



Designation: B 276 – 91 (Reapproved 2000)

## Standard Test Method for Apparent Porosity in Cemented Carbides<sup>1</sup>

This standard is issued under the fixed designation B 276; 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 approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope

1.1 This test method specifies procedures for the metallographic determination of apparent porosity in cemented carbides.

NOTE 1—The term “apparent porosity” is construed to mean all microstructures observed on a properly prepared, unetched surface, including structures resulting from uncombined carbon, non-metallic inclusions, etc., as well as true, inherent porosity.

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 243 Terminology of Powder Metallurgy<sup>2</sup>

B 665 Practice for Metallographic Sample Preparation of Cemented Tungsten Carbides<sup>2</sup>

#### 2.2 ASTM Adjunct:

ADJA0276 Apparent Porosity (5 prints of 5 photomicrographs each)<sup>3</sup>

#### 2.3 ISO Standard:

ISO 4505 Hardmetals—Metallographic Determination of Porosity and Uncombined Carbon<sup>4</sup>

### 3. Terminology

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

### 4. Significance and Use

4.1 Cemented carbide materials may contain small voids that, depending on the application, may affect the performance of the product. To assist users in specifying the maximum

acceptable level of porosity, this test method illustrates a broad range of porosity levels for each of three porosity types. This test method is not intended to be used as a specification, but the levels shown here may be cited in specifications written by producers and users of cemented carbides.

### 5. Interferences

5.1 Lack of adequate pressure on the specimen during polishing may result in material being torn from the surface of the specimen. This condition may be erroneously interpreted as porosity.

### 6. Apparatus

6.1 Ordinary laboratory apparatus.

6.2 A metallographic microscope permitting observation and measurement up to a magnification of 200 diameters.

6.3 Equipment for the metallographic preparation of test specimens.

### 7. Specimen Preparation

7.1 Where possible, specimens should be metallographically mounted in a plastic material, so that they can be polished without rounding the edges. Larger specimens may be polished without mounting. When the specimens are too large, they shall be sectioned using a diamond cut-off wheel or by fracturing (appropriate safety precautions shall be utilized when fracturing a specimen). The area selected for examination shall represent, as nearly as possible, the entire cross section.

7.2 The specimen shall be prepared for metallographic examination. The surface to be examined shall be unetched and free of grinding and polishing marks.

NOTE 2—A suitable procedure is described in Practice B 665.

### 8. Procedure

8.1 Pore size shall be defined as the maximum dimension of the pore. Make special reference to the presence of cracks and slits, as well as nonmetallic inclusions.

8.2 Classification of apparent porosity is based entirely on comparison of the microstructures found with the photomicrographs in Figs. 1-5.<sup>3</sup> This can be accomplished by scanning the specimen surface under the microscope at the appropriate

