



Standard Test Method for Surface Finger Oxide Penetration Depth and Presence of Interparticle Oxide Networks in Powder Forged (P/F) Steel Parts¹

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1. Scope

1.1 This test method covers a metallographic method for determining the maximum depth of surface finger oxide penetration and the concentration of subsurface interparticle oxide networks in critical areas of powder forged steel parts.

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 Document

2.1 *ASTM Standards:*²

E 3 Guide for Preparation of Metallographic Specimens

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *surface finger oxides*—surface finger oxides are surface oxides that follow prior particle boundaries into a powder forged part from the surface and cannot be removed by physical means such as rotary tumbling. Examples of surface finger oxides are shown in **Fig. 1**.

3.1.2 *interparticle oxide networks*—interparticle oxide networks are continuous or discontinuous oxides that follow prior particle boundaries in powder forged parts. Examples of interparticle oxide networks are shown in **Fig. 2**.

4. Summary of Test Method

4.1 A section representing both surface and subsurface regions of a critical area is cut from the powder forged part and mounted for metallographic grinding and polishing.

4.2 For surface finger oxide penetration, the polished and unetched sample is examined microscopically at a magnification of 400×. The maximum depth of penetration of surface finger oxides is measured.

4.3 For interparticle oxide network concentration, the polished and unetched sample is examined microscopically at a magnification of 200 to 400× to determine the presence of interparticle oxide networks.

5. Significance and Use

5.1 The presence of surface finger oxide penetration and interparticle oxide networks are two of the properties used to evaluate powder forged steel parts for proper processing. Maximum acceptable depths of penetration of surface finger oxide penetration and acceptable concentrations of subsurface interparticle oxide networks depend on the component and its service environment.

5.2 Results of tests may be used to qualify parts for shipment.

6. Apparatus

6.1 Equipment for the metallographic preparation of test specimens.

6.2 A metallographic microscope permitting observation and measurement up to a magnification of 400×.

7. Sampling

7.1 A metallographic specimen shall be removed from the powder forged part to cover each designated critical area. Critical areas shall be defined by the applicable part drawing or the purchaser order. Specimens shall be taken from the powder forged part in the condition in which it is to be supplied. The polished surface of the specimens shall be parallel to the forging direction, that is, parallel to the direction of travel of the forging punch.

8. Procedure

8.1 *Preparation of Specimens*—In mounting the specimen for grinding and polishing, protection from rounding the edge of the part is essential. In polishing the specimen it is important that a clean polish be obtained and that edge detail of the part

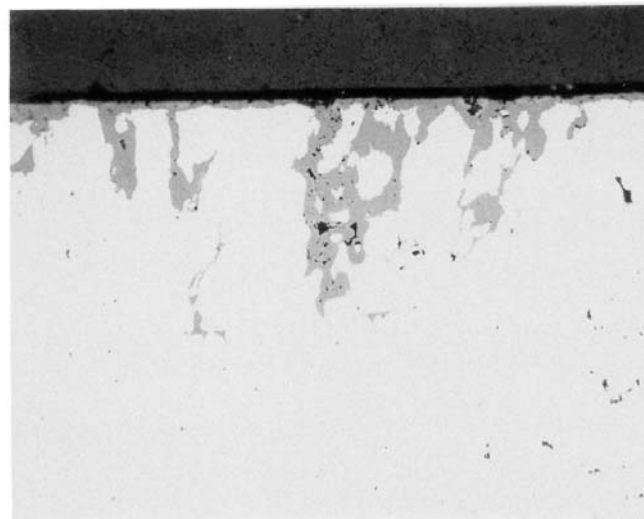
¹ This test method is under the jurisdiction of ASTM Committee B09 on Metal Powders and Metal Powder Products and is the direct responsibility of Subcommittee B09.11 on Near Full Density Powder Metallurgy Materials.

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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.

