



Designation: E 381 – 98

Standard Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings¹

This standard is issued under the fixed designation E 381; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 Macroetching, which is the etching of specimens for macrostructural examination at low magnifications, is a frequently used technique for evaluating steel products such as bars, billets, blooms, and forgings.

1.2 Included in this method is a procedure for rating steel specimens by a graded series of photographs showing the incidence of certain conditions. The method is limited in application to bars, billets, blooms, and forgings of carbon and low alloy steels.

1.3 A number of different etching reagents may be used depending upon the type of examination to be made. Steels react differently to etching reagents because of variations in chemical composition, method of manufacture, heat treatment and many other variables. Establishment of general standards for acceptance or rejection for all conditions is impractical as some conditions must be considered relative to the part in which it occurs.

1.4 *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.* See the specific precautionary statement in 5.3.

2. Referenced Documents

2.1 ASTM Standards:

E 7 Terminology Relating to Metallography²

E 340 Test Method for Macroetching Metals and Alloys²

E 1180 Practice for Preparing Sulfur Prints for Macrostructural Examination²

2.2 ASTM Adjuncts:

Photographs for Rating Macroetched Steel (3 plates)³

3. Terminology

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 Terminology Applicable Only to Ingot Cast Product:

3.2.1.1 *splash*—a nonuniform etch pattern where irregularly-shaped areas exhibit a different etch contrast than surrounding areas. Splash is normally associated with molten steel which solidifies and oxidizes during initial pouring and which is not completely redissolved by the remaining molten steel.

3.2.1.2 *butt tears*—subsurface cracks normally parallel to the surface of the ingot mold wall.

3.2.1.3 *flute cracks*—cracks perpendicular to the surface of the ingot mold wall which may, or may not, extend to the surface of the product.

3.2.1.4 *burst*—a single or multi-rayed crack normally located at the center of the wrought product.

3.2.2 Definitions Applicable Only to Continuously Cast Products:

3.2.2.1 *chill zone*—rapidly cooled metal with a fine structure at the surface of the product which is normally continuous around that surface.

3.2.2.2 *chill zone crack*—any crack which is located partially or completely in the chill zone and may extend to the surface of the product.

3.2.2.3 *diagonal crack*—a crack which lies completely or partially in the diagonal regions of a non-round product where adjacent columnar or dendritic growth patterns intersect.

3.2.2.4 *subsurface crack*—a crack perpendicular to and just beneath the chill zone.

3.2.2.5 *mid-radius crack*—a crack perpendicular to the surface of the product located approximately halfway between the surface and center of the product.

3.2.2.6 *center crack*—a crack with an aspect ratio (length/width) of approximately 3 or greater located at, or near, the center of the product.

3.2.2.7 *star crack*—a star-shaped or multi-rayed crack at the center of the product.

¹ This method is under the jurisdiction of ASTM Committee E-4 on Metallography, and is the direct responsibility of Subcommittee E04.01 on Sampling, Specimen Preparation, and Photography.

Current edition approved October 10, 1998. Published December 1998. Originally published as E 381 – 68. Last previous edition E 381 – 94.

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

³ Available from ASTM Headquarters. Order Adjunct: ADJE038101 (Plate I), ADJE038102 (Plate II), and ADJE038103 (Plate III).