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

This second edition cancels and replaces the first edition (ISO 11998:1998), which has been technically revised. The main changes are:

- the definitions for stroke length and scrub cycle have been changed and a new term scrub length has been introduced;
- the method for the determination of the dry-film density of the coating, specified in Annex A, has been replaced by a new method.

## Introduction

As noted in the Foreword, this International Standard is a revision of ISO 11998:1998. The use and application of the standard is now established globally, and improved procedures/equipment have been proposed. A joint CEN/ISO working group has agreed to undertake interlaboratory testing with a new type of abrasive pad (different from that specified in 6.5). It is anticipated that the results of the testing will be available by the end of 2006 and an early revision of the standard might be initiated.



# 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 withstand penetration by soiling agents is an important consideration both from a practical point of view and when comparing and rating such coatings. This International Standard describes 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 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 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

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

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

#### **cleanability**

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 scrub length in both directions

### 3.3

#### **scrub length**

stroke length plus the length of the pad

### 3.4

#### **stroke length**

distance traversed by one stroke of the apparatus

### 3.5

#### **wet-scrub resistance**

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

### 4.1 Wet-scrub resistance

The test coating is applied to a test panel using a film applicator at the appropriate gap clearance. After drying and conditioning, the coated panel is weighed and subjected to 200 wet-scrub cycles in a scrub testing machine.

NOTE Some classification standards, e.g. EN 13300, require fewer scrub cycles.

It is then washed, dried and weighed again to determine its loss in mass, from which the mean loss in film thickness is calculated.

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.

### 4.2 Cleanability

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.

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 conforming to the requirements of grade 3 of ISO 3696. Allow the solution 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**, 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, approximately 430 mm long and not less than 80 mm wide.

Other types of plastics film may be used where the coating contains solvent which might 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 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**, consisting of a reciprocating scrub testing machine with a stroke length of  $(300 \pm 10)$  mm and operating at approximately  $(37 \pm 2)$  scrub cycles per minute. A counter for recording the number of scrub cycles shall be provided.

**6.4 Scrub pad holder**, 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 and Figure 2). The mass of the scrub pad holder which exerts a downward force on the test panel shall be  $(135 \pm 1)$  g.

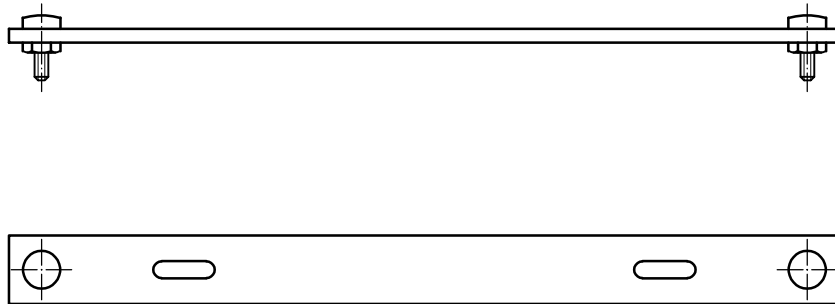
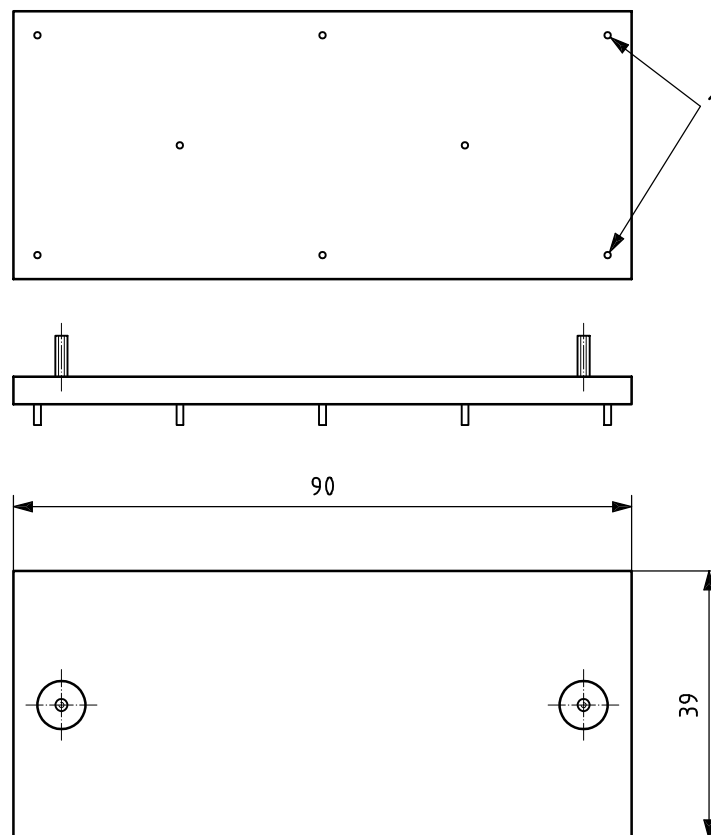


