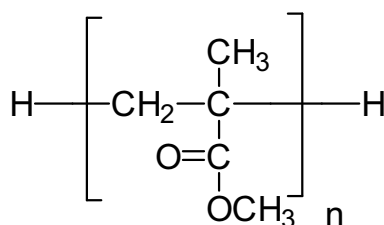


Certified Reference Material

BAM-P003

**Poly(methylmethacrylate)
(PMMA)**



Charge No.: mibr100k

Certified values (confidence interval 95%)

1. Weight-average molecular weight (M_w) by light scattering (LS) ¹⁾

Investigator	Mean values of investigators
	Weight-average molecular weight M_w [g/mol]
1	110700 ^{a)}
2	111000 ^{b)}
3	97800 ^{c)}
4	107000 ^{b)}
5	103800 ^{c)}
6	102000 ^{b)}
7	113800 ^{b)}
8	104500 ^{a)}
9	111300 ^{b)}
10	105100 ^{c)}
11	112900 ^{b)}
12	104700 ^{d)}
Mean value	107050
Confidence interval	2500
[%]	2,33

2. Intrinsic viscosity by viscometry ²⁾

Investigator	Mean values of investigators
	Intrinsic viscosity [η] [ml/g]
1	31,59 ^{a,b)}
2	30,46 ^{a,b)}
3	32,67 ^{a,b)}
4	30,67 ^{a,b)}
5	32,12 ^{a,b)}
6	29,72 ^{c)}
7	30,72 ^{a,b)}
	33,60 ^{c)}
8	31,73 ^{c)}
Mean value	31,48
Confidence interval	1,21
[%]	3,85

Experimental conditions

- 1) Values correspond to a Rayleigh-ratio $R_{\theta} = 1,406 \text{ E-5 cm}^{-1}$ at 633 nm in toluene
 a) Low-Angle Laser Light Scattering (LALLS), b) Multi-Angle Laser Light Scattering (MALLS), c) Size Exclusion Chromatography coupled with MALLS-Detector,
 d) Size Exclusion Chromatography coupled with Right-Angle Laser Light Scattering (RALLS) – Detector

Investigator	Method	Angle (°)	Solvent	Equipment	Wave length (nm)	dn/dc
1	LALLS	6-7	THF	KMX-6	633	0,0865
2	MALLS	30-150	THF	Dawn EOS	690	0,0865
3	SEC-LS	30-145	THF	Dawn F	488	0,0890
4	SEC-LS	30-145	THF	Dawn F	633	0,0865
5	MALLS	20-145	THF	FICA SLS	633	0,0865
6	MALLS	30-150	THF	Dawn DSP	488	0,1990
7	MALLS	30-145	MEK	FIKA 50	633	0,1148
8	LALLS	6-7	THF	KMX-6	633	0,0865
9	MALLS	30-145	THF	Sofica	633	0,0865
10	SEC-LS	30-150	THF	Dawn F	633	0,0865
11	MALLS	90	THF	Sofica	633	0,0870
12	SEC-LS	90	THF	TDA-300	633	0,0865

- 2) In THF at 30 °C, 6 concentrations from 5 to 15 g/l in an Ubbelohde type viscometer according to HUGGINS^{a)} and KRÄMER^{b)} following DIN 51562-1, resp. by means of a capillary viscometer (Viscotek, Weingarten)^{c)}

Non-certified values

Averaged mol. weights (M_w , M_n , M_z and M_p) and polydispersity M_w/M_n by size exclusion chromatography (SEC)

Investigator	Mean values of investigators				
	Weight-average M_w [g/mol]	Number-average M_n [g/mol]	Z-average M_z [g/mol]	Mol. weight at peak max. M_p [g/mol]	M_w/M_n
1	95850	39950	174200	83700	2,40
2	103600	43600	175900	97700	2,37
3	102000	44000	176000	84000	2,31
4	93300	44000	162900	91200	2,12
5	103300	47100	186300	98300	2,19
6	96000	43400	164600	-	2,21
7	101200	49500	178900	91600	1,97
8	99800	35200	198100	100400	2,84
9	108100	61200	181200	97600	1,77
10	84100	40250	132000	105500	2,09
11	113000	62100	206500	87000	1,82
	101500	49300	192500	78900	2,06
12	109850	52650	194650	-	2,09
13	104500	58500	171000	90000	1,78
Mean values	101100	47900	178200	92200	2,15
Confidence interval	3400	3800	8600	3700	0,13
[%]	3,40	8,03	4,84	4,04	6,16

The experimental conditions were determined by DIN 55 672 – 1 (size exclusion chromatography (SEC) using tetrahydrofurane (THF) as eluent). Calibration standards from Polymer Standards Service (PSS), Mainz, were used.

NMR-spectroscopy:	Ratio of isotactic to syndiotactic linkages 45:55
IR-Spectroscopy:	IR-spectrum corresponds with reference spectra
Differential Scanning Calorimetry:	glass transition temperature $T_g = 109,6 \text{ }^\circ\text{C}$
Melt Flow Index:	$6,3 \pm 0,6 \text{ g/10 min}$ (3,8 kg, $230 \text{ }^\circ\text{C}$, according to DIN ISO 1133)
Density:	$1,27 \text{ g/ml}$ ($25 \text{ }^\circ\text{C}$, according to DIN 53479)

Investigators

Aventis, Frankfurt / M.
Bundesanstalt für Materialforschung und -prüfung, Berlin
Bayer AG, Uerdingen
Bayer AG, Leverkusen
Bundeskriminalamt, Wiesbaden
BMW, Dingolfing
Fraunhofer Institut für Angewandte Polymerforschung, Teltow
RWTH Aachen, Institut für Kunststoffverarbeitung
Institut für Lacke und Farben, Magdeburg
Institut für Polymerforschung, Dresden
Martin-Luther-Universität, Halle-Wittenberg
Max-Planck-Institut für Polymerforschung, Mainz
Polymer Standards Service GmbH, Mainz
Röhm GmbH, Darmstadt
RWTH Aachen, Institut für Textilchemie und Makromolekularen Chemie
Goldschmidt AG, Essen
Technische Universität Dresden
Universität Bayreuth
Universität Erlangen-Nürnberg
Universität Essen
Universität Freiburg
Universität Hamburg, Institut für Technische und Makromolekulare Chemie
Universität Hamburg, Institut für Technische und Makromolekulare Chemie
Universität Leipzig
Johannes-Gutenberg-Universität Mainz, Institut für Makromolekulare Chemie
Johannes-Gutenberg-Universität Mainz, Institut für Physikalische Chemie
Universität Osnabrück
Universität Stuttgart, Institut für Technische Chemie
Universität Stuttgart, Institut für Textil- und Faserchemie
Universität Ulm
Universität - Gesamthochschule Siegen
Viscotek GmbH, Weingarten

Producer and Sales

The standard material is produced by Aldrich, Taufkirchen. It is distributed by Polymer Standards Service GmbH (PSS), Mainz, in packaging sizes of 1, 2, 5 and 10 g.

Storage

The material should be stored at dry conditions below +7°C.

Berlin, 2001-12-13

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Head of division VI. 3
„Analysis and structure of polymers“