



Designation: ~~B855-06~~ Designation: **B855 – 11**

Standard Test Method for Volumetric Flow Rate of Metal Powders Using the Arnold Meter and Hall Flowmeter Funnel¹

This standard is issued under the fixed designation B855; 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.

1. Scope*

~~1.1 This test method covers a procedure for measuring the flow characteristics of a given volume of powder.~~

~~1.2 The values stated in SI units are to be regarded as the standard (except for the Hall Flowmeter Funnel, which is produced in inch-pound units). The values given in parentheses are for information only.~~

1.1 This test method covers a laboratory procedure for the quantitative determination of the flow rate of a specific volume of a free-flowing metal powder or lubricated powder mixture.

1.2 With the exception of the values for mass, volume and density, for which the use of the gram and the cubic centimeter unit is long-standing industry practice, the values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 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

B213 [Test Method for Flow Rate of Metal Powders](#)

B215 [Practices for Sampling Metal Powders](#)

B243 [Terminology of Powder Metallurgy](#)

~~B703 [Test Method for Apparent Density of Metal Powders and Related Compounds Using the Arnold Meter](#)~~ [Test Method for Apparent Density of Metal Powders and Related Compounds Using the Arnold Meter](#)

E456 [Terminology Relating to Quality and Statistics](#)

2.2 *MPIF Standard*³

[MPIF Standard 48 Determination of Apparent Density of Metal Powders using the Arnold Meter](#)

3. Terminology

3.1 *Definitions*—Useful definitions of terms for metal powders and powder metallurgy used in this standard are found in Terminology B243. Additional descriptive PM information is available in the Related Material section of Vol 02.05 of the *Annual Book of ASTM Standards*.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *volumetric flow rate*—~~the time required for a given volume of powder to flow through an orifice in a standard instrument according to a specified procedure.~~—the relation between time and volume of a free-flowing metal powder determined by measuring the time for a specific volume to flow through the orifice in a Hall Flowmeter Funnel and expressing the ratio in seconds per 20 cubic centimetres. ($s/20 \text{ cm}^3$).

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.

~~Current edition approved July 1, 2006. Published July 2006. Originally approved in 1994. Last previous edition approved in 1999 as B855-94 (1999)^{\epsilon}. DOI: 10.1520/B0855-06.~~

Current edition approved Nov. 15, 2011. Published November 2011. Originally approved in 1994. Last previous edition approved in 2006 as B855-06. DOI: 10.1520/B0855-11.

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 ~~The sole source of supply of the Arnold Density Meter complete with bushing known to the committee at this time is Arnold P/M Consulting Services, 648 Cedar Road, St. Marys, PA 15857. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.~~

³ Available from ASTM or Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540 and initially reported in MPIF Standard 48

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

4. Summary of Test Method

~~4.1 This test method consists of slowly sliding a bushing partially filled with powder over a 20 cm³ hole in a hardened steel block. The volume of the powder obtained upon removal of the steel block is transferred to a Hall Flowmeter and the flow rate reported in seconds per 20 cm³ test portion of powder is prepared from the lot to be tested following the procedures in Test Methods B215 and B703.~~

~~4.2 This 20 cm³ test portion is timed as it flows through the orifice in a Hall Flowmeter Funnel following the procedure in Test Method B213.~~

~~4.3 The volumetric flow rate is calculated and reported in seconds per 20 cubic centimetres. (s/20 cm³)~~

5. Significance and Use

~~5.1 The~~5.1 The volumetric flow rate is a measure of the flow characteristics of a metal powder. Measuring flow by volume as compared with flow per unit mass eliminates the variable of the powder density and relates to the production practice of die filling by volume.

5.2 The ability of a powder to flow and pack is a function of interparticle friction. As the surface area increases, the amount of friction in a powder mass also increases. Consequently, the friction between particles increases, giving less efficient flow and packing.

~~5.3 Knowledge~~5.3 Knowledge of the volumetric flow rate permits the part producer to estimate the number of parts that can be made compacted per hour to be estimated. hour.

5.4 This test method may be part of the purchase agreement between metal powder manufacturers and powder metallurgy (P/M)(PM) part producers, or it can be an internal quality control test by either the producer or the end user for any company using metal powders.

6. Apparatus

6.1 *Arnold Density Meter*—(Test Method B703) a hardened, tempered, and demagnetized steel block having a center hole 31.6640 ± 0.0025 mm (1.2466 ± 0.0001 in.) in diameter and a height of 25.4000 ± 0.0025 mm (1.0000 ± 0.0001 in.) that corresponds to a volume of 20 cm³ (1.22 in.³) (Fig. 1). Workbench—A level, vibration-free table or laboratory workbench to support the Arnold Meter and the Hall Flowmeter apparatus.

6.2 *Bushing*—either brass or bronze. Approximately 38 mm (1.50 in.) inside diameter (ID) by 45 mm (1.75 in.) outside diameter (OD) by 38 mm (1.50 in.) long (Fig. 1).

6.3 *Hall Flowmeter Arnold Meter*⁴—(Test Method B213) A standard flowmeter funnel having a calibrated orifice of 0.10 in. (2.54 mm) in diameter complete with stand (Fig. 2).—The steel die block and powder delivery cylinder described in Test Method B703 that is used to obtain the 20 cm³ test portion of powder.

6.3 *Collection Paper*—A 6.0 by 6.0 in. square sheet of glazed or waxed paper (~150 by 150 mm) used to collect the 20 cm³ test portion of powder from the die block of the Arnold Meter.

6.4 *Base*—A level, vibration-free base to support the Hall Flowmeter. Powder Scoop—A small nonmagnetic spoonlike laboratory utensil with handle, having a minimum capacity of 25 cm³, used for the controlled transfer of the 20 cm³ test portion of powder from the collection paper into the Hall Flowmeter Funnel.

6.5 *Paper*—Glazed or waxed paper measuring approximately 150 mm by 150 mm square (6.0 in. by 6.0 in.). Hall Flowmeter Funnel⁵—An aluminum funnel having a nominal orifice of 0.10 inches (2.54 mm) with support stand as is shown in Test Method B213. The funnel is stamped with a correction factor determined by the manufacturer using a Certified Flow Standard.

6.6 *Timing Device*—Stopwatch or other suitable device.—A stopwatch or other instrumentation capable of measuring the flow time of the powder to the nearest 0.1 second.

7. Sampling

~~7.1 Obtain a test sample in accordance with Practices B215~~

7.1 Obtain a sample of approximately 150 cm³ from the lot that is to be tested following the procedure in Practices B215.

~~7.2 The powder sample shall be of sufficient volume to fill the bushing to three-quarters of its height.~~

7.2 Using a micro-sample rotary riffler or a micro-splitter, divide the quantity into three test samples of approximately 50 cm³ each.

⁴ The sole source of supply of the Arnold Density Meter complete Hall Flowmeter with bushing known to the committee at this time is ACuPowder International LLC, 901 Lehigh Avenue, Union NJ 07083-7632; Arnold P/M Consulting Services, 648 Cedar Road, St. Marys, PA 15857. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

⁵ The correction factor is a value supplied by the manufacturer of the funnel using a standardized powder. Periodically, the funnel must be calibrated with the standard powder to compensate for orifice wear. For the calibration procedure refer to Test Method B213.

⁶ The sole source of supply of the complete Hall Flowmeter known to the committee at this time is ACuPowder International LLC, 901 Lehigh Avenue, Union NJ 07083-7632. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.