Designation: B214 – 22

Standard Test Method for Sieve Analysis of Metal Powders[1]

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, using sieves with openings ranging from 45 to 850 micrometres.

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 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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
E456 Terminology Relating to Quality and Statistics
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:*[3]

MPIF 05 Determination of Sieve Analysis of Metal Powders

3. Terminology

3.1 *Definitions*—Useful definitions of terms relating to powder metallurgy (PM) 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 PM 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, "U.S. Standard Series Test Sieves." These shall conform to Specification E11 and be 203 mm in diameter. In addition to the sieves listed in Table 1, a cover and collection pan are also required.

NOTE 1—The 203 mm diameter sieve is most commonly referenced as an 8 in. diameter sieve. 8 in. diameter sieves do not nest with 200 mm diameter sieves.

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.

[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.

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

*A Summary of Changes section appears at the end of this standard

TABLE 1 U.S. Standard Series Test Sieves

Sieve Number	Sieve Opening (μm)
20	850
40	425
60	250
80	180
100	150
140	106
200	75
230	63
325	45

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 readable to 0.01 g, with a minimum capacity of 150 g.

6. Test Portion

6.1 The size of the test portion shall be 90 to 110 g for any metal powder having an apparent density greater than or equal to 1.5 g/cm^3 when tested in accordance with Test Methods B212, B329, B417, or B703. A test portion of 40 to 60 g shall be used when the apparent density of the powder is less than 1.5 g/cm^3. The test portion 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 portion 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 at least 15 min and report the actual time used along with the test data.

NOTE 3—For some materials, for example brittle and friable materials, the 15 min 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.

NOTE 4—Test results may be affected by the number of sieves in the sieve stack. Sieving times should be adjusted if needed to account for this.

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 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, record the mass, 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 portion. Add the difference between this sum and the mass of the test portion (in accordance with Section 6) to the mass of the fraction collected in the pan.

NOTE 5—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.

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

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	...

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 portion 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 portion as "trace." If a fraction is absent, report it as "0.0". Report the actual time period of sieving.

9. Precision and Bias[4]

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. Standard Series 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 9.1.4 – 9.1.7 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.

[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.

9.1.4 The 95 % repeatability limit, *r*, (within a laboratory), as defined by Terminology E456, is represented by the equation:

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

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

9.1.5 The 95 % reproducibility limit, *R*, (between laboratories), as defined by Terminology E456, is smaller for the circulated sieves than for the in-house sieves. For in-house sieves, *R* can be calculated from the following equations:

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

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

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:

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

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

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 limit.

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 limit.

9.2 *Bias*—No information can be presented on the bias in Test Method B214 for measuring sieve analysis because no material is universally accepted as a standard reference material.

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; U.S. standard series

APPENDIXES

(Nonmandatory Information)

X1. SIEVE COMPLIANCE—MASTER SET

X1.1 Compliance, inspection, and calibration sieves conforming to Specification E11 can be obtained from the sieve manufacturers. If used continually, the sieves will, after a period of time, become less accurate and might no longer meet the requirements set in Specification E11. A common acceptable practice would be to use either inspection- or calibration-grade sieves as a master set for quality control of compliance-grade working 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. Over time, the correcting results should continually be evaluated. Replacement of working sieves is required if a change of 3 % in correcting results is present.

X2. MATCHED SIEVES

X2.1 To correlate sieve results from two different locations, producers and purchasers may use a reference powder to create correcting results as explained in Appendix X1.

X3. SIEVE SERIES GUIDELINES

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