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Paints and varnishes — Determination of mar resistance —

Part 1:

Method using a curved stylus

*Peinture et vernis — Détermination de la résistance à la détérioration —
Partie 1. Méthode utilisant un stylet arrondi*



Reference number
ISO 12137-1:1997(E)

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.

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.

International Standard ISO 12137-1 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 12137 consists of the following parts, under the general title *Paints and varnishes — Determination of mar resistance*:

- *Part 1: Method using a curved stylus*
- *Part 2: Method using a pointed stylus*

Annex A forms an integral part of this part of ISO 12137. Annex B is for information only.

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Paints and varnishes — Determination of mar resistance —

Part 1: Method using a curved stylus

1 Scope

1.1 This part of ISO 12137 is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It specifies a method for determining, using a curved (loop-shaped or ring-shaped) stylus, the mar resistance of a single coating of a paint, varnish or related product, or the upper layer of a multicoat system. Part 2 of ISO 12137 specifies a method using a pointed stylus. The choice between the two methods will depend on the particular practical problem.

1.2 This test has been found to be useful in comparing the mar resistance of different coatings. It is most useful in providing relative ratings for a series of coated panels exhibiting significant differences in mar resistance.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 12137. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 12137 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1512:1991, *Paints and varnishes — Sampling of products in liquid or paste form.*

ISO 1513:1992, *Paints and varnishes — Examination and preparation of samples for testing.*

ISO 1514:1993, *Paints and varnishes — Standard panels for testing.*

ISO 2808:—¹⁾, *Paints and varnishes — Determination of film thickness.*

1) To be published. (Revision of ISO 2808:1991)

3 Definition

For the purposes of this part of ISO 12137, the following definition applies:

3.1 mar resistance: The resistance of the surface of a paint film to marking or the formation of other defects as a result of the action of a specified stylus pushed across the surface.

Marring covers a very broad range of defects in the surface of the paint film. These defects include small scratches and other marks in the surface of the paint film caused by finger nails or car wash brushes, for instance.

The defects are defined as follows:

- a) Plastic deformation — the permanent indentation of the surface with or without any surface blemish or cohesive fracture.
- b) Surface blemish — a superficial surface effect caused by a difference in the scattering of light between the line of test and the adjacent surface.
- c) Surface scratch — a continuous cut or gouge through the surface.
- d) Cohesive fracture — the presence of a visible surface break or rupture.
- e) Combinations of the above.

NOTE — In some cases, one of these types of defect will be of particular importance, while in other cases one of the other types of defect may be of interest.

4 Principle

The product or system under test is applied at uniform thickness to flat panels of uniform surface texture. After drying/curing, the mar resistance is determined by pushing the panels beneath a curved (loop-shaped or ring-shaped) stylus which is mounted so that it presses down on the surface of the test panel at an angle of 45°. The load on the test panel is increased in steps until the coating is marred.

5 Required supplementary information

For any particular application, the test method specified in this part of ISO 12137 needs to be completed by supplementary information. The items of supplementary information are given in annex A.

6 Apparatus

6.1 A suitable tester²⁾ is shown in figure 1. It consists principally of a counterbalanced beam with a small scale pan on which weights can be placed to load the stylus. The stylus is mounted at the lower end of a rod which extends down from the beam at a fixed angle of 45°. The test panel is placed on a sliding table which can be pushed under the stylus, preferably by the use of mechanical equipment.

The tester shall be designed so that tests can be performed with stylus loadings of up to 5 kg and so that the load can be increased or decreased in steps of 0,5 kg, or in steps of 0,25 kg or 0,1 kg when greater accuracy is required near the mar point.

2) Other types of scratch tester may be used if they give similar relative ratings. For instance, the scratch apparatus described in ISO 1518:1992, *Paints and varnishes — Scratch test*, is suitable with some modifications.

