INTERNATIONAL STANDARD

ISO 2811-1

Second edition
2011-03-01

Paints and varnishes — Determination of density —

Part 1: Pyknometer method

Peintures et vernis — Détermination de la masse volumique —

Partie 1: Méthode pycnométrique

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
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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 2811-1 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

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This second edition cancels and replaces the first edition (ISO 2811-1:1997), which has been technically revised.

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The main changes are the following.

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a) The unit for the density has been changed from grams per millilitre to grams per cubic centimetre, because this is the more common SI unit.

b) The determination in duplicate has been changed to a single determination.

c) The information on calibration procedure has been changed to an example only and the status of Annex B has been changed from normative to informative.

d) The Hubbard pyknometer has been deleted because it is not used for paints and varnishes and their raw materials, but for bitumen and putty only (see ISO 3507).

e) The dust-proof container has been deleted because it is not used in practice.

f) The precision data has been updated by an interlaboratory test.

g) The normative references have been updated.

ISO 2811 consists of the following parts, under the general title *Paints and varnishes — Determination of density*:

— *Part 1: Pyknometer method*

— *Part 2: Immersed body (plummet) method*

— *Part 3: Oscillation method*

— *Part 4: Pressure cup method*

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Paints and varnishes — Determination of density —

Part 1:
Pyknometer method

1 Scope

This part of ISO 2811 specifies a method for determining the density of paints, varnishes and related products using a metal or Gay-Lussac pyknometer.

The method is limited to materials of low or medium viscosity at the temperature of test. The Hubbard pyknometer (see ISO 3507) can be used for highly viscous materials.

2 Normative references

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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.

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ISO 1513, *Paints and varnishes — Examination and preparation of test samples*

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
density

ρ

mass divided by the volume of a portion of a material

NOTE It is expressed in grams per cubic centimetre.

4 Principle

A pyknometer is filled with the product under test. The density is calculated from the mass of the product in the pyknometer and the known volume of the pyknometer.

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5 Temperature

The effect of temperature on density is highly significant with respect to filling properties, and varies with the type of product.

For international reference purposes, it is essential to standardize one test temperature, and (23,0 ± 0,5) °C is specified in this part of ISO 2811. It can be more convenient, however, to carry out comparative testing at some other agreed temperature, for example (20,0 ± 0,5) °C, as specified by relevant weights and measures legislation (see B.2).

The test sample and pyknometer shall be conditioned to the specified or agreed temperature, and it shall be ensured that the temperature variation does not exceed 0,5 °C during testing.

6 Apparatus

Ordinary laboratory apparatus and glassware, together with the following.

6.1 Pyknometer

6.1.1 Metal pyknometer, with a volume of either 50 cm^3 or 100 cm^3, a circular cross-section and a cylindrical form, made of a smoothly finished corrosion-resistant material with a snugly fitting lid having a hole in its centre. The inside of the lid shall be concave (see Figure 1).

or

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6.1.2 Glass pyknometer, with a volume in the range 10 cm^3 to 100 cm^3 (Gay-Lussac type) (see Figure 2).

6.2 Analytical balance, accurate to 1 mg.

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6.3 Thermometer, accurate to 0,2 °C and graduated at intervals of 0,2 °C or finer.

6.4 Temperature-controlled chamber, capable of accommodating the balance, pyknometer and test sample and maintaining them at the specified or agreed temperature (see Clause 5), or **water bath**, capable of maintaining the pyknometer and test sample at the specified or agreed temperature.

7 Sampling

Take a representative sample of the product under test, as described in ISO 15528. Examine and prepare the sample, as described in ISO 1513.

8 Procedure

8.1 General

Carry out a single determination on a fresh test sample.

The pyknometer shall be calibrated. An example of a calibration method is given in Annex A.

