International Standard

ISO 2411

Fifth edition
2024-09

Rubber- or plastics-coated fabrics — Determination of coating adhesion

Supports textiles revêtus de caoutchouc ou de plastique — Détermination de l'adhérence du revêtement

Reference number
ISO 2411:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).This fifth edition cancels and replaces the fourth edition (ISO 2411:2017), which has been technically revised.

The changes are as follows:

— Terms and definitions 3.3, 3.4, 3.5, 3.6, and 3.7 have been deleted as these had not been cited in the text, instead, they have been moved to 9.5 as they are the failure types and important in adhesion test.

— Figure 3 and 4 have been revised to reflect the procedures described in Clause 8 and Clause 9 on the figures;

— A.2 has been revised to prevent the confusion by deleting the different way from the procedure in the body text of 9.2.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Knowledge of the strength of adhesion between the coating and the adjacent layer is important as an inadequate adhesion strength can often result in failure of the product due to delamination.

Rubber- or plastics-coated fabrics — Determination of coating adhesion

WARNING — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine applicability of any other restrictions.

1 Scope

This document specifies a method of determining the coating adhesion strength of coated fabrics.

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.

ISO 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

ISO 2286-1, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 1: Methods for determination of length, width and net mass*

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
delamination
partial or whole separation of two, or more, of the component layers of a coated fabric

Note 1 to entry: This can be either a fabric to coating layer separation or separation within the actual coating layer.

3.2
substrate
textile component of a coated fabric

4 Atmosphere for conditioning and testing

4.1 For conditioning

The atmosphere shall be the method of conditioning "1" specified in ISO 2231:1989.

For fabrics coated on one side only, a minimum of 16 h exposure is recommended.

For fabrics coated on both sides, a minimum of 24 h is recommended.

4.2 For testing

The atmosphere shall be selected from A through C specified in ISO 2231:1989.

NOTE The temperature 23 °C is normally the testing atmosphere in temperate countries and 27 °C is normally in tropical and subtropical countries.

5 Time-interval between manufacture and testing

For all test purposes, the minimum time between manufacture and testing shall be 16 h. For non-product tests, the maximum time between manufacture and testing shall be 4 weeks, and for evaluations intended to be comparable, the tests, as far as possible, shall be carried out after the same time-interval.

For products, unless otherwise agreed between the interested parties, the time between manufacture and testing shall not exceed 3 months.

6 Preparation of test specimens

6.1 General

For the determination of coating adhesion all samples shall be taken within the usable width defined in accordance with ISO 2286-1 of the coated fabric under test. A total of 10 test specimens shall be tested.

Each test specimen before its width is trimmed shall have at least 20 % extra width of the trimmed test specimen and not less than 200 mm length.

Five test specimens shall be cut with the length parallel to the longitudinal direction and five test specimens with their length parallel to the transverse direction of the coated fabric under test.

In the case of coated fabrics with substrate having a pile, prepare 10 test specimens, five in the direction of the pile and five against the direction of the pile respectively.

Either method of preparation may be used. The method of preparation to adopt is determined by pretesting if necessary.

NOTE Generally, thick coatings are processed by method 1, thin coatings by method 2.

6.2 Method of preparation 1

6.2.1 Where the strength of the coating layer exceeds the force of the adhesive bond to the substrate, prepare the test specimen by carefully cutting through the coating to the substrate at right angles to the length of the test specimen. From this, cut carefully to separate the coating layer from the substrate, for a distance sufficient to enable the ends of the test specimen to be mounted in the jaws of the test apparatus. Trim the width of the test specimen to (50 ± 0,5) mm or (20 ± 0,5) mm taking care to avoid damaging the longitudinal threads of the substrate.

6.2.2 Condition the test specimens in accordance with 4.1.

6.2.3 After conditioning, mount the test specimen in the test apparatus, clamping the coated end in the stationary jaw and the coating film in the traversing or moveable jaw (see Figure 1). When the adhesion is very strong and it is not possible to manually separate the coating layer from the substrate, method of preparation 2 described in 6.3 should be used.

