INTERNATIONAL STANDARD

ISO 29863

Second edition
2018-05

Self adhesive tapes — Measurement of static shear adhesion

Rubans auto-adhésifs — Mesurage de la résistance au cisaillement statique

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Reference number
ISO 29863:2018(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 29863:2007) of which it constitutes a minor revision.

The changes compared to the previous edition are as follows:

— the Introduction has been revised to remove outdated information;

— the normative references in Clause 2 have been updated;

— the definition of "shear adhesion" has been revised and a definition has been added for "self adhesive tape" in Clause 3;

— a Bibliography has been added;

— the text has been editorially revised to comply with the most recent editing rules.

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Introduction

This document has been prepared in conjunction with AFERA (International Association for the Self Adhesive Tape Industry) in Europe and PSTC (Pressure Sensitive Tape Council) in USA.

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Self adhesive tapes — Measurement of static shear adhesion

1 Scope

This document specifies a series of methods for the determination of the ability of a pressure sensitive tape to remain adhered under a constant load applied parallel to the surfaces of the tape and substrate.

This document contains:

— method A: Self adhesive tapes – Measurement of shear adhesion to a vertical standard steel panel;

— method B: Self adhesive tapes – Measurement of shear adhesion to a vertical panel covered with NIST SRM 1810A[1)] standard fibreboard;

— method C: Self adhesive tapes – Measurement of shear adhesion to a vertical panel covered with a fibreboard agreed upon by the buyer and seller;

— method D: Self adhesive tapes – Measurement of shear adhesion of filament reinforced tape applied to a horizontal standard steel panel;

— method E: Self adhesive tapes – Measurement of shear adhesion of filament reinforced tape applied to a horizontal panel covered with NIST SRM 1810A[1)] standard fibreboard;

— method F: Self adhesive tapes – Measurement of shear adhesion of filament reinforced tape applied to a horizontal panel covered with a fibreboard agreed upon by the buyer and seller;

— method G: Self adhesive tapes – Measurement of shear adhesion to a vertical standard steel panel at elevated temperature after a 10 min dwell time.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12481, *Self adhesive tapes — Terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12481 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

1) NIST SRM 1810A is National Institute of Standards and Technology – Standard Reference Material 1810A and is available from the Institute at Gaithersburg, Maryland MD 20899, USA.

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3.1
shear adhesion
resistance of the pressure sensitive adhesive against shear when static forces are exerted parallel to the bonding surface

Note 1 to entry: It is expressed as the time to failure under constant load.

3.2
self adhesive tape
pressure sensitive adhesive
adhesive which in a dry state is permanently tacky at room temperature and adheres readily to surfaces under brief and light pressure

4 Significance and use

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

These methods 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.

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.

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

5 Method A: Measurement of shear adhesion to a vertical standard steel panel

5.1 Principle

Method A measures the shear adhesion of a self adhesive tape to a standard steel panel by its time to failure at 23 °C and 50 % relative humidity (RH) under constant load.

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.

5.2 Materials

5.2.1 Absorbent cleaning material, surgical gauze, cotton wool or tissue. To be suitable, materials shall be lint free during use, absorbent, contain no additives that are soluble in the solvents listed in 5.2.2 and made exclusively from virgin materials.

5.2.2 One or more of the following solvents:

— diacetone alcohol (4-hydroxy-4-methyl-2-pentanone) non–residual grade;

— methanol;

— methyl ethyl ketone;

— acetone;

— *n*-heptane;

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— a mixture of *n*-heptane and a fluorinated hydrocarbon such as refrigerant (suitable when toxicity or flammability restrictions apply).

Solvents shall be of general purpose chemical grade and held in a suitable dispensing system.

5.3 Apparatus

5.3.1 Typical shear adhesion tester

See Figure 1 for a typical shear adhesion tester.

5.3.2 Test piece cutter

A test piece cutter shall hold two single edge razor blades in parallel planes a precise distance apart, to form a cutter of exact specimen width; two cutters, 12 mm and 24 mm cutting width, shall be available or appropriate alternatives which will not cause edge damage. The precision of the razor blade separation shall be the nominal width ±0,1 mm.

