



Standard Guide for Microspectrophotometry and Color Measurement in Forensic Paint Analysis¹

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INTRODUCTION

Color is one of the most important comparative characteristics of paints. The comparison of color is one of the first steps taken in a forensic paint comparison and it is essential to note that this guide does not propose the use of instrumental color comparison for objects that are distinguishable to the eye. Since the 1940s, analytical instruments have been able to discriminate colors that the average human eye cannot distinguish. Microspectrophotometers (MSPs), in particular, allow for an objective measurement of the color of small, millimetre or submillimetre samples and are more precise or quantitative compared to the more subjective results of visual microscopical color comparisons.

Suitable instruments with appropriate optics, sensitivity, resolution, and dynamic range can measure and produce spectral curves of light energy from small samples as that light is transmitted, absorbed, or reflected by the sample. These spectra are collected over small measurement steps or increments of one-half to a few nanometers each. MSPs typically operate in the visible spectral region (~380 to ~800 nm) and also in the ultraviolet region (~190 to ~380 nm). They should not be confused with broadband or absorption filter-based, tristimulus systems or low-resolution, large measurement step (5 nm or more) spectral analyzers.

The spectral limits of different instruments can vary in all of the above noted spectral regions and may also include the near infrared region from about 780 to 2100 nm. The usefulness of this last spectral region in the analysis and comparison of paint fragments is currently indeterminate and will not be covered in this guide.

Subjective terms such as “blue,” “violet,” or “purple” are inadequate descriptors of actual color. MSP instruments can be used to describe or numerically “name” an item’s color by calculating the item’s colorimetric values. These values, or chromaticity coordinates, can be expressed in any one of several coordinate systems and are useful in the development and maintenance of color comparison databases.

Colorimetric values are of limited use in actual color comparison of evidence samples because differing spectral curves can yield identical colorimetric values. This is commonly found in industrial or commercial paint-matching protocols in which the only requirement is to paint an item so it appears to be the same as others. The eye’s perception and the colorimetric values of two items may indicate that they are the same color, but the spectral curves of those items may still be distinguished. This leads to the use of the MSP in the comparison of visually indistinguishable colored items.

1. Scope

1.1 This guide is intended to assist individuals and laboratories that conduct forensic visible and ultraviolet (UV) spectral analyses on small fragments of paint using Guide E1610.

1.2 This guide deals primarily with color measurements within the visible spectral range but will also include some details concerning measurements in the UV range.

1.3 This guide does not address other areas of color evaluation such as paint surface texture or paint pigment particle size, shape, or dispersion within a paint film that are evaluated by other forms of microscopy. Other techniques such as spectral luminescence, fluorescence, and near infrared (NIR) are not included in this guide because of their limited use, lack of validation, or established efficacy in forensic paint analysis.

1.4 This guide is directed at the color analysis of commercially prepared paints and coatings. It does not address the analysis or determination of provenance of artistic, historical, or restorative paints, but it may be found useful in those fields.

¹ This guide is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.01 on Criminalistics.

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