INTERNATIONAL STANDARD

ISO 2411

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

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

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 2411 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 45, *Rubber and rubber products*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

This third edition cancels and replaces the second edition (ISO 2411:1991), which has been technically revised.

Annex A of this International Standard is for information only.

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Foreword

The text of EN ISO 2411:2000 has been prepared by Technical Committee CEN/TC 248 "Textiles and textile products", the secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 45 "Rubber and rubber products".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2000, and conflicting national standards shall be withdrawn at the latest by November 2000.

This standard includes an informative annex A.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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.

NOTE Persons using this standard should be familiar with normal laboratory practice. This standard 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 ensure compliance with any national regulatory conditions.

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

1 Scope

This European Standard specifie*s* a method of determining the coating adhesion strength of coated fabrics.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated by amendment or revision. For undated references the latest edition of the publication referred to applies.

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

EN ISO 2286-1, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 1: Methods for the determination of length, width and net mass (ISO 2286:1998)*

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

EN ISO 7500-1, *Metallic materials — Verification of static uniaxal testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force - measuring system*

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
delamination
partial or whole separation of two, or more, of the component layers of a coated fabric. This can be either a fabric to polymer separation or separation within the actual polymeric layer

3.2
coating to fabric peel
separation with no coating polymer residue remaining on the substrate

3.3
partial film tear
delamination leaving patches of coating polymer still adhering to the substrate

3.4
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 polymer strength

3.5
coating or film delamination
splitting of a multilayer coating leaving one or more layers of coating film residue on the substrate

3.6
fabric failure
breaking of substrate during test, indicating that the coating adhesion strength is greater than the substrate strength

3.7
fabric delamination
splitting or delamination of substrate leaving a partial layer or complete fabric laminate adhering to the coating

NOTE 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.

3.8
substrate
textile component of a coated fabric

4 Preparation of test specimens

4.1 General

For the determination of coating adhesion all samples shall be taken within the usable width (according to EN ISO 2286-1) of the coated fabric under test. A total of ten *test* specimens shall be tested.

Each test specimen shall be not less then 75 mm wide and not less than 200 mm long.

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 ten test specimens in the longitudinal direction, five in the direction of the pile and five against the direction of the pile.

Either methods 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.

4.2 Method of preparation 1

4.2.1 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 separate the coating film 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 taking care to avoid damaging the longitudinal threads of the substrate.

4.2.2 Condition the test specimens in one of the atmospheres in accordance with EN ISO 2231.

4.2.3 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).

NOTE When the adhesion is very strong and it is not possible to manually separate the coating film from the substrate, method of preparation 2 described in 4.3 should be used.

4.3 Method of preparation 2

4.3.1 Where the coating layer is not sufficiently strong to be stripped continuously from the substrate, but where the coating layer can be distinctly identified from the substrate and can be cut through separately, bond two test specimens of the same material face to face, leaving the first 50mm clear of adhesive, and an adhesive system suitable for the type of coating being evaluated. It is important that the adhesive chosen does not cause the coating to swell irreversibly or otherwise affect the coating/fabric bond strength.

NOTE 1 Where the coated surface is treated in any way for example siliconising which can inhibit the coating-to-coating bond, it is recommended that the adhesion test be conducted before any such treatment is applied.

NOTE 2 If necessary, it is possible to use a plain weave cotton fabric, desized and bleached, in order to ensure complete release of remaining solvent.

NOTE 3 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.

4.3.2 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.

4.3.3 All types of adhesive can be used e.g. solvent based, aqueous based, hot melt reactive. Wherever possible, the adhesive system used should be as agreed between those responsible for carrying out the test and those to whom the test results are reported.

4.3.4 Apply the adhesive strictly in accordance with the recommendations of the adhesive supplier. Allow sufficient time for the bond to attain its optimum strength, 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 taking care to avoid damaging the longitudinal threads of the substrate.

4.3.5 Condition the test specimens in one of the atmospheres as detailed in accordance with EN ISO 2231.

4.3.6 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).

4.4 Determination of wet coating adhesion

4.4.1 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 4.4.2 and 4.4.3 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.

4.4.2 Preparation of test specimens.

Prepare ten test specimens in accordance with 4.2 or 4.3.

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 EN 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.

4.4.3 Conducting the test.

Remove the test specimen from the wetting-out solution described in 4.4.2 and immediately, without drying, conduct the test in accordance with clause 6.

5 Apparatus

A constant rate of traverse (CRT) machine, as described under Grade B in accordance with ISO 5893, or a constant rate of elongation (CRE) machine (class of precision 1 according to EN 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.