Figure 1 — Mounting device

Dimensions in millimetres



**Key**

1 pins

Figure 2 — Scrub pad holder

**6.5 Abrasive pad**<sup>1)</sup>, of non-woven plastics material, with embedded abrasive, measuring  $(90,0 \pm 0,5)$  mm  $\times$   $(39,0 \pm 0,5)$  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 the nearest 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 15528.

Examine and prepare the sample as described in ISO 1513.

## 8 Procedure

### 8.1 Film application

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 scrub 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.

For the determination of wet-scrub resistance, dry the film in the standard atmosphere defined in ISO 3270 for the specified period. Weigh the test panel with the dried coating film to the nearest 1 mg.

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 the Note). Dry the film in the standard atmosphere 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.

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

The mass of the soiling agents normally applied (marks made using e.g. a lead pencil, red-wax crayon or charcoal pencil) is not significant. If soiling agents having a significant mass are applied, separate panels shall be used for the determination of cleanability and wet-scrub resistance.

### 8.2 Wet-scrub resistance

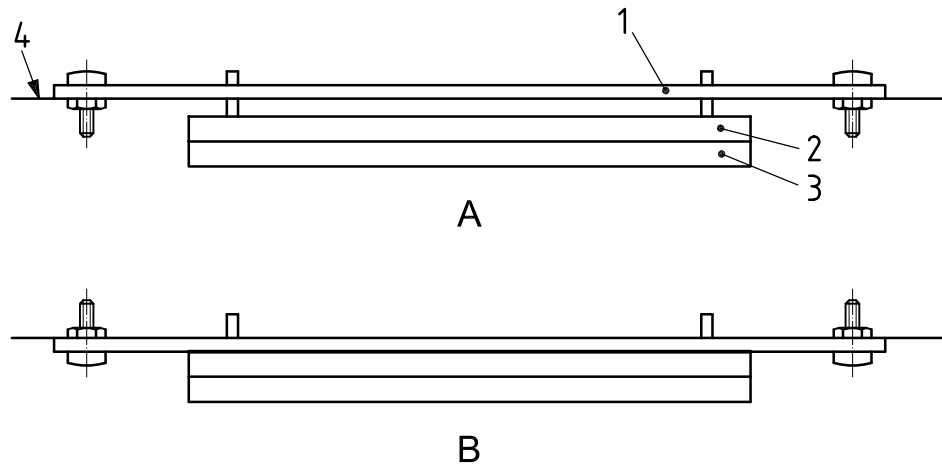
Ensure that the pad-displacing system is parallel to the surface of the test panel and that the mounting device is not in contact with the scrub pad holder (see Figure 3).

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 4), but not so tight as to cause warping of the test panel.

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.

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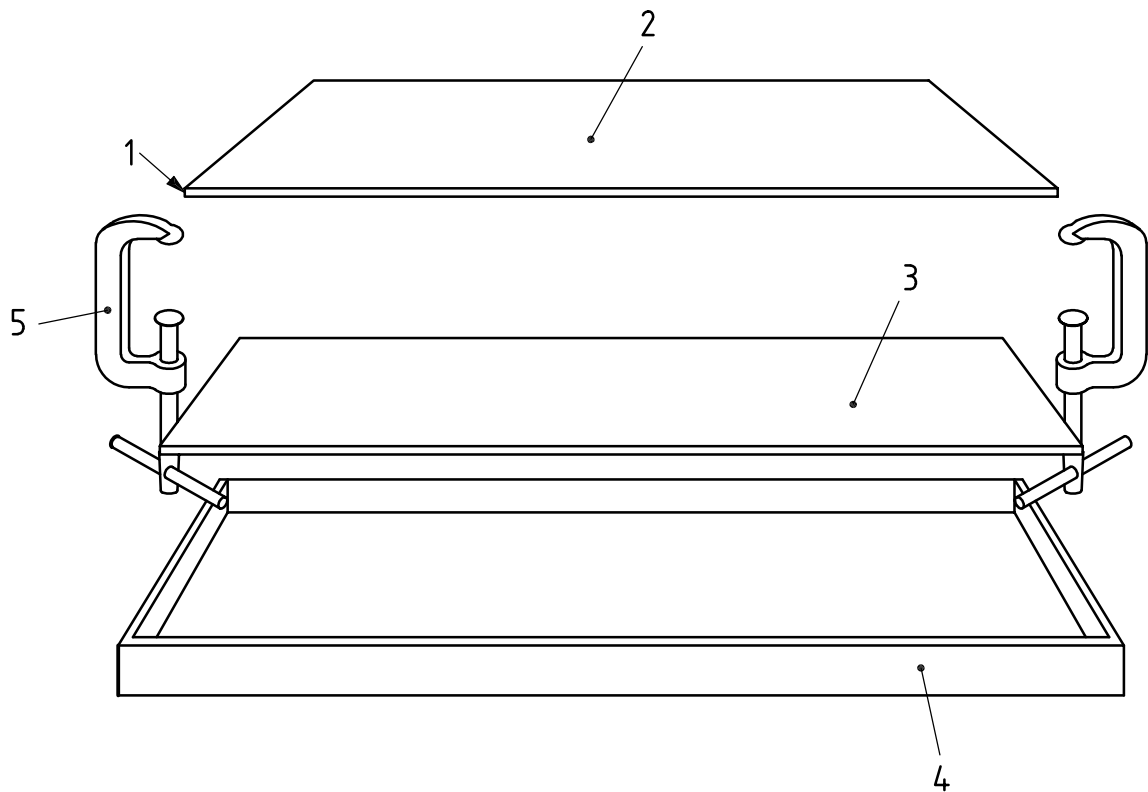
1) 3M Scotch Brite® handpads, No. 7448, Type S, Grade UFN, grey, which can be cut to size, are an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of this product.



