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## **Paints and varnishes — Determination of mar resistance**

*Peintures et vernis — Détermination de la résistance à la détérioration*



Reference number  
ISO 12137:2011(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.

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

It cancels and replaces ISO 12137-1:1997, which has been technically revised. It also incorporates the Technical Corrigendum ISO 12137-1:1997/Cor.1:1998.

The main changes are the following:

- a) A definition of mar has been introduced.
- b) The supplementary test conditions (formerly Annex A) have been integrated in the test report.
- c) The text has been editorially revised and the normative references have been updated.

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# Paints and varnishes — Determination of mar resistance

## 1 Scope

This International Standard 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.

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.

This International Standard does not specify a method using a pointed stylus, two of which are specified in ISO 1518-1 and ISO 1518-2, respectively. The choice between the three methods will depend on the particular practical problem.

## 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 test samples*

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

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

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

## 3 Terms and definitions

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

### 3.1

#### mar, n

blemish on the surface of a coating, extending over a particular area of the coating and visible due to the difference in the light-reflection properties of the area affected compared with the light-reflection properties of adjacent areas

## 4 Principle

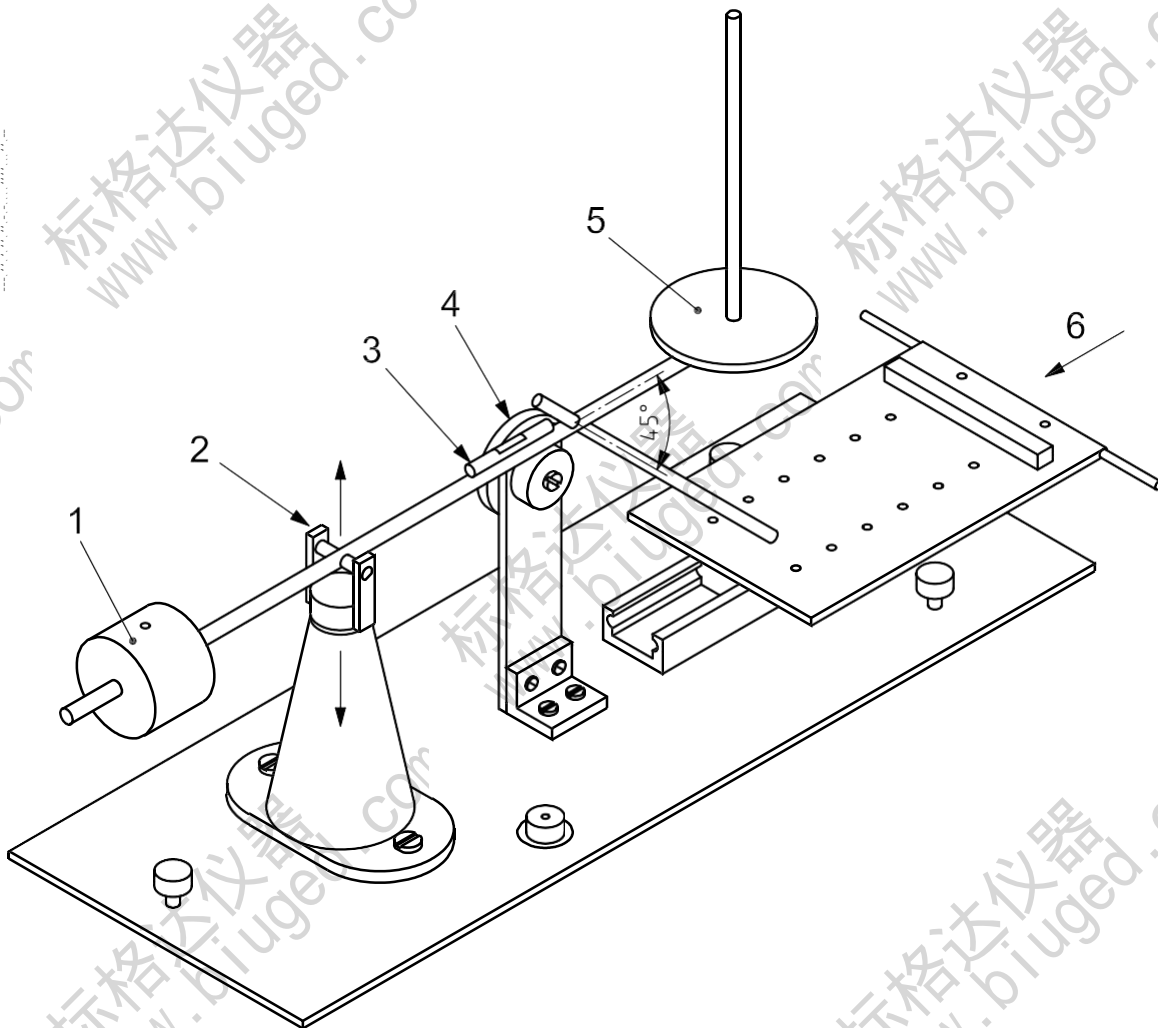
The product or system under test is applied at uniform thickness to flat panels of uniform surface texture. After drying/curing, the mar resistance is determined by pushing the panels beneath a curved (loop-shaped or ring-shaped) stylus which is mounted so that it presses down on the surface of the test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

## 5 Apparatus

### 5.1 Instrument for determining mar resistance.

A suitable instrument 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 instrument 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.



