Harmonized International Standard

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Shear Adhesion of Pressure Sensitive Tape

1. SCOPE

1.1 These procedures help determine the ability of a pressure sensitive tape to remain adhered under a constant load applied parallel to the surface of the tape and substrate. Shear adhesion (shear resistance) is the ability of a tape to resist static forces applied in the same plane as the backing.

1.1.1 Procedure A measures the shear adhesion when applied to a vertical standard steel panel.

1.1.2 Procedure B measures the shear adhesion when applied to a vertical panel covered with NIST (National Institute of Standards and Technology, USA) SRM 1810A standard fiberboard.

1.1.3 Procedure C measures the shear adhesion when applied to vertical panel covered with a fiberboard agreed upon by the buyer and seller.

1.1.4 Procedure D measures the shear adhesion of reinforced filament tape when applied to a horizontal standard steel panel.

1.1.5 Procedure E measures the shear adhesion of a filament-reinforced tape when applied to a horizontal panel covered with NIST SRM 1810A standard fiberboard.

1.1.6 Procedure F measures shear adhesion of a filament-reinforced tape when applied to a horizontal panel covered with a fiberboard agreed upon by the buyer and seller.

1.1.7 Procedure G is the same as Test Method A except the test is conducted at an elevated temperature and a 10-minute dwell time.

1.2 These procedures provide a means of assessing the uniformity of the adhesive of a given type of pressure sensitive tape (an example are tapes used for packaging applications). The assessment may be within a roll of tape, between rolls or production lots.

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

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:

D 3654/D 3654M Standard Test Method for Holding Power of Pressure-Sensitive Tapes

D 3715 Practice for Quality Assurance of Pressure-Sensitive Tapes

D 5750 Guide for Width and Lengths of Pressure-Sensitive Tapes

2.2 AFERA Standards:

2.2.1 AFERA 5012 Self Adhesive Tapes - Measurement of Static Shear Adhesion

2.3 CEN Standards

2.3.1 EN 1943 Self Adhesive Tapes - Measurement of Static Shear Adhesion

2.3.2 EN 10088/2, 2R - Specification for Stainless Steel Plate

2.4 PSTC Standards:

2.4.1 PSTC-107 Shear Adhesion of Pressure Sensitive Tape

3. SUMMARY OF TEST METHOD

3.1 Procedure A - Shear adhesion to standard steel panel - A strip of tape is applied to a standard steel panel under controlled roll down. The panel is mounted vertically, a standard mass is attached to the free end of the tape and the time to failure is determined.

3.2 Procedure B - Shear adhesion to a standard NIST fiberboard - A strip of tape is applied to a panel covered with NIST SRM 1810A fiberboard under controlled pressure. The panel is mounted vertically, a standard mass is attached to the free end of the tape and the time to failure is determined.

3.3 Procedure C - Shear adhesion to a vertical fiberboard surface with controlled roll down (see Figure 1). The fiberboard, corrugated board, or other substrate agreed upon prior to testing and described in the report section. A standard mass is attached to the tape and the time to failure is determined (see Figure 2).

3.4 Procedure D - Shear adhesion to a standard steel panel. A strip of filament-reinforced tape is applied to a standard steel panel with a 120˚ bend at one end with controlled roll down. The panel is mounted horizontally, tape side up, with the free end of the tape allowed to hang vertically over the rounded end. A standard mass is attached to the end of the tape and allowed to act for specified time.

3.5 Procedure E - Shear adhesion of filament reinforced tape to a standard (NIST) fiberboard - A strip of reinforced filament tape is applied to a panel with a 120˚ bend, covered with NIST SRM 1810A standard fiberboard under controlled roll down. The panel is mounted horizontally, tape side up, with the free end of the tape allowed to hang vertically over the rounded end of the panel. A standard mass is attached to the end of the tape and allowed to act for specified time (see Figure 3).

3.6 Procedure F - Shear adhesion of filament reinforced tape to a fiberboard - A strip of reinforced filament tape is applied to a panel with a 120˚ bend at one end under controlled roll down. The panel is covered with a fiberboard, corrugated board or other substrate agreed upon prior to testing and described in Section 12. The panel is mounted horizontally, tape side up, with the free end of the tape allowed to hang vertically over the round end of the panel. A standard mass is attached to the end of the tape and allowed to act for a specified time.

