Designation: ~~B796 – 07~~ B796 – 14

Standard Test Method for Nonmetallic Inclusion Content of Ferrous Powders Intended for Powder Forging (PF) Applications[1]

This standard is issued under the fixed designation B796; 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 ferrous 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×.

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 µm to 15 µm.

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.
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1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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]

E3 Guide for Preparation of Metallographic Specimens

E768 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~~ specimen, parallel to the direction of forging, to obtain a rectangular section that is mounted for metallographic grinding and polishing.

3.2 The polished sample is examined microscopically at a magnification of 100× 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.

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[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 Materials.

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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.

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

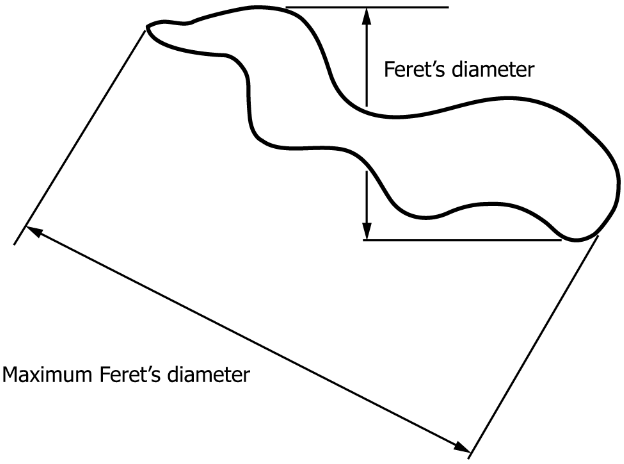

FIG. 1 Schematic illustration of Feret's diameter.

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 µm 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 mm^2 greater than or equal to the predetermined size.

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.

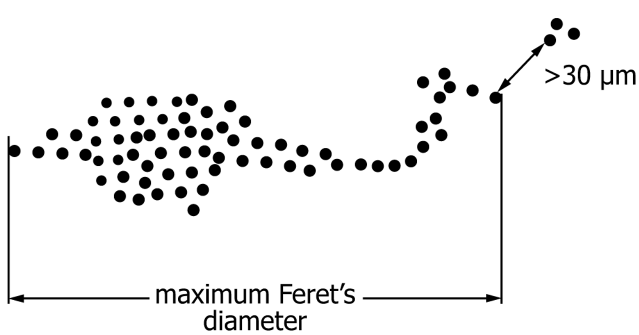

FIG. 2 Schematic illustration of the "near neighbor" concept and maximum Feret's diameter.