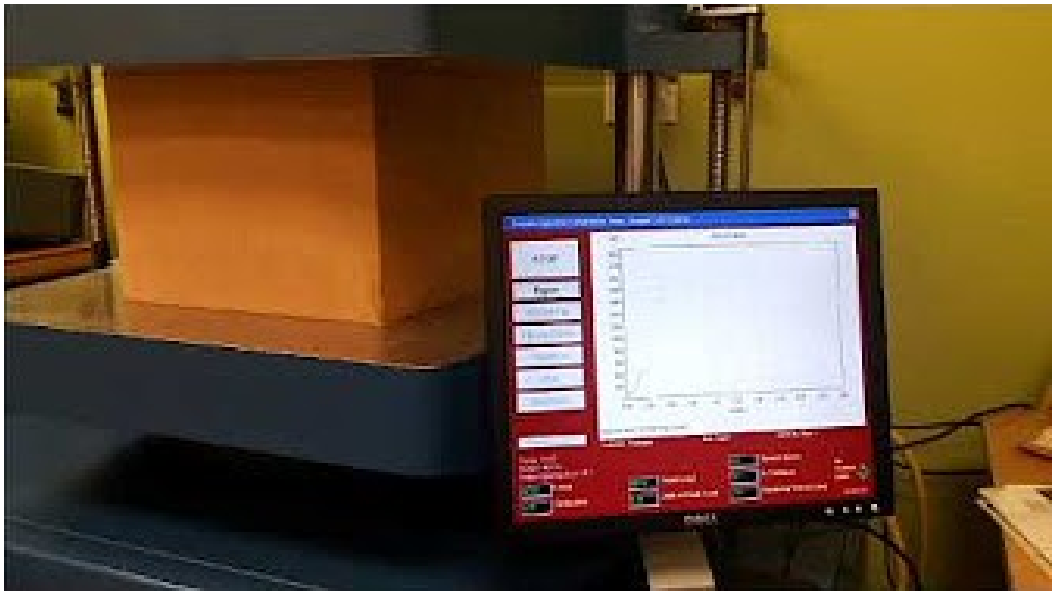


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Box Compression – Small and Large

Return to Table of Contents

We perform box compression tests for folding cartons. small-fluted cartons, and large-fluted corrugated boxes. These tests are performed using either our small dedicated compression tester or our large compression tester. These test are run according to TAPPI Test Method T804.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

BRDA Plybond

Return to Table of Contents

This is a rolling or peeling plybond test that is used exclusively for multi-ply products. The test was developed years ago by BRDA, the Boxboard Research and Development Association (now RPTA, Recycled Paperboard Technical Association).

It is very good at detection poor bonding between plys in multi-ply products, but at the same time, it is not heavily influenced by the internal bonding of the individual plys. This test has been used for multi-ply coated and uncoated paperboard, as well as coated and uncoated cylinder board.

Brightness

Return to Table of Contents

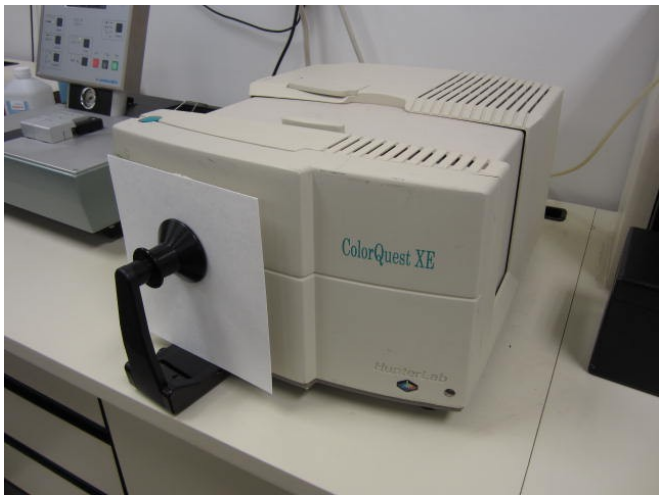
We measure TAPPI (or GE) brightness using either a Technidyne S-4 Brightmeter, or a Technidyne S-5 Brightmeter; both of which measure brightness in accordance with TAPPI test method T-452. The S-4 only measures directional brightness, while the S-5 measures both directional brightness and shade.

Technidyne S-4

Technidyne S-5

For measuring diffuse brightness and shade, we have both an L&W Elrepho 070 spectrophotometer and a Hunter ColorQuest XE spectrophotometer. Both of these instruments measure brightness and shade using diffuse lighting and an integrating sphere. Measurements can be performed with either “C” or “D65” illuminates.

L&W Elrepho 070



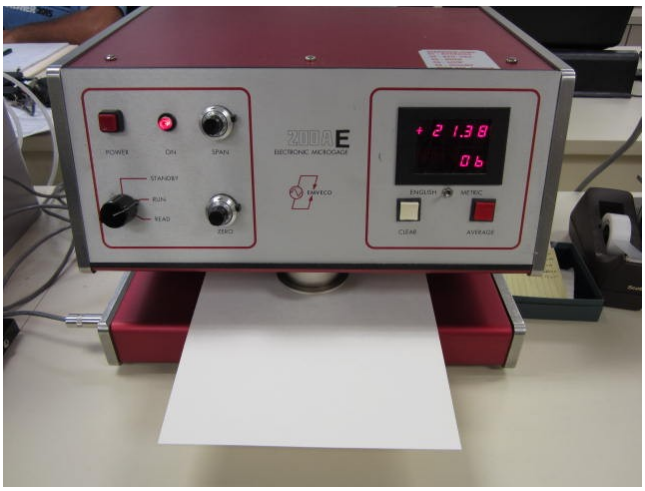
ColorQuest XE

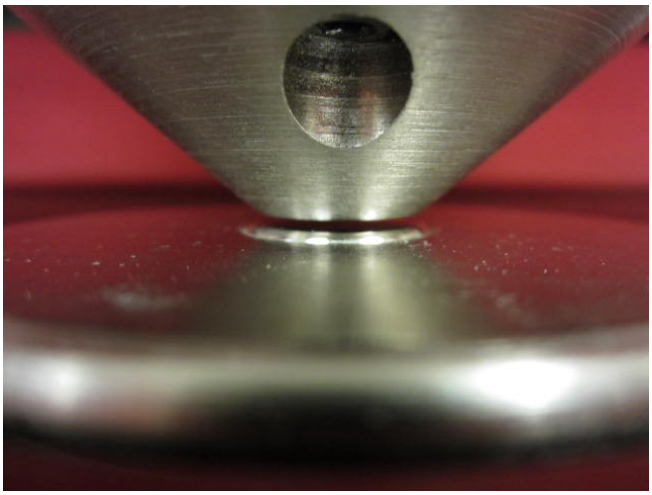
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Caliper

Return to Table of Contents

Caliper is the thickness of a paper or board. Caliper is expressed as points in the English system, with one point of caliper representing .001 inch in thickness. In the metric system, caliper is expressed in microns. Unless otherwise stated, TAPPI Test Method T411 is the standard procedure used for measuring caliper. The caliper of combined board is also measured using TAPPI Test Method T411 to measure the thickness of the combined product.





APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Coefficient of Friction – Static, Kinetic Horizontal Plane

Return to Table of Contents

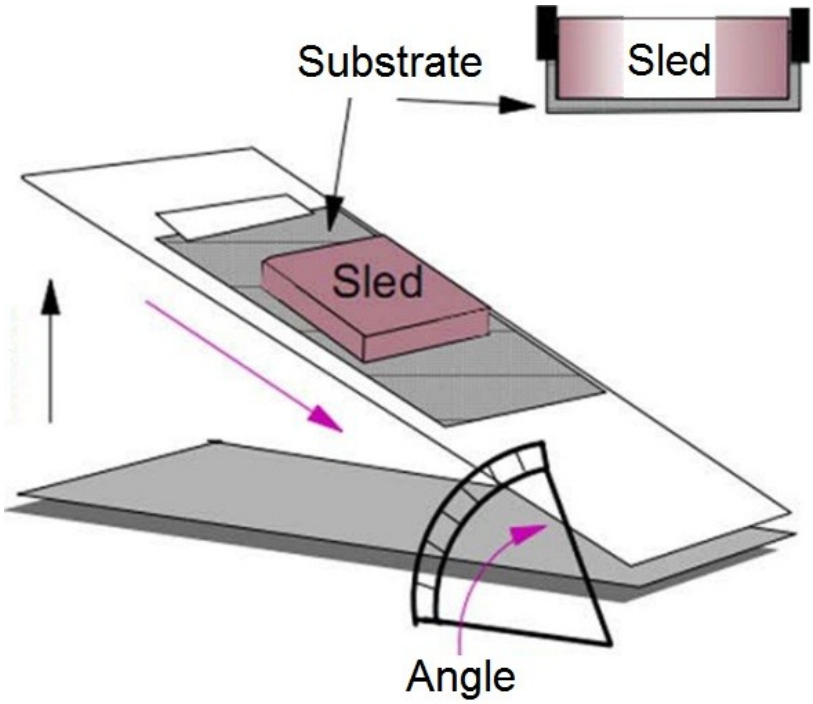
Coefficient of Friction (COF) is a measure of the force required to overcome the friction between two surfaces. Static COF is a measure of the force required to start movement, while Kinetic COF is a measure of the force required to keep the surfaces in motion. We measure both of these properties with a horizontal plane COF tester, following TAPPI Test Method T549. A 3 by 12 inch sample, test side up, is attached to the base of the tester. A 2.5 by 2.5 in sample, test side down, is placed under a 200-gram sled which is then placed on top of the first sample. The samples are usually tested in the machine direction, but can also be tested in the cross direction if desired. At the completion of the test, both static and kinetic coefficients are displayed on the instrument.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Coefficient of Friction – Static

Return to Table of Contents

Static COF is a measure of the force required to overcome the friction between two surfaces and start movement. We measure Static COF using a slide angle tester, following TAPPI Test Method T815. It has a bed that lifts at an increasing angle until the sled starts to slide. The slide angle is used to calculate the Static Coefficient of Friction.

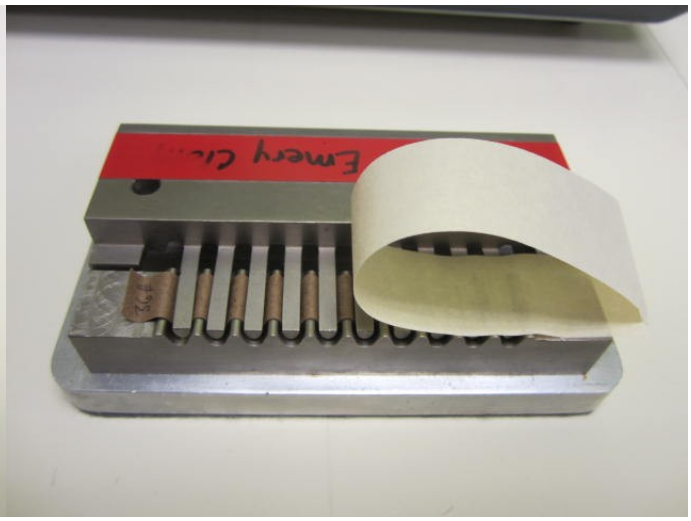


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Concora Corrugating Medium Test (CMT)

Return to Table of Contents

The Concora Corrugating Medium Test measures the crushing resistance of a laboratory fluted strip of corrugating medium, and provides a means of estimating the potential flat crush resistance of a corrugated board. We run this test according to TAPPI Test Method T809. The method uses a laboratory fluter to prepare a fluted strip of board medium. The flutes of this strip are then held in position with a piece of adhesive tape. The prepared, fluted test-piece is placed in the compression tester and the compressive force at failure is measured.

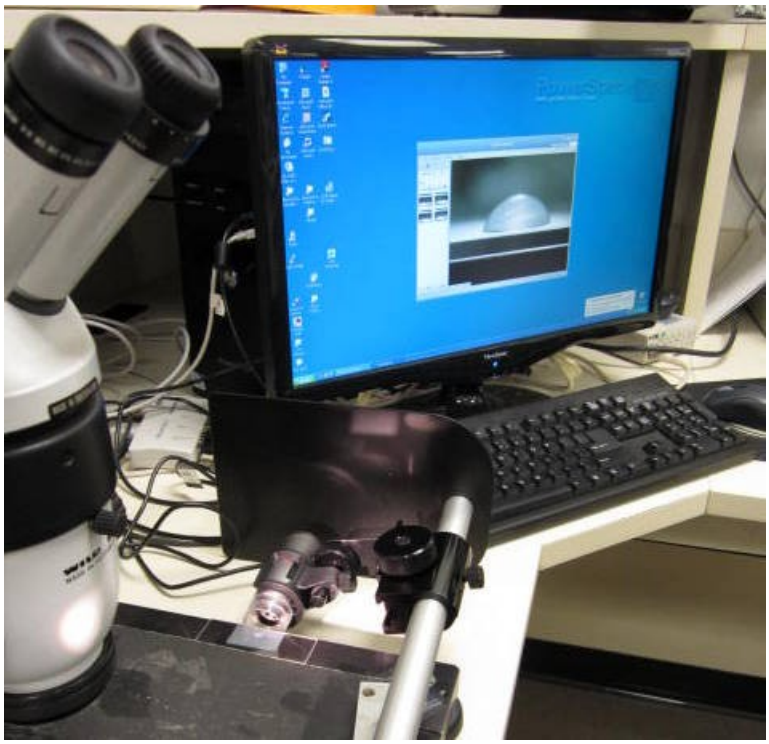


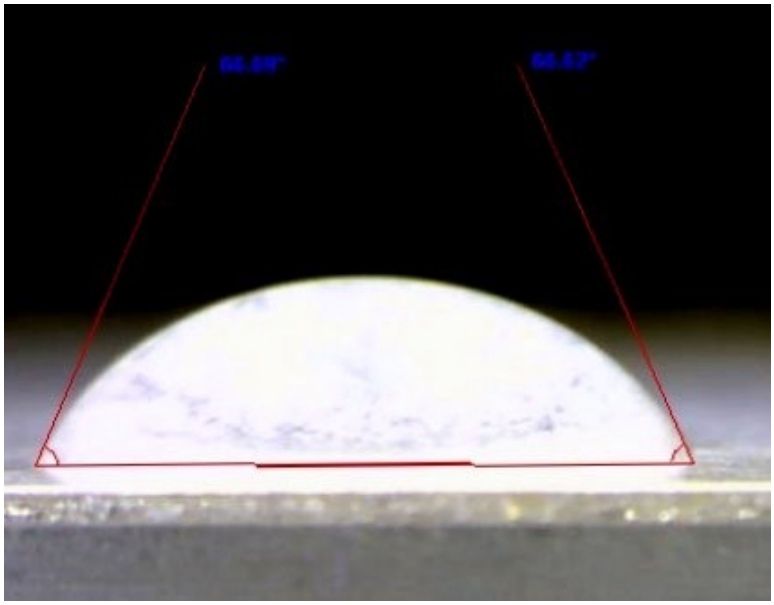
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Contact Angle – Surface Energy

Return to Table of Contents

Contact angle is a measure of the surface energy of a surface relative to the surface tension of a fluid in contact with it. Water is used to measure contact angle in normal paper and paperboard tests. If the surface energy is high relative to the fluid, the contact angle will be low. If the surface energy is low relative to the fluid, the contact angle will be high. A rapid decrease in contact angle with time likely means the test fluid is being absorbed by the substrate. Contact angle cannot be measured on highly-absorptive surfaces.



