INTERNATIONAL STANDARD 2811

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

35

Paints and varnishes — Determination of density

Peintures et vernis — Détermination de la masse volumique

First edition — 1974-04-01

UDC 667.612.33 : 531.75

Ref. No. ISO 2811-1974 (E)

Descriptors : paints, varnishes, density measurement, pycnometers.

Price based on 3 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2811 was drawn up by Technical Committee ISO/TC 35, *Paints and varnishes*, and circulated to the Member Bodies in May 1972.

It has been approved by the Member Bodies of the following countries :

Austria	Ireland	Sweden
Chile	Israel	Switzerland
Czechoslovakia	Netherlands	Thailand
Egypt, Arab Rep. of	New Zealand	Turkey
France	Poland	United Kingdom
Germany	Portugal	U.S.A.
India	Romania	U.S.S.R.
Iran	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Canada

Printed in Switzerland

Paints and varnishes — Determination of density

0 INTRODUCTION

This International Standard is one of a series dealing with the sampling and testing of paints, varnishes and related products. It should be read in conjunction with ISO/R 1512, *Paints and varnishes — Sampling*, and ISO/R 1513, *Paints and varnishes — Examination and preparation of samples for testing.*

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for determining the density of liquid paints and related products[1], by the use of a pyknometer or a mass per volume cup.

2 DEFINITION

density : Mass divided by volume.
For the purpose of this International Standard the density is determined at a specified temperature, and is expressed in grams per millilitre.

3 APPARATUS

3.1 Suitable glass pyknometers of capacity 20 to 100 ml, shown in Figures 1 and 2. A metal pyknometer (mass per volume cup) is shown in Figure 3.

3.2 Thermometer, graduated in divisions of 0,1 °C and accurate to 0,2 °C.

3.3 Water-bath, or constant temperature room, capable of being maintained within ± 0,5 °C of the test temperature when high accuracy is required, or within ± 2 °C for production control purposes.

3.4 Analytical balance, accurate to 0,2 mg, when the highest accuracy is required.

4 SAMPLING

A representative sample of the product to be tested shall be taken as described in ISO/R 1512. The sample shall then be examined and prepared for testing as described in ISO/R 1513.

5 PROCEDURE

5.1 Calibration of pyknometer

Clean a glass pyknometer by using in turn chromic acid solution, distilled water and a solvent leaving no residue on evaporation. Thoroughly dry the pyknometer. Clean a metal pyknometer by using a solvent leaving no residue on evaporation and dry it.

Allow the pyknometer to attain room temperature and weigh it. If maximum accuracy is required the cleaning, drying and weighing of the pyknometer shall be continued until the difference between two successive weighings does not exceed 0,5 mg.

Fill the pyknometer with distilled water at a temperature not more than 1 °C below the test temperature (23 ± 2 °C or if a more accurate determination is required 23 ± 0,5 °C)[2].

Stopper or cap the pyknometer leaving the overflow orifice open. Every care must be taken to prevent the formation of bubbles in the pyknometer.

Place the pyknometer in the constant temperature water-bath, or place it in the constant temperature room, until the temperature of the bottle and its contents is constant. Remove the overflow by wiping with absorbent material (see Note 1) and thoroughly dry the outside of the pyknometer by wiping with absorbent material.

Do not remove any subsequent overflow (see Note 2).

Immediately weigh the filled apparatus to the nearest 0,001 % of its mass (see Note 3).

NOTES

1 A paper tissue is recommended for this purpose.

1) ISO/R 758, *Method for the determination of density of liquids at 20 °C*, describes a method for the determination of the density of liquids, but this International Standard is required to meet the special problems of pigmented materials.

2) Other temperatures may be agreed between the interested parties.

2 Handling the pyknometer with bare hands will increase the temperature and cause more overflow from the overflow orifice, and will also leave fingerprints; hence, handling only with tongs and with hands protected by clean, dry, absorbent material is recommended.

3 Immediate and rapid weighing of the filled pyknometer is recommended in order to minimize loss in mass due to evaporation of the water through orifices, and from overflow subsequent to the first wiping after attainment of temperature where this overflow is not retained within a capped enclosure.

5.2 Calculation of volume of pyknometer

Calculate the volume of the pyknometer, V, in millilitres, by the formula :

$$V = \frac{m_1 - m_0}{\rho}$$

where

m_0 is the mass, in grams, of the empty pyknometer;

m_1 is the mass, in grams, of the pyknometer and water;

ρ is the density of water at 23 °C or other agreed temperature, in grams per millilitre (see the Table).

TABLE — **Density of water**

Temperature °C	Density g/ml
15	0,999 1
16	0,998 9
17	0,998 7
18	0,998 6
19	0,998 4
20	0,998 2
21	0,998 0
22	0,997 8
23	0,997 5
24	0,997 3
25	0,997 0
26	0,996 8
27	0,996 5
28	0,996 2
29	0,996 0
30	0,995 7

5.3 Determination of density of product

Repeat the procedure in 5.1 using the product in place of the distilled water. Remove any residues of paint from the outside of the pyknometer by wiping with absorbent material moistened with a suitable solvent and thoroughly dry by wiping with clean absorbent material.

