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Peel Adhesion of Pressure Sensitive Tape

1. SCOPE

1.1 These methods cover the measurement of the peel adhesion of pressure sensitive tapes. Peel adhesion is the force required to remove a pressure sensitive tape from a test panel or its own backing at a controlled angle and at a standard rate and condition.

1.1.1 Test Method A gives a measure of the adherence, when peeled at 180° angle at 5 mm/sec, to a standard steel panel or other surface of interest for a single-coated tape.

1.1.2 Test Method B gives a measure of the adherence to the backing of a single-coated tape.

1.1.3 Test Method C gives a measure of adherence of double-coated tape to a standard steel panel or other surface of interest.

1.1.4 Test Method D gives a measure of adherence of the release liner to the adhesive of either single or double-coated tape.

1.1.5 Test Method E gives a measure of adherence of an adhesive transfer tape to a standard steel panel or other surface of interest.

1.1.6 Test Method F gives a measure of adherence, when peeled at 90° angle, to a standard steel panel or other surface of interest for a single-coated tape.

1.2 These methods provide a means of assessing the uniformity of the adhesion of a given type of pressure sensitive adhesive tape. The assessment may be within a roll of tape, between rolls, or between production lots.

1.3 Variations in the tape backing and adhesive affect the response. Therefore, these methods cannot be used to pinpoint the specific cause(s) of non-uniformity.

1.4 These test methods may not be appropriate to test tapes having either relatively stiff backings, stiff liners, or backing showing high stretch at low forces. These characteristics will result in a high variability for the test response which is not a true indication of the real nature of the adhesive bond.

Afera: Association des Fabricants Europeens de Rubans Auto-Adhesives (Association of European Tape Manufacturers)
ASTM: American Society for Testing and Materials (USA)
EN: European Norm (Europe)
PSTC: Pressure Sensitive Tape Council (North America)

A Summary of Changes section appears at the end of this test method.

2. REFERENCED DOCUMENTS

2.1 ASTM Standards

A 666 Specification for Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.

D 3330/D 3330M Test Method for Peel Adhesion of Pressure-Sensitive Tape.

D 3715/D 3715M Practice for Quality Assurance of Pressure-Sensitive Tapes.

D 5750 Guide for Width and Length of Pressure-Sensitive Tape.

2.2 Afera

2.2.1 Afera 5001 Self adhesive tapes - Measurement of peel adhesion from stainless steel or from its own backing.

2.3 EN

2.3.1 EN 1939 Self adhesive tapes - Determination of peel adhesion properties.

3. SUMMARY OF TEST METHOD

3.1 Test Method A - Single-coated tapes, peel adhesion at 180˚ angle - A strip of tape is applied to a standard test panel (or other surface of interest) with controlled pressure. The tape is peeled from the panel at 180˚ angle at a specified rate, during which time the force required to effect peel is measured.

3.2 Test Method B - Adhesion to backing, single-coated tapes - A strip of the tape under test is applied to a rigid panel. A strip of the tape under test is applied to the backing of the first strip and tested for peel adhesion as described in method A.

3.3 Test Method C - Double-coated tapes

3.3.1 Face side adhesion - A strip of double coated tape is adhered to a stainless steel panel (or other surface of interest), liner side up. The liner is removed and the exposed adhesive covered with a strip of 0.025 mm thick polyester film. The resulting tape is then tested as described in method A.

3.3.2 Liner side adhesion - The face side adhesive of a strip of tape is adhered to a 0.025 mm thick polyester film. The liner is removed and the strip is applied adhesive down, to a stainless steel panel (or other surface of interest). Testing is conducted as described in method A.

3.4 Test Method D - Adhesion to liner - A strip of tape is adhered to a standard steel test panel with the liner side up. The liner is peeled from the adhesive in the same manner as in peeling a strip of single coated tape from a standard panel as described in method A.

3.5 Test Method E - Adhesion of adhesive transfer tapes

3.5.1 Face side - A strip of the transfer tape is adhered to a standard panel (or other surface of interest), liner side up. The liner is removed and the exposed adhesive covered with a strip of 0.025 mm thick polyester film to form a film backed strip of tape. The adhesion is measured as described in method A.

