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T _____ 516 _____

BALLOT NO. _____ 3 SARG _____

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WORKING GROUP
CHAIR _____ Chris Czyryca _____

SUBJECT
CATEGORY _____ Physical Properties _____

RELATED
METHODS _____ See "Additional Information" _____

CAUTION:

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 test method, the user should 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.

Envelope seal, seam, and window patch testing
(Proposed WITHDRAWAL of Classical Method T 516 cm-11)
(Underscores, notes, and strikethroughs show changes from Draft 1)

1. Scope

This method describes procedures for evaluating the following properties of envelopes: (1) film thickness of seal, (2) seal, seam, and window patch adhesion, (3) humidity resistance, (4) discoloration and staining of seal, seams, and patch.

2. Significance

The functionality of an envelope may be impaired if the adhesion characteristic between paper surfaces is impaired due to the changing environment to which the envelope is subjected. Since many envelope adhesives are affected by increased humidity environments, the adhesive properties of envelopes should be examined at various high humidities. The thickness of the adhesives may also affect adhesive properties. Discoloration and/or staining may result from exposure to high humidities that might damage the contents of the envelope. These test procedures are useful for the comparison of envelope quality. In addition, these standard methods are needed by the envelope industry in place of the wide variety of non-standard tests previously used.

3. Apparatus

3.1 *Micrometer*, graduated in units of 0.002 mm (0.0001 in.) [see TAPPI T 411 “Thickness (Caliper) of Paper and Paperboard”].

3.2 *Oven*, maintained at 60°C (140°F).

3.3 *Brush applicator*, or the equivalent, for moistening seals.

3.4 *Enclosed vessels*, such as large desiccators, to give required RH (1,2) with different saturated salt solutions.

3.5 *Conditioning room*, or chamber with a circulating atmosphere accurately controlled to a relative humidity of 50% ± 2% and a temperature of 23.0 ± 2°C (73.4 ± 3.6°F).

NOTE 1: If a conditioning room is not available, use an enclosed vessel with a saturated solution of calcium nitrate, $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$, at 23°C, to obtain the equivalent RH (1,2).

NOTE 2: The room or vessel must be brought to equilibrium before any tests are conducted.

4. Reagents

Saturated salt solutions (1), to provide the indicated relative humidity at 23°C:

<i>Salt</i>	<i>Relative humidity, %</i>
Ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$	80.1
Ammonium monophosphate, $\text{NH}_4\text{H}_2\text{PO}_4$	92.9
Calcium nitrate, $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$	51.8
Lithium chloride, LiCl	11.1
Potassium chromate, K_2CrO_4	86.5
Sodium chloride, NaCl	75.5

NOTE 3: TIP 0808-03 “Equilibrium Relative Humidities over Saturated Salt of Salt Solutions” contains additional information relative to the use of salt solutions. In addition, there is an expanded table for temperature and relative humidity. This is an up-to-date source for reference 2.

5. Test specimens

Select the envelopes in accordance with T 400 “Sampling and Accepting a Single Lot of Paper, Paperboard, Fiberboard, or Related Product” taking at least five envelopes at random for each test procedure. Open up those envelopes to be evaluated for patch adhesion by cutting them along the side folds. Condition the envelopes for 24 h in an atmosphere in accordance with T 402 “Standard Conditioning and Testing Atmospheres for Paper, Board, Pulp Handsheets, and Related Products.”

6. Procedure

6.1 Film thickness of seal.

6.1.1 After conditioning, extend the seal flap of each envelope and, in accordance with T 411, measure the thickness of the paper at five different places adjacent to the seal and at five different places along the seal.

6.1.2 Calculate the difference between the average paper thickness and the average thickness of the paper plus seal.

6.1.3 *Report.* Report this difference as the average dry thickness of the seal adhesive application to the nearest 0.002 mm (0.0001 in.).

6.2 Adhesion.

6.2.1 **Seals.** After the conditioning period, remove a set of envelopes and moisten each seal using the brush applicator or equivalent means. Apply no more water than is necessary to completely moisten the seal.

6.2.1.1 Immediately place the envelopes face down on a smooth surface and seal each by pressing the thumb once along the entire length of the seal.