5.3.3 Stainless steel panels

These shall be perfectly flat, at least 125 mm long and 50 mm wide and at least 1,1 mm thick, stainless steel type 1.4301 in accordance with the 2 R quality defined in EN 10088-2, having a bright annealed finish with a surface roughness of 50 nm ± 25 nm. Panels showing stains, discoloration or many scratches are not acceptable. New panels shall be cleaned prior to use as described in 5.5.2 except with ten washes of the final solvent. Between uses the panel test surface shall be protected from scratches and contamination and the panels shall be stored in the conditions described in 5.5.2.

5.3.4 Roller mechanically or hand operated

5.3.4.1 A steel roller 85 mm ± 2,5 mm in diameter and 45 mm ± 1,5 mm in width, covered with rubber approximately 6 mm in thickness, having a Shore 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.

5.3.4.2 No part of the apparatus shall increase the mass of the roller during use. The roller shall move either mechanically or by hand at the rate of 10 mm/s ± 0,5 mm/s.

5.3.5 Test stands and ancillary apparatus

5.3.5.1 Test stand

A test stand that shall hold the test panel, with tape applied, at an angle between 0° and 2° from the vertical, so that when the mass is acting on the test specimen, no peel force will be exerted on the tape.

5.3.5.2 Clamps

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

5.3.5.3 Test masses

The test mass shall be 1 000 g ± 5 g or other mass as specified. The mass of the clamp described in 5.3.5.2 shall be included as part of the total mass.

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5.3.5.4 Timing system

A timing system to measure the interval between the application of the load to the specimen and its separation from the panel.

5.4 Test samples and test piece

5.4.1 Condition the sample rolls of tape in the standard conditions of 23 °C ± 1 °C and 50 % ± 5 % RH. Test at these conditions unless otherwise specified [see 5.7 h)].

If these tolerances cannot be maintained, the closest possible tolerances shall be used and these revised tolerances quoted in the report.

5.4.2 The test requires three test pieces, each shall be 12 mm ± 0,5 mm wide by approximately 150 mm long. Alternatively test pieces of 24 mm ± 0,5 mm or other widths may be used specifying the contact area used with the results.

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

5.4.4 Remove three test pieces for each test to be performed. Remove each test piece from a freely rotating roll at the rate of 500 mm/s to 750 mm/s. Where high unwind force makes it impossible to remove the test piece at the prescribed rate, remove it at a rate as close to 500 mm/s as possible.

5.4.5 When the tape is wider than 12 mm, test pieces of the specified width are to be cut with an apparatus as described in 5.3.2 from the centre of a strip removed from the roll in accordance with 5.4.4.

5.4.6 Apply the test pieces within 5 min after unwinding.

5.5 Procedure

5.5.1 Standard test conditions

Standard test conditions shall be the same as 5.4.1 for test pieces and test samples conditioning.

5.5.2 Preparation of the panel

Dispense one of the solvents listed in 5.2.2 on to 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 with methyl ethyl ketone or acetone. The panel should be allowed to dry for at least 10 min. Panels not used within 10 h should be recleaned.

In order to obtain consistent results a new panel shall be wiped at least 10 times with final solvent before use.

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

5.5.3 Shear adhesion

5.5.3.1 Test piece preparation

Centre the test piece at one end of the test panel and apply without added pressure to cover an area of 12 mm ± 0,5 mm by 12 mm ± 0,5 mm, unless other dimensions are specified. The exposed adhesive of the free area of the test piece may be masked.

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To prevent damaging the test piece 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 test piece, and in contact with the end of the panel prior to roll down. Roll down the applied test area twice, once in each lengthwise direction.

Individually prepare each specimen and begin test within 1 min. For tapes other than packaging tapes, other dwell times may be used but shall be reported.

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.

5.5.3.2 Shear adhesion test

The following action shall be completed within 1 min of rolling the sample in 5.5.3.1.

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

Place the test assembly in the test stand so that the free end of the test piece is vertical, ensuring that no peel force acts on the test piece.

Apply the mass to the clamp gently so as to cause no shear impact force on the test piece. Record the time elapsed until the test piece has completely separated from the test panel.

5.6 Expression of results

To determine the test result, convert each of the test piece 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.

