



Standard Test Method for Sieve Analysis of Metal Powders¹

This standard is issued under the fixed designation B214; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the dry sieve analysis of metal powders or mixed powders, using sieves with openings ranging from 45 to 1000 micrometers.

1.2 This test method is based on a particular type of mechanical sieve shaker (see 5.2). Other types of sieve shakers are also available, but their precision and reproducibility have not been determined.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- B212 Test Method for Apparent Density of Free-Flowing Metal Powders Using the Hall Flowmeter Funnel
- B215 Practices for Sampling Metal Powders
- B243 Terminology of Powder Metallurgy
- B329 Test Method for Apparent Density of Metal Powders and Compounds Using the Scott Volumeter
- B417 Test Method for Apparent Density of Non-Free-Flowing Metal Powders Using the Carney Funnel
- B703 Test Method for Apparent Density of Metal Powders and Related Compounds Using the Arnold Meter
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

¹ This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.02 on Base Metal Powders.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1638 Terminology Relating to Sieves, Sieving Methods, and Screening Media

2.2 MPIF Standard:

MPIF 05 Determination of Sieve Analysis of Metal Powders³

3. Terminology

3.1 *Definitions*—Useful definitions of terms relating to powder metallurgy are found in B243 and those relating to sieve analysis are found in E1638.

4. Significance and Use

4.1 The particle size distribution of a metal powder affects its behavior in P/M processing and other applications of these materials. The test method may be part of the purchase agreement between powder supplier and user, or it may be an internal quality control test for either.

5. Apparatus

5.1 *Sieves*—Select a set of standard sieves from the table entitled, “Nominal Dimensions, Permissible Variations for Wire Cloth of Standard Test Sieves (U.S.A.) Standard Sieves,” of Specification E11, or the equivalent Tyler standard sieves. The sieves shall be 200 mm (8 in.) in diameter and either 25 or 50 mm (1 or 2 in.) in depth, and fitted with bronze, brass, stainless steel, or other suitable wire cloth. The U.S. sieves given in the table entitled, “U.S. Standard Series Test Sieves and Equivalent Tyler Standard Sieves,” of this test method shall conform to Specification E11. If Tyler standard sieves are substituted, they shall conform to the permissible variations given in the table entitled, “Nominal Dimensions, Permissible Variations for Wire Cloth of Standard Test Sieves (U.S.A.) Standard Sieves” of Specification E11.

NOTE 1—The new U.S. Series standard sieves, adopted in 1970, are the preferred sieves to use. The old U.S. Series standard sieves and equivalent sieves manufactured by other companies, such as Tyler, may also be used if the new U.S. Series is not available. Care should be taken to make sure

³ Available from Metal Powder Industries Federation (MPIF), 105 College Road East, Princeton, NJ 08540, <http://www.mpif.org>.

that sieve opening sizes are correct when performing standardization work.

TABLE 1 U.S. Standard Series Test Sieves and Equivalent Tyler Standard Sieves

Sieve Number	Sieve Opening (μm)		
	New U.S. Series	Old U.S. Series	Tyler Series
20	850	841	833
35	—	—	417
40	425	420	—
60	250	250	250
80	180	177	175
100	150	149	147
140	106	105	—
150	—	—	104
200	75	74	74
230	63	63	—
250	—	—	63
325	45	44	45

5.2 Sieve Shaker—A mechanically operated, single eccentric sieve shaker shall be used that imparts to the set of sieves a rotary motion and a tapping action of uniform speed. The number of rotations per minute shall be between 270 and 300. The number of taps per minute shall be between 140 and 160. The hold down arm of the sieve shaker shall be fitted with a shock absorbing plug to receive the impact of the tapping device. The entire apparatus shall be rigidly mounted by bolting to a solid foundation, preferably of concrete.

NOTE 2—Use of a sound proof enclosure is recommended.