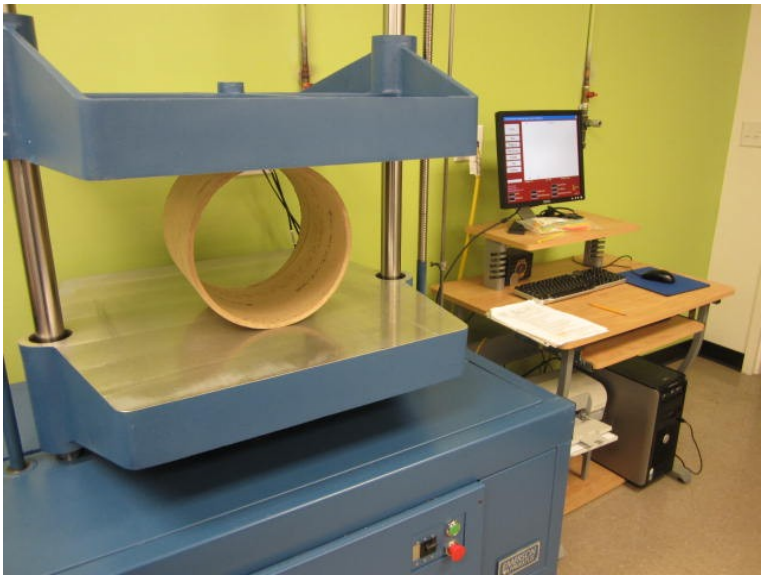


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Core Compression (Side-to-Side Flat Crush)

Return to Table of Contents

Core compression measures the side-to-side crush resistance of composite tubes and cores by compressing them to failure according to CCTI test method T108. Prior to testing, measurements are recorded of the core diameter, wall thickness and core length. The cores are then placed into a compression tester and crushed at a rate of 2.5 inches per minute. The maximum load is determined when the load becomes constant, or falls off by 5%. The maximum load is divided by the core length and the crushing strength is reported in lb/inch.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Corner Crush

Return to Table of Contents

Corner Crush simulates the failure of the corners of a folding carton as the carton is compressed. Two Taber stiffness samples are scored and folded to fit into the Block Compression jig, back to back. They are compressed and the force required to crush the samples is reported in pounds force. This test is applicable to solid fiber and small fluted products.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Curl

Return to Table of Contents

Curl is the tendency of paper or paperboard to curl or roll up, generally in the cross-machine direction, due to changes in relative humidity (RH). This is often referred to as "CD curl". Machine direction curl (MD) is often called "roll set curl".

Curl tendency can be measured using a variety of sample sizes and sample orientations. We measure curl at various relative humidities, but normally samples are tested at 50% RH and 20 % RH. Our normal sample size is 1 inch x 6 inches, with the long dimension in the cross direction for measuring CD curl. We use multiple samples, placing the test strips on a flat surface and measuring the distance from the surface to the corners of the strips.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

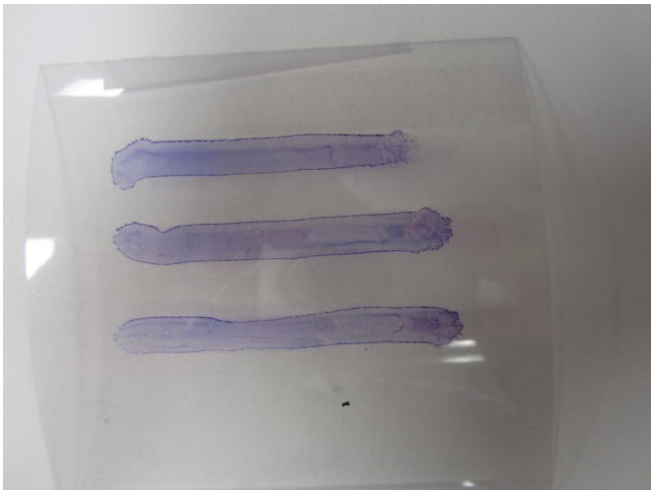
Dyne Level – Surface Energy

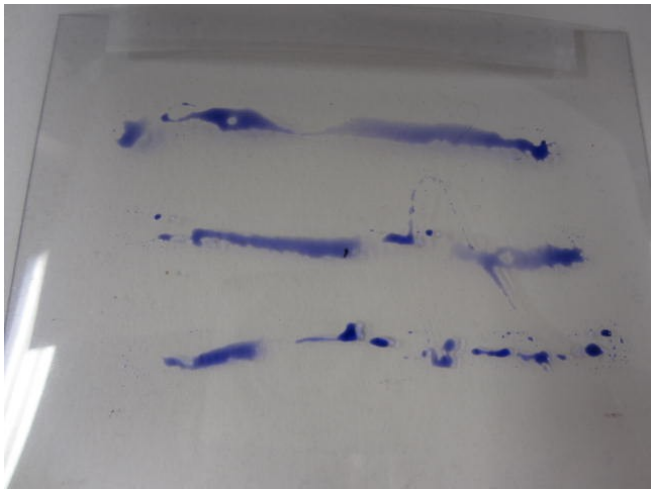
Return to Table of Contents

Surface energy is a critical variable in the spreading and adhesion of inks, coatings and adhesives on a surface. To ensure that a fluid properly wets a surface, the surface energy of the surface must be higher than the surface tension of the fluid. If not, than the fluid will “bead up” instead of spreading.

We use a series of dyne pens containing fluids of different surface tensions to measure surface energy per ASTM test method D2578. If a line of test fluid is applied to the surface and it does not “bead up” within three seconds, the next higher surface-tension fluid should tested. If the fluid “beads up” in under a second, then the next lower surface-tension fluid should tested. If the line of fluid remains unbroken for one to three seconds, the surface tension of the fluid is nearly equal to the surface energy of the surface.

This test method is only appropriate for surfaces that are non-porous and non-absorptive of the test fluids.



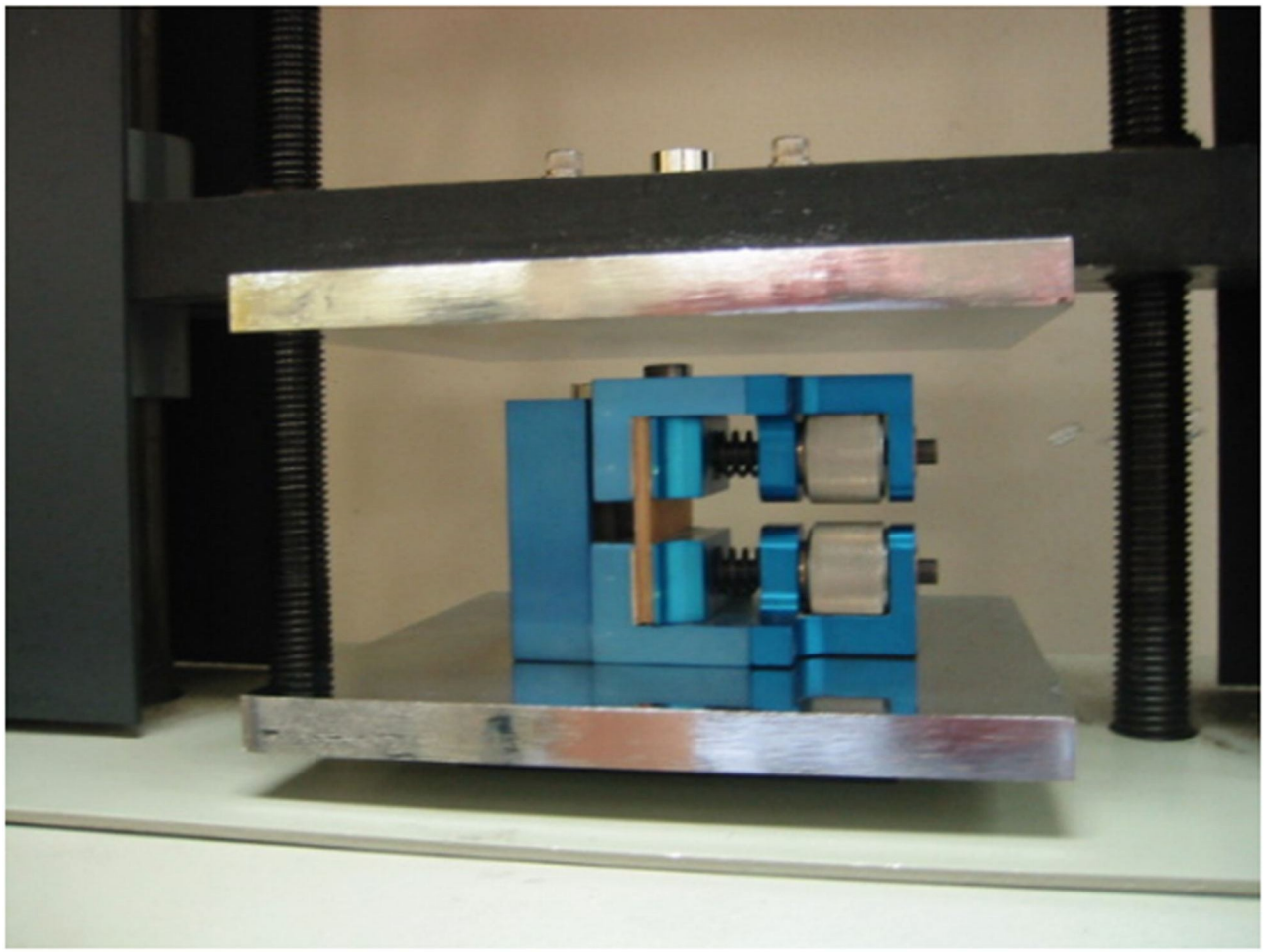


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

ECT – Edge Crush Test

Return to Table of Contents

The Edge Crush Test is a traditional corrugated box test of compression strength. We normally measure ECT using the clamp method to hold the sample. according to TAPPI Test Method T839. Many corrugated boxes are specified in terms of ECT, expressed as lbs/inch. The test is performed on combined board with the flutes in the vertical, or cross-machine, orientation. There is another ECT method (TAPPI Test Method T811) that uses wax to reinforce the edges and we will use this test method upon request.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Emveco 210-R Smoothness Tester

Return to Table of Contents

The Emveco 210-R Smoothness Tester is a stylus type profiling instrument designed for use on flat flexible materials such as paper, box board, plastic sheets and films. Profiles are generated by a very light stylus tip riding within the floating reference head, as per TAPPI Test Method T575. This stylus contacts the moving surface and follows the contours while at the same time generating vertical position readings at pre-determined intervals. These position readings are then stored and processed by the computer for display and printout. Readings at intervals of 0.0005 inch are possible. A drive system is used to advance the samples beneath the floating reference head.

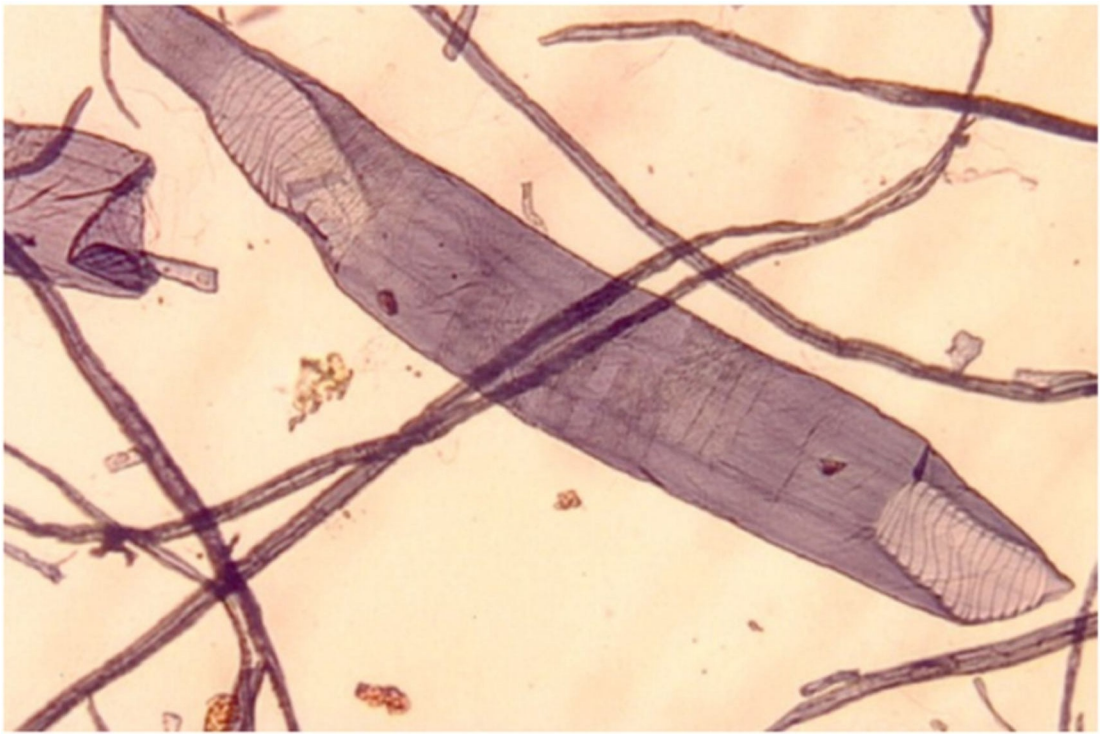
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Fiber Analysis

Return to Table of Contents

We perform traditional fiber analysis, measuring softwood and hardwood amounts and identifying species. Fibers from paper, paper board, or pulp are dispersed in water, placed on slides, dried, stained, and counted using a microscope. It is not possible to determine the amount of recycled fiber contained in a paper product.

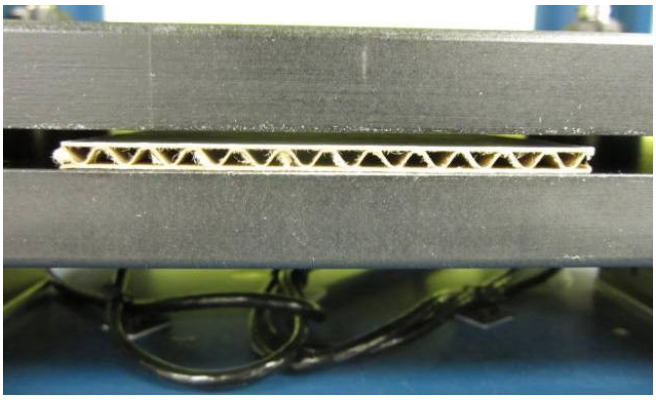
Microscopic inspection can show the amount of damage that has been done to the fibers. The amount and degree of fiber damage helps in developing an opinion regarding the amount of recycled fiber in the sample. It is not possible to determine post consumer versus post industrial recycled fiber.