6.3 Method of preparation 2

6.3.1 Where the coating layer is not sufficiently strong to be stripped continuously from the substrate, and also where the coating layer can be distinctly identified from the substrate to be cut through separately, the two test specimens of the same material are bonded or welded face to face by leaving the first 50 mm of adhesive-free after evaluating the adhesive system suitable for the type of coating. It is important that the adhesive chosen does not cause the coating to swell irreversibly or otherwise affect the coating/fabric bond strength. Where the coated surface is treated in any way, e.g. siliconising, which can inhibit the coating-to-coating bond, it is recommended that the adhesion test be conducted before any such treatment is applied. Alternatively, when testing PU coated fabrics, a sheet of rubber can be used in place of one of the coated specimens. The formulation of the rubber compound should be such as to produce a sheet with low stiffness and low elongation.

6.3.2 To ensure a good bond, the composite test specimen shall be rolled at least twice with a roller of 76 mm face width and mass of 2 kg.

6.3.3 All types of adhesives can be used, e.g. solvent based, aqueous based, hot melt reactive. Or welding method may be applied, e. g. high frequency, hot air, hot plate, hot wedge. Wherever possible, the adhesive or welding system used should be as agreed between those responsible for carrying out the test and those to whom the test results are reported.

NOTE If necessary, it is possible to use a plain weave cotton fabric, desized and bleached, in order to ensure complete release of remaining solvent.

6.3.4 Apply the adhesive strictly in accordance with the recommendations of the adhesive supplier. Allow sufficient time for the bond to attain its optimum strength. The welding condition parameter shall be adapted to the product. Turn back the uncoated length of one of the plies of the test specimen and carefully cut through the coating down to the substrate at the adhesion line.

Carefully separate the substrate from its coating for a distance sufficient to enable the ends of the test specimen to be mounted in the jaws of the test apparatus. Trim the test specimen at each edge to a width of (50 ± 0,5) mm or (20 ± 0,5) mm taking care to avoid damaging the longitudinal threads of the substrate.

6.3.5 Condition the test specimens in accordance with 4.1.

6.3.6 After conditioning, mount the test specimen in the test apparatus, clamping the end of the specimen under test in the stationary jaw and the non-adhesive coated end in the traversing or moveable jaw of the test apparatus (see Figure 2).

6.4 Determination of wet coating adhesion

6.4.1 End-use

It is often desirable, where coated fabric is employed in a damp or wet environment, to measure the coating adhesion strength when the coated fabric is wet. In so doing, it is important that the procedures in 6.4.2 and 6.4.3 are carried out before any silicone finish is applied, as it has been found that attempts to remove silicone can seriously affect the strength of the coating adhesion, and thus give a misleading result.

6.4.2 Preparation of test specimens

Prepare 10 test specimens in accordance with 6.2 or 6.3.

Totally immerse them for (1 ± 0,1) h in an aqueous solution of a non-ionic wetting agent of concentration no more than 0,1 % in volume at temperature equilibrium with a standard atmosphere in accordance with ISO 2231, using a liquor ratio of approximately 20:1. If it is suspected that wetting equilibrium is not attained in 1 h, then use immersion times of either (6 ± 0,25) h or (24 ± 0,25) h. This time shall be stated in the test report.

6.4.3 Conducting the test

Remove the test specimen from the wetting-out solution described in 6.4.2 and immediately, without drying, conduct the test in accordance with Clause 8.

7 Apparatus

A constant rate of traverse (CRT) machine, as described under class B in accordance with ISO 5893, or a constant rate of elongation (CRE) machine, class 1 in accordance with ISO 7500-1, shall be used. It shall be fitted with a suitable recording system for measuring the variation of applied force.

The central points of the two jaws of the machine shall be in the line of pull, the front edges shall be at right angles to the line of pull, and their clamping faces shall be in the same plane. The jaws shall be capable of holding the test specimen without allowing it to slip; designed so that they do not cut or otherwise weaken the test specimen; and shall not be less than the width of the test specimen. The faces of the jaws shall be smooth and flat, except that when, even with packing, the test specimen cannot be held satisfactorily with flat-faced jaws, engraved or corrugated jaws shall be used. Suitable packing materials for use with either smooth or corrugated jaws include paper, felt, leather, plastics, or rubber sheet.

8 Procedure

Adjust the tensile testing machine to give a jaw separation speed of (100 ± 10) mm/min. Select an appropriate load capacity range.

