Designation: B 390 – 92 (Reapproved 2000)

Standard Practice for Evaluating Apparent Grain Size and Distribution of Cemented Tungsten Carbides[1]

This standard is issued under the fixed designation B 390; 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 procedure for the visual comparison and classification of the apparent grain size and distribution of cemented tungsten carbides is limited to cemented tungsten carbides that contain approximately 6, 10, and 18 % cobalt.

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:*

B 657 Test Method for Metallographic Determination of Microstructure in Cemented Carbides[2]

B 665 Practice for Metallographic Sample Preparation of Cemented Tungsten Carbides[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *apparent grain size*—the average diameter of a tungsten carbide particle as measured on an etched metallographically polished surface of a specimen of sintered cemented carbide. The apparent grain size is expressed in micrometres and is generally reported as a range.

4. Significance and Use

4.1 The apparent size and distribution of tungsten carbide grains in cemented carbides affects the material's wear resistance and fracture. For a given chemical composition, an increase in the average grain size will result in increased toughness and decreased wear resistance. This practice illustrates representative micro-structures for a wide range of tungsten carbide-cobalt grades. This is not intended to be used as a specification for carbide grades; producers and users may use the micrographs and the grain size chart as a guide in developing their own specifications.

5. Specimen Preparation

5.1 Specimens shall be prepared for metallographic examination in accordance with a procedure suitable for this type of cemented carbides.

NOTE 1—A suitable procedure is described in Method B 657 and Practice B 665.

6. Procedure

6.1 Examine metallographically the entire surface of an etched specimen at a magnification of 1500 diameters. Select a representative area and make a comparison with the photomicrographs in Fig. 1, Fig. 2, and Fig. 3.

6.2 The nominal analyses of the cemented tungsten carbide samples that were used to prepare the nine photomicrographs shown in Fig. 1, Fig. 2, and Fig. 3 are as follows:

6.2.1 Fig. 1—Tungsten carbide plus 6 % cobalt,

6.2.2 Fig. 2—Tungsten carbide plus 10 % cobalt, and

6.2.3 Fig. 3—Tungsten carbide plus 18 % cobalt.

6.3 The grain size for each of these specimens may be designated as follows:

Type F—Fine grain,

Type M—Medium grain, and

Type C—Coarse grain.

7. Evaluation

7.1 The grain size rating of a cemented tungsten carbide specimen is accomplished by selecting the photomicrographs in Fig. 1, Fig. 2, or Fig. 3 that most nearly match the field observed on the specimen being evaluated (see Appendix X1).

7.2 A range of numerical values for various concentrations of tungsten carbide particles, even though arbitrary, is suggested in Table 1.

8. Report

8.1 After visual comparison of a specimen with the photomicrographs contained in this practice, the apparent grain size of a particular specimen shall be rated relative to one or more of the photomicrographs. Cobalt contents should always be specified. For example, a cemented tungsten carbide specimen containing approximately 6 % cobalt, having a fine grain size and a grain size distribution similar to the one shown in Fig. 1(*a*) would be reported as Type 6-F. The "F" indicates a fine grain size and the "6" identifies the cobalt content.

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[1] This practice is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Productsand is the direct responsibility of Subcommittee B09.06 on Cemented Carbides.

Current edition approved Jan. 15, 1992. Published June 1992. Originally published as B 390 – 62 T. Last previous editions B 390 –86.

