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**Paints and varnishes — Determination of  
viscosity using rotary viscometers —**

Part 2:

**Disc or ball viscometer operated at a  
specified speed**

*Peintures et vernis — Détermination de la viscosité au moyen de  
viscosimètres rotatifs —*

*Partie 2: Viscosimètre à disque ou à bille fonctionnant à vitesse  
spécifiée*



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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 2884-2 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 2884 consists of the following parts, under the general title *Paints and varnishes — Determination of viscosity using rotary viscometers*:

- *Part 1: Cone-and-plate viscometer operated at a high rate of shear*
- *Part 2: Disc or ball viscometer operated at a specified speed*

# Paints and varnishes — Determination of viscosity using rotary viscometers —

## Part 2: Disc or ball viscometer operated at a specified speed

**WARNING** — Persons using this part of ISO 2884 should be familiar with normal laboratory practice. This part of ISO 2884 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate health and safety practices and to ensure compliance with any national regulatory conditions.

### 1 Scope

This part of ISO 2884 specifies a general procedure for determining the viscosity of paints, varnishes and related products with a viscosity of up to 34 Pa·s. It is applicable mainly during production and thinning.

It supplements

ISO 2431, *Paints and varnishes — Determination of flow time by use of flow cups*;

ISO 2884-1, *Paints and varnishes — Determination of viscosity using rotary viscometers — Part 1: Cone-and-plate viscometer operated at a high rate of shear*.

For more accurate methods of measurement of viscosity, refer to ISO 3219, *Plastics — Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscometer with defined shear rate*.

The apparatus specified may be used in both a laboratory and a factory environment to determine the viscosity of a product and to monitor the viscosity whilst thinning during a manufacturing process.

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

ISO 3104:1994, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

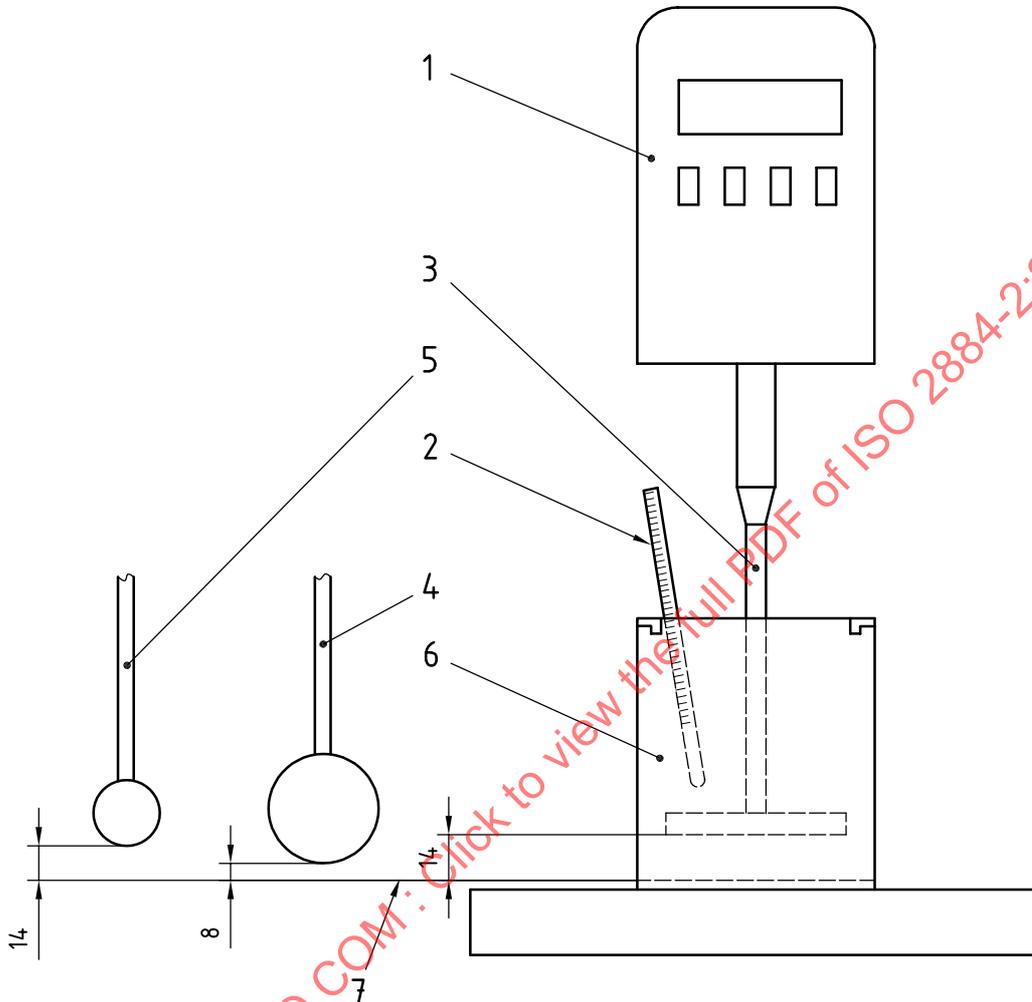
ISO 3105:1994, *Glass capillary kinematic viscometers — Specifications and operating instructions*

