INTERNATIONAL STANDARD

ISO 11890-1

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Paints and varnishes — Determination of volatile organic compound (VOC) content —

Part 1: Difference method

Peintures et vernis — Détermination de la teneur en composés organiques volatils (COV) —

Partie 1: Méthode par différence

Reference number
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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 3.

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 part of ISO 11890 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11890-1 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 10, *Test methods for binders for paints and varnishes*.

ISO 11890 consists of the following parts, under the general title *Paints and varnishes — Determination of volatile organic compound (VOC) content*:

— *Part 1: Difference method*

— *Part 2: Gas-chromatographic method*

Annex A forms a normative part of this part of ISO 11890.

Paints and varnishes — Determination of volatile organic compound (VOC) content —

Part 1: Difference method

1 Scope

This part of ISO 11890 is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It specifies a method for the determination of the volatile organic compound (VOC) content of paints, varnishes and their raw materials. This part may be used where the expected VOC content is greater than about 15 % by mass. When the expected VOC content is greater than 0,1 % by mass and less than about 15 % by mass, ISO 11890-2 shall be employed.

This method assumes that the volatile matter is either water or organic. However, other volatile inorganic compounds may be present and may need to be quantified by another suitable method and allowed for in the calculations.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11890. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11890 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 760:1978, *Determination of water — Karl Fischer method (General method)*.

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

ISO 2811-1:1997, *Paints and varnishes — Determination of density — Part 1: Pyknometer method*.

ISO 2811-2:1997, *Paints and varnishes — Determination of density — Part 2: Immersed body (plummet) method*.

ISO 2811-3:1997, *Paints and varnishes — Determination of density — Part 3: Oscillation method*.

ISO 2811-4:1997, *Paints and varnishes — Determination of density — Part 4: Pressure cup method*.

ISO 3251:1993, *Paints and varnishes — Determination of non-volatile matter of paints, varnishes and binders for paints and varnishes*.

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

ISO 4618-1:1998, *Paints and varnishes — Terms and definitions for coating materials — Part 1: General terms*.

ISO 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*.

ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*.

ISO 11890-2:2000, *Paints and varnishes — Determination of volatile organic compound (VOC) content — Part 2: Gas-chromatographic method*.

ISO 15528:—[1], *Paints, varnishes and raw materials for paints and varnishes — Sampling*.

ASTM D 3960-98, *Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings*.

3 Terms and definitions

For the purposes of this part of ISO 11890, the following terms and definitions apply.

3.1
VOC
volatile organic compound
fundamentally, any organic liquid and/or solid that evaporates spontaneously at the prevailing temperature and pressure of the atmosphere with which it is in contact

[ISO 4618-1:1998]

3.2
VOC content
volatile organic compound content
the mass of the volatile organic compounds present in a coating material, as determined under specified conditions

NOTE 1 The properties and the amount of the compounds to be taken into account will depend on the field of application of the coating material. For each field of application, the limiting values and the methods of determination or calculation are stipulated by regulations or agreement.

NOTE 2 Under certain US governmental legislation, the term VOC is restricted solely to those compounds that are photochemically active in the atmosphere (see ASTM D 3960). Any other compound is then defined as being an exempt compound.

[Adapted from ISO 4618-1:1998]

3.3
exempt compound
organic compound that does not participate in atmospheric photochemical reactions (see note 2 to definition 3.2)

3.4
ready for use
the state of a product when it is mixed in accordance with the manufacturer's instructions in the correct proportions and thinned if required using the correct thinners so that it is ready for application by the approved method

4 Principle

After preparation of the sample, the non-volatile matter content is determined in accordance with ISO 3251, and then the water content is determined using a titration technique employing Karl Fischer reagent in accordance with ISO 760. The contents of exempt compounds, if applicable, are determined using the method specified in ISO 11890-2. A calculation is then performed to give the VOC content of the sample.

1) To be published. (Revision of ISO 842:1984 and ISO 1512:1991)

5 Required supplementary information

For any particular application, the test method specified in this part of ISO 11890 of needs to be completed by supplementary information. The items of supplementary information are given in annex A.

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 specified in ISO 15528.

Examine and prepare each sample for testing as specified in ISO 1513, preparing the final sample for testing in the "ready for use" state.

7 Procedure

7.1 Number of determinations and general test conditions

Carry out all tests in duplicate at (23 ± 2) °C and a relative humidity of (50 ± 5) % unless otherwise agreed (see ISO 3270).

7.2 Determination of parameters

Determine the parameters required by the calculation (see 8.2 to 8.5) as specified in 7.3 to 7.6. Some may be determined by difference, depending on the compounds present in the sample.

7.3 Density

If required by the calculation (see 8.3 to 8.5), determine the density of the sample using the part of ISO 2811 which will give the best precision for the type of sample concerned. Determine the density at 23 °C.

7.4 Non-volatile matter content

Unless otherwise specified, determine the non-volatile matter content by the method given in ISO 3251.

7.5 Water content

Determine the water content, as a percentage by mass, by the method given in ISO 760, selecting the reagents so that there will be no interference from the compounds contained in the sample. If the compounds are not known, then determine them qualitatively, e.g. by the method given in ISO 11890-2.

