

BS ISO 16014-1:2012



BSI Standards Publication

Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography

Part 1: General principles

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National foreword

This British Standard is the UK implementation of ISO 16014-1:2012. It supersedes BS ISO 16014-1:2003 which is withdrawn.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.

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Amendments issued since publication

Date	Text affected
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**Plastics — Determination of average
molecular mass and molecular mass
distribution of polymers using size-
exclusion chromatography —**

**Part 1:
General principles**

*Plastiques — Détermination de la masse moléculaire moyenne
et de la distribution des masses moléculaires des polymères par
chromatographie d'exclusion stérique —*

Partie 1: Principes généraux





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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 16014-1 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 16014-1:2003), which has been technically revised. The main changes are the following:

- a) the normative references have been updated (see Clause 2);
- b) the text has been adapted to allow for the fact that a new part, ISO 16014-5, has now been published;
- c) Subclause 6.5 (concerning the chromatographic columns used) has been revised;
- d) Subclause 8.2 (concerning the evaluation of data and the correction of chromatograms) has been revised.

It also incorporates the Technical Corrigendum ISO 16014-1:2003/Cor.1:2005.

ISO 16014 consists of the following parts, under the general title *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography*:

- *Part 1: General principles*
- *Part 2: Universal calibration method*
- *Part 3: Low-temperature method*
- *Part 4: High-temperature method*
- *Part 5: Method using light-scattering detection*

Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography —

Part 1: General principles

1 Scope

This part of ISO 16014 specifies a general method for determining the average molecular mass and the molecular mass distribution of polymers using size-exclusion chromatography (SEC). The average molecular mass and the molecular mass distribution are calculated from a calibration curve constructed using polymer standards if using one of the SEC techniques described in Parts 2 to 4 of this International Standard or from a calibration curve constructed using absolute molecular mass data if using size-exclusion chromatography coupled with light-scattering detection (SEC-LS) as described in Part 5 of this International Standard.

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 472, *Plastics — Vocabulary*

ISO 16014-2:2012, *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography — Part 2: Universal calibration method*

ISO 16014-3, *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography — Part 3: Low-temperature method*

ISO 16014-4, *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography — Part 4: High-temperature method*

ISO 16014-5:2012, *Plastics — Determination of average molecular mass and molecular mass distribution of polymers using size-exclusion chromatography — Part 5: Method using light-scattering detection*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and the following apply.

3.1

size-exclusion chromatography

SEC

a liquid chromatographic technique in which the separation is based on the hydrodynamic volume of molecules eluting in a column packed with porous non-adsorbing material having pore dimensions that are similar in size to the molecules being separated

NOTE The term gel permeation chromatography (GPC) should only be used where the porous non-adsorbing packing material is a gel; however, the term size-exclusion chromatography (SEC) is preferred.

3.2 light-scattering detection LS detection

a technique for determining the mass or size of polymer molecules dissolved in solution by measuring the light scattered by the polymer molecules

3.3 molecular mass

M
sum of the masses of the atoms making up a molecule

NOTE Molecular weight is also used for molecular mass, but is deprecated.

3.4 average molecular mass

four types of average molecular mass are defined by the following equations, where N_i is the number of molecules of species i of molecular mass M_i and a is the exponent of the Mark-Houwink-Sakurada equation.

3.4.1 number-average molecular mass

M_n

$$M_n = \frac{\sum_{i=1}^{\infty} (N_i \times M_i)}{\sum_{i=1}^{\infty} N_i} \quad (1)$$

3.4.2 mass-average molecular mass

M_w

$$M_w = \frac{\sum_{i=1}^{\infty} (N_i \times M_i^2)}{\sum_{i=1}^{\infty} (N_i \times M_i)} \quad (2)$$

3.4.3 z-average molecular mass

M_z

$$M_z = \frac{\sum_{i=1}^{\infty} (N_i \times M_i^3)}{\sum_{i=1}^{\infty} (N_i \times M_i^2)} \quad (3)$$

3.4.4 viscosity-average molecular mass

M_v

$$M_v = \left[\frac{\sum_{i=1}^{\infty} (N_i \times M_i^{a+1})}{\sum_{i=1}^{\infty} (N_i \times M_i)} \right]^{1/a} \quad (4)$$