

# Certified Reference Material

## BAM-P012

### Molar mass and intrinsic viscosity of Polystyrene

#### Certified Values

Characteristic (method specific)	$M_w$ in g/mol	Uncertainty $U^{(3)}$ in g/mol
Molar mass by LS <sup>1)</sup>	348,000	8,000
Molar mass by SEC <sup>2)</sup>	343,000	12,000
Intrinsic viscosity by viscometry	$\eta_{30^\circ\text{C, THF}}$ in mL/g	1.8

<sup>1)</sup> Light scattering, Rayleigh-ratio  $R_\theta = 1.406 \text{ E-}5 \text{ cm}^{-1}$  at 633 nm in toluene

<sup>2)</sup> Size exclusion chromatography

<sup>3)</sup>  $U$  expressed as expanded uncertainty (coverage factor  $k = 2$ )

#### Informative Values

derived from certified molar mass by SEC

Characteristic (SEC specific)	Molar Mass in g/mol	Uncertainty $U^{(3)}$ in g/mol
Number-averaged $M_n$	141,000	15,000
Z-averaged $M_z$	555,000	22,000
M at peak maximum $M_p$	340,000	21,000
Ratio	- no unit -	- no unit -
$M_w/M_n$	2.43	0.06

This certificate is valid for 5 years after date of shipment considering the storage instructions given below.

#### Description of the Material

The Certified Reference Material BAM-P012 is distributed in packaging sizes of 1 g, 2 g, 5 g and 10 g. The weight of single pellets of the polymer material is approximately 20 mg.

#### Intended Use

BAM-P012 is primarily intended for calibration and performance evaluation of instruments used to determine the molar mass and the molar mass distribution of polymers.

#### Storage

This material should be stored at dry and light protected conditions below +7 °C.

## Experimental Conditions

Tetrahydrofuran (THF) was used as the solvent of the polymer in all experiments.

BAM light scattering investigations were carried out at 25 °C using a Multi Angle Laser Light Scattering Photometer (MALS). The LS values correspond to a Rayleigh-ratio  $R_{\theta} = 1.406 \text{ E-5 cm}^{-1}$  at 633 nm in toluene at 25 °C.

BAM tests by means of Size Exclusion Chromatography (SEC) were performed and evaluated according to ISO 13885-1 using THF as eluent at 30 °C. For SEC calibration polystyrene samples with narrow molar mass distribution were characterized by LS and coupling SEC with LS. The SEC-LS Debye plot  $M_p$  values were used for SEC calibration.

Viscosity measurements were performed at BAM according to DIN 51562-1 using an Ubbelohde type viscometer and THF at 30 °C.

Homogeneity of the material was tested using SEC, described in more detail in the certification report, which is available on request.

## References

1. U. Just, St. Weidner, Certification Report of Reference Material BAM-P012 – Polystyrene [http://www.rm-certificates.bam.de/en/certificates/polymer\\_materials/index.htm](http://www.rm-certificates.bam.de/en/certificates/polymer_materials/index.htm)
2. Guidelines for the production of BAM reference materials, BAM, Berlin 2006 <http://www.bam.de/en/fachthemen/referenzmaterialien/index.htm>
3. ISO 13885–1 (GPC using tetrahydrofuran (THF) as eluent)
4. DIN 51562–1 (Viscometry: Determination of kinematic viscosity using a Ubbelohde – Viscometer, Part 1: Design and realisation of measurements)

## BAM Bundesanstalt für Materialforschung und -prüfung

D-12200 Berlin, Germany, December 2007

Date of shipment:

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