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Standard Test Method for Determination of Tap Density of Metallic Powders and Compounds[1]

This standard is issued under the fixed designation B 527; 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.

ε[1] NOTE—All referenced documents, except Practice B 215, were deleted editorially from Section 2.

1. Scope

1.1 This test method specifies a method for the determination of tap density (packed density) of metallic powders and compounds, that is, the density of a powder that has been tapped, to settle contents, in a container under specified conditions.

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 215 Practice for Sampling Finished Lots of Metal Powders[2]

3. Significance and Use

3.1 This test method covers the evaluation of the tapped density physical characteristic of metallic powders and compounds. The degree of correlation between the results of this test method and the quality of powders in use will vary with each particular application and has not been fully determined.

4. Apparatus

4.1 *Balance*, of appropriate capacity and accuracy to satisfy the requirements shown in Table 1.

4.2 *Graduated Glass Cylinder*,[3] calibrated to contain 100 cm^3 at 20°C, the height of the graduated portion being approximately 175 mm. The graduations shall be at 1 cm^3 intervals, thus allowing a measuring accuracy of ± 0.5 cm^3. For apparent densities over 4.0 g/cm^3, do not use the 100 cm^3 cylinder.

4.2.1 Alternatively, the following may be used:

4.2.1.1 *Graduated Glass Cylinder*, calibrated to contain 25 cm^3 at 20°C, the height of the graduated portion being approximately 135 mm. The graduations shall be at 0.2 cm^3 intervals.

4.2.1.2 A 25-cm^3 cylinder shall be used for powders of apparent density higher than 4 g/cm^3, in particular for refractory metal powders, but may also be used for powder of lower apparent density.

TABLE 1 Accuracy and Capacity of Balance

Cylinder Capacity, cm^3	Apparent Density, g/cm^3	Mass of Test Portion, g
100	>1	100 ± 0.5
100	<1	50 ± 0.2
25	>7	100 ± 0.5
25	2 to 7	50 ± 0.2
25	<2	20 ± 0.1

4.3 *Tapping Apparatus*,[4] which permits the tapping of the graduated cylinder against a firm base. The tapping shall be such that a densification of the powder can take place without any loosening of its surface layers. The stroke shall be 3 mm (0.118 in.) and the tapping frequency shall be between 100 and 300 taps/min. An example of a tapping apparatus is shown in Fig. 1.

5. Test Specimen

5.1 For the quantities of powder required for each test, see Table 1. Obtain test powder samples according to Practices B 215.

5.2 In general, the powder should be tested in the as-received condition. In certain instances the powder may be dried. However, if the powder is susceptible to oxidation, the drying shall take place in a vacuum or in inert gas. If the powder contains volatile substances, it shall not be dried.

5.3 The test shall be carried out on three test samples.

6. Procedure

6.1 Clean the inside wall of the graduated cylinder (5.2) with a suitable clean brush or, if necessary, by rinsing with a

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[2] *Annual Book of ASTM Standards*, Vol 02.05.

[3] Corning No. 3046, Pyrex brand has been found suitable.

[4] The following have been found suitable: Shandon Southern Instruments, Inc., Tap-Pak Volumeter Model JEL-ST2 (Manufactured by J. Engelsmann A.G. or Ludwigshafen 9. Rh. West Germany), 515 Broad Street, Sewickly, PA 15143; Vankel Industries, Vanderkamp Tap Density Tester, 36 Meridian Road, Edison, NJ 08820; Quantachrome Corp., Dual Autotap, 6 Aerial Way, Syosset, NY 11791.