5.3 Balance—A balance having a capacity of at least 150 g and a sensitivity of 0.01 g.

6. Test Specimen

6.1 The size of the test specimen shall be 90 to 110 g for any metal powder having an apparent density greater than or equal to 1.50 g/cm³ when determined in accordance with Test Method B212, B329, B417, or B703. A specimen of 40 to 60 g shall be used when the apparent density of the powder is less than 1.50 g/cm³. The test specimen should be obtained in accordance with Practices B215.

7. Procedure

7.1 Examine the sieves to make sure that they are not damaged and are clean.

7.2 Assemble the group of sieves selected in consecutive order by the size of their openings, with the coarsest sieve at the top, the assembly being completed by a solid collecting pan below the bottom sieve. Place the test specimen on the top sieve and close this sieve with a solid cover. Then fasten the sieve assembly securely in the sieve shaker and operate the machine for a period of 15 minutes.

NOTE 3—For some materials, for example brittle and friable materials, the 15 minutes may be too long. Sieving time may be adjusted for such materials, and the actual time used should be reported along with the test data.

7.3 Remove the screened fractions from the nest of sieves by removing the coarsest sieve from the nest, gently tapping its contents to one side and pouring them upon a glazed paper. Brush any material adhering to the bottom surface of the sieve and the lower frame with a soft brush into the next finer sieve. Tap the sieve just removed upside down, on the paper containing the portion that had been retained on it, and brush the back side of the sieve with the flat side of the brush so as to dislodge any particles that may have been wedged in the screen openings, by pushing to the upper side of the screen. Weigh this fraction to the nearest 0.1 g and remove it from the balance. Repeat this process for each sieve in the nest. Remove the fraction collected in the pan and weigh. The sum of the masses of all the fractions shall be not less than 99 % of the mass of the test specimen. Add the difference between this sum and the mass of the test specimen (in accordance with Section 6) to the mass of the fraction collected in the pan.

NOTE 4—If the sum is less than 99 %, check the condition of the screens and the pan and also check for possible errors in weighing. Repeat the test if error persists.

8. Report

8.1 Express the masses of the fractions retained on each sieve, and the mass of the fraction collected in the pan, as percentages of the mass of the test specimen to the nearest 0.1 %, and report them in the form shown in Table 2. Report any fraction that is less than 0.1 % of the mass of the test specimen as “trace.” If a fraction is absent, report it as “0.0”. Report the actual time period of sieving, if it is different than 15 minutes.

8.2 Interpretation of this report should be made with reference to Specification E11 in which the dimensional tolerances of standard sieves are specified.

TABLE 2 Format for Reporting Test Data of a Typical 100-Mesh Powder

New U.S. Standard Series		
Particle Size (μm)	Sieve Number	% By Mass
> 180	+ 80	...
≤ 180 > 150	– 80 + 100	...
≤ 150 > 106	– 100 + 140	...
≤ 106 > 75	– 140 + 200	...
≤ 75 > 45	– 200 + 325	...
≤ 45	– 325	...
Old U.S. Standard Series		
Particle Size (μm)	Sieve Number	% By Mass
> 177	+ 80	...
≤ 177 > 149	– 80 + 100	...
≤ 149 > 105	– 100 + 140	...
≤ 105 > 74	– 140 + 200	...
≤ 74 > 44	– 200 + 325	...
≤ 44	– 325	...
Tyler Standard Sieve Series		
Particle Size (μm)	Sieve Number	% By Mass
> 175	+ 80	...
≤ 175 > 147	– 80 + 100	...
≤ 147 > 104	– 100 + 150	...
≤ 104 > 74	– 150 + 200	...
≤ 74 > 45	– 200 + 325	...
≤ 45	– 325	...



9. Precision and Bias⁴

9.1 Precision:

9.1.1 An interlaboratory study of the sieve analysis of metal powders was run in 1993 and 1994 using the procedures contained in MPIF Standard 05 (1992). Each of twelve laboratories made three tests on four powder samples using each of two sets of sieves. One set of sieves was a standard set that was circulated to each laboratory in turn. A second set of sieves was chosen by each laboratory from its in-house sieve stock. Practice E691 was followed for the design and analysis of the data. The details are given in MPPA Research Report MPPA R-05-95.³

9.1.2 There were five U.S. Series standard sieves in each sieve nest: 80 mesh, 100 mesh, 140 mesh, 200 mesh, and 325 mesh plus a cover and a pan.