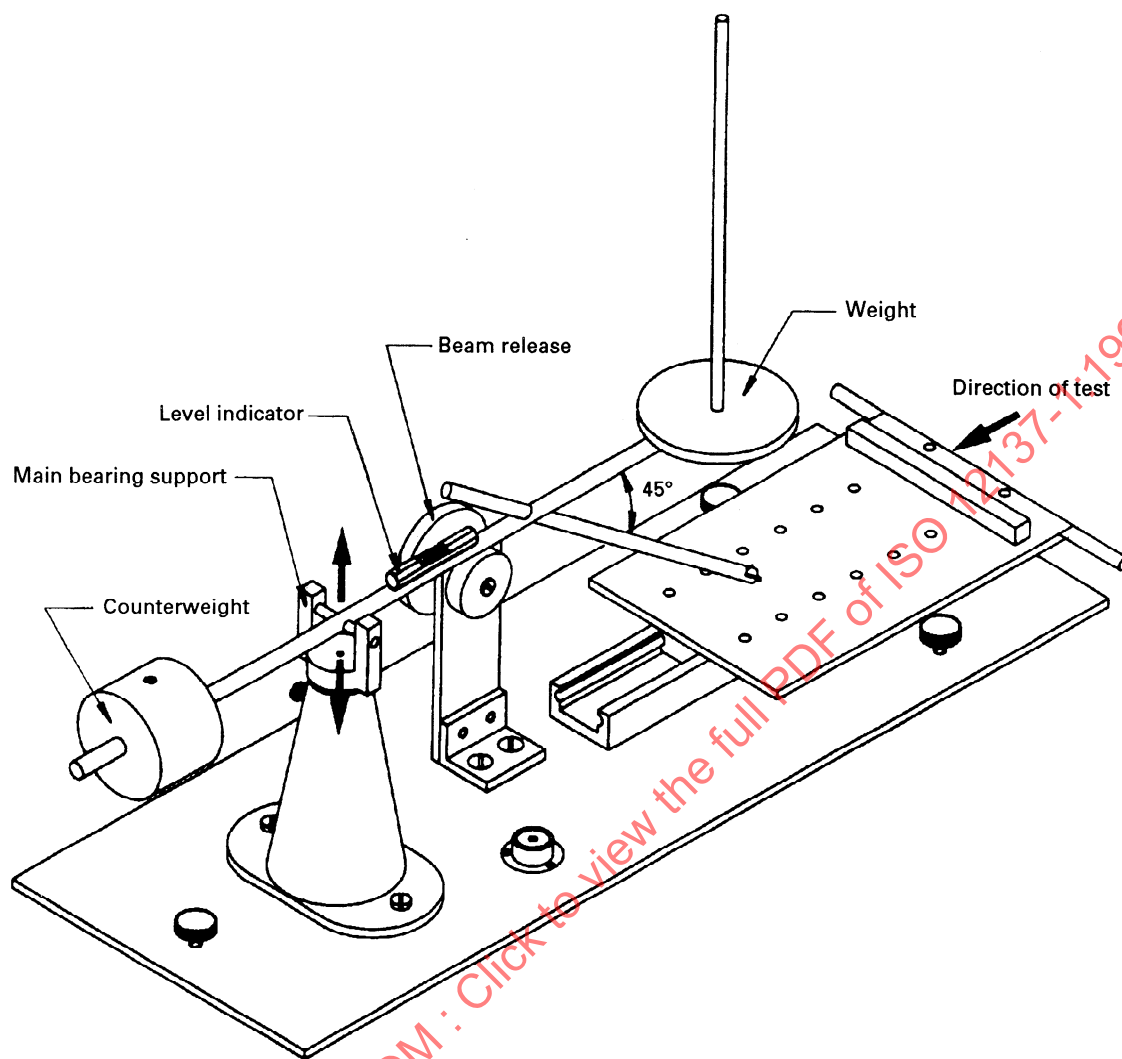


Figure 1 — A balanced-beam mar-resistance tester

6.2 Either a loop-shaped or a ring-shaped stylus can be used.

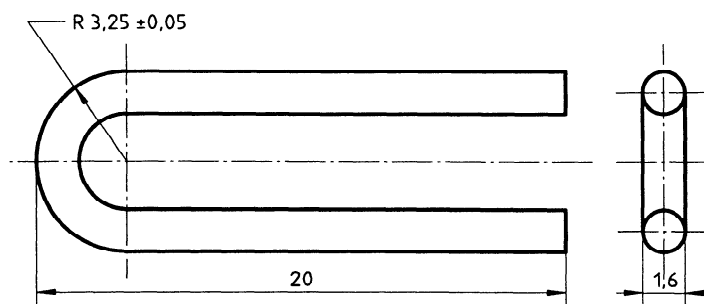
The loop-shaped stylus shall be made of chromium-plated steel and shall be in the form of a 1,6-mm-diameter rod bent into a "U" shape with an outside radius of $(3,25 \pm 0,05)$ mm [see figure 2a)].

The ring-shaped stylus shall be made of the same 1,6-mm-diameter chromium-plated steel rod, but bent into the shape of a ring [see figure 2b)].

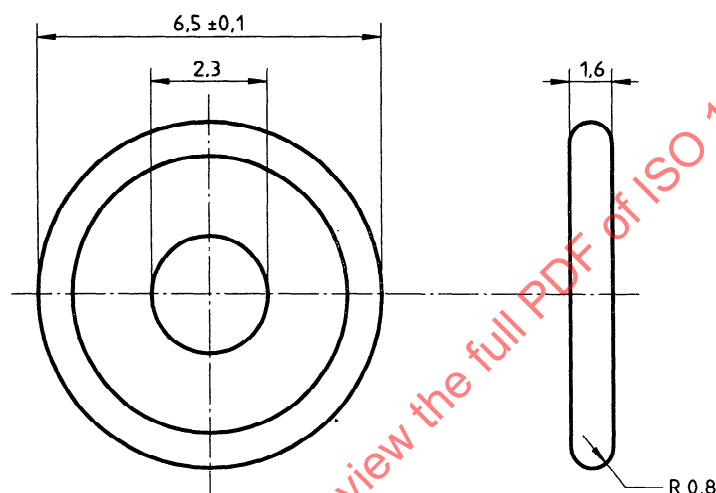
In each case, the stylus shall be hardened to Rockwell HRC56 to 58 and its surface shall be smooth (roughness $< 0,05 \mu\text{m}$).

