



Standard Guide for Using Scanning Electron Microscopy/X-Ray Spectrometry in Forensic Paint Examinations¹

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1. Scope

1.1 This guide is an outline of methods for scanning electron microscopy (SEM) intended for use by forensic paint examiners. This guide is intended to supplement information presented in Guide E1610.

1.2 The methods used by each examiner or laboratory or both depend upon sample size, sample suitability, and laboratory equipment.

1.3 The term “scanning electron microscopy” occasionally refers to the entire analytical system including energy dispersive X-ray spectrometry (EDS) or wavelength dispersive X-ray spectrometry (WDS) or both.

1.4 This guide does not cover the theoretical aspects of many of the topics presented.

1.5 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.

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

1.7 *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:²

E766 Practice for Calibrating the Magnification of a Scanning Electron Microscope

E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory
E1508 Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy
E1610 Guide for Forensic Paint Analysis and Comparison
E1732 Terminology Relating to Forensic Science

3. Terminology

3.1 *Definitions*—For additional terms commonly employed for general forensic examinations, see Terminology E1732.

3.1.1 *background X-rays (Bremsstrahlung, braking radiation, continuous spectrum)*, *n*—nonspecific X-ray radiation with a continuous energy range from zero up to the beam voltage in which background radiation results from the deceleration of beam electrons in the atomic Coulombic field.

3.1.1.1 *Discussion*—A typical X-ray spectrum consists of both a continuous background and peaks from characteristic X-rays.

3.1.2 *backscattered electrons*, *n*—primary beam electrons that are scattered from the sample after undergoing few inelastic interactions.

3.1.2.1 *Discussion*—The probability of backscattering is proportional to the atomic number.

3.1.3 *bulk analysis*, *n*—type of scanning electron microscopy (SEM) analysis that determines the average elemental composition of a material in which the area of analysis is as large as possible and may be achieved by a single large area raster or the summed results from multiple smaller area rasters.

3.1.4 *cathodoluminescence*, *n*—emission of photons in the ultraviolet (UV), visible (Vis), and infrared (IR) regions of the electromagnetic spectrum as a result of electron beam interaction with certain materials.

3.1.5 *characteristic X-rays*, *n*—X-ray emission resulting from de-excitation of an atom following inner shell ionization in which the energy of the X-rays is related to the atomic number of the atom, providing the basis for energy dispersive X-ray spectrometry (EDS).

3.1.5.1 *Discussion*—A typical X-ray spectrum consists of both a continuous background and peaks from characteristic X-rays.

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

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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.