Flat Crush of Corrugated Board

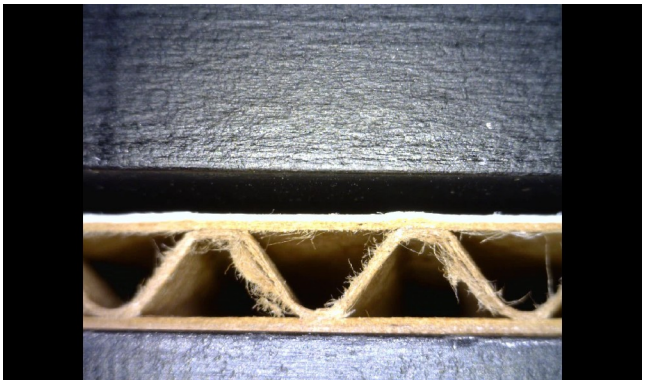
Return to Table of Contents

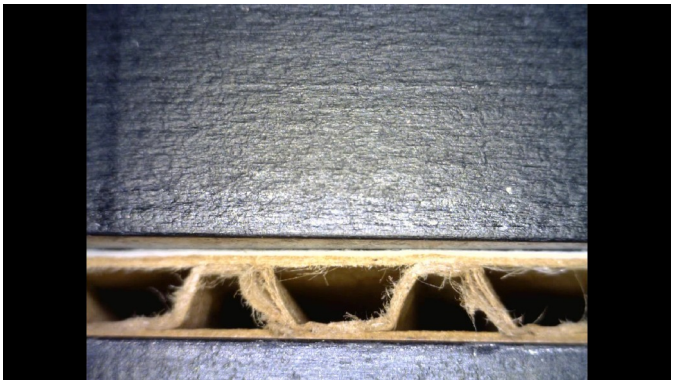
Flat crush is a measure of the flute rigidity of corrugated board as it is compressed between two ridged platens. We conduct this test according to TAPPI Test Method T825. It is largely a measure of the performance characteristics of the corrugating medium and is measured on a 4 x 4 inch sample of the combined board. The force-to-failure is reported in units of psi or kPa, The test is appropriate for single-faced or single-wall (double-faced) board, but not for double-wall or triple-wall corrugated board.



Before Test

After Test



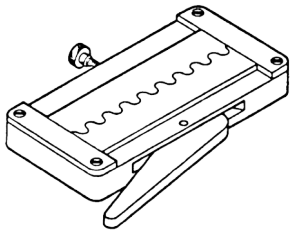


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Fluted Edge Crush (CFC, rigid support method)

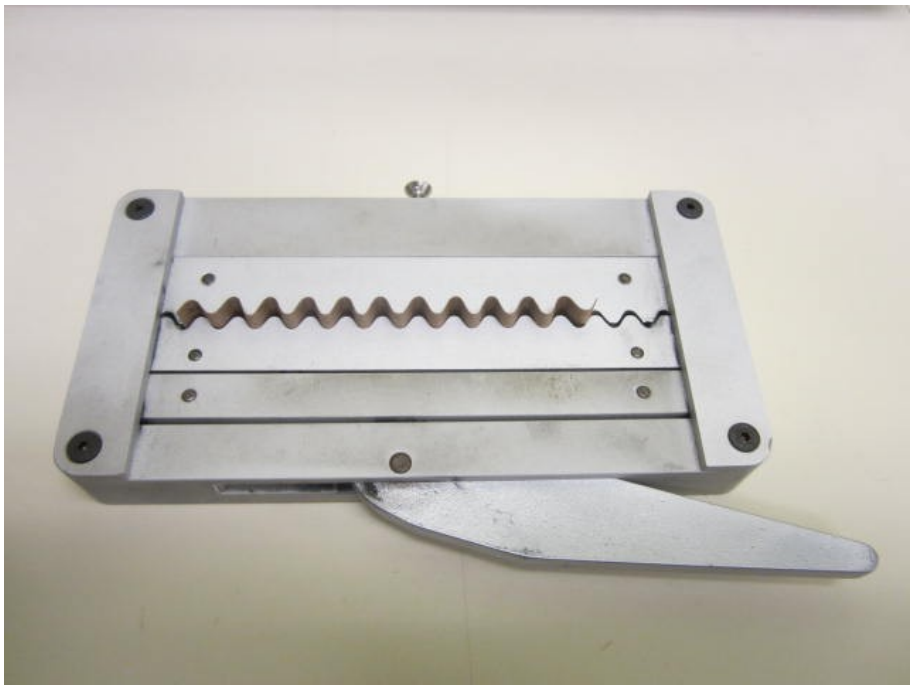
Return to Table of Contents

The Fluted Edge Crush Test evaluates the ability of corrugating medium to contribute to the compression strength of a corrugated box. The test is run according to TAPPI Test Method T843. The suitable holder for this test is shown below. The holder consists of a pair of matched fluted jaws which are spring-loaded and which are opened and closed by means of a hand lever. The spring-loaded feature allows for variations in the caliper of specimens and also allows loading of the specimen within 3 seconds.



Fluted crush specimen holder.

The test strip is fluted as prescribed in TAPPI Test Method T 809 “Flat crush of corrugating medium (CMT
Test)”, and is inserted into the holder as quickly as possible after emerging from the fluter. The holder with the sample strip is placed on the platen of the compression tester and the maximum compression force is measured.

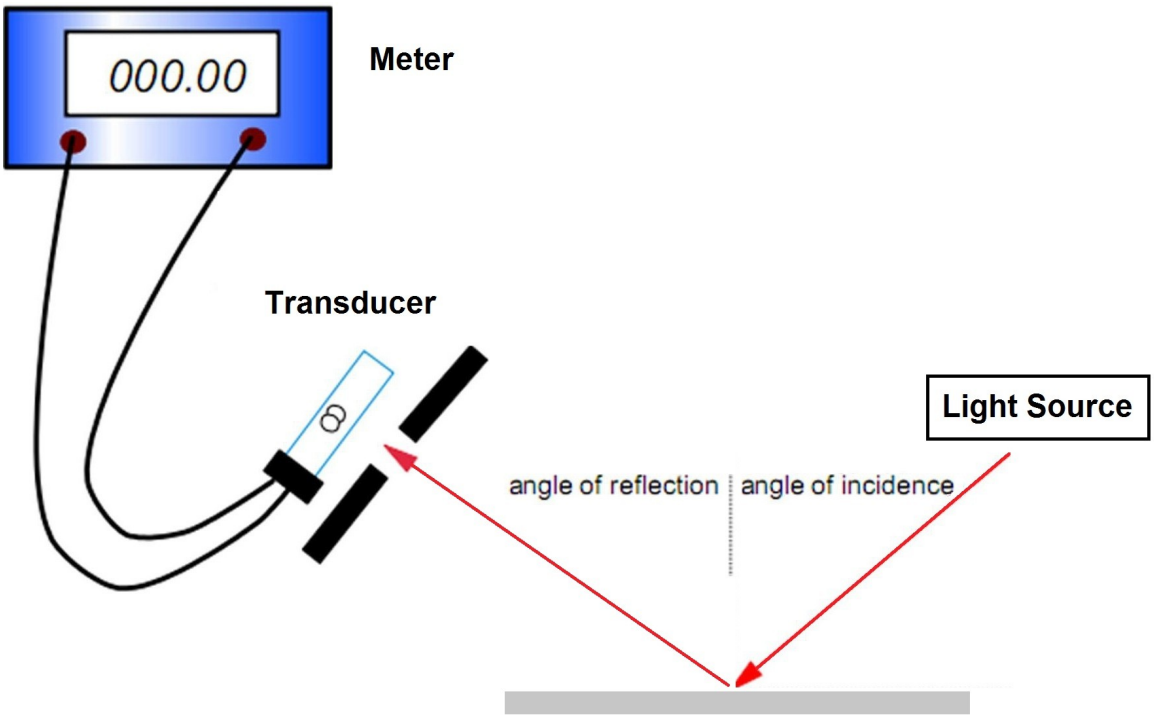


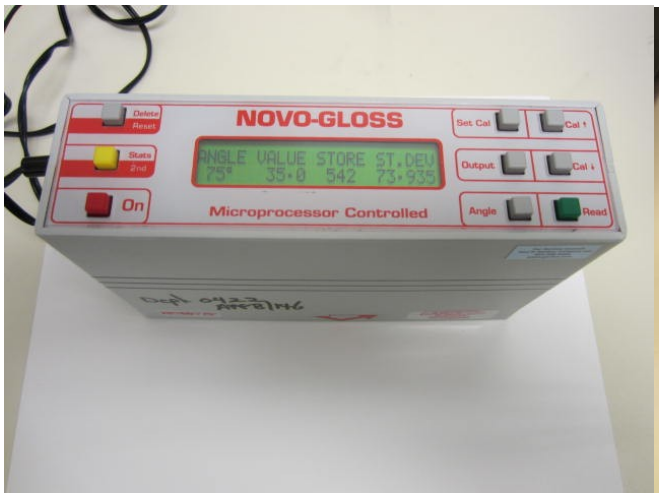
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Gloss, 75 Degree, 60 Degree or 20 Degree

Return to Table of Contents

A beam of light is reflected off the surface of the paper or paperboard at a specified angle in the machine direction (MD), as per TAPPI Test Method T480. The amount of light reflected is compared to a 100% reflective surface. The test result, called the gloss of the product, is the percentage of light reflected. Paper and unprinted board is usually measured with 75 degree gloss and printed board grades are often measured with 60 degree gloss. High-gloss surfaces are measured using 20 degree gloss.



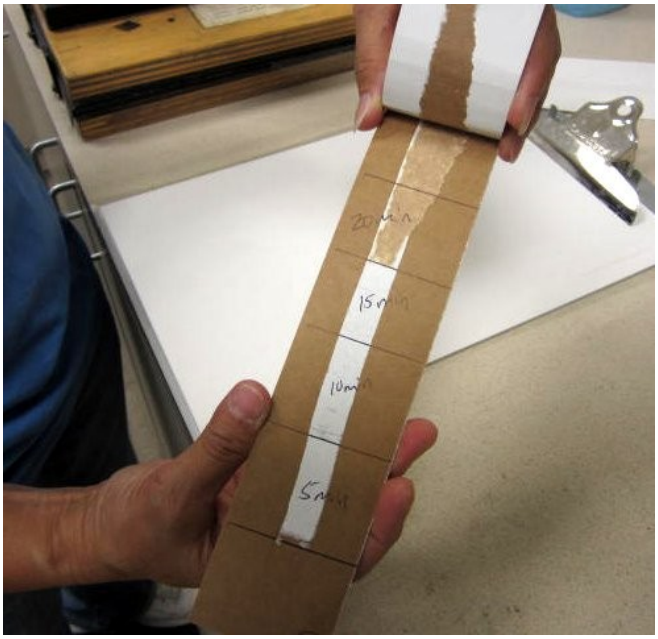


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Glue Speed (Pull Tab)

Return to Table of Contents

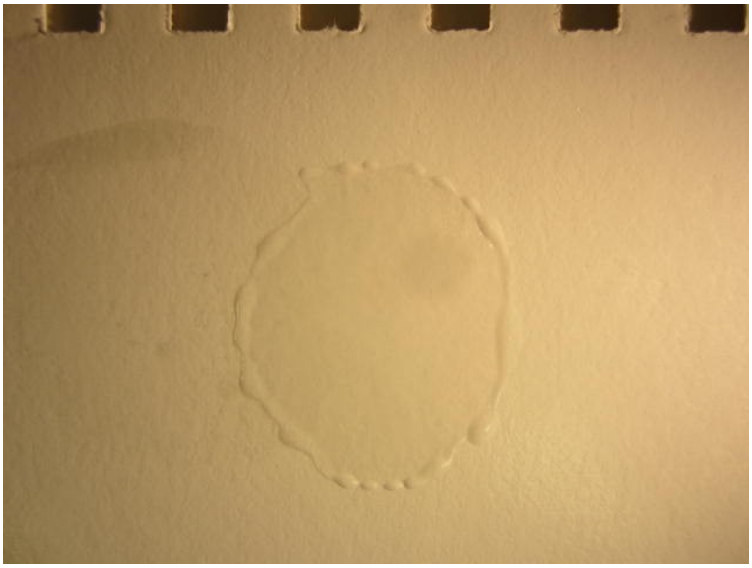
Glue speed is a test used to determine the time required for standard glue to achieve fiber tear. The glue is applied to the backside of a sample with a Bird bar applicator to provide a uniform wet film thickness. The coated side is placed on top and the glued joint is compressed under a load of 12 pounds. A portion of the sample is separated manually at set time intervals, and the time required to achieve fiber tear is reported.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Grease resistance – Kit Test (TAPPI T559) Return to Table of Contents

Commonly known as the Kit test, this method describes a procedure for testing the degree of repellency and/or the antiwicking characteristics of paper or paperboard treated with fluorochemical sizing agents. The test is run according to TAPPI Test Method T559. Fluorochemical agents may impart both organophobic and hydrophobic characteristics to paper through a reduction in the surface energy of the sheet. This is often done by a surface treatment of the fibers without the formation of continuous films. This test was originally developed to allow papermakers to know when the applied fluorochemical was incorporated into the sheet and the approximate level of grease resistance imparted. Testing involves placing a series of numbered reagents (varying in surface tension and viscosity or “aggressiveness”) onto the surface of the sample. The solutions are numbered from 1 (the least aggressive) to 12 (the most aggressive). The highest numbered solution that does not stain the surface is reported as the “kit rating.”

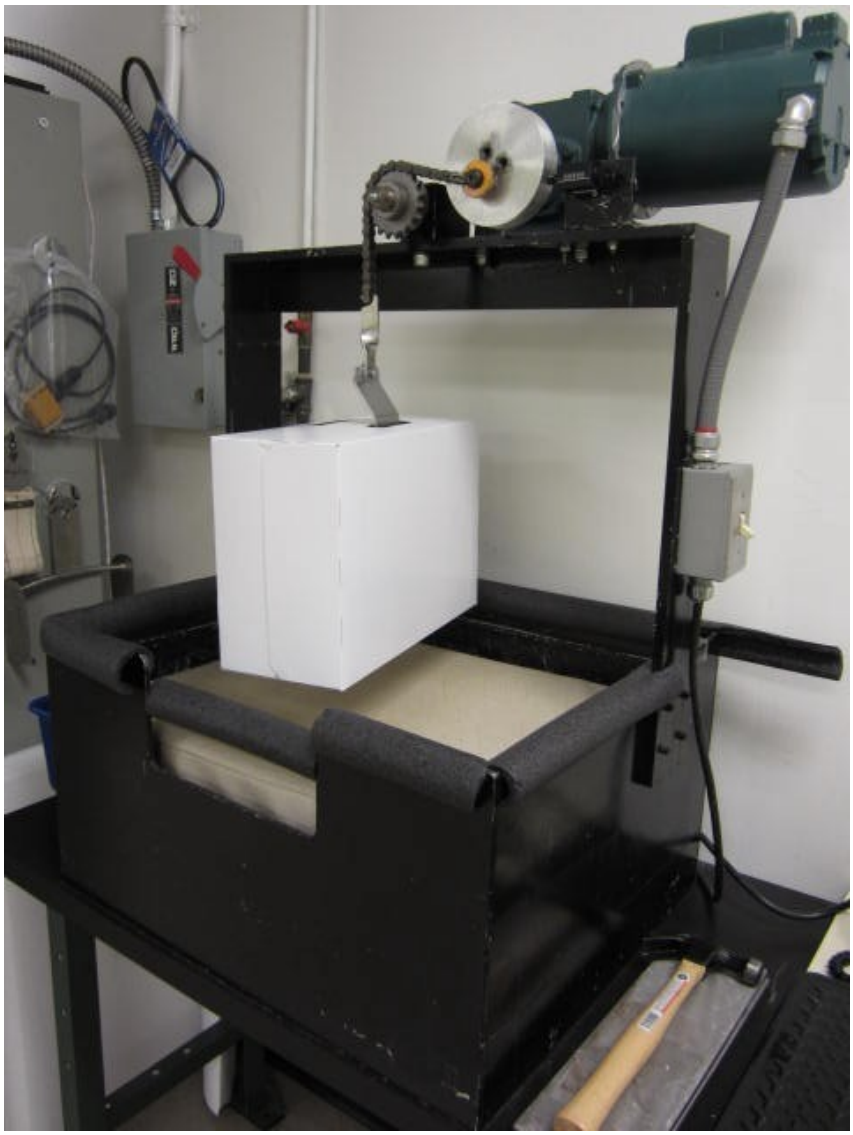


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Handle Cyclic Drop (Jerk) Testing

Return to Table of Contents

Cyclic drop testing is performed by suspending the filled package using a gripping device to hold the package by the handle. The filled package is dropped repeatedly with a hard stop until it fails. The drop distance varies based on the weight of the package. Heavier packages are dropped shorter distances. The drop distance is typically specified by the beverage producers. A typical drop distance for packages weighing less than 15-lbs is 1.5 inches. Packages weighing over 15-lbs are dropped 1.25". Soaking for wet jerk testing is the same as for handle integrity. Specifications for the minimum number of drops vary according to package weight.



