
**Plastics — Determination of viscosity
using a falling-ball viscometer —**

**Part 1:
Inclined-tube method**

*Plastiques — Détermination de la viscosité au moyen d'un
viscosimètre à chute de bille —*

Partie 1: Méthode du tube incliné

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This second edition cancels and replaces the first edition (ISO 12058-1:1997), of which it constitutes a minor revision to update normative references, to change the units of temperature ranges to Kelvin and to convert footnotes into Notes.

A list of all parts in the ISO 12058 series can be found on the ISO website.

Plastics — Determination of viscosity using a falling-ball viscometer —

Part 1: Inclined-tube method

1 Scope

This document specifies the general principles of a method, using an inclined-tube falling-ball viscometer, for determining the viscosity of polymers and resins in the liquid emulsified or dispersed state. It is intended for application to liquids over a viscosity measurement range of 0,6 mPa·s to 250 000 mPa·s (temperature range -20 °C to +120 °C) for which the shear stress and shear rate are proportional, i.e. the viscosity is independent of the shear rate. This ideal behaviour is commonly known as Newtonian behaviour. If a liquid differs significantly from this behaviour, different results can be obtained with the different balls of a falling-ball viscometer or from viscometers with different geometries, such as capillary and rotational viscometers.

2 Normative reference

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 2811-1, *Paints and varnishes — Determination of density — Part 1: Pycnometer method*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Principle

The viscosity of a liquid is determined by observing the motion of a solid sphere under the influence of gravity in an inclined cylindrical tube filled with the liquid.

5 Measurand and units

Dynamic viscosity, expressed in millipascal seconds (mPa s).

6 Measurement range and temperature range

Viscosity-measurement range: 0,6 mPa·s to 250 000 mPa·s

Minimum falling time for ball: 60 s for ball No. 1

50 s for balls 2 to 4

30 s for balls 5 and 6

Temperature range: -20 °C to +120 °C

7 Apparatus

7.1 Falling-ball viscometer

See [Figure 1](#).

The apparatus consists of an inclined measurement tube (falling-ball tube) filled with the liquid under test and made of thermally aged, calibrated, precision borosilicate-glass tubing with a coefficient of linear expansion of $(3,3 \times 10^{-6}) \text{ K}^{-1}$, plus six balls of diameter 15,81 mm to 11,0 mm (see [Table 1](#)), each of balls 1 to 4 having the same coefficient of expansion as the tube itself. To minimize errors, the measurement tube and balls shall be free of flaws.

NOTE 1 The determination of viscosity using an inclined-tube falling-ball viscometer can be carried out using equipment supplied by a number of manufacturers. One example of such an instrument is the Hoesppler viscometer as described in DIN 53015:1978[1].

Table 1 — Balls for use in falling-ball viscometer having a measurement tube with an inside diameter of 15,94 mm ± 0,01 mm

Ball No.	Material	Density, ρ_1 (typical) g/cm ³	Diameter mm	Out-of-round- ness mm	Constant K (typical) mPa·s·cm ³ /(g s)	Dynamic viscosity measurement range (typical) mPa·s
1	Borosilicate glass	2,4	15,81 ± 0,01	±0,000 5	0,007	0,6 to 10
2	Borosilicate glass	2,4	15,60 ± 0,05	±0,000 5	0,09	7 to 130
3	Nickel-iron	8,1	15,60 ± 0,05	±0,001	0,09	30 to 700
4	Nickel-iron	8,1	15,2 ± 0,1	±0,001	0,7	200 to 4 800
5	Nickel-iron or steel	7,7 to 8,1	14,0 ± 0,5	±0,001	7	1 500 to 45 000
6	Steel	7,7 to 7,8	11 ± 1	±0,002	35	>7 500

For a given ball, the calibration constant K of the apparatus depends on the internal diameter of the tube. The values given in [Table 1](#) apply to a tube 15,94 mm ± 0,01 mm in diameter.

The measurement tube has two circular marks defining the measurement distance to within 100 mm ± 1 mm. The tube is surrounded by a tubular glass jacket for temperature control and fixed to a stand in such a manner that the axis of the tube is inclined at $10^\circ \pm 1^\circ$ to the vertical for measurement purposes.

NOTE 2 Apparatus with an inclination other than 10° is not suitable for use with this document.