WI 250808.09

T 459

BALLOT NO. 02 - SARG

DRAFT NO. 01

DATE June 9, 2026

WORKING GROUP CHAIR N/A

SUBJECT CATEGORY Physical Properties

RELATED METHODS See "Additional Information"

CAUTION:
This Test Method may include safety precautions which are believed to be appropriate at the time of publication of the method. The intent of these is to alert the user of the method to safety issues related to such use. The user is responsible for determining that the safety precautions are complete and are appropriate to their use of the method, and for ensuring that suitable safety practices have not changed since publication of the method. This method may require the use, disposal, or both, of chemicals which may present serious health hazards to humans. Procedures for the handling of such substances are set forth on Safety Data Sheets which must be developed by all manufacturers and importers of potentially hazardous chemicals and maintained by all distributors of potentially hazardous chemicals. Prior to the use of this method, the user must determine whether any of the chemicals to be used or disposed of are potentially hazardous and, if so, must follow strictly the procedures specified by both the manufacturer, as well as local, state, and federal authorities for safe use and disposal of these chemicals.

Surface Strength of Paper (Wax Pick Test)

(*Five-year review of Official Method T 459 om-21)*

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 papers containing materials that soften with heat such as waxes or latex type additives. Light weight papers that lack stiffness may slip under the block during the wax removal step are not suitable for testing by this procedure.

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 z-direction 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 (*1*).

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 those 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 ($3^1/_2 \times 1^1/_2 \times {}^3/_8$ in.) having a 30 mm ($1^1/_4$ in.) diameter hole with an edge about 3 mm ($^1/_8$ 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

Waxes, a series of hard-resin, non-oily waxes numbered respectively from 2A to 14A, 16A, 18A, 20A and 23A. Each wax is made up according to a specific formula and molded to stick form with a cross-sectional area of 18 × 18 mm ($^{11}/_{16} \times {}^{11}/_{16}$ in.). Each higher numbered wax in the series is more adhesive than the previous one.

NOTE 1: The above-mentioned stick numbers are the currently available ones. In the past there have been sticks numbered from 1 to 26 and later the A-series including the currently missing ones. The old sticks, without the A, are not compatible with the new sticks.

CAUTION: This method involves the use of molten wax. Thus, extreme caution should be exercised to avoid the potential of severe burns.

7. Safety

This method involves the use of molten wax. Thus, extreme caution should be exercised to avoid the potential of severe burns. The heating procedure may involve the use of an open flame. Be cautious of flammable material in the proximity the flame.

8. 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.

NOTE 2: The production of the sticks has moved several times over the years (locations and producers), this is not always visible on the packaging. It has been noticed that different batches of sticks, from different producers or locations, give sometimes very different results. Results of these numbers cannot be compared.

9. Sampling and test specimens

9.1 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).

9.2 In cases such as single-sided coated graphic arts papers or boxboards where the test is to be performed on a single side, select a number of test specimens such that the area is large enough to perform 5 tests with a minimum of 100 mm (4 in.) between test locations.

10. Procedure

10.1 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."

10.2 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. 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 × 18 mm size.

10.3 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 (not on the sample to be tested), 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.

10.4 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.

10.5 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.

10.6 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.

10.7 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 three specimens on their wire side and three other specimens on their topside, or if not identifiable as such, three each from the two different sides of the paper. In the case of sheets that have a single side to be evaluated, make three tests on the side of interest.

10.8 Record the highest numerical designation of the wax that does **NOT** disturb the surface of the paper and average the results on each side that was evaluated to the nearest wax number.

Caution: Wax is hot and will burn skin if molten wax comes in contact with hands.

11. Report

11.1 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.

11.1.1 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.

11.2 With coated papers, state whether the picking or lifting occurred on the coating or on the base stock, 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.

12. Precision

12.1 Repeatability (within laboratory) = 2 wax units

12.2 Reproducibility (between laboratories) = 3 wax units

These values are based on CEPI Collaborative Testing Service data for samples tested at a mean of 4, 8, 12 and 16 wax units during the period of February 2015 and October 2019.

12.3 The user of these precision data is advised that it is based on laboratory testing. There is no knowledge of the exact degree to which personnel skills were optimized during its generation but during the first testing rounds it was found that old sticks gave very different results. The results are the averages of the tests after removing all the determinations with traceable old results. 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.

12.4 The variation between laboratories is mostly due to operator variation in the heating, application and removal of the wax sticks.

13. Keywords

Paper, Paperboard, Coated boards, Surface strength, Pick resistance, Wax pick tests

14. Additional Information

14.1 Effective date of issue: To Be Assigned

14.2 Related methods: TAPPI T 514 “Surface Strength of Coated Paperboard” and PAPTAC D-11 (Canada).

14.3 Changes in the 2013 edition include a procedural change to allow for single-side testing, as well as the addition of a safety section.

14.4 Changes in the 2020 edition include the latest version of the available stick numbers, the reduction of the number of replicas to three per side and an update of the r&R data.

Reference

1. Kirkpatrick, W. A., “The Use of Waxes and Case Testing Ink in Testing Printing Papers,” *Paper Trade J.* **109** (12): 36 (1939); *Tech. Assoc. Papers* **22**:322 (1939).

Your comments and suggestions on this procedure are earnestly requested and should be sent to the TAPPI Standards Department.

■