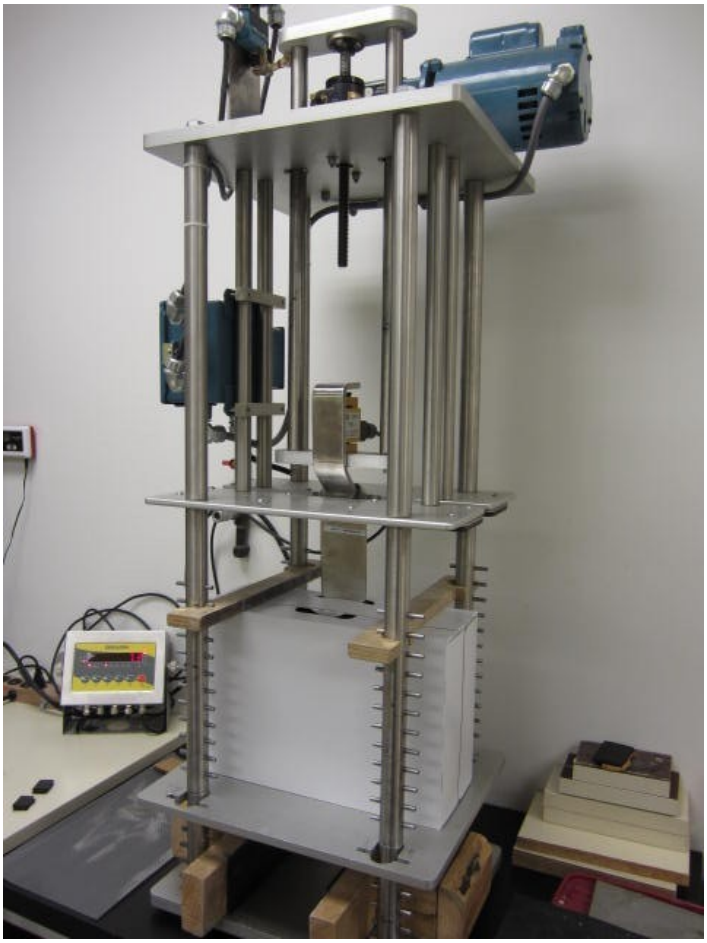
Handle Integrity Testing

Return to Table of Contents

In this test the filled package is clamped or physically held down while the gripping device holds the handle. The instrument pulls the multi-pack carrier handle until it fails. A load cell measures the force as the handle is pulled to failure. The result of the test includes the peak force at failure and a description of the location of the handle failure.

The generally accepted rule in beverage packaging is that the force required to cause handle failure must be at least 3 times the weight of the package.

Wet handle strength testing is performed by submerging a filled package in water for 3 minutes, then testing the handle strength as in the dry test. Naturally the paperboard and glue used in the package must be designed for a wet environment. In addition to board and glue, package design is very important for adequate wet performance.



Heat Seal Testing – Sentinel Heat Sealer, Model 12 ASL

Return to Table of Contents

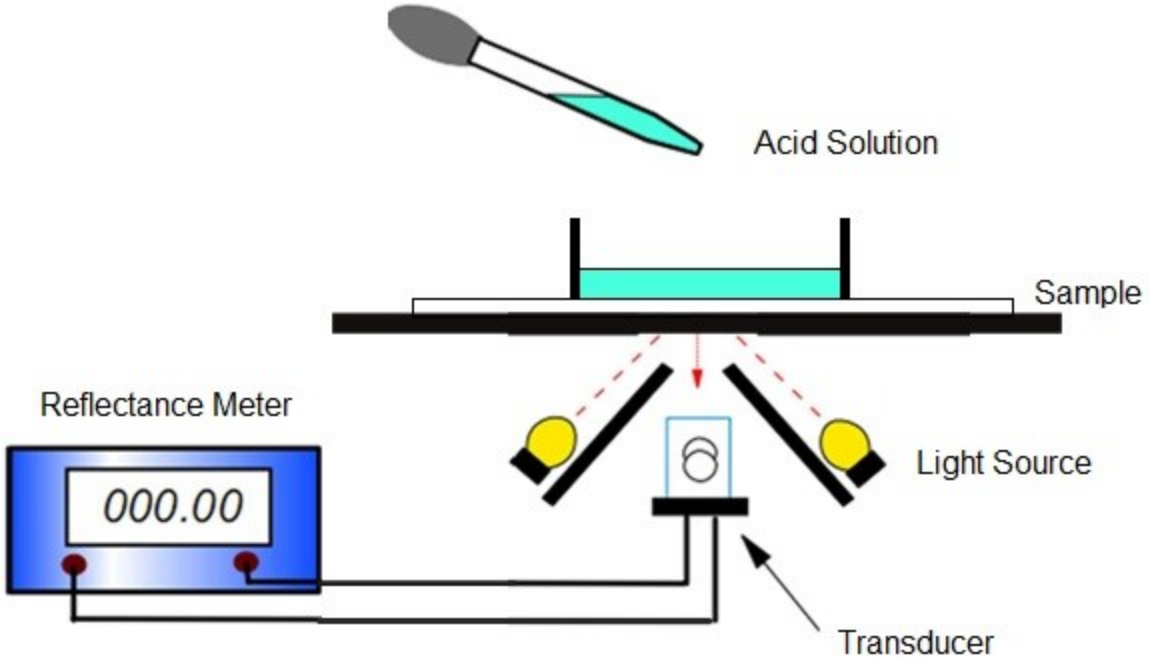
Heat sealing has a number of different packaging applications. The Sentinel Heat Sealer has two independently heated platens and can test a variety of nip pressures and dwell times. We generally test paperboard materials and determine the degree of heat sealability by measuring the percent fiber tear from the substrate. These tests provide a means for screening various coatings and laminating materials for a given application.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

HST (Hercules Size Test)

Return to Table of Contents

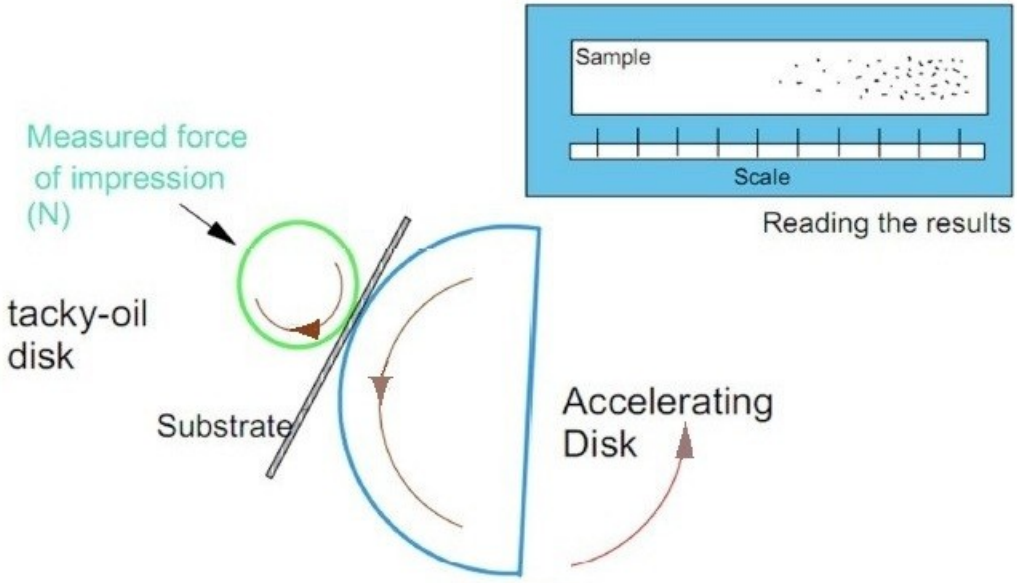
This is a measure of the sizing of paper or paperboard. The test measures the time required for a Formic Acid ink to penetrate the product and the test is run according to TAPPI Test Method T530. Various Formic Acid concentrations are used, depending on the paper product being tested.

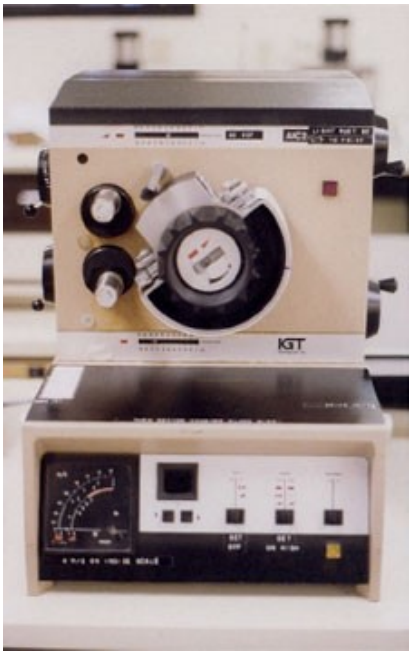


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

IGT Pick & Blister (Traditional Inking Unit) Return to Table of Contents

This test measures the ability of coated or uncoated paper or paperboard to resist picking or blistering during offset printing. The test device operates by applying a known film thickness of polybutyne oil of a given viscosity to an aluminum printing disk. The oil is applied to the disk with a standard IGT inking unit. The oil is transferred to the sample surface while under acceleration (ie, the application speed increases from 0 m/s to 4 m/s during the application). The oil creates a pulling action on the paper surface, like offset ink, resulting in picking, blistering, or both. The point at which the picking and blistering starts is the end point of the test. The reported units for both pick and blister are viscosity-velocity product (vvp). At a known oil viscosity, this value relates to the velocity or press speed that can be achieved before the sheet is damaged.

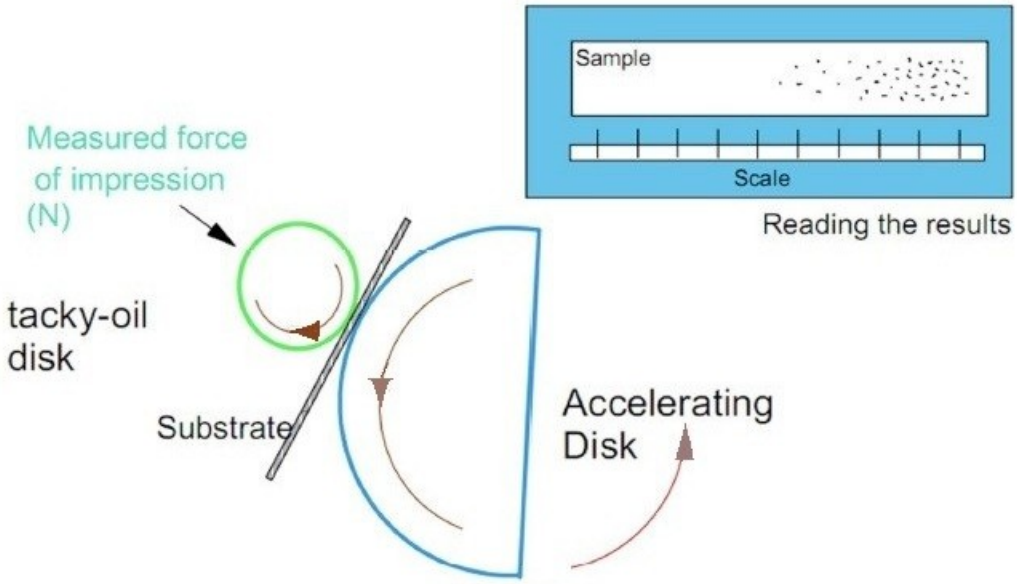


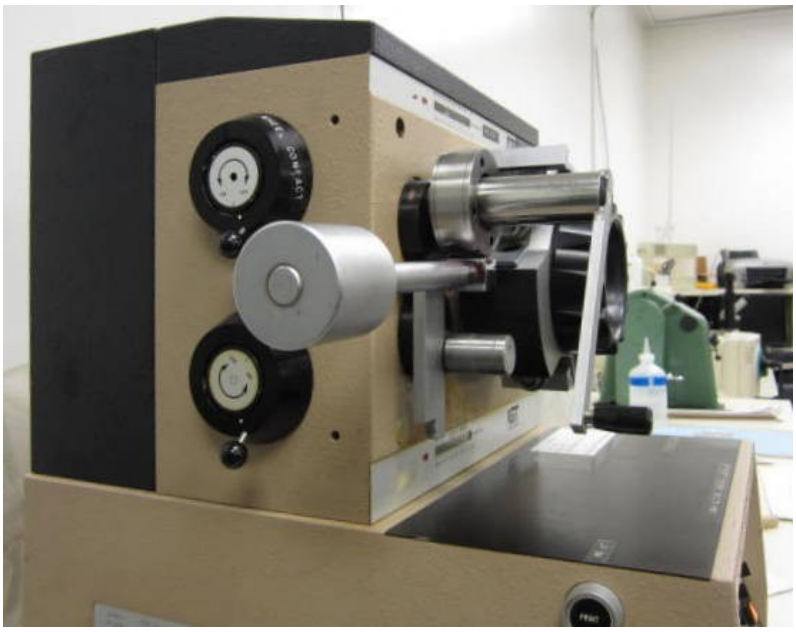


IGT Pick & Blister (Westvaco Rod Applicator)

Return to Table of Contents

This test measures the ability of coated or uncoated paper or paperboard to resist picking or blistering during offset printing. The test device operates by metering a 15µm film thickness of polybutyne oil of a given viscosity onto the surface of a steel roll with a Westvaco Rod Applicator. The oil is transferred to the surface of the substrate while under acceleration (i.e., the speed increases from 0 m/s to 4 m/s during application). The oil creates a pulling action on the paper surface, like offset ink, resulting in picking, blistering, or both. The point at which the picking and blistering starts is the end point of the test. The reported units for both pick and blister are viscosity-velocity product (vvp). At a known oil viscosity, this indicates the velocity or press speed that can be achieved before the sheet is damaged.



