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

This standard is issued under the fixed designation B887; 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~~ 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 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A340 Terminology of Symbols and Definitions Relating to Magnetic Testing

B243 Terminology of Powder Metallurgy

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO Standard:*[3]

ISO 3326 Hardmetals - Determination of (the Magnetization) Coercivity

3. Terminology

3.1 *Definitions:*

3.1.1 For definition of terms used in this procedure refer to Terminology A340 and Terminology B243.

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

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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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

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. Asymmetrically shaped test specimens should be tested in several positions, the measurement values recorded, and the average value reported.

6.5 Compositional variation of the binder in hardmetal due to cooling rate can affect Hc. For instance, formation of Co_3W precipitate in the binder phase during aging of hardmetal after fast cooling can significantly change Hc of the material.

6.6 Difference in contiguity of hard particles in hardmetal can affect Hc. For instance, two materials with different WC/WC contiguity but similar WC grain size will have different interphase areas and different Hc values.

6.7 Deformation and residual stresses affect Hc. Deformed hardmetal shows a significant increase in Hc due to deformation of its binder phase. Tumbling which is a standard method used for imparting residual stress into hardmetal, increases Hc.

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. Standards

8.1 No certified cemented carbide standards, powder materials or sintered product, are available for Hc measurement. Most common practice is the development of (internal) reference materials representative of the test samples being evaluated.

8.2 Soft magnetic material (50 percent Ni – 50 percent Fe alloy) with low Hc and hard ferromagnetic material with high Hc are recommended for calibrating the instrument.

9. Procedure

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