



J15 X-Ray Cabinets Applied to Forensic Document Examination

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Learning Overview: After attending this presentation, attendees will learn how X-ray cabinet radiography can be used in examinations of questioned documents and the materials used to produce documents.

Impact on the Forensic Science Community: The presentation will impact the forensic science community by demonstrating how X-ray cabinets can be used in a variety of examinations in the questioned document laboratory.

Questioned document examination is one of the oldest areas of forensic science, spanning more than 100 years, coincidentally emerging around the same time frame as when X-rays were first reported in the scientific literature by W.C. Röntgen.¹ Documents may take many forms, for example: single sheets of paper, bound books, packaging, and plastic cards. The increase in the different types of materials, such as ink, toner, papers, and polymers that may be used in making documents, is also diverse. Consequentially, the range of instrumental techniques and technologies used in their examination is equally diverse.

X-rays are commonly used in non-destructive examinations of objects in industry, medicine, dentistry, and materials science. It follows that its use in forensic science will apply to many situations where similar types of non-destructive examinations may be beneficial, such as those encountered in questioned documents. Forensic document examination has used radiography and in particular “soft” X-rays to reveal the inner structures of documents and the materials used to make them. While specific application of X-rays to document examination has been published at least as early as 1953, it has not always been straightforward to obtain suitable radiographs.² The difficulties are not always solely due to the time taken for film processing but to the fact that most X-ray equipment is not well suited for low-density materials, such as documents. Many instruments are not capable of producing X-rays of low enough energy to disclose these subtle radiographic densities. As a result, many X-ray devices and sources are too powerful, resulting in poor contrast radiographs. Other challenges include requiring specialized knowledge to operate certain devices and shielded areas for health and safety regulatory requirements.

The characteristics of X-ray exposure and nomenclature will be reviewed. This will educate the document examination community on how radiograph exposures are described in terms of factors such as: X-ray tube voltages and current, exposure time, beam diameter, sensor capability, and geometric magnification. Some basic physics on X-ray interactions with matter will provide insight into what happens when an object is subjected to X-ray radiation. These interactions include scattering, transmission, and absorption, and these may pose radiograph imaging problems, especially when the shape of objects is irregular.

Many practical lessons on successful implementation of X-ray radiography of documents can be drawn upon from the conservation and restoration community. Objects including documents and books are subjected to X-ray radiography in a similar fashion to what may be desired for matters pertaining to forensic document examination.³

Modern cabinet X-ray devices afford the convenience of instant results, flexibility in setup, and safety and convenience of digital radiographs, permitting adaptable post-processing for optimal viewing. This presentation will include several examples of different document types along with discussion on how this type of non-destructive examination can provide valuable insights into document construction, alterations, and materials differences. Digital radiograph formats including the Digital Imaging and Communications in Medicine (DICOM) will be explained as will the advantages and disadvantages of each.

Reference(s):

1. W.C. Röntgen. On a new kind of rays. *Nature*, Vol 53:274-76.
2. Harris B. Tuttle. X-Rays Held to Trip Stamp Counterfeiters. *Identification News*, November 1953, p5.
3. Janet Lang and Andrew Middleton (Editors). *Radiography of Cultural Material*. Elsevier Butterworth Heinemann, 2005.

Questioned Documents, X-Rays, Radiography