6 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 when 20 mm of coated fabric have been separated. 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.

7 Calculation and expression of results

7.1 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 7.3 and Figure 3.

7.2 Alternatively, the record of variability can be less definable and take various forms, as shown in Figures 4(a), 4(b) and 4(c).

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.

7.3 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/50 mm width to the nearest newton.

7.4 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 4.1).

7.5 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 7.4.

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 are 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.

8 Test report

The test report shall include the following particulars :

(a) the description of the coated fabric;

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

(c) 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 7.5);

(d) the type of failure observed (see clause 3);

(e) the rate of jaw separation if different from 100 mm/min*;*

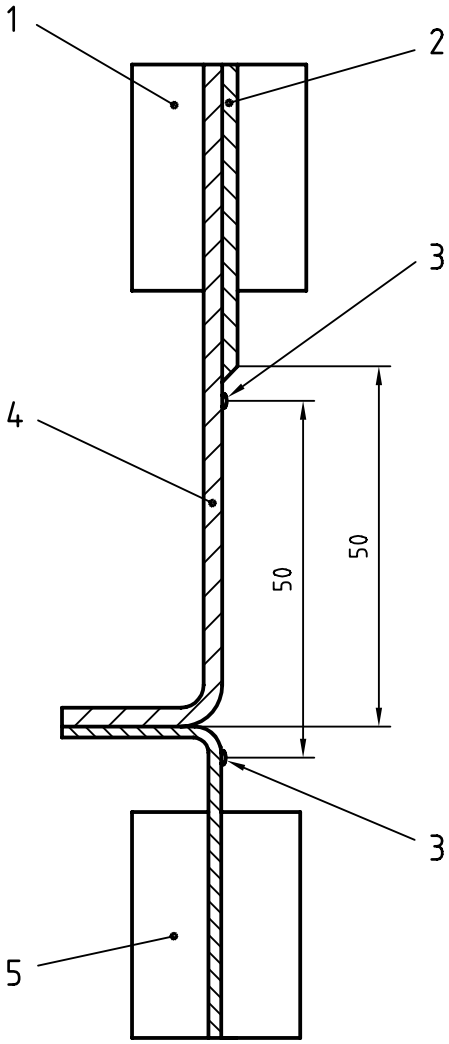
(f) the initial distance between the jaws;

(g) the standard deviation of the mean, if required;

(h) details of any deviation from the standard test procedure;

(i) copy of the graphical trace, to be attached.

