



Designation: ~~B796-02~~ Designation: **B 796 – 07**

Standard Test Method for Nonmetallic Inclusion Content of Powders Intended for Powder Forging (P/F)(PF) Applications¹

This standard is issued under the fixed designation B 796; 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 test method covers a metallographic method for determining the nonmetallic inclusion level of powders intended for powder forging (P/F) applications.*~~

1.1 This test method covers a metallographic method for determining the nonmetallic inclusion level of powders intended for powder forging (PF) applications.

1.2 The test method covers repress powder forged test specimens in which there has been minimal lateral material flow ($< 1\%$). The core region of the powder forged test specimen shall contain no porosity detectable at $100\times$.

1.3 This test method is not suitable for determining the nonmetallic inclusion level of powder forged test specimens that have been forged such that the core region contains porosity. At the magnification used for this test method residual porosity is hard to distinguish from oxide inclusions. Too much residual porosity makes a meaningful assessment of the inclusion population impossible.

1.4 The test method may be applied to materials that contain manganese sulfide (admixed or prealloyed) provided the near neighbor separation distance is changed from $30\ \mu\text{m}$ to $15\ \mu\text{m}$.

NOTE 1—The test method may be applied to powder forged parts where there has been a greater amount of material flow provided:

The near neighbor separation distance is changed, or

The inclusion sizes agreed between the parties are adjusted for the amount of material flow.

1.5 *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

E 3 *Practice Guide for Preparation of Metallographic Specimens*

E 768 *Guide for Preparing and Evaluating Specimens for Automatic Inclusion Assessment of Steel*

3. Summary of Test Method

3.1 A section representing the core region is cut from the powder forged test specimen and mounted for metallographic grinding and polishing.

3.2 The polished sample is examined microscopically at a magnification of $100\times$ and a note made of inclusions larger than a predetermined size.

3.3 The maximum Feret's diameter is used to determine inclusion size. A Feret's diameter is a caliper diameter as illustrated in Fig. 1.

3.4 The fragmented nature of some inclusions means that their size determination is somewhat complicated. The concept of near neighbor separation is used in determining inclusion size. If an inclusion is within a certain distance of its neighboring particles, it is considered a member of an inclusion cluster or agglomerate. Detected features within $30\ \mu\text{m}$ of one another are considered part of the same inclusion. The concept is illustrated schematically in Fig. 2.

3.5 The nonmetallic inclusion level of the test specimen is reported as the number of inclusions per $100\ \text{mm}^2$ greater than or equal to the predetermined size.

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 B09.11 on Near Full Density Powder Metallurgy Parts: Materials.

Current edition approved April 10, 2002; Oct. 1, 2007. Published May 2002; November 2007. Originally published as B-88; approved in 1988. Last previous edition B-00; approved in 2002 as B 796 – 02.

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*, Vol 03.01, volume information, refer to the standard's Document Summary page on the ASTM website.

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

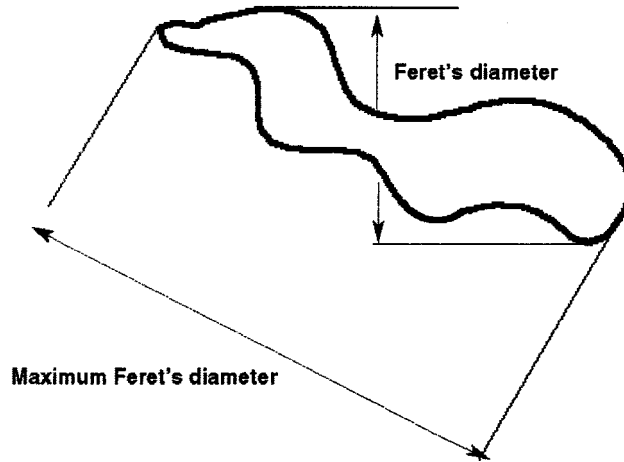


FIG. 1 Schematic illustration of Feret's diameter.



FIG. 2 Schematic illustration of the "near neighbor" concept and maximum Feret's diameter.

4. Significance and Use

4.1 The extensive porosity present in pressed and sintered ferrous materials masks the effect of inclusions on mechanical properties. In contrast, the properties of material powder forged to near full density are strongly influenced by the composition, size, size distribution, and location of nonmetallic inclusions.

4.2 The test for nonmetallic inclusions in powder forged steels is useful as the following:

- 4.2.1 Characteristic to classify or differentiate one grade of powder from another.
- 4.2.2 Means of quality comparison of powders intended for powder forging, lot to lot.

4.3 Significant variations in nonmetallic inclusion content will occur if:

4.3.1 The powder used to form the test specimen does not meet powder forging quality standards for nonmetallic inclusion content.

4.3.2 Processing of the powder forged test specimen has been carried out under conditions that do not permit oxide reduction or allow oxidation of the test specimen, or both.

5. Apparatus

5.1 Equipment for the metallographic preparation of test specimens.

5.2 A metallographic microscope permitting observation and measurement up to a magnification of 100× using light with a wavelength of 544 nm (green filter), an objective lens with a magnification of from 8× to 12.5×, and a numerical aperture between 0.16 and 0.20.

NOTE 2—Defining the light optics used is important because this determines the features that will be resolved, and all detected features are included in the assessment of inclusion size.

6.

6. Test Specimen Preparation

6.1 Mix the powder that is intended for use in a powder forging application with an appropriate amount of graphite and lubricant.

6.2 Press a cylindrical compact to a specified green density and heat the compact to the desired forging temperature using a furnace with a suitable reducing gas atmosphere.