3.5.2 Liner side - The face side adhesive of a strip of transfer tape is applied to a strip of 0.025 mm thick polyester film. The liner is removed and the strip is applied, adhesive down, to a stainless steel panel (or other surface of interest). Testing is described in method A.

3.6 Test Method F - Single-coated tapes, 90˚ peel - A strip of tape is applied to a standard test panel (or other surface of interest) with controlled pressure. The tape is peeled from the panel at a 90˚ angle at a specified rate, during which time the force required to effect peel is measured.

4. SIGNIFICANCE AND USE

4.1 These test methods are tools for quality assurance use. Given specific pressure sensitive tape and a requirement in terms of the minimum or maximum peel value expected for this tape, the data from the test can be used in conjunction with acceptance criteria.

4.2 Test Methods A, B, C, E, or F can show the relative bond strength of a given tape to one or more surfaces (material and texture) as compared to the standard stainless steel panel. Substitution of representative samples of materials in question for the standard steel panel would suffice to do this.

4.3 Test Methods A, B, C, E, or F cannot be used to compare two pressure sensitive tapes of the same type but of different manufacture for their ability to adhere to a surface. This is because the measured peel force is not normalized for a fixed area of stress. The area under stress varies with backing stiffness and adhesive rheology (firmness). Two different tapes seldom agree in these properties.

4.4 Test Method D can show the amount of force required to remove a liner that covers the adhesive side of a tape at a specified peel rate. The force will be different at other peel rates.

4.5 These test methods may not provide design information as there is usually no direct relationship between peel adhesion and any functional requirement.

5. APPARATUS - See Appendix B

5.1 Specimen cutter - The specimen cutter shall hold two single-edge razor blades in parallel planes, a precise distance apart, to form a cutter of exact specimens widths. Two cutters, 12 and 24 mm cutting width, shall be available or appropriate alternates which will not cause edge damage.[1]

Note - The 12 mm cutter shall consist of a 12 mm thick by 200 mm length aluminum bar stock 12 mm wide. The edges for about 125 mm from one end shall be slightly rounded to form a handle. The width of the bar for 75 mm from the opposite end shall be narrowed to exactly 12 mm minus the thickness of a single razor blade (one of two used as cutting edges). The razor blades shall be held in position using side plates. The end of the cutter shall be cut away at a 45° angle to expose the cutting edge at one end of the blades. The edges shall be separated by 12 + 0.10 mm. The 24 mm cutter shall follow the same description except the bar stock shall be 24 mm and shall be narrowed exactly 24 mm minus the thickness of a single razor blade.

5.2 Dispensing system, for solvents, such as a wash bottle.

5.3 Panel - A 50 by 125 mm no less than 1.1 mm thick stainless steel 302 or 304 in accordance with Specification ASTM A 666 having a bright annealed finish. The surface roughness height shall be 50 ± 25 nm arithmetical average deviation from the mean line. Panels showing stains, discoloration, or many scratches are not acceptable. New panels should be cleaned prior to use as described in 10.1, except with ten washes of the final solvent. Between uses, the panel test surface shall be protected from scratches and contamination, and the panels stored at conditions described in 9.

5.4 Roller, mechanically or hand operated (See Figures 1 & 2).

5.4.1 A steel roller 85 ± 2.5 mm in diameter and 45 ± 1.5 mm in width, covered with rubber approximately 6 mm in thickness, having a Shore scale A durometer hardness of 80 ± 5. The surface shall be a true cylinder void of any convex or concave deviations. The mass of the roller shall be 2040 ± 45 g.

5.4.2 No part of the apparatus shall increase the pressure of the roller during use. The roller shall move either mechanically or by hand at the rate of 10 ± 0.5 mm/s. A mechanical roll down is recommended for referee purposes.