Dimensions in millimetres



Key

1 Stationary jaw

2 Coating

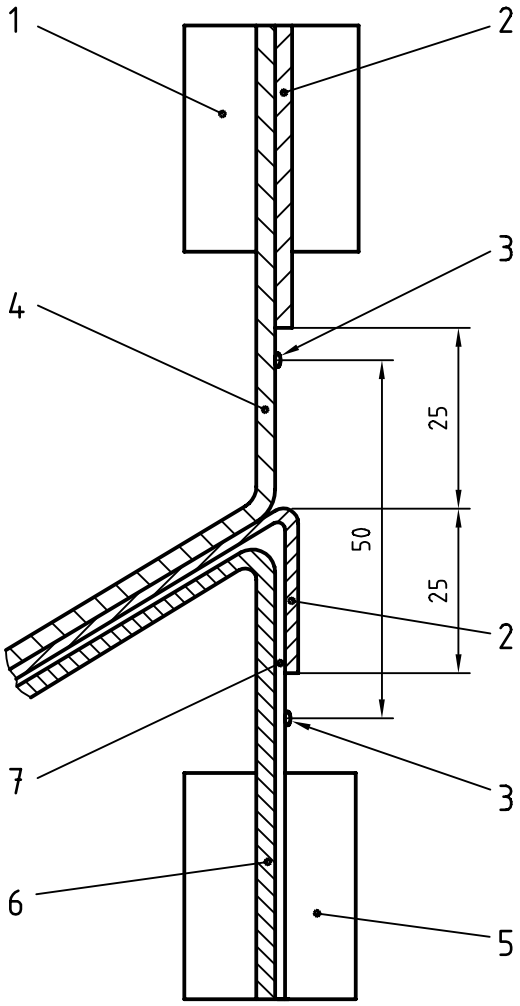
3 Gauge marks

4 Substrate

5 Moveable jaw

Figure 1 — Mounting of thick coatings

Dimensions in millimetres



Key

1 Stationary jaw

2 Coating 1

3 Gauge marks

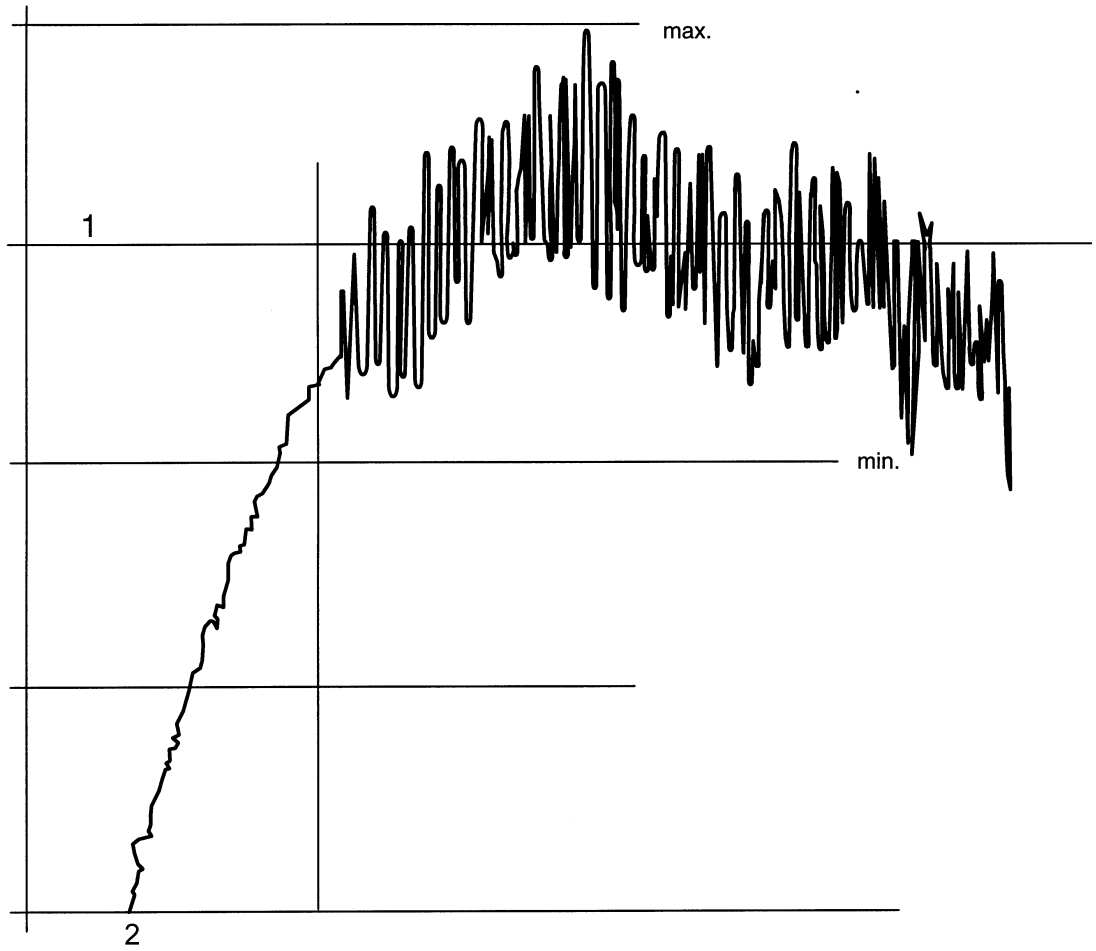
4 Substrate 1

5 Moveable jaw

6 Substrate 2

7 Coating 2

Figure 2 — Mounting of thin coatings and coatings of low adhesive strength

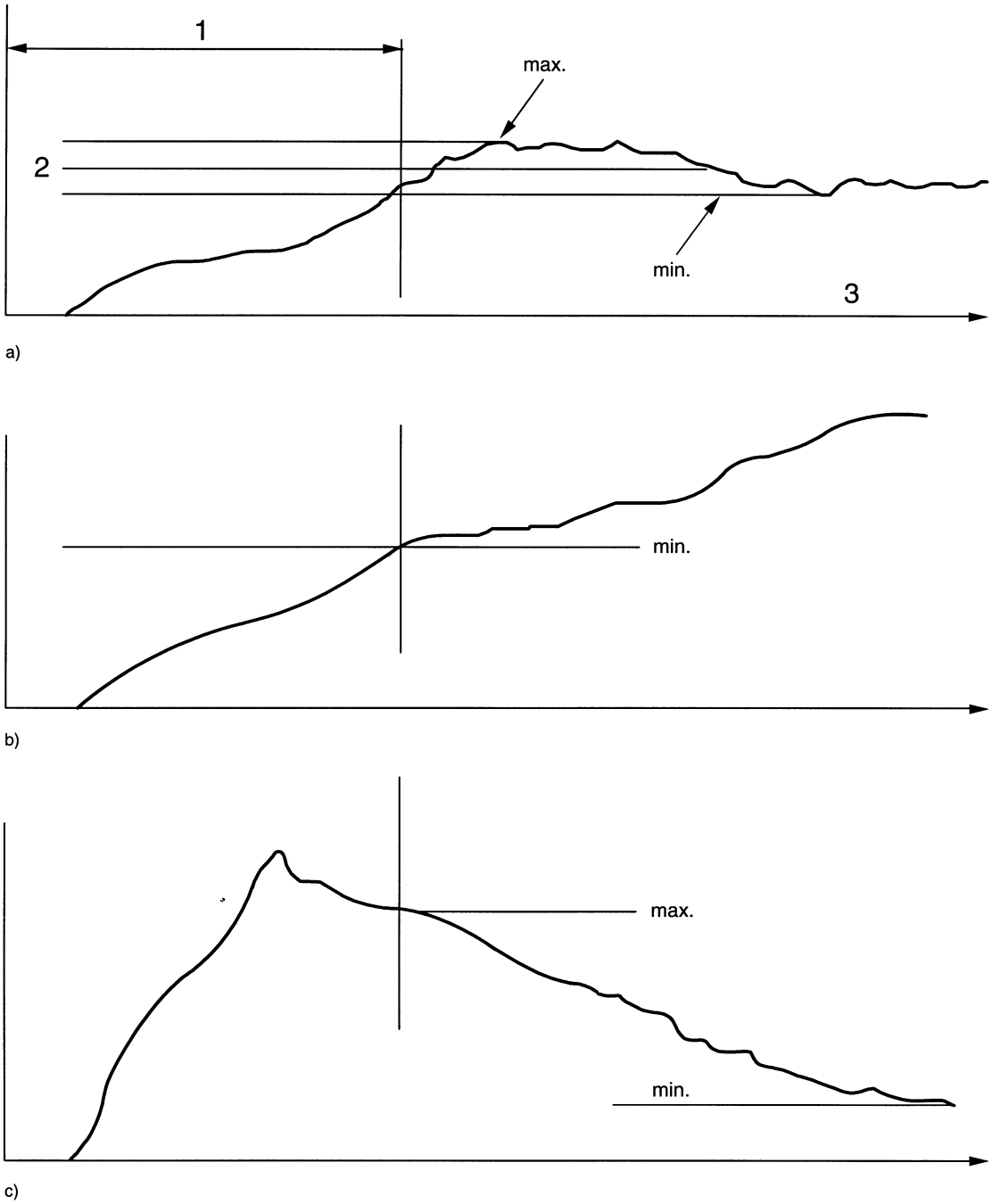


Key

1 Mid point value

2 20 mm of delamination

Figure 3 — Representation of identifiable peaks in recorded force values



Key

1 20 mm of delamination

2 Mid point value

3 Direction of trace

Figure 4 — Representation of typical less definable variability in recorded force values

Annex A
(informative)

Comments on interpretation of the autographic traces

The interpretation of the autographic traces given in this standard is noticeably different from those proposed in other usual standards and needs explanation.

This interpretation has been chosen in an attempt to take account of the specificity of the phenomena that occur during a peeling test, which are quite different from those occurring during other tests, e.g. tearing tests.

Traces with definite peaks (figure 3)

Contrary to tests where the presence of definite peaks indicates that different elements are successively broken (e.g. rupture of successive threads of a fabric during a tearing test), in peeling tests every point of the trace corresponds to an instant value of the separating force. Troughs are as significant as peaks. It seems therefore more realistic to define the mean adhesion force as the mid-point value of the trace rather than considering only the peaks (using either the arithmetic mean or the median value).

All traces with less defined peaks are treated in the same way (Figure 4(a)).

Traces with a positive slope (Figure 4(b))

It is clear that the notion of a mean force of separation is meaningless. Whatever the physical interpretation of the phenomenon, it is not possible to determine a coating adhesion force. Nevertheless, recording the "minimum" value may be of some help in evaluating the material.

Traces with a negative slope (figure 4(c))

Again, the notion of a mean force of separation for continuously decreasing traces is meaningless. Recording the "maximum" and "minimum" values may be of some help in evaluating the material.

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