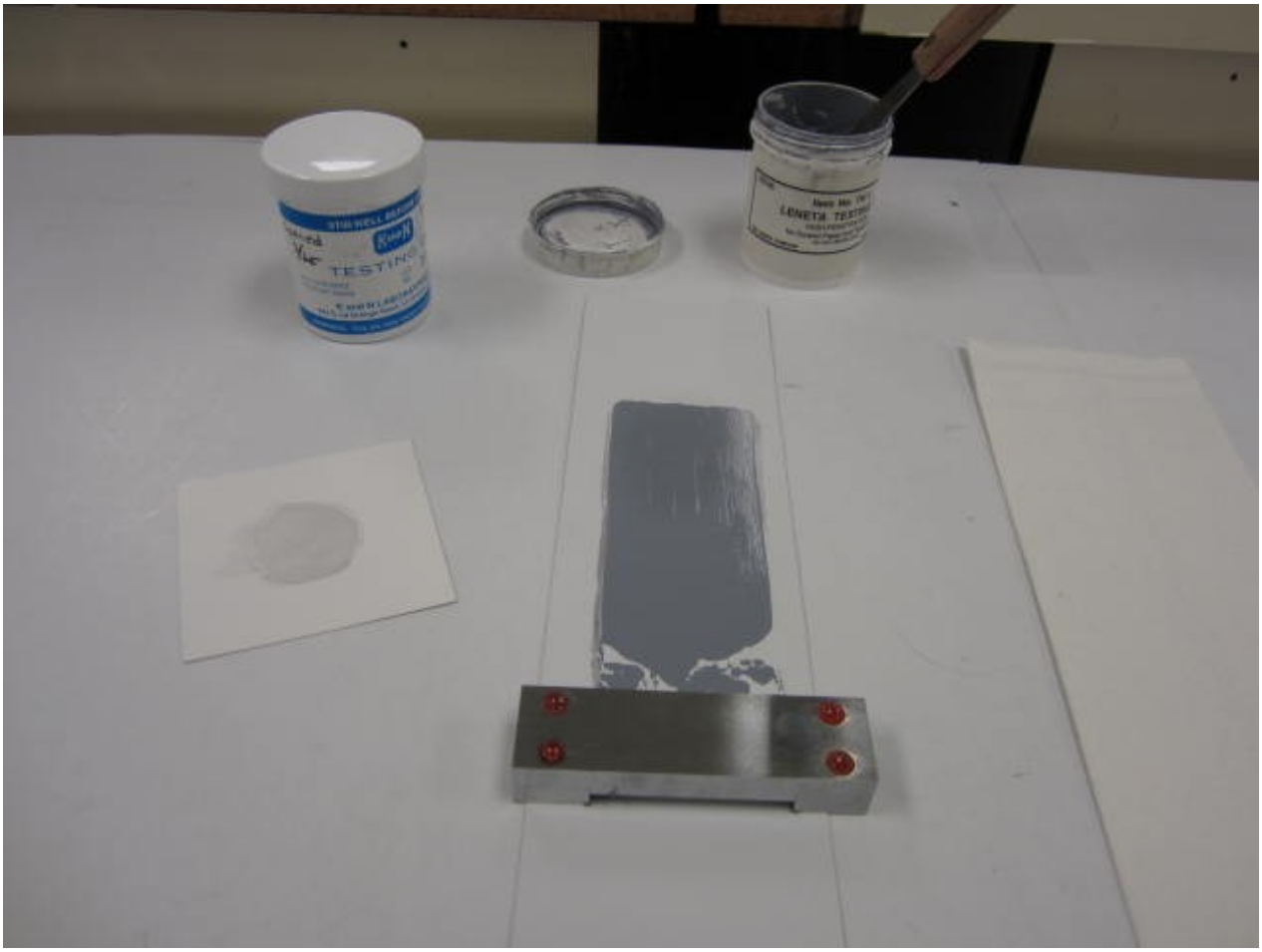


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Ink Absorption Tests (K&N, TK1, & TK2)

Return to Table of Contents

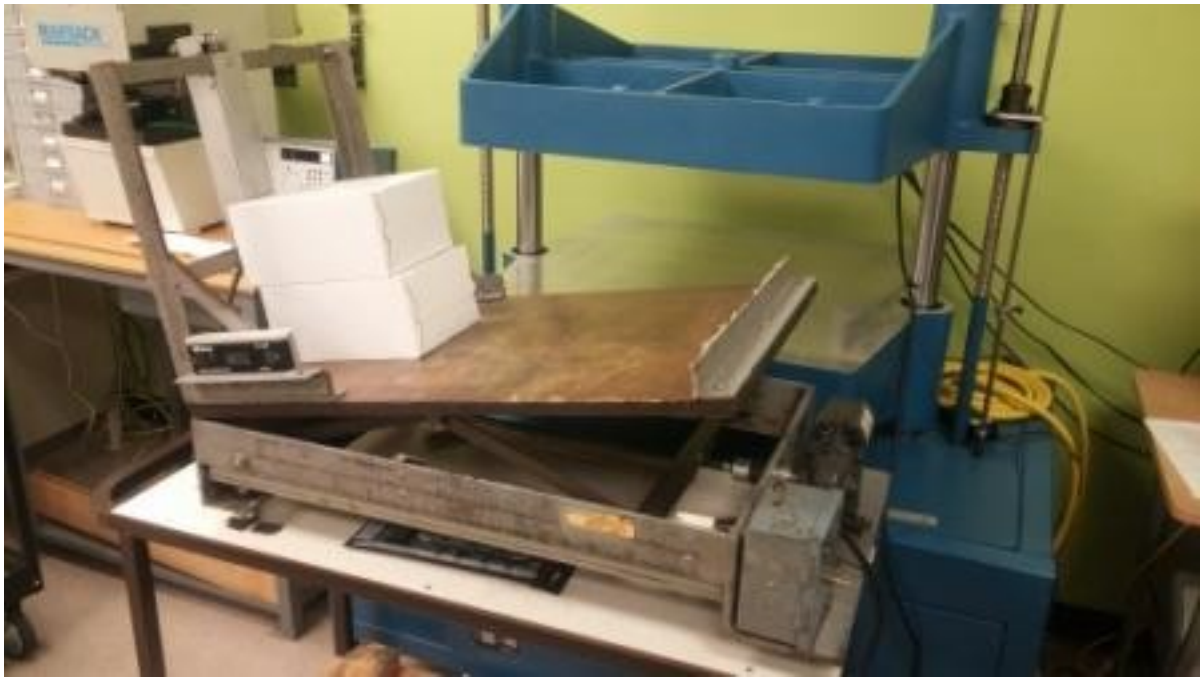
Ink smears or drawdowns have been used for years to evaluate the receptivity of paper or paperboard surfaces to oil based ink. These tests are intended to indicate the general level of absorbency and any variation in absorbency or mottle tendency. Ink is applied to the surface and is left in contact for a measured length of time. The ink is then wiped from the surface and the brightness drop measured. A surface that is more receptive to ink will show a larger loss in brightness.



MARA Slide Angle

Return to Table of Contents

The MARA Slide Angle test provides a way of measuring the slide angle of filled cartons. Two loaded cartons are placed onto the bed of the tester, one on top of the other. Care is taken not to handle the carton surfaces in contact with each other as this may influence the measurement. The bed of the tester is slowly raised to an increasing angle until the top carton slides on the bottom carton. The slide angle is recorded and the apparent static COF is calculated as the tangent of the slide angle.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Marbach Bench-Top Die Cutter

Return to Table of Contents

We have a Marbach bench top die cutter with a 4 inch footprint. It is a small version of a commercial die cutter. We are able to produce technically correct scores for a wide range of board calipers. We evaluate score cracking complaints by scoring board with the correct scoring geometry at 50% RH, 20% RH, and on oven dry board. This is an excellent tool to evaluate scoring issues. We also are able to show the effect of using incorrect scoring geometry.

Metal Detection

Return to Table of Contents

We have a commercial metal detector along with several sensitivity calibration standards. We test paper and board products that are suspected of containing metal. We check the entire sample, then, if metal is detected, we halve the sample and test both halves separately. If metal is found in one half only, we then halve that sample again and repeat the process until we get to a postage stamp size piece containing the metal. Then we go to the microscope and visually find the metal. This test is very useful when filled food cartons are being rejected since we can prove the presence of metal if it is in the paperboard.

We can also manipulate the sensitivity of the metal detector to determine the level at which known metal will set off the alarm.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

MIT Double Fold

Return to Table of Contents

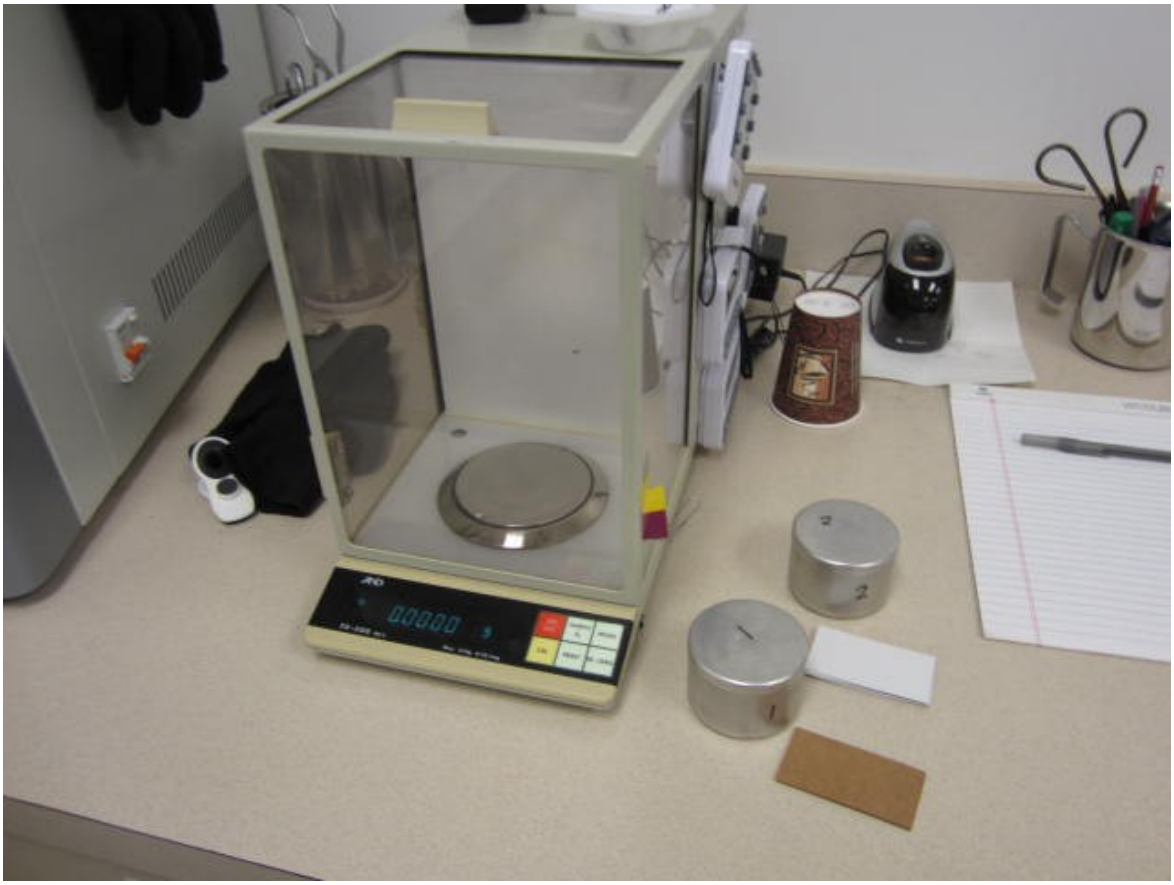
This test measures the resistance of paper to breaking during repeated folding, as per TAPPI Test Method T511. It was developed for use on publication papers, which are subjected to multiple folding and unfolding. The test has also been found to be useful in predicting score cracking tendency in high hardwood SBS board.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Moisture Content

Return to Table of Contents

This test measures the amount of moisture in pulp, paper or paperboard “as received” (TAPPI T412) or after conditioning at TAPPI Laboratory Conditions (73°F and 50% RH per TAPPI T550). A representative sample of the material to be tested is placed in a sealed pre-weighed weighing tin and the initial sample weight is determined. The weighing tin is then opened in an oven environment of 105°C until the weight of the same no longer changes with time. The “dry” weight of the sample is measured and the % moisture of the original sample is calculated. Papermaking fibers naturally absorb moisture from the environment and the amount of moisture in paper or paperboard significantly affects strength and elastic properties. TAPPI Test Method T402, Standard conditioning and testing atmospheres for paper, board, pulp handsheets, and related products, provides conditions for preconditioning and conditioning of paper materials to help control moisture content prior to testing.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Mullen Burst

Return to Table of Contents

This test measures the ability of paper, paperboard, or combined board to resist the penetration of a hydraulic ram that is reminiscent of a human thumb. The test is conducted according to TAPPI Test Method T403, T810, or T807, depending on the grade being tested.

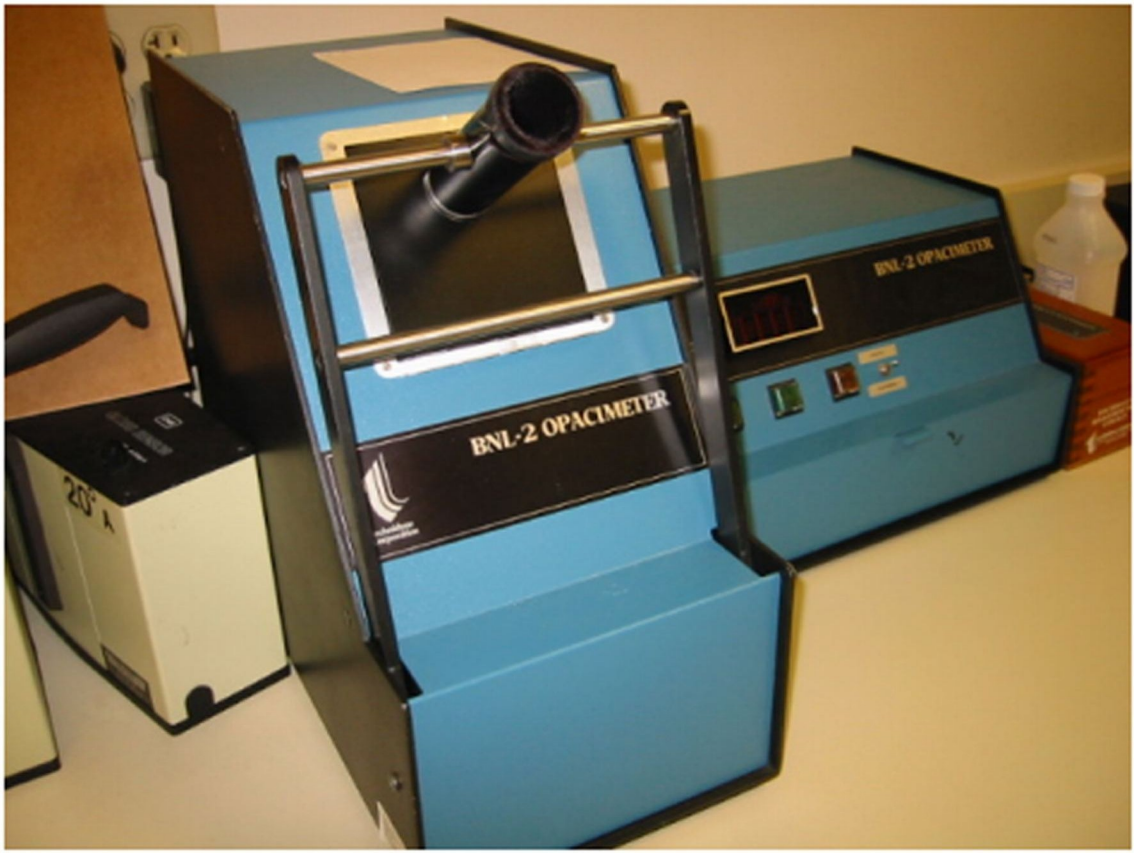
The ram is pressed against the surface of the paper product that is clamped between two circular clamps. The test result is in units of pressure within the hydraulic ram required to burst the paper product.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Opacity

Return to Table of Contents

Opacity is a measure of the ability of paper to obstruct the passage of light through the sheet, and is run according to TAPPI Test Method T425. Paper opacity determines whether text or graphics are visible from the opposite side of the paper. Opacity is influenced by basis weight and filler or coating materials that are added to the sheet. Percent opacity is the ratio of the reflectance of a single paper sheet backed with a black backing to the reflectance of the same sheet backed with a white backing. If the white backing is a stack of the same paper, the opacity value is referred to as printing opacity. If the white backing is a surface with a 0.89 reflectance, the opacity value is referred to as contrast ratio.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

PCA Score Bend and Opening Force Return to Table of Contents

The PCA Score Bend Tester is the predominant instrument for measuring carton opening force and the force to fold carton flaps and body scores. In addition to measuring peak force we measure spring back, which is the force exerted by the sample after the score has been bent to 90° and has been held there for 20 seconds. Score ratio, is the ratio of the force required to bend a scored paperboard sample to the force required to bend an unscored paperboard sample.

