



Standard Practice for Obtaining JK Inclusion Ratings Using Automatic Image Analysis¹

This standard is issued under the fixed designation E 1122; 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 This practice covers procedures to perform JK-type inclusion ratings using automatic image analysis in accordance with microscopical methods A and D of Practice E 45.

1.2 This practice 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.

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

1.4 *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 Guide for Preparation of Metallographic Specimens²

E 7 Terminology Relating to Metallography²

E 45 Test Methods for Determining the Inclusion Content of Steel²

E 768 Practice for Preparing and Evaluating Specimens for Automatic Inclusion Assessment of Steel²

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

2.2 ASTM Adjuncts:

Inclusions in Steel, Plates I and III³

Colored Plate Illustrating Use of DIC for Evaluating the Quality of Specimen Preparation⁴

3. Terminology

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *aspect ratio*—the length-to-width ratio of a microstructural feature.

3.2.2 *discontinuous stringer*—three or more inclusions separated by less than 40 μm (0.0016 in.) that are aligned in a plane parallel to the hot-working axis.

3.2.3 *stringer*—an individual inclusion that is highly elongated in the deformation direction, or three or more inclusions separated by less than 40 μm (0.0016 in.) and aligned in the same plane parallel to the deformation direction.

3.2.4 *threshold setting*—isolation of a range of gray level values exhibited by one constituent in the microscope field.

4. Summary of Practice

4.1 The inclusions on the surface of a properly prepared as-polished metallographic specimen are viewed with a high-quality, metallurgical microscope. The bright-field image is picked up by a suitable television camera and transferred to the image analyzer screen. For the manual Method D in Practice E 45, each 0.50-mm² test area is examined at 100X, classified and rated before moving to the next contiguous field until a total area of 160 mm² is covered. Using image analysis, the 160-mm² area can be examined at any desired magnification and field area. The inclusions are classified by type and thickness. Then, severity values are determined based upon the required 0.50-mm² field areas. Hence, with image analysis, the examination field size may be larger or smaller than 0.50 mm² as long as the severity calculations are based on 0.50-mm² subdivisions of the 160-mm² total examination area.

4.2 Inclusion types (A, B, C, and D in accordance with microscopical Practice E 45) are separated based on gray-level differences and morphology. These inclusions are the indigenous types resulting from the deoxidation of steel and the precipitation of sulfide during solidification. Sulfides (Type A) are separated from oxides (Types B, C, and D) based on gray level. All of the oxides are lower in light reflectivity than the sulfides. The oxides are separated based on morphology: Type

¹ This practice is 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 *Annual Book of ASTM Standards*, Vol 03.01.

³ Available from ASTM Headquarters. Order PCN 12-500450-01.

⁴ Available from ASTM Headquarters. Order PCN 12-507680-22.