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Standard Practice for Determining the Resistance of Carbonless Papers to Capsular Damage[1]

This standard is issued under the fixed designation F 598; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 The test procedures of this practice are applicable to any carbonless paper product that employs a coating of microcapsules bonded to one side of the paper wherein the active material within the capsules is a colorless reactant capable of generating color when the capsules are broken and the contained solution is simultaneously transferred to a reactive receptor surface capable of changing the chemical from a colorless to a colored condition.

1.2 The procedures are designed to demonstrate the extent of damage incurred by (*1*) controlling the rate of slippage of test units held in contact with each other under a calibrated weight and (*2*) by the controlled application of pressure to test units held stationary with respect to each other.

1.2.1 The first test procedure is designed to demonstrate the resistance to capsular damage related to plies slipping under pressure.

1.2.2 The second test procedure is designed to demonstrate the resistance to capsular damage related only to pressure, such as between plies within rolls, between sheets in a stack or due to nip effects in web processing, converting, or end-use equipment.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 585 Practice for Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, and Related Products

D 685 Practice for Conditioning Paper and Paper Products for Testing

D 774/D 774M Test Method for Bursting Strength of Paper

F 549 Terminology Relating to Carbonless Copy Products

2.2 *TAPPI Standard:*

T 425 Opacity of Paper (15°/Diffuse Illuminant A, 89% Reflectance Backing and Paper Backing)[3]

2.3 *ANSI Standards:*

IT 2.16–1995 [4]

IT 2.17–1995 [4]

3. Terminology Definitions

3.1 Refer to Terminology F 549.

4. Summary of Practice

4.1 *Test Under Dynamic Conditions*—A receptor (CF) test unit of fixed area is held in position under fixed pressure while a donor test unit of specified length is drawn under it by controlled mechanical means. The receptor coated side of the CF sample and the donor coated side of the CB sample must be in contact.

4.2 The degree of color development, as indicated by the contrast ratio between the CF test specimen and the background is used to calculate the damage factor.

4.2.1 Reversing the positions of the CF and CB test units will result in an invalid test. In a situation where the fixed area of CB test unit is affected by a strip of CF unit, an attenuation of the released reactant will occur along the length of the test area. The test must be conducted according to the conventions specified under 4.1 or the test conditions are not being met.

4.3 *Test Under Stationary Conditions*—CB and CF units of identical areas are placed face to face and subjected to controlled pressure without slippage. The degree of color development on the CF test specimen, as indicated by the contrast ratio between the test specimen, and the background is used to calculate the damage factor.

5. Significance and Use

5.1 The primary purpose of these tests is to obtain information from a statistical sampling of a lot or shipment of paper

[1] This practice is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.06 on Carbonless and Thermal Imaging Products.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from the Technical Association of the Pulp and Paper Industry, P.O. Box 105113, Atlanta, GA 30348.

[4] Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036.

that will predict how well the whole lot will resist capsular damage from normal handling processes, either in manufacturing or in subsequent processing, storage, and use.

5.2 Other aspects of significance are covered in 1.2.

6. Interferences

6.1 If tests are performed as specified, there are no known interferences.

7. Apparatus

7.1 *Bursting Strength Tester*[5]—Modified ASTM/TAPPI bursting strength tester (see Annex A1).

7.2 *Smooth Steel Plate*, 3 by 3 by ¼ in. (76 by 76 by 6.4 mm) thick, for modifying clamp of bursting strength tester.

7.3 *Opacimeter*—Standard ASTM/TAPPI (BNL) Opacimeter or alternative reflectometer (see Annex A2).

7.4 *Motorized Dynamic Slippage Tester*. [5,6]

7.5 *Stop Watch or Timer*.

8. Sampling

8.1 The sample of the lot of paper to be tested shall consist of a percentage of test units so selected that the sample is statistically representative of the average quality of the lot.

8.2 *Test Under Dynamic Conditions*—The size of the individual test units shall be: CF sheet, 2 in. wide by 13 in. (51 by 330 mm) long, long side in machine direction; CB sheet, 2⅛ in. wide by 13 in. (54 by 330 mm) long, long side in machine direction.

8.3 *Test Under Stationary Conditions*—The size of both CF and CB test units shall be 3 by 3 in. (76 by 76 mm).

9. Calibration

9.1 *Bursting Strength Tester*—For general information on the calibration and use of bursting strength testers, refer to Test Method D 774 and Annex A1.

9.2 *Opacimeter/Reflectometer*—For general information on the calibration and use of BNL Opacimeter/Reflectometers (or alternative instruments), refer to TAPPI T 425, ANSI IT 2.16 and IT 2.17 and Annex A2.

9.3 *Dynamic Slippage Tester*—Information on calibration and use will be furnished by manufacturer or purchaser.

10. Conditioning

10.1 Condition the test units for at least 12 h at 73± 2°F (23 ± 1°C) and 50 % relative humidity prior to testing. Refer to Practice D 685.

11. Procedure

11.1 *Test Under Dynamic Conditions*—This test should be conducted in a conditioned cabinet or room with the temperature and relative humidity controlled as specified in Section 10. Each sample is run in triplicate.