5.7 Test report

The test report shall include the following information:

a) a reference to this document;

b) statement that this test method was used and indicating any deviations from the method as written;

c) identification of each roll of tape tested;

d) the time to separate completely from the panel as calculated in 5.6;

e) the dwell time, if other than 1 min;

f) test contact area if other than 12 mm ± 0,5 mm by 12 mm ± 0,5 mm;

g) mode of failure, cohesive or adhesive failure or other observation:

   — cohesive failure: failure of an adhesive bond such that the separation is within the adhesive,

   — adhesive failure: failure of an adhesive bond such that the separation is at the interface of adhesive and substrate leaving negligible residue;

h) conditions of test if other than 23 °C ± 1 °C and 50 % ± 5 % RH.

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6 Method B: Measurement of shear adhesion to a vertical panel covered with NIST SRM 1810A standard fibreboard

6.1 Principle

Method B measures the shear adhesion of a self adhesive tape to a standard fibreboard surface by its time to failure at 23 °C and 50 % relative humidity (RH) under constant load.

Shear Adhesion to fibreboard – A strip of tape is applied to a suitable panel covered with fibreboard 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.

6.2 Materials

6.2.1 **Standard fibreboard**, NIST SRM 1810A[1)].

6.2.2 **Double sided tape**, of a width suitable to adhere the fibreboard to the panel.

6.3 Apparatus

6.3.1 Test piece cutter

As 5.3.2.

6.3.2 Suitable panels

Any suitable clean rigid panel with dimension 50 mm by not less than 50 mm and not less than 1,1 mm thick.

6.3.3 Roller mechanically or hand operated

As 5.3.4.

6.3.4 Test stands and ancillary apparatus

As 5.3.5.

6.4 Test samples and test piece

As 5.4.

6.5 Procedure

6.5.1 Standard test conditions

As 5.4.1.

6.5.2 Preparation of the panel

Apply a piece of double sided tape centrally to the clean panel. Superimpose a piece of the fibreboard wider and longer than the sample to be tested, ensuring that it is correctly applied with the proper side up and the grain of the paper perpendicular to the long axis of the test panel and roll firmly.

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6.5.3 Shear adhesion

6.5.3.1 Test piece preparation

Follow 5.5.3.1 applying the test piece onto the fibreboard.

6.5.3.2 Shear adhesion test

As 5.5.3.2.

6.6 Expression of results

As 5.6.

6.7 Test report

As 5.7.

7 Method C: Measurement of shear adhesion to a vertical panel covered with a fibreboard agreed upon by the buyer and the seller

7.1 Principle

Method C measures the shear adhesion of a self adhesive tape to a fibreboard surface agreed upon by the buyer and the seller by its time to failure at 23 °C and 50 % RH under constant load.

Shear Adhesion to fibreboard – A strip of tape is applied to a suitable panel covered with fibreboard 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.

7.2 Procedure

This method is identical to method B (6.5.1 to 6.5.3.2) except for the choice of fibreboard used.

The fibreboard identity shall be reported with the results.

8 Method D: Measurement of shear adhesion of filament reinforced tape applied to a horizontal standard steel panel

8.1 Principle

Method D measures the shear adhesion of a filament reinforced tape horizontally applied to a standard steel panel by its slippage at 23 °C and 50 % RH under constant load after 48 h.

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 horizontally with a free end of the tape allowed to hang vertically over the rounded end of the panel. A standard mass is attached to the free end of the tape, allowed to act for a specified time and the resultant slippage measured.

8.2 Materials

As 5.2.

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8.3 Apparatus

8.3.1 Test piece cutter

As 5.3.2.

8.3.2 Stainless steel panels

These shall be at least 125 mm long and 50 mm wide conforming to 5.3.2.

A 12 mm length of the panel at one end shall be bent through an arc of 120° away from the test surface, such that the radius of curvature at the bend is between 1,5 mm and 3 mm (as shown in Figure 2).

8.3.3 Roller mechanically or hand operated

As 5.3.4.

8.3.4 Test stands and ancillary apparatus

8.3.4.1 Test stand

A test stand that shall hold the test panel, with tape applied, in a horizontal plane, approximately 300 mm above the work surface.

8.3.4.2 Clamps

As 5.3.5.2.

8.3.4.3 Test masses

The test mass shall be 4,5 kg ± 0,2 kg or other mass as specified. The mass of the clamp described in 8.3.4.2 shall be included as part of the total mass.

8.3.4.4 Measuring rule

A measuring rule capable of reading to the nearest 1 mm.

8.4 Test samples and test piece

As 5.4 except that test pieces shall be approximately 300 mm long rather than 150 mm.

