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**Paints and varnishes — Determination of  
wet-scrub resistance and cleanability of  
coatings**

*Peintures et vernis — Détermination de la résistance au frottement humide  
et de l'aptitude au nettoyage des revêtements*

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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 11998 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

Annex A forms an integral part of this International Standard.

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# Paints and varnishes — Determination of wet-scrub resistance and cleanability of coatings

## 1 Scope

The ability of coatings to withstand wear caused by repeated cleaning operations and to resist permanent blemishing by stains is an important consideration both from a practical point of view and when comparing and rating such coatings. This International Standard specifies an accelerated method for the determination of wet-scrub resistance. With regard to the cleanability of coatings, only the method itself and not the soiling agents are specified.

NOTE — Since these properties depend not only on the quality of a coating but also on the substrate, the method of application, the drying conditions and other factors, the results obtained are not directly transferable to actual practice. In this standard the evaluation of the coating is based on a defined substrate, a fixed application method, specified drying conditions and a defined method of wet scrubbing.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 and paste form.*

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

ISO 2808:1997, *Paints and varnishes — Determination of film thickness.*

ISO 3270:1984, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing.*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

## 3 Definitions

For the purposes of this International Standard, the following definitions apply.

**3.1 cleanability:** The ability of a dry coating film to withstand penetration by soiling agents and to be freed from them through the cleaning process without removing more than a defined film thickness.

**3.2 scrub cycle:** One reciprocal movement of the scrub pad over the full stroke length in both directions.

**3.3 stroke length:** The total distance, end to end, traversed by the scrub pad in a scrub testing machine.

**3.4 wet-scrub resistance:** The ability of a dry coating film to sustain less than a specified loss in film thickness, averaged over a defined area, when exposed to 200 wet-scrub cycles.

## 4 Principle

The test coating is applied to a test panel using a film applicator at the specified gap clearance. After drying and conditioning, the coated panel is weighed and subjected to 200 wet-scrub cycles in a scrub testing machine. It is then washed, dried and weighed again to determine its loss in mass, from which the mean loss in film thickness is calculated.

For the determination of cleanability, soiling agents are applied to similarly prepared coated panels. The soiling agents specified are left in contact with the coating film for a specified time. The coated, soiled panels are then subjected to 200 wet-scrub cycles.

Through comparison of the mean loss in film thickness with a specified value, as agreed between interested parties, the coating can be rated in wet-scrub resistance classes.

When the applied soiling agent is observed to be removed and the coating is wet-scrub resistant, the coating is said to be cleanable in terms of the soiling agent used.

## 5 Reagents

### 5.1 Washing liquid

Use a 2,5 g/l solution of sodium *n*-dodecylbenzenesulfonate in water of grade 3 purity as defined in ISO 3696. The solution shall be allowed to stand before use until all air-bubbles and foam have dissipated.

### 5.2 Soiling agents

The soiling agents and manner of application shall be agreed between the interested parties.

## 6 Apparatus

**6.1 Test panel,**<sup>1)</sup> made of PVC film free of migration-susceptible chemical plasticizers, of sufficient rigidity to ensure a flat surface, impervious to and unaffected by water or aliphatic organic solvents and of nominal thickness 0,25 mm, 430 mm long and not less than 80 mm wide.

Other types of plastic film may be used where the coating contains solvent which may adversely affect the PVC film. If the coating delaminates before or during the test, another, more suitable substrate shall be used.

**6.2 Film applicator** (preferably an automatic film applicator), used at an application speed of 10 mm/s

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1) Suitable plasticized PVC film can be obtained from the Leneta Co., 15 Whitney Road, Mahwah, NJ 07430-3129, USA, or Erichsen GmbH, Am Iserbach 14, 58675 Hemer, Germany, or Sheen Instruments, Unit 4, St George's Industrial Estate, Richmond Road, Kingston, Surrey KT2 5BQ, UK.

to 15 mm/s and fitted with a doctor blade with an appropriate gap clearance and a gap width of at least 60 mm.