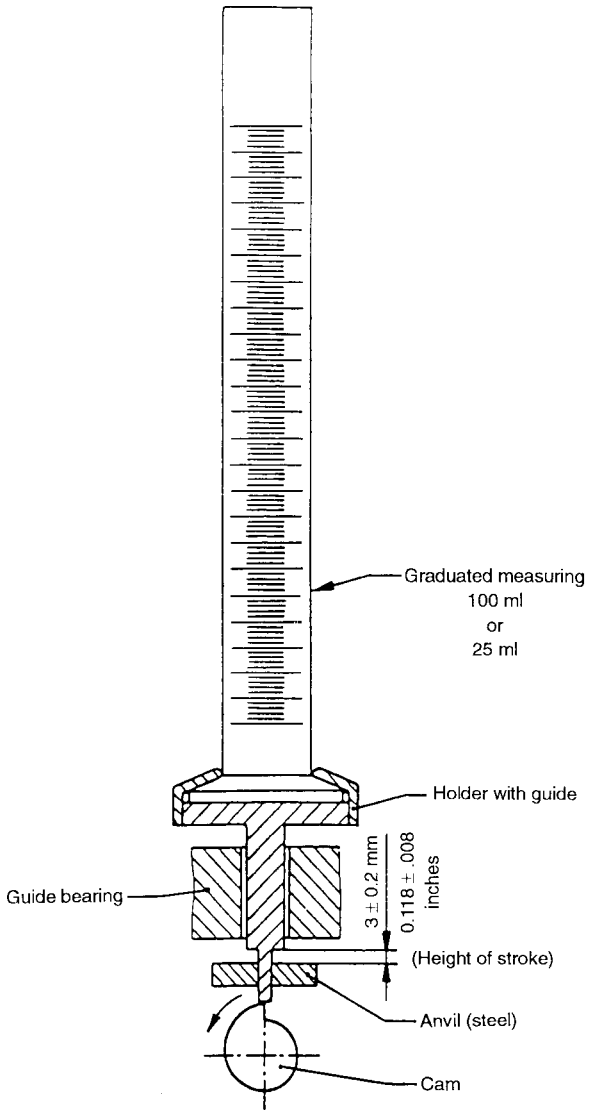

FIG. 1 Example of Tapping Apparatus

solvent, such as acetone. If a solvent is used, thoroughly dry the cylinder before reuse.

6.2 Weigh, to the nearest 0.1 g, the mass of the test portion as indicated in Table 1, using a balance (4.1).

6.3 Pour the test portion into the graduated cylinder. Take care that a level surface of the powder is formed. Place the cylinder in the tapping apparatus (4.3). Tap the cylinder until no further decrease in the volume of the powder takes place (see Note 1).

NOTE 1—In practice, the minimum number of taps, *N*, such that no further change in volume takes place would be determined. For all further tests on the same type of powder, the cylinder would be subjected to 2*N* taps, except where general experience and acceptance have established a specific number of taps (no less than *N* taps) as being satisfactory. For fine refractory metal powders, 3000 taps has been found to be satisfactory for all sizes.

6.4 If the tapped surface is level, read the volume directly. If the tapped surface is not level, determine the tape volume by calculating the mean value between the highest and the lowest reading of the tapped surface. Read the final volume to the nearest 0.5 cm^3 when using a 100 cm^3 cylinder and to the nearest 0.2 cm^3 when using a 25 cm^3 cylinder.

7. Calculation

7.1 The tap density is given in the following equation

$$Pt = \frac{M}{V} \quad (1)$$

where:
Pt = tap density, g/cm^3,
M = mass of powder, g, and
V = volume of tapped powder, cm^3.

8. Report

8.1 Report the following information:

8.1.1 Reference to this test method,

8.1.2 All details necessary for identification of the test sample,

8.1.3 The drying procedure, if the powder has been dried,

8.1.4 Cylinder capacity, mass of test portion and method used,

8.1.5 The result obtained,

8.1.6 All operations not specified in this test method or regarded as optional,

8.1.7 Details of any occurrence that may have affected the result.

9. Precision and Bias

9.1 Precision and bias cannot be stated at this time because this test method covers a broad range of powders and associated densities.

10. Keywords

10.1 apparent density; bulk density; density; density ratio; metal powders; packed density; powder metallurgy; tap density