



Designation: E3234 – 20

Standard Practice for Forensic Paint Analysis Training Program¹

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1. Scope

1.1 This document is intended as a practice for use by laboratory personnel responsible for training examiners to perform forensic examinations and comparisons of paint. It contains a list of training objectives with recommended methods of instruction, reading assignments and structured exercises to provide practical experience for the trainee.

1.1.1 The trainees and training program shall meet or exceed the minimum training requirements set forth in Practice [E2917](#).

1.1.2 Additional training could be required for a particular method or instrument referred to herein. The application of analytical techniques to paint analysis assumes the trainee is already competent in the use of each particular analytical technique or instrumental method.

1.1.3 Other sources of information on forensic paint examination not specifically mentioned in this document can be considered and added.

1.1.4 Additional paint analysis training beyond that which is listed here should be made available to the trainee. Such training could include off-site courses, internships, and specialized training by experienced examiners.

1.1.5 Continuing education and training is recommended. Additional training provides a forensic paint examiner with the opportunity to remain current in the field.

1.1.6 Paint samples occasionally are evaluated for physical matches of broken edges. This document does not provide training requirements for physical match comparisons. Additional training is required to conduct this type of analysis.

1.2 This practice is in a modular format for easy adaptation to an individual laboratory's training program. Recommendations as to lessons, practical exercises, progress monitoring, and trainee evaluations are included. Reading assignments are listed in each subsequent section of this practice; full citations are available in the References section.

1.3 A paint analysis training program provides a theoretical foundation and basic practical skills necessary to prepare a trainee to become a qualified forensic paint examiner. At the

end of the paint analysis training program, the trainee is capable of forming opinions based upon sound scientific knowledge, appropriate examinations, and practical experience. The trainee also is able to independently work cases, write reports, testify in court, and peer review cases. Upon completion of the program by a trainee or at some regular interval (for example, once per accreditation cycle), the training program should be evaluated for its efficacy and relevance according to the guidance set forth in Practice [E2917](#).

1.4 This standard practice does not address human factors (for example, cognitive bias). It is the responsibility of the user of this standard to address human factors during the initial or general training of a forensic scientist. Refer to Practice [E2917](#).

1.5 *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

[E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs](#)

[D16 Terminology for Paint, Related Coatings, Materials, and Applications](#)

[D1535 Practice for Specifying Color by the Munsell System](#)

[D4764 Test Method for Determination by X-ray Fluorescence Spectroscopy of Titanium Dioxide Content in Paint](#)

[D5380 Test Method for Identification of Crystalline Pigments and Extenders in Paint by X-Ray Diffraction Analysis](#)

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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.

- D5381** Guide for X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders
- E308 Practice for Computing the Colors of Objects by Using the CIE System
- E1459** Guide for Physical Evidence Labeling and Related Documentation
- E1492** Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory
- E1610** Guide for Forensic Paint Analysis and Comparison
- E2808** Guide for Microspectrophotometry in Forensic Paint Analysis
- E2809** Guide for Using Scanning Electron Microscopy/X-Ray Spectrometry in Forensic Paint Examinations
- E2937 Guide for Using Infrared Spectroscopy in Forensic Paint Examinations

3. Significance and Use

3.1 The procedures outlined herein are grounded in the generally accepted body of knowledge and experience in the field of forensic paint examination and comparison.

3.2 With successful completion of this paint analysis training program, the trainee gains the theoretical knowledge and practical skills necessary to perform, document, and evaluate forensic paint examinations and comparisons.

3.3 This training practice covers a variety of instrumental methods which can be used in the analysis of paint. Not all laboratories will have access to all of the instrumentation. It is expected that a paint analysis training program will include all the techniques that are found within a laboratory's procedures for the forensic examination of paint.

3.3.1 Instrumental methods that provide organic and inorganic analysis capabilities are utilized in the laboratory training program. Examples include Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, pyrolysis gas chromatography (PGC), scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM/EDS), X-ray fluorescence (XRF), and X-ray diffraction (XRD).

