

INTERNATIONAL STANDARD

**ISO
1522**

Third edition
2006-12-01

Paints and varnishes — Pendulum damping test

Peintures et vernis — Essai d'amortissement du pendule



Reference number
ISO 1522:2006(E)

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Published in Switzerland

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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 1522 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This third edition cancels and replaces the second edition (ISO 1522:1998), which has been technically revised. The main changes are the following.

- The references to the original national standards, DIN 53157 (König pendulum) and NF T 30-016 (Persoz Pendulum), and to the ASTM standard ASTM D 4366 have been deleted since Germany, France and ASTM have adopted ISO 1512.
- The hardness of the ball bearings for the Persoz pendulum has been corrected.
- For the Persoz pendulum, the tolerance on the time for damping from a 12° displacement to a 4° displacement on a polished plate-glass panel has been changed from ± 10 s to ± 15 s.
- A preferred minimum dry-film thickness of the coating under test of 30 μm has been added.
- For the König pendulum, it is common practice to measure the number of swings. A note has been added explaining how the number of swings can be converted into the time for the amplitude of swing to decrease.

Introduction

Two test procedures are considered in some detail, namely those of König and Persoz. The instruments embody the same principle — that the amplitude of oscillation of a pendulum touching a surface decreases more rapidly the softer the surface — but differ in respect of dimensions, period and amplitude of oscillation.

The interaction between the pendulum and the paint film is complex, depending as it does on both elastic and viscoelastic properties, and it is not possible to establish a general relationship between results obtained by the two tests. Therefore, only one type of pendulum should be used in a given series of measurements of damping time.

The following considerations may serve as a guide when considering which pendulum may offer an advantage for a particular purpose.

- a) On surfaces with a low coefficient of friction, the Persoz pendulum may skid, which would invalidate results; however, this occurs only rarely with paints and varnishes.
- b) It should be noted that both instruments reflect the sensitivity of the physical properties of a paint to its environment, and the test therefore should be under controlled conditions of temperature and humidity and in the absence of draughts. The thickness of the paint film and the nature of the substrate may also affect the damping times.

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Paints and varnishes — Pendulum damping test

1 Scope

This International Standard specifies two methods of carrying out a pendulum damping test on a coating of paint, varnish or other, related, product. It is applicable to single coatings and to multicoat systems.

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*

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

3 Principle

A pendulum resting on a coating surface is set into oscillation and the time for the oscillation amplitude to decrease by an amount specified in this International Standard is measured. The shorter the damping time, the lower the hardness.

4 Apparatus

4.1 Pendulum.

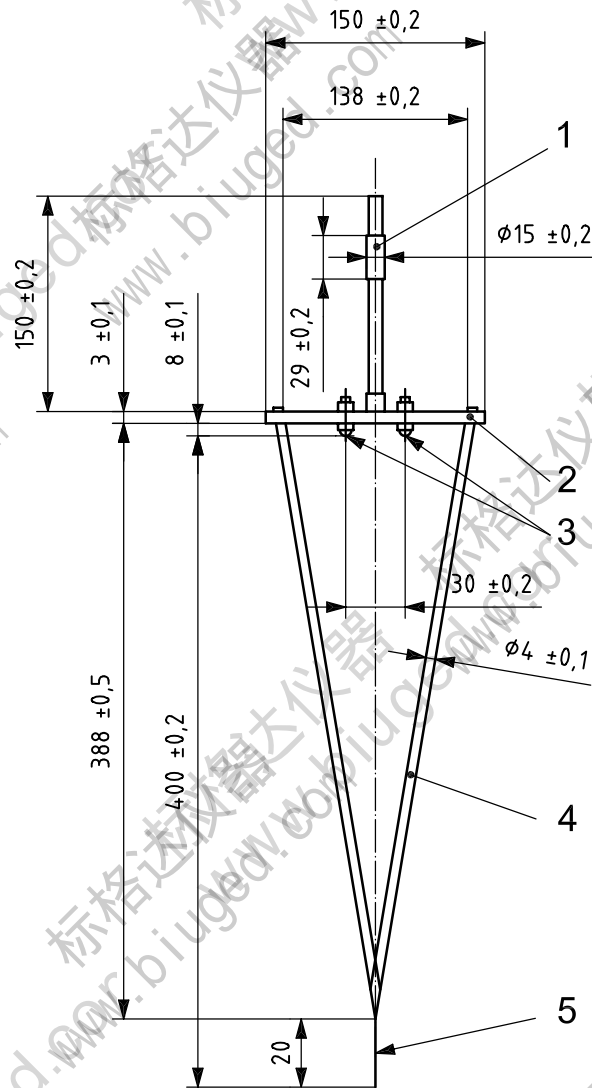
4.1.1 Both the pendulums, as described in 4.1.2 and 4.1.3, comprise an open framework connected by a cross-bar on the under face of which two balls are inset to serve as the fulcrum, the lower end of the framework being formed into a pointer. The two pendulums differ in shape, mass, swinging time and other details, as described in 4.1.2 and 4.1.3.

