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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Preparing Sulfur Prints for Macrostructural Examination[1]

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1. Scope

1.1 This practice provides information required to prepare sulfur prints (also referred to as Baumann Prints) of most ferrous alloys to reveal the distribution of sulfide inclusions.

1.2 The sulfur print reveals the distribution of sulfides in steels with bulk sulfur contents between about 0.005 and 0.40 weight percent.

1.3 Certain steels contain complex sulfides that do not respond to the test solutions, for example, steels containing titanium sulfides or chromium sulfides.

1.4 The sulfur print test is a qualitative test. The density of the print image should not be used to assess the sulfur content of a steel. Under carefully controlled conditions, it is possible to compare print image intensities if the images are formed only by manganese sulfides.

1.5 The sulfur print image will reveal details of the solidification pattern or metal flow from hot or cold working on appropriately chosen and prepared test specimens.

1.6 This practice does not address acceptance criteria based on the use of the method.

1.7 *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.* For specific precautionary statements, see Section 9.

2. Referenced Documents

2.1 *ASTM Standards:*

E 3 Methods of Preparation of Metallographic Specimens[2]
E 7 Terminology Relating to Metallography[2]
E 340 Test Method for Macroetching Metals and Alloys[2]
E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings[2]
E 407 Test Methods for Microetching Metals and Alloys[2]

3. Terminology

3.1 *Definitions:* For definitions of terms used in this practice, see Terminology E 7.

4. Summary of Practice

4.1 The sulfur print provides a means for macroscopic evaluation of the sulfur distribution in steels and cast irons by contact printing using photographic paper, or an equivalent, soaked in an aqueous acid solution, for example, sulfuric acid, citric acid, or acetic acid.

NOTE 1—There are light weight emulsion coated papers suitable for sulfur printing currently on the market.

4.2 The test specimen is usually a disk, such as used in macroetch evaluations, cut from an as-cast or wrought specimen with either a transverse or longitudinal orientation. The disk is ground smooth and cleaned.

4.3 A sheet of photographic paper (or equivalent) with a (usually) matte surface finish of appropriate size is soaked in the dilute aqueous acid solution and the emulsion side of the paper is placed on the ground surface of the disk. After a suitable time, the paper is removed, washed in water, fixed, washed and dried.

4.4 The distribution of sulfur in the disk is revealed as a mirror image on the photographic paper as darkly colored areas of silver sulfide.

5. Significance and Use

5.1 The sulfur print reveals the distribution of sulfur as sulfide inclusions in the test sample. The sulfur print complements macroetch methods by providing an alternative procedure for evaluating the homogeneity of a steel product.

5.2 Sulfur prints of as-cast specimens generally reveal the solidification pattern and may be used to assess the nature of deoxidation, that is, rimming action versus killed steel sulfur distributions.

5.3 Sulfur prints will reveal segregation patterns and may reveal certain physical irregularities, for example, porosity or cracking.

5.4 The nature of metal flow, such as in various forging operations, can be revealed using sulfur prints of specimens cut parallel to the metal flow direction.

5.5 The sulfur print method is suitable for process control, research and development studies, failure analysis, and for materials acceptance purposes.

5.6 The intensity of the sulfur print is influenced by the concentration of sulfur in the steel, the chemical composition of the sulfide inclusions, the aggressiveness of the aqueous acid solution, and the duration of the contact printing between the acid soaked emulsion coated paper and the ground surface of

[1] This practice is under the jurisdiction of ASTM Committee E-4 on Metallography and is the direct responsibility of Subcommittee E04.01 on Selection and Preparation of Samples.

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