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

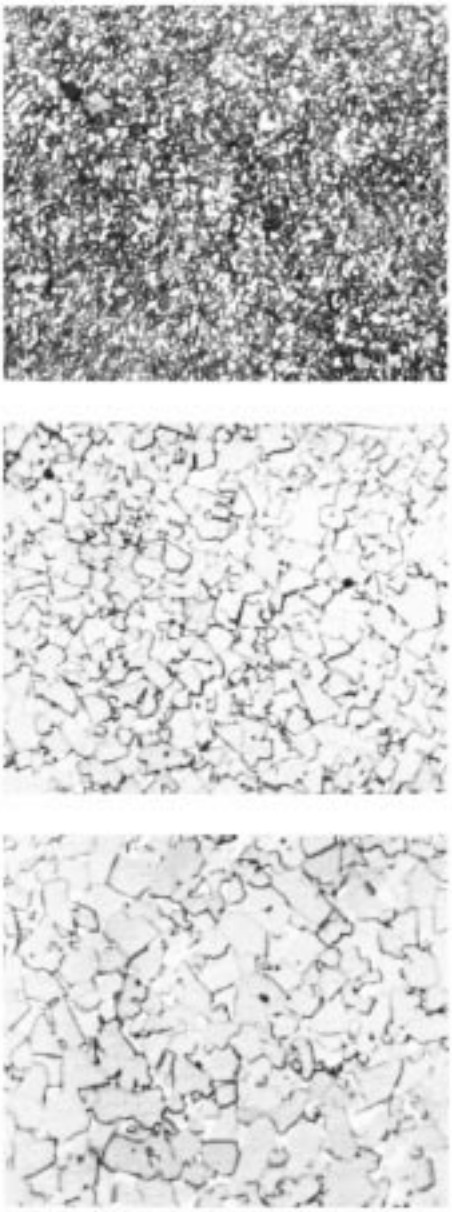

FIG. 1 Apparent Grain Size of Tungsten Carbide plus 6 % Cobalt (1500×)

FIG. 2 Apparent Grain Size of Tungsten Carbide plus 10 % Cobalt (1500×)

9. Precision and Bias

9.1 Visual comparison of cemented carbide microstructures with the Carbide Grain Size Chart is subjective. No precision and bias statement can be made for this practice.

10. Keywords

10.1 apparent grain size; cemented carbides; cemented tungsten carbides; grain size distribution; hardmetals; microstructure; powder metallurgy

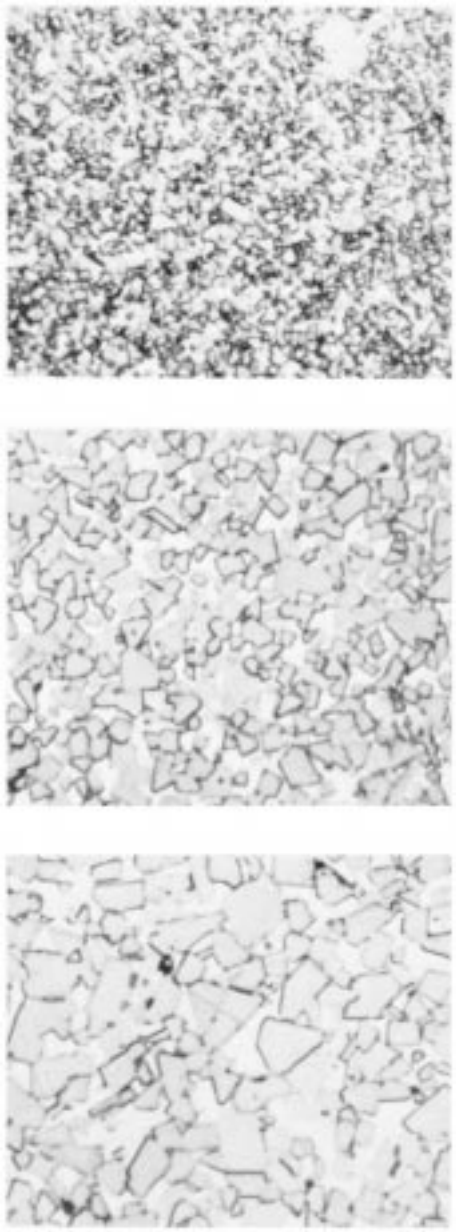

FIG. 3 Apparent Grain Size of Tungsten Carbide plus 18 % Cobalt (1500×)