**Key**

- |                         |             |
|-------------------------|-------------|
| 1 mounting device       | A correct   |
| 2 scrub pad holder      | B incorrect |
| 3 abrasive pad          |             |
| 4 pad-displacing thread |             |

**Figure 3 — Mounting of scrub pad holder**



**Key**

- |                 |
|-----------------|
| 1 test panel    |
| 2 paint coating |
| 3 float glass   |
| 4 base pan      |
| 5 clamp         |

**Figure 4 — Test panel clamping arrangement**

Saturate the abrasive pad with washing liquid to a final mass of  $(4,0 \pm 0,5)$  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.

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.

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.

To be able to calculate the scrubbed area, measure the length and width of the scrub trace on the coated panel using a straight-edge ruler (6.7).

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

### 8.3 Cleanability

Carry out the procedure as specified in 8.2.

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).

## 9 Expression of results

### 9.1 Calculation of the loss in coating mass per unit area

#### 9.1.1 Area traversed by the scrub pad

Calculate the area  $A$ , in square metres, traversed by the scrub pad using Equation (1):

$$A = \frac{S \times W}{10^6} \quad (1)$$

where

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

$W$  is the scrub width, in millimetres.

#### 9.1.2 Loss in coating mass per unit area

Calculate the loss in coating mass per unit area  $L$ , in grams per square metre, using Equation (2):

$$L = \frac{m_1 - m_2}{A} \quad (2)$$

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

Calculate the mean loss in dry-film thickness  $L_{\text{dff}}$ , in micrometres, using Equation (3):

$$L_{\text{dff}} = \left( \frac{m_1 - m_2}{A \times \rho_{\text{df}}} \right) = \frac{L}{\rho_{\text{df}}} \quad (3)$$

where

$\rho_{\text{df}}$  is the dry-film density, in grams per cubic centimetre, 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 (see e.g. EN 13300).

## 9.4 Assessment of cleanability

When no more than the specified film thickness is removed, there shall be no discernible 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 interlaboratory study done in Japan during 1997. The tests were performed on a crosslinking-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  $(65 \pm 5) \%$  relative humidity.

## 10.2 Repeatability

The difference between results obtained by the same operator working in the same laboratory on identical test material gives a reproducibility 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 (manufacturer, trade name, batch number, etc.);
- b) a reference to this International Standard (ISO 11998:2006);
- c) the drying conditions if other than the standard atmosphere given in ISO 3270;
- d) the density of the dry coating, determined as specified in Annex A;
- e) the results of the wet-scrub resistance test, calculated as specified in Clause 9, including, if required:
  - the loss in coating mass per unit area,
  - the results of the cleanability test (cleanable or not cleanable) in respect of each soiling agent used;
- f) the person who conducted the test;
- g) the laboratory where the test was performed;
- 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)

### Determination of the dry-film density of the coating

#### A.1 General

This method presumes that variations in the thickness (and consequently also in the mass) of two adjacent areas of a test panel are negligible.

#### A.2 Preparation of the test coating

Apply the coating material under test to one half of a test panel. Use a film applicator with the same gap clearance as used when carrying out the test. The minimum gap width shall be 60 mm. Apply the film for determination of the dry-film density at the same time as that for the wet-scrub resistance test.

