

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1628

PLASTICS

DIRECTIVES FOR THE STANDARDIZATION OF METHODS FOR THE DETERMINATION
OF THE DILUTE SOLUTION VISCOSITY OF POLYMERS

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1628, *Plastics – Directives for the standardization of methods for the determination of the dilute solution viscosity of polymers*, was drawn up by Technical Committee ISO/TC 61, *Plastics*, the Secretariat of which is held by the American National Standards Institute (ANSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1628, which was circulated to all the ISO Member Bodies for enquiry in May 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	Iran	South Africa, Rep. of
Belgium	Israel	Spain
Brazil	Italy	Sweden
Czechoslovakia	Japan	Switzerland
France	Netherlands	U.A.R.
Germany	Poland	United Kingdom
Hungary	Portugal	U.S.A.
India	Romania	U.S.S.R.

No Member Body opposed the approval of the Draft.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in June 1970, to accept it as an ISO RECOMMENDATION.

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INTRODUCTION

This ISO Recommendation is composed of two parts :

- Part I : Recommendations for the preparation of "standard methods of test" for the determination of the dilute solution viscosity of polymers;
- Part II : Significance and justifications of these recommendations.

PART I

RECOMMENDATIONS

1. DEFINITIONS AND UNITS

1.1 Definitions applicable to any liquid

- 1.1.1 *Viscosity (or dynamic viscosity)* (symbol η) (see ISO Recommendation R 31 — Part III, *Quantities and units of mechanics*).

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

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

where

- τ is the shear stress;
- η is the viscosity;
- $\dot{\gamma} = \frac{dv}{dz}$ the velocity gradient (v is the velocity of one plane relative to the other and z the coordinate perpendicular to the two planes).

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

The dimensions of viscosity are

$$ML^{-1}T^{-1}$$

and its units are

- *c.g.s. system* : poise (P) = $1 \text{ g.cm}^{-1} \cdot \text{s}^{-1}$
- *international system* : $\text{N.s.m}^{-2} = 10 \text{ P}$

1.1.2 Viscosity/density ratio* (kinematic viscosity) (symbol ν)

This ratio is defined by the equation :

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

where ρ is the density of the fluid.

Its dimensions are

$$\text{L}^2 \text{T}^{-1}$$

and its units are

- *c.g.s. system* : stokes (St) = $1 \text{ cm}^2 \cdot \text{s}^{-1}$
- *international system* : $\text{m}^2 \cdot \text{s}^{-1} = 10^4 \text{ St}$

1.2 Definitions applicable to polymer solutions

1.2.1 Viscosity ratio (formerly called relative viscosity). The ratio of the viscosities of the polymer solution (of stated concentration) η and of the pure solvent η_0 at the same temperature :

$$\frac{\eta}{\eta_0} \quad \dots (3)$$

This ratio being a number, it is dimensionless.

1.2.2 Viscosity relative increment (formerly called specific viscosity). Viscosity ratio minus one :

$$\left(\frac{\eta}{\eta_0} \right) - 1 = \frac{\eta - \eta_0}{\eta_0} \quad \dots (4)$$

Being a number, it is dimensionless.

1.2.3 Viscosity number (formerly called reduced viscosity). Ratio of the viscosity relative increment to the polymer concentration c in the solution :

$$\frac{\eta - \eta_0}{\eta_0 c} \quad \dots (5)$$

Its dimensions are

$$\text{M}^{-1} \text{L}^3$$

and its units in the c.g.s. system : ml/g.

The viscosity number is usually determined at low concentration (under 0.01 g/ml).

1.2.4 Logarithmic viscosity number (formerly called inherent viscosity). Ratio of the natural logarithm of the viscosity ratio to the polymer concentration in the solution :

$$\frac{\ln \left(\frac{\eta}{\eta_0} \right)}{c} \quad \dots (6)$$

Dimensions and units are the same as those given in clause 1.2.3. The logarithmic viscosity number is usually determined at low concentration (under 0.01 g/ml).

* This name and several of the following names are the result of I.U.P.A.C. decisions ⁽⁶⁾.