**6.3 Wet-scrub tester apparatus:** a reciprocating scrub testing machine with an effective stroke length of  $(300 \pm 5)$  mm and operating at approximately  $(37 \pm 2)$  scrub cycles per minute shall be used. A counter for recording the number of scrub cycles shall be provided.

**6.4 Scrub pad holder,**<sup>2)</sup> consisting of a metal plate fitted with pins to hold the abrasive pad. A mounting device with elongated holes is loosely fitted on the top of the plate (see figure 1).

The mass of the scrub pad holder and the supporting mechanism which exerts a downward force on the test panel shall be  $(135 \pm 1)$  g.

**6.5 Abrasive pad,**<sup>3)</sup> of non-woven plastic material, with embedded abrasive, measuring  $(90 \pm 0,5)$  mm  $\times$   $(39 \pm 0,5)$  mm. A new abrasive pad shall be used for every test.

**6.6 Analytical balance,** shielded from draughts, capable of weighing the test panel with applied coating to an accuracy of 1 mg.

**6.7 Straight-edge ruler,** with 0,5 mm divisions.

## 7 Sampling

Take a representative sample of the coating to be tested, as described in ISO 1512.

Examine and prepare the sample, as described in ISO 1513.

## 8 Procedure

### 8.1 Film application

**8.1.1** Using the film applicator, make a draw-down of the prepared sample of coating material on the test panel to achieve an even film at least 10 mm longer than the stroke length (see 3.3).

Ensure the gap clearance is sufficient that the resulting dry film is of such a thickness that, after 200 wet-scrub cycles, the substrate is not exposed.

**8.1.2** For the determination of wet-scrub resistance, dry the film in a standard atmosphere, as defined in ISO 3270, for the specified period. Weigh the test panel with the dried coating film (rolled up to fit onto the balance, where possible) to the nearest 1 mg.

**8.1.3** Either prepare panels for the determination of cleanability at the same time as for the determination of wet-scrub resistance, or use one half of a panel for cleanability and the other half for wet-scrub resistance (see note). Dry the film in a standard atmosphere, as defined in ISO 3270, for the specified period. Apply the specified soiling agents (see 5.2) in the manner agreed 24 h before completion of the drying period.

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2) A suitable holder can be obtained from Erichsen GmbH, Am Iserbach 14, 58675 Hemer, Germany; Order No. 0513.01.32.

3) Suitable pads may be cut from "3M Scotch Brite" handpads, No. 7448, Type S, Grade UFN, grey, manufactured by 3M France, Avenue Boulé, BP 28, 95250 Beauchamp, France.

NOTE — Duplicate panels are best prepared by using a standard panel measuring (165 × 430) mm and making a draw-down approximately 150 mm wide. After drying, the panel may then be cut in half lengthwise.

## 8.2 Wet-scrub resistance

**8.2.1** Place the test panel with the applied coating film in the base pan of the scrub testing machine on a float glass support and hold it down with clamps (see figure 2), but not so tight as to cause warping of the test panel.

**8.2.2** Spread the washing liquid with a soft paint brush on the surface of the coating. Leave the liquid in contact with the coating for 60 s.

**8.2.3** Ensure that the transporting threads are parallel to the surface of the test panel and that the mounting device is not in contact with the scrub pad holder (see figure 3).

**8.2.4** Saturate the abrasive pad with washing liquid to a final mass of  $(4 \pm 0,5)$  g. Place the abrasive pad on the scrub pad holder and in contact with the coating film. The unprinted side of the pad shall be the side in contact with the coating during the test.

**8.2.5** Start the scrub testing machine and run for exactly 200 cycles. The excess washing liquid applied with the brush will be removed within the first cycle.

**8.2.6** Detach the test panel from the machine and the float glass support, rinse it immediately with tap water, and leave it to dry to constant mass in the same standard atmosphere already used in 8.1.