ISO 15528:2000, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

### 3 Apparatus

3.1 **Rotary viscometer** (see Figure 1), of one of the types specified in 3.1.1 and 3.1.2.

Dimensions in millimetres



**Key**

- |                                    |  |
|------------------------------------|--|
| 1 viscometer                       | 5 type 3 spindle   |
| 2 thermometer or temperature probe | 6 container  |
| 3 type 1 spindle                   | 7 level of inside surface of bottom of container, with nominal spindle heights indicated |
| 4 type 2 spindle                   |  |

**Figure 1 — Rotary viscometer with disc and ball spindles**

**3.1.1 Digital-display viscometer**, capable of operating at a spindle speed of 562 rpm  $\pm$  2 % and having an accuracy, for a Newtonian fluid, within 1 % of the full-scale reading, for the viscosity ranges stated in 3.2.1 and 3.2.2.

The torque is measured by an electronic method.

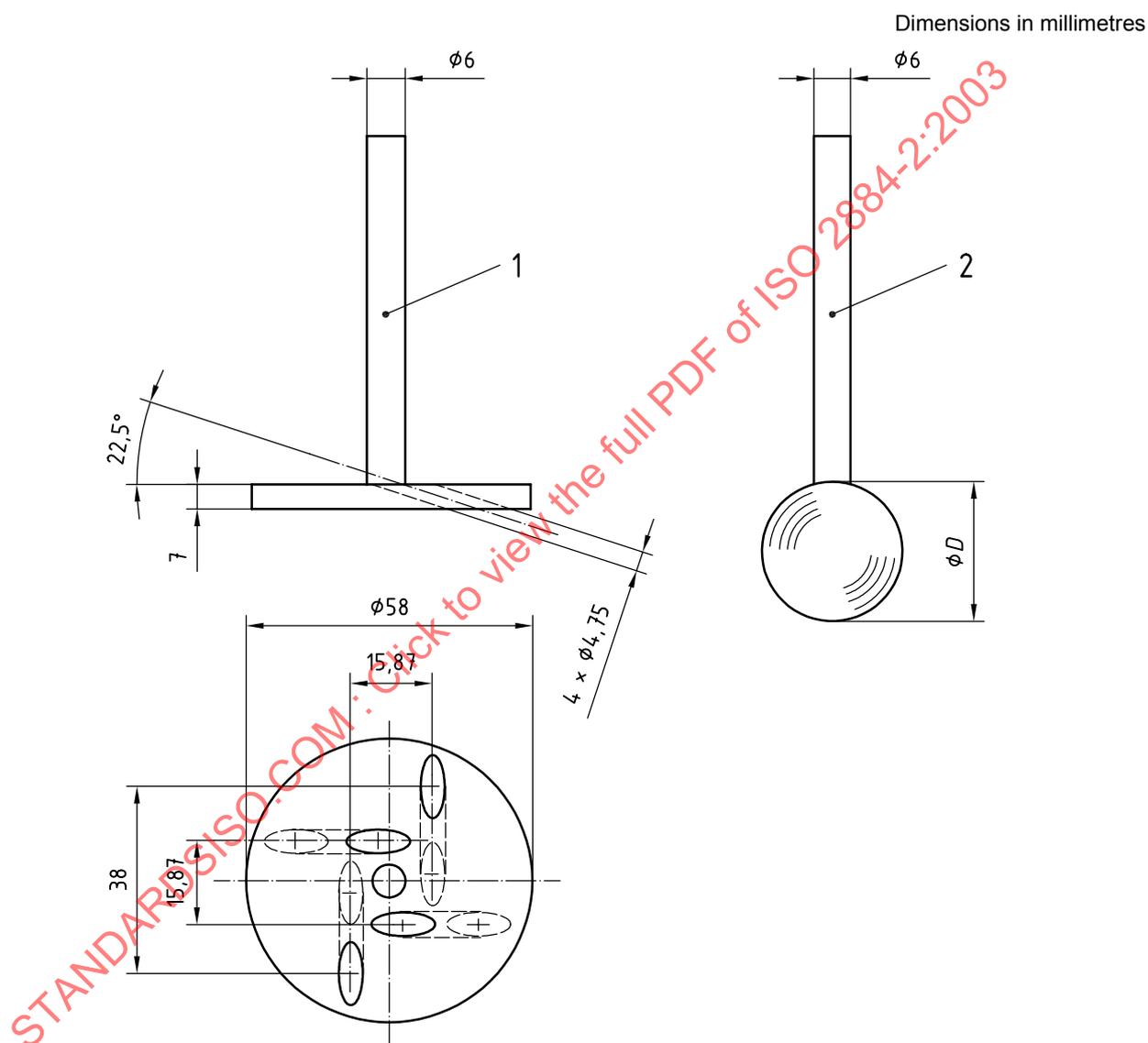
**3.1.2 Analogue-display viscometer**, capable of operating at a spindle speed of 562 rpm  $\pm$  2 % and having an accuracy, for a Newtonian fluid, within 1 % of the full-scale reading, for the viscosity ranges stated in 3.2.1 and 3.2.2.

