

# INTERNATIONAL STANDARD

**ISO**  
**7784-2**

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## **Paints and varnishes — Determination of resistance to abrasion —**

### **Part 2:**

Rotating abrasive rubber wheel method

*Peintures et vernis — Détermination de la résistance à l'abrasion —  
Partie 2: Méthode utilisant une roue abrasive en caoutchouc*

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## Foreword

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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 7784-2 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 7784 consists of the following parts, under the general title *Paints and varnishes — Determination of resistance to abrasion*:

- Part 1: *Rotating abrasive-paper-covered wheel method*
- Part 2: *Rotating abrasive rubber wheel method*
- Part 3: *Reciprocating test panel method*

Annex A forms an integral part of this part of ISO 7784. Annexes B and C are for information only.

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## Introduction

This document is one of three parts of ISO 7784 dealing with the determination of resistance to abrasion of a dried film of paint, varnish or related product.

Parts 1 and 3 both specify a method using abrasive paper for determination of the resistance to abrasion. In part 2, a method using abrasive rubber wheels is described. The user of ISO 7784 should note that the methods using abrasive paper (parts 1 and 3) are the preferred methods.

# Paints and varnishes — Determination of resistance to abrasion —

## Part 2: Rotating abrasive rubber wheel method

### 1 Scope

This part of ISO 7784 is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

This part of ISO 7784 specifies a method for determining the resistance to abrasion of a dried film of paint, varnish or related product, using abrasive rubber wheels and abrading by making a rotary movement.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 7784. 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 7784 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 48:1994, *Rubber — Determination of hardness (hardness between 30 and 85 IRHD)*.

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:—<sup>1)</sup>, *Paints and varnishes — Determination of film thickness*.

ISO 6507-1:1982, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 100*.

### 3 Principle

A dried paint or varnish film is abraded, under specified conditions, with abrasive rubber wheels which are attached to an abrasion testing machine. During the test the wheels are loaded with specified weights. The resistance to abrasion is calculated as the loss in mass after a specified number of abrasion cycles or as the number of cycles required to remove the coating down to the next layer or down to the substrate.

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

## 4 Required supplementary information

For any particular application, the test method specified in this part of ISO 7784 needs to be completed by supplementary information. The items of supplementary information are given in annex A.

## 5 Apparatus

**5.1 Abrasion testing machine**<sup>2)</sup>, consisting of the elements described in 5.1.1 to 5.1.4 (see also figure 1).

**5.1.1 Turntable**, capable of rotating at a speed of  $(60 \pm 2)$  rpm, on which the test panel can be centrally mounted and firmly attached.

**5.1.2 Two abrasive rubber wheels**<sup>2)</sup>, each of thickness  $(12,7 \pm 0,1)$  mm. The wheels shall be mounted on and able to rotate freely about horizontal spindles. Their internal faces shall be  $(53,0 \pm 0,5)$  mm apart and the hypothetical line through the two spindles shall be  $(19,1 \pm 0,1)$  mm away from the central axis of the turntable. The external diameter of the wheels shall be  $(51,6 \pm 0,1)$  mm when new, and in no case less than 44,4 mm.

The type of wheel shall be chosen by agreement between the interested parties.

A slow hardening of the rubber bonding material in this type of wheel may occur. Therefore the hardness shall be checked to agree with the specification given by the manufacturer. Wheels shall not be used after the expiration date marked on them by the manufacturer, or more than one year after their purchase if no expiration date is given.

**5.1.3 Counter**, to record the number of cycles (turns) made by the turntable.

**5.1.4 Suction device**, with two nozzles. One of the nozzles shall be positioned between the two wheels and the other placed diametrically opposite the first. The distance between the axes of the two nozzles shall be  $(75 \pm 2)$  mm and the distance between them and the test panel 1 mm to 2 mm.

When the suction nozzles are in position, the air pressure in the suction device shall be 1,5 kPa<sup>3)</sup> to 1,6 kPa<sup>3)</sup> lower than atmospheric pressure.

