Surface strength of paper (wax pick test)

1. Scope

This method, applicable to uncoated and coated papers, is designed to measure the surface strength of paper or its resistance to picking. It is not applicable to loosely felted papers such as blotters or roofing felts nor to some coated papers containing thermoplastic resins in the coating adhesive.

2. Summary

In this test, calibrated sealing waxes with increasing adhesive power are pulled from the surface of the specimens. The highest number of the wax in the series which does not disturb the surface of the paper is the numerical rating of the pick.

3. Significance

3.1 Many printing and converting operations require the surfaces of the paper to have sufficient transverse strength to give satisfactory results. Since no absolute values are obtained with this method, test results should be correlated with actual performance of the material during the subsequent coating, converting, printing or packaging operation (I).

3.2 For coated paper, where a significant portion of the casein or starch coating adhesive has been replaced with a thermoplastic resin, there is very little, if any, correlation between printing press performance and wax test results. The molten wax forms a stronger bond with the coating containing thermoplastic resin and the resulting pick causes the paper to appear weak, when in fact it is not.

3.2.1 For these sheets containing latex and similar substances, a more direct method employing the actual medium to be applied is recommended.
4. Definitions

4.1 Pick. A pick occurs when the surface of the paper specimen blisters, breaks, or lifts and/or paper or coating substance adheres to the surface of the wax.

4.2 Critical wax strength number, the average highest numerical designation of the wax that does not disturb the surface of the paper.

5. Apparatus

5.1 Heating device, such as: Bunsen burner, alcohol lamp, propane torch, or electric heat element.

5.2 Wooden block, about 90 × 40 × 10 mm (3½ x 1½ x ⅜ in.) having a 30 mm (⅞ in.) diameter hole with an edge about 3 mm (⅛ in.) from one end.

5.3 Work surface that is smooth, hard, and a poor conductor of heat, such as wood. (Glass, metal, or artificially cooled surfaces are unsuitable.)

6. Materials

Waxes1, a series of hard-resin, non-oily waxes numbered respectively from 2A to 26A. Each wax is made up according to a specific formula and molded to stick form with a cross-sectional area of 18 × 18 mm (⅜ × ⅜ in.). Each higher numbered wax in the series is more adhesive than the previous one. CAUTION: This method involves the use of molten wax. Thus extreme caution should be exercised to avoid the potential of severe burns.

7. Calibration

The sealing wax sticks used in this method are calibrated by the manufacturer against retained wax sticks and paper standards. Not only does each wax stick equal the corresponding standard stick, but each will effectively distinguish the surface strength when compared with adjacent wax numbered sticks. The tester can calibrate any series of wax sticks by noting whether the surface is progressively more ruptured with ascending wax stick numbers and by checking new boxes of waxes against retained wax sticks and/or paper standards.

8. Sampling and test specimens

Select a number of specimens, usually 10, each 100 × 100 mm (4 × 4 in.) or larger, from each test unit of a sample of paper obtained in accordance with TAPPI T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Containerboard, or Related Product,” so that five replicate critical waxes may be determined for each tested surface (wire and felt).

9. Procedure

9.1 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.”

9.2 Place a test specimen on the work surface. Select a wax stick estimated to have less adhesiveness than will disturb the surface of the specimen. Clean the end with a sharp blade or if necessary by melting off any paper or coating residue.

NOTE 1: Normally, the end of the wax stick will tend to spread out after repeated use. Thus, the wax sticks should be trimmed to maintain their original 18 mm x 18 mm size.

9.3 Heat the end in a low flame or by electrical heat element, rotating the stick slowly between the thumb and finger until several drops of melted wax have fallen, but do not let the stick catch fire. Also the molten wax should not “bubble” which indicates wax is too hot. The entire surface should be molten wax.

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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 Services Department.
9.4 Quickly place the melted end of the wax stick on the surface of the paper specimen with firm, but not undue, pressure so that the end spreads out to about 20 mm diameter, and withdraw the fingers immediately, allowing the wax stick to stand vertically on the paper.

9.5 Allow the wax to cool for at least 15 min and not more than 30 min. Place the wooden block with the hole over the vertical stick of wax so that the stick protrudes through the hole; press the block down firmly with one hand to prevent the paper from wrinkling or tearing, and with the other pull the wax from the sheet with a quick jerk at right angles to the paper surface.

9.6 Examine both the tip of the wax and the paper specimen under normal reading illumination with no magnification. There must be a definite indication of fibers or coating disturbed to be called a pick or surface rupture.

9.7 If the surface is not ruptured, repeat the test, using the same specimen with waxes of ascending numerical order until the surface of the paper specimen blisters, breaks, picks, or lifts. Test a minimum of five specimens on their wire side and five other specimens on their top side, or if not identifiable as such, five each from the two different sides of the paper.

9.8 Record the highest numerical designation of the wax that does not disturb the surface of the paper and average the results on each side to the nearest wax number.

10. Report

10.1 Report as the critical wax strength number (CWSN) the average highest numerical designation of the wax that does not disturb the surface of the paper.

10.1.1 Report the number of tests made on each side as well as the range of highest numerical designation of the wax for the specimens on each side of the paper.

10.2 With coated papers, state whether the picking or lifting occurred on the coating or on the bodystock, or both. If desired, include also the degree of surface disturbance with waxes more adhesive than for the critical strength. For example, a paper may have a CWSN of 14A, a blister at 16A, a partial fiber pick at 18A, and complete rupture at 20A.

11. Precision

11.1 Repeatability (within laboratory) = 1.98 wax units

11.2 Reproducibility (between laboratories) = 4.0 wax units

These values are based on Collaborative Testing Service data for samples tested at a mean of 10.64 wax units during the period of July, 1989 to May, 1990.

The user of these precision data is advised that it is based on actual mill testing, laboratory testing, or both. There is no knowledge of the exact degree to which personnel skills or equipment were optimized during its generation. The precision quoted provides an estimate of typical variation in test results which may be encountered when this method is routinely used by two or more parties.

12. Additional Information

12.1 Effective date of issue: August 10, 1993.

12.2 Related methods: TAPPI UM 591 “Surface Strength of Paper (IGT Tester)” and T 514 “Surface Strength of Coated Paperboard”; ASTM D 2482; Canadian, CPPA D-11.

Reference


Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Technical Divisions Administrator.

Note that UM 591 was formerly TAPPI 499, a method which was withdrawn in 1985. At the time of revision of T 549, a Committee Assignment has been initiated by the Physical Properties Committee to review UM 591 and to consider reinstating it as a TAPPI Test Method.