Store the coated test panel under the same standard conditions as used for the coated panels for the wet-scrub resistance test.

#### A.3 Cutting out test pieces

One or two days before determining the wet-scrub resistance, cut the test panel prepared in Clause A.2 into two pieces (one coated, the other uncoated) and trim off the intermediate zone (see Figure A.1). It is recommended that a metal template and a cutter be used for cutting the panel.

From each of the resulting halves, cut two identical test pieces measuring 50 mm × 150 mm (or more, depending on the width of the original test panel and of the film applicator).

#### A.4 Procedure

Determine the area  $A$ , in square millimetres, of one of the test pieces by measuring the length and width to the nearest 0,5 mm. The areas of the other test pieces will be the same because they were all cut to the same size.

Determine the mass  $m$ , in milligrams to the nearest 1 mg, of the dry film on each of the coated test pieces from the difference between the mass of the coated test piece and the mass of the corresponding uncoated test piece, using an analytical balance.

Determine the mean thickness  $d$ , in micrometres to the nearest 1  $\mu\text{m}$ , of the dry film on each of the coated test pieces from the difference between the thickness of the coated test piece and the corresponding uncoated test piece, using either a micrometer gauge or an Eddy-current instrument zeroed on an uncoated test piece.

From the values determined for  $m$  and  $d$ , calculate the mean values for the two coated test pieces.

### A.5 Calculation of the dry-film density

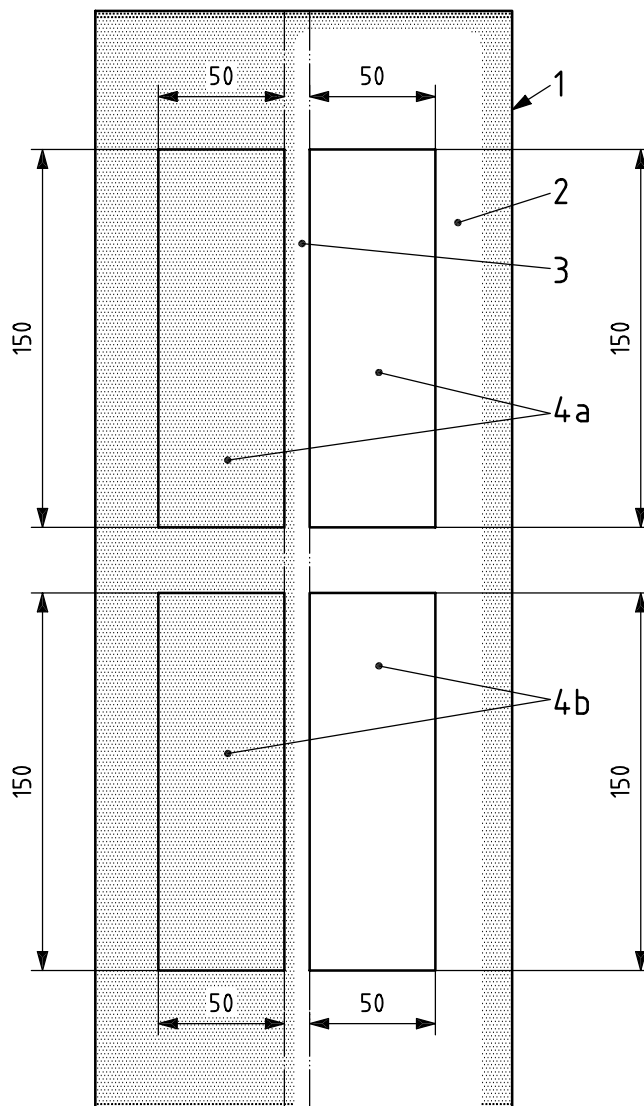
Calculate the dry-film density  $\rho_{df}$ , in grams per cubic centimetre, using the following equation:

$$\rho_{df} = \frac{m}{A \times d} \times 1000$$

where

- $m$  is the mean mass, in milligrams, of the dry film;
- $d$  is the mean dry-film thickness, in micrometres;
- $A$  is the area, in square millimetres, of each test piece.

Dimensions in millimetres



**Key**

- |                     |  |
|---------------------|--|
| 1 test panel        | 4a corresponding pair of coated/uncoated test pieces |
| 2 coating           | 4b corresponding pair of coated/uncoated test pieces |
| 3 intermediate zone |  |

**Figure A.1 — Locations of test pieces in panel**



## Bibliography

- [1] EN 13300, *Paints and varnishes — Water-borne coating materials and coating systems for interior walls and ceilings — Classification*