**5.2 Weights**, to enable the mass of each wheel to be increased by up to 1 kg.

**5.3 Resurfacing medium**, in the form of an abrasive disc, used for resurfacing the wheels.

**5.4 Calibration panel**, of thickness between 0,8 mm and 1 mm, for calibration of the apparatus (see annex B).

**5.5 Balance**, with an accuracy of 0,1 mg.

## 6 Sampling

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.

2) This apparatus is commercially available from Teledyne Taber, 455 Bryant Street, North Tonawanda, NY 14120, USA.

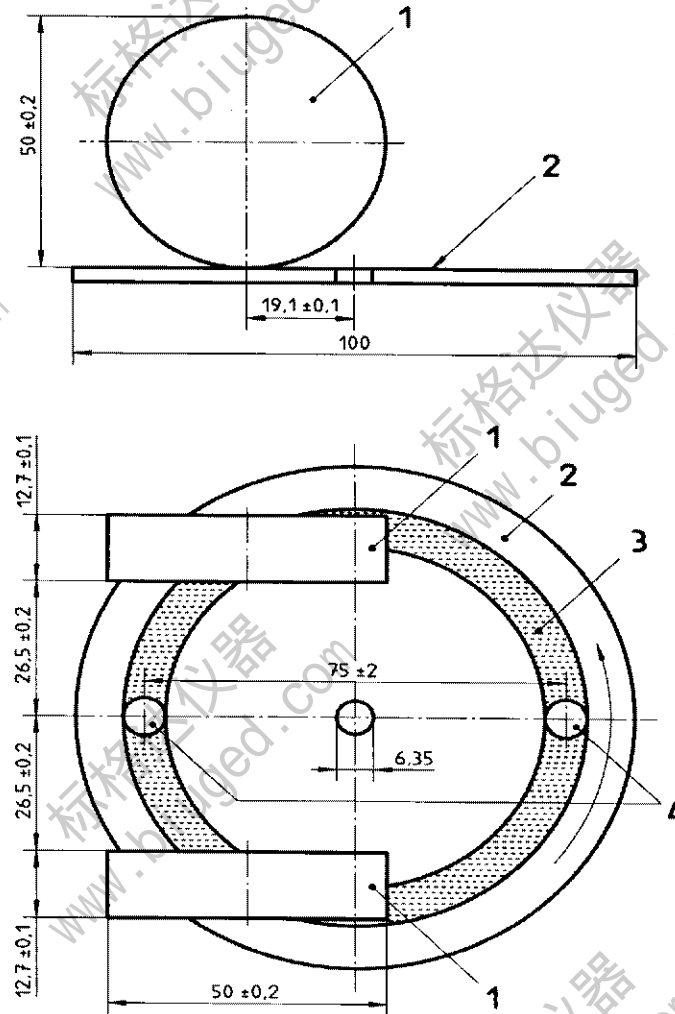
3) 1 kPa = 10 mbar.

## 7 Test panels

### 7.1 Substrate

Unless otherwise agreed, select the substrate from one of those described in ISO 1514, using, where possible, the same type of material as will be used in practice. The substrate panels shall be plane and free from distortion, otherwise the wear of the coating under test will not be uniform.

Dimensions in millimetres



- Key**
- 1 Abrasive wheels
  - 2 Test specimen
  - 3 Wear zone
  - 4 Vacuum nozzles  
 $\varnothing 8 \pm 0,5$

Figure 1 — Diagrammatic arrangement of apparatus

## 7.2 Shape and dimensions

The shape and dimensions of the test panels shall be such that they can be fitted correctly on the apparatus. They shall have a central hole of diameter 6,35 mm.

NOTE — Typical dimensions for a test panel are 100 mm x 100 mm.

## 7.3 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.

## 7.4 Drying and conditioning

Dry (or stove) and age, if applicable, each coated test panel for the specified time under the specified conditions.

## 7.5 Thickness of coating

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

# 8 Procedure

## 8.1 Test conditions

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

## 8.2 Calibration of the apparatus

Calibrate the apparatus (an example of a calibration procedure is given in annex B).