[1] These widths correspond to the primary metric (SI) units described in ASTM D 5750. These so called “modular metric” units are used throughout the world except for Europe. If it is desirable to test slightly different widths (e.g., 25 mm) of specimens per 8.1, this should be noted per 17.1.7 and calculations per 16.1 must also account for the difference.

5.5 Adhesion tester (See Figure 3) - A constant-rate-of-extension (CRE) tension tester shall be used. It is proposed to use an electronic machine taking at least one reading per mm tape peeled. The tester shall have two clamps with centers in the same plane, parallel with the direction of the motion on the same plane, parallel with the direction of the motion on the stressing clamp, and so aligned that they will hold the specimen wholly in the same plane; a means of moving the stressing clamp at a uniform rate of 5.0 ± 0.2 mm/s and a device for recording load. The instrument shall be calibrated to an accuracy of 0.5% of full scale and the scale range used for any test shall be such that the mean test level falls within 20 to 80% of full scale.

5.6 Fixture, 90˚ peel, for method F (1.1.6). The fixture shown in Figure 4 is to be employed.

6. REAGENT MATERIALS

6.1 Purity of reagents - Reagent grade chemicals should be used in all tests. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening accuracy of the determination.

6.2 Solvents:

6.2.1 Any of the following solvents may be used for cleaning:

6.2.1.1 Diacetone alcohol non-residual, technical grade or better.

6.2.1.2 Methanol (95%).

6.2.1.3 Methyl Ethyl Ketone (MEK)

6.2.1.4 n-Heptane

6.2.1.5 Acetone

6.2.2 For final cleaning, before each test, MEK or acetone shall be used.

6.2.3 Where toxicity and flammability requirements are paramount, a mixture of n-Heptane and a fluorinated hydrocarbon, such as refrigerant, may meet requirements.

6.3 Cleaning material, absorbent; surgical gauze, cotton, wool, or tissue. To be suitable, materials must be lint-free during use, absorbent, contain no additives that are soluble in the solvents listed in 6.2, and made exclusively from virgin materials.

7. SAMPLING

7.1 Sampling shall be in accordance with ASTM Practice D 3715/D 3715M.

7.2 It is common to test at least five specimens of a particular tape.

8. TEST SPECIMENS

8.1 The specimen shall be 24 mm wide. If different, refer to note after 10.2. A tolerance of ± 0.5 mm shall be allowed. The length shall be approximately 300 mm.

8.2 Discard at least three but no more than six outer wraps of tape from the sample roll before taking the specimens for testing.

8.3 Remove one specimen per sample roll for each test to be performed. Remove the specimen from a freely rotating roll at the rate of 500 to 750 mm/s. Where width or other factors causing a high adherence to backing makes it impossible to remove the specimen at the prescribed rate, remove it at a rate as close to 500 mm/s as possible.

8.4 When tape is wider than 24 mm, specimens of the widest specified width are to be cut from the center of a strip removed from the roll in accordance with 8.3.

8.5 Apply specimen shortly after unwinding (within 5 minutes).

9. CONDITIONING

9.1 Condition the sample rolls of tape in the standard conditions of 23 ± 1˚ C and 50 ± 5% RH. Test at these conditions.

Note - Caution: The tester should know that, by prolonged handling, heat is transmitted to the stainless steel test panel. Therefore, during and after application of the adhesive tape to the test panel, the panel should be handled as little as possible.

10. TEST METHOD A - Single-Coated Tapes at 180˚ Angle

10.1 Dispense one of the solvents listed in 6.2.1 onto the panel, wiping it to dryness with fresh absorbent cleaning material. Repeat for a total of three washes with this solvent. Final wipe shall be MEK or acetone. The panel should be allowed to dry for at least 10 minutes. Panels not used within 10 hours should be recleaned.

Note - Discard panels showing stains, discoloration, or many scratches. Avoid contacting panel surface with fingers. During storage, panels should be protected from damage or contamination.

