Designation: E312 – 06 (Reapproved 2011)

Standard Practice for Description and Selection of Conditions for Photographing Specimens Using Analog (Film) Cameras and Digital Still Cameras (DSC)[1]

This standard is issued under the fixed designation E312; 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.

INTRODUCTION

Photographs are often used to convey information about the appearance of objects, materials, or phenomena involved in testing. The appearance of a photograph of an object depends not only on the appearance of the object, but on the conditions of formation of the optical image, the conditions of formation of the photographic record, and the conditions of viewing the photograph. If the photographic method of recording appearance is to be reproducible from one laboratory to another and if photographs of various specimens or one specimen at various times are to be used for valid comparisons, there must be an established method of describing pertinent conditions, so they may be recorded, communicated, and standardized. The purpose of this practice is to provide such a method of description.

1. Scope

1.1 This practice defines terms and symbols and provides a systematic method of describing the arrangement of lights, camera, and subject, the characteristics of the illumination, the nature of the photographic process, and the viewing system. Conditions for photographing certain common forms of specimens are recommended. Although this practice is applicable to photographic documentation in general, it is intended for use in describing the photography of specimens involved in testing and in standardizing such procedures for particular kinds of specimens. This practice is applicable to macrophotography but photomicrography is excluded from the scope of this practice.

1.2 *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:*[2]

D1535 Practice for Specifying Color by the Munsell System

E284 Terminology of Appearance

E1360 Practice for Specifying Color by Using the Optical Society of America Uniform Color Scales System

E1541 Practice for Specifying and Matching Color Using the Colorcurve System[3]

2.2 *ANSI Standards:* [4]

ANSI/ISO 517-1996 Apertures and Related Properties Pertaining to Photographic Lenses—Designations and Measurements

ISO 3664:2000 Viewing Conditions—Graphic Technology and Photography

ISO 18920:2000 Imaging Materials Processed Photographic Reflection Prints – Storage Practices

[1] This practice is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.03 on Geometry.

Current edition approved June 1, 2011. Published June 2011. Originally approved in 1966. Last previous edition approved in 2006 as E312 – 06. DOI: 10.1520/E0312-06R11.

[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] Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

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

ISO 6846:1992 Black-and-White Continuous Tone Papers—Determination of ISO Speed and Range for Printing

3. Terminology

3.1 *Definitions*—Appearance terms used in this practice conform to definitions in Terminology E284. Terms related to photography conform to the cited standards of the American National Standards Institute.

4. Significance and Use

4.1 This practice provides a basis for choosing, specifying, recording, communicating, and standardizing the conditions and processes that determine the nature of a photographic image of a specimen. Its provisions are particularly useful when the photographic image is used to preserve or communicate the appearance of a specimen involved in an aging or stressing test that affects its appearance. It is often useful to compare photographs made under identical conditions before and after a test to illustrate a change in appearance.

4.2 This practice deals with specific details of camera technique and the photographic process, so it will probably be best understood and implemented by a technical photographer or someone trained in photographic science. The person requiring the photograph must clearly indicate to the photographer what features of the specimen are of technical interest, so he may use techniques that make those features clearly evident in the photograph, without misrepresenting the appearance of the specimen.

4.3 This practice provides useful guidance on presenting photographs for viewing, providing an indication of dimensions or scale, indicating the orientation of the picture, and referring to particular points on a picture. These techniques should be useful to those writing technical literature involving illustrations of the appearance of specimens. The methods of this practice should contribute materially to the accuracy and precision of other standards that rely on pictures to indicate various grades of some attribute of appearance, such as blistering or cracking.

4.4 For acceptance testing, manufacturing control, and regulatory purposes, it is desirable to employ measurement, but in those cases where there are no methods of measuring the attribute of appearance of interest, well-made photographs or photomechanical reproductions of them may be the best available way to record and communicate to an inspector the nature of the attribute of appearance.

5. Descriptors for Conditions

5.1 *Primary Points*:

5.1.1 *Central Image Point, I*—The geometrical center of the picture area on the film or plate, designated by the symbol *I* (see Fig. 1).