## 8.3 Preparation of the abrading rubber wheels

**8.3.1** Check that the abrasive rubber wheels meet the requirements specified in 5.1.2.

**8.3.2** To ensure that the abrading function of the wheels is maintained at a constant level, prepare the abrasive rubber wheels as prescribed by the manufacturer, following 8.3.2.1 to 8.3.2.4.

**8.3.2.1** Mount the selected abrasive rubber wheels on their respective flange holders, taking care not to touch the abrasive surfaces. Adjust the load on the wheels to the value agreed between the interested parties.

**8.3.2.2** Mount the resurfacing-medium disc on the turntable. Lower the abrading heads carefully until the wheels rest on the disc. Place the suction nozzle in position and adjust it to a distance of 1 mm above the surface of the disc.

**8.3.2.3** Set the counter to zero.

**8.3.2.4** Start up the suction and then the turntable. Resurface the wheels by running them for a specified number of cycles against the resurfacing-medium disc.

NOTE — A typical number of cycle is 50.

Resurface the wheels in this manner before testing each specimen and after every 500 cycles, in such a way that the abrasive surface is exactly cylindrical and that the edges between the abrasive surface and the side faces are sharp, without any bending radius. Resurface new wheels before the first use.

## 8.4 Determination

**8.4.1** Condition the coated test panels at a temperature of  $(23 \pm 2)$  °C and a relative humidity of  $(50 \pm 5)$  %, unless otherwise agreed, for a minimum period of 16 h.

**8.4.2** If the surface of the coating is irregular, due to orange peel, brush marks, etc., abrade it for 50 cycles and clean it with lint-free paper prior to the determination. Report this operation, if carried out, in the test report.

**8.4.3** Weigh the conditioned test panel to the nearest 0,1 mg, and record this mass.

**8.4.4** Attach the test panel to the turntable, lower the abrading heads on to the test panel and place the suction nozzles in position.

**8.4.5** Set the counter to zero and start up the suction and then the turntable.

**8.4.6** After a specified number of cycles, remove any loose abrasings remaining on the test panel with lint-free paper, reweigh the test panel and record this mass. Inspect the panel to see if wearthrough of the coating has occurred.

**8.4.7** By interrupting the test at intervals, the point of wearthrough can be determined more accurately and the average loss in mass for a given number of cycles can be calculated.

**8.4.8** Repeat 8.4.2 to 8.4.6 for two more test panels and record the results.

## 9 Expression of results

**9.1** For each test panel, calculate the loss in mass after the agreed number of cycles by subtraction.

Calculate the mean loss in mass for all three test panels and report the result to the nearest 1 mg.

NOTE — The loss in mass can also be calculated at each of the intervals at which the test was interrupted.

**9.2** Calculate the mean number of cycles required to reach wearthrough of the coating or of the topcoat in a multicoat system.

NOTE — After the wearthrough of the coating, the loss in mass is affected by abrasion of the substrate.

## 10 Precision

See annex C.

## 11 Test report

The test report shall contain at least the following information:

- all details necessary to identify the product tested;
- reference to this part of ISO 7784 (ISO 7784-2);
- the items of supplementary information referred to in annex A;



- d) a reference to the international or national standard, product specification or other document supplying the information referred to in c);
- e) the wheel load and the type of abrasive rubber wheel used;
- f) the results of the test as indicated in clause 9;
- g) whether the surface had to be pre-abraded because of surface irregularities;
- 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, including the 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 the method of measurement in accordance with ISO 2808, and whether it is a single coat or a multi-coat system.
- e) Temperature and humidity during the test, if different from those specified in 8.1.

## Annex B (informative)

### Calibration of the apparatus

#### B.1 General

The accessories needed for calibration, such as calibration panels and the abrasive paper, should preferably be obtained from the manufacturer of the abrasion tester. Usually, zinc panels are delivered as calibration panels by the manufacturer.

#### B.2 Apparatus

Apparatus as described in clause 5, and in addition the following.

