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Standard Guide for Calibrating Reticles and Light Microscope Magnifications¹

This standard is issued under the fixed designation E1951; 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 guide covers methods for calculating and calibrating microscope magnifications, photographic magnifications, video monitor magnifications, grain size comparison reticles, and other measuring reticles. Reflected light microscopes are used to characterize material microstructures. Many materials engineering decisions may be based on qualitative and quantitative analyses of a microstructure. It is essential that microscope magnifications and reticle dimensions be accurate.

1.2 The calibration using these methods is only as precise as the measuring devices used. It is recommended that the stage micrometer or scale used in the calibration should be traceable to the National Institute of Standards and Technology (NIST) or a similar organization.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E7 Terminology Relating to Metallography

E112 Test Methods for Determining Average Grain Size

3. Terminology

3.1 *Definitions*—All terms used in this guide are defined in Terminology E7.

¹ This guide is under the jurisdiction of ASTM Committee E04 on Metallography and is the direct responsibility of Subcommittee E04.03 on Light Microscopy.

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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.

4. Significance and Use

4.1 These methods can be used to determine magnifications as viewed through the eyepieces of light microscopes.

4.2 These methods can be used to calibrate microscope magnifications for photography, video systems, and projection stations.

4.3 Reticles may be calibrated as independent articles and as components of a microscope system.

5. Procedures

5.1 Nominal Magnification Calculations:

5.1.1 A calculated magnification, using the manufacturer's supplied ratings, is only an approximation of the true magnification, since individual optical components may vary from their marked magnification. For a precise determination of the magnification observed through an eyepiece, see the procedure describe in 5.5.

5.1.2 For a compound microscope, the total magnification (M_t) of an image through the eyepiece is the product of the objective lens magnification (M_o), the eyepiece magnification (M_e), and, if present, a zoom system or other intermediate lens magnification (M_i). An expression for the total magnification is shown in Eq 1.

$$M_t = M_o \times M_e \times M_i \quad (1)$$

5.1.3 *Example 1*—For a microscope configured with a 10X objective, a 10X eyepiece, and a 1.25X intermediate lens, the total magnification observed through the eyepiece would be calculated as follows.

$$M_t = 10 \times 10 \times 1.25 = 125 \quad (2)$$

5.2 Calibration for Photomicrography Magnifications:

5.2.1 The magnification of an image can be determined by photographing a calibrated stage micrometer using the desired optical setup. First, photograph the stage micrometer using the desired combination of objective, bellows extension, zoom and intermediate lens, and then measure the apparent ruling length on the photomicrograph. The measurement should be made consistently from an edge or center of one division to the corresponding edge or center of another (see Note 1). By dividing this apparent length of ruling by the known dimension of the micrometer, the magnification of the photomicrograph is determined (see Fig. 1). The accuracy of the calibration is