The pendulum shall be used away from draughts and vibrations.

The use of a protective enclosure is recommended.

4.1.2 The König pendulum (see Figure 1) rests on two tungsten-carbide balls of $(5 \pm 0,005)$ mm diameter, of hardness $(1\ 600 \pm 32)$ HV 30^1 , and $(30 \pm 0,2)$ mm apart and is counterpoised (to adjust the natural frequency of oscillation) by means of a weight sliding on a vertical rod attached to the cross-bar. On a polished plate-glass panel, the period of oscillation shall be $(1,40 \pm 0,02)$ s and the time for damping from a 6° displacement to a 3° displacement shall be (250 ± 10) s. The total mass of the pendulum shall be $(200 \pm 0,2)$ g.

Dimensions in millimetres



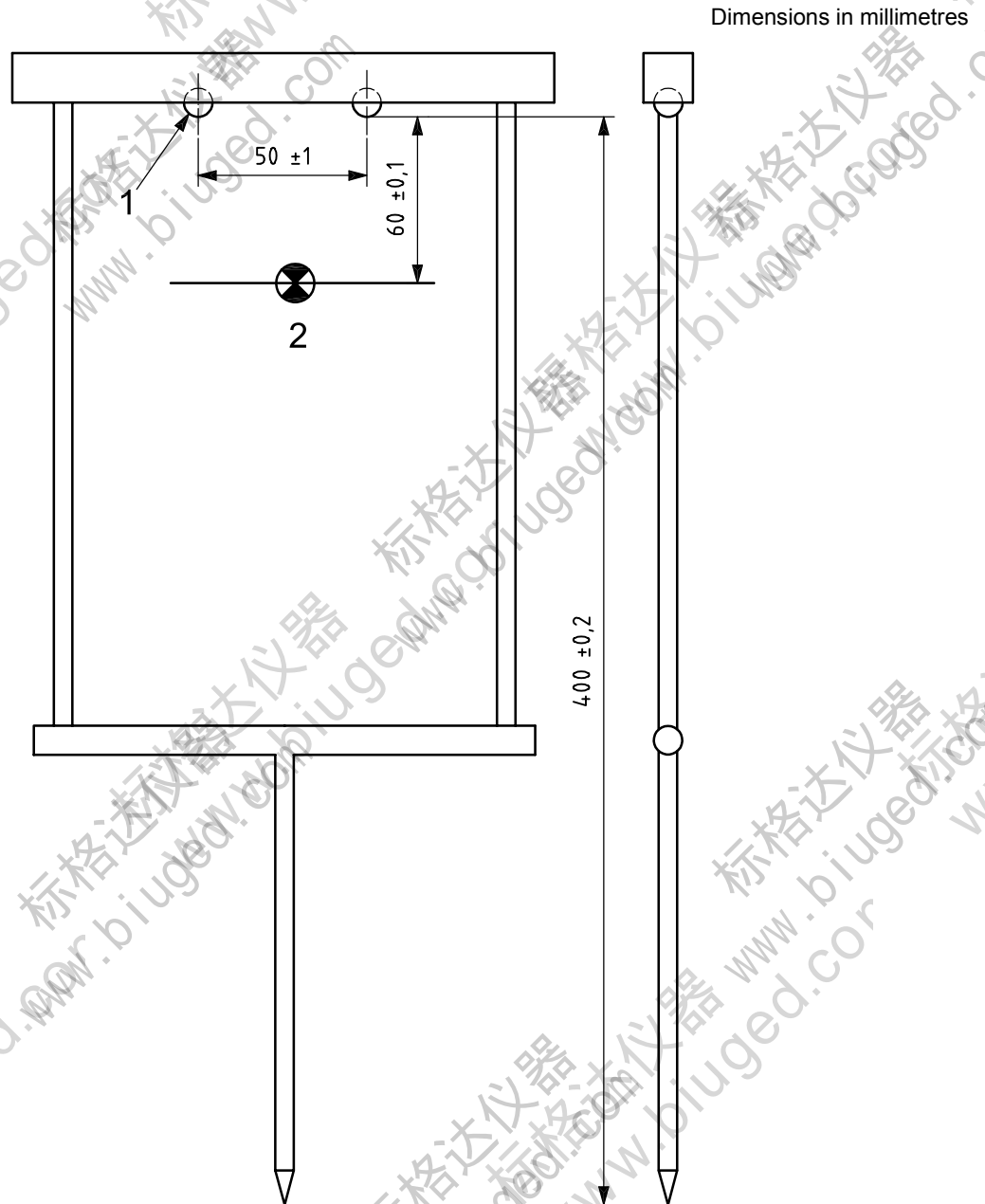
Key

- 1 counterpoise (adjustable)
- 2 cross-bar, width $12 \pm 0,1$
- 3 ball, $\varnothing 5 \pm 0,005$
- 4 frame
- 5 tip

Figure 1 — König pendulum

1) HV = Vickers hardness determined in accordance with ISO 6507-1 [2].

4.1.3 The Persoz pendulum (see Figure 2) rests on two tungsten-carbide balls of $(8 \pm 0,005)$ mm diameter, of hardness $(1\ 600 \pm 32)$ HV $30^{1)}$ and (50 ± 1) mm apart. A counterpoise is not provided. On a polished plate-glass panel, the period of oscillation shall be $(1 \pm 0,01)$ s and the time for damping from a 12° displacement to a 4° displacement on the same substrate shall be (430 ± 15) s. The total mass of the pendulum shall be $(500 \pm 0,1)$ g and its centre of gravity at rest shall be $(60 \pm 0,1)$ mm below the plane of the fulcrum, the pointer tip being $(400 \pm 0,2)$ mm below the plane of the fulcrum.

**Key**

- 1 ball, $\varnothing 8 \pm 0,005$
- 2 centre of gravity

Figure 2 — Persoz pendulum

4.2 Instrument stand.

The stand for supporting test panel and pendulum is common to both pendulums and comprises a heavy supported vertical rod to which is attached a horizontal table with a flat working surface, the dimensions of which may conveniently be 95 mm × 110 mm and not less than 10 mm thick. The stand also has a stirrup to support the pendulum away from the table and a mechanism for shock-free lowering of the pendulum on to the test panel.

4.3 Scale.

The front of the stand shall be marked to show angular displacement of the pendulum from a centre point, indicating the rest position of the pendulum, through 6° and 3° for a König pendulum and through 12° and 4° for a Persoz pendulum. The scale may be moved horizontally, and locked in position so that the zero marking and the test position of the pendulum tip coincide.

This scale may be marked on a mirror, or a mirror may be placed behind the scale, to assist in eliminating parallax errors during observation.

