INTERNATIONAL STANDARD

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Second edition
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Paints and varnishes — Determination of the percentage volume of non-volatile matter —

Part 2: Method using the determination of non-volatile-matter content in accordance with ISO 3251 and determination of dry film density on coated test panels by the Archimedes' principle

Peintures et vernis — Détermination du pourcentage en volume de matière non volatile —

Partie 2: Méthode utilisant la teneur en matière non volatile déterminée conformément à l'ISO 3251 et la masse volumique du feuil sec déterminée par le principe d'Archimède sur des panneaux d'essai revêtus

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document 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 3233-2:2014), which has been technically revised. The main changes compared to the previous edition are as follows:

— the definitions and sources in Clause 3 have been updated;

— a minimum mass of 25 mg of the coating on the plate has been added in 7.2.2, because measurements and simulation calculations demonstrate the need for a minimum mass for the coated panel.

A list of all parts in the ISO 3233 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Paints and varnishes — Determination of the percentage volume of non-volatile matter —

Part 2:
Method using the determination of non-volatile-matter content in accordance with ISO 3251 and determination of dry film density on coated test panels by the Archimedes' principle

1 Scope

This document specifies a method for determining the non-volatile matter by volume (NV_V) of coating materials by determining the practical dry-film density. This method determines the volume percentage of non-volatile matter in paints, varnishes and related products by measuring the density of a dry coating for any specified temperature range and period of drying or curing. The non-volatile matter content is determined in accordance with ISO 3251.

Using the non-volatile matter by volume results obtained in accordance with this document, it is possible to calculate the practical spreading rate of coating materials.

This method specifies an additional shape of plate to those described in ISO 3233-1 and is suitable for all products which can be applied by dipping.

This document is not applicable to coating materials which exceed the Critical Pigment Volume Concentration (CPVC).

Annex A gives an overview of the existing methods for the determination of non-volatile matter content and of non-volatile matter volume.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2808, *Paints and varnishes — Determination of film thickness*

ISO 2811 (all parts), *Paints and varnishes — Determination of density*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
non-volatile matter
NV
residue by mass obtained by evaporation under specified conditions

Note 1 to entry: Instead of the term "non-volatile matter", different terms, such as solid, dry residue, dry matter, solid matter, stoving residue are being used commonly with the respective abbreviations. The term "non-volatile matter" which is also applied in ISO 3251 should be used together with the abbreviation "NV" instead of these terms.

[SOURCE: ISO 4618:2014, 2.176]

3.2
non-volatile matter by volume
NV_V
percentage residue by volume obtained by evaporation under specified conditions

[SOURCE: ISO 4618:2014, 2.177]

3.3
spreading rate
surface area that can be covered by a given quantity of coating material to give a dried film of requisite thickness

Note 1 to entry: It is expressed in m^2/l or m^2/kg.

Note 2 to entry: See also *practical spreading rate* (3.4).

[SOURCE: ISO 4618:2014, 2.238, modified — "Application rate" and "theoretical spreading rate" have been deleted from Note 2 to entry.]

3.4
practical spreading rate
s_p
spreading rate (3.3) which is obtained in practice on the particular substrate being coated

[SOURCE: ISO 4618:2014, 2.203, modified — Symbol, s_p, has been added.]

3.5
practical dry-film density
ρ_p
practically determined density of a dried and cured coating

[SOURCE: ISO 3233-1:2013, 3.4]

4 Principle

The non-volatile matter by volume is calculated from the quotient of the density of the coating material and the dry film, with the dry-film density being determined practically.

5 Apparatus

Standard laboratory apparatus together with the following:

5.1 Metal plate, (40 ± 1) mm × (85 ± 1) mm, with a small hole at least 2 mm to 3 mm from the upper edge. A plate with a tip on one of the shorter edges is easier to immerse in the coating material (see Figure 1).

The material of the plate shall be suitable and adapted to the coating material under test. In addition, the material of the plate shall not change its volume during contact with the coating material under test. The thickness of the plate shall be about 0,7 mm or it shall be agreed between the interested parties.

Smaller plates may be used, subject to agreement between the interested parties, provided that the coated surface area is at least 5 600 mm^2.

Dimensions in millimetres

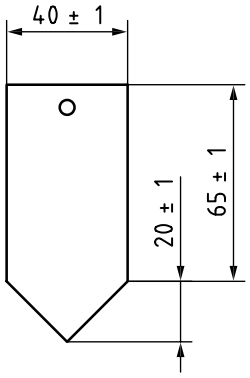

Figure 1 — Suitable plate for immersion

5.2 Hook, made of stainless material or synthetic thread, for attaching the plate to the balance during weighing operations. The diameter of the wire shall not exceed 0,30 mm because of surface tension effects.

5.3 Beaker, of a size convenient for immersing the plate with a clearance of at least 10 mm and which can be accommodated in the balance case.

5.4 Analytical balance, accurate to 0,1 mg. A single-pan balance is most convenient, and a useful modification is to replace the balance pan by a standard counterweight attachment.

