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Standard Test Method for Apparent Density of Non-Free-Flowing Metal Powders Using the Carney Funnel[1]

This standard is issued under the fixed designation B 417; 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—Keywords were added editorially in September 1995.

[1] This test method is under the jurisdiction of ASTM Committee B-9 B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.02 on Base Metal Powders. Products.
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1. Scope

1.1 This test method covers a procedure for determining the apparent density of non-free-flowing metal powders. It is designed for those metal powders which that do not freely flow through the Hall flowmeter funnel.

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. Summary Referenced Documents

2.1 *ASTM Standards:*

B 215 Practices for Sampling Finished Lots of Test Method

2.1 A container Metal Powders[2]

B 243 Terminology of Powder Metallurgy[2]

B 873 Test Method for Measuring the Volume of definite volume is filled under controlled conditions. The weight of powder per unit volume is determined Apparent Density Cup Used in Test Methods B 212, B 329, and reported as apparent density. B 417[2]

3. Significance and Use

3.1 This test method provides a guide for evaluation of the apparent density physical characteristic of powders. The density measured bears some relationship to the weight of powder that will fill a fixed volume die cavity when partsTerminology

3.1 *Definitions*—Terms in Terminology B 243 are being made. The degree of correlation between the results of applicable to this test method and the quality of powders in use will vary with each particular application. method.

4. Summary of Test Method

4.1 A container of definite volume is filled with non-free-flowing powder under controlled conditions. The mass of powder per unit volume is determined and reported as apparent density, Carney.

5. Significance and Use

5.1 This test method provides a guide for evaluation of the apparent density physical characteristic of powders. The density measured bears a relationship to the mass of powder that will fill a fixed volume die cavity when parts are being made. The degree of correlation between the results of this test method and the quality of powders in use will vary with each particular application.

6. Apparatus

46.1 *Powder Flowmeter Funnel*—A standard[3]—A Carney flowmeter funnel (Fig. 1) having an orifice of 0.20 in. (5 mm) in diameter.

4.2).

[2] The flowmeter funnel, density cup, and stand are available from the Alcan Powders and Pigments, Division
[2] *Annual Book of Alcan Aluminum Corp., 901 Lehigh Ave., Union, NJ 07083-7632. ASTM Standards*, Vol 02.05.
[3] The flowmeter funnel, density cup, and stand are available from Acu Powder International, LLC.

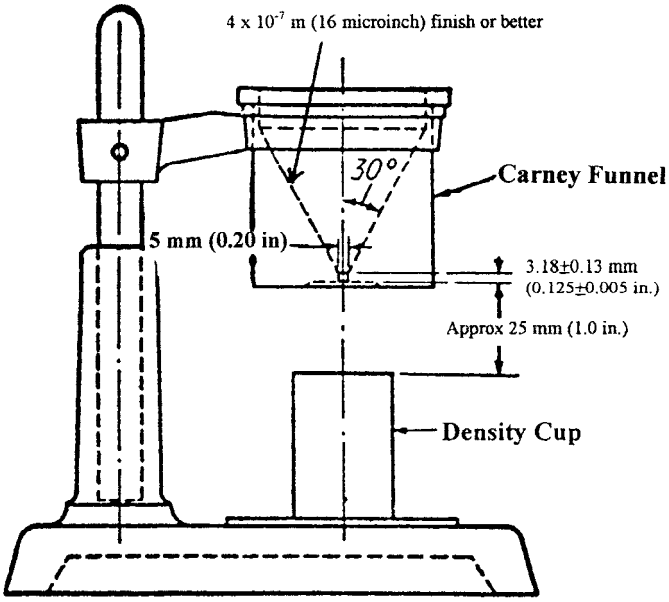

FIG. 1 Carney Funnel and Stand

6.2 *Density Cup* ~~3,~~[3]—A cylindrical brass cup (Fig. ~~1),~~ 2) having a capacity of 25 ~~± 0.05~~ cm^3. The actual cup volume shall be determined according to Test Method B 873.