4.4 **Stopwatch**, or other timing device, for timing the oscillation damping of the pendulum.

4.5 **Polished plate (float) glass panel**, for calibrating the pendulum.

5 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.

6 Test panels

6.1 Substrate

Select the substrate from one of those specified in ISO 1514, ensuring that the panels are plane, rigid and free from distortion. Metal or glass panels are recommended, with dimensions of approximately 100 mm × 100 mm × 5 mm.

6.2 Preparation and coating

Unless otherwise specified, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test. The test coating shall then be smooth and free from surface irregularities.

6.3 Drying and conditioning

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

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

6.4 Thickness of coating

Determine the thickness, in micrometres, of the dried coating by one of the procedures specified in ISO 2808. The minimum dry-film thickness of the coating should preferably be 30 µm.

7 Procedure

7.1 Calibration of the instruments

Calibrate the instrument using the procedures specified in Annexes A and B.

7.2 Ambient conditions

Unless otherwise specified, test panels shall be tested at (23 ± 2) °C and a relative humidity of (50 ± 5) % (see also ISO 3270).

7.3 Determination of pendulum damping time

Determine pendulum damping time on three different parts of the same test panel.

Place the panel on the table with the paint film uppermost. Gently bring the pendulum onto the panel surface.

Deflect the pendulum, without lateral displacement of the fulcrum, through the appropriate angle (6° for the König pendulum, 12° for the Persoz pendulum) and allow it to rest against the stop provided.

Release the pendulum and simultaneously start the stopwatch or other timing device.

NOTE 1 In the case of automatic versions, the damping time will be measured automatically.

Record the time, in seconds, for the amplitude of swing to decrease from either 6° to 3° (König pendulum) or from 12° to 4° (Persoz pendulum).

NOTE 2 For the pendulum damping test using the König pendulum, it is common practice to measure the number of swings. The time for the amplitude of swing to decrease can be calculated by multiplying the number of swings by 1,4 s.

8 Expression of results

Record each result and the mean of the three determinations to the nearest second.

9 Precision

9.1 König pendulum

9.1.1 Repeatability limit (r)

The repeatability limit r is the value below which the absolute difference between three single test results, each mean of duplicates, can be expected to lie when this method is used under repeatability conditions. In this case, the test results are obtained on identical material by one operator in one laboratory within a short interval of time using the standardized test method. In this International Standard, r is 5 swings, with a 95 % probability.

9.1.2 Reproducibility limit (R)

The reproducibility limit R is the value below which the absolute difference between three single test results, each the mean of duplicates, can be expected to lie when this method is used under reproducibility conditions. In this case, the test results are obtained on identical material by operators in different laboratories using the standardized test method. In this International Standard, R is 10 swings, with a 95 % probability.

9.2 Persoz pendulum

9.2.1 Repeatability limit (r)

The repeatability limit r is the value below which the absolute difference between three single test results, each mean of duplicates, can be expected to lie when this method is used under repeatability conditions. In this case, the test results are obtained on identical material by one operator in one laboratory within a short interval of time using the standardized test method. In this International Standard, r is 3 % of their mean value, with a 95 % probability.

9.2.2 Reproducibility limit (R)

The reproducibility limit R is the value below which the absolute difference between three single test results, each the mean of duplicates, can be expected to lie when this method is used under reproducibility conditions. In this case, the test results are obtained on identical material by operators in different laboratories using the standardized test method. In this International Standard, R is 8 % of their mean value, with a 95 % probability.

10 Supplementary test conditions

If agreed, the following supplementary test conditions shall be specified, as appropriate, in addition to those specified in Clauses 5, 6 and 7:

- a) type of substrate material, substrate thickness and surface preparation of the substrate;
- b) method of application of the test coating to the substrate, including duration and conditions of drying between coats in the case of a multi-coat system;
- 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 relative humidity of the test, if different from those specified in 7.2 (see ISO 3270).