A spring is used to counteract the torque generated by the fluid.

**3.2 Spindles** (see Figure 2), of the following types:

**3.2.1 Disc spindle (type 1)**, for use with viscosities up to 1,5 Pa·s (1 500 mPa·s), with an average shear rate of approximately  $200 \text{ s}^{-1}$  with a Newtonian fluid. The disc shall have cross-channels designed to produce a slight agitating action. The dimensions shall be as shown in Figure 2.

**3.2.2 Ball spindles (types 2 and 3)**, for use with viscosities up to 6,5 Pa·s (type 2) and 34 Pa·s (type 3), with an average shear rate of approximately  $44 \text{ s}^{-1}$  and  $20 \text{ s}^{-1}$ , respectively, with a Newtonian fluid. The dimensions shall be as shown in Figure 2.



**Key**

- 1 disc spindle (type 1)
- 2 ball spindle (types 2 and 3)

Spindle	Viscosity range	Diameter, <i>D</i>
Type 2	0 mPa·s to 6 500 mPa·s (6,5 Pa·s)	31,75 mm
Type 3	0 mPa·s to 34 000 mPa·s (34 Pa·s)	19,05 mm

**Figure 2 — Disc and ball spindles**

**3.3 Container**, comprising a round paint can, as shown in Figure 3, with a capacity of 250 ml, a nominal internal diameter of 74 mm, a height of 74 mm and a filling-aperture diameter of 61 mm. If a different container is used, the viscometer shall be calibrated accordingly (see Clause 5).

NOTE Different can sizes may result in different viscosity readings. Therefore users are advised to use the same can size when comparing samples.

Dimensions in millimetres

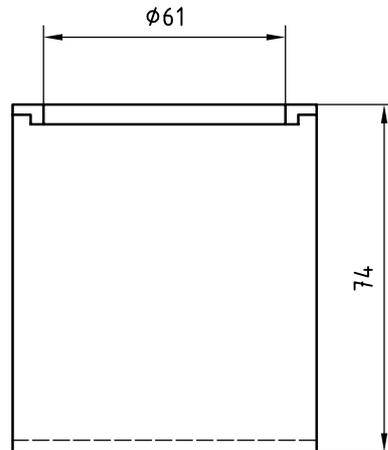


Figure 3 — Container

**3.4 Temperature-control device**, capable of maintaining the container and fluid at  $(23 \pm 0,3) ^\circ\text{C}$ .

**3.5 Calibrated thermometer**, accurate to  $0,3 ^\circ\text{C}$  and graduated at intervals of  $0,2 ^\circ\text{C}$  or finer.