3.7 Procedure G - This test method is conducted as described in Procedure A except the test is conducted at an elevated temperature.

3.8 For Procedures A, B, C, and G the normal test area shall be 12 by 12 mm. A test area of 24 by 24 mm may be specified.

3.9 For Procedures D, E, F, the specimen width shall be 12 mm.

4. SIGNIFICANCE AND USE

4.1 Procedure A measures the ability of a pressure sensitive tape to adhere to a standard steel panel under constant stress. This may or may not relate to the ability of the tape to adhere to other surfaces.

4.2 Procedure B may be used to determine the shear adhesion of tapes generally used to close fiberboard boxes in packaging applications.

4.3 Procedure C measures the ability of a pressure sensitive tape to adhere to a non-standard fiberboard, linerboard or other substrate which is agreed upon for testing. This may be used to compare the shear adhesion of tapes to a particular surface or to compare the shear adhesion of a tape to a variety of surfaces.

4.3.1 The surface of similar fiberboard may exhibit considerable variations between paper mills, between batches from one mill, and within batches. Take care in the choice of samples and when comparing test results between substrates which may not be exactly the same.

4.3.2 The precision of test conducted on non-standard surfaces may be different from that described in section 13.

4.4 Procedures D, E, and F may be used to determine the ability of a filament reinforced tape to hold when placed under constant stress. The reinforced tapes may also be tested using Procedures A, B, and C.

4.5 Procedure G may be used to compare the shear adhesion of tape when applied to a standard steel surface and tested at an elevated temperature (see 10.6.3 and 12.1.8).

5. APPARATUS

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.

Note 1 - The 12 mm cutter shall consist of a bar stock 1 mm wide. The edges for about 125 mm from one end shall be slightly rounded to form a handle. The width of the end of the bar shall be narrowed to exactly 12 mm minus the thickness of a single edge razor (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 24.0 mm wide and shall be narrowed to exactly 24 mm minus the thickness of a single edge razor.

Note 2 - These widths correspond to the primary metric (SI) units described in ASTM D 5750. If it is desirable to test slightly different widths (e.g. 12.5 or 25 mm) of specimens per 9.4, this should be noted per 12.1.5.

Note 3 - There may be several suppliers of these items. See Appendix B.

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

5.3 Panel

5.3.1 For Procedures A, B, C, and H, a panel at least 50 mm long and 50 mm wide and not less than 1.1 mm thickness stainless steel 302 or 304 in accordance with Specification EN 10088/2, 2R having a bright annealed finish. The surface roughness height shall be 50 ± 25 nm arithmetical average deviation from the mean line. One or both panel ends shall be ground to form a 90° angle with the surface. Panels showing stains, discoloration, or many scratches are not acceptable. New panels should be cleaned prior to use as 10.2.1, 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 8.1.

5.3.2 For Procedures D, E, and F, a panel as described in 5.3.1 shall have a 12 mm length of one end of the panel bent through an arc of 120° away from the test surface. The radius of the curvature of the finished surface at the bend shall be 1.5 to 3 mm.

5.4 Roller, mechanically or hand operated

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 2 kg ± 0.1 kg.

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. (See Figure 5.)

5.5 Test stands and ancillary apparatus

5.5.1 Procedures A, B, C, and G - A test stand that shall hold the test panel (see Figure 6), with the tape applied, at an angle of 2° with the vertical, so that when the mass is acting on the test specimen, no peel forces will be exerted on the tape.

5.5.2 Procedures D, E, and F - A test stand that will support the test panel in a horizontal plane, approximately 300 mm above the work surface.

5.5.3 Clamp, that will allow the attachment of the mass to the specimen, distributing the load equally across the tape specimen width.

5.5.4 Test masses

5.5.4.1 Procedures A, B, D, and H. The test mass shall be 1000 ± 5 g or other mass as specified. The mass of the clamp described in 5.5.3 shall be included as part of the total mass.

