Designation: B 214 – 99

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

This standard is issued under the fixed designation B 214; 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 Department of Defense.

1. Scope

1.1 This test method covers the determination of the dry sieve analysis of metal powders.

1.2 *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:*

B 212 Test Method for Apparent Density of Free-Flowing Metal Powders Using the Hall Flowmeter Funnel[2]

B 215 Practices for Sampling Finished Lots of Metal Powders[2]

B 243 Terminology of Powder Metallurgy[2]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[4]

2.2 *MPIF Standard:*

MPIF 05 Determination of Sieve Analysis of Metal Powders[5]

3. Terminology

3.1 *Definitions*—Useful definitions of terms for metal powders and powder metallurgy are found in Terminology B 243.

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 manufacturer and user, or it may be an internal quality control test for either. This test method is appropriate for materials with size distributions typified by metal powders used in powder metallurgy.

5. Apparatus

5.1 *Sieves*—A set of standard sieves selected from Table 1 of Specification E 11, or the equivalent Tyler standard sieves. The sieves shall be 8 in. (203.2 mm) in diameter and either 1 or 2 in. (25 or 50 mm) in depth and fitted with bronze, brass, stainless steel, or other suitable wire cloth. The U.S. sieves given in Table 1 of this method shall conform to Specification E 11. If Tyler standard sieves are substituted, they shall conform to the permissible variations given in Table 1 of Specification E 11.

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 that sieve opening sizes are correct when performing standardization work.

5.2 *Sieve Shaker*— A mechanically operated, single eccentric sieve shaker which imparts to the set of sieves a rotary motion and tapping action of uniform speed, shall be used. 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 sieve shaker shall be fitted with a 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. A time switch should be provided to ensure accuracy of duration of the test.

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

5.3 *Balance*—A balance having a capacity of at least 110 g and a sensitivity of 0.01 g.

6. Test Specimen

6.1 The size of the test specimen shall be 90 to 100 g for any metal powder having an apparent density greater than 1.50 g/cm^3 when determined in accordance with Test Method B 212. A 40 to 60-g specimen shall be used when the apparent

[1] This test method is under the jurisdiction of ASTM Committee B-9 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] *Annual Book of ASTM Standards* , Vol 02.05

[3] *Annual Book of ASTM Standards* , Vol 14.02.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from Metal Powder Industries Federation (MPIF), 105 College Road East, Princeton, NJ 08540.

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

Mesh Designation 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

density of the powder is less than 1.50 g/cm^3. The test specimen should be obtained in accordance with Practices B 215.

7. Procedure

7.1 Assemble the group of sieves selected in consecutive order as to size of 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 a suitable mechanical sieve shaking device and operate the machine for a period of 15 min.

7.2 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 of the sieve and 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. Weigh this fraction to the nearest 0.1 g and remove it from the balance. Repeat this process for each sieve in the nest and 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 3—If the sum is less than 99 %, check the condition of the screens and pan or possible errors in weighing and repeat the test.

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".

8.2 Interpretation of this report should be made with reference to Specification E 11 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)	Mesh Designation No.	% 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)	Mesh Designation No.	Percentage 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)	Mesh Designation No	Percentage 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 Bias [6]

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 E 691 was followed for the design and analysis of the data. The details are given in MPPA Research Report MPPA R-05-95.[5]

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 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 fitness 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.

[6] 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.