4. Responsibilities

4.1 Each trainee is trained by and works under the guidance of, one or more qualified forensic paint examiners.

4.1.1 The trainee shall meet or exceed the minimum training criteria set forth in Practice **E2917** and the objectives set forth in the training program.

4.2 A trainer shall be technically qualified in forensic paint examination and comparison or associated techniques. Other members of the laboratory are encouraged to offer relevant information regarding their specialty to the trainee. The trainer(s) is responsible for:

4.2.1 Introducing the trainee to the relevant scientific literature, appropriate procedures, training material, and reference collections.

4.2.2 Discussing readings and theory with the trainee.

4.2.3 Teaching basic microscopy and instrumental methods for the analysis and comparison of paint evidence.

4.2.4 Teaching case management.

4.2.5 Fostering ethical professional conduct.

4.2.6 Reviewing ways in which bias can influence paint examinations.

4.2.7 Teaching appropriate quality assurance and quality control procedures.

4.2.8 Reviewing tests, practical exercises, and casework samples with the trainee.

4.2.9 Teaching expert testimony skills through moot court or observation, or both.

4.2.10 Monitoring the trainee's progress

4.3 Each laboratory is required to maintain:

4.3.1 An up-to-date training program which is reviewed and assessed for efficacy and relevance as described in Practice **E2917**.

4.3.2 Documentation of training according to Practice **E2917**.

4.3.3 Documentation of competency tests and proficiency tests.

5. Syllabus

5.1 A paint analysis training program provides the trainee theoretical knowledge and practical skills in examining, interpreting, reporting, testifying, and reviewing forensic paint cases. This is accomplished through a combination of the following training methods:

5.1.1 *Reading of Relevant Literature:*

5.1.1.1 The reading assignments listed are suggestions. Newer versions can be used. Other relevant literature can be used or substituted.

5.1.2 *Instruction and Observation of Forensic Paint Examiners:*

5.1.2.1 Lectures and discussions,

5.1.2.2 Practical demonstration of basic skills,

5.1.2.3 Casework, and

5.1.2.4 Court testimony.

5.1.3 *Practical Skills:*

5.1.3.1 Practical exercises which includes analysis of reference materials and known samples.

5.1.4 *Final Competency Evaluations:*

5.1.4.1 Written or oral tests,

5.1.4.2 Practical laboratory tests,

5.1.4.3 Mock cases, and

5.1.4.4 Moot court or oral exam.

5.1.5 *Performing Supervised Casework.*

5.2 The recommended training period is between three to six months, full time, for a forensic examiner that has been previously trained and is competent in the analytical techniques utilized in the analysis of paint evidence. For new examiners with no previous training in microscopical or instrumental techniques, the expected training period is between twelve to eighteen months.

5.3 Successful completion of each milestone in the training program will be recorded using the guidance set forth in Practice **E2917**.

6. Paint Analysis Training Program Objectives

6.1 *Encountering Paint Evidence:*

6.1.1 This section introduces the trainee to the types of cases and the various conditions in which paints are encountered as physical evidence.

6.1.2 Types of paints which could be encountered as evidence include automotive paint, other vehicle paint (for example, motorcycle, aircraft, marine, trains, bicycle.), architectural paint, maintenance paint, spray paint, and other specialty paints.

6.1.3 *Reading Assignments:*

6.1.3.1 Ryland, “Infrared Microspectroscopy of Forensic Paint Evidence,” pp. 163–170 and pp. 185–191 **(1)**.³

6.1.4 *Practical Exercises:*

6.1.4.1 Demonstrate knowledge of the types of cases and the various conditions in which paints are encountered as physical evidence through an oral or written exercise.

6.1.5 The methods of instruction for this unit are reading and research by the trainee and discussions with the trainer(s).