5.5 Support, for holding the beaker under the balance stirrup without jamming the pan damper, if a counterweight as recommended in 5.4 is not available.

5.6 Immersion liquid of suitable density, in which the plate is immersed.

NOTE Water is a suitable immersion liquid for most coating materials. Other organic liquids are also suitable provided that they do not attack the coating.

5.7 Desiccator containing a suitable desiccant.

5.8 Air oven, capable of maintaining the specified or agreed test temperature to ± 2,0 °C (for temperatures up to 150 °C) or ± 3,5 °C (for temperatures above 150 °C and up to 200 °C). An air oven with forced ventilation shall be used.

WARNING — To protect against explosions and fire, careful handling of products containing flammable volatile materials is essential.

Drying in a vacuum can be beneficial for certain applications. In such cases, the conditions shall be agreed. Air ovens of the same type shall be used by all parties for referee tests.

6 Sampling

Take a representative sample of the coating material to be tested, in accordance with ISO 15528.

Examine and prepare the samples for testing in accordance with ISO 1513.

7 Procedure

7.1 Number of determinations and preparation

Carry out the determination in duplicate.

Degrease and clean the plate (5.1). Dry the plate and hook at the specified temperature for 10 min, and cool in the desiccator.

7.2 Determination of the practical dry-film density

7.2.1 Determination of the mass of the uncoated plate in air and in the immersion liquid

Weigh the cleaned and dried plate plus hook in air to an accuracy of 1 mg (m_1).

Then place the plate in the beaker with the immersion liquid, e.g. water, and weigh to an accuracy of 1 mg (m_2). Ensure that the plate is always immersed to the same depth, with the liquid about 10 mm above the top of the plate. There shall be no air bubbles at any place on the plate (see Figure 2).

NOTE If water is used as the immersion liquid, it is beneficial to add 1 or 2 drops of a wetting agent to ensure thorough wetting of the plate.

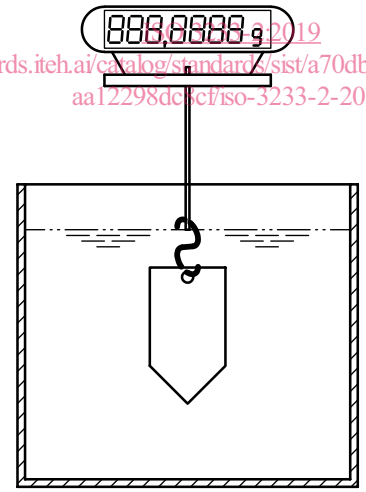

Figure 2 — Weighing the plate

7.2.2 Weighing the coating material and determination of the mass of the plate with coating material

The coating material shall always be ready to use when it is tested.

The dry-film thickness on the plate shall correspond approximately to the dry-film thickness of the coating material used in practice and the minimum mass of the coating on the plate shall be 25 mg.

In the case of thixotropic or high viscous coating materials, they may be diluted in accordance with the manufacturer's instructions until the sample is uniformly spread over the plate.

The preferred method of coating the plate is to immerse it in the coating material. Withdraw it at a steady rate and remove any excess coating material by, for example, drawing a glass rod along the lower edge of the plate. No thick edge shall be allowed to form on the lower edge. If any air bubbles form on the coated surfaces, burst them with a needle.

Dry/cure the coated plate product-specifically in accordance with the instructions of the manufacturer of the coating material under test.

Cool the coated plate to room temperature after drying/curing in the desiccator.

After cooling, weigh the coated plate in air to an accuracy of 1 mg (m_3).

Then place the coated plate in the beaker with the immersion liquid, e.g. water, and weigh to an accuracy of 1 mg (m_4). Ensure that the coated plate is always immersed to the same depth, with the liquid about 10 mm above the top of the plate. There shall be no air bubbles at any place on the coated plate.

7.3 Determination of the density

The density of the immersion liquid (ρ_1) and the coating material (ρ_2) shall be determined to an accuracy of 0,001 g/cm^3, in accordance with one of the methods specified in the ISO 2811 series.

7.4 Determination of the non-volatile-matter content

Determine the non-volatile-matter content in accordance with ISO 3251.

7.5 Determination of film thickness

Determine the dry film thickness using one of the methods described in ISO 2808.

8 Evaluation

8.1 Calculation of the practical dry-film density

Calculate the practical dry-film density (ρ_p), in grams per cubic centimetre, as follows using the determined mass values and the density of the immersion liquid in Formula (1):

$$\rho_p = \frac{m_3 - m_1}{m_2 + m_3 - m_1 - m_4} \cdot \rho_1 \quad (1)$$

where

m_1 is the mass of the uncoated plate weighed in air, in grams;

m_2 is the mass of the uncoated plate weighed in the immersion liquid, in grams;

m_3 is the mass of the coated plate weighed in air, in grams;

m_4 is the mass of the coated plate weighed in the immersion liquid, in grams;

ρ_1 is the density of the immersion liquid, in grams per cubic centimetre.