Designation: E 45 – 97 (Reapproved 2002)

Standard Test Methods for Determining the Inclusion Content of Steel[1]

This standard is issued under the fixed designation E 45; 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 These test methods cover a number of recognized methods for determining the nonmetallic inclusion content of wrought steel. Macroscopical methods include macroetch, fracture, step-down, and magnetic particle tests. Microscopical methods include five generally accepted systems of examination. In these microscopical 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 microscopical 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 These test methods are suitable for manual rating of inclusion content. Other ASTM standards cover automatic methods for obtaining JK ratings (Practice E 1122) and inclusion content using image analysis (Practice E 1245).

1.3 Depending on the type of steel and the properties required, either a macroscopical or a microscopical 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 *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:*

A 295 Specification for High-Carbon Anti-Friction Bearing Steel[2]

A 485 Specification for High Hardenability Anti-Friction Bearing Steel[2]

A 534 Specification for Carburizing Steels for Anti-Friction Bearings[2]

A 535 Specification for Special-Quality Ball and Roller Bearing Steel[2]

A 756 Specification for Stainless Anti-Friction Bearing Steel[2]

A 866 Specification for Medium Carbon for Anti-Friction Bearing Steel[2]

D 96 Test Method for Water and Sediment in Crude Oil by Centrifuge Method (Field Procedure)[3]

E 3 Guide for Preparation of Metallographic Specimens[4]

E 7 Terminology Relating to Metallography[4]

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings[4]

E 709 Guide for Magnetic Particle Examination[5]

E 768 Practice for Preparing and Evaluating Specimens for Automatic Inclusion Assessment of Steel[4]

E 1122 Practice for Obtaining JK Inclusion Ratings Using Automatic Image Analysis[4]

E 1245 Practice for Determining Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis[4]

2.2 *SAE Standards:*[6]

J421, Cleanliness Rating of Steels by the Magnetic Particle Method

J422, Recommended Practice for Determination of Inclusions in Steel

2.3 *Aerospace Material Specifications:*

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

2301, Aircraft Quality Steel Cleanliness: Magnetic Particle

[1] This practice is under the jurisdiction of ASTM Committee E04 on Metallography and is the direct responsibility of Subcommittee E04.09 on Inclusions.

Current edition approved Apr. 10, 1997. Published June 1997. Originally published as E 45 – 42 T. Last previous edition E 45 – 97$^{\epsilon 2}$.

[2] *Annual Book of ASTM Standards*, Vol 01.05.

[3] *Annual Book of ASTM Standards*, Vol 05.01.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

[5] *Annual Book of ASTM Standards*, Vol 03.03.

[6] Available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.