



National Institute of Standards & Technology

Certificate

Standard Reference Material[®] 706a

Polystyrene

This Standard Reference Material (SRM) is intended primarily for use in calibration and performance evaluation of instruments used to determine the molar mass and molar mass distribution. A unit of SRM 706a consists of approximately 18 g of polystyrene pellets. Each pellet weighs approximately 80 mg.

Certified Value: The certified value for mass-average molar mass (M_w) is based on original results from light scattering and ultracentrifugation measurements on SRM 706 [1,2] and a remeasurement of 706a using light scattering [3]. The certified value represents the highest level of confidence NIST has in its accuracy in that all known or suspected sources of bias have been fully investigated or accounted for.

The certified measurement uncertainty is expressed as a combined expanded uncertainty with a coverage factor $k = 2$, calculated in accordance with NIST procedure [4]. Type A and Type B contributions to the expanded uncertainty of the certified molar mass include the uncertainties in the light scattering method due to the Rayleigh ratio of the scattering standard, optical alignment, and calibration of the differential refractometer.

Table 1. Certified Value

Property ^a	Certified Value and Uncertainty
mass-average molar mass (M_w)	$2.85 \times 10^5 \text{ g/mol} \pm 0.23 \times 10^5 \text{ g/mol}$

^aExpressed as molar mass, previously expressed as molecular weight [5].

Expiration of Certification: The certification of SRM 706a is valid, within the measurement uncertainties specified, until **26 August 2010** provided that the SRM is handled in accordance with the storage instructions given in this certificate. This certification is nullified if the SRM is modified or contaminated.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before expiration of this certificate, NIST will notify the purchaser. Return of the attached registration card will facilitate notification.

Technical coordination leading to certification of this SRM was provided by B.M. Fanconi of the NIST Polymers Division.

Technical measurement and data interpretation were provided by C.M. Guttman, W.R. Blair, and J.R. Maurey of the NIST Polymers Division.

Eric J Amis, Chief
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Certificate Issue Date: 17 November 2003
See Certificate Revision History on Last Page

John Rumble, Jr., Chief
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The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by R.J. Gettings and B.S. MacDonald of the NIST Measurement Services Division.

Reference Values: The reference values for intrinsic viscosity were determined by measurements made on SRM 706 in the solvent benzene at 25 °C and in cyclohexane at 35 °C. Details of the measurements are given in references 1 and 2. The reference values are the best estimate of the true value, however all known or suspected sources of bias have not been fully investigated. The uncertainties in the reference values for intrinsic viscosity are expressed as the standard deviation of the mean.

Table 2. Reference Values

Property	Reference Value and Standard Deviation of the Mean
intrinsic viscosity [η], in benzene at 25 °C	93.70 mL/g \pm 0.19 mL/g
intrinsic viscosity [η], in cyclohexane at 35 °C	39.50 mL/g \pm 0.10 mL/g

Storage: The SRM should be stored in the original bottle with the lid tightly closed under normal laboratory conditions.

Homogeneity and Characterization: The homogeneity of SRM 706a was tested using size exclusion chromatography (SEC) analysis of solutions in tetrahydrofuran at 30 °C. The characterization of this polymer is described in reference 3. SRM 706a is a reblending and bottling of the remaining stock of polystyrene used to produce SRM 706.

The SRM 706 polystyrene was originally prepared by thermal polymerization of styrene at 140 °C to 37 % conversion. Ash content is less than 0.001 %. Volatile content is approximately 0.8 %. Determinations of molar mass and intrinsic viscosity are based on the mass of the polystyrene pellets uncorrected for volatiles.

REFERENCES

- [1] *Polystyrene (Broad Molecular Weight Distribution) Certificate*; SRM 706; National Bureau of Standards, U.S. Department of Commerce: Gaithersburg, MD (1967).
- [2] McIntyre, D.; *Jour. Research of NBS*; Vol. 71A, No. 1, p. 43 (1967).
- [3] Guttman, C.M.; Blair, W.R.; Maurey, J.R.; *Recertification of SRM 706a, a Polystyrene*; NISTIR 6091; National Institute of Standards and Technology, U.S. Department of Commerce: Gaithersburg, MD (1998).
- [4] *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st Ed.; ISO: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.
- [5] Taylor, B.N.; *Guide for the Use of the International System of Units (SI)*; NIST Special Publication 811, 1995 Ed.; U.S. Government Printing Office: Washington, DC (1995).

Certificate Revision History: 17 November 2003 (This revision reflects a change in the certification expiration date); 2 September 1998 (Original certificate date).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; e-mail srminfo@nist.gov; or via the Internet <http://www.nist.gov/srm>.