



Standard Practice for Macroetching Metals and Alloys¹

This standard is issued under the fixed designation E340; 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 U.S. Department of Defense.

1. Scope

1.1 These procedures describe the methods of macroetching metals and alloys to reveal their macrostructure.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.* For specific warning statements, see [6.2](#), [7.1](#), [8.1.3](#), [8.2.1](#), [8.8.3](#), [8.10.1.1](#), and [8.13.2](#).

2. Referenced Documents

2.1 *ASTM Standards:*²

[E3](#) Guide for Preparation of Metallographic Specimens

[E381](#) Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

3. Significance and Use

3.1 *Applications of Macroetching:*

3.1.1 Macroetching is used to reveal the heterogeneity of metals and alloys. Metallographic specimens and chemical analyses will provide the necessary detailed information about specific localities but they cannot give data about variation from one place to another unless an inordinate number of specimens are taken.

3.1.2 Macroetching, on the other hand, will provide information on variations in (1) structure, such as grain size, flow lines, columnar structure, dendrites, and so forth; (2) variations

in chemical composition as evidenced by segregation, carbide and ferrite banding, coring, inclusions, and depth of carburization or decarburization. The information provided about variations in chemical composition is strictly qualitative but the location of extremes in segregation will be shown. Chemical analyses or other means of determining the chemical composition would have to be performed to determine the extent of variation. Macroetching will also show the presence of discontinuities and voids, such as seams, laps, porosity, flakes, bursts, extrusion rupture, cracks, and so forth.

3.1.3 Other applications of macroetching in the fabrication of metals are the study of weld structure, definition of weld penetration, dilution of filler metal by base metals, entrapment of flux, porosity, and cracks in weld and heat affected zones, and so forth. It is also used in the heat-treating shop to determine location of hard or soft spots, tong marks, quenching cracks, case depth in shallow-hardening steels, case depth in carburization of dies, effectiveness of stop-off coatings in carburization, and so forth. In the machine shop, it can be used for the determination of grinding cracks in tools and dies.

3.1.4 Macroetching is used extensively for quality control in the steel industry, to determine the *tone* of a heat in billets with respect to inclusions, segregation, and structure. Forge shops, in addition, use macroetching to reveal flow lines in setting up the best forging practice, die design, and metal flow. For an example of the use of macroetching in the steel forging industry see Method [E381](#). Forging shops and foundries also use macroetching to determine the presence of internal faults and surface defects. The copper industry uses macroetching for control of surface porosity in wire bar. In the aluminum industry, macroetching is used to evaluate extrusions as well as the other products such as forgings, sheets, and so forth. Defects such as coring, cracks, and porthole die welds are identified.

4. Sampling

4.1 As in any method of examination, sampling is very important. When macroetching is used to solve a problem, the problem itself largely dictates the source of the sample as to the location on the work piece and the stage of manufacture; for example, when looking for pipe, the sample should represent the top of the ingot, or when looking for bursts or flakes, the sample should be taken as soon after hot working as possible.

¹ This test method is under the jurisdiction of ASTM Committee [E04](#) on Metallography and is the direct responsibility of Subcommittee [E04.01](#) on Specimen Preparation.

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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.