

# Standard Practice for Determining the Adhesion of Prints and Laminating Films<sup>1</sup>

This standard is issued under the fixed designation F2226; 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.

<sup>ε1</sup> NOTE—The units of measure were editorially corrected in December 2009.

## 1. Scope

1.1 This practice covers procedures for printing a document, applying a laminating film and subsequently delaminating. The laminate film is used for encapsulating and mounting prints to preserve them in office and outdoor environments.

1.2 This practice describes procedures for determining the adhesion strength of lamination film when it is applied to black and white and color prints produced by printers, copiers and other reprographic devices.

1.3 This practice can be used to test different laminates with a given set of inks and media or it can be used to evaluate inks and media with a given laminate.

1.4 This practice specifies size of specimens and defines conditions for measurement of peel adhesion at a 180° angle and delamination speed.

1.5 This practice is applicable to constructions where the substrate surface is subject to failure under peel conditions.

1.6 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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

## 2. Terminology

### 2.1 Definitions:

2.1.1 *high temperature lamination*—lamination at temperature not lower than 180°F (80°C). The maximum applied temperature is 240 to 250°F (115 to 121°C).

2.1.2 *lamination film*—plastic film having an adhesive layer on one side. The film can be glossy, semi-glossy, or matte and

contain additives modifying its optical properties. The film usually has a thickness between 1 to 10 mils (25 to 250 μ).

2.1.3 *low temperature lamination*—lamination at room temperature with applied pressure mostly to mounting board using a pressure-sensitive adhesive.

2.1.4 *mounting board*—paperboard, plastic board, or any supporting board, which could be used to display prints.

2.1.5 *printed media*—recording elements used by printers to receive inks or toners. The substrate may be paper, plastic, canvas, fabric, or other ink receptive material. The substrate may, or not, be coated with an ink receptive layer(s).

### 2.2 Definitions of Terms Specific to This Standard:

2.2.1 *adhesion strength of a laminate*—load per unit necessary to remove the laminate from a prescribed surface when measured in accordance with this test method.

2.2.2 *delaminating/debonding*—separation of a laminating film from a printed media.

2.2.3 *kinetic peak*—load per unit presenting the maximum force that occurs during the average time during the peel test. See Fig. 1.

2.2.4 *peel or stripping strength*—the average load per unit width of sample required to separate or peel the laminate from the printed media at the adhered interface at a separation angle of approximately 180° and at a separation rate of preferably 12 in. (308 mm) per minute. It is expressed in Newtons per meter width, grams per inch width, or ounces per inch width.

2.2.5 *root-mean-square (RMS)*—a mathematical treatment of the force data intended to qualify the extent to which the value deviates about its average value.

2.2.6 *static peak*—load per unit presenting the maximum force that occurs during the delay time before starting the peel test. See Fig. 1.

2.2.7 *valley*—load per unit presenting minimum force during the average time under kinetic conditions. See Fig. 1.

## 3. Summary of Practice

3.1 Coated or uncoated substrate is printed under standard conditions using four primary, three secondary colors and composite black. Eight color strips 1 in. (25.4 mm) wide and one unprinted are generated.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee F05 on Business Imaging Products and is the direct responsibility of Subcommittee F05.03 on Research.

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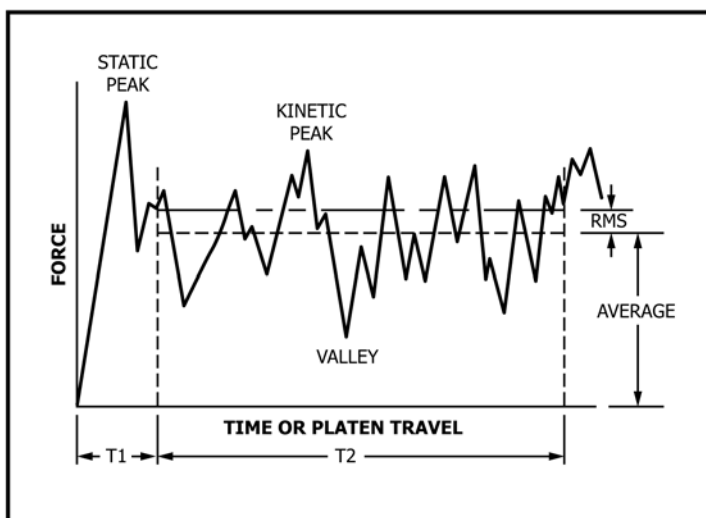


FIG. 1 Data Trace

3.2 The prints having eight color strips are conditioned (preferably for 24 h) and subsequently laminated.

3.3 The laminated prints are conditioned (preferably for 24 h), cut into 1 in. (25.4-mm) strips and subsequently delaminated.

3.4 Comparative studies require testing under well-defined conditions.

#### 4. Significance and Use

4.1 The image life of printed media displayed in both typical office and outdoor environments can be extended by lamination or encapsulation. While natural aging is the most reliable method of assessing lamination adhesion, the length of the time required makes this method impractical for most materials. The peel strength method allows comparative studies of prints and laminating films.

4.2 Good adhesion is prime consideration for laminating films and prints. A laminating film, which does not adhere to a print or vice versa generally, has no commercial value. This method is used to obtain comparative data of peel strength of encapsulated or laminated media.

4.3 Peel strength can be measured up to a point where the peel strength is equal to the tensile strength of the adhesive or the print.

4.4 In many applications, having sufficient laminate adhesion strength is important to give satisfactory performance. The property is also important in determining the uniformity of quality.

4.5 A rough or raspy peel test will produce a higher RMS value than one that is smooth and continuous. It can be related to “zippering,” “shocking,” or “stick-slip.”

4.6 *Bond Strength and Interfacial Adhesion*—The bond strength of a laminate essentially depends on both the adhesive and the cohesive strength of the laminating system. Peel strength of the laminate is typically determined by debonding the laminate using 180° peel test. Fig. 2 presents five possible

modes of failure: (1) debonding of the ink receptive underlayer from the substrate (2) debonding of the ink receptive top layer from the underlayer, (3) debonding of the adhesive from the top ink receptive surface, (4) debonding the adhesive from the laminating film, (5) the substrate or film failure tear. The failure of the laminate will occur at its weakest link. It is generally desirable to have high bond strength to the recording element with failure occurring where the adhesive debonds from the ink receptive.

#### 5. Interferences

5.1 Since the ability of laminating film to adhere to printed media is dependent on temperature and humidity, it is important that lamination be assessed under the conditions appropriate to the end use applications. While printed media may be handled and displayed under a variety of conditions, this test practice is intended to measure peel strength in typical office environments.

5.2 It is recognized that the peel strength of the laminate to the printed media is dependent on toner or ink color, toner or ink load, temperature and relative humidity. Additionally, it is dependent on the substrate, type and coat weight of absorptive layer and the colorant type (dye versus pigment). Consequently, test results must be determined individually for each printed recording media/laminate.

5.3 The peel strength of the laminate is dependent on lamination temperature and should be tested at the manufacturers recommended temperature for the best performance.

5.4 Using a laminating film thicker than 75  $\mu$  (3 mil) can create a problem in obtaining a 180° angle at the start of the test. A starting angle of less than 180° can significantly change the peel speed and mostly lead to delamination from the support instead of the coating (tearing of paper base).

5.5 The variation in recording and laminating elements requires carrying out comparative tests under well-defined conditions.