Designation: B 795 – 93 (Reapproved 2002)ε1

Standard Test Method for Determining the Percentage of Alloyed or Unalloyed Iron Contamination Present in Powder Forged (P/F) Steel Parts[1]

This standard is issued under the fixed designation B 795; 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.

ε[1] NOTE—Titles of referenced documents were updated and paragraphs 4.3, 6.2, 7.1, and 8.1.2 were revised editorially in June 2002.

1. Scope

1.1 This test method covers a metallographic procedure for determining the percentage of alloyed or unalloyed iron contamination present in powder forged low-alloy steel parts and the percentage of alloyed iron contamination in powder-forged iron and carbon steel parts.

1.2 Property values stated in SI units are the standard. Conversion factors to inch-pound units may be approximate.

1.3 *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[2]

E 3 Practice for Preparation of Metallographic Specimens[3]

E 562 Test Method for Determining Volume Fraction by Systematic Manual Point Count[3]

3. Terminology

3.1 *Definitions*—Definitions of powder metallurgy terms can be found in Terminology B 243. Additional descriptive information is available in the Related Material Section of Vol 02.05 of the *Annual Book of ASTM Standards*.

3.2 *Description of Term Specific to This Standard:*

3.2.1 *cross product contamination*—the unintentional mixing of powders with distinct differences in chemical composition.

4. Summary of Test Method

4.1 A section representing the core region of the part is taken from the powder forged part and prepared for metallographic examination.

4.2 The polished and etched sample is examined microscopically at a magnification of 100× and a systematic point count made of features with etching characteristics different from that of the matrix.

4.3 The amount of contaminant is reported as a percentage to the nearest 0.1 %.

5. Significance and Use

5.1 Cross product contamination occurs whenever alloy steel powders are processed in the same equipment as iron powders.

5.2 Unalloyed iron particles, because they may not harden upon heat treatment, are a potential source of soft spots in low-alloy steel parts.

5.3 Alloyed iron particles, having higher hardenability than an iron or carbon steel matrix, are a potential source of hard spots.

5.4 Hard or soft spots may cause problems in service or machining.

5.5 The results of the tests may be used to qualify parts for shipment in accordance with guidelines agreed between purchaser and manufacturer.

6. Apparatus

6.1 Equipment for the metallographic preparation of test specimens.

6.2 A metallographic microscope permitting observation and measurement at a magnification of 100×.

7. Sampling

7.1 Take a metallographic specimen from the powder-forged part. The polished surface of the specimen should be not less than that required to superimpose 2500 grid points at a magnification of 100×. Multiple sections are permitted in order to obtain the necessary area for measurement on small parts.

7.2 The polished surface shall be parallel to the direction of forging, that is, parallel to the direction of travel of the forging

[1] This specification 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] *Annual Book of ASTM Standards*, Vol 02.05.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

punch, or as specified in the contract or purchase order, and shall represent an area away from the surface of the part.

8. Procedure

8.1 *Preparation of Specimens*:

8.1.1 *Polishing*—In polishing the specimens, it is highly important that the polished surface be free from artifacts and debris. It is recommended that the procedures described in Practice E 3 be followed. Automated grinding and polishing procedures are recommended.

8.1.2 *Etching*—Lightly etch the freshly polished specimen with 2 % nital (2 mL nitric acid, 98 mL ethyl alcohol). Next, etch the polished and lightly etched specimen by immersion in a freshly prepared aqueous solution containing 3 g potassium metabisulfite and 10 g sodium thiosulfate per 100 mL. Rinse the specimen in running water, then rinse with low residue alcohol and dry with a blast of dry air.

8.1.2.1 The etching time will depend on alloy type, carbon content, and microstructure. The greater the alloy content, the slower the etching rate; the greater the carbon content, the faster the etching rate.

8.1.2.2 A good contrast is developed between the matrix and the contaminant because of a combination of etching and staining. The areas containing the highest alloy content are the least affected. Unalloyed iron will become darkened in a low-alloy matrix and low-alloy particles will remain light in an iron or carbon steel matrix. In a low-alloy matrix, contaminant particles of another low-alloy powder can be distinguished from unalloyed iron contamination because the particles etch differently (see Fig. 1 and Fig. 2).