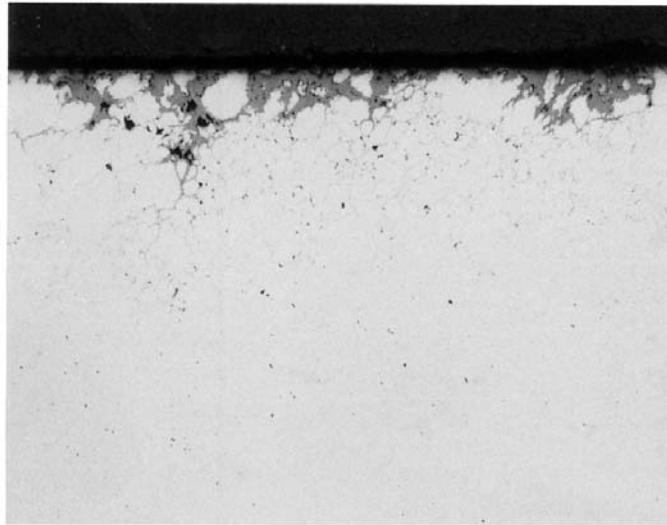


100X

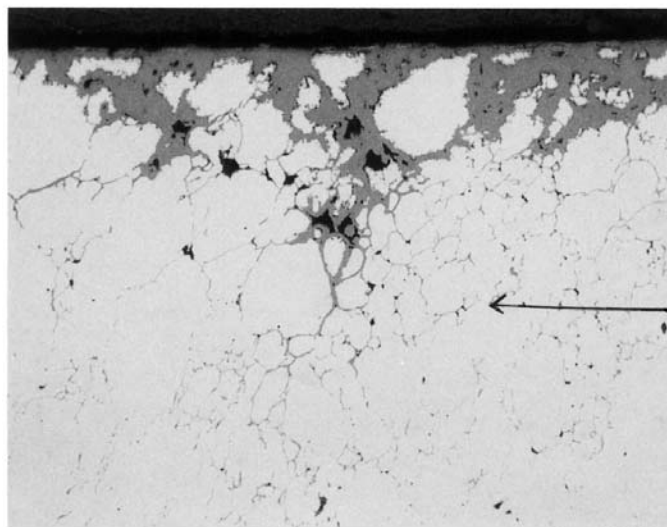


400X

FIG. 1 Example of Surface Finger Oxide Penetration Extending Inward from the Powder Forged Part Surface (Shown more clearly at high magnification.)



100X



Surface finger
oxide

Interparticle
oxide network

200X

FIG. 2 Example of Interparticle Oxide Networks Within a Powder Forged Part (Shown more clearly at high magnification.)



not be destroyed. Specimens shall be examined in the as-polished condition, free of the effects of any prior etching (if used). It is recommended that the procedures described in Methods E 3 be followed. Automated grinding and polishing procedures are recommended.

8.2 Measurement of Surface Finger Oxide Penetration Depth—Scan the perimeter of the metallographic specimen, initially at a magnification of 100×, and carefully examine each designated critical area at a higher magnification, for example, 400×. Measure the maximum depth of penetration of surface finger oxides from the finished part surface in micrometers for each designated critical area.

8.3 Measurement of Interparticle Oxide Network Concentration—Scan the perimeter of the metallographic specimen at a magnification of 100×. Carefully examine each designated critical area at a higher magnification, for example, 200 to 400×. Record the presence of any interparticle oxide networks in the designated critical areas.

9. Report

9.1 The test report shall include the following information:

9.1.1 Identification of the part and location of the test specimen,

9.1.2 The maximum depth of penetration of surface finger oxides from the finished part surface in micrometers for each designated critical area, and

9.1.3 The presence or lack of interparticle oxide networks in each designated critical area. If interparticle oxide networks are present, if possible, prepare a photomicrograph for record purposes.

10. Precision and Bias

10.1 The precision and bias that can be expected through use of the test method for determining the maximum depth of surface finger oxide penetration is currently under review by Subcommittee B09.11 on Near Full Density Powder Metallurgy Parts.

10.2 The test method for interparticle oxide network concentration is a “go-no go” test designed to give a qualitative estimate. This method will be subject to sample preparation care and to interpretation.

11. Keywords

11.1 interparticle oxide networks; powder-forged (P/F) steel parts; surface finger oxides

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