

National Institute of Standards & Technology

Certificate

Standard Reference Material 1960

Nominal 10 μm Diameter Polystyrene Spheres

(In Cooperation with the American Society for Testing and Materials)

This Standard Reference Material (SRM) is intended for use as a primary particle size reference standard for the calibration of particle size measuring instruments including optical and electron microscopes. The SRM is a suspension of polystyrene spheres in water at a weight concentration of about 0.4%.

The number average particle diameter was measured in air by center distance finding (CDF), an optical technique related to array sizing [1]. The certified value is:

Number Average Diameter, μm	Uncertainty, μm
9.89	± 0.04

The uncertainty consists of both random and systematic errors, and includes sample-to-sample variability.

The size distribution of the polystyrene spheres, as determined by CDF [1], is a narrow Gaussian with a standard deviation of 0.9% (excluding particles with diameters not on the main peak). The number of undersized particles is negligible and the number of oversized particles is less than 1%. Supporting measurements were made using resonance light scattering and metrology electron microscopy. The results from these techniques for the diameter were: resonance light scattering ($9.90 \pm 0.03 \mu\text{m}$) and metrology electron microscopy ($9.89 \pm 0.06 \mu\text{m}$).

The material is expected to have at least a four-year shelf life when stored at room temperature, provided the cap on the vial is not removed. Care should be exercised to prevent contamination once the cap has been removed. Fifty $\mu\text{g/g}$ of sodium azide was added as a biocide before the material was packaged.

Before sampling, manually shake and/or expose the SRM vial to ultrasonics until the spheres are uniformly distributed, then take a sample by squeezing a drop from the vial. Use filtered (0.4- μm pore size filter) distilled water for dilution. When electrolytes are used for electrical sensing zone counter measurements, first dilute the sample with water to prevent agglomeration.

The technology necessary to produce these polystyrene particles was developed by the Lehigh University and the National Aeronautics and Space Administration (NASA) during five shuttle missions in 1982 and 1983. The 10- μm particles in SRM 1960 were manufactured in space aboard the Space Shuttle CHALLENGER during the NASA STS-6 mission, 4-9 April 1983. The particles were provided by NASA for certification by NIST as a SRM to be made available to the scientific and technical communities.

The technical direction and physical measurements leading to certification were provided by T.R. Lettieri, A.W. Hartman, and G.G. Hembre of the Precision Engineering Division.

Gaithersburg, MD 20899
October 18, 1991
(Revision of Certificate dated 4-4-85)

William P. Reed, Chief
Standard Reference Materials Program

(over)

Manufacture of the particles was carried out under the direction of J.W. Vanderhoff of the Lehigh University and D.M. Kornfeld of the National Aeronautics and Space Administration.

The overall coordination of the measurements by the cooperating laboratories was performed under the direction of R.C. Obbink, Research Associate, ASTM/NIST Research Associate Program.

The technical and support aspects involved in the revision, update, and issuance of this Standard Reference Material were coordinated through the Standard Reference Materials Program by N.M. Trahey. The original coordination of certification efforts was performed by L.J. Kieffer.

[1] Hartman, A.W., Powder Technology 46 pp. 109-120 (1986).

Cooperative determinations were performed in the following laboratories:

Climet Corporation, Redlands, California, L.D. Carver.
 Duke Scientific Corp., Palo Alto, California, S.D. Duke.
 Eastman Kodak Co., Rochester, New York, B.C. Wood.
 Food & Drug Administration, Minneapolis, Minnesota, G.S. Oxborrow.
 General Electric Co., Worthington, Ohio, E.J. Consors.
 Lehigh University, Bethlehem, Pennsylvania, J.W. Vanderhoff.
 National Aeronautics & Space Administration, Huntsville, Alabama, D.M. Kornfeld.
 Pacific Scientific, Menlo Park, California, L.D. Carver.
 Particle Data Laboratories, Ltd., Elmhurst, Illinois, R. Karuhn.

The following results are given for information only:

<u>Method</u>	<u>Laboratory</u>	<u>Number Average Diameter (μm)</u>	<u>Standard Deviation of Distribution (μm)</u>
Optical Microscopy	Duke	9.90	0.05
	FDA	10.215	0.176
	Kodak	9.93	---
Electron Microscopy	Lehigh	9.96	0.115
	Kodak	9.90	0.05
Sensing Zone	Duke	9.89	0.08
	G.E.	10.02	---
	Climet	10.08	---
	NASA	9.93	0.12
	Pacific Scientific	10.1	---
	Particle Data	9.94	---