National Institute of Standards & Technology

Report of Investigation

Reference Material 8010

Sand for Sieve Analysis

This Reference Material (RM) is intended to serve as a test material in the sieve analysis of granular materials. Each unit comprises a three-bottle set of sands covering three size distributions. Each bottle contains approximately 130 g of sand, enough for the sample sizes designated in ASTM C 429 Standard Test Method for Sieve Analysis of Raw Materials for Glass Manufacture [1].

Six sands were obtained by ASTM Committee C-14 for use in a 1997 round robin study involving 15 participating laboratories to establish a precision statement for ASTM C 429. Three of these six sands, Materials A, C, and D, were selected by NIST to be measured as RMs. This selection was done with the objective of covering the size range of U.S.A. standard testing sieve numbers (No.), from No. 30 (600 μm) to No. 325 (45 μm). Material A is a test material for the coarser sieves (No. 30 to No. 100), Material C is for the midrange (No. 70 to No. 200), and Material D is for the finer sieves (No. 100 to No. 325).

Sieve Analysis: Fifteen laboratories provided sieve analysis of two samples of each of the three sands. Each mechanical sieving analysis was done following recommendations in ASTM STP 447B [2] and used a test stack of nine sieves: No. 30 (600 μm), No. 40 (425 μm), No. 50 (300 μm), No. 70 (212 μm), No. 100 (150 μm), No. 140 (106 μm), No. 200 (75 μm), No. 270 (53 μm), and No. 325 (45 μm). The sieve testing was designed to provide reference values (average mass fractions) for sieve analysis and estimates of the standard deviations for within-lab repeatability (s_r) and between-lab reproducibility (s_R). The entire bottle of sand was poured onto the top sieve and the sieves were then shaken for 15 min in an automated unit. After the shaking was completed, the stack of sieves was disassembled, and the sand removed from each sieve and weighed. The mass of sand retained on each sieve was used to calculate the mass fraction retained on that sieve. This is the ratio of the mass of sand retained on a sieve to the total sand mass. Each laboratory reported the mass fractions to a precision of 0.1 %.

Expiration: This RM can be used indefinitely within the measurement uncertainties specified, provided the RM is used in accordance with the instructions given in this report. However, it is expected that some material will be lost with each use. When the unit's loss exceeds 2 % of the original mass, or if spillage or contamination occurs, use of the RM unit should be discontinued.

The technical direction and sieve analysis at NIST were provided by J.F. Kelly of the NIST Ceramics Division.

Organization of the interlaboratory testing program was coordinated by D.J. O'Donnell of Unimin Corp., R.J. DeLuca, Consultant and S.L. Gray of Corning, Inc.

Statistical review was performed by K.R. Eberhardt of the NIST Statistical Engineering Division.

The support aspects involved in the issuance of this RM were coordinated through the NIST Standard Reference Materials Program by R.J. Gettings and B.S. MacDonald of the Measurement Services Division.

Debra L. Kaiser, Chief
Ceramics Division

Gaithersburg, MD 20899
Report Issue Date: 18 May 2004
See Report History on Last Page

Robert L. Watters, Jr., Acting Chief
Measurement Services Division

INSTRUCTION FOR USE

To evaluate a set of standard 203 mm (8 in) or 305 mm (12 in) diameter test sieves with this RM, the entire bottle of sand should be poured onto the top sieve screen. The sieves are then shaken in 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 sand is removed from each sieve and placed into a suitable weighing container. To reduce loss of material during this step, the transfer operation should utilize a large funnel or be carried out over glazed paper to recover any spillage. A soft brush is useful in removing the sand from the sieve and funnel. Each of the sieve fractions is weighed to a precision of 0.01 g. After weighing, the sand is returned to the original RM bottle and kept for reuse. The mass fraction retained on each sieve is compared to the reference value given in Table 1.

The above procedure is for use in comparison of sieve results and as a method to periodically monitor for changes in screens after service. This procedure is **NOT** to be used as a certification for test sieves. For assistance in complying with the calibration of wire cloth sieves according to ASTM E 11 specifications, contact the NIST Calibration Program by telephone at (301) 975-3471 or (301) 975-2002, or by fax at (301) 869-3548.

