National Institute of Standards & Technology

Certificate

Standard Reference Material 1003b

Calibrated Glass Beads

This Standard Reference Material (SRM) consists of spherical soda-lime glass beads with diameters covering the 10 to 60 micrometer (µm) range. The glass beads are packaged in a bottle containing approximately 25 g. This SRM is intended for use in evaluating and calibrating particle size measurement instrumentation.

The cumulative number and cumulative volume size distributions were determined by optical microscopy and by the Coulter' Principal Electronic Sensing Zone technique. The certified numbers are the microscopy values determined by the measurement of over 12,000 individual beads from eight bottles. Measurements were made using a digitizing tablet to measure diameters from enlarged optical micrographs of the beads. Calibration of the measurement process was done using SRM 1965. The certified values are presented in Table I as the number and volume percentage of beads with diameters less than a given length. For each diameter, the certified value and the uncertainty define a 95% confidence interval for the mean percentile. The Coulter measurements are in close agreement with the optical values and were used to determine bottle-to-bottle homogeneity. A comparison of the optical and Coulter results is included for informational purposes as Table II.

Use: The entire bottle of beads should be used for measurement. However, if this is impractical, special care must be exercised when taking subsamples from the SRM bottle. The recommended procedure is to use a micro-riffler to divide the unit into subsamples and then further dividing these subsamples by riffling until a suitable sample size is obtained.

The overall technical direction and optical measurements leading to the certification were provided in the NIST Ceramics Division by J.F. Kelly.

The Coulter measurements were provided by H. Hildebrand at Coulter Instruments, Inc.

Statistical analysis was performed in the NIST Statistical Engineering Division by S.B. Schiller.

The technical and support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

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Table I. Certified Cumulative Size Distribution
Percent of Spheres with Diameters Less Than the Size Indicated

Diameter (µm)	Number (%)	Uncertainty (%)	Volume (%)	Uncertainty (%)
6	0.08	0.07	0.00	0.00
8	0.54	0.13	0.009	0.003
10	1.61	0.35	0.03	0.01
12	3.70	0.62	0.13	0.03
14	6.98	1.13	0.39	0.08
16	11.69	1.80	0.93	0.19
18	17.44	2.54	1.92	0.38
20	24.76	3.17	3.62	0.65
22	32.85	3.60	6.18	0.94
24	40.87	3.62	9.47	1.18
26	48.90	3.66	13.72	1.53
28	55.86	3.44	18.33	1.70
30	62.00	3.25	23.38	2.03
32	67.89	2.99	29.29	2.13
34	73.19	2.49	35.67	2.12
36	77.83	2.05	42.38	1.93
38	82.48	1.65	50.23	1.93
40	86.39	1.35	57.99	2.30
42	89.75	1.22	65.74	2.92
44	92.70	0.84	73.60	2.05
46	95.08	0.54	80.92	1.50
48	97.15	0.20	88.02	0.85
50	98.91	0.23	95.01	1.06
52	99.74	0.09	98.69	0.42
54	99.96	0.05	99.79	0.27
56	99.98	0.04	99.94	0.14
58	99.99	0.02	100.00	0.00
60	100.00	0.00	100.00	0.00

Table II. Volume % Less Than Diameter Values for Optical and Coulter Techniques
(Results are given for information only)

Volume %	Diameter (µm)	
	Optical	Coulter
10	24.2	25.9
20	28.8	30.0
30	32.2	33.3
40	35.3	36.2
50	37.9	38.9
60	40.5	41.6
70	43.2	44.1
80	45.8	46.7
90	48.6	49.7

The density of the glass is 2.445 g/cm³ as determined by helium gas pycnometry. This value is not certified, but is provided for those wishing to apply Stokes' Law calculations.