10.2 Remove a 300 mm specimen of the tape to be tested, as described in 8.3. Fold 12 mm at one end, adhesive-to-adhesive to form a tab. Touch other end of the specimen to an end of the test panel. Hold the other end of the specimen so that it does not make contact with the panel but is positioned loosely above it, roll mechanically or by hand twice in each lengthwise direction, causing the roller to apply the tape to the panel. This prevents entrapment of air between the adhesive and the panel. Should this occur, discard the specimen.

Note - Where the width of the specimen is less than 24 mm, prior to applying test specimen, apply a strip or strips of the tape, to give an equivalent width of 24 mm for rolling purposes or use roller of appropriate weight to obtain a line pressure equal to 2040 g ± 45 gm for 24 mm width.

10.3 Individually prepare each specimen and test within 1 minute.

Note - Longer dwell time will give different results. Peel adhesion increases with dwell time at different rates for various tapes. A longer dwell time may be chosen purposely.

10.4 Double back the folded end of the tape at an angle of 180˚ and peel 24 mm of the tape from the panel. Clamp that end of the panel into the movable jaw of the adhesion testing machine and the free end of the tape into the other jaw. Operate the movable jaw at 5.0 ± 0.2 mm/s. See Figure 5.

10.5 After the movable jaw is started in motion, disregard the values obtained while the first 24 mm of tape is mechanically peeled. Use the average force obtained during peeling of the next 48 mm as the adhesion value.

11. TEST METHOD B - Adhesion to Backing of Single-Coated Tapes

11.1 Apply a sample of the tape under test to a rigid panel such as the standard stainless steel panel. Roll firmly. Apply a second strip of the tape to the backing of the strip on the test panel as described in 10.2 taking care to align the edges of the second specimen with those of the strip in the test panel. Complete testing as described in 10.3, 10.4, and 10.5.

12. TEST METHOD C - Adhesion of Double-Coated Tape

12.1 Face side - Follow the procedure of 10.1 through 10.3, then remove the liner and superimpose on the test strip a strip of 0.025 mm thick polyester film, as wide or slightly wider than that of the double-coated tape. Apply this film in the manner of applying the double-coated test strip to the panel so that the roller makes the actual application of the film to the double-coated tape.

Note - The four passes of the roller in applying polyester film may be made using the hand roller, The rolling rate may be increased to 50 mm/s.

12.1.1 Continue in accordance with 10.4 and 10.5.

12.2 Liner side - Adhere the face side of the specimen to a strip of 0.025 mm thick polyester film in the manner described in 10.2 so that the roller makes actual application of the tape to the film. Trim the film to be as wide as or slightly wider than the tape. Remove the liner.

12.2.1 Continue in accordance with 10.1 through 10.5.

13. TEST METHOD D - Adhesion to Liner of Double-Coated and Single-Coated Tapes

13.1 Double-coated tapes - Follow 10.1. Apply 125 mm of one end of the specimen with the adhesive side (face side) down, to the panel. Make four passes with the roller, twice in each direction at a rate of 10 ± 0.5 mm/s. Separate the liner from the tape at the free end and cut away the free tape. Do not disturb the liner adhered to the tape on the panel.

13.1.1 Double back the liner and proceed in accordance with 10.4 and 10.5.

13.2 Single-coated tapes - Follow 10.1. Apply a strip of double-coated tape, as wide as the specimen, the full length of the panel. Remove the liner from the double-coated tape. Superimpose 125 mm of one end of the specimen, backing side down, against the double-coated tape on the panel. Make four passes with the roller, twice in each direction at a rate of 10 ± 0.5 mm/s. Separate the liner from the tape at the free end and cut away the free tape. Do not disturb the liner adhered to the specimen on the panel.

13.2.1 Double back the liner and proceed in accordance with 10.4 and 10.5.

14. TEST METHOD E - Adhesion of Adhesive Transfer Tapes

14.1 Face side - Follow procedure of 10.1 through 10.3, then remove the liner and superimpose on the test strip a strip of 0.025 mm thick polyester film, as wide or slightly wider than the adhesive transfer tape. Apply this film in the manner as 10.2 so that the roller makes the actual application of the film to the adhesive transfer tape. Proceed as described in 10.4 and 10.5.