Table 1. Reference Values

	Material A		Material C		Material D	
Sieve No.	Mass Fraction (%)	Uncertainty ± (%)	Mass Fraction (%)	Uncertainty ± (%)	Mass Fraction (%)	Uncertainty ± (%)
30	0.3	0.3	0.0	0.1	0.0	0.1
40	22.4	6.0	0.0	0.1	0.0	0.1
50	42.0	7.1	0.2	0.2	0.0	0.2
70	19.5	3.9	5.7	1.9	0.1	0.2
100	9.2	1.5	41.4	5.1	5.4	3.6
140	5.0	0.7	41.4	6.1	28.5	3.3
200	1.5	0.3	10.4	2.2	27.7	4.8
270	0.2	0.2	0.7	0.6	23.3	4.2
325	0.0	0.1	0.0	0.2	7.2	4.5
Pan	0.1	0.2	0.1	0.3	8.2	3.2

Table 2. Repeatability (s_r) and Reproducibility (s_R) Values Derived From Round Robin Data Using ASTM E 691 [3]

	Material A		Material C		Material D	
Sieve No.	s_r (%)	s_R (%)	s_r (%)	s_R (%)	s_r (%)	s_R (%)
30	0.16	0.16	0.03	0.05	0.02	0.07
40	0.78	2.72	0.02	0.02	0.01	0.03
50	1.09	3.24	0.05	0.07	0.03	0.07
70	1.15	1.80	0.13	0.85	0.04	0.09
100	0.38	0.69	0.78	2.29	1.45	1.64
140	0.15	0.31	0.71	2.75	0.72	1.50
200	0.08	0.14	0.27	0.97	0.94	2.15
270	0.07	0.11	0.14	0.26	0.45	1.87
325	0.04	0.05	0.06	0.09	0.51	2.03
Pan	0.05	0.09	0.05	0.12	0.50	1.42

Uncertainty Analysis: The reference values listed in Table 1 are the average mass fraction, expressed in percent, of material retained on each sieve. The uncertainties in Table 1 are expanded uncertainties, which are calculated according to the ISO/NIST guidelines [4], and represent the 95 % level of confidence. The expanded uncertainties are calculated as $U = ku_c$, where u_c is the combined standard uncertainty and k is a coverage factor. The value of u_c represents, at the level of one standard deviation, the combined effects of uncertainty due to (1) between-laboratory reproducibility of the sieve measurements, (2) within-laboratory repeatability of measurements, and (3) possible small bottle-to-bottle differences in the material. The value of coverage factor k ranges from 2.03 to 2.16 over the cases reported, depending on the calculated effective degrees of freedom for u_c. It is expected that a qualified operator sieving a bottle of this RM, using sieves manufactured in compliance with ASTM E 11-95 Standard

Specification for Wire Cloth and Sieves for Testing Purposes [5], will obtain values within this prediction interval approximately 95 % of the time. For example, it may be expected that a No. 40 screen will retain between 16.4 % and 28.4 % of the original mass of Material A, at a confidence level of approximately 95 %.

REFERENCES

[1] ASTM C 429-82; *Standard Test Method for Sieve Analysis of Raw Materials for Glass Manufacture*; Annu. Book of ASTM Stand, Vol. 15.02, West Conshohocken, PA (1996).

[2] *Manual on Test Sieving Methods*; ASTM Special Technical Publication 447B, Philadelphia, PA (1985).

[3] ASTM E 691-92: *Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method*; Annual Book of ASTM Stand, Vol. 14.02, West Conshohocken, PA (1997).

[4] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, lst ed. International Organization for Standardization: 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/.

[5] ASTM E 11-95; *Standard Specification for Wire Cloth and Sieves for Testing Purposes*; Annu. Book of ASTM Stand, Vol. 14.02, West Conshohocken, PA (1997).

Report Revision History: 18 May 2004 (This revision reports a correction in the mass of sample provided in the unit size); 14 February 2002 (This revision reports corrected sieve designations); 03 June 1998 (Original report 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.