



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1963

Nominal 0.1 µm Diameter Polystyrene Spheres

This Standard Reference Material (SRM) is intended primarily for the calibration of electron microscopes and of surface scanning inspection systems. The standard is **NOT** appropriate for applications where monosize, unagglomerated spheres are necessary. A unit of SRM 1963 consists of 5 mL of carboxylated polystyrene spheres in deionized (0.2 µm pore size filter) filtered water. The particle suspension contains primary spheres (monomers) and clusters of primary spheres. The spheres have a mass concentration of approximately 0.5 % and are supplied in a dispensing vial.

The average primary sphere diameter was measured in air as an aerosol by electrical mobility measurements [1]. The size distribution of the primary spheres is narrow, with a standard deviation of 0.0018 µm excluding outliers. The mass fraction of dimers, trimers, and larger clusters may exceed the mass fraction of primary spheres. The number of undersized primary spheres is negligible and the number of oversized primary spheres (diameters greater than 0.2 µm) is less than 0.1 %. The certification applies only to the primary spheres.

Table 1. Certified Average Primary Size Sphere and Expanded Uncertainty

Average Particle Size Diameter, in µm

$$0.1007 \pm 0.0010^a$$

^a The expanded uncertainty (95 % confidence interval) includes both Type A and Type B uncertainties calculated according to the ISO Guide [2].

Expiration of Certification: The certification of SRM 1963 is valid until **31 January 2010**, within the measurement uncertainty specified, provided the SRM is handled in accordance with instructions given in this certificate (see *Instructions for Use*). This certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of Certification: NIST will periodically monitor the stability of the SRM and if changes occur that affect the certification before its expiration, NIST will notify the purchaser. Return of the attached registration card will facilitate notification.

The coordination of the technical measurements leading to certification was performed under the direction of G.W. Mulholland of the NIST Fire Research Division.

The technical direction and physical measurements leading to certification were provided by G.W. Mulholland and N.P. Bryner of the NIST Fire Research Division and P. Kinney and D. Pui of the Particle Technology Laboratory at the University of Minnesota.

The original support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by T.E. Gills. Revision of this certificate was coordinated through the NIST Standard Reference Materials Program by B.S. MacDonald of the NIST Measurement Services Division.

William L. Grosshandler, Chief
Fire Research Division

John Rumble, Jr., Chief
Measurement Services Division

Gaithersburg, MD 20899
Certificate Issue Date: 25 August 2003
See Certificate Revision History on Last Page

The statistical analysis of the data was performed by S.B. Schiller and M.C. Croarkin of the NIST Statistical Engineering Division.

Information results were provided by National Metrology Institute of Japan, Duke Scientific Corporation, The Scatter Works, Inc., and NIST.

INSTRUCTIONS FOR USE

Storage: Refrigerate the sample (5 °C to 15 °C) but **DO NOT** allow the sample to become frozen. **DO NOT** remove the cap from the vial until the sample is used. It should be noted that no surfactant was used during production of the spheres and no biocide was added during packaging. Once the sample is opened, there is a possibility of biological contamination leading to growth of bacteria or spores. To minimize the occurrence of this unwanted growth, replace the cap immediately after dispensing the sample drops.

Handling and Use: A sample of the spheres may be obtained by squeezing a drop from the vial. Use filtered (0.2 µm pore size filter) distilled water for dilution. Care should be exercised to prevent contamination once the cap has been removed. For some applications it is useful to filter the sample with a 0.5 µm pore size filter to remove large flocs.

Supplemental Information: Information values for primary sphere size using a variety of techniques are provided in Table 2 to illustrate the variation in results obtained from selected laboratories using different techniques. Collaborating laboratories and NIST determined these results. These are noncertified values with no uncertainty assessed that are provided for information purposes only. These results were not used in calculating the certified value and should **NOT** be used as substitutes for the certified value.

Table 2. Information Values

Primary Size	Technique
100.8 nm	Electro-gravitational Aerosol Balance
100.2 nm	Transmission Electron Microscopy
100.6 nm	Light Scattering by Particles on a Surface
99.7 nm	Light Scattering by Particles on a Surface

REFERENCES

- [1] Mulholland, G.W.; Nelson, B.P.; Croarkin, C.; *Measurement of the 100 nm NIST SRM 1963 by Differential Mobility Analysis*; Aerosol Science and Technology, Vol. 31, pp. 39-55 (1999).
- [2] *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/>.

Certificate Revision History: 25 August 2003 (Corrected the approximate mass concentration given in the unit description) 31 December 2002 (This revision reports a change in the intended use of this SRM, specifying certification is for primary particles only and that agglomerates may exist in high concentrations. New expiration date given); 16 January 2001 (This revision reflects a change in the uncertainty and editorial changes); 16 November 1993 (Information value added); 13 May 1991 (Editorial changes); 16 November 1990 (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>.