**3.6 Calibration fluids**: standard refined mineral oils having Newtonian characteristics. The viscosities shall be within  $\pm 2 \%$  of the stated values. The viscosities of the standard fluids shall have been determined by an accredited laboratory using an absolute method such as one of those specified in ISO 3104 or ISO 3105.

## 4 Sampling

Take a representative sample of the product to be tested, as described in ISO 15528. Examine the sample and prepare it for testing as described in ISO 1513. If necessary, strain the sample through a sieve of nominal mesh size  $125 \mu\text{m}$  into a clean container (3.3).

The volume of the sample shall be sufficient to fill the 250 ml container to within about 15 mm of the top.

## 5 Checking the apparatus

The apparatus shall be checked on a regular basis in accordance with the manufacturer's recommendations and from experience gained in the use of the instrument (i.e. comparing results against those from previous checks, hence enabling the required frequency of checking to be established).

The instrument shall be checked at  $(23 \pm 0,3) ^\circ\text{C}$ , or, by agreement between the interested parties, at another temperature, with three calibration fluids (3.6) selected to cover the measurement range of the apparatus.

Pour one of the calibration fluids into the 250 ml container (3.3), maintained at  $(23 \pm 0,3) ^\circ\text{C}$  (or the temperature agreed between the interested parties), filling it to within about 20 mm of the top. Place the filled container under the viscometer and position it centrally below the spindle. Slowly lower the spindle into the

fluid until it reaches the correct level above the bottom of the container (see Figure 1). Then add fluid until the level reaches the line on the spindle shaft. During these operations, ensure that there are no air bubbles trapped in the fluid, paying special attention to the rotating surfaces and the container walls. Any air bubbles present may be removed by the use of a clean, pointed probe.

Allow to stand for sufficient time to ensure thermal equilibrium between the fluid, container and spindle. Carefully raise and lower the spindle, if necessary, to assist in reaching thermal equilibrium. When equilibrium has been reached, remove the thermometer (3.5).

With the spindle in the operating position (see Figure 1) and turning at  $562 \text{ rpm} \pm 2 \%$ , take a reading from the viscosity display. Compare the reading against the certified viscosity of the fluid at the same temperature.

Repeat for each calibration fluid, cleaning the spindle immediately after each run using a suitable solvent.

The readings obtained shall not differ by more than  $\pm 5 \%$  from the certified viscosity values. In the event of any of the readings falling outside this limit, the apparatus shall be checked and re-calibrated by a competent engineer or returned to the manufacturer for adjustment.

## 6 Procedure

The determination shall be carried out at  $(23 \pm 0,5) \text{ }^\circ\text{C}$  unless otherwise agreed between the interested parties.

Prior to use, ensure the instrument is thoroughly clean and free from any deposits. Pour the test sample into a 250 ml container of the same size as that used for calibration, filling it to within about 20 mm of the top. Proceed as in Clause 5.

Immediately after taking the reading, raise the spindle and check the temperature of the sample. If the temperature is not within the range  $(23 \pm 0,5) \text{ }^\circ\text{C}$  (or that agreed between the interested parties), repeat the determination at the correct temperature.

If the sample is to be thinned to a specific viscosity, add small, measured amounts of thinner, at the same temperature as the sample, until the desired value is obtained. Allow sufficient time to permit complete mixing to take place before taking readings.

After the viscosity reading has been taken, allow the sample to stand for approximately 5 min before repeating the determination to confirm the reading.

With some samples, the initial reading may not be steady, but may fall or rise slowly to a steady value. This may indicate that the material exhibits thixotropic properties, in which case both the initial and final values shall be recorded. The initial reading will, however, depend upon the rheological history of the sample.

NOTE Thixotropic paints may initially be stirred at a given rate for a specified time before a reading is taken.

## 7 Cleaning of apparatus

Clean the spindle immediately after each determination using a suitable solvent. The procedure used shall be in accordance with the instrument manufacturer's instructions. Take care not to exert excessive force which may alter the concentricity of the spindle.

Ensure that all traces of test material are removed from the apparatus.

Never use metallic cleaning tools.