NOTES

1 When using glass pyknometers with pigmented products difficulties can be experienced in removing residual pigment, especially from ground-glass surfaces. Such residues can be removed by ultrasonic vibration in a water or solvent bath.

2 To minimise errors, joints shall be firmly seated. For accurate determinations, glass pyknometers are preferred. Metal pyknometers (mass per volume cups) are normally used for density determinations required for production control purposes.

3 If the sample retains air bubbles which do not readily disperse on standing, the method described in this International Standard is unsuitable.

5.4 Calculation of density

Calculate the density of the product, ρ_t, in grams per millilitre, at the test temperature by the formula :

$$\rho_t = \frac{m_2 - m_0}{V}$$

where

m_0 is the mass, in grams, of the empty pyknometer;

m_2 is the mass, in grams, of the pyknometer and product;

V is the volume of the pyknometer, in millilitres, at the test temperature as determined in 5.1 and 5.2;

t is the test temperature (23 °C or other agreed temperature).

NOTE — It is essential that the pyknometer be calibrated and the density of the product be determined at the same temperature.

5.5 Precision

With accurate control and measurement of temperature, i.e. at the ± 0,5 °C level, it is possible to attain the following :

Repeatability

The difference between successive results obtained by the same operator within a short time interval, with the same apparatus under constant operating conditions on identical test material shall, at the 95 % confidence level, not exceed 0,000 6 g/ml.

Reproducibility

The difference between single and independent results obtained by different operators in different laboratories on identical test material shall, at the 95 % confidence level, not exceed 0,001 2 g/ml.

NOTE — In the case of some liquid paint products, especially those showing structure viscosity or thixotropy, the above precision limits may not be attained.

6 TEST REPORT

The test report shall include the following particulars :

a) a reference to this International Standard or to a corresponding national standard;

b) type and identification of the product under test;

c) details of the pyknometer used;

d) the test temperature and tolerance permitted if different from ± 0,5 °C;

e) any deviation, by agreement or otherwise, from the test procedure described;

f) the result of the test, expressed in grams per millilitre;

g) the date of the test.

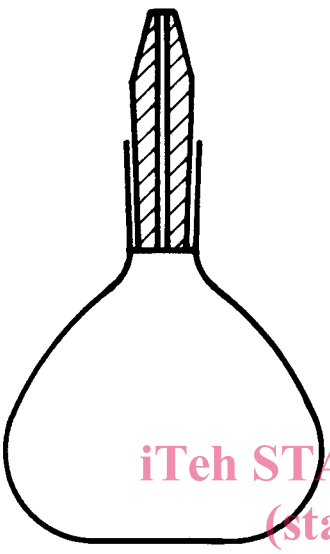

FIGURE 1 – **Gay-Lussac pyknometer**

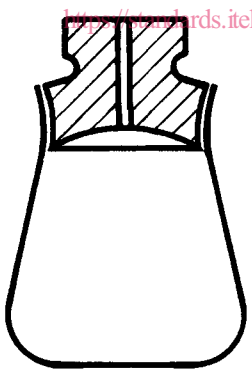

FIGURE 2 – **Hubbard pyknometer**

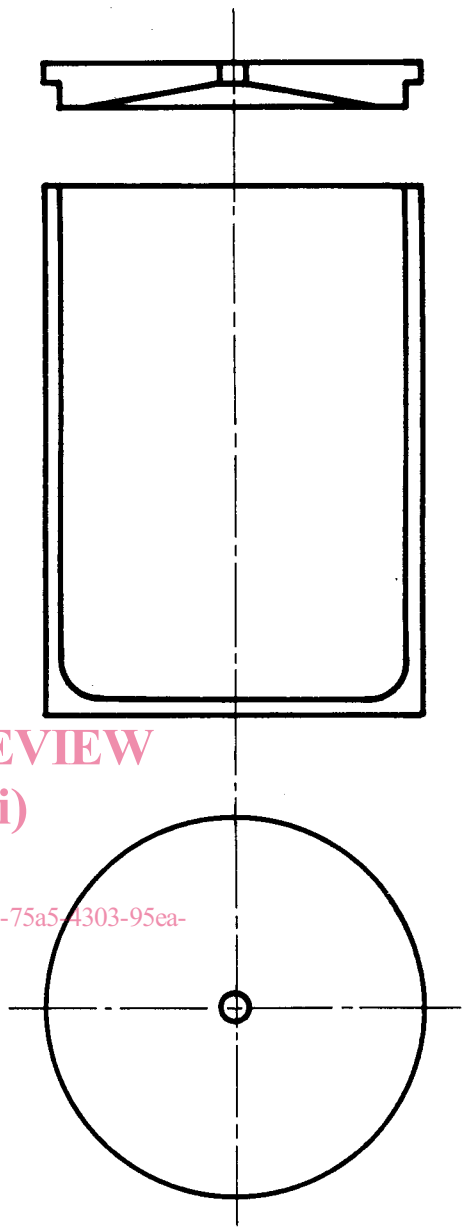

FIGURE 3 – **Metal pyknometer**