9.1.3 The precision information given in - covers the percent retained between any pair of sieves, the percent retained on the coarsest sieve, the percent passing the finest sieve, and the cumulative percentages calculated from all sieves of greater openings above any sieve in the set.

9.1.4 The 95 % repeatability limit, r , (within a laboratory) is represented by the equation:

$$r = 0.4 + 0.03 \times [SF] \quad (1)$$

where $[SF]$ is the % retained on the sieve of interest.

⁴ The precision contained in this standard was determined by the Metal Powder Producers Association Standards Committee of the Metal Powder Industries Federation for MPIF Standard 05. The precision is used herein with the permission of the Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540-6692, USA.

9.1.5 The 95 % reproducibility limit, R , (between laboratories) is smaller for the circulated sieves than for the in-house sieves. For in-house sieves R can be calculated from the following equations:

$$R = 1.2 + 0.15 \times [SF] \text{ for } [SF] \text{ from } 0 \text{ to } 22 \quad (2)$$

$$R = 4.5 \text{ for } [SF] \text{ from } 22.1 \text{ to } 50 \quad (3)$$

where $[SF]$ is the % retained on the sieve of interest.

For circulated sieves (or by analogy matched sieves obtained by two laboratories) R can be calculated from the following equations:

$$R = 0.3 + 0.064 \times [SF] \text{ for } [SF] \text{ from } 0 \text{ to } 30 \quad (4)$$

$$R = 2.2 \text{ for } [SF] \text{ from } 30.1 \text{ to } 50 \quad (5)$$

Where $[SF]$ is the % retained on the sieve of interest.

9.1.6 Duplicate results from the same laboratory should be considered acceptable at the 95 % confidence level unless they differ by more than r , the repeatability interval.

9.1.7 Duplicate results from the different laboratories should be considered acceptable at the 95 % confidence level unless they differ by more than R , the reproducibility interval.

9.2 *Bias*—No information can be presented on bias in Test Method B214 for sieve analysis since there are no universally accepted standard sieves.

9.3 *Measurement uncertainty*—The precision of this test method shall be considered by those performing the test when reporting results.

10. Keywords

10.1 mesh designation number; particle size; screened fraction; sieves; Tyler; U.S. standard series



APPENDIXES

(Nonmandatory Information)

X1. CERTIFIED SIEVES—MASTER SET

X1.1 Sieves conforming to Specification E11 can be obtained from the sieve manufacturers, and arrangements can be made through them to have the sieves certified by the National Institute of Standards and Technology (formerly the National Bureau of Standards).⁵ If used continually, the sieves will, after

a period of time, become less accurate and might no longer be acceptable as certified sieves. The common practice, which would be considered acceptable according to this standard, would be to use the certified sieves as a master set for checking other working sets of sieves. By comparing sieve tests on the same sample, run in both the master set and the working set, a factor can be established for correcting results on the working sieves.

⁵ Contact the National Institute of Standards and Technology, Gaithersburg, MD 20899.

X2. MATCHED SIEVES

X2.1 The use of a matched set of sieves, established through use of a standard powder, is recommended when closer correlation of tests between supplier and consumer is desired.

X3. SIEVE SERIES GUIDELINES

X3.1 Suggested combinations of sieves are given in Table X3.1 for several nominal mesh size metal powders.

TABLE X3.1 Suggested Sieve Series for Metal Powders

Nominal Powder Mesh Size		20	40	60	100	140	200	325
New U.S. Sieve Series	20	✓	✓					
	40	✓	✓	✓				
	60	✓	✓	✓				
	80				✓			
	100	✓	✓	✓	✓	✓		
	140			✓	✓	✓	✓	
	200	✓	✓	✓	✓	✓	✓	✓
	230						✓	✓
	325		✓	✓	✓	✓	✓	✓
	Pan	✓	✓	✓	✓	✓	✓	✓

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