Clamp the separated plies of the prepared test specimen in the jaws of the machine, in a central position and without uneven tension or excessive slack in the test specimen, as indicated in Figure 1 or Figure 2. Mark gauge marks on the test specimen 50 mm apart, as shown in Figure 1 and Figure 2.

Set the traversing jaw in motion and obtain a record of the fluctuation of applied force as ply separation proceeds. Observe the distance between the gauge marks, mark the graphical trace of the applied force to indicate that the 20 mm distance of the test specimen has been separated and delamination for force measurement starts as illustrated in Figure 3 and Figure 4. Continue the separation over a distance of approximately 100 mm, so that the gauge marks on the test specimen are at least 200 mm further apart than they were at the commencement of the test, i.e. 100 mm of coated fabric have been separated.

9 Calculation and expression of results

9.1 General

9.1.1 A record of the fluctuation in the force applied during delamination can consist of a series of identifiable peaks, as shown in Figure 3.

Record the mid-point value from the final 80 % of the delaminating process, as defined in 9.2 and Figure 3.

9.1.2 Alternatively, the record of variability can be less definable and take various forms, as shown in Figure 4.

For Figure 4 a), record the mid-point value.

For Figure 4 b), record the minimum value.

For Figure 4 c), record the minimum and maximum values.

It is important that a copy of the graphical trace is attached to the test report. Comments on the interpretation of the autographic traces are available in Annex A.

9.2 Determination of mid-point value

Ignoring that part of the recorded trace which represents the first 20 mm of delamination, determine the mid-point value of the trace as being the value which lies midway between the maximum and minimum points of oscillation of the force recording device, as illustrated in Figures 3 and 4.

Express this value as the mid-point value in N/20 mm or N/50 mm width to the nearest newton. N/10 mm can be used when comparing the value between the different width as required.

9.3 Calculation of mean result

Calculate the arithmetic mean of the five mid-point values in the longitudinal direction and the arithmetic mean of the five mid-point values in the transverse direction of the coated fabric. In the case the substrate has a pile, calculate the two arithmetic means of each of the five values obtained (see 6.1).

9.4 Coating adhesion strength

Wherever mid-point values can be calculated [cases illustrated in Figures 3 and 4 a)], the coating adhesion strength is reported, for each direction tested, as the arithmetic means of the mid-point values as explained in 9.3.

If only minimum values can be recorded [Figure 4 b)], report the individual results and the mean value in each direction. The test report shall indicate the fact that coating adhesion strength is not definable and that only minimum values are reported. It is essential that a copy of the graphical traces is attached to the test report.

In the case illustrated in Figure 4 c), minimum and maximum values for each specimen are given. No mean is calculated. The test report shall indicate the fact that coating adhesion strength is not definable and that only individual minimum and maximum values are reported. It is essential that a copy of the graphical traces are attached to the test report.

9.5 Type of failure

Adhesion failure type is classified using the symbols as follows to report in Clause 10 e). When the type is mixed, report the majority at the operator's discretion from the broken tested test pieces.

CP: coating to fabric peel, separation without coating layer residue remaining on the substrate.

PT: partial or full layer tear, delamination (3.1) leaving patches of coating layer still adhering to the substrate (3.2).

IS: inseparable, inability of the coating to peel because it breaks during preparation or test, indicating that the coating adhesion strength is greater than the coating layer strength.

CD: coating or layer delamination, splitting of a multilayer coating leaving one or more layers of coating residue on the substrate.

FF: fabric failure, breaking of substrate during test, indicating that the coating adhesion strength is greater than the substrate strength.

FD: fabric delamination, splitting or delamination (3.1) of substrate leaving a partial layer or complete fabric layer adhering to the coating.

Note 1 An example of this is in the case of coated non-woven laminates, when the non-woven textile element can fail due to the coating adhesion strength being greater than the between-fibre cohesion of the non-woven textile fabric.