Opening force is the maximum force required to fully "open" a flat folded carton until all four of the carton corners are 90°. A separate test fixture is used to press on opposite sides of the flat-folded carton to open it. Spring back can also be measured as the force exerted by the open carton after it has been held open for 20 seconds.

PCA Score Bend

PCA Opening Force

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Peel Force Testing (Thwing-Albert)

Return to Table of Contents

We use a Thwing-Albert Friction/Peel Tester (Model 225-1) to measure the peel force for various types of materials, adhesives and tapes. Testing is done according to ASTM D1876. The instrument has a 2000 g load cell and can measure samples of different widths at different test speeds. The length of the peel can also be adjusted to accommodate the size of the test sample. While the test speed can be adjusted, measurements can only be made at speeds of less than 22 inches per minute.

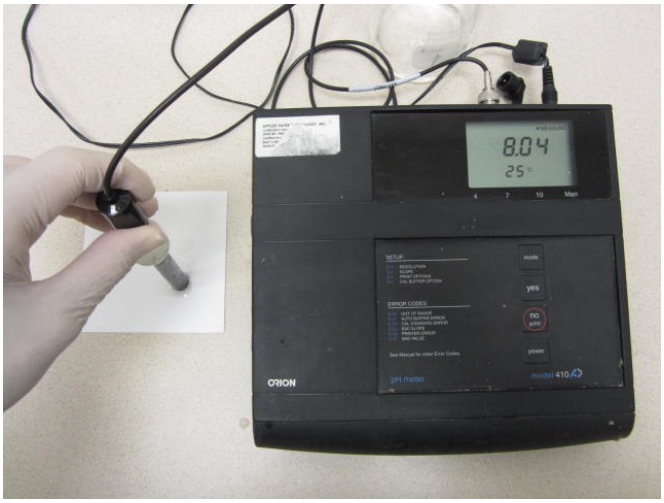
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

pH – Surface, Cold Extraction and Hot Extraction

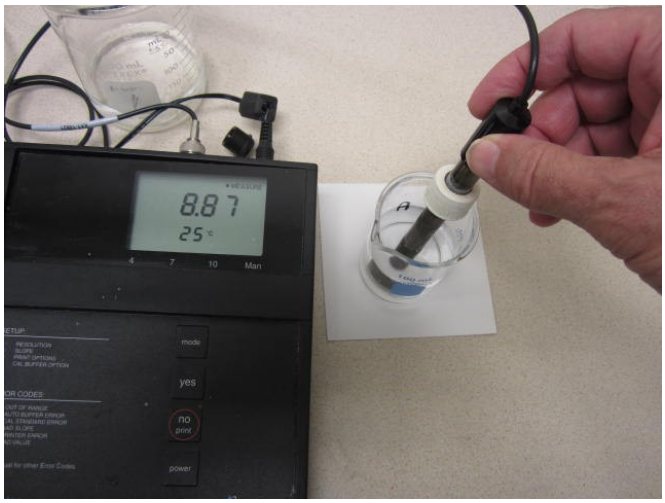
Return to Table of Contents

We measure surface pH according TAPPI test method T529. A drop of distilled water is placed on the surface to be tested, either coated or uncoated. A surface pH probe is placed on top of the drop and allowed to equilibrate for five minutes. At the end of five minutes the pH of the wetted surface is recorded.

We also measure cold extraction pH according to TAPPI test method T509 and hot extraction pH according to TAPPI test method T435.



Surface pH



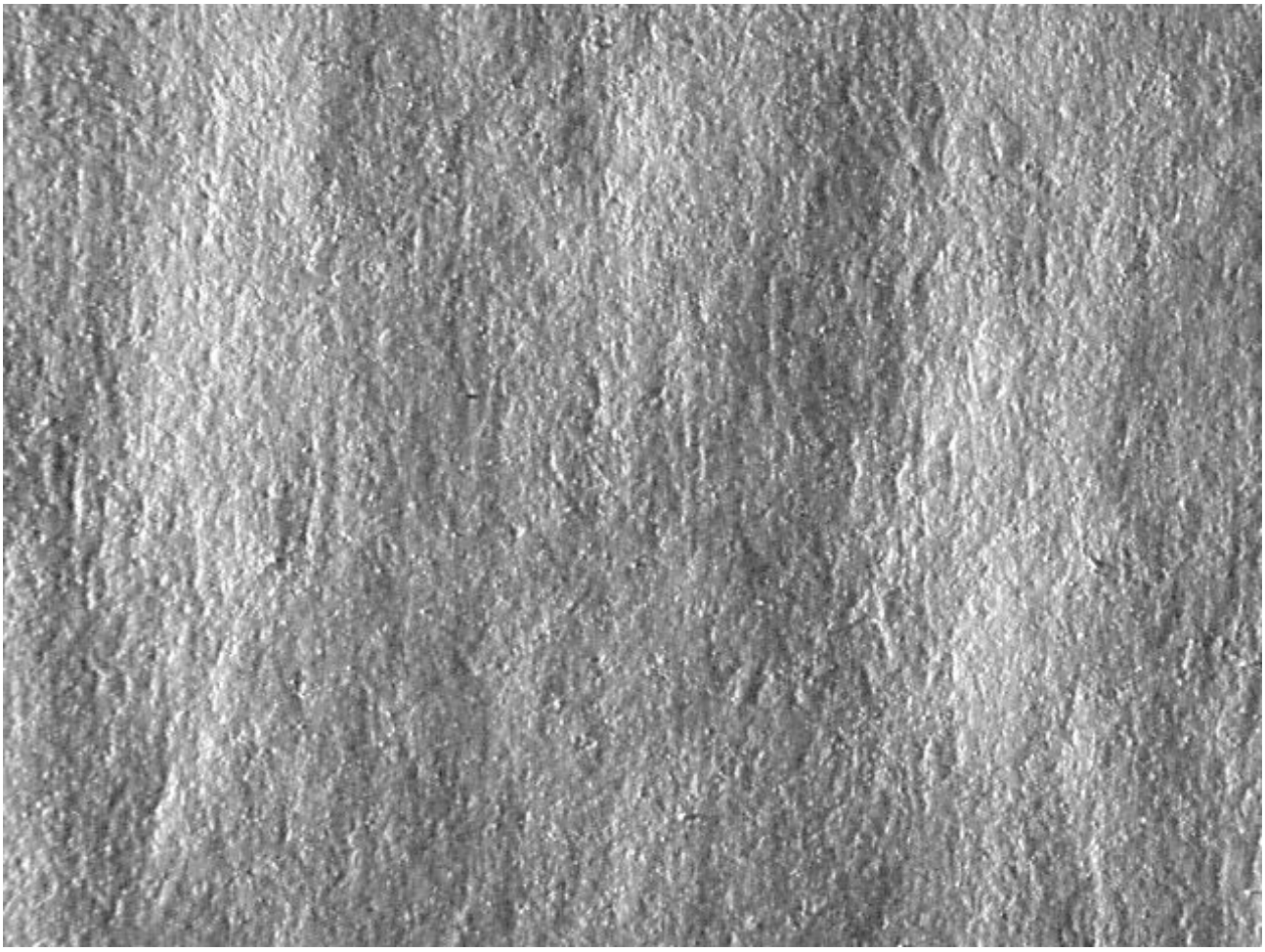
Hot or Cold Extraction pH

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Photomicrographs

Return to Table of Contents

We produce photomicrographs using low angle light and moderate magnification to show the hills and valleys or the topography of paper and board surfaces. These images show characteristics that influence printability, and they are an excellent tool for comparing coated and uncoated surfaces.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Pin Adhesion

Return to Table of Contents

Pin Adhesion is a test of corrugated board. It measures the strength of the adhesion of the flutes to the adjacent liner. Testing is run according to TAPPI Test Method T821. There are a couple of different ways to run the test. There is a selective method, in which the operator forces failure to occur on only one side, measuring the force required to separate the flutes from the liner. There is also a non-selective method in which the failure is allowed to occur at the weakest interface.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Porosity (Gurley)

Return to Table of Contents

This is a test of the openness of uncoated papers. We conduct this test according to TAPPI Test Method T460, using a Gurley porosity tester. The instrument measures porosity by forcing air through the sheet and measuring the rate of flow. More open sheets allow air to pass through the sheet more rapidly. The units for Gurley Porosity is seconds/100 cc^3

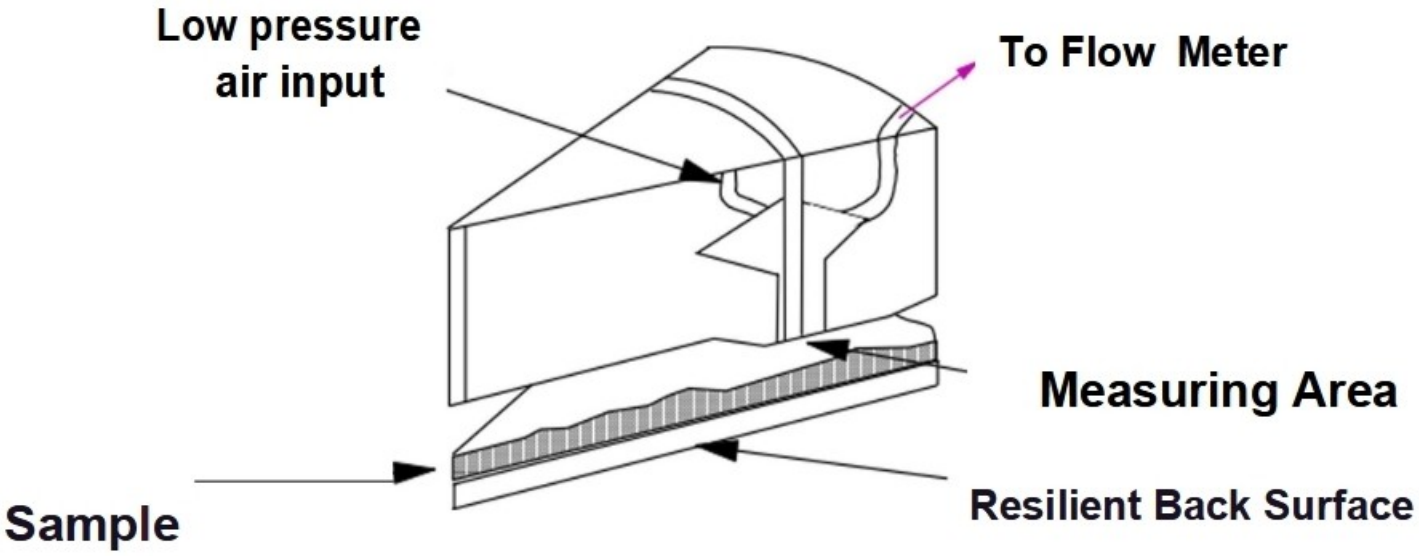
The porosity test is sometimes used on coated paper or coated paperboard. These products are not generally porous, so the apparent porosity measurement is in reality a measurement of air leakage from the clamp.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Parker Print Surf (PPS)

Return to Table of Contents

PPS is an air leak smoothness test that responds to relatively small imperfections in the coated surface. A smoother surface results in a lower PPS value. The test device can apply several levels of pressure , with less pressure used for smoother surfaces. We run this test according to TAPPI Test Method T555.