6.1.6 The method of evaluation for this unit is a review of the trainee’s completed exercise by the trainer.

6.2 *Paint Terminology:*

6.2.1 This section introduces the trainee to the following terms:

- 6.2.1.1 Additives,
- 6.2.1.2 Binder (resin),
- 6.2.1.3 Coating,
- 6.2.1.4 Cross-linker,
- 6.2.1.5 Drier,
- 6.2.1.6 Drying oils,
- 6.2.1.7 Enamel,
- 6.2.1.8 Extender,
- 6.2.1.9 Lacquer,
- 6.2.1.10 Latex,
- 6.2.1.11 Paint,
- 6.2.1.12 Pigment,
- 6.2.1.13 Plasticizer,
- 6.2.1.14 Solvent,
- 6.2.1.15 Stain,
- 6.2.1.16 Thermoplastic polymer,
- 6.2.1.17 Thermosetting polymer,
- 6.2.1.18 Varnish, and
- 6.2.1.19 Vehicle.

6.2.2 *Reading Assignments:*

6.2.2.1 Lambourne, “Paint Composition and Applications – A General Introduction” **(2)**.

6.2.2.2 Koleske, ed., *Paint and Coating Testing Manual* **(3)**.

6.2.3 *Practical Exercises:*

6.2.3.1 Define the terms listed in this section.

6.2.4 The methods of instruction for this unit are reading and research by the trainee.

6.2.5 The method of evaluation for this unit is an oral or written quiz.

6.3 *The Use and Composition of Paint:*

6.3.1 This section introduces the trainee to the uses and compositions of different types of paints to include the following:

6.3.1.1 The significance of oils, driers, solvents, plasticizers, resinous vehicles, extenders, and pigments in the formation of paint films, examples of materials used in each of these components, and the differences between a liquid paint and a dried paint film in terms of each of these components.

6.3.1.2 The manner in which latex, thermoplastic and thermosetting paint films are formed.

6.3.1.3 The impact of the film formation mechanism on a forensic paint examination.

6.3.1.4 Various types of paint to end-use applications.

6.3.1.5 Additives used in latex paints.

6.3.2 *Reading Assignment:*

6.3.2.1 Morgans, *Outlines of Paint Technology* **(4)**.

6.3.3 *Practical Exercise:*

6.3.3.1 Explain the uses and differences of the paint components listed in this section.

6.3.4 The methods of instruction for this unit are reading and research by the trainee.

6.3.5 The method of evaluation for this unit is an oral or written quiz.

6.4 *Manufacturing Processes:*

6.4.1 This section introduces the trainee to paint manufacturing and application processes to include the following:

6.4.1.1 How raw materials are acquired and mixed.

6.4.1.2 What variations could be present in raw materials.

6.4.1.3 What variations could exist in binders from different companies.

6.4.1.4 What a batch of paint is and typically how large it is.

6.4.1.5 What quality control procedures are used in the manufacture of paint.

6.4.1.6 How paint is packaged and distributed.

6.4.1.7 Application processes for non-motor vehicle paints (for example, brush, spray, powder coating, coil-coating).

6.4.1.8 The application process of original equipment manufacturer (OEM) finishes to motor vehicles.

6.4.1.9 Processes used in repainting and repairing vehicles.

6.4.1.10 The purposes of each motor vehicle finish layer.

6.4.1.11 Differences between OEM and repainted motor vehicle finishes.

6.4.1.12 Analytical and physical testing methods used by the paint industry.

6.4.2 *Reading Assignments:*

6.4.2.1 Bentley, “Composition, Manufacture and Use of Paint” **(5)**.

6.4.2.2 Farkas, “The Industrial Paint-Making Process” **(6)**.

6.4.2.3 Ryer, “Alkyd Chemistry and New Technology Trends in Coatings Resin Synthesis” **(7)**.

6.4.2.4 Ryntz, “Automotive Coatings: Current Trends for Coating Plastic – Part 1” **(8)**.

6.4.2.5 Wright and Mehlretter, “The Prevalence of Original Equipment Manufacturer (OEM) Factory Repairs in Automotive Paint Samples” **(9)**.

6.4.3 *Practical Exercises:*

6.4.3.1 Explain the manufacturing and application processes of paint.

6.4.3.2 Visit paint manufacturing facilities when practical.

6.4.4 The method of instruction for this unit is reading by the trainee.

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