5.1.2 *Nodal Points*, *H*, *H′*—The two points *H* and *H′* in the lens system, located on the line joining the centers of curvature

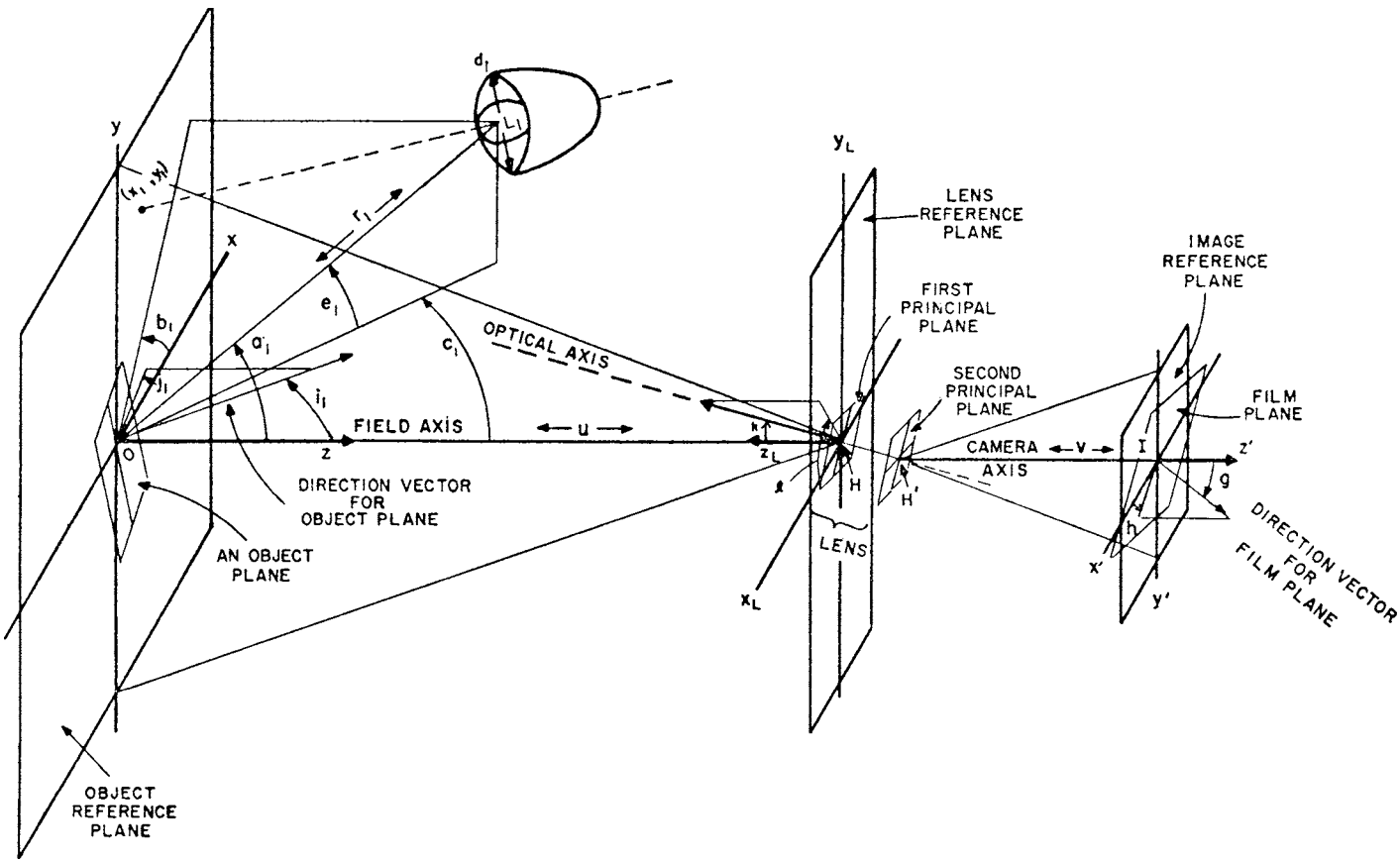

FIG. 1 Coordinate System for Specifying the Geometric Relationship of Camera, Subject, and Lighting

of the elements and having the property that any ray from the object directed toward H emerges from H' parallel to the original path. The nodal point with respect to rays from the object is called the " first nodal point" and is designated by the symbol H while the nodal point with respect to rays directed to the image is called the "second nodal point" and is designated by the symbol H.

5.1.3 *Central Object Point, O*—The point in the object space that is imaged at the central image point, designated by the symbol O. (It is not necessary that any material thing exist at this point.)

5.2 *Primary Axes*:

5.2.1 *Camera Axis*—The straight line between the central image point and the second nodal point. The distance between these points is called the "axial image distance" and is designated by the symbol v.