5.5.4.2 Procedures D, E, and F. The test mass shall be 4.5 ± 0.2 kg or other mass as specified. The mass of the clamp described in 5.5.3 shall be included as part of the total mass.

5.5.5 Timing system

5.5.5.1 For Procedures A, B, C, and G, to measure the interval between the application of the load to the specimen and its separation from the panel.

5.5.5.2 For Procedures D, E, and F, a suitable means of measuring the amount of slippage of the tape to 1 mm on the panel after the mass has acted for 48 h.

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 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.

6.3 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, and made exclusively from virgin materials.

7. SAMPLING

7.1 Sampling shall be in accordance with ASTM Practice D 3715/D 3715M or other formal sampling procedure agreed to by both parties for referee testing. Five replicate specimens shall be averaged for all procedures. No single value shall be considered as representative of the roll under test.

8. CONDITIONING

8.1 Condition the sample rolls of tape in the standard conditions of 23 ± 1° C and 50 ± 5% RH. Test at these conditions unless otherwise specified (see 12.1.7). If these tolerances cannot be maintained, the closest possible tolerances shall be used and these revised tolerances quoted in the report (see 12.1.7).

Note 4 - Caution: The tester should know that by prolonged handling of the test panel, heat from the hand is transmitted to the test panel. Therefore, just prior to, during, and after application of the specimen to the test panel, the panel should be handled as little as possible.

9. TEST SPECIMENS

9.1 Removal from roll

9.1.1 Unwind and discard at least three but no more than six outer wraps of tape from the sample roll before taking specimens for testing.

9.1.2 Remove three specimens per sample roll for each test to be performed for Procedures A, D, and G; and five specimens per roll for Procedures B, C, E, and F. Remove specimens from freely rotating roll at the rate of 500 to 750 mm/s. Where width or other factor 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.

9.2 When tape is wider than specified for in the test method, cut the specimen from the center of the strip removed from the roll in accordance with 9.1.2.

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

9.4 Test specimen size.

9.4.1 Procedures A, B, C, and G. The test contact area shall be 12 ± 0.5 by 12 ± 0.5 mm, or other width, as specified (24 ± 0.5 mm by 24 ± 0.5 mm may be used). The length of the specimen shall be approximately 150 mm.

9.4.2 Procedures D, E, and F specimens shall be 12 ± 0.5 mm in width and approximately 300 mm long.

10. PROCEDURES

10.1 For Procedures B and C, apply by means of a double-coated pressure-sensitive tape a 30 by 75 mm piece of fiberboard (see 3.2, 3.3) with the 30 mm dimension centered on the 50 mm dimension at one end of the test panel (see 5.3.1 and 5.3.2).

Note 5 - Take care that the fiberboard is applied with the proper side up and is oriented so that the grain of the paper, machine direction (MD), is perpendicular to the intended direction of the shear stress.

10.2 Procedure A

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

Note 6 - Discard panels showing stains, discoloration, or many scratches. Avoid contacting panel surface with fingers. During storage, panels should be protected from damage or contamination.

10.2.2 Center the test specimen on the 50 mm dimension at one end of the test panel and apply without added pressure to cover an area exactly 12 x 12 mm, unless other width specified, with the tape. Mask the exposed adhesive of the free area of the specimen.

10.2.3 To prevent cutting the specimen by the end of the panel during roll down, place another panel of the same or slightly lesser thickness under the free masked end of the specimen, and in contact with the end of the panel prior to roll down. Roll down the applied test area twice in each lengthwise direction.

10.2.4 Individually prepare each specimen and test within 1 minute. For tapes other than packaging tape, other dwell times may be used but must be reported (See 12.1.4).

10.2.5 Place the clamp on the masked free end of the specimen, ensuring that the clamp extends completely across the width of the specimen and is aligned to uniformly distribute the load.

10.2.6 Place the test assembly in the test stand so that the free end of the test specimen is vertical, ensuring that no peel forces act on the specimen.

10.2.7 Apply the 1000 g mass to the clamp gently so as to cause no impact force on the tape specimen. Record the time elapsed until the specimen has completely separated from the test panel. (See Figure 4.)

