



Standard Test Method for Determining Ink or Coating Adhesion on Flexible Substrates for a Membrane Switch or Printed Electronic Device¹

This standard is issued under the fixed designation F1842; 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 This test method is based on existing Test Method [D3359](#), with modifications to make it suitable for flexible substrates, printed electronic devices and membrane switches.

1.2 Despite the problems associated with a tape test on plastic substrates, it is our belief that this is still one of the best ways to test ink and coating for adhesion for membrane switch or printed electronic device applications. In writing this test method we are addressing several of the objections to the test method that could affect its precision and repeatability on plastic substrates.

1.3 These test methods cover whether the adhesion of coating or ink to a substrate is at an acceptable level. They do not distinguish between higher levels of adhesion, for which more sophisticated methods of measurement may be required.

NOTE 1—It should be recognized that differences in adherability of the ink or coating surface can affect the results obtained with inks or coatings having the same inherent adhesion.

1.4 In multi-coat systems adhesion failure may occur between coats, so that the adhesion of the coating system to the substrate is not determined.

1.5 This test method is specifically designed for measuring adhesion of inks and coatings (films) that have a thickness of 5 mil (125 microns) or less, on plastics such as polyester and polycarbonate.

1.6 *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.*

¹ This practice is under the jurisdiction of ASTM Committee [F01](#) on Electronics and is the direct responsibility of Subcommittee [F01.18](#) on Printed Electronics.

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2. Referenced Documents

- 2.1 *ASTM Standards*:²
[D3359 Test Methods for Measuring Adhesion by Tape Test](#)

3. Terminology

3.1 *membrane switch*—a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

4. Summary of Test Method

4.1 A lattice pattern with six cuts in each direction is made in the ink or coating to the substrate. Pressure sensitive tape is applied over the lattice and then removed, and adhesion is evaluated by comparison with the descriptions and illustrations.

5. Significance and Use

5.1 If the ink or coating is to fulfill its function, it must adhere to the substrate. Substrates and their surface preparation have a significant effect on the adhesion of inks or coatings. Therefore, a method of evaluating adhesion of inks or coatings to different substrates or surface treatments, or of different inks or coatings to the same substrate and surface treatment, is useful to the industry.

5.2 The limitations of all adhesion methods and the specific limitation of this test method to lower levels of adhesion should be recognized before using it. The intra- and inter-laboratory precision of this test method is under evaluation.

5.3 Printing area to be tested should be a solid area large enough to include the entire cross hatch pattern.

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.

6. Interferences

The type of tape used should be compatible with the type of inks used.

7. Apparatus

7.1 *Cutting Tool*—A multi-blade cutter having a cutting edge angle between 15 and 30 degrees that will make six cuts at once that are 2 mm apart. It is of particular importance that the cutting edges be in good condition.

NOTE 2—Dull cutting edges require more pressure on the tool, which increases the difficulty in controlling the depth of the cuts. Dull edges can also rupture or chip the substrate, ink, or coating and thus yield inconsistent or inaccurate results.

7.2 *Tape*—One inch (25 mm) wide clear or semi-transparent pressure sensitive tape with an adhesion strength agreed upon by the supplier and the user is needed. Because of the variability in adhesion strength from batch-to-batch and with time, it is essential that tape from the same batch be used when tests are to be run in different laboratories. If this is not possible, the test method should be used only for ranking a series of test coatings.

7.3 *Illumination and Magnification* —This is helpful in order to determine if the cuts have been made through the inks and or coatings.

8. Test Specimen

8.1 The specimen is the printed or coated structure on which adhesion is to be evaluated. The area to be tested should have good planarity since warpage, waviness, or curvature may seriously affect test results.

8.2 Laminate the test specimen to a rigid substrate to meet the requirements of 8.1 and 9.1.

8.3 Condition the test specimen at $25 \pm 5^\circ\text{C}$ and $45 \pm 15\%$ relative humidity for 24 h. This is to ensure that inks and coatings achieve full adhesion before the test is conducted.

9. Procedure

9.1 Place specimen on flat, smooth, hard surface.

9.2 With the cutting tool, make a cut approximately $\frac{3}{4}$ in. (20 mm) long. Cut through the ink or coating to the substrate in one steady motion using just sufficient pressure on the tool to penetrate the ink or coating. Particular attention should be paid to ensuring that pressure is applied evenly across all six cutting edges.

9.3 Make a second cut perpendicular to the first in order to achieve a grid pattern.

9.4 Remove loose particles from the test area.

9.5 Remove two complete laps of tape and discard. Remove an additional length at a steady (not jerked) rate and cut a piece about 3 in. (75 mm) long.

9.6 Place the center of the tape over the grid with the tape oriented in the direction of one of the cuts and smooth into place by a finger. To ensure good contact with the ink or coating, press tape firmly to thoroughly wet the adhesive to the surface of the ink or coating. The color under the tape is a useful indication of when good contact has been made.

9.7 Within 90 ± 15 s of application, remove the tape by seizing the free end and pulling rapidly (not jerking) back upon itself at as close to an angle of 180° as possible. Ensure specimen remains flat and in contact with the base surface.

9.8 Inspect grid area for removal of ink or coating. Rate adhesion according to the scale in Fig. 1:

- Grade 5—The edges of the cuts are completely smooth; none of the squares of the lattice is detached.
- Grade 4—Small flakes of the coating are detached at intersections; less than 5 % of the area is affected.
- Grade 3—Small flakes of the coating are detached along edges and at intersections of cuts. The area affected is 5 to 15 % of the lattice.
- Grade 2—The coating has flaked along the edges and on parts of the squares. The area affected is 15 to 35 % of the lattice.
- Grade 1—The coating has flaked along the edges of cuts in large ribbons and whole squares have detached. The area affected is 35 to 65 % of the lattice.
- Grade 0—Flaking and detachment worse than Grade 1.

10. Report

10.1 Report the number of tests and for each test the resulting classification of each where the failure occurred, that is, between first coat and substrate, between first and second coat, and so on.

10.2 Report the substrate employed, the type of ink or coating, and the method of cure.

10.3 If the adhesion strength of the tape has not been determined, report the specific tape used and its manufacturer.

10.4 Report the location of the test, and type of test (ink to ink or ink to substrate).

11. Precision and Bias

11.1 *Precision*—It is not possible to specify the precision of the procedure in Test Method F1842 for measuring coating adhesion because inter-laboratory studies have proven inconclusive due to insufficient participating laboratories with the appropriate equipment.

11.2 *Bias*—No information can be presented on the bias of the procedure in Test Method F1842 for measuring coating adhesion because no standard sample is available for this industry.

12. Keywords

12.1 adhesion, tape; adhesion test method—crosscut; adhesion test method—cross-hatch; adhesion test method—tape; coatings; inks; membrane switch; printed electronic device

Classification of Adhesion Test Results

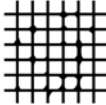
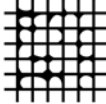

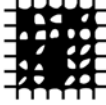
Classification	Surface of cross-cut area from which flaking has occurred. (Example for six parallel cuts)
5B	None
4B	
3B	
2B	
1B	
0B	Greater than 65%

FIG. 1 Classification of Adhesion Test Results

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