14.2 Liner side - Apply to the face side of the adhesive transfer tape a strip of 0.025 mm thick polyester film. Make two passes of the roller using a hand roller of the same size. The roller rate may be increased to 50 mm/s. Remove the liner from the tape and apply to a standard test panel as described in 10.2 through 10.3. Proceed as described in 10.4 and 10.5.

Note - In spite of its apparent simplicity, the use of this method is rather delicate and involves the use of great care in following the procedure as written to give coherent and identical results between one laboratory and another as well as between one operator and another.

15. TEST METHOD F - Single-Coated Tapes at 90˚ Angle

15.1 Prepare specimen for testing as described in 10.1 through 10.3.

15.2 Double back the folded end of the tape at a 90˚ angle and peel 25 mm of the tape from the panel. Place the panel into a fixture (see Figure 3) clamped to the moving jaw of the adhesion tester so that it will maintain a peeling angle at 90˚ during the peeling of the next 75 mm of tape and the free end of the tape into the other jaw (see Figure 4). Operate the moving jaw at 5.0 ± 0.2 mm/s.

15.3 Proceed per 10.5.

16. CALCULATIONS

16.1 If the observed pull value is not in Newtons, convert to Newtons per 10 mm by converting the pull value to Newtons and dividing by the width of the tape in mm and multiplying by 10.

17. REPORT

17.1 The report shall include the following:

17.1.1 Statement that this test method was used and indicating any deviations from the method as written.

17.1.2 Identify the source of each roll of tape tested.

17.1.3 Anomalous behavior during testing (such as adhesive transfer or splitting).

17.1.4 Peel adhesion value in Newtons per 10 mm to the nearest 0.1 N/10 mm. Use actual specimen width in calculations.

17.1.5 Which test method was used - A, B, C, D, E, or F, and if C or E, whether face side or liner side.

17.1.6 Dwell time, if less or greater than the standard 1 minute.

17.1.7 Test specimen widths if different from 8.1.

17.1.8 Conditions of test if other than 23 ± 1˚C or 50 ± 5% RH.

18. KEYWORDS

18.1 Pressure sensitive tape; peel adhesion at 180˚ angle; peel adhesion at 90˚ angle; adhesion to liner; adhesion to backing.

SUMMARY OF CHANGES

- Added reference to Afera 5001 in section 2.2
- Added section 2.3
- Added section 7.2