10.3 Procedures B and C

10.3.1 Conduct these tests as described in 10.2 except the test panel shall be covered with fiberboard described in 10.1

10.4 Procedure D

10.4.1 Clean, as described in 10.2.1, a test panel described in 5.3.1.

10.4.2 Apply one end of the specimen, about 100 mm in length, adhesive side down, to the longitudinal surface of the test panel. The tape must be at a true right angle to the bent edge of the panel. Allow the remaining length to extend over and beyond the bend edge of the panel.

10.4.3 Using a square, cut across and through the width of the tape specimen 75 mm back from the front of the bend in the horizontal plane of the test panel surface.

10.4.4 Roll twice, once in each lengthwise direction.

10.4.5 Place the clamp on the free end of the specimen, ensuring that the clamp extends completely across the width, and is aligned so as to distribute the load uniformly.

10.4.6 Place the test assembly in the test stand so that the panel is horizontal, tape side up, and the free end of the test specimen in vertical. Apply the 4.5 kg mass to the clamp gently so as not to cause any impact force on the specimen.

10.4.7 At the end of 48 h under load, examine the specimen for evidence of slippage. Measure any slippage that has occurred to the nearest 1 mm. (See Figure 4.)

10.5 Procedures E and F

10.5.1 Conduct these tests as described in 10.4 except the test panels shall be covered with fiberboard as described in 10.1.

10.6 Procedure G

10.6.1 Prepare test specimens as described in 10.2.1, 10.2.2, 10.2.3, 10.2.4, and 10.2.5.

10.6.2 Place the test stand, with specimen in place, in an oven maintained at 50 ± 1˚C, or other temperature, as specified.

10.6.3 Allow to condition for 10 min., then apply the 1000 g mass to the clamp gently so as not to cause any shear impact force on the tape specimen. Record the time lapsed in which the tape specimen has completely separated from the test panel (See 12.1.8).

11. CALCULATIONS

11.1 Procedures A, B, C, and G - To determine the test results for each roll of tape, convert each of the five specimen test results (times to failure) to its common or natural logarithm. Obtain the arithmetic mean of all logarithms and then convert back to time by obtaining the appropriate antilogarithm. This gives the test result for the roll of tape under consideration in the sampling plan.

11.2 Procedures D, E, and F - The average slippage in mm shall be reported.

12. REPORT

12.1 The report shall include the following:

12.1.1 Statement including which test method was used and indicating any deviation from the method as written.

12.1.2 Identify the source of each roll of tape.

12.1.3 For Procedures A, B, C, and G, the time for the tape to separate completely from the panel. For Procedures D, E, and F, the amount of slippage in mm to the nearest mm.

12.1.4 Dwell time, if other than the standard 1 minute.

12.1.5 Test specimen size for Procedures A, B, C, and G if other than 12 by 12 mm. Width of specimen for Procedures E, F, and G if other than 12 mm.

12.1.6 Conditioning if other than 23 ± 1˚C or 50 + 5% RH.

12.1.7 Test temperatures for Procedures A, B, C, D, E, and F, if other than 23˚C and test temperature for Procedure G, if other than 50˚C.

12.1.8 Mode of failure - Cohesion (cohesive strength, internal bond) - The ability of the adhesive to resist splitting. Good cohesion is necessary for clean removal. Adhesion - A bond produced between a pressure sensitive tape adhesive and a surface for Procedures A, B, C, and G.

12.1.9 Fiberboard substrate if Procedure C or F is used.

13. PRECISION AND BIAS STATEMENT

13.1 The surfaces of similar fiberboard may exhibit considerable variations between paper mills, between batches from one mill, and within batches, therefore results using different fiberboard should not be compared except when one wishes to use Procedure C as a means of comparing how well a given tape will adhere to different fiberboards.