8.2 *Examination*—Superimpose a grid of between 100 and 250 systematically placed points upon a 100× magnified image (that is, a field of view) of the polished and etched specimen. Count and record the number of grid points falling upon contaminant particles; if necessary, a separate count may be kept to distinguish between alloy contamination and unalloyed iron contamination in low-alloy steel parts, or, types of alloy contaminant in iron or carbon steel parts. (See Note 1.) Counting of randomly selected discrete fields should be continued until at least 2500 grid points have been superimposed on the specimen. The total number of points falling on contaminant particles for all fields counted shall be divided by the total number of grid points superimposed and multiplied by 100 to determine the area percentage of contamination.

NOTE 1—Any grid point that falls on a contaminant particle boundary should be counted as one half. To avoid bias, questionable points should be counted as one half.

9. Report

9.1 Report the area percentage of contaminant to the nearest 0.1 %.

10. Precision and Bias

10.1 The precision and bias that can be expected through the use of this test method is currently under review by Subcommittee B09.11 on Near Full Density Powder Metallurgy Materials.

11. Keywords

11.1 cross product contamination; powder forging (P/F); powder forged (P/F) parts; powder forged (P/F) steels

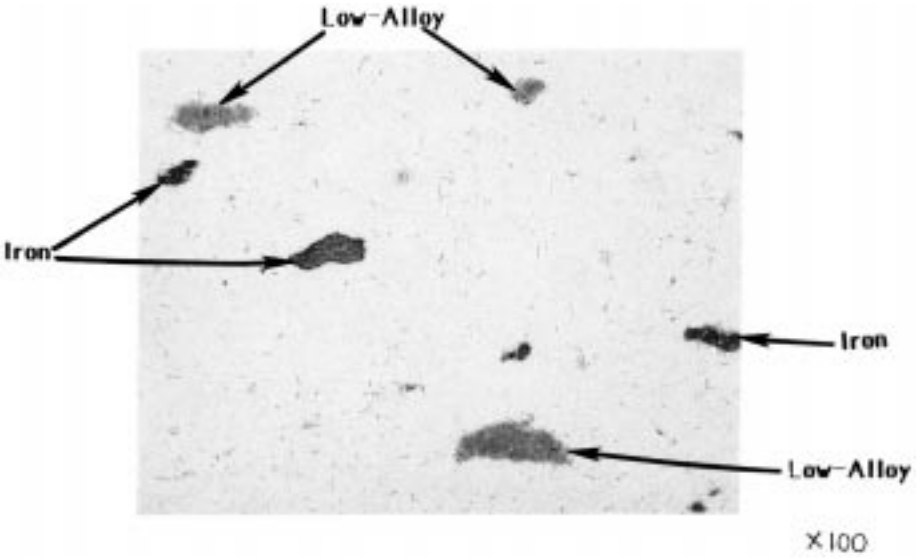

FIG. 1 Illustration of Iron and Low-Alloy Contaminants in P/F-4650

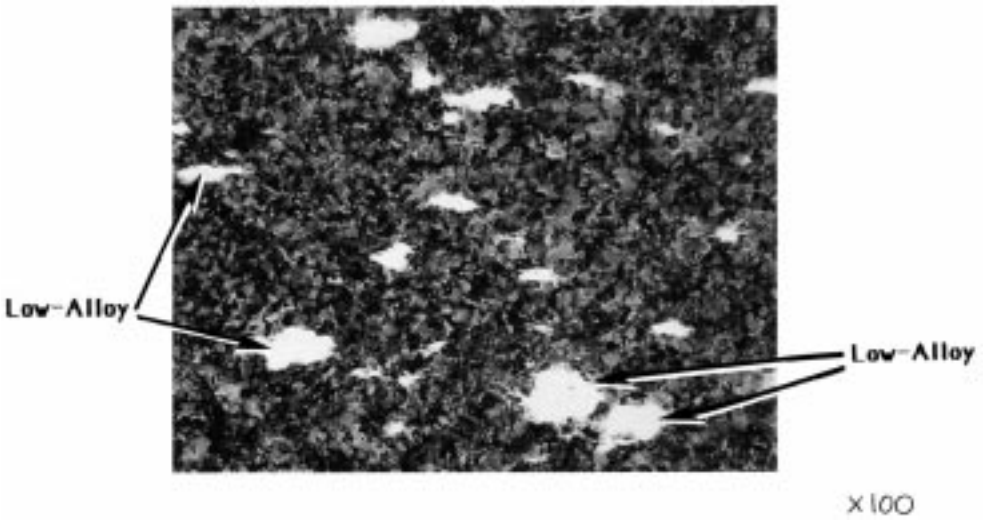

FIG. 2 Illustration of Low-Alloy Contaminant in P/F-1060