Designation: F3152 – 16

Standard Test Method for Determining Abrasion Resistance of Inks and Coatings on Substrates Using Dry or Wet Abrasive Medium[1]

This standard is issued under the fixed designation F3152; 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 describes the procedure for subjecting inks or coatings on substrates to an abrasive medium, with or without the application of chemicals, at a specified force.

1.2 Within certain limitations, as described in this standard, this test method is applicable for materials including, but not limited to: printed or coated polyester, polycarbonate, and silicone rubber. The samples can be either flat or contoured.

1.3 *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 *final breakthrough, n*—the number of cycles until complete removal of the first surface ink or coating being tested.

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

2.1.3 *wear limit, n—in testing membrane switches*, the number of cycles until an underlying layer of different color may be seen through the first layer (not applicable for transparent coatings).

3. Significance and Use

3.1 Membrane switch keys are subjected to repeated actuations, usually by a human finger. This can transfer body oil, hand creams, automotive fluids and so forth. Materials are often subjected to other conditions (for example, wiping, cleaning, rubbing) during handling, end-use, shipment, or storage that may cause abrasion damage. The result may be a significant removal of the coatings, text, or decorative inks.

3.2 This test method is applicable to a wide range of materials. The main criterion is that the abrasion process produces visible wear or breakthrough of the surface being tested.

3.3 The amount of abrasion damage to a surface is dependent on numerous variables. This test method provides a way of comparing relative abrasion resistance and the effect of chemicals on inks, coatings, and substrates. In no way do the results provide a correlation value of the number of human finger touches before coating failure. It only provides a means to compare results of tests performed using the same equipment, abrasive materials and loading conditions.

3.4 The test method can be used for quality control purposes, as a research and development tool, to evaluate material combinations for a given application, or for the comparison of materials with relatively similar properties and the effect of chemicals on the abrasion resistance.

4. Interferences

4.1 Inconsistent wear can occur which will compromise the results. Caution is necessary to ensure the mounting method does not deflect the specimen, which may influence the wear characteristics.

4.2 Contoured surfaces can be tested but results may be more difficult to duplicate and some equipment is not designed to test non-flat surfaces.

4.3 Whenever possible, a smooth surface is preferred. Extra care should be taken when evaluating a non-uniform surface (that is, rough surface), and for the user to recognize potential variations between specimens.

5. Apparatus

5.1 Machine capable of providing cyclic abrasion to a test specimen under controlled loading conditions.

5.2 Suggested sources:

[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.18 on Printed Electronics.

Current edition approved May 1, 2016. Published May 2016. Originally approved in 2015. Last previous edition approved in 2015 as F3152-15. DOI: 10.1520/F3152-16.

5.2.1 *Dry & Wet:* Norman Tool Abrader Model WA-1010.[2]
5.2.2 *Dry Only:* Norman Tool RCA Abrader.

5.3 *Specimen Mounting Fixture or Holder,* a suitable device of sufficient strength and rigidity used to secure the specimen so that it is held rigidly and perpendicular to the load during testing.

5.4 *Abrasive Media,* commonly available from Norman Tool, PN# 1116-M-40.
5.4.1 *0.6875 in.-wide Paper,* most applications.
5.4.2 *0.25 in.-wide Polyester Tape,* recommended for specimens with concave surfaces and fine graphic details.

6. Conditioning

6.1 *Abrasive Media and Specimen Conditioning*—Unless otherwise agreed upon between purchaser and seller, condition the specimens for at least 24 h at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity.

6.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity.

7. Pre-Test Setup

7.1 Mount the test specimen on the mounting fixture. This holding device should firmly hold the test specimen in a fixed position, without distortion, in a perpendicular position relative to the force probe.

7.2 *Cleaning of Specimen*—Specimens shall be cleaned in such a way that the surface is free from grit, grease, fingerprints or other contaminates.
7.2.1 Use a clean lint-free piece of absorbent material and either commerical grades of n-heptane or isopropyl alcohol.
7.2.2 Lightly wipe the surface of the test area with a moistened piece of cleaning material.
7.2.3 Allow the surface to air dry completely (minimum 2 h).
7.2.4 Inspect the test area to ensure no visual damage has been caused by the cleaning process.

7.3 Inspect for residue and quality of ink or coating in area of test.

7.4 Install specified abrasive material.

7.5 Adjust applied force to specified value.

8. Procedure

8.1 Align specimen targeted test point to the applied force.

8.2 Adjust Force.
8.2.1 *Wet:* 250 g or as specified.
8.2.2 *Dry:* 175 g or as specified.

8.3 Gently lower the abradant onto the specimen.

8.4 Fill chemical reservoir (if testing wet) with specified chemical and lower wet media into the chemical.

8.5 Start the abrasion process.

8.6 Subject the test specimen to abrasion for the specified number of cycles; or until sought after visual change has been detected. Wear limit is determined when an underlying layer of different color may be seen through the first layer (not applicable for transparent coatings). In determining the extent of wear, periodically interrupt the instrument at intervals for examination of the test specimen. Final breakthrough, not wear, on a first surface printed line constitutes a failure regardless of size.
8.6.1 **Warning—**When the test is stopped prior to achieving final end point, it is recommended the specimen not be moved. Doing so may present problems in aligning the wear path for additional testing.

8.7 Periodically remove any loose abrading that remains on the test specimen, by light brushing or compressed air.

9. Report

9.1 Report the following information:
9.1.1 Model number and description of Abrasion Tester used,
9.1.2 Abrasive material,
9.1.3 Force applied to specimen,
9.1.4 Number of cycles to wear limit (not applicable for transparent coatings),
9.1.5 Number of cycles to final breakthrough,
9.1.6 Temperature and humidity,
9.1.7 Identity of specimen, describing the material or coating,
9.1.8 Method of cleaning, if applicable,
9.1.9 Visual evaluation of test specimen and include photos of target test area, if possible, and
9.1.10 Chemical (if testing wet).

10. Precision and Bias

10.1 Precision and bias have not been determined at this time, but will be developed by Subcommittee F01.18.

11. Keywords

11.1 abrasion; breakthrough; coatings; inks; membrane switch; Norman Tool; RCA; Taber

[2] The sole source of supply of the apparatus known to the committee at this time is Norman Tool Co., 15415 Old State Road, Evansville, IN 47725. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.