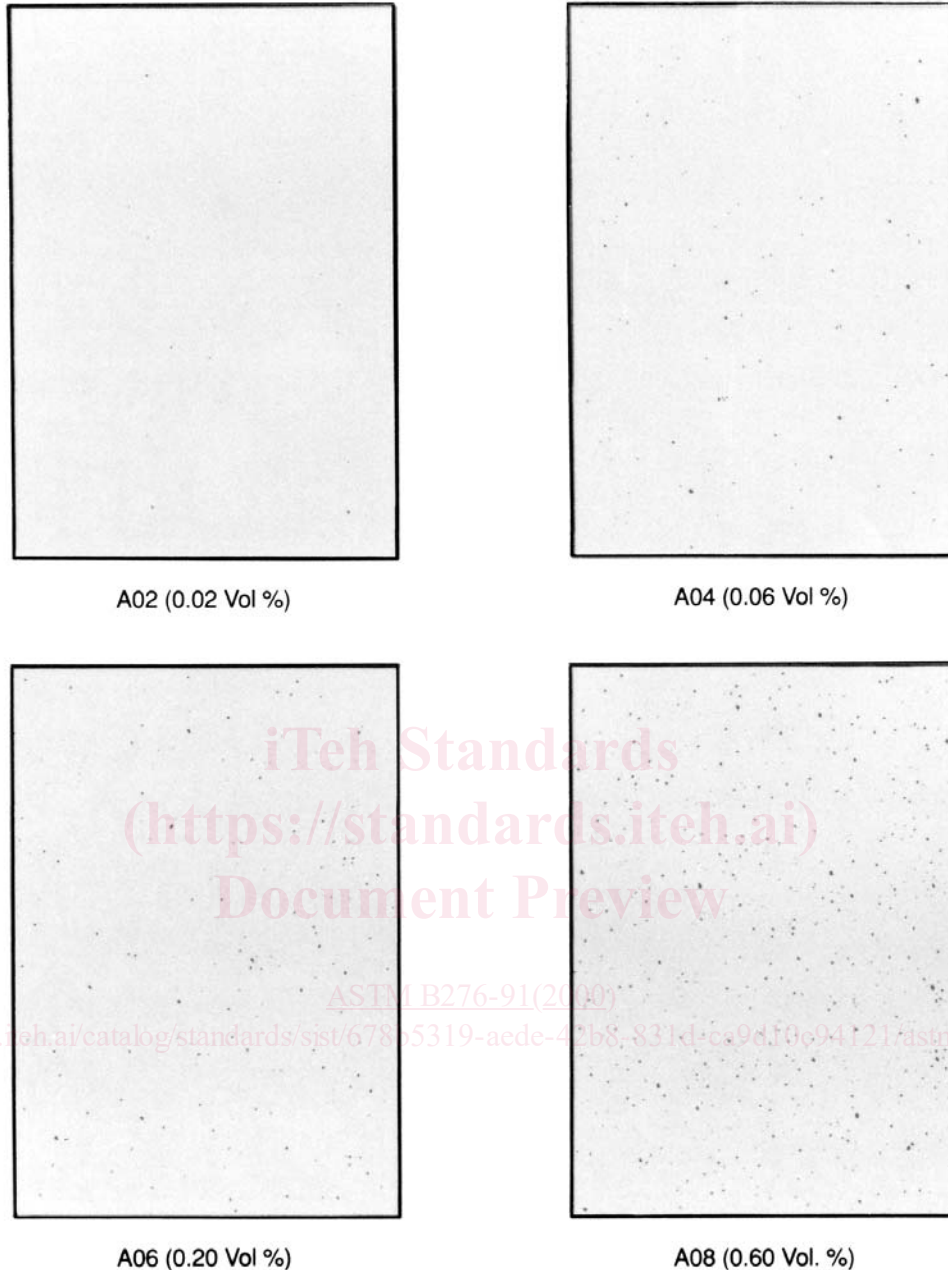
<sup>1</sup> This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.06 on Cemented Carbides.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.05.

<sup>3</sup> Available from ASTM Headquarters. Request ADJA0276.

<sup>4</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.



**FIG. 1 Type A Apparent Porosity ( $\times 100$ )**

magnification, and noting which of the photomicrographs most nearly represents the fields observed. Choose an area fully representative of the specimen surface for comparison with the photomicrographs.