14. KEYWORDS

14.1 Pressure sensitive tape, filament tape, shear adhesion.

SUMMARY OF CHANGES

- Corrected unit of measurement for surface roughness in section 5.3.1, line 3
- Required five replicate samples for all procedures in section 7.1

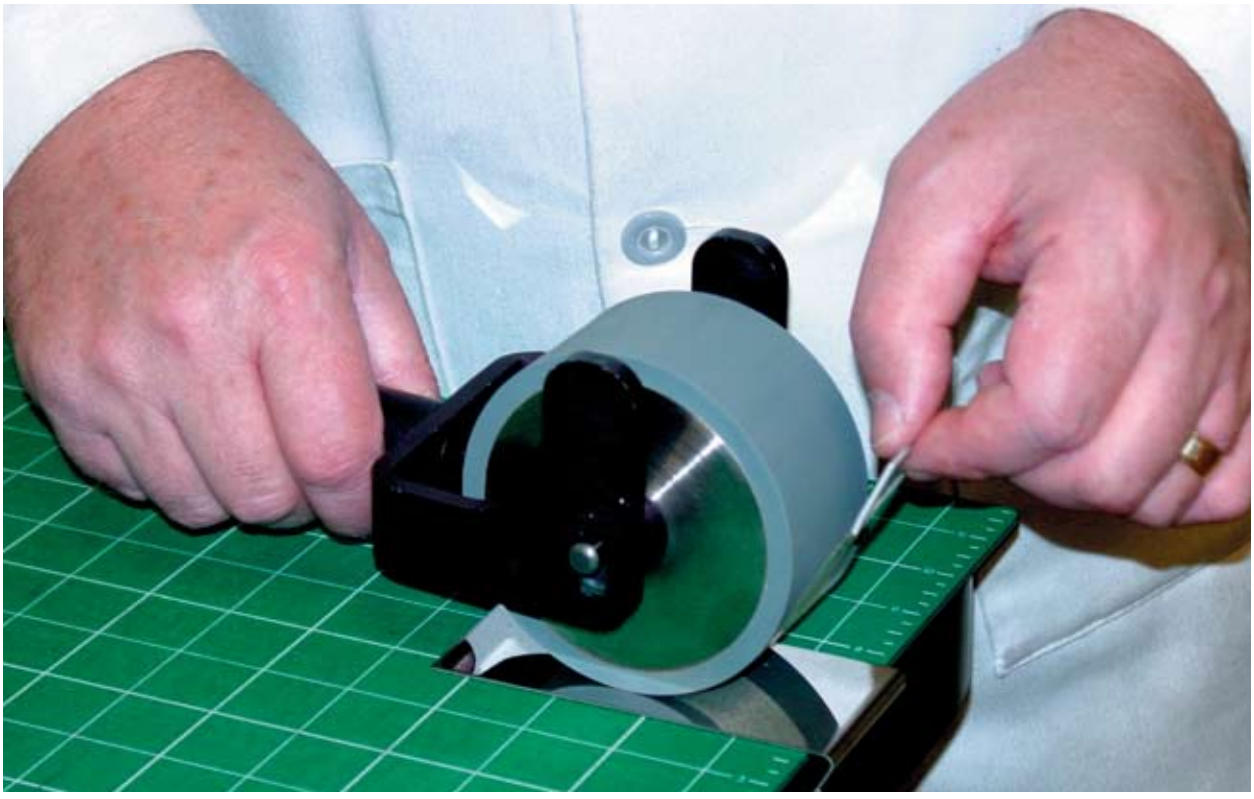

Figure 1. Controlled roll down shear adhesion sample preparation.