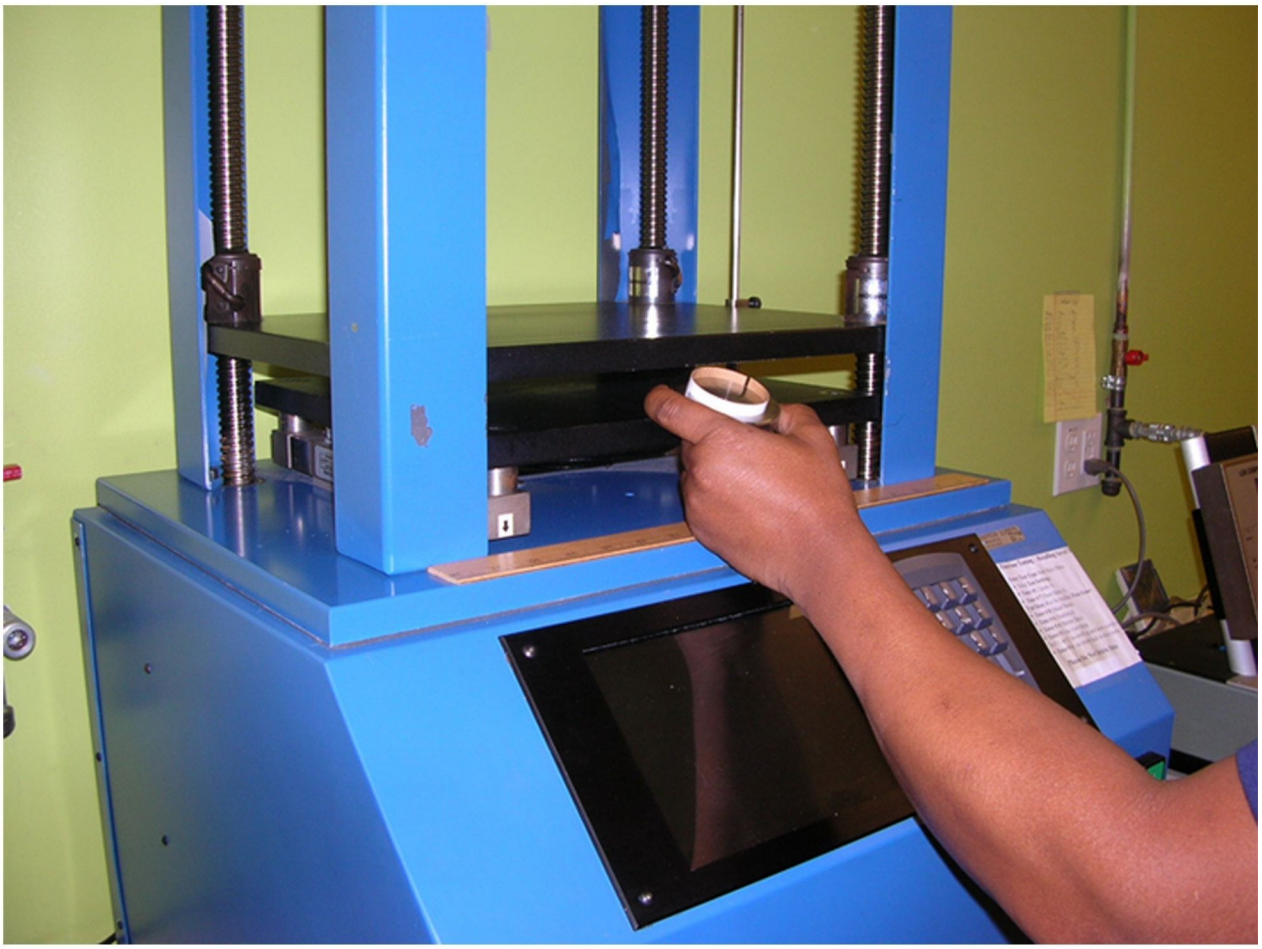


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Ring Crush

Return to Table of Contents

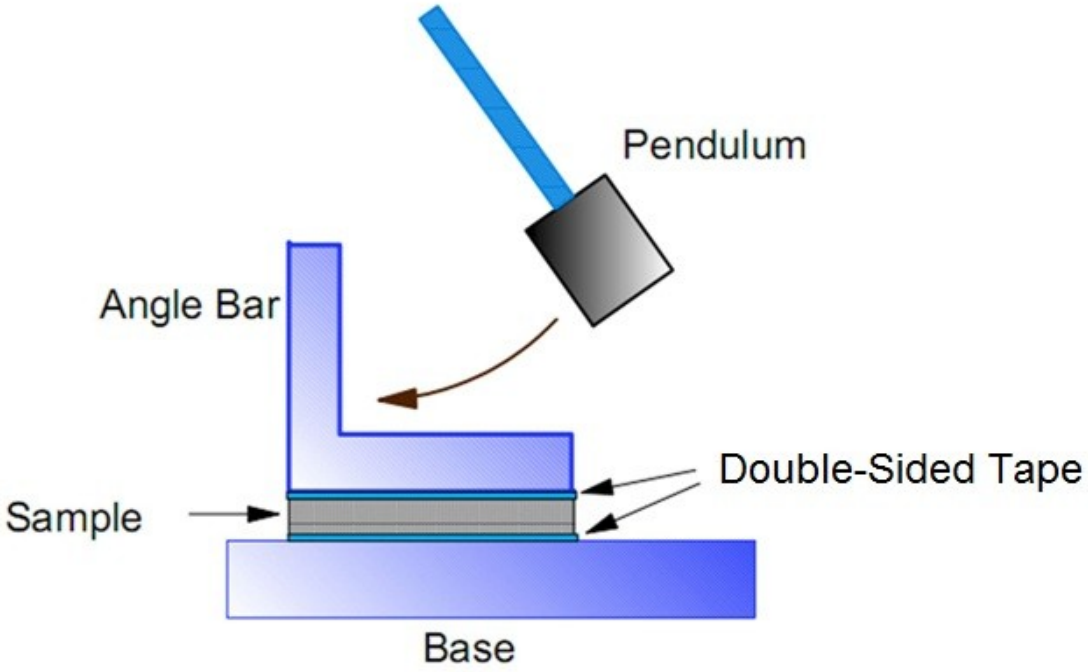
This is a traditional test of linerboard and corrugating medium strength. Ring crush measures compression resistance, and this compression strength is considered to relate to the eventual compression strength of combined board made from the components. The test is run according to TAPPI Test Method T822. Linerboard called high strength or high performance linerboard is board that is able to achieve a specified minimum ring crush at basis weights that are lower than traditional basis weights.



Scott Plybond

Return to Table of Contents

The Scott Plybond test measures the internal bonding strength of paper, using a lifting motion that is somewhat similar to peeling. A pendulum strikes an aluminum angle bar that has been taped to the paper. If the paper has high internal bond strength, the energy in the pendulum is absorbed to a greater degree. This test is used for both single-ply products and multi-ply products, and is run according to TAPPI Test Method T569.

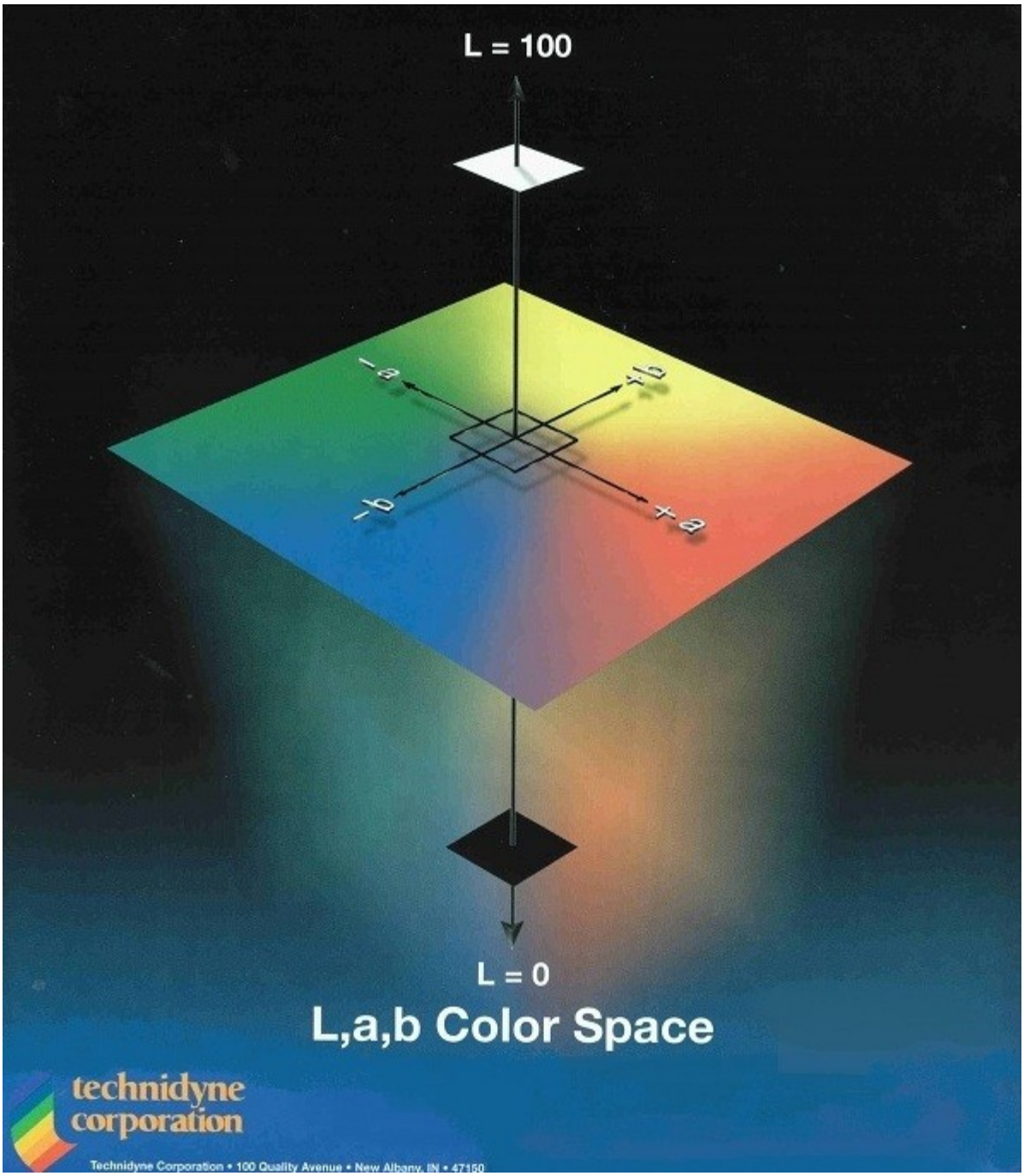


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Shade

Return to Table of Contents

Shade is measured using the L, a, b system. L measures the whiteness on a 0-100 scale. It is similar to brightness. The "a" value indicates the red-green component of shade, with positive values being more red and negative values being more green. The "b" value indicates the blue-yellow component of shade, with positive values being more yellow and negative values being more blue. Shade is generally measured according to TAPPI Test Method T524.

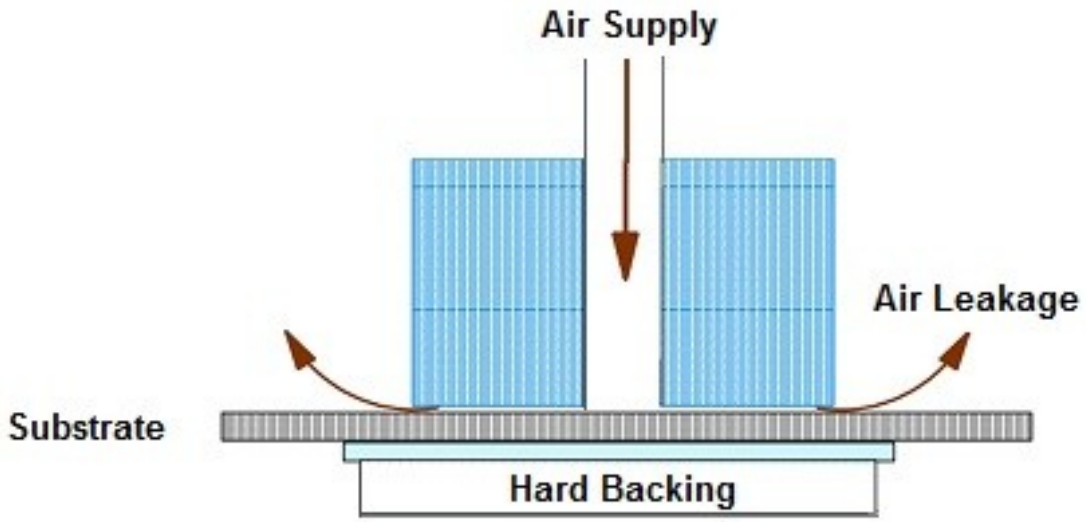


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Sheffield Smoothness

Return to Table of Contents

Sheffield Smoothness is an air leak smoothness test that responds to relatively large surface imperfections or undulations. A smoother, more level surface results in a lower Sheffield Smoothness value. We use a Haggerty test device to measure Sheffield Smoothness according to TAPPI Test Method T538.

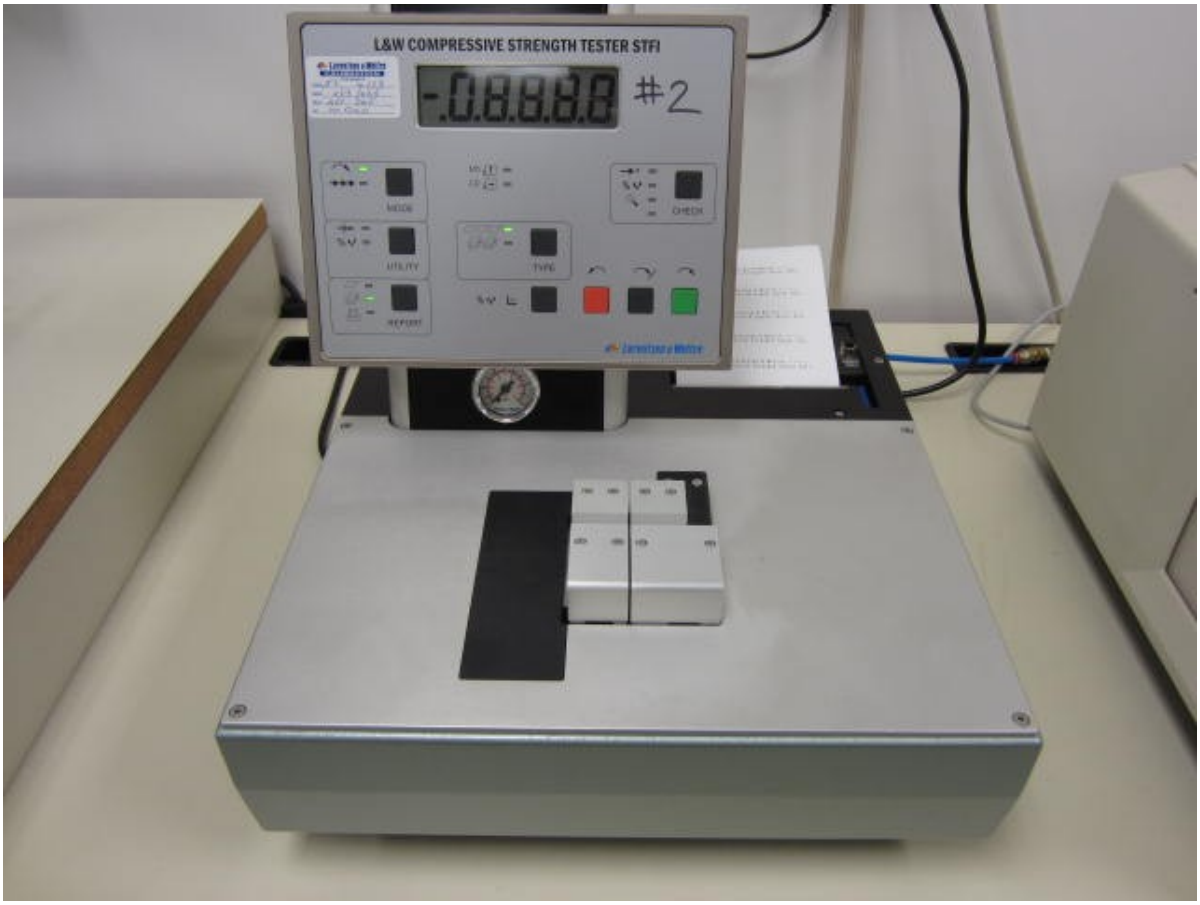


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

STFI Compression

Return to Table of Contents

The STFI instrument measures the compression strength of linerboard and corrugating medium, using essentially a zero span or gap. This test is an alternative to ring crush and is intended to relate to the eventual compression strength of combined board made from the components. The test is run according to TAPPI Test Method T526.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Stiffness – Taber, L&W, Gurley

Return to Table of Contents

Bending stiffness is an expression of the of the rigidity of paper of paperboard. This property is related to the modulus of elasticity or the product and its thickness. There are several instruments in use in the industry that measure stiffness, and they all bend the product to measure stiffness. There are 2-point bending instruments and 4-point bending instruments. Solid fiber board and small fluted combined board (to be used in folding cartons) are typically measured with 2-point bending instruments.

Commonly used instruments include Taber (TAPPI Test Method T489), Gurley (TAPPI Test Method T543) and L&W (TAPPI Test Method T556). In the USA, Taber Stiffness is the most common stiffness measurement. In Europe, L&W is most common.

When stiffness is reported it is important to know how much bending took place. The typical Taber Stiffness test for solid fiber board uses a 15 degree bending. Small flute combined board cannot be bent to 15 degree without damaging the product, so it is necessary to bend it to a lesser angle of 7.5 degrees. We discard results when we recognize the sample was damaged at 7.5 degrees.