**8.2.7** Record the residual dry mass of the test panel and coating film to the nearest 1 mg.

## 8.3 Cleanability

**8.3.1** Carry out the procedure as specified in 8.2.1 to 8.2.5.

**8.3.2** Detach the test panel from the machine and float glass support, rinse immediately with tap water, and leave it to dry for the same time and under the same conditions as the test panel for the determination of wet-scrub resistance (see 8.2.6).

**8.3.3** Visually compare the scrubbed area where the soiling agents were applied with the scrubbed area on a duplicate panel or on the other half of the same panel (see 8.1.3).

## 9 Expression of results

### 9.1 Calculation of the loss in coating mass

#### 9.1.1 Area traversed by the scrub pad

The area  $A$ , in square metres, traversed by the scrub pad is given by

$$A = \frac{W \times S}{10^6}$$

where

$S$  is the stroke length, in millimetres (see 3.3);

$W$  is the width, in millimetres, of the abrasive pad.

The width shall be obtained by determining, to the nearest 0,5 mm, the average width of the abrasive pad or of the scrubbed area on the coated panel by means of a straight-edge ruler (6.7).

### 9.1.2 Loss in coating mass

The mean loss in coating mass per unit area  $L$ , in grams per square metre, is given by

$$L = \frac{m_1 - m_2}{A}$$

where

$A$  is the area, in square metres, traversed;

$m_1$  is the initial mass, in grams, of the test panel and dry coating film;

$m_2$  is the mass, in grams, of the test panel and dry coating film after 200 scrub cycles.

### 9.2 Calculation of mean loss in film thickness

The mean loss in dry-film thickness  $L_{\text{dft}}$ , in micrometres, may then be calculated from the following equation:

$$\begin{aligned} L_{\text{dft}} &= \left( \frac{m_1 - m_2}{\rho_{\text{nv}}} \right) \times \frac{1}{A} \\ &= \frac{L}{\rho_{\text{nv}}} \end{aligned}$$

where

$\rho_{\text{nv}}$  is the non-volatile density, in grams per millilitre, of the coating, determined in accordance with annex A;

$A$ ,  $m_1$ ,  $m_2$  and  $L$  are as defined in 9.1.1 and 9.1.2.

### 9.3 Assessment of wet-scrub resistance

The mean loss in film thickness is determined in micrometres. This value is compared with the specified maximum loss in dry film thickness to rate the coating.

### 9.4 Assessment of cleanability

When no more than the specified film thickness is removed, there shall be no discernable visual difference between the areas where soiling agents were applied and the scrubbed area on a duplicate panel or on the other half of the same panel.

If the soiling agent is not removed totally, the coating can be rated visually in cleanability classes in accordance with another suitable standard.

## 10 Precision

### 10.1 General

The results given below are taken from an inter-laboratory study done in Japan during 1997. The tests were performed on a cross-linking type emulsion, at a dry-film thickness of approximately 65  $\mu\text{m}$ , with three different batches of abrasive pad and the drying conditions used were:  $(20 \pm 1)^\circ\text{C}$  and  $(65 \pm 5) \% \text{RH}$ .

### 10.2 Repeatability

The difference between results obtained by the same operator within a short time interval with the same apparatus under constant operating conditions on identical test material gives a repeatability confidence interval, at the 95 % confidence level, of

average ( $\mu\text{m}$ )  $\pm 18 \%$

### 10.3 Reproducibility

The difference between results obtained by different operators working in different laboratories on identical test material gives a reproducibility confidence interval, at the 95 % confidence level, of

