Designation: C748 – 98 (Reapproved 2015)

An American National Standard

Standard Test Method for Rockwell Hardness of Graphite Materials[1]

This standard is issued under the fixed designation C748; 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 Rockwell L scale hardness testing of graphite materials with grain size less than 0.8 mm and a hardness range between 0 and 120.

1.2 Test Methods E18 shall be followed except where otherwise indicated.

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

1.4 *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:*

E18 Test Methods for Rockwell Hardness of Metallic Materials

E171 Practice for Conditioning and Testing Flexible Barrier Packaging

3. Summary of Test Method

3.1 The specimen is held in position and the load is applied. Final position of the indicator on the scale is observed and recorded as the hardness number.

4. Significance and Use

4.1 A Rockwell L scale hardness number is a number derived from the net increase in depth of impression as the load on a 6.3500 mm ± 0.0025 mm diameter steel-ball indenter is increased from a fixed 10 kg minor load to a 60 kg major load and then returned to the minor load.

4.2 A Rockwell hardness number is directly related to the indentation hardness of a material; the higher the Rockwell L scale reading, the harder the material. The test is useful in the evaluation and the manufacturing control of carbon and graphite materials.

5. Apparatus

5.1 *Rockwell Hardness Tester,* calibrated in accordance with the requirements of Section 7.

5.2 *Rockwell Hardness Tester Anvil,* appropriate for the material shall be used as the specimen base plate.

6. Test Specimen

6.1 The recommended test specimen shall be flat and have a minimum thickness of 6.35 mm.

6.2 The test surface roughness shall not exceed 3175 nm arithmetical average.

6.3 The test surface to opposite face parallelism for flat specimens shall be within 1 %. For all other specimen shapes, the test surface must be maintained normal to the direction of load application.

7. Verification of Calibration

7.1 Level the Rockwell hardness tester in accordance with the manufacturer's instructions.

7.2 The adjustment of speed-of-load application is of great importance. Adjust the dashpot on the Rockwell tester so that the operating handle completes its travel in 4 s to 7 s with no specimen on the machine or no load applied by the indenter to the anvil. The major load shall be 60 kg for this calibration. When so adjusted, the period taken for the mechanism to come to a stop with the specimen in place will vary from 5 s to 15 s, depending upon the particular specimen, the indenter, and the load used. The operator should check the instrument manual for this adjustment.

7.3 Select a test block for Rockwell L scale ball-type indenters and make five impressions on the test surface of the block. Compare the average of these five tests against the hardness calibration of the block. If the error is more than ±2 hardness numbers, the machine or penetrator, or both, must be checked to determine and correct the cause of error.

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

Current edition approved Oct. 1, 2015. Published December 2015. Originally approved in 1973. Last previous edition approved in 2010 as C748 – 98 (2010)ε1. DOI: 10.1520/C0748-98R15.

[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.

8. Conditioning

8.1 Allow the specimen(s) to reach equilibrium with room-temperature air, and test under the same conditions in accordance with Specification E171.

8.2 Keep specimens free from contamination.

9. Procedure

9.1 Before using the Rockwell hardness tester, calibrate it as described in Section 7.

9.2 Select the proper anvil for the specimen used.

9.3 Clean the shoulder of the screw and seat the anvil securely.

9.4 Record the Rockwell L scale hardness values (the position of the pointer of the red dial after the major load has been removed and while the minor load is still applied). Estimate the readings to the nearest full-scale division within 15 s after removing the major load.

9.5 At least five hardness tests shall be made on isotropic material in accordance with 11.1.9.

9.6 For anisotropic material, at least five hardness tests shall be made on the surface perpendicular to the molding or extrusion direction unless otherwise specified and in accordance with 11.1.9.

10. Report

10.1 Report the following information:

10.1.1 Material identification;

10.1.2 Total thickness of the specimen;

10.1.3 Shape and surface condition; for example, flat or round, molded or machined;

10.1.4 Orientation of test with respect to material anisotropy, for example, parallel or perpendicular;

10.1.5 Average hardness reading to the nearest full division and indicating the Rockwell scale use;

10.1.6 The standard deviation when applicable; and

10.1.7 The testing conditions including test date, test machine serial number, operator's name, and environmental conditions.

11. Precision and Bias[3]

11.1 The precision and bias in 11.2 and 11.3 are affected by the following factors:

11.1.1 If the table on which a Rockwell hardness tester is mounted is subject to vibration, such as is experienced in the vicinity of other machines, the tester should be effectively protected. Mounting the hardness tester on a metal plate with 25 mm thick sponge rubber pads is recommended.

11.1.2 Indenters that show rust, nicks, burrs, or are out of round will cause erroneous readings.

11.1.3 The condition of the test equipment is an important factor in the accuracy of the tests. Dust, dirt, grease, or heavy oil act as a cushion to the load supporting members of the test equipment and cause erroneous readings. The shoulders of the instrument housing, indenter chuck, ball seat in the instrument housing, capstan, capstan screw, and anvil shoulder seat should be kept clean and true. Only the capstan screw should be lightly oiled.

11.1.4 Geometry of the specimens may have a marked effect on the readings obtained in a test. Tubular or unsupported curved specimens are not recommended for hardness testing; such shapes have a tendency to deform with the load and influence the reading.

11.1.5 Many graphites have anisotropic characteristics which may cause hardness to vary with the orientation of the specimen.

11.1.6 Rockwell hardness tests should be made on specimens of sufficient thickness so that the Rockwell reading is not affected by the supporting anvil.

11.1.7 Specimen surface finish and surface parallelism may influence the readings.

11.1.8 Contaminants like water, oil, and so forth, absorbed in the specimen pores may influence the readings.

11.1.9 Do not make the tests near the edge of the specimen or too close together. In no case shall the clearance between the edge of the specimen and between individual indentations be less than 6.35 mm. Never test on the opposite face of a single specimen; if a specimen is turned over and retested on the opposite face, the indentation ridges on the first face may affect the reading on the opposite face.

11.1.10 Rockwell L scale hardness readings over 120 shall not be reported. Readings between 0 and 100 are recommended, but readings up to 120 are permissible.

11.2 Precision among eight laboratories is ±2 hardness numbers.

11.3 Bias of a properly calibrated instrument is ±2 hardness numbers.

12. Keywords

12.1 carbon; graphite; hardness; indenter; Rockwell L

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C05-1007.