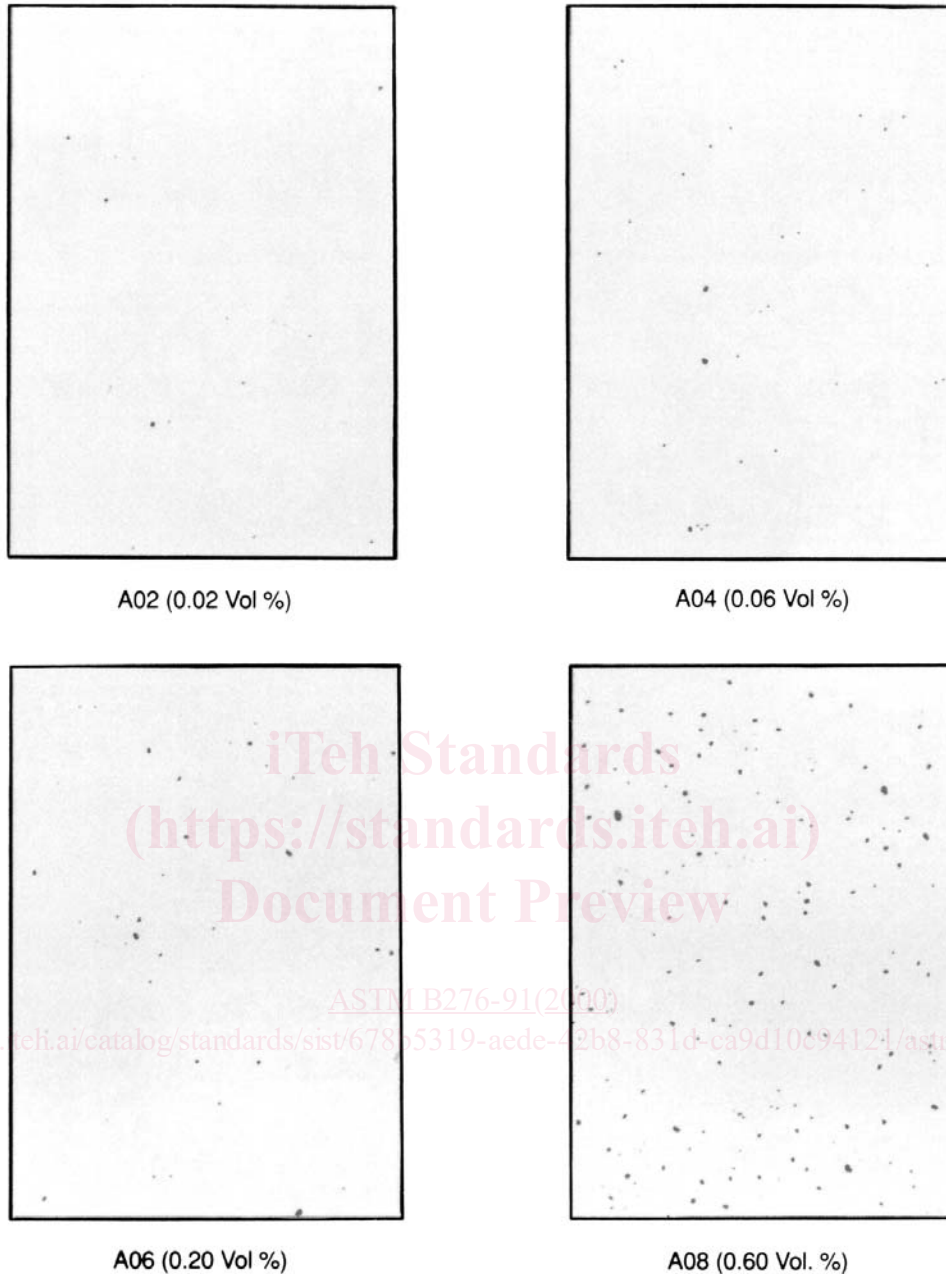
8.2.1 If the porosity of uncombined carbon is not uniform over the area of the test-piece section being examined, the locations on the section to which the evaluation refers must be identified, for example as top, bottom, edge, rim (case), core, etc.

8.2.2 Classify pores up to  $10\ \mu\text{m}$  as Type A (see Fig. 1 and Fig. 2), and examine at a magnification of 100 or 200

diameters. Report the porosity level by reference to the appropriate photomicrograph, and designate as A02, A04, A06, or A08.

8.2.3 Classify pores in the range from  $10$  to  $25\ \mu\text{m}$  as Type B (see Fig. 3), and examine at a magnification of 100 diameters. Report the porosity level by reference to the appropriate photomicrograph, and designate as B02, B04, B06, or B08.

8.2.4 Count and report pores larger than  $25\ \mu\text{m}$  as the number of pores per unit area. Choose the size ranges as follows:  $25$  to  $75\ \mu\text{m}$ ,  $75$  to  $125\ \mu\text{m}$ , and over  $125\ \mu\text{m}$ .



**FIG. 2 Type A Apparent Porosity ( $\times 200$ )**

8.2.5 Classify porosity resulting from uncombined carbon as Type C (see Fig. 4 and Fig. 5), and examine at a magnification of 100 or 200 diameters. Report the porosity level by reference to the appropriate photomicrograph, and designate as C02, C04, C06, or C08.

8.3 If no porosity of either Type A, B, or C is detected, report it as A00, B00, or C00, as applicable.

NOTE 3—This classification procedure follows essentially ISO 4505.

## 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 Results obtained, and

9.1.4 Details of any occurrence that may have affected the result.

## 10. Precision and Bias

10.1 A precision and bias statement cannot be made for this test method.

## 11. Keywords

11.1 apparent porosity; cemented carbides; hardmetals; microstructure; powder metallurgy