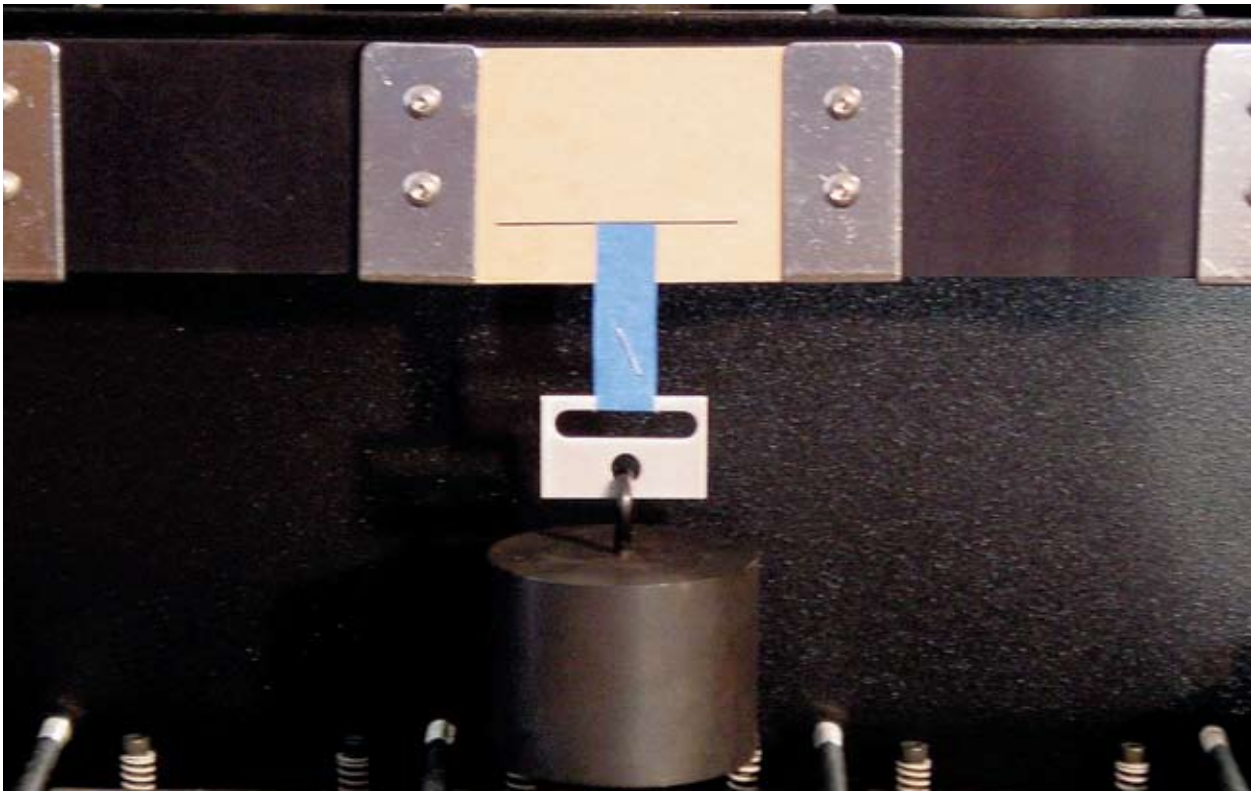

Figure 2. Shear adhesion sample preparation with weight.