The L&W instrument can be set to reach an end-point at various degrees of bending. We use an angle of 5 degrees when testing small flute products on this instrument. This helps assure that the sample is not damage and is a common bending angle used in Europe.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Sutherland Rub Test

Return to Table of Contents

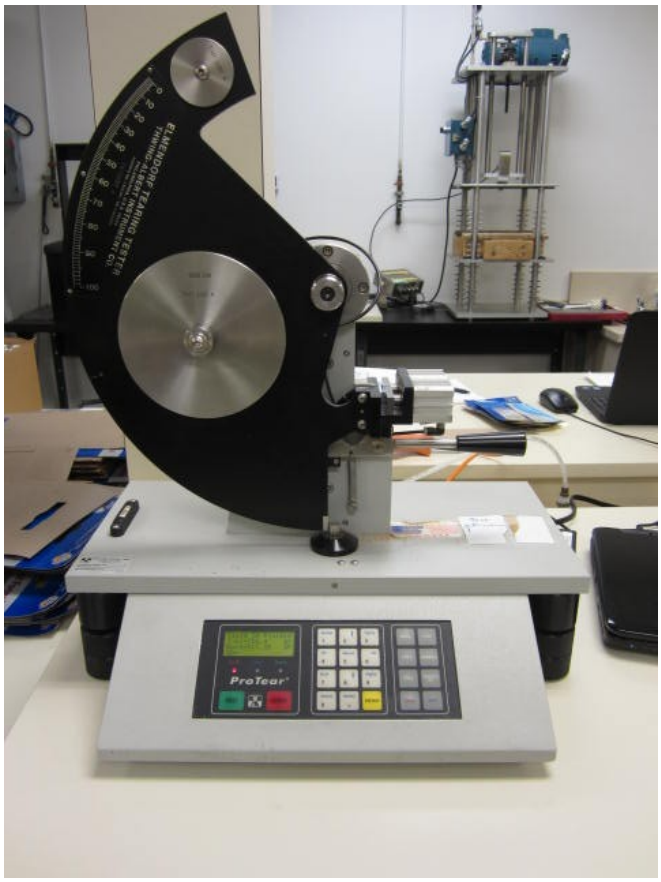
The tester is a motor driven instrument for moving a weighted test strip over a printed specimen through an arc. This test instrument is used in various ways to expose paper surfaces to a rubbing action and test its resistance to damage. The test is generally run according to TAPPI Test Method T830. Some tests are run dry, while others are run wet or with moistening of the surfaces. Some tests are run with the test material rubbed against itself, while others rub the surface with some other material.

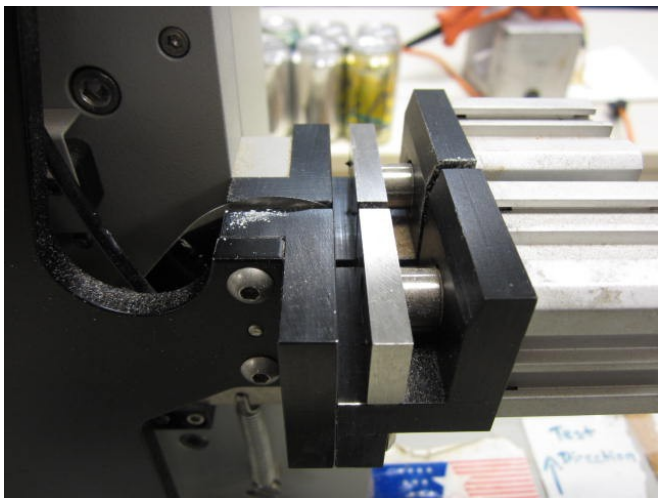
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

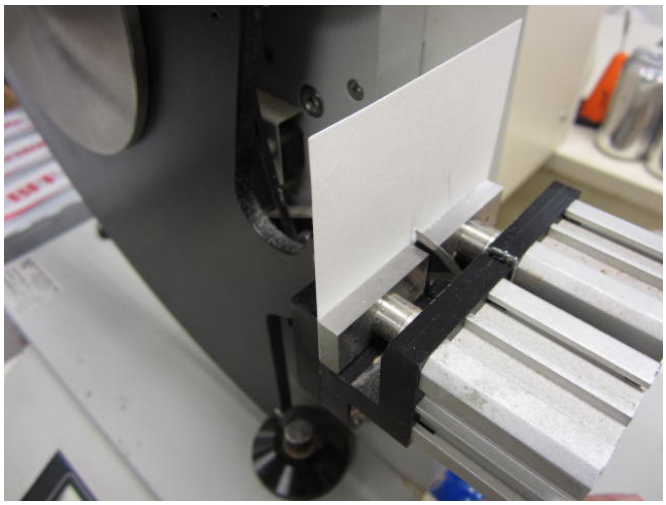
Tear, Dry & Wet

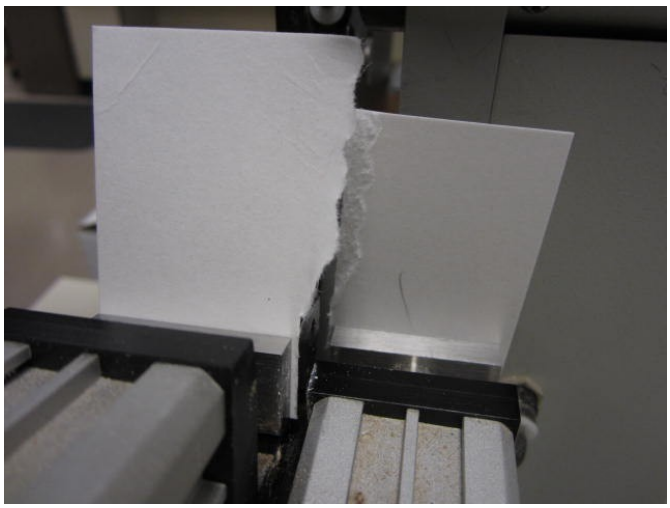
Return to Table of Contents

The Elmendorf type test of internal tear resistance measures the force required to tear a paper that already has a cut to initiate the tear. The Tear test is run according to TAPPI Test Method T414. The test is performed on either conditioned paper (dry) or saturated paper (wet). Wet tear is of interest where paper products are to be used in a wet environment.







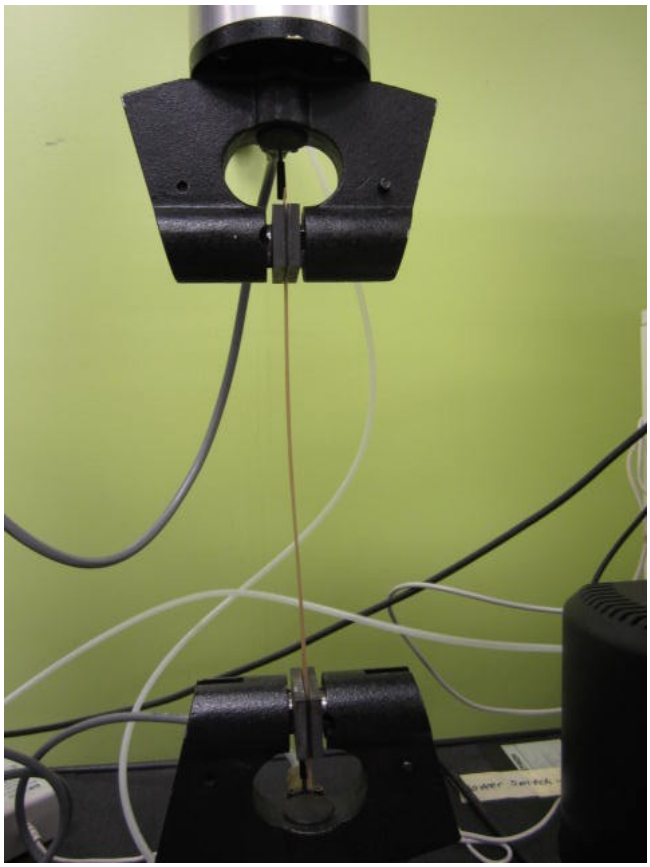


APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Tensile, Stretch, TEA

Return to Table of Contents

Tensile strength is the ability of material to maintain its integrity when under tension, and the test is run according to TAPPI Test Metod T494. Samples are cut to prescribed widths, clamped, and pulled to the breaking point. Stretch is the amount of extension that takes place during the test. TEA, tensile energy absorbed, is the amount of work that is done during a tensile test. Tensile tests are run on standard conditioned paper samples or on samples that have been saturated with water. This is wet tensile. Wet tensile is of interest where paper products are used in wet environments.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Waldorf Hot Melt Gluability

Return to Table of Contents

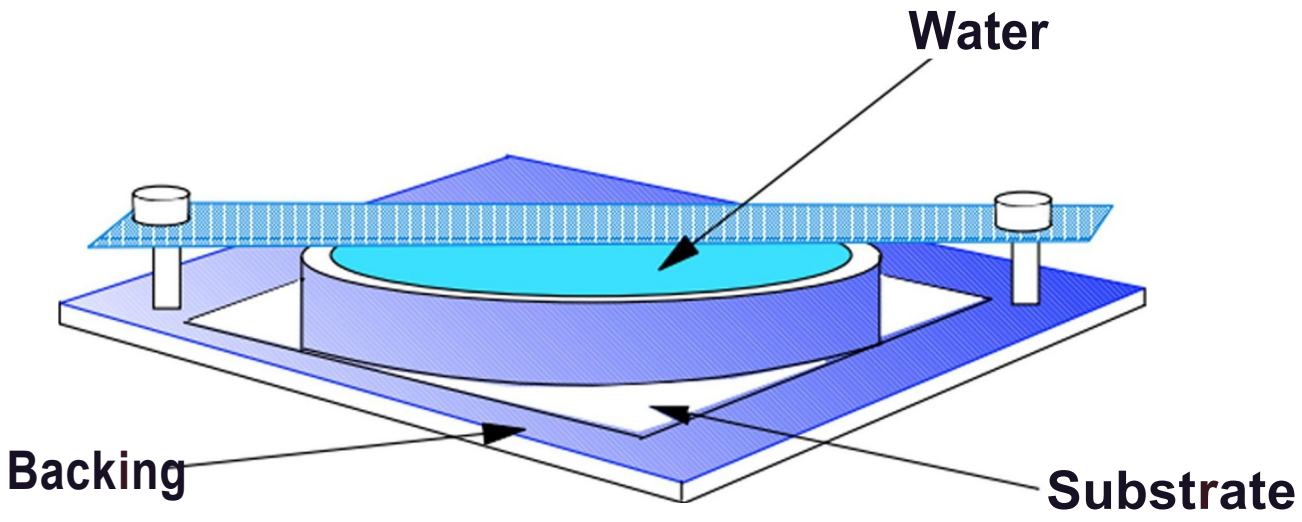
We use the Waldorf Hot Melt Glue tester to evaluate the gluability of paper and paperboard because it allows very good control of conditions, including glue temperature, open time, and compression time. We use a standard hot melt glue or we use customer's hot melt glue when it is provided. We use this instrument to evaluate glues on standard paperboard. This instrument can also glue corrugated samples.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Water Cobb

Return to Table of Contents

Water Cobb is a test of surface and internal sizing and is run according to TAPPI Test Method T441. It can be run from either the back side or the coated side of the paper. Each test evaluates a different property of the paper. The test run from the back side measures the base sheet sizing. The test run from the coated side responds to the "openness" of the coating. This method is less frequently used. A column of water is placed on the paper for 2 minutes, and the amount of water absorbed is measured. More water resistance will result in a lower Water Cobb value.



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

Wax Pick

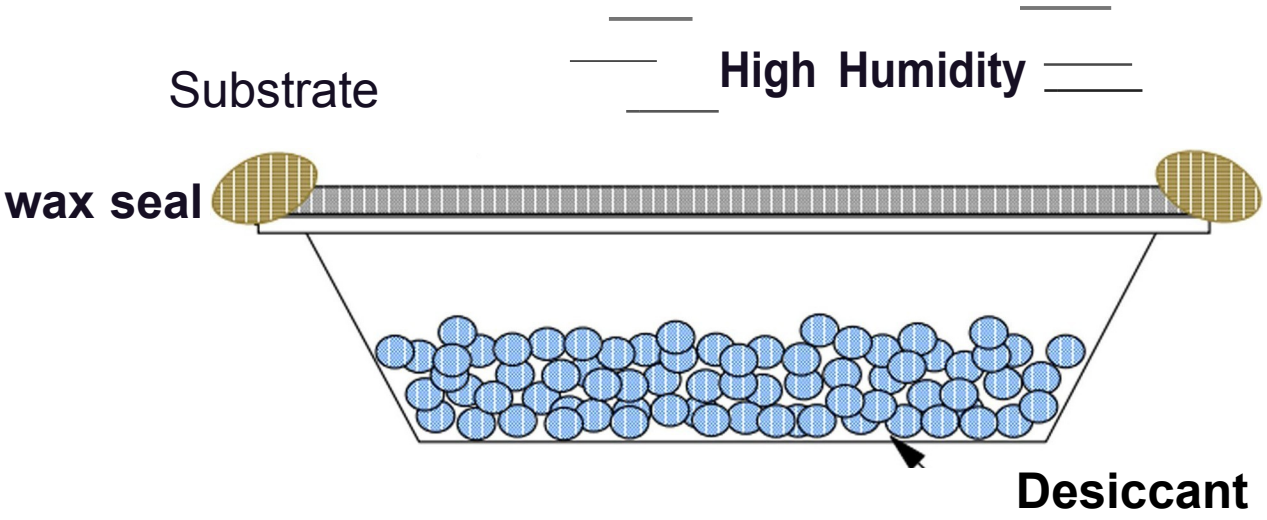
Return to Table of Contents

The Dennison Wax Pick test is used on paper and board to measure surface strength, or to measure how well the fibers are attached at the surface. It is run according to TAPPI Test Method T562. In this test, waxes with different hardness are heated and applied to the surface being tested. When they have cooled they are pulled away from the surface. The waxes are numbered with higher numbers assigned to harder waxes, so the higher the wax pick number, the stronger the surface strength of the substrate.
The wax pick number is the highest hardness wax that does not pick fiber from the surface.

APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

WVTR (Water Vapor Transmission Rate) Return to Table of Contents

WVTR (also referred to as MVTR, Moisture Vapor Transmission Rate), is a measure of the rate at which water vapor in the surrounding atmosphere will pass through a paper product. A specified relative humidity, % RH, is on one side of the sample and a desiccant is on the other side. The change in weight of the desiccant over time is a measure of the transmission of water vapor through the substrate. The test is usually run for 3 days, with a measurement taken each day. The water vapor transmission rate is calculated and is reported in g/m²/day. The test is run according to TAPPI Test Method T448 or T464, depending on the specified relative humidity.



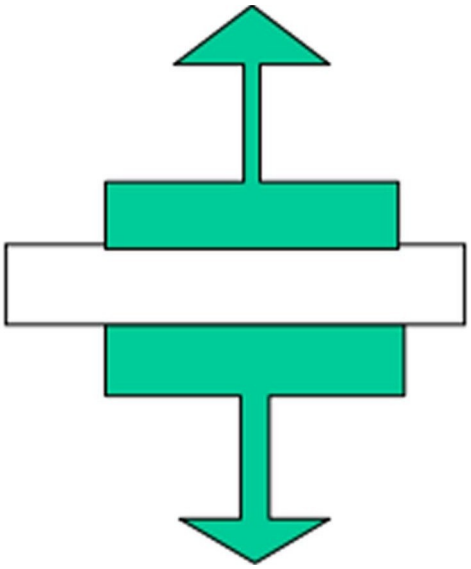
APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com

ZDT (Z-Direction Tensile)

Return to Table of Contents

This test uses double-stick tape to attach the sample to anvils in a test instrument. The anvils are then separated while measuring the maximum force required to delaminate the sample. ZDT is a measure of the internal bond strength of paper or paperboard. It is particularly useful for measuring the internal bond strength of single-ply sheets. The test is run according to TAPPI Test Method T541.

Paper or Paperboard
(attached with double-stick tape)



APPLIED PAPER TECHNOLOGY, INC.
678 627-0222 I 1935 DELK INDUSTRIAL BLVD., SUITE B, MARIETTA, GA 30067 I APPLIEDPAPERTECH.com