U.S. Department of Commerce
Elliot L. Richardson,
Secretary

National Bureau of Standards
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National Bureau of Standards Certificate

Standard Reference Material 1484

Linear Polyethylene
(Narrow Molecular Weight Distribution)

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This Standard Reference Material is intended for the calibration and checking of instruments used in polymer technology and science for the determination of molecular weight and molecular weight distribution, and for use as a characterized sample for measurements of other physical properties of linear polyethylene.

Property	Value	Sample standard deviation of value, percent	Number of degrees of freedom	Expected limit of systematic error, percent
Number-average molecular weight, M_n, g/mol[a]	100,500	3.7	34	4[b]
Weight-average molecular weight, M_w, g/mol[c]	119,600	1.8	5	11[b,d]
Limiting viscosity number, ml/g:				
at 130 °C in 1,2,4-trichloro-benzene	197.9	0.30	22	1
at 130°C in 1-chloro-naphthalene	169.4	0.35	22	1

a. Determined by membrane osmometry in 1-chloronaphthalene at 130 °C.

b. The expected limits of systematic error for the number-and weight-average molecular weights are based on analyses of the osmometry and light-scattering determinations, respectively, without taking account of the necessity of M_w exceeding M_n.

c. Determined by light scattering in 1-chloronaphthalene at 135 °C based on a value of 17.8×10^{-6} cm^{-1} for the Rayleigh ratio for the vertically polarized scattering of vertically polarized light, of wavelength 546 nm in vacuum, from benzene at 23 °C. This value was derived from published values of the unpolarized Rayleigh ratio and the depolarization ratio for unpolarized light [D. J. Coumou, J. Colloid Sci. **15**, 408 (1960)]. The differential refractive index of this polyethylene in 1-chloronaphthalene at 135 °C, also required for the calculation of molecular weight, was found to be −0.191 ml/g at wavelength 546 nm in vacuum, based on the value of 0.1429 ml/g for the differential refractive index of sucrose in aqueous solution at 25 °C [Norberg and Sundelöf, Makromol. Chem. 77, 77 (1964)].

d. The expected limit of systematic error from all sources *except* the vertically polarized Rayleigh ratio for benzene is 4 percent.

Measurements leading to the certification of this Standard Reference Material were performed by J. E. Brown, R. G. Christensen, C. C. Han, J. R. Maurey, P. H. Verdier and H. L. Wagner in the Polymers Division, Institute for Materials Research.

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J. Paul Cali, Chief
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This sample of linear polyethylene was prepared by fractional recrystallization from 1,2,4-trichlorobenzene and subsequent blending of fractions produced by Waters Associates, Inc. of Milford, Mass., by large-scale gel permeation chromatography, from a linear polyethylene substantially identical with Standard Reference Material 1475 (Linear Polyethylene, Whole Polymer). The fractions as received contained several percent by weight of polyethylene components with molecular weights in the range 1,000-4,000. The amount of this material remaining after the fractional recrystallization is less than 0.5 percent. Both total volatiles, estimated gravimetrically, and residual 1,2,4-trichlorobenzene content, estimated spectrophotometrically, do not exceed 0.1 percent.

The maximum rate of shear in the Ubbelohde capillary viscometers employed for the determination of limiting viscosity numbers was 3,000 sec^{-1} for 1,2,4-trichlorobenzene and 2,000 sec^{-1} for 1-chloronaphthalene. The maximum specific viscosities were 0.4 in both solvents.

A report describing the investigations required for this and related polyethylene Standard Reference Materials will be published as an NBS Special Publication.