National Institute of Standards and Technology

Certificate of Calibration

Standard Reference Material 1003a
Calibrated Glass Spheres

(8 to 58 micrometers)

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

This Standard Reference Material (SRM) is intended for use in calibrating equipment and in evaluating methods for measuring particle size in the 8 to 58 micrometer range. SRM 1003a consists of 25 grams of glass spheres.

The cumulative number size distribution was determined by optical microscopic sizing of over 8000 particles, sampled from 10 bottles of SRM 1003a. The certified values, shown in Table 1, are presented as percent of spheres with diameters less than a given diameter. The uncertainties of the certified values are expressed as the standard deviation of the mean of the ten samples at a given diameter. The cumulative volume (or mass) distribution has been calculated from the cumulative number size distribution and is presented in columns four and eight of Table 1. These values are not certified, and are presented for informational purposes only.

Table 1. Cumulative Size Distribution

Percent of Spheres with Diameters Less Than the Size Indicated

Diameter	Number	Uncertainty	Volume	Diameter	Number	Uncertainty	Volume
4 μm	0.00	±0.00	0.0	34 μm	83.99	±1.42	46.84
6	0.47	±0.12	0.00	36	87.50	±1.25	53.64
8	1.50	±0.16	0.02	38	90.32	±1.08	60.09
10	3.40	±0.23	0.08	40	92.58	±0.87	66.15
12	6.87	±0.37	0.29	42	94.41	±0.67	71.87
14	12.01	±0.61	0.80	44	95.80	±0.51	76.86
16	18.84	±0.89	1.84	46	96.95	±0.38	81.57
18	27.17	±1.10	3.69	48	97.80	±0.27	85.58
20	36.43	±1.25	6.57	50	98.48	±0.19	89.13
22	45.67	±1.39	10.44	52	98.98	±0.13	92.24
24	54.34	±1.50	15.21	54	99.38	±0.08	94.87
26	62.06	±1.57	20.67	56	99.64	±0.04	96.96
28	68.84	±1.59	26.71	58	99.85	±0.02	98.53
30	74.74	±1.58	33.21	60	99.95	±0.01	99.52
32	79.78	±1.52	40.00	62	99.98	±0.00	99.86
				64	100.00	±0.00	100.00

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(over)

The various measures of the central tendencies of the two distributions are given below.

Table 2. Non-certified Values of the Mode, Median, and Mean of the Size Distributions

	By Count	By Volume
Mode, Linear Class Size	20.0 μm	31.1 μm
Mode, Logarithmic Class Size	22.9	37.5
Median	23.0	33.7
Mean	24.5	35.6

The density of the glass spheres is 2.414 $g \cdot cm^{-3}$ as determined by the classical volume displacement method using 25-mL pycnometers and xylene as the displacement fluid. This value is not certified, but is given for the benefit of those wishing to apply Stoke's law calculations.

Before sampling this SRM, the spheres should be thoroughly mixed in the bottle using a mechanical device or a manual technique that consists of a combination of shaking and rolling. Samples should be taken from a number of places in the bottle.

Previous experience has shown that a reaction can occur between the surfaces of glass spheres subjected to moisture that can make them difficult to disperse. Once opened, the bottle should be stored in a dry atmosphere; e.g., a desiccator.

The glass spheres used for this SRM were provided by Potters Industries of Hasbrook Heights, New Jersey. The microscopic measurements were made by R.C. Obbink, ASTM/NIST Research Associate. The data reduction was performed by R.K. Kirby of NBS Measurement Services. The density was determined by W.F. Koch of the NBS Center for Analytical Chemistry.

J.R. Thompson of the Alcoa Technical Center in Pennsylvania provided valuable assistance in determining that the homogeneity of this SRM was satisfactory by making many measurements with a Leeds & Northrop Microtrac and a modified Coulter Counter. Measurements were also made by S.D. Duke of Duke Scientific Corp., Palo Alto, California, L.D. Carver of the Hiac Corp., Monclair, California, and F. Kosel of Marco Scientific, Sunnyvale, California.

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 R.L. McKenzie. The original coordination of certification efforts was performed by L.J. Kieffer and R.K. Kirby.

The following results are given for information only:

Table 3. Results Obtained by Cooperating Laboratories with Commercial Equipment

Method/Instrumentation[a]	Laboratory	Vol. Mean Diameter	Distribution Sigma (s.d.)
Air Sedimentation	Alcoa	38.1 μm	1.22 μm
Electronic Sensing Zone	Alcoa	36.0	1.25
Granulometre	Marco	35.8	1.28
Hiac PA-720	Hiac	36.8	1.28
Hiac PA-720	Hiac	36.9	1.36
Microtrac (L&N)	Alcoa	36.6	1.45
X-Ray Sedimentation	Duke	36.5	1.38
Electronic Sensing Zone	Duke	32.2	1.29

[a]Reference to specific instrumentation by its commercial name does not constitute an endorsement by either the National Institute of Standards and Technology or the American Society for Testing and Materials.