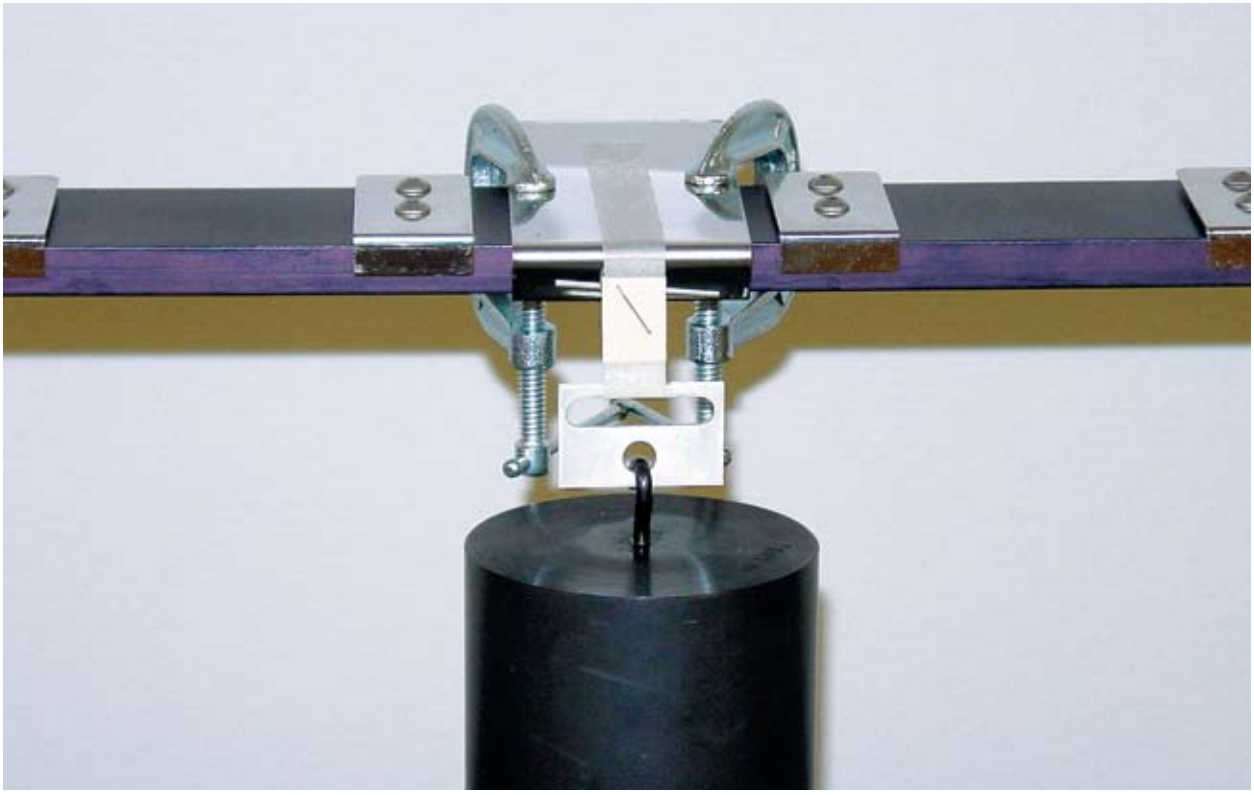

Figure 3. Shear adhesion sample in test stand (initial).