6.3 A microscope, preferably with a magnification range extending up to $\times 50$, may be used.

Dimensions in millimetres



a) Loop-shaped stylus



b) Ring-shaped stylus

Figure 2 — Details of styluses

7 Sampling

7.1 Take a representative sample of the product to be tested (or of each product in the case of a multi-coat system), as described in ISO 1512.

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

8 Test panels

8.1 Substrate

Unless otherwise agreed, select the substrate from one of those described in ISO 1514 and, where possible, in accordance with the desired practical application. The panels shall be plane and free from distortion, with a maximum thickness of about 12 mm, and 100 mm to 400 mm wide and long.

8.2 Preparation and coating

Unless otherwise agreed, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test.

8.3 Drying and conditioning

Dry (or stove) and age, if applicable, each coated test panel for the specified time and under the specified conditions. Before testing, condition the coated panels at $(23 \pm 2)^\circ\text{C}$ and a relative humidity of $(50 \pm 5)\%$ unless otherwise agreed, for a minimum period of 16 h.

Fingerprints, dust or other contamination on the surface will result in a lower accuracy. The coated panels shall therefore be stored and handled in the appropriate way.

8.4 Thickness of coating

Determine the thickness, in micrometers, of the dried coating by one of the procedures specified in ISO 2808.

9 Procedure

9.1 Test conditions

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

9.2 Preparation for the test

Ensure that the tester is level, and place it so that the end with the weight pan is nearest the operator (the beam release switch will now be on the operator's right).

Insert the stylus in the holder and tighten the clamping screw.

Both sides of the loop-shaped stylus can be used. Examine the stylus periodically to ensure that it has a smooth surface without any scratches. If the contacting surface is worn, turn the loop over. When both sides are worn, replace the loop by a new one. If the ring-shaped stylus is used, examine it periodically in the same way and, when the contact point is worn, rotate it so that an unworn area is in contact with the panel. When all the ring is worn, replace it by a new one.

Adjust the main bearing support so that the beam is balanced in the horizontal plane when the stylus is just touching the panel surface. The alignment of the beam shall be such that the middle of the stylus is over the centreline of the sliding table.

Raise the beam and lock it in the raised position. Clean the stylus, if necessary, with a clean cloth or lint-free paper.

9.3 Determination

Place a test panel up against the stop on the sliding table.

Place a weight on the scale pan, starting at a weight somewhat less than that expected to cause marring of the paint surface.

Release the beam slowly and carefully (it is very important to carry out this operation with great care). Immediately after the stylus has come to rest on the coating, push the sliding table towards the far end of the tester (i.e. away from the operator) at a rate of about 30 mm/s to 60 mm/s for a distance of 75 mm at least.

Unless otherwise agreed, inspect the coating for marring under a suitable magnification or with the naked eye.

If no marring occurs with the initial load, continue the test, using larger loads, in test areas that do not overlap, increasing the load in 0,5 kg increments until marring does occur.

If marring occurs with the initial load, continue the test using smaller loads, decreasing the load in 0,5 kg decrements until the coating is no longer marred.

Determine which type of defect is involved (see 3.1).

When the critical load (that at which marring just occurs) has been approximately located, repeat the test five times at each of the following three loadings: 0,5 kg above the critical load, 0,5 kg below the critical load and at the critical load.

NOTE — By agreement, higher accuracy can be obtained using smaller increments and decrements in the region of the critical load (e.g. 0,25 kg or 0,1 kg).

For each load at or near the critical load, record the number of times the coating was marred.

The minimum load which causes marring is that load at which at least two of the five determinations resulted in marring of the coating.

10 Precision

See annex B.

11 Test report

The test report shall contain at least the following information:

- a) all details necessary to identify the product tested;
- b) reference to this part of ISO 12137 (ISO 12137-1);
- c) the type of apparatus used;
- d) the type of stylus used;
- e) the size of the increment/decrement used in the region of the critical load;
- f) whether marring was assessed using the naked eye or a microscope and, if a microscope was used, the magnification setting at which it was used;
- g) the test results:
 - 1) a description of those of the elements of marring defined in 3.1 which actually occurred (not all will necessarily occur);
 - 2) the minimum load at which each of these elements of marring occurred;
- h) any deviation from the test method specified;
- i) the date of the test.

Annex A

(normative)

Required supplementary information

The items of supplementary information listed in this annex shall be supplied as appropriate to enable the method to be carried out.

The information required should preferably be agreed between the interested parties and may be derived, in part or totally, from an international or national standard or other document related to the product under test.

- a) Substrate material, substrate thickness and surface preparation of the substrate.
- b) Method of application of the test coating to the substrate.
- c) Duration and conditions of drying (or stoving) and ageing (if applicable) of the coating before testing.
- d) Thickness, in micrometres, of the dry coating and method of measurement in accordance with ISO 2808, and whether it is a single coating or a multi-coat system.
- e) Temperature and humidity of the test, if different from those specified in 9.1.

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