Designation: B 887 – 98

Standard Test Method for Determination of Coercivity (Hcs) of Cemented Carbides[1]

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1. Scope

1.1 This test method covers the determination of magnetization coercivity (Hcs) of cemented carbide materials and products using coercive force instrumentation. It is patterned after ISO 3326.

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:*

A 340 Terminology of Symbols and Definitions Relating to Magnetic Testing[2]

B 243 Terminology of Powder Metallurgy[3]

2.2 *ISO Standard:*

ISO 3326 Hardmetals - Determination of (the Magnetization) Coercivity[4]

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this procedure refer to Terminology A 340 and Terminology B 243.

3.1.2 *dc*—direct current

4. Summary of Test Method

4.1 A test sample is positioned in the dc magnetic field of the test apparatus and magnetized to technical saturation. The magnetic field polarity is then reversed and the test sample is demagnetized by increasing the energy of the reversed magnetic field until the test sample reaches zero magnetism. The coercive force (Hc) is the magnetizing force required to return the saturated magnetic induction to zero.

5. Significance and Use

5.1 Measurement of coercivity provides a relative comparison of carbide grain size, binder content, and possibly carbon deficiency for a given graded carbide material or product, and may be employed as a non-destructive measurement indicating deviation from a specified norm.

5.2 This test method allows the non-destructive estimate of average carbide grain size in sintered cemented carbide hardmetals. It is appropriate for a wide range of compositions and tungsten carbide (WC) WC grain sizes, and can be used for acceptance of material or product to specification.

6. Interferences

6.1 Hcs measurement is a non-destructive "bulk" measurement that is averaged over the specimen volume. Bi-modal grain size distributions will give approximately the same Hc value as would be obtained from a normal grain size distribution about the same mean value.

6.2 Large test specimens must be sized to fit within the magnetic field coil spacing available for the apparatus employed.

6.3 Small test specimens may be immeasurable if their size prohibits detection by the magnetic field coils for the apparatus employed.

6.4 Specimen shape, that is, symmetry and aspect ratio, influence Hc measurement values and repeatability of results. Test specimens should be positioned with their long axis in the direction of the magnetic field. Asymetrically shaped test specimens should be tested in several positions, the measurement values recorded, and the average value reported.

7. Apparatus

7.1 Instrumentation capable of the dc magnetization of appropriately sized test samples to technical saturation and accurate measurement of the energy required to restore the magnetic induction to zero.

8. Procedure

8.1 For commercial instrumentation, refer to the equipment operators manual and follow the manufacturer's operating instructions.

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[2] *Annual Book of ASTM Standards*, Vol 03.04.

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

[4] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

8.2 Position the test sample in the center of the magnetic field. The test sample should be positioned with its long axis in the direction of the magnetic field (see 6.4).

8.3 Magnetize the test sample to technical saturation.

8.4 Reverse the magnetic field polarity and demagnetize the test sample to zero.

8.5 Record the Hc measurement, that is, energy required to demagnetize the test sample.

8.6 Replicate measurement of the same test sample shall be made, reversing the polarity of the saturation and demagnetizing magnet fields, where possible.

8.7 For asymmetric sample shapes, repeat measurements shall be made by repositioning the specimen in the d-c magnetic field of the instrumentation with consideration being given to the shape, that is, symmetry of the test sample, and to its aspect ratio, that is, length versus width.

9. Report

9.1 Report the following information:

9.1.1 Test sample identification,

9.1.2 Mass of the specimen,

9.1.3 Average Hcs coercivity (oersteds or amps per meter (A/m)), and

9.1.4 Range of measured Hc values, especially for replicate measurements of asymmetric sample shapes.

10. Precision and Bias

10.1 *Precision*—Measurement of coercive force is a relative comparison against well characterized reference materials (see Section 8). No statement about precision can be made due to the effects of test specimen shape, variations in the binder content that are within material or product specification, and the presence of carbon deficiency.

10.2 *Bias*—Measurement of coercive force is a relative comparison against well characterized reference materials (see Section 8). No statement about bias can be made due to the effects of test specimen shape, variations in the binder content that are within material or product specification, and the presence of carbon deficiency.

10.3 No certified cemented carbide standards are available for coercive force measurement. Most common practice is the development of (internal) reference materials representative of the product(s) being evaluated.

11. Keywords

11.1 cemented carbide; coercive force; coercivity; magnetization