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Standard Guide to Evaluation of Optical Properties of Powder Coatings[1]

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INTRODUCTION

The term optical properties of coatings refers to those properties associated with the interaction of visible light with the coatings. These properties include, but are not limited to, color, color difference, gloss, and metamerism. Powder coatings users and producers may sometimes be overwhelmed by the sheer number of standard practices and standard test methods available in ASTM for the evaluation of the optical properties of coatings.

This guide is intended to lead the user to each of the practices and test methods needed, once the user decides whether the evaluation is to be by visible means or by instrumental means. Further, the user must decide which of the several optical properties mentioned above are to be evaluated. This guide will lead the user to the applicable practices and test methods for the properties chosen by the means selected.

1. Scope

1.1 This standard provides the user with a guide to the various available practices and test methods for the evaluation of color, color difference, gloss, and metamerism by both visual and by instrumental means.

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:*

D 523 Test Method for Specular Gloss[2]
D 1535 Test Method for Specifying Color by the Munsell System[2]
D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials[2]
D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates[2]
D 2616 Test Method for Evaluation of Visual Color Difference With a Gray Scale[2]
D 3134 Practice for Establishing Color and Gloss Tolerances[2]
D 4039 Test Method for Reflection Haze of High-Gloss Surfaces[2]
D 4086 Practice for Visual Evaluation of Metamerism[2]
D 4449 Test Method for Visual Evaluation of Gloss Differences Between Surfaces of Similar Appearance[2]
E 284 Terminology Relating to Appearance[2]
E 308 Practice for Computing the Colors of Objects by Using the CIE System[2]
E 430 Test Methods for Measurement of Gloss of High-Gloss Surfaces by Goniophotometry[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 Effect of Variability of Color Measurement by Use of Multiple Measurements[2]
E 1347 Test Method for Color and Color–Difference Measurement by Tristimulus (Filter) Colorimetry[2]
E 1349 Test Method for Reflectance Factor and Color by Spectrophotometry Using Bidirectional Geometry[2]
E 1360 Practice for Specifying Color by Using the Optical Society of America Uniform Color Scales System[2]
E 1541 Practice for Specifying and Matching Color by Using the Colorcurve System[2]

3. Terminology

3.1 The definitions in E 284 are applicable to the appearance terms used in this standard. The following terms from Terminology E 284 are specific to this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *color, n*—(2) *perceived*, attribute of visual perception that can be described by color names such as white, gray, black, yellow, brown, vivid red, deep reddish purple, or by combinations of such names.

(3) *psychophysical*, characteristics of a color stimulus (that

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

is, light producing a sensation of color) denoted by a colorimetric specification with three values, such as tristimulus values.

3.2.2 *color difference*, *n*—(1) *perceived*, the magnitude and character of the difference between two colors described by such terms as redder, bluer, lighter, darker, grayer, or cleaner.

(2) *computed*, the magnitude and direction of the difference between two psychophysical color stimuli and their components computed from tristimulus values, or chromaticity coordinates and luminance factor, by means of a specified set of color-difference equations.

3.2.3 *gloss*, *n*—angular selectivity of reflectance, involving surface reflected light, responsible for the degree to which reflected highlights or images of objects may be seen as superimposed on a surface.

3.2.4 *metamerism*, *n*—property of two specimens that match under a specified illuminator and to a specified observer and whose spectral reflectances or transmittances differ in the visible wavelengths.

4. Visual Evaluation of Optical Properties

4.1 *Visual Gloss:* To assess the visual gloss difference between two powder coated surfaces of similar appearance use Test Method D 4449.

4.2 *Color:* To obtain the color notation of a specimen in the Munsell Color Order System use Test Method D 1535. To obtain the color notation of a specimen in the Optical Society of America Uniform Color System use Practice E 1360. To obtain the color notation of a specimen in the Colorcurve System use Practice E 1541.

4.3 *Color Difference:* Practice D 1729 will provide visual color difference in descriptive terms. If it is desirable to quantify the color difference visually, use Test Method D 2616.

4.4 *Metamerism:* Carry out visual evaluation of a metameric pair of specimens by Practice D 4086.

4.5 *Miscellaneous Optical Properties:* Evaluate visually reflection haze of high gloss surfaces, as well as distinctness-of-image gloss, by Test Method D 4449.

5. Instrumental Evaluation of Optical Properties

5.1 *Specular Gloss:* Measure the specular gloss of a powder coating by Test Method D 523.

5.2 *Color:* If filter photometry is to be employed, use Test Method E 1347. If spectrophotometric means are to be employed, acquire spectral data on instruments having 45° illumination and normal viewing by Test Method E 1349, and on instruments having an integrating sphere by Practice E 1331. The spectrophotometric data are then integrated to tristimulus values by Practice E 308.

5.3 *Color Difference:* Finally, evaluate the color difference between two powder-coating specimens by Test Method D 2244 using the tristimulus values acquired in 5.2.

5.4 *Metamerism:* Although Practice D 4086 is a visual method, Note 1 to Section 7 in that practice describes a method for comparison of spectral curves of two specimens to detect the presence of metamerism.

5.5 *Miscellaneous Optical Properties and Methods:* Evaluate reflection haze of high gloss surfaces instrumentally by Test Method D 4039. Evaluate distinctness-of-image gloss of high gloss surfaces by Test Method E 430. Fluorescence in a powder coating may be identified by Test Method E 1247. Establish color and gloss tolerances by Practice D 3134. Practice E 1345 gives methods of reducing the variability of color measurements by making multiple measurements.

6. Report

6.1 Reports that may be required are contained in each of several referenced standards that may be utilized as a result of following this guide.

7. Keywords

7.1 color; color difference; gloss; metamerism; powder coatings