5.2.2 *Optical Axis*—The straight line joining the centers of curvature of the elements of the lens.

5.2.3 *Field Axis*—The straight line between the central object point and the first nodal point. The distance between these points is called the "axial object distance" and is designated by the symbol u.

5.3 *Reference Planes*:

5.3.1 *Image Reference Plane*—The plane normal to the camera axis, passing through the central image point.

5.3.2 *Lens Reference Plane*—The plane normal to the field axis, passing through the first nodal point.

5.3.3 *Object Reference Plane*—The plane normal to the field axis, passing through the central object point.

5.4 *Orientations*:

5.4.1 *Film Orientation*—The film or detector orientation is described in a right-handed orthogonal coordinate system having x' and y' axes in the image reference plane and z' axis on the camera axis, with the positive direction away from the lens. A film plane is described by the angles of a direction vector making an angle g with the z' axis and having a projection on the image reference plane making an angle h with the x' axis.

5.4.2 *Lens Orientation*—The lens orientation is described in a right-handed orthogonal coordinate system having x_L and y_L axes in the lens reference plane and z_L axis on the field axis, with the positive direction toward the object space. The x_L axis is parallel to the x' axis and the y_L axis is parallel to the y' axis. The lens orientation is described by the angles of a direction vector making an angle k with the z_L axis and having a projection on the lens reference plane making an angle l with the x_L axis.

5.4.3 *Object Orientation*—The object orientation is described in a right-handed orthogonal coordinate system having x and y axes in the object reference plane and z axis on the field axis, with the positive direction toward the lens. The x axis is parallel to the x' axis and the y axis is parallel to the y' axis. An object plane can be described in terms of the angles of a direction vector making an angle i with the z axis and having a projection on the object reference plane making an angle j with the x axis. Since an object plane may or may not pass through the central object point, the intersection of the plane with the z axis must be stated. If a cylindrical coordinate is found useful, the distance from a point to the z axis measured along the normal to the z axis may be designated by the symbol p. If there are a number of planes or points to be specified, they can be numbered and the coordinates given numerical subscripts accordingly, for example, x_1, x_2, x_3, i_1, i_2, p_1, p_2, etc.

5.4.4 *Illuminant Orientation*—The geometrical aspect of the illumination is described with respect to the same coordinate system used for describing the orientation of the object. The center or centroid of a light source is designated by the symbol L, with the appropriate subscript when more than one light source is used. The distance between the central object point and the center of a light source is designated by the symbol r, with the appropriate numerical subscript. The direction of the light from the point O is described in terms of the angles of a direction vector making an angle a with the z axis and having a projection on the object reference plane making an angle b with the x axis, or, alternatively, making an angle c with the yz plane (the angle c being positive on the positive x side) and an angle e with the xz plane (the angle e being positive on the positive y side). The diameter of the lamp reflector is designated by the symbol d, with appropriate subscript. The coordinates (x, y) of the point on the object reference plane toward which the lamp reflector is directed must be given. The size and shape of the lamp and reflector must be described with sufficient precision for the intended purpose.

5.5 *Spectral Nature of Illumination*—Incandescent lamps may be specified adequately by stating the kind of illuminant, the rated color temperature, and the electrical potential, in volts, at which the lamps are operated. The correlated color temperature of these lamps increases about 11 K for each volt increase in applied potential, in the neighborhood of 115 V. As lamps are used, the correlated color temperature (at a given voltage) decreases, often from 50 K above to 50 K below the rated value during the life of the lamp. Fluorescent lamps, arcs, and flash lamps differ more than incandescent lamps from black-body spectral emittance and must be described in detail as to make, model, type, etc. The nature of reflectors, including incidental nearby surfaces, can have an important effect on the spectral nature of the energy falling on the object. The neutrality of such surfaces should be specified when spectral quality is of interest.

5.6 *Contrast*:

5.6.1 *Object-Surround Contrast*—The appearance of an object may depend on the contrast between the object and the background or other visual surroundings against which the object is seen. The orientation of the background or surrounding materials may be described in the same way as the orientation of the object and the reflection characteristics of the materials appearing with the object may be completely specified. However, it is usually more convenient to specify the ratio of the luminance of the object to the luminance of the background or other surroundings, as measured from the direction of the camera lens by a photographic exposure meter. If constant contrast is desirable, it may be specified in that way but it should be noted that the use of constant contrast tends to minimize the visual appreciation of the variation of lightness among specimens.