**B.2.1 Two rubber wheels**, each of thickness  $(12,7 \pm 0,1)$  mm and overall diameter  $(50,0 \pm 0,2)$  mm, the periphery of which is covered with a rubber strip of thickness 6 mm and hardness  $(50 \pm 5)$  IRHD (determined in accordance with ISO 48). The wheels shall be mounted on and able to rotate freely about horizontal spindles.

Their internal faces shall be  $(53,0 \pm 0,5)$  mm apart and the hypothetical line through the two spindles shall be  $(19,1 \pm 0,1)$  mm away from the central axis of the turntable. The mass distribution within the assembly shall be such that each of the wheels exerts a force of  $(1 \pm 0,02)$  N on the test panel.

**B.2.2 Strips of abrasive paper**, of width  $(12 \pm 0,2)$  mm and approximate length 175 mm. The grade of abrasive paper shall be P 180 as defined in the P series of the grain size standard published by the Federation of European Producers of Abrasive Products (FEPA).<sup>4)</sup>

NOTE — Self-adhesive abrasive paper is also available from some manufacturers.

**B.2.3 Double-sided adhesive tape**, in strips of width  $(12 \pm 0,2)$  mm and approximate length 175 mm, for use if self-adhesive abrasive paper is not available.

#### B.3 Calibration procedure

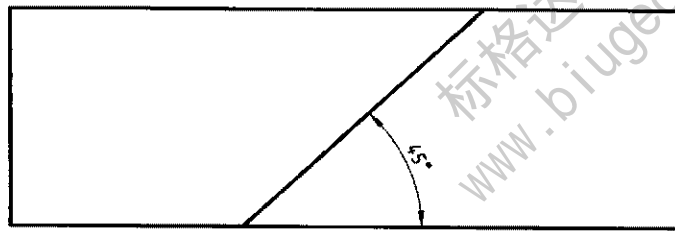
**B.3.1** Condition the abrasive paper, the adhesive tape, if used, and the test panel at a temperature of  $(23 \pm 2)$  °C and a relative humidity of  $(50 \pm 5)$  %, unless otherwise agreed, for a minimum period of 16 h.

**B.3.2** Attach a conditioned abrasive-paper strip to the circumference of the wheels, using the conditioned adhesive tape, if necessary. Adjust the length of each strip so that it covers the peripheral surface of the wheel without any overlap or gap.

NOTE — It is recommended that the strips be cut at an angle of approximately 45° so that the joint is not at right angles to the direction of travel of the wheels (see figure B.1).

4) FEPA Standard 43-GB-1984, obtainable from the British Abrasive Federation, P.O. Box 58, Trafford Park Road, Trafford Park, Manchester M17 1JD, United Kingdom.

- B.3.3** If a new zinc panel is being used, abrade it for 200 cycles of the turntable before use, following the procedure specified in B.3.5 and B.3.6, and then clean it with lint-free paper.
- B.3.4** Weigh the conditioned test panel to the nearest 1 mg, and record this mass.
- B.3.5** Install a 500 g load on each arm of the abrasion testing machine, attach the test panel to the turntable, lower the abrading heads on to the test panel and place the suction machine, lower the suction nozzles in position.
- B.3.6** Set the counter to zero and start up the suction and then the turntable.
- B.3.7** After 500 cycles, clean the test panel with lint-free paper, reweigh the test panel and record this mass.
- B.3.8** Carry out B.3.2 to B.3.7 twice more, each time with a new strip of abrasive paper.
- B.3.9** After the third test, calculate the mean loss in mass for the three calibration runs.
- B.3.10** The average loss in mass of the zinc plate should be  $(110 \pm 30)$  mg. If the average loss in mass is outside this range, check the apparatus and rectify any faults.



**Figure B.1** — Recommended method for joining the ends of the abrasive-paper strip

## **Annex C** (informative)

### **Precision**

No relevant precision data are currently available.

If numerical values are to be measured, this method should be performed in only one laboratory. In case of work between laboratories, it is better to use rankings for the coatings.

ISO/TC 35 intends to obtain precision data for all relevant standards, including this part of ISO 7784. When precision data are available, they will be incorporated in the document.

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