



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

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1. Scope

1.1 This test method covers procedures to obtain particle size distribution, chemical classification, and Test Methods E45 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 Test Method E45, which uses image analysis and light microscopy to produce automated Test Methods E45 ratings. Method 2 produces similar ratings based predominantly on sorting inclusions by chemistry into the traditional classes defined in Test Methods E45. Method 3 is recommended when explicit detail is needed on particular inclusion types, not necessarily defined in Test Methods E45, 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 Test Methods E45 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 standard. No other units of measurement are included in this standard.

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.*

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.

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2. Referenced Documents

2.1 ASTM Standards:²

E3 Guide for Preparation of Metallographic Specimens

E7 Terminology Relating to Metallography

E45 Test Methods for Determining the Inclusion Content of Steel

E766 Practice for Calibrating the Magnification of a Scanning Electron Microscope

E768 Guide for Preparing and Evaluating Specimens for Automatic Inclusion Assessment of Steel

E1245 Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis

E1508 Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy

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 E7.

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

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.

³ Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., P.O. Box 1331, Piscataway, NJ 08854-1331, <http://www.ieee.org>.