



Standard Test Method for Rating Grain Size and Frequency of Abnormally Large Grains in Cemented Tungsten Carbides (Hardmetals)¹

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1. Scope

1.1 This test method describes a procedure for measuring abnormally large grains and the frequency of those grains in cemented tungsten carbides (hardmetals).

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:*²

B 243 Terminology of Powder Metallurgy

B 406 Test Method for Transverse Rupture Strength of Cemented Carbides

B 657 Guide for Metallographic Identification of Microstructure in Cemented Carbides

B 665 Guide for Metallographic Sample Preparation of Cemented Tungsten Carbides

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology **B 243**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *E-Rating*—the number/cm² of grains larger than a specified size in a fully-etched specimen.

3.2.2 *L-Rating*—the size, in μm , of the largest grain observed in a fully-etched specimen.

4. Summary of Test Method

4.1 A polished and fully etched specimen/specimens having a minimum observable area of 0.5 cm² is examined using a

metallograph. Abnormally large grains, compared to the finer-grained background material, are identified. These grains are categorized as: (1) The number of grains larger than a specified size, or (2) The largest grain observed, or both.

5. Significance and Use

5.1 The microstructure and grain growth of cemented tungsten carbides affect the material's mechanical and physical properties. The grain size and distribution will affect the material's wear resistance and fracture toughness. Abnormally large grains as compared to the background may introduce an area of weakness in a sintered part.

5.2 This test method may be used in acceptance testing of cemented tungsten carbide materials or the tungsten carbide powder used in their manufacture. The specified grain size used for the E-Rating is to be agreed upon between purchaser and supplier.

6. Apparatus

6.1 *Metallographic Microscope*, capable of magnifications of up to 1500 $\times$.

6.2 Ordinary metallurgical laboratory equipment.

6.3 Equipment for specimen preparation as outlined in Guide **B 665**.

7. Test Specimens

7.1 *Specimen Size*—The recommended specimen shall be the standard transverse rupture specimen as specified in Test Method **B 406**; that is, ground to the following dimensions: 5.00 $\pm$ 0.25 mm (0.200 $\pm$ 0.010 in) thick by 6.25 $\pm$ 0.25 mm (0.250 $\pm$ 0.010 in) wide by 19.0 mm (0.750 $\pm$ in) long. Alternatively, the specimen shall be a size to provide a minimum 0.5 cm² surface area of examination, or it may consist of several samples that provide this minimum area.

7.2 *Specimen Preparation:*

7.2.1 Polish the specimen/specimens according to the procedure described in Guide **B 665**, or other suitable metallographic polishing procedure. If using the recommended specimen, polish the 6.25 by 19.0 mm side.

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 B09.06 on Cemented Carbides.

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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.



7.2.2 Etch the specimen according to the procedure described in Test Method **B 657**, or other suitable etching procedure that will reveal the tungsten carbide grain structure.

8. Procedure

8.1 Examine a fully-etched specimen at a minimum of 200× magnification.

8.1.1 *For E-rating*—Count the number of grains larger than the specified size observed in the full cross-section of the polished and etched specimen/specimens. Divide this number by the total area examined (1.2 cm² for the recommended transverse rupture specimen) to obtain a number of grains/cm².

8.1.2 *For L-Rating*—Measure the largest dimension of the largest grain observed in the polished and etched specimen/specimens.

9. Report

9.1 The report shall include the following:

9.1.1 Reference to this test method,

9.1.2 Complete identification of the test specimen,

9.1.3 Details of any occurrence that may have affected the results,

9.1.4 The total area examined, in cm²,

9.1.5 The E-Rating as grains/cm², rounded to the nearest whole integer, and

9.1.6 The L-Rating in μm, rounded to the nearest whole integer.

10. Precision and Bias

10.1 No statement regarding precision and bias of this test method can be made at this time. Plans for an interlaboratory study are being formulated.

11. Keywords

11.1 abnormally large grains; cemented carbides; cemented tungsten carbide; E-rating; hardmetals; L-rating; microstructure

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