11 Test report

The test report shall contain at least the following information:

- a) all information necessary for complete identification of the product tested (manufacturer, trade name, batch number, etc.);
- b) a reference to this International Standard (ISO 1522:2006);
- c) the method used, i.e. König or Persoz pendulum;
- d) the items of supplementary information referred to in Clause 10;
- e) a reference to the international or national standard, product specification or other document supplying the information referred to in d);
- f) the results of the test, including the results of the individual determinations and their mean as specified in Clause 8;
- g) any specific agreements between the interested parties;
- h) any deviations from the procedure specified;
- i) any unusual features (anomalies) observed during the test;
- j) the date of the test.

Annex A (normative)

Calibration of the König pendulum

A.1 Check the alignment of the pendulum and panel table as follows.

A.1.1 Place the polished glass panel on the panel table and gently bring the pendulum to rest on the surface of the glass. Be sure the pendulum oscillates freely.

A.1.2 Place a spirit level on the glass panel surface. Level the glass panel by means of the adjusting screws at the base of the instrument.

A.1.3 Clean the glass panel by wiping with a soft, lint-free cloth wetted with a suitable solvent.

A.1.4 Clean the fulcrum balls by wiping them with a soft tissue wetted with a suitable solvent. Leave the pendulum in ambient conditions and then bring it to rest on the glass panel.

A.1.5 Check the position of the scale relative to the pendulum pointer. With the pendulum at rest, its pointer should indicate zero on the scale. If the pointer does not indicate zero, move the scale to obtain the correct zero setting.

A.2 Check the duration of the pendulum swing on the glass panel as follows.

A.2.1 Deflect the pendulum through 6° , release it and simultaneously start the stopwatch or other timing device.

A.2.2 Determine whether the time for 100 swings of the pendulum is (140 ± 2) s.

A.2.3 If the measured time is less than that specified, move the weight downward. Continue adjustments until the specified time is obtained. If adjustments do not give the required time, the instrument shall be judged faulty.

A.3 Check the duration of damping of the pendulum on the glass panel as follows.

A.3.1 Deflect the pendulum through 6° , release it and simultaneously start the stopwatch or other timing device.

A.3.2 Determine whether the time for the amplitude of swing to decrease from 6° to 3° is (250 ± 10) s (corresponding to 172 to 185 pendulum swings).

Annex B (normative)

Calibration of the Persoz pendulum

B.1 Check the alignment of the pendulum and panel table as follows.

B.1.1 Place the polished glass panel on the panel table and gently bring the pendulum to rest on the surface of the glass. Be sure the pendulum oscillates freely.

B.1.2 Place a spirit level on the glass panel surface. Level the glass panel by means of the adjusting screws at the base of the instrument.

B.1.3 Clean the glass panel by wiping with a soft, lint-free cloth wetted with a suitable solvent.

B.1.4 Clean the fulcrum balls by wiping them with a soft tissue wetted with a suitable solvent. Leave the pendulum in ambient conditions and then bring it to rest on the glass panel.

B.2 Check the duration of the pendulum swing on the glass panel as follows.

B.2.1 Deflect the pendulum through 12° , release it and simultaneously start the stopwatch or other timing device.

B.2.2 Determine whether the time for 100 swings of the pendulum is (100 ± 1) s.

B.2.3 If this value cannot be achieved, reclean the glass panel and the bearing balls of the pendulum, recheck that the glass panel is level, and retest. Do not adjust the instrument scale at this point.

B.3 Check the duration of damping of the pendulum on the glass panel as follows.

B.3.1 Deflect the pendulum through 12° , release it and simultaneously start the stopwatch or other timing device.

B.3.2 Determine whether the time for the amplitude of swing to decrease from 12° to 4° is (430 ± 15) s.

B.3.3 If this value cannot be achieved, repeat the glass panel and instrument checks described in B.2.3.

Bibliography

- [1] ISO 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*
- [2] ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

