



Standard Test Methods for Determining the Inclusion Content of Steel¹

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

1. Scope

1.1 These test methods cover a number of recognized procedures for determining the nonmetallic inclusion content of wrought steel. Macroscopic methods include macroetch, fracture, step-down, and magnetic particle tests. Microscopic methods include five generally accepted systems of examination. In these microscopic methods, inclusions are assigned to a category based on similarities in morphology, and not necessarily on their chemical identity. Metallographic techniques that allow simple differentiation between morphologically similar inclusions are briefly discussed. While the methods are primarily intended for rating inclusions, constituents such as carbides, nitrides, carbonitrides, borides, and intermetallic phases may be rated using some of the microscopic methods. In some cases, alloys other than steels may be rated using one or more of these methods; the methods will be described in terms of their use on steels.

1.2 This practice covers procedures to perform JK-type inclusion ratings using automatic image analysis in accordance with microscopic methods A and D.

1.3 Depending on the type of steel and the properties required, either a macroscopic or a microscopic method for determining the inclusion content, or combinations of the two methods, may be found most satisfactory.

1.4 These test methods deal only with recommended test methods and nothing in them should be construed as defining or establishing limits of acceptability for any grade of steel.

1.5 The values stated in SI units are to be regarded as the standard. Values in parentheses are conversions and are approximate.

1.6 *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 is the direct responsibility of Subcommittee E04.09 on Inclusions.

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2. Referenced Documents

2.1 ASTM Standards:²

E3 Guide for Preparation of Metallographic Specimens

E7 Terminology Relating to Metallography

E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E709 Guide for Magnetic Particle Testing

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

E1444 Practice for Magnetic Particle Testing

E1951 Guide for Calibrating Reticles and Light Microscope Magnifications

2.2 SAE Standards:³

J422, Recommended Practice for Determination of Inclusions in Steel

2.3 Aerospace Material Specifications:³

AMS 2300, Premium Aircraft-Quality Steel Cleanliness: Magnetic Particle Inspection Procedure

AMS 2301, Aircraft Quality Steel Cleanliness: Magnetic Particle Inspection Procedure

AMS 2303, Aircraft Quality Steel Cleanliness: Martensitic Corrosion-Resistant Steels Magnetic Particle Inspection Procedure

AMS 2304, Special Aircraft-Quality Steel Cleanliness: Magnetic Particle Inspection Procedure

2.4 ISO Standards:⁴

ISO 3763, Wrought Steels—Macroscopic Methods for Assessing the Content of Nonmetallic Inclusions

ISO 4967, Steel—Determination of Content of Nonmetallic Inclusions—Micrographic Methods Using Standard Diagrams

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Around Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.