
Paints and varnishes — T-bend test

Peintures et vernis — Essai de pliage en T

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 the member bodies casting a vote.

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.

ISO 17132 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

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Introduction

This International Standard is one of five standards which specify empirical test procedures for assessing the resistance of coatings of paints, varnishes and related products to cracking and/or detachment from the substrate under different conditions of deformation. The other International Standards are ISO 1519, ISO 1520, ISO 6272 and ISO 6860.

The T-bend test has already been standardized in the USA (ASTM D 4145), Europe (EN 13523-7) and Japan (JIS G 3312). The test methods in these standards are basically the same, but differ from each other in details such as

- whether the coated test panel is folded back on itself or is bent round a mandrel or a test panel used as a spacer;
- the way in which the test result is expressed.

In this International Standard, the basic contents common to the US, European and Japanese standards have been adopted, but details in which the US, European and Japanese standards differ, in particular the use of a mandrel or spacer panels, have been made subject to agreement between the interested parties.

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1 Scope

This International Standard describes a method of evaluating the flexibility and adhesion of an organic coating on a metallic substrate by observing the cracking or loss of adhesion when a coated test panel is bent.

The method can be used to confirm whether paints, varnishes or related products meet a given test requirement in a pass/fail test, or to determine the minimum bending diameter at which cracking does not occur.

2 Normative references

The following referenced documents are indispensable for the application 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 1513, *Paints and varnishes — Examination and preparation of samples for testing*

ISO 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

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ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

IEC 60454-2, *Specification for pressure-sensitive adhesive tapes for electrical purposes — Part 2: Methods of test*

3 Terms and definitions

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

3.1

T-bend test

test designed to determine the flexibility of a paint coating by bending a coated test panel through 180°

3.2

T-bend rating

minimum number of spacers of defined thickness around which a coated test panel can be bent (or, if bent around a mandrel, the number of spacers equivalent to the diameter of the mandrel) without cracking or loss of adhesion (flaking) of the coating occurring

4 Principle

Coated panels are bent back on themselves to 180°, with the coated surface on the outside of the bend, at progressively less severe radii of curvature, the radii of curvature being defined by spacers or mandrels. After bending, each panel is examined with a magnifying glass for cracking of the coating and by a tape pull-off test

for loss of adhesion of the coating. The minimum diameter to which the test panel can be bent without cracking or loss of adhesion, i.e. when failures no longer occur, is taken as the T-bend rating.

Visual examination with a magnifying glass can also be used to determine whether there is any loss of adhesion.

5 Apparatus

5.1 Vice, with flat and smooth jaws. This is used to hold one end of the test piece firmly in place at the start of the bending test.

If the test panel is not bent around itself, a series of bending mandrels with smoothly rounded ends may be used as guides around which the test panel is bent (see Figure 1).

By agreement between the interested parties, one or more uncoated panels may also be used as mandrels.

5.2 Magnifying glass, $\times 5$ to $\times 10$ magnification.

5.3 Adhesive tape, with an adhesive strength between 6 N/25 mm width and 10 N/25 mm width when determined in accordance with IEC 60454-2.

6 Sampling

Take a representative sample of the product to be tested, as described in ISO 15528.

Examine and prepare each sample for testing, as described in ISO 1513.

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7 Test panels

7.1 Substrate

Unless otherwise agreed, use rectangular steel test panels. The panel surfaces shall be plane.

7.2 Preparation and coating

Unless otherwise agreed, prepare each test panel in accordance with ISO 1514 before coating it using the specified application method (see Clause 9) and drying, curing or stoving.

7.3 Thickness of the coating

Determine the thickness, in micrometres, of the dry coating by one of the procedures given in ISO 2808.

8 Procedure

8.1 Conditioning of the test panels

Unless otherwise agreed, condition the coated test panels for at least 16 h at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity before carrying out the test.

8.2 Test conditions

Unless otherwise agreed, carry out the test at $(23 \pm 2) ^\circ\text{C}$ and $(50 \pm 5) \%$ relative humidity.

8.3 Bending

8.3.1 General

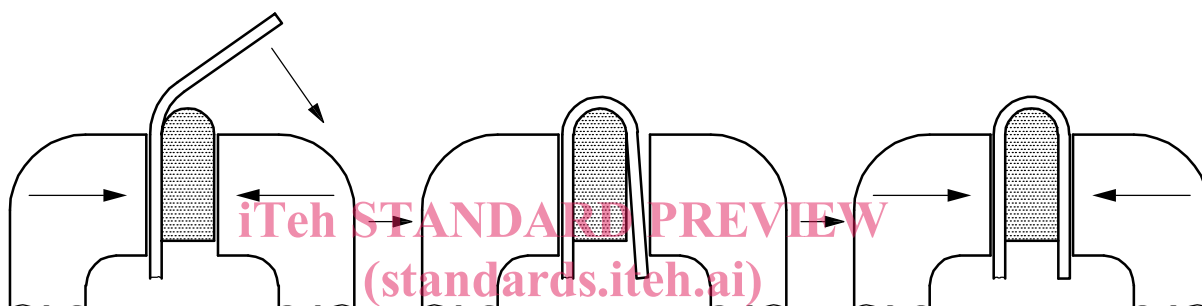
The bending shall be performed in accordance with one of the procedures given in 8.3.2, 8.3.3 and 8.3.4, as agreed between the interested parties.

Unless otherwise agreed, the bend shall be across the direction of rolling of the panel, except for coil coatings in which case the test panel shall be bent parallel to the direction of rolling.

No bends shall be made closer than 10 mm to the jaws of the vice.

8.3.2 T-bend test around a mandrel

Clamp a coated test panel and a mandrel in the vice. Then bend the panel 180° around the mandrel (see Figure 1) in a smooth and uniform manner with the coated side of the panel on the outside of the bend.



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Figure 1 — Bending around a mandrel

Examine the bend for cracking and for loss of adhesion as described in 8.4. Repeat the bending procedure, using a new test panel and a different size of mandrel each time, to determine the minimum mandrel thickness at which no cracking or loss of adhesion occurs.

Express the T-bend rating, T_m , as the number of panel thicknesses equivalent to the thickness of the narrowest mandrel around which the test panel could be bent without cracking or loss of adhesion occurring, reporting the result as 1 T_m for one panel thickness, 2 T_m for two panel thicknesses, etc. (see also Table A.1).

8.3.3 T-bend test with spacer panels

Clamp one end of a coated test panel in the vice and bend it with the coated side of the panel on the outside of the bend. Remove the panel from the vice and bend it further with the fingers until it can be placed in the vice again. Insert one or more uncoated panels as spacers inside the bent panel as shown in Figure 2, fasten the assembly in the vice and bend it quickly to an angle of 180°. Each spacer panel shall have the same thickness as the test panel.

Examine the bend for cracking and loss of adhesion as described in 8.4. Repeat the bending procedure, using a new test panel and a different number of spacers each time, to determine the smallest number of spacers at which no cracking or loss of adhesion occurs.

Express the T-bend rating, T_p , as the minimum number of spacers around which the test panel could be bent without cracking or loss of adhesion occurring, reporting the result as 1 T_p for one spacer, 2 T_p for two spacers, etc. (see also Table A.1).