



Standard Guide for Forensic Paint Analysis and Comparison¹

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1. Scope

1.1 Forensic paint analyses and comparisons are typically distinguished by sample size that precludes the application of many standard industrial paint analysis procedures or protocols. The forensic paint examiner must address concerns such as the issues of a case or investigation, sample size, complexity and condition, environmental effects, and collection methods. These factors require that the forensic paint examiner choose test methods, sample preparation schemes, test sequence, and degree of sample alteration and consumption that are suitable to each specific case.

1.2 This guide is intended as an introduction to standard guides for forensic examination of paints and coatings. It is intended to assist individuals who conduct forensic paint analyses in their evaluation, selection, and application of tests that can be of value to their investigations. This guide describes methods to develop discriminatory information using an efficient and reasonable order of testing. The need for validated methods and quality assurance guidelines is also addressed. This document is not intended as a detailed methods description or rigid scheme for the analysis and comparison of paints, but as a guide to the strengths and limitations of each analytical method. The goal is to provide a consistent approach to forensic paint analysis.

1.3 This guide cannot replace knowledge, skill, or ability acquired through appropriate education, training, and experience and should be used in conjunction with sound professional judgment.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *Some of the methods discussed in this guide involve the use of dangerous chemicals, temperatures, and radiation sources. This guide does not purport to address the possible safety hazards or precautions associated with its application. 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.

1.6 *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

D16 Terminology for Paint, Related Coatings, Materials, and Applications

D1535 Practice for Specifying Color by the Munsell System

E308 Practice for Computing the Colors of Objects by Using the CIE System

E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory

E2808 Guide for Microspectrophotometry in Forensic Paint Analysis

E2809 Guide for Using Scanning Electron Microscopy/Energy Dispersive X-Ray Spectroscopy (SEM/EDS) in Forensic Polymer Examinations

E2937 Guide for Using Infrared Spectroscopy in Forensic Paint Examinations

3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide other than those listed in 3.2, see Terminology **D16**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *additive (modifier)*—any substance added in a small quantity to improve properties. Additives can include substances such as driers, corrosion inhibitors, catalysts, ultraviolet absorbers, plasticizers, etc.

3.2.2 *binder*—a non-volatile portion of a paint which serves to bind or cement the pigment particles together.

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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.

3.2.3 *coating*—a generic term for paint, lacquer, enamel, or other liquid or liquifiable material which is converted to a solid, protective, decorative, or combination thereof, film after application.

3.2.4 *discriminate*—to distinguish between two samples based on meaningful differences; to differentiate.

3.2.5 *discriminating power*—the ability of an analytical procedure to distinguish between two items of different origin.

3.2.6 *known sample*—a coating sample of established origin.

3.2.7 *meaningful difference*—a feature or property of a sample that does not fall within the variation exhibited by the comparison sample, considering the limitations of the sample or technique, and therefore indicates the two samples do not share a common origin. The use of this term does not imply the formal application of statistics.

3.2.8 *paint*—commonly known as a pigmented coating (see 3.2.3).

3.2.9 *pigment*—a finely ground, inorganic or organic, insoluble, dispersed particle. Besides color, a pigment can provide many of the essential properties of paint, such as opacity, hardness, durability, and corrosion resistance. The term pigment includes extenders.

3.2.10 *questioned sample*—a coating sample whose original source is unknown.

4. Quality Assurance Considerations

4.1 A quality assurance program must be used to ensure that analytical testing procedures and reporting of results are monitored by means of proficiency tests and technical audits. General quality assurance guidelines may be found in “Trace Evidence Quality Assurance Guidelines” (1).³

5. Summary of Guide

5.1 Paint films are characterized by a number of physical and chemical features. The physical characteristics can include color, layer sequence and thickness, surface and layer features, contaminants, and weathering. Chemical components can include pigments, polymers, additives, and solvents. These features can be determined and evaluated by a variety of macroscopical, microscopical, chemical, and instrumental methods. Limited sample size and sample preservation requirements mandate that these methods be selected and applied in a reasonable sequence to maximize the discriminating power of the analytical scheme.

5.2 Searching for differences between questioned and known samples is the basic thrust of forensic paint analysis and comparison. However, differences in appearance, layer sequence, size, shape, thickness, or some other physical or chemical feature can exist even in samples that are known to be from the same source. A forensic paint examiner’s goal is to assess the significance of any observed differences. The absence of meaningful differences at the conclusion of an

analysis suggests that the paint samples could have a common origin. The strength of such an interpretation is a function of the type or number of corresponding features, or both.

5.3 An important aspect of forensic automotive paint analysis is the identification of the possible makes, models, and years of manufacture of motor vehicles from paint collected at the scene of a crime or accident. The color comparison and chemical analysis of both the undercoat and top coat systems requires knowledge of paint formulations and processes, collections of paint standards, and databases of color and compositional information.

5.4 The test procedure selected in a paint analysis and comparison begins with thorough sample documentation. Some features of that documentation are described in Practice E1492. Analysis generally begins with appropriate nondestructive tests. If these initial tests are inconclusive or not exclusionary, the examination may proceed with the selection of additional tests based on their potential for use in evaluating or discriminating the samples of interest, or both.

6. Significance and Use

6.1 This guide is designed to assist the forensic paint examiner in selecting and organizing an analytical scheme for identifying and comparing paints and coatings. The size and condition of the sample(s) will influence the selected analytical scheme.

7. Collection of Suitable Samples

7.1 The potential for physical matches between known and questioned samples must be considered before selecting the method of paint sample collection. Care should be taken to preserve the potential for a physical match.

7.2 Questioned Samples:

7.2.1 Questioned samples should include all loose or transferred paint materials. Sources of questioned samples can include tools, floors, walls, glass fragments, hair, fingernails, roadways, adjacent structures, transfers or smears on vehicles, or transfers to or from individuals such as damaged fabric with paint inclusions. Whenever possible, items with paint transfers should be appropriately packaged and submitted in their entirety for examination. If sampling is necessary, the procedures listed in “Trace Evidence Recovery Guidelines” (2) can be used. When paint evidence is recognized, every effort should be made to manually remove it before using tape lifts to collect other types of evidence. If paint is collected with tape lifts, one should be aware of the possible difficulty encountered when attempting to manipulate paint samples bearing adhesive residues. In addition, components of the adhesive could contaminate the paint sample and change its apparent chemistry.

7.2.2 Smeared transfers can exhibit mingling of components from several layers or films that could preclude application of some of the analytical methods discussed in this guide. Due to the difficulties associated with collecting smeared or abraded samples, the entire object bearing the questioned paint should be submitted to the laboratory whenever possible.

³ The boldface numbers in parentheses refer to the list of references at the end of this standard.