OT: other than CP through FD

10 Test report

The test report shall include the following particulars:

a) a reference to this document including its year of publication, i.e. ISO 2411:2024;

b) the description of the coated fabric;

c) the method of preparation used; if wet test specimen have been tested, indicate the time of immersion;

d) the coating adhesion strength for each direction, or the indication that coating adhesion strength is not definable and the minimum or maximum and minimum values where relevant (see 9.4);

e) the type of failure observed (see 9.5);

f) the width of test specimen;

g) the rate of jaw separation if different from 100 mm/min;

h) the initial distance between the jaws;

i) the standard deviation of the mean, if required;

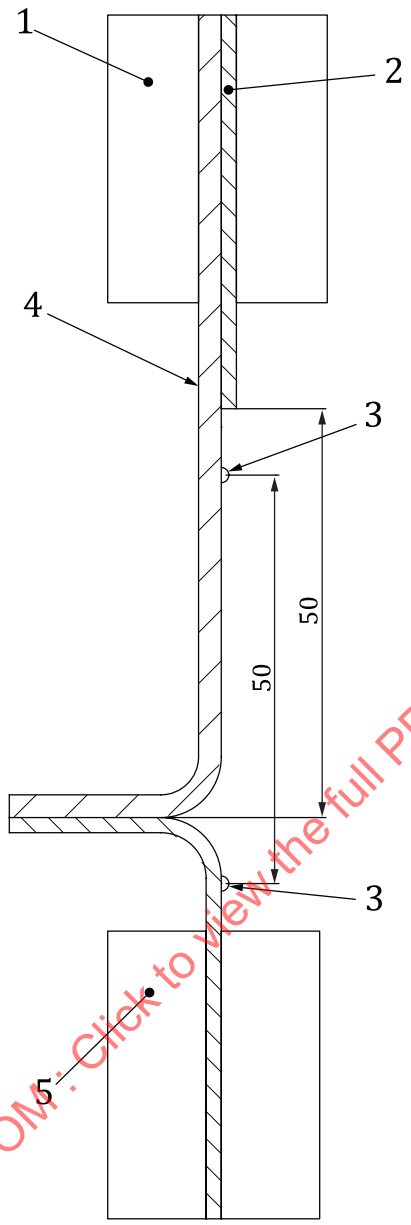
j) details of any deviation from the standard test procedure;

k) copy of the graphical trace, to be attached;

l) details of the welding condition;

m) the date of the test.

Dimensions in millimetres

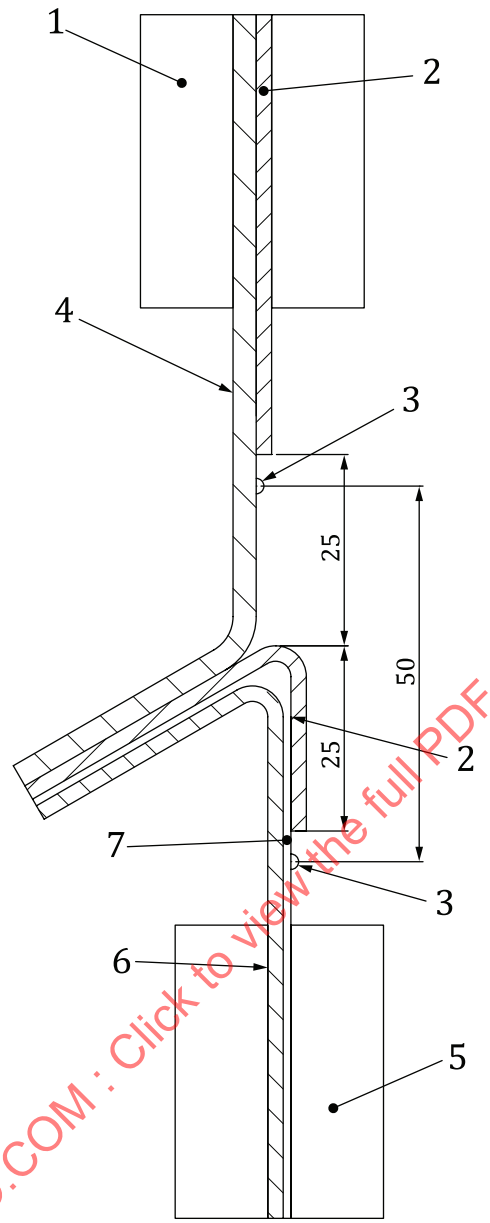


Key

1 stationary jaw
2 coating
3 gauge marks
4 substrate
5 moveable jaw

Figure 1 — Mounting of test specimens Method 1

Dimensions in millimetres



Key

1 stationary jaw
2 coating
3 gauge marks
4 substrate 1
5 moveable jaw
6 substrate 2
7 coating 2

Figure 2 — Mounting of test specimens Method 2