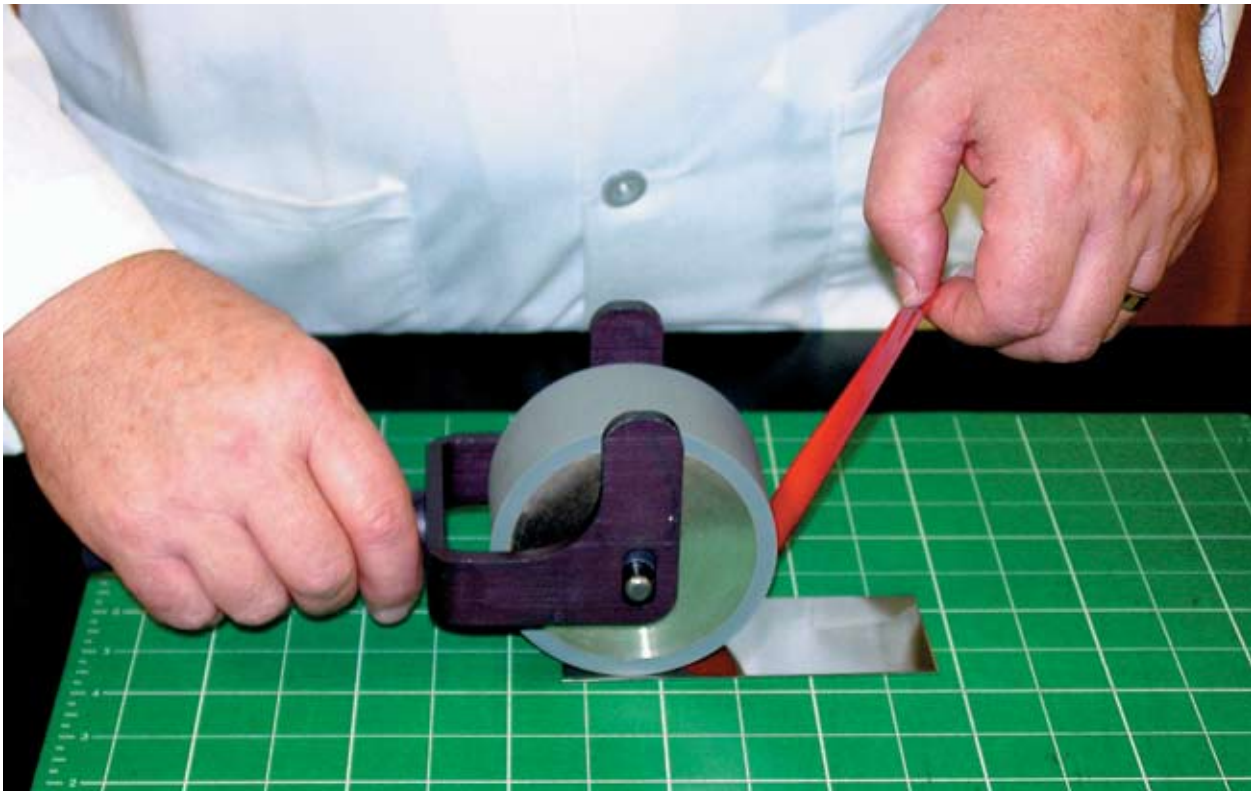

Figure 1. Hand operated roll down unit.

Figure 2. Mechanical roll down unit.

Figure 3. Tensile tester.

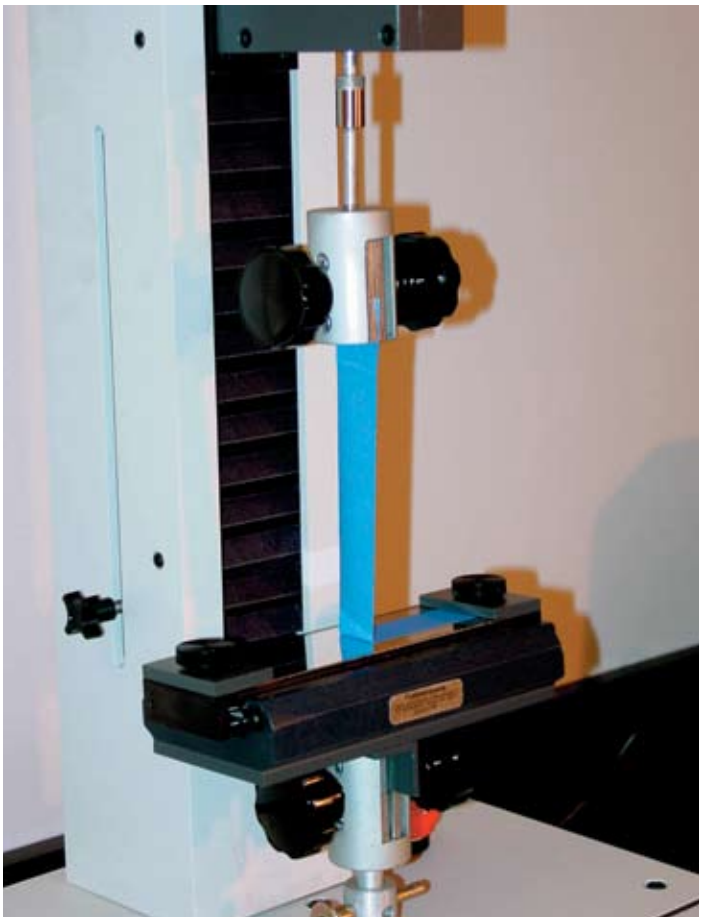

Figure 4. Tensile tester with 90 degree peel fixture.

Figure 5. Peel adhesion 180 degree peel.