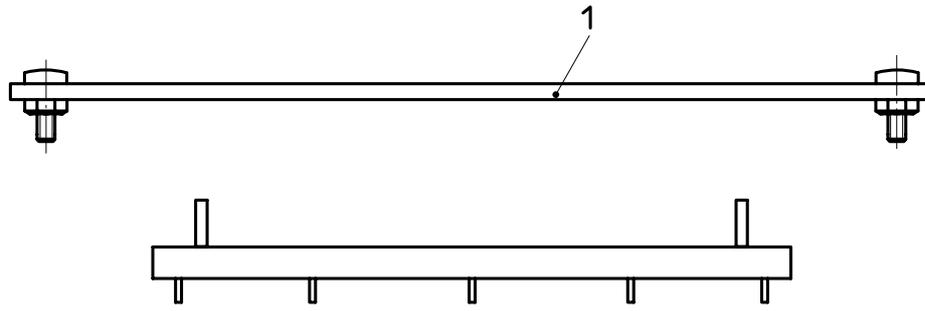
average ( $\mu\text{m}$ )  $\pm 30 \%$

## 11 Test report

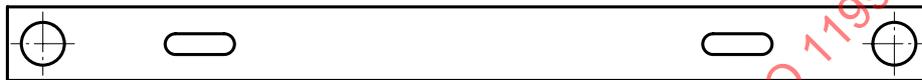
The test report shall contain at least the following information:

- a) all details necessary for complete identification of the product tested;
- b) a reference to this International Standard (ISO 11998);
- c) the drying time if other than standard atmosphere defined in ISO 3270;
- d) the results of the wet-scrub resistance test;
- e) where required, the results of the cleanability test (cleanable or not cleanable) in respect of each soiling agent used;
- f) the loss in coating mass per unit area and the density of the dry coating, if required;
- g) any deviation, by agreement or otherwise, from the specified procedures;
- h) the person who conducted the test;
- i) the laboratory where the test was performed;
- j) the date of the test.