~~4~~6.3 *Stand*[3] ~~—A~~—A stand (Fig. 1) to support the powder ~~flowmeter~~ funnel concentric with the density cup so that the bottom of the powder ~~flowmeter orifice~~ funnel is ~~1 in. (25 mm)~~ approximately 25 mm (1 in.) above the top of the density cup when the apparatus is assembled as shown in Fig. 1.

~~4~~6.4 *Base*—A level, vibration-free base to support the powder flowmeter.

~~4~~6.5 *Balance*, having a capacity of at least 200 g and a sensitivity of 0.01 g.

~~4~~6.6 *Wire*, approximately ~~0.10 in. (2.5 mm)~~ 2.5 mm (0.10 in.) in diameter by ~~6 in. (150 mm)~~ 150 mm (6 in.) in length.

~~5~~7. Test Specimen

~~5~~7.1 The test specimen shall consist of a volume of approximately 30 to 40 cm^3 of metal powder obtained in accordance with Practice B 215.

~~5~~7.2 The test specimen shall be tested as sampled. Note, however, that temperature, moisture, oils, stearic acid, stearates, waxes, ~~etc.~~ and so forth may alter the characteristics of the powder.

~~6~~8. Procedure

~~6.1 Load~~

8.1 Weigh the empty density cup to the nearest 0.1 g or, alternatively, place the empty density cup on the balance and tare the balance to zero.

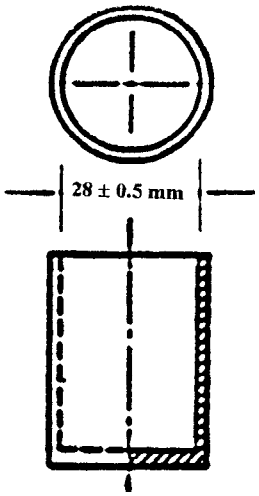

FIG. 2 Density Cup (25 ± 0.03 cm^3)

8.2 Load the test specimen carefully into the flowmeter funnel and permit it to run into the density cup through the discharge orifice. If necessary, it may be agitated or pushed by use of the length of wire but take care to prevent the wire from entering the density cup. The density cup should not be moved during the filling operation.

68.23 When the powder completely fills and overflows the periphery of the density cup, rotate the funnel approximately 90° in a horizontal plane so that the remaining powder falls away from the cup.

68.34 Using a nonmagnetic spatula, with the blade held perpendicular to the top of the cup, level off the powder flush with the top of the density cup. Take care to avoid jarring the apparatus at any time.

68.45 After the leveling operation, tap the density cup lightly on the side to settle the powder to avoid spilling in transfer.

68.56 Transfer the ~~powder~~ filled density cup to the balance and weigh to the nearest 0.1 g to determine the mass (*M*) of powder.

~~7~~9. Calculation

79.1 Calculate the apparent density as follows:

~~Apparent density, g/cm^3 = weight in grams × 0.04~~ (1)

$$\text{Apparent density, g/cm}^3 = M/V \quad (1)$$

where:

M = mass of powder in the density cup in grams and

V = volume of the density cup in cubic centimetres.

810. Report

~~8.1 Results shall be reported~~

10.1 Report the results as apparent density, Carney, to the nearest 0.01 g/cm^3.

911. Precision and Bias

~~9.1 Precision and bias cannot be stated at~~

11.1 *Precision*—The precision of this ~~time because this~~ test method ~~covers~~ has not been determined by a statistically valid interlaboratory test. Results obtained by eight laboratories testing a sample of ~~powders. The development~~ tin powder suggest the following:

11.1.1 *Repeatability r* = 1 % (tin powder)—Duplicate analysis of ~~values for precision~~ a tin powder by the same operator and ~~accuracy is being studied~~ same apparatus should not differ by ~~Subcommittee B09.02~~ more than 1 % at the 95 % confidence level.

11.1.2 *Reproducibility R* = 4 % (tin powder)—The difference between two single and independent results obtained by different operators working in different laboratories on tin powder should not differ by more than 4 % at the 95 % confidence level.

11.2 *Bias*—Since ~~M~~ there is no accepted reference material ~~P~~ fo~~r~~ determining the bias for the procedure in Test Method B 417 for measuring apparent density (Carney), bias has not been determined.

102. Keywords

102.1 apparent density; Carney; ~~Hall~~ flowmeter funnel; metal powders