#### Key

- |                        |                     |
|------------------------|---------------------|
| 1 counterweight        | 4 beam release      |
| 2 main bearing support | 5 weight            |
| 3 level indicator      | 6 direction of test |

Other types of mar instrument may be used if they give similar relative ratings. For instance, the scratch apparatus specified in ISO 1518-1 is suitable with some modifications.

**Figure 1 — Balanced-beam mar-resistance instrument**

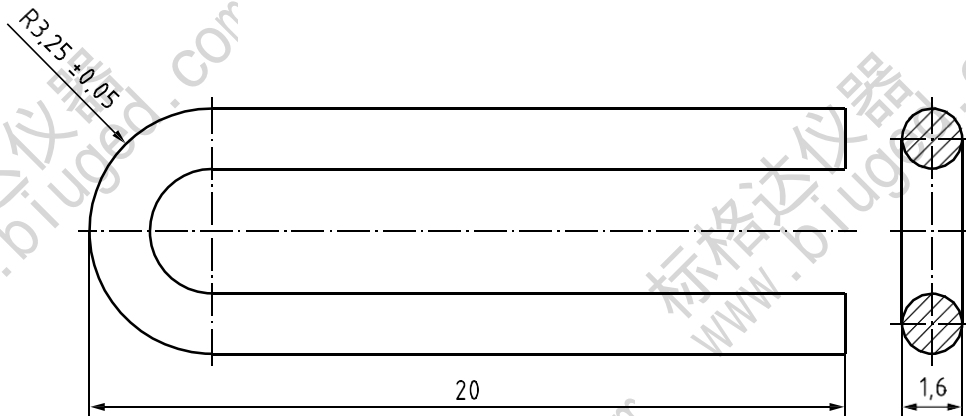
## 5.2 Loop-shaped or ring-shaped stylus.

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

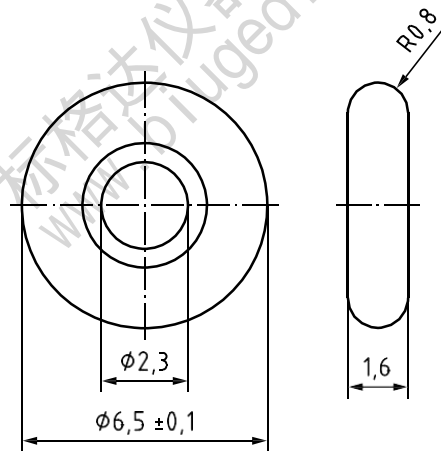
In each case, the stylus shall be hardened to Rockwell HRC56 to HRC58 and its surface shall be smooth (roughness  $< 0,05 \mu\text{m}$ ).

**5.3 Microscope**, preferably with a magnification range extending up to  $\times 50$ .

Dimensions in millimetres



a) Loop-shaped stylus



b) Ring-shaped stylus

Figure 2 — Details of styluses

## 6 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multicoat system), as specified in ISO 15528.

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

## 7 Test panels

### 7.1 Substrate

Select the substrate from one of those specified 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.

### 7.2 Preparation and coating

Prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test.

### 7.3 Drying and conditioning

Dry (or stove) and age, if applicable, each coated test panel according to the instructions given for the product or system under test. Before testing, condition the coated panels at  $(23 \pm 2)$  °C and a relative humidity of  $(50 \pm 5)$  % for a minimum period of 16 h.

The coated panels shall be stored and handled so as to avoid contamination by fingerprints and dust.

NOTE Fingerprints, dust or other contamination on the surface will result in a lower accuracy.

### 7.4 Thickness of coating

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

## 8 Procedure

### 8.1 Test conditions

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

### 8.2 Preparation for the test

Ensure that the instrument is level, and place it so that the end with the weight pan is nearest the operator. In the case of the instrument shown in Figure 1, 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.



### 8.3 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 instrument (i.e. away from the operator) at a rate of about 3 mm/s to 6 mm/s for a distance of 75 mm at least.

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. 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: a visible surface break or rupture.
- e) Combinations of the above.

NOTE In some cases, one of these types of defect might be of particular importance.

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. To obtain higher accuracy, smaller increments and decrements may be used (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.

## 9 Precision

No relevant precision data are currently available.

## 10 Test report

The test report shall contain at least the following information:

- a) all details necessary to identify the product tested;
- b) a reference to this International Standard (ISO 12137:2011);

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- c) all details on preparation of the test panels, including
  - 1) the material (including thickness) and surface preparation of the substrate (see 7.1),
  - 2) the method of application of the test coating to the substrate (see 7.2),
  - 3) the duration and conditions of drying (or stoving) and ageing (if applicable) of the coating before testing (see 7.3),
  - 4) the 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 multicoat system (see 7.4);
- d) the temperature and relative humidity during the test, if different from those specified in 8.1;
- e) the type of apparatus used;
- f) the type of stylus used;
- g) the size of the increment/decrement used in the region of the critical load;
- h) 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;
- i) the test results:
  - 1) a description of those of the elements of marring defined in 8.3 which actually occurred (not all will necessarily occur),
  - 2) the minimum load at which each of these elements of marring occurred;
- j) any deviation from the test method specified;
- k) any unusual features (anomalies) observed during the test;
- l) the date of the test.

## Bibliography

- [1] ISO 1518-1, *Paints and varnishes — Determination of scratch resistance — Part 1: Constant-loading method*
- [2] ISO 1518-2, *Paints and varnishes — Determination of scratch resistance — Part 2: Variable-loading method*

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