

# Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers

Part 1: General principles (ISO  
1628-1:2009)

ICS 83.080.01

# National foreword

This British Standard is the UK implementation of EN ISO 1628-1:2009+A1:2012. It supersedes BS EN ISO 1628-1:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/21, Testing of plastics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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|              |                                                                                                            |
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English Version

Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 1: General principles  
(ISO 1628-1:2009)

Plastiques - Détermination de la viscosité des polymères en solution diluée à l'aide de viscosimètres à capillaires -  
Partie 1: Principes généraux (ISO 1628-1:2009)

Kunststoffe - Bestimmung der Viskosität von Polymeren in verdünnter Lösung durch ein Kapillarviskosimeter - Teil 1:  
Allgemeine Grundlagen (ISO 1628-1:2009)

This European Standard was approved by CEN on 12 January 2009.

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## **Foreword**

This document (EN ISO 1628-1:2009) has been prepared by Technical Committee ISO/TC 61 "Plastics" in collaboration with Technical Committee CEN/TC 249 "Plastics" the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2009, and conflicting national standards shall be withdrawn at the latest by August 2009.

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### **Endorsement notice**

The text of ISO 1628-1:2009 has been approved by CEN as a EN ISO 1628-1:2009 without any modification.

## **Foreword to amendment A1**

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### **Endorsement notice**

The text of ISO 1628-1:2009/Amd 1:2012 has been approved by CEN as a EN ISO 1628-1:2009/A1:2012 without any modification.

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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.

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ISO 1628-1 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This third edition cancels and replaces the second edition (ISO 1628-1:1998), of which it constitutes a minor revision intended primarily to correct an error in Subclause 9.1, paragraph 4 (starting: “The intrinsic viscosity shall be calculated from”), where, in line 2, “intrinsic-viscosity values” has been replaced by “inherent-viscosity” values.

ISO 1628 consists of the following parts, under the general title *Plastics – Determination of the viscosity of polymers in dilute solution using capillary viscometers*:

- *Part 1: General principles*
- *Part 2: Poly(vinyl chloride) resins*
- *Part 3: Polyethylenes and polypropylenes*
- *Part 4: Polycarbonate (PC) moulding and extrusion materials*
- *Part 5: Thermoplastic polyester (TP) homopolymers and copolymers*
- *Part 6: Methyl methacrylate polymers*

# Plastics – Determination of the viscosity of polymers in dilute solution using capillary viscometers –

## Part 1: General principles

### 1 Scope

This part of ISO 1628 defines the general conditions for the determination of the reduced viscosity, intrinsic viscosity and  $K$ -value of organic polymers in dilute solution. It defines the standard parameters that are applied to viscosity measurement, and can be used to develop standards for measuring the viscosities in solution of individual types of polymer. It can also be used to measure and report the viscosities of polymers in solution for which no separate standards exist.

### 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 3105:1994, *Glass capillary kinematic viscometers – Specifications and operating instructions*

ISO 3205, *Preferred test temperatures*

ISO 80000-1, *Quantities and units – Part 1: General*<sup>1)</sup>

ISO 80000-4, *Quantities and units – Part 4: Mechanics*

### 3 Definitions

#### 3.1 Dimensions and units

The dimensions of properties defined in this part of ISO 1628 are expressed in terms of L for length, M for mass and T for time in accordance with ISO 80000-1, while the units appropriate to the properties are given in ISO 80000-1 and ISO 80000-4.

#### 3.2 Definitions applicable to any liquid

##### 3.2.1

##### viscosity

viscosity of a fluid sheared between two parallel plates, one of which moves relative to the other in uniform rectilinear motion in its own plane, defined by the Newton equation

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1) To be published. (Revision of ISO 31-0:1992)

$$\tau = \eta \dot{\gamma} \quad (1)$$

where

$\tau$  is the shear stress;

$\eta$  is the viscosity;

$\dot{\gamma}$  is the velocity gradient or rate of shear, given by  $\frac{dv}{dz}$  where  $v$  is the velocity of one plane relative to the other and  $z$  the coordinate perpendicular to the two planes

NOTE 1 The dimensions of viscosity are  $\text{ML}^{-1}\text{T}^{-1}$ .

NOTE 2 The units of viscosity are  $\text{Pa}\cdot\text{s}$ .

NOTE 3 For practical use, the sub-multiple  $10^{-3} \text{ Pa}\cdot\text{s}$  is more convenient.

NOTE 4 Viscosity is usually taken to mean “Newtonian viscosity”, in which case the ratio of shearing stress to velocity gradient is constant. In non-Newtonian behaviour, which is the usual case with high-polymer solutions, the ratio varies with the shear rate. Such ratios are often called “apparent viscosities” at the corresponding shear rate.

### 3.2.2 viscosity/density ratio kinematic viscosity

$\nu$   
ratio defined by the equation

$$\nu = \frac{\eta}{\rho} \quad (2)$$

where  $\rho$  is the density of the fluid at the temperature at which the viscosity is measured

NOTE 1 The dimensions of kinematic viscosity are  $\text{L}^2\text{T}^{-1}$ .

NOTE 2 The units of kinematic viscosity are  $\text{m}^2\cdot\text{s}^{-1}$ .

NOTE 3 For practical use, the sub-multiple  $10^{-6} \text{ m}^2\cdot\text{s}^{-1}$ , i.e.  $\text{mm}^2\cdot\text{s}^{-1}$ , is more convenient.

## 3.3 Definitions applicable to polymer solutions

### 3.3.1 relative viscosity

$\eta_r$   
ratio of the viscosity of the polymer solution (of stated concentration)  $\eta$  and the viscosity of the pure solvent  $\eta_0$ , at the same temperature:

$$\eta_r = \frac{\eta}{\eta_0} \quad (3)$$

NOTE 1 Also known as viscosity ratio.

NOTE 2 The ratio has no dimensions.