11.1.1 Pull a fixed length of CB test unit under a fixed area of CF test unit.

11.1.1.1 The characteristics of the dynamic slippage tester are such that the CF test unit will be affected by the entire length of the exposed CB test unit at a rate of 1 ft/s (305 mm/s) with a contact area of 2¼ in.^{2}(14.51 cm ^{2}) under a pressure of 4 psi (28 kPa).

11.1.2 After 10 min ± 30 s, take reflectance readings on the CF test specimen at three equidistant intervals across the affected area, being careful to avoid the edges when taking the readings. Average the three readings for calculation and reporting.

11.1.3 Optionally a control sample with known performance qualities can be run at the same time. Follow the same procedure as given in 11.1.1 and 11.1.2.

11.2 *Test Under Stationary Conditions*—The test should be conducted in a conditioned cabinet or room, with the temperature and relative humidity controlled as specified in Section 10. Each sample is run in triplicate.

11.2.1 Insert the CB test unit first, capsular coated side up, onto the bottom plate of the tester clamp, followed by the CF unit, face side down. Then carefully position the metal plate over the top side of the CF unit.

11.2.2 Lower the bursting strength tester clamp into position and increase the diaphragm pressure to 300 psi (2.1 MPa) within 5 s. Hold the pressure at 300 psi for 30 ± 1 s and then relieve. Carefully remove the test units from the tester without separating and keep in contact without pressure for 24 h.

11.2.3 After 24 h, discard the CB test unit and read the reflectance of the CF test specimen. Take three readings, avoiding any readings from the edges of the affected area. Average the three readings for calculation and reporting.

11.2.4 Optionally a control sample with known performance qualities can be run at the same time. Follow the same procedure as given in 11.2.1 through 11.2.3.

12. Calculation

12.1 Calculate the damage resistance as follows:

$$\text{Percent damage resistance} = \frac{\text{reflectance of test specimen} \times 100}{\text{background}}$$

Background is determined in advance by taking the average of three reflectance readings for each receptor test unit.

13. Report

13.1 Report the contrast ratio to the nearest whole percent of the average of three readings per test specimen. Use data from three individual test units. The reported result will therefore consist of an average of a total of nine readings.

14. Precision and Bias

14.1 This practice will provide repeatable ranking order results or repeatable relationship to a control within a laboratory using the same equipment. It may not be possible to establish a reproducible ranking order and comparative results between locations because of differences in equipment, materials, and conditions.

[5] The sole source of supply of the bursting strength testers (Mullen Testors) known to the committee at this time is Testing Machines, Inc., 400 Bayview Road, Amityville, NY 11711. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee [1], which you may attend.

[6] The sole source of supply of the dynamic slippage testers known to the committee at this time is Fox River Tool Co., Inc., 1084 Valley Road, Menasha, WI 54952.

15. Keywords

15.1 carbonless copy paper; carbonless paper; capsule damage; CB; microcapsules

ANNEXES

(Mandatory Information)

A1. BURSTING STRENGTH TESTER

A1.1 *Stationary Conditions*—Equipment is required that will bring a predetermined uniform pressure to bear across a specified area of juxtaposed CB and CF test units. For all practical purposes, any device that will produce the conditions specified for the test should produce the required results.

A1.2 In practice, it has been found that a hand-operated jumbo Mullen Testor with a maximum capacity of 400 psi (2.8 MPa) is desirable because of the ease with which the pressure may be brought up to that specified in the test, held constant over the required time period and then released.

A1.3 Although the hand-operated tester is preferable for reasons stated above, mechanically driven models can be used. Their use, however, requires more practice and skill on the part of the operator to stop the mechanical cycle before it reaches the 300-psi (2.1-MPa) point, advance the pressure manually to 300 psi, hold for the specified time interval, and then allow the mechanical cycle to return the pressure to zero.

A1.4 *Alternative Methods of Applying Pressure for Test Under Stationary Conditions*— It has been suggested that means other than the bursting strength tester might be utilized for applying the pressure necessary to produce controlled capsular damage under stationary conditions and, as a matter of fact, before bursting strength testers came into general use, considerable work was done trying to use hydraulic presses for this purpose.

A1.5 At the time when the bursting strength tester was adopted, none of these approaches had demonstrated the necessary pressure retention stability at the 300-psi (2.1-MPa) test point. However, the use of such equipment is not ruled out if it can be demonstrated that control equivalent to the bursting strength tester approach can be achieved.

A2. REFLECTANCE-MEASURING EQUIPMENT

A2.1 The important factors to consider in selecting a reflectometer for measuring the reflectance of carbonless copy papers are:

A2.1.1 *Optical Response Curve*—Some reflectometers have a fixed optical response. Others are equipped with filters which may be used to shift the optical response into a desired range.

A2.1.2 *Simplicity of Operation*—The test procedures require that many readings be taken and, therefore, the easier the equipment is to use and the more rapid the readout per test, the better.

A2.1.3 *Availability*— If a more complex apparatus is at hand, one may wish to use it instead of investing in a secondpiece of equipment.

A2.2 Any reflectometer that has a spectral energy distribution curve close to that of the sensitivity curve of the human eye or that can be modified with a proper filter to provide such response, should be adequate for the job.

A2.3 In all cases, the ability to set up calibration curves to bring the data from one type of reflectometer into agreement with other types should be given the highest priority. Without this ability, data gathered by a customer using one type of equipment may be meaningless to a supplier using another type. Customers should consult with their suppliers to determine which type of reflectometer is recommended for their products.