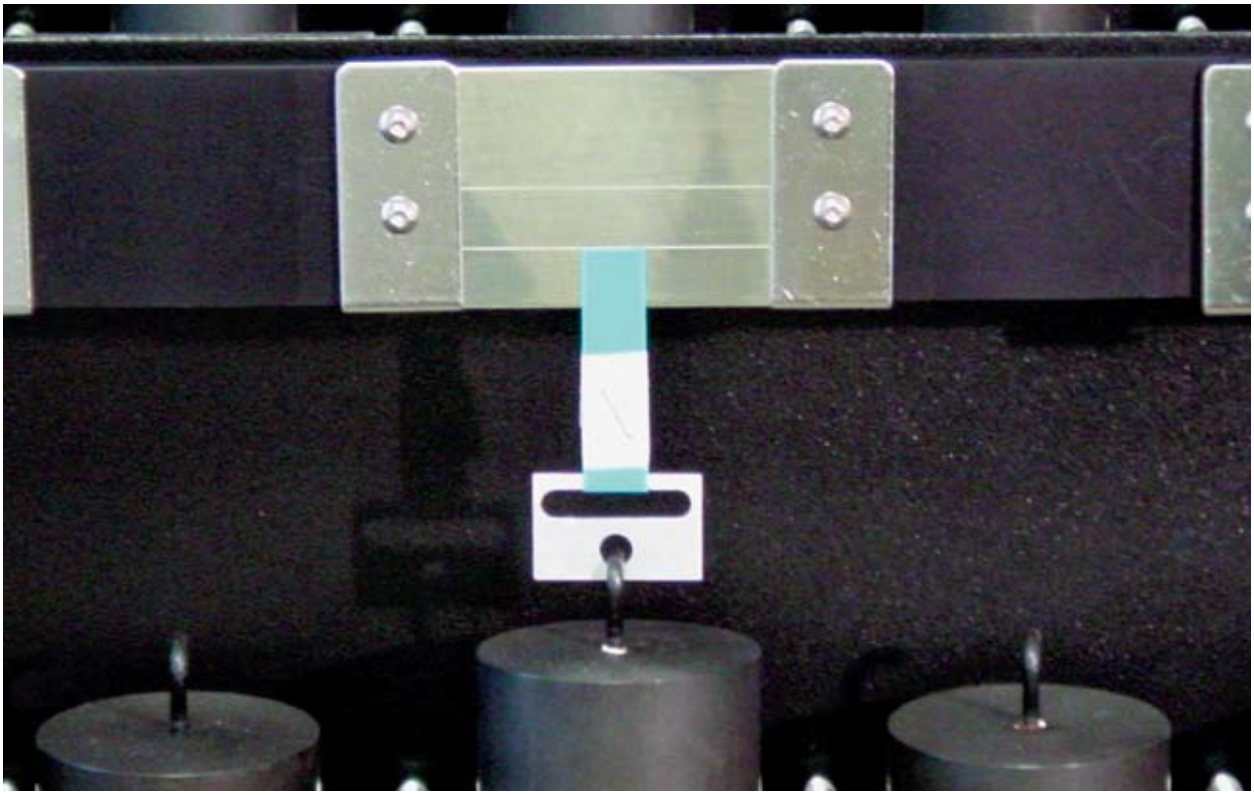

Figure 4. Shear adhesion sample in test stand (final).

Figure 5. Sample preparation for shear adhesion hand roll down.

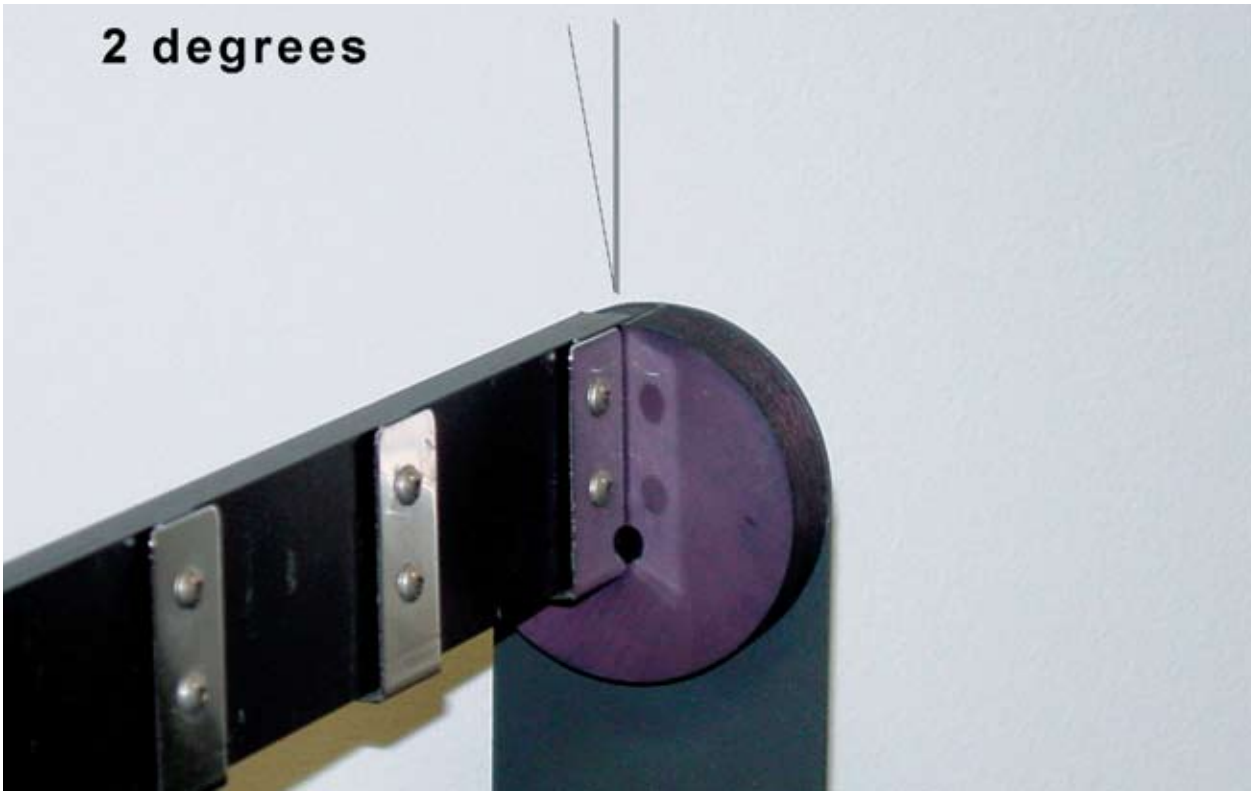

Figure 6. Test stand for shear adhesion.