6.2.1.2 Promptly place the sealed envelopes in the conditioning room (or enclosed vessel at the equivalent RH). After 24 h, remove them individually and attempt to delaminate the seal by very slowly peeling it back from the body of the envelope at its edge. If fiber tear occurs, try delaminating at another point on the seal.

6.2.2 **Seams.** Remove the conditioned envelopes individually and test the adhesion of the seams by very slowly peeling them back from the body of the envelope. If fiber tear occurs, try delaminating at another point on the seam.

6.2.3 **Patches.** After the conditioning period, remove each envelope and determine the adhesion of the window patch by trying to peel back the edge of the patch as slowly as possible from the body of the envelope. If fiber tear occurs, try delaminating at another place on the patch. If the patch is a transparent film, make an additional attempt to delaminate it by a fast “snapping action,” because the patch may separate with a “zipper” type of release if peeled rapidly.

6.2.4 *Report.*

6.2.4.1 For seals, seams, and patches, respectively, report one of the following: (a) no fiber tear and no resistance to delamination; (b) resistance to delamination with no fiber tear and other observations, e.g., coating lift; and (c) estimated percent of fiber tear encountered on delamination by peeling.

6.2.4.2 For transparent film patches, also report “zipper” type of release, if encountered.

6.3 *Humidity resistance.*

6.3.1 After the conditioning period, remove the envelopes and moisten the seals using the brush applicator or equivalent means. Apply no more water than is necessary to completely moisten the seal. Immediately after the seals are moistened, place the envelopes face down on a smooth surface and seal each by pressing the thumb in one motion over the entire length of the seal. Place these envelopes, and additional ones that have not been sealed, in the conditioning room (or enclosed vessel of equivalent RH). Position the envelopes vertically seals up. After 24 h, remove the envelopes and place them in the same position in the enclosed vessels with the various saturated salt solutions. Remove each sealed envelope after 24 h and rapidly evaluate the adhesion of the seal. Also remove each unsealed envelope and rapidly evaluate the adhesion of the seams or patch.

6.3.2 *Report.*

6.3.2.1 Report adhesion of seal, seam and patch, after exposure to various humidity conditions, as in 6.2.

6.3.2.2 Report also subjection of the vessel at any time to temperatures other than $23^{\circ} \pm \square 2^{\circ}\text{C}$. Abnormal variations in laboratory temperatures may cause condensation within high relative humidity chambers and give erroneous results.

6.4 *Discoloration and staining.*

6.4.1 After conditioning, place a set of envelopes in an oven at 60°C (140°F), another set in a vessel with an atmosphere of 86.5% RH at 23°C , and a third set in a vessel with an atmosphere of 93% RH at 23°C . Adjacent envelopes within each vessel must not touch each other. After 24 h, remove the envelopes, allow them to condition 2 h at room temperature, then observe the condition of the adhesive film and the bonded area.

NOTE 4: If no discoloration or staining is evident, replace the specimens in the oven and enclosed vessels for two additional 24-h periods and reexamine them after each cycle.

6.4.2 *Report.*

6.4.2.1 Report discoloration as a change in the color of the original adhesive film.

6.4.2.2 Report staining (by adhesive interaction) as a change in color of the paper substrate.

7. Precision

The precision statement in TAPPI T 411 is applicable for dry adhesive film thickness. A precision statement is not applicable to the qualitative and/or subjective procedures for adhesion, humidity resistance, discoloration, and staining.

8. Keywords

Envelopes, Window envelopes, Film, Thickness, Adhesion, Humidity, Discoloration, Staining, Sealants

9. Additional information

9.1 Effective date of issue: **To be assigned.**

9.2 This method, formerly T 516 su-69, was reclassified as a Classical Method in 1982. Such procedures are no longer in common use or have been superseded by advanced technology; they are technically sound, have a history of use, and contain a body of literature references that make their preservation valuable.

9.3 A revised version of this method is available as UM 583. This method, reconfirmed in 2000, is now equivalent to UM 583.

9.4 Standard reconfirmed as a Classical Method in 2011 and 2022.

Literature cited

1. Institute of Paper Chemistry, Report No. 40, "The Equilibrium Relative Humidities Above Saturated Solutions at Various Temperatures," February 15, 1945.
2. Wink, W.A. and Sears, G.R., "Instrumental Studies LVII Equilibrium Relative Humidities Above Saturated Salt Solutions at Various Temperatures," *Tappi* **33**(9):96A (1950).

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

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