TABLE 1 Suggested Range of Values for Concentrations of Particles

Figure Number	Grain Size	High Concentration, µm	Low Concentration, µm	Rating
1(*a*)	fine	0.25 to 1.00	1.25 to 2.00	6-F
1(*b*)	medium	2.00 to 5.00	0.75 to 1.00	6-M
1(*c*)	coarse	4.00 to 6.00	0.50 to 3.00	6-C
2(*a*)	fine	0.25 to 0.75	1.00 to 2.00	10-F
2(*b*)	medium	2.00 to 4.00	0.50 to 1.00	10-M
2(*c*)	coarse	3.00 to 6.00	0.75 to 2.00	10-C
3(*a*)	fine	0.25 to 0.50	1.00 to 2.00	18-F
3(*b*)	medium	1.50 to 4.00	0.50 to 1.00	18-M
3(*c*)	coarse	3.00 to 6.00	0.75 to 2.00	18-C

APPENDIX

(Nonmandatory Information)

X1. CARBIDE GRAIN SIZE CHART

X1.1 Fig. X1.1 illustrates the relationship of grain sizes from 1 to 10 μm as observed at a magnification of 1500 diameters (1 μm = 0.00003937 in.).

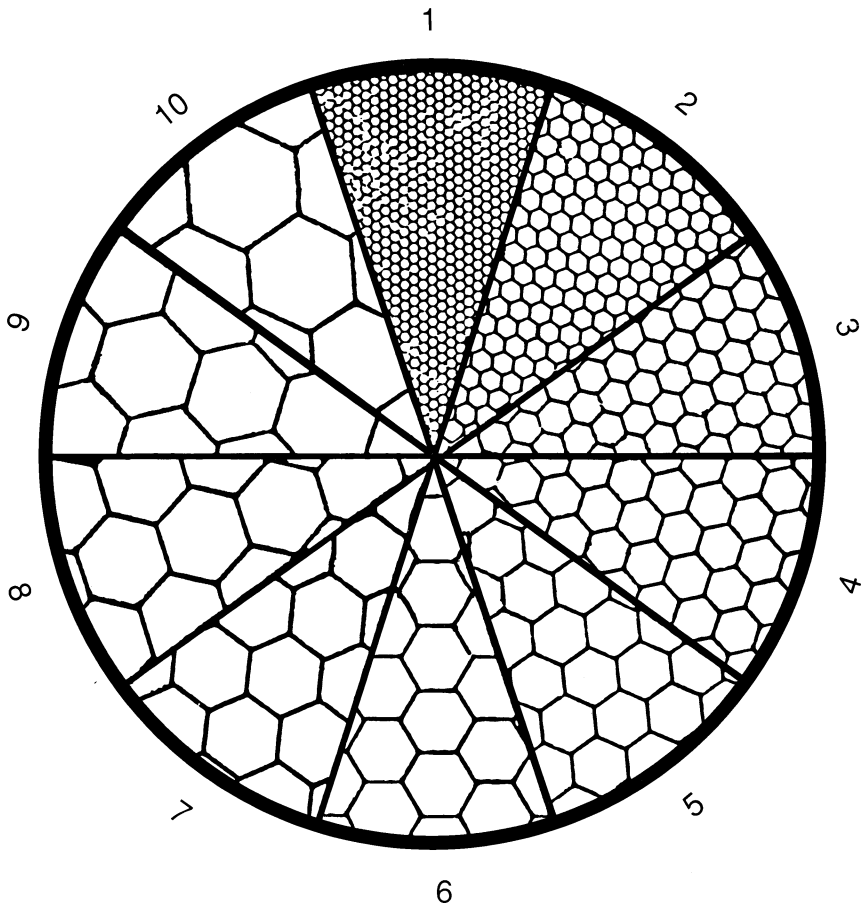

FIG. X1.1 Relationship of Grain Sizes at Magnification of 1500 Diameters