8.5 Procedure

8.5.1 Standard test conditions

As 5.4.1.

8.5.2 Preparation of the panel

As 5.5.2.

8.5.3 Shear adhesion

8.5.3.1 Test piece preparation

Refer to Figure 2 for guidance in preparation.

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Apply approximately 100 mm of one end of the test piece centrally to the panel in the longitudinal axis of the panel. The tape shall be applied such that it makes a true right angle to the bent edge of the panel. Allow the remaining 200 mm of test piece to hang over the bent edge of the panel.

Using a straight edge cut through the width of the test piece on the panel 75 mm from the front of the bend at the end of the panel.

Roll twice, in each direction with a roller as described in 5.3.4.

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.

8.5.3.2 Shear adhesion test

The following action shall be completed within 1 min of rolling the sample in 8.5.3.1.

Place the clamp or hook on the free end of the test piece, ensuring that it extends completely across the width of the specimen, and is aligned to distribute the load uniformly.

Place the test assembly in the test stand so that the panel is horizontal, tape side up, and the free end of the test piece is vertical.

Apply the 4,5 kg mass to the clamp or hook gently so as to cause no shear impact force on the test piece.

After 48 h under load, examine the test piece for evidence of slippage. Measure any slippage that has occurred to the nearest 1 mm.

8.6 Expression of results

Determine the arithmetic mean of the slippage recorded for each test piece.

NOTE While the slippage in mm will be reported it is common to interpret the result of this test method as a pass or fail against a preset acceptance criterion.

8.7 Test report

The test report shall include the following information:

a) a reference to this document;

b) statement that this test method was used and indicating any deviations from the method as written;

c) identification of each roll of tape tested;

d) the dwell time, if other than 1 min;

e) width of test piece if other than 12 mm;

f) slippage in mm;

g) conditions of test.

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9 Method E: Measurement of shear adhesion of filament reinforced tape applied to a horizontal panel covered with NIST SRM 1810A standard fibreboard

9.1 Principle

Method E measures the shear adhesion of a filament reinforced tape horizontally applied to a standard panel covered with a standard fibreboard by its slippage at 23 °C and 50 % RH under constant load after 48 h.

Shear adhesion to standard fibreboard panel – A strip of tape is applied to a standard fibreboard applied to a standard panel under controlled roll down. The panel is mounted horizontally with a free end of the tape allowed to hang vertically over the rounded end of the panel. A standard mass is attached to the free end of the tape, allowed to act for a specified time and the resultant slippage measured.

9.2 Procedure

Follow procedure as in method D (8.5.1 to 8.5.3.2) except that the test surface shall be the standard fibreboard adhered to the panel by double-sided tape in the manner described in 6.5.2.

10 Method F: Measurement of shear adhesion of filament reinforced tape applied to a horizontal panel covered with a fibreboard agreed upon by the buyer and the seller

10.1 Principle

Method F measures the shear adhesion of a filament reinforced tape horizontally applied to a standard panel covered with an agreed fibreboard by its slippage at 23 °C and 50 % RH under constant load after 48 h.

Shear adhesion to a fibreboard panel – A strip of tape is applied to a fibreboard applied to a standard panel under controlled roll down. The panel is mounted horizontally with a free end of the tape allowed to hang vertically over the rounded end of the panel. A standard mass is attached to the free end of the tape, allowed to act for a specified time and the resultant slippage measured.

10.2 Procedure

Follow procedure as in method D (8.5.1 to 8.5.3.2) except that the test surface shall be the agreed fibreboard adhered to the panel by double-sided tape in the manner described in 6.5.2.

The fibreboard identity shall be reported with the results.

11 Method G: Measurement of shear adhesion to a vertical standard steel panel at an elevated temperature after 10 min dwell time

11.1 Principle

Method G measures the shear adhesion of a self adhesive tape to a standard steel panel at an elevated temperature after a 10 min dwell time by its time to failure under constant load.

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, in an oven at the test temperature, a standard mass is attached to the free end of the tape and the time to failure is determined.

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11.2 Procedure

This method is identical to method A (5.5.1 to 5.5.3.2) except that the test stand shall be installed in an oven capable of maintaining the desired elevated temperature ±1 °C. The test piece shall be conditioned in the oven for 10 min before attaching the mass.

The temperature used for the test shall be reported with the results.

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