Designation: C 838 – 96 (Reapproved 2005)

An American National Standard

Standard Test Method for Bulk Density of As-Manufactured Carbon and Graphite Shapes[1]

This standard is issued under the fixed designation C 838; 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 the determination of the density of as-manufactured carbon and graphite from measurements of mass and dimensions at room temperature.

1.2 This test method is applicable to boronated carbon and graphite.

1.3 This test method is not applicable to carbon- and graphite-containing materials that are thermally unstable at or below temperatures of 200°C.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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]

C 559 Test Method for Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bulk density*, *n*—the mass of a unit volume including both permeable and impermeable voids (and boron compounds in the case of boronated carbon or boronated graphite) present in the material at room temperature.

4. Significance and Use

4.1 This test method provides a means of determining bulk density on as-manufactured logs, blocks, or shaped articles.

4.2 This test method is suitable for manufacturing control and acceptance specifications.

4.3 Test Method C 559 may be used when a higher degree of accuracy is required.

5. Test Specimens

5.1 *Logs or Blocks*—May be measured and weighed as-manufactured or after rough ends have been squared by machining. The stock shall preferably have been indoors after heat treatment; if there is doubt that the piece is dry, weigh, dry, and reweigh it. Repeat, if necessary, until there is less than 0.1 % weight loss. The drying temperature should be from 110 to 200°C.

5.2 *Shaped Articles*—Other than right circular cylinders or rectangular parallelepipeds may be measured, and a correction made for the cavities or protuberances if the specimen volume can be determined within 0.5 % (see 6.2).

6. Procedure

6.1 *Logs or Blocks*—Measure as-manufactured on the diameter or cross section at two different locations, taking care to avoid distortions. Take four length measurements on cylinders 90° apart on the periphery of the circular end faces. On rectangular pieces, make four length measurements, two each along opposite faces. Make additional measurements, if needed, to determine a valid mean for each dimension. Make dimensional and mass measurements with equipment accurate to 0.5 %.[3]

6.2 *Shaped Articles*—Make dimensional and mass measurements with equipment accurate to 0.5 %.

7. Calculation

7.1 Calculate the bulk density as follows:

$$D = \frac{M}{V}$$

where:

[1] This test method is under the jurisdiction of Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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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] Corrections of mass measurements for buoyancy effects in air are generally negligible for the accuracy obtained.

D = density, kg/m^3,
M = mass, kg, and
V = volume, m^3.

7.2 Calculate to three significant figures.

8. Report

8.1 Report the following:

8.1.1 Type, source, grade, geometry, and whether the specimen is as-manufactured or machined.

8.1.2 Densities of the individual specimens and the averages.

8.1.3 On shaped articles, other than right circular cylinders or rectangular parallelepipeds, the amount of volume correction and method of calculation used in 5.2.

9. Precision and Bias [4]

9.1 *Precision*:

9.1.1 A machined steel mass and an unmachined graphite billet, both right circular cylinders, were circulated to five laboratories. Each laboratory utilized two independent observers, each making a replicate set of measurements. Also, each laboratory was instructed to use normal industrial practice, that is, no special calibration or precaution. The data were tested against the null hypothesis (no difference between labs) and the random effects model for between-laboratory variance.

9.1.2 Measurements on dimensions satisfied the null hypothesis with a pooled coefficient of variation of 0.25 % for the calculated volume. Masses, and hence densities, did not satisfy the null hypothesis. Within-laboratory coefficient of variation on density was 0.28 % and between-laboratory coefficient was 0.81 %. Although the between-laboratory data indicated a bias, subsequent rechecking failed to identify such.

9.1.3 These precision measures represent normal industrial practice and do not indicate the precision attainable under controlled conditions.

9.2 *Bias*—No statement on bias is derivable since the tests were performed with normal industrial practices and procedures.

10. Keywords

10.1 boronated; bulk; carbon; density; graphite; gravimetric; physical

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: C05-1002.