I. S. Department of Commerce
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Certificate of Calibration

Standard Reference Material 1019a

Glass Spheres for Calibrating Test Sieves

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

This Standard Reference Material (SRM) is intended for use in the evaluation of the effective opening of wire-cloth sieves in the range 0.76 to 2.16 mm (Test Sieve Nos. 20, 18, 16, 14, 12, and 10).

SRM 1019a consists of 200 g of glass spheres in a glass bottle. While most of the "spheres" are spherical, about 6 percent by number are either ellipsodial or fused.

The distribution of sizes in this SRM, as determined by microscopic measurement, is given in Table 1 as the weight percent of glass spheres that are smaller than those that have the indicated diameter.

Over 10,000 spheres were measured in the course of this calibration. These spheres were sampled from 11 bottles that were randomly selected throughout the bottling process. The size distributions of the spheres in these bottles were also carefully compared with those from 9 other bottles, also selected at random, by sieving. These intercomparisons show no significant difference between the distributions from all 20 bottles. Considering the values of percent finer to be exact, the standard deviation associated with each test sieve is: No. 20, 0.010 mm; No. 18, 0.020 mm; No. 16, 0.045 mm; No. 14, 0.015 mm; No. 12, 0.020 mm; and No. 10, 0.025 mm. It was assumed that the effective opening would be within the permissible variation of the average opening as specified in the ASTM Standard Specification for Wire-Cloth Sieves, E-11. This error includes those errors due to the bottling and measuring processes and is to be expected when a given sieve is calibrated with different bottles of this SRM. The reproducibility is dependent upon the sieving method and the care exercised by the operator.

The microscopic measurement of sphere diameters was made by R.C. Obbink, ASTM Research Associate. The data reduction was performed by R.K. Kirby of NBS Measurement Services.

The technical and support aspects involved in the certification and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by L.J. Kieffer and R.K. Kirby.

Gaithersburg, MD 20899
October 22, 1984

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(over)

Table 1

Cumulative Size Distribution by Weight

Weight percent finer	Diameter (Effective sieve opening)	Weight percent finer	Diameter (Effective sieve opening)
%	mm	%	mm
2	0.755	52	1.460
4	0.790	54	1.475
6	0.815	56	1.495
8	0.830	58	1.535
10	0.845	60	1.605
12	0.860	62	1.650
14	0.880	64	1.670
16	0.905	66	1.690
18	0.935	68	1.705
20	0.970	70	1.720
22	1.000	72	1.740
24	1.025	74	1.755
26	1.055	76	1.775
28	1.085	78	1.795
30	1.115	80	1.820
32	1.155	82	1.840
34	1.210	84	1.860
36	1.285	86	1.885
38	1.330	88	1.920
40	1.360	90	1.950
42	1.380	92	1.980
44	1.395	94	2.015
46	1.410	96	2.065
48	1.425	98	2.170
50	1.440		

Directions for Using Calibrated Glass Spheres for the Evaluation of the Effective Opening of Sieves

The Calibration Process

The aperture size of a sieve can be determined as the average size of the openings in the sieve. However, the purpose of a sieve is to measure the size of particles, and therefore, it is the effective opening that must be determined. This is done by using particles of known size. Thus the effective opening is determined by the size of calibrated glass spheres that will just pass through the sieve. This in turn permits the measurement of the particle size of an unknown material that will also just pass through the sieve.

The openings of a sieve are not all the same size, and particles that are coarser than the average opening can pass through the larger holes. Thus, the effective opening is generally larger than the average opening. In addition, the separation achieved by a sieve is not sharp. A few particles capable of passing the sieve are always retained. The number of particles retained or passed depends upon the manner and time of shaking, and any measurement of the effective opening must take these variables into account. To a large extent, the glass-sphere method of calibration automatically includes these effects because the sieves are shaken in the same manner, when calibrated, as when measuring an unknown material.

The sieve openings are essentially square in shape and particles of irregular shape can pass through even though one of the dimensions of the particle is considerably larger than the diameter of the opening. This is especially true for needle-like shapes. The average diameter of such irregular particles that pass a sieve cannot be considered equal to the effective opening of the sieve as measured by the diameter of spheres that just pass.

Calibration Procedure

To evaluate the effective opening of test sieves with this SRM, all of the glass spheres are placed on the top sieve. The sieves are then shaken in a shaking device, or by hand, in exactly the same manner as that to be followed in routine analysis.

After the shaking has been completed, the stack of sieves is disassembled, and the spheres removed from each sieve and placed into a suitable weighing bottle. Experience has shown that loss of spheres is very likely to occur during this operation. Therefore, the whole operation should be carried out over a large pan to permit recovery of any spheres that may accidently be spilled. The sieve is inverted over a pan and all of the glass spheres removed with a stiff brush.

Each sieve fraction is weighed to the nearest 0.01 g. After weighing, all spheres are returned to the original container and kept for reuse. The weight percent retained on each sieve is calculated from the weights of the sieve fractions. The percent passing through each sieve is determined by subtracting the percentage on the coarsest sieve from 100 percent, the percentage on the next sieve from that result, and so on. The effective size of the sieve opening is determined by interpolation between the nearest values given in Table 1. An example of data and calculations are shown below in which six sieves were calibrated at the same time.

Example of calculation for effective opening

U.S. sieve No.	Weight on sieve	Weight Percent: On sieve	Weight Percent: Finer than sieve	Opening of Sieve: Effective[a]	Opening of Sieve: Nominal
10	8.04 g	4.02 %	96.0 %	2.065 mm	2.00 mm
12	52.85	26.41	69.6	1.715	1.70
14	32.33	16.15	53.4	1.470	1.40
16	38.64	19.31	34.1	1.210	1.18
18	24.86	12.42	21.7	0.995	1.00
20	18.86	9.42	12.3	0.865	0.85
Pan	24.56	12.27			
Total	200.14				

[a]Determined by interpolation between values given in Table 1.

Foreign Material and Dirt

If the sieves are not cleaned sufficiently before the calibration, some foreign material will be found among the glass spheres. If possible, this foreign material must be removed by hand. A dirty appearance of the glass spheres indicates that they have picked up a small amount of dust. The weight of the dust is usually so small that only a negligible error is introduced. If the sieves to be calibrated have been used, they may be cleaned thoroughly with a sturdy brush, not too stiff, using soap and water or solvents. Under no circumstance should a sharp object be used to dislodge particles that are stuck in the meshes.

Loss of Weight with Use

Experience has shown that there is a loss in weight of the beads with use. How great a loss can be tolerated without introducing large errors in the calibration is difficult to state. However, the variation of the accuracy of the "working sample" can be monitored by periodically calibrating a set of sieves that are kept in reserve. A variation significantly greater than 0.02 mm would indicate that the accuracy of the SRM has suffered from a loss of weight. If the SRM is ruined by either repeated use, or accident, the only recourse is to purchase a new unit from the National Bureau of Standards.