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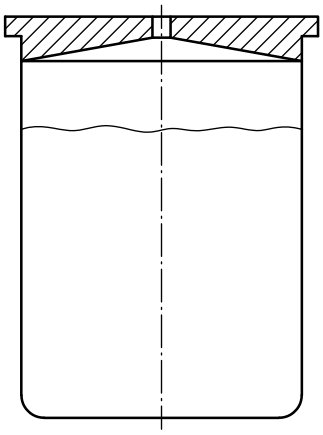

Figure 1 — Metal pyknometer

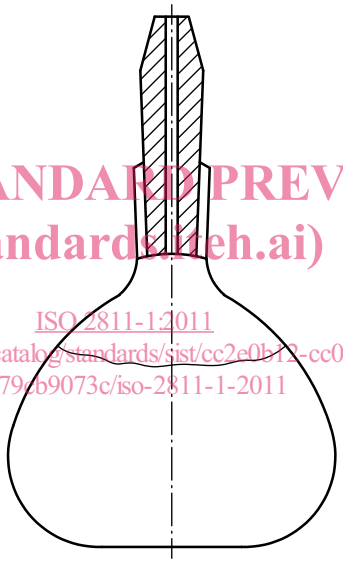

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Figure 2 — Gay-Lussac pyknometer

8.2 Determination

If working with a temperature-controlled chamber (see 6.4), put the pyknometer (6.1) and the test sample next to the balance (6.2) in the chamber maintained at the specified or agreed temperature.

If working with a water bath (see 6.4) rather than a temperature-controlled chamber, put the pyknometer and the test sample in the water bath, maintained at the specified or agreed temperature.

Allow approximately 30 min for temperature equilibrium to be reached.

Using the thermometer (6.3), measure the temperature, t_T, of the test sample. Check throughout the determination that the temperature of the chamber or water bath remains within the specified limits.

Weigh the pyknometer and record the mass, m_1, to the nearest 10 mg for 50 cm^3 to 100 cm^3 pyknometers and to the nearest 1 mg for pyknometers less than 50 cm^3 in volume.

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Fill the pyknometer with the product under test, taking care to avoid the formation of air bubbles. Place the lid or stopper of the pyknometer firmly in position and wipe off any excess liquid from the outside of the pyknometer with an absorbent material wetted with solvent; wipe carefully with cotton wool.

Record the mass of the pyknometer filled with the product under test, m_2.

NOTE Liquid adhering to the ground-glass surfaces of a glass pyknometer or to the areas of contact between the lid and body of a metal pyknometer causes too high a balance reading. This source of error can be minimized by ensuring that the joints are firmly seated and by limiting air bubbles.

9 Calculation

Calculate the density, ρ, of the product, in grams per cubic centimetre, at the test temperature, t_T, using Equation (1):

$$\rho = \frac{m_2 - m_1}{V_t} \tag{1}$$

where

m_1 is the mass, in grams, of the empty pyknometer;

m_2 is the mass, in grams, of the pyknometer filled with the product at the test temperature, t_T;

V_t is the volume, in cubic centimetres, of the pyknometer at the test temperature, t_T, determined in accordance with Annex B.

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NOTE The result is not corrected for air buoyancy because the uncorrected value is required by most filling-machine control procedures and the correction (0,001 2 g/cm^3) is negligible in relation to the precision of the method.

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If the test temperature used is not the reference temperature, the density may be calculated using Equation (B.2).

10 Precision

10.1 Repeatability limit, r

The value below which the absolute difference between two single test results, obtained on identical material by one operator in one laboratory using the same equipment within a short interval of time using the standardized test method, may be expected to lie, with a 95 % probability, is

— 0,001 g/cm^3 for solvents, and

— 0,005 g/cm^3 for coating materials.

10.2 Reproducibility limit, R

The value below which the absolute difference between two test results, obtained on identical material by operators in different laboratories using the standardized test method, may be expected to lie, with a 95 % probability, is

— 0,002 g/cm^3 for solvents, and

— 0,007 g/cm^3 for coating materials.

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11 Test report

The test report shall include at least the following information:

a) all details necessary to identify the product tested;

b) a reference to this part of ISO 2811, i.e. ISO 2811-1:2011;

c) the type of pyknometer used;

d) the test temperature;

e) the result of the density measurement, in grams per cubic centimetre, rounded to the nearest 0,001 g/cm^3 for pyknometers less than 50 cm^3 in volume and to the nearest 0,01 g/cm^3 for 50 cm^3 to 100 cm^3 pyknometers;

f) any deviation from the test method specified;

g) any unusual features (anomalies) observed during the test;

h) the date of the test.

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