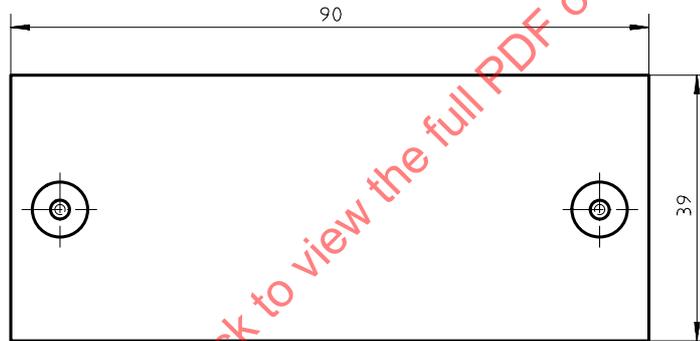
Dimensions in millimetres



a) Side view



b) Top view



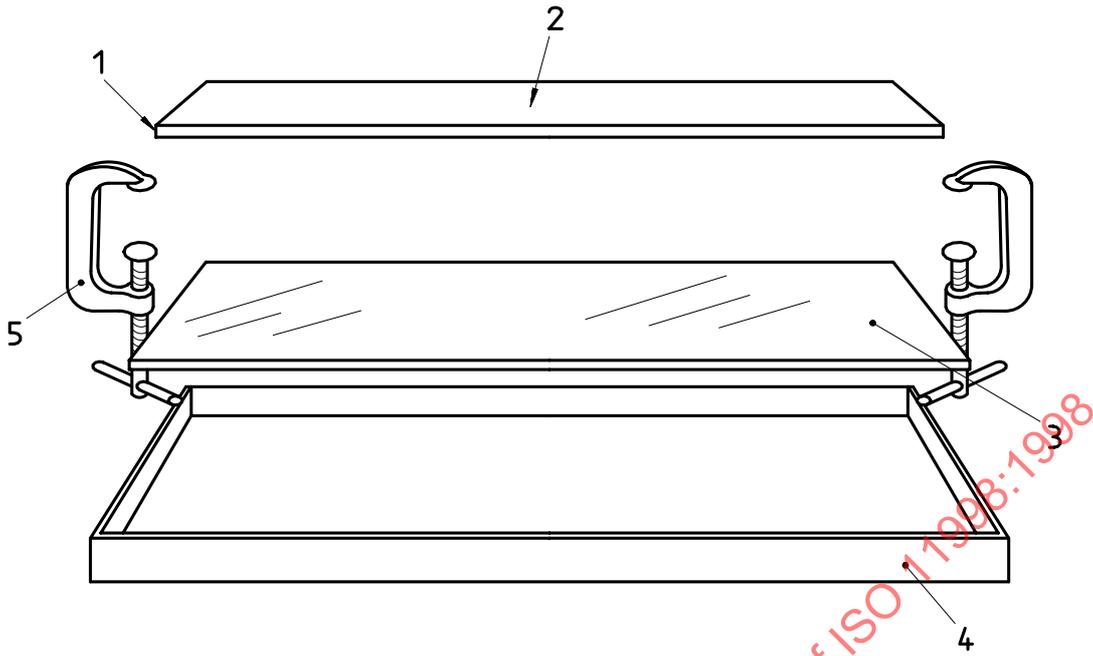
c) Bottom view



**Key**

- 1 Mounting device
- 2 Pins

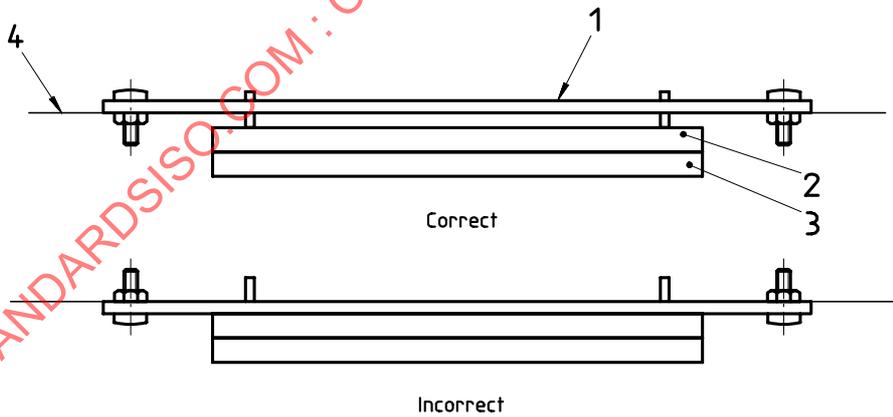
**Figure 1 — Scrub pad holder**



**Key**

- 1 Test panel
- 2 Paint coating
- 3 Float glass
- 4 Base pan
- 5 Clamp

**Figure 2 — Test panel clamping arrangement**



**Key**

- 1 Mounting device
- 2 Pad holder
- 3 Abrasive pad
- 4 Transporting thread

**Figure 3 — Mounting of abrasive-pad holder**

## Annex A (normative)

### Determination of non-volatile density of coating

#### A.1 Procedure

**A.1.1** Determine the surface area, to the nearest square millimetre, and the mass, to the nearest 1 mg, of an uncoated test panel.

**A.1.2** Mark out four to six test areas in the middle of the test panel. These areas shall coincide with the area to which the coating is going to be applied (see figure A.1).

**A.1.3** Determine the average panel thickness in the test areas, with a suitable instrument, to the nearest 1 µm. Methods in ISO 2808 may be used.

**A.1.4** Coat the test panel on the unmarked side with the coating material under test. Dry this panel in the same way as the panel(s) prepared for wet-scrub resistance testing.

**A.1.5** Cut or punch out the marked test areas from the coated test panel. Determine the mass and the film thickness of each of these test pieces.

NOTE — A pipe with one end sharpened can be used as a punch. To prevent the test panel from tearing during punching, sheets of paper can be placed on each side of the panel.

#### A.2 Calculation of the mass of the uncoated test pieces

Calculate the average mass  $m_2$  of the uncoated test pieces, in grams, using the following equation:

$$m_2 = \frac{m_1 \times A_2}{A_1}$$

where

$m_1$  is the mass of the uncoated test panel, in grams;

$A_1$  is the area of the uncoated test panel, in square millimetres;

$A_2$  is the average area of the uncoated test pieces, in square millimetres.