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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Identification of Instrumental Methods of Color or Color-Difference Measurement of Materials[1]

This standard is issued under the fixed designation E 805; 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 practice covers the identification of instrumental methods for the measurement of color or color difference. The practice is applicable to instrumental measurements of materials where color is seen by reflected or transmitted light. The practice is recommended for documentation of methodology in interlaboratory color-measurement programs.

1.2 An adequate identification of an instrumental measure of color or color-difference consists of five parts:

1.2.1 Nature and source of available samples and the form of specimens actually measured,

1.2.2 Instrumental conditions of measurement, including instrument geometry and spectral properties of illuminating and receiving systems,

1.2.3 Standards used,

1.2.4 Data-taking procedure, and

1.2.5 Trichromatic color scales employed.

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 whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1535 Test Method for Specifying Color by the Munsell System[2]

D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates[2]

E 179 Guide for Selection of Geometric Conditions for Measurement of Reflection and Transmission Properties of Materials[2]

E 259 Practice for Preparation of Pressed Powder White Reflectance Factor Transfer Standards for Hemispherical Geometry[2]

E 284 Terminology of Appearance[2]

E 308 Practice for Computing the Colors of Objects by Using the CIE System[2]

E 991 Practice for Color Measurement of Fluorescent Specimens[2]

E 1164 Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation[2]

E 1247 Test Method for Identifying Fluorescence in Object-Color Specimens by Spectrophotometry[2]

E 1331 Test Method for Reflectance Factor and Color by Spectrophotometry Using Hemispherical Geometry[2]

E 1345 Practice for Reducing the Variability of Color Measurement by the Use of Multiple Measurements[2]

E 1347 Test Method for Color and Color Difference Measurement by Tristimulus (Filter) Colorimetry[2]

E 1348 Test Method for Transmittance and Color by Spectrophotometry Using Hemispherical Geometry[2]

E 1349 Test Method for Reflectance Factor and Color Using Bidirectional Geometry[2]

3. Terminology

3.1 Definitions of terms in Terminology E 284 are applicable to this practice.

4. Significance and Use

4.1 The options available in methods for the measurement of color or color-difference are many. These involve choices in: (*1*) specimens, (*2*) geometric and spectral properties of instruments, (*3*) calibration bases for standards used, (*4*) procedure for taking data, and (*5*) equations for converting instrumental data to final results. A sample form is provided in Fig. 1 to record identifying information applicable to any instrumental method of color or color-difference measurement.

4.2 Refer to Practices E 991, E 1164, and E 1345 and Test Methods E 1247, E 1331, E 1347, E 1348, and E 1349 for specific details of actual measurements.

5. Identification of Samples and Specimens

5.1 *Identification of Samples*:

5.1.1 Identify samples by material and form, together with markings or document identification.

5.1.2 From available samples, select or prepare specimens that represent the samples in appearance attributes of interest. Specimens should be planar and uniform to the unaided eye over an area large enough to cover the specimen port of the instrument to be used for measurement.

5.2 *Identification of Specimens*:

[1] This practice is under the jurisdiction of ASTM Committee E-12 on Appearanceand is the direct responsibility of Subcommittee E12.04 on Color and Appearance Analysis.

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[2] *Annual Book of ASTM Standards*, Vol 06.01.

(1) *Instrumental Method for Measurements of:* ☐ Color ☐ Color difference of: _____ _____ (Material).
(2) *Color Scales Used* (Section 9):_____ Date:_____
(3) *Specimen Description* (Section 5)
(a) *Form:* ☐ thickness (number of layers) ☐ single layer backed by_____
☐ powder (note packing pressure) ☐ paste ☐ liquid ☐ film drawdown (specify thickness and backing material).
(b) *Optical Character:* ☐ opaque, nonmetallic ☐ metallic
☐ translucent ☐ transparent
(c) *Special Considerations:*
☐ effect pigment
☐ metal flake
☐ pearlescent
☐ fluorescent
☐ retroreflective
(d) *Sensitivity to Environmental Conditions:*
☐ Temperature _____
☐ Humidity _____
☐ Light _____
(e) *Specimen Directionality:* Specify orientation and any rotation _____
(4) *Instrument Description* (Section 6)
☐ Spectrophotometer ☐ Tristimulus Colorimeter
Make and model _____ Serial No.: _____
(a) *Geometry*: Angle(s) of illumination of specimen_____ Specular included or excluded? Light trap (if applicable) size, shape, and position _____
Size and shape of aperture _____
Aperture angle _____Beam diameter at specimen_____
Viewing angle(s) at specimen _____Aperture angle_____
Cover glass at specimen window _____ Yes _____ No _____ Method for correction _____
(b) *Spectral:* Lamp _____Filters and elements used_____
Viewing is by _____ Modified by filters and elements_____
(5) *Material Standard Used:*_____
Date of preparation or calibration:_____
(6) *Reduction of Data:*
(a) Tristimulus Integration: ☐ Filter ☐ Computed from spectral data taken every _____ nm over range _____nm to_____ nm. _____with spectral bandwidth _____nm.
(b) Decimal places carried in computation: _____

FIG. 1 Sample Report Form

5.2.1 Mark each specimen with sample identification, a serial number or letter, and any other identifying markings that may be desired.

5.2.2 Identify form of specimens as either:

5.2.2.1 Solid sheet or web (specify thickness and backing material).

5.2.2.2 Powder or granular substance (packed or poured; if placed behind window, state material and thickness).

5.2.2.3 Fiber or yarn (describe form, type of transparent specimen window, pressure on backing plate).

5.2.2.4 Paste (if placed behind window, state material and thickness).

5.2.2.5 Liquid (if observed through window, state window material and thickness).

5.2.2.6 Film drawdown (specify film thickness and background).

NOTE 1—When specimens are measured behind glass or other material, specify thickness and material type. In addition, specify the method used for data correction.

5.2.3 Identify optical character of specimens as either:

5.2.3.1 Opaque, nonmetallic (majority of materials).

5.2.3.2 Opaque, metallic (bare metal or foil).

5.2.3.3 Translucent.

5.2.3.4 Transparent.

5.2.4 Identify special specimen characteristics, if any, such as:

5.2.4.1 Effect pigment (metal flake or pearlescent),

5.2.4.2 Fluorescent, and

5.2.4.3 Retroreflective.

5.2.5 Determine whether the specimen exhibits directionality. If applicable, specify the orientation and any rotation of the specimen between measurements. The use of a datum mark may be helpful.

6. Identification of Instrument

6.1 *Geometric Properties of Instrument*:

6.1.1 *Directions of Illumination and View*—Identify axial angles of illumination and view, and aperture angles of illumination and view, when known.

NOTE 2—For more detail on geometric analysis, see Practice E 179. Whenever the extents to which rays deviate from axial angles within illuminating and viewing beams are unimportant, aperture angles may be omitted and a shorthand notation may be used as follows: Designate bidirectional 45° illumination and 0° viewing as 45/0; designate hemispherical illumination and 0° viewing as d/0. Reverse geometries should be designated 0/45 and 0/d. When more than one beam is used, their number and directions shall be stated. The term circumferential or annular shall be used to indicate that rays are incident at selected or all azimuth angles through 360°.