NOTE 1 Typical compounds likely to cause interference are ketones and aldehydes. Reagent manufacturers normally publish literature for guidance on correct reagent selection.

NOTE 2 If the product to be tested is well characterized and known not to contain water, it may not be necessary to determine the water content, which can be assumed to be zero.

7.6 Exempt compounds (only where national legislation applies)

7.6.1 If the organic compounds contained in the sample are not known, then determine them qualitatively, e.g. by the method given in ISO 11890-2.

7.6.2 Determine the contents of the exempt compounds contained in the sample using the method given in ISO 11890-2.

7.6.3 Determine the densities of the exempt compounds by the method given in 7.3, or by referring to published reference data.

8 Calculation

8.1 General

Calculate the VOC content by the method specified in the referring specification. If no particular method is specified, calculate the VOC content by method 1.

Method 1 is the preferred calculation method as the precision is better since it does not involve the determination of density (which introduces the potential for additional errors).

8.2 Method 1: VOC content, as a percentage by mass, of the product “ready for use”

$$\text{VOC} = 100 - \text{NV} - m_{\text{w}}$$

where

VOC is the VOC content, as a percentage by mass, of the product “ready for use”;

NV is the non-volatile matter content, as a percentage by mass (see 7.4);

m_{w} is the water content, as a percentage by mass (see 7.5).

8.3 Method 2: VOC content, in grams per litre, of the product “ready for use”

$$\text{VOC} = (100 - \text{NV} - m_{\text{w}}) \times \varrho_{\text{s}} \times 10$$

where

VOC is the VOC content, in grams per litre, of the product “ready for use”;

NV is the non-volatile matter content, as a percentage by mass (see 7.4);

m_{w} is the water content, as a percentage by mass (see 7.5);

ϱ_{s} is the density, in grams per millilitre, of the sample at 23 °C (see 7.3);

10 is a conversion factor.

8.4 Method 3: VOC content, in grams per litre, of the product “ready for use” less water

$$\text{VOC}_{\text{lw}} = \left(\frac{100 - \text{NV} - m_{\text{w}}}{100 - \varrho_{\text{s}} \times \frac{m_{\text{w}}}{\varrho_{\text{w}}}} \right) \times \varrho_{\text{s}} \times 1\,000$$

where

VOC_{lw} is the VOC content, in grams per litre, of the product “ready for use” less water;

NV is the non-volatile matter content, as a percentage by mass (see 7.4);

m_{w} is the water content, as a percentage by mass (see 7.5);

ϱ_s is the density, in grams per millilitre, of the sample at 23 °C (see 7.3);

ϱ_w is the density, in grams per millilitre, of water at 23 °C (= 0,997 537 g/ml);

1 000 is a conversion factor.

8.5 Method 4: VOC content, in grams per litre, of the product "ready for use" less water and less exempt compounds (only required if national legislation applies)

$$\mathrm{VOC}_{\mathrm{lwe}} = \left(\frac{100 - \mathrm{NV} - m_{\mathrm{w}} - \sum_{i=1}^{i=n} m_{\mathrm{ec}i}}{100 - \varrho_{\mathrm{s}} \times \frac{m_{\mathrm{w}}}{\varrho_{\mathrm{w}}} - \varrho_{\mathrm{s}} \times \sum_{i=1}^{i=n} \frac{m_{\mathrm{ec}i}}{\varrho_{\mathrm{ec}i}}} \right) \times \varrho_{\mathrm{s}} \times 1\,000$$

where

$\mathrm{VOC}_{\mathrm{lwe}}$ is the VOC content, in grams per litre, of the product "ready for use" less water and less exempt compounds;

NV is the non-volatile matter content, as a percentage by mass, of the sample (see 7.4);

m_w is the water content, as a percentage by mass, of the sample (see 7.3);

m_{eci} is the content, as a percentage by mass, of exempt compound i (see 7.6);

ϱ_s is the density, in grams per millilitre, of the sample at 23 °C (see 7.3);

ϱ_w is the density, in grams per millilitre, of water at 23 °C (= 0,997 537 g/ml);

ϱ_{eci} is the density, in grams per millilitre, of exempt compound i (see 7.6.3);

1 000 is a conversion factor.

9 Expression of results

If the two results (duplicates) differ by more than the value indicated in 10.2, repeat the procedure.

Calculate the mean of two valid results (replicates) and report the result to the nearest 1 %.

10 Precision

10.1 General

The precision of the test method was determined by interlaboratory testing in accordance with ISO 5725-1 and ISO 5725-2. Three different materials were tested by five to seven laboratories. Some of the results were not considered when calculating the precision because they were not in the scope of the test method (see footnote "a" to Table 1). Their VOC content was below 15 % by mass but they were tested for a better comparison with the precision of ISO 11890-2.

10.2 Repeatability limit r

The repeatability limit r is the value below which the absolute difference between two single test results, each the mean of duplicates, obtained on identical material by one operator in one laboratory within a short interval of time using the standardized test method, may be expected to lie.