



Standard Test Methods for Rating and Classifying Inclusions in Steel Using the Scanning Electron Microscope¹

This standard is issued under the fixed designation E 2142; 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.

1. Scope

1.1 This test method covers procedures to obtain particle size distribution, chemical classification, and E 45 ratings of inclusions in steels using an automated scanning electron microscope (SEM) with X-ray analysis and automatic image analysis capabilities.

1.2 There are three discrete methods described. Method 1 is the SEM analog of E 1122, which uses image analysis and light microscopy to produce automated E 45 ratings. Method 2 produces similar ratings based predominantly on sorting inclusions by chemistry into the traditional classes defined in E 45. Method 3 is recommended when explicit detail is needed on particular inclusion types, not necessarily defined in E 45, such as to verify the composition of inclusions in inclusion-engineered steel. Method 3 reports stereological parameters such as volume or number fraction, rather than E 45 type ratings.

1.3 This test method deals only with the recommended test methods and nothing in it should be construed as defining or establishing limits of acceptability for any grade of steel or other alloy where the method is appropriate.

1.4 The values stated in SI units are to be regarded as the standard. Values in parentheses are conversions and are approximate, and for information only.

1.5 *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:

E 3 Practice for Preparation of Metallographic Specimens²

E 7 Terminology Relating to Metallography²

E 45 Test Methods for Determining the Inclusion Content of Steel²

E 766 Practice for Calibrating the Magnification of a Scanning Electron Microscope²

E 768 Practice for Preparing and Evaluating Specimens for Automated Inclusion Analysis of Steel²

E 1122 Practice for Obtaining Inclusion Ratings Using Automatic Image Analysis²

E 1245 Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis²

E 1508 Guide for Quantitative Analysis by Energy Dispersive Analysis²

2.2 Adjuncts:

ANSI/IEEE STD 759 IEEE Standard Test Procedure for Semiconductor X-Ray Energy Spectrometers³

3. Terminology

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 Analysis Rules—

3.2.1.1 *acquisition analysis rules*—include the criteria to terminate X-ray collection (counts or time, or both), the list of elements to be analyzed, the number of fields or particles to be analyzed, morphologies of particles from which spectra will be collected, etc. (see Appendix X1 for a more complete listing of typical Acquisition Rules).

3.2.1.2 *post-acquisition analysis rules*—define ratios of X-ray intensities or elemental compositions required to identify an inclusion as belonging to a particular chemical classification and, for Methods 1 and 2 herein, define the main inclusion class (A, B, or C) to which each chemical classification belongs.

3.2.2 *chemical classification*—defined compositional categories in which inclusions are placed according to the analysis rules. Categories may be broad (e.g., sulfide, aluminate, silicate) or more precise (e.g., calcium sulfide, calcium silicate, anorthite, etc.).

¹ These test methods are under the jurisdiction of ASTM Committee E04 on Metallography and are the direct responsibility of Subcommittee E04.11 on X-Ray and Electron Metallography jointly with E04.09 on Steel Inclusions.

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

³ This standard is available from The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017.