Designation: E2389 – 05

StandardGuide for Examination of Documents Produced with Liquid Ink Jet Technology[1]

This standard is issued under the fixed designation E2389; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides procedures that should be used by forensic document examiners (Guide E444) for examinations of documents produced with liquid inkjet technology and related procedures.

1.2 These procedures are applicable whether the examination is of a questioned and known item(s) or of exclusively questioned item(s).

1.3 These procedures include evaluation of the sufficiency of the material available for examination.

1.4 The particular methods employed in a given case will depend upon the nature and sufficiency of the material available for examination.

1.5 This guide may not cover all aspects of unusual or uncommon examinations.

1.6 These methods are applicable to examinations involving copiers, printers, facsimile devices, and multifunction devices using ink jet technology.

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]

D1968 Terminology Relating to Paper and Paper Products (Withdrawn 2010)[3]

E444 Guide for Scope of Work of Forensic Document Examiners

E1732 Terminology Relating to Forensic Science

E2195 Terminology Relating to the Examination of Questioned Documents

E2331 Guide for Examination of Altered Documents

F221 Terminology Relating to Carbon Paper and Inked Ribbon Products and Images Made Therefrom

F909 Terminology Relating to Printers

F1156 Terminology Relating to Product Counterfeit Protection Systems (Withdrawn 2001)[3]

F1457 Terminology Relating to Laser Printers

F1857 Terminology Relating to Ink Jet Printers and Images Made Therefrom

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms in this guide, refer to Terminologies E1732 and E2195.

3.1.2 *coalescence, n*—puddling or pooling of adjacent ink drops on the substrate before they can be dried or absorbed resulting in nonuniformity of color density. **F1857**

3.1.3 *cockle, n—of paper*, a defective, puckered condition of a paper sheet as a result of non-uniform hygro-expansion which can be related to any non-uniformity in the sheet, including mass distribution and drying stresses. **D1968**

3.1.4 *continuous spray, n*—ink jet technology where drops are generated at a regular unbroken rate. Images are then generated by deflections of the ink droplets after they are charged so they are either intercepted by a catcher and not permitted to impact the substrate or deflected to intercept the substrate at specific locations.

3.1.5 *cracking, n*—condition in which ink that has been absorbed into a substrate causes the coating to shrink to a state much smaller than the original coating dimension causing fractures in the image area. **F1857**

3.1.6 *crystallization, n*—condition in which ink evaporates and forms crystals. **F1857**

3.1.7 *drop on demand (DOD), n*—ink jet technology where drops are generated as needed to create an image.

3.1.8 *full-color copiers, n—of ink jet technology*, copiers that can reproduce color originals containing gradations of color. They have a minimum of three colored inks (cyan, magenta and yellow).

[1] This guide is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.90 on Executive.

Current edition approved Dec. 1, 2005. Published January 2006. DOI: 10.1520/E2389-05.

[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] The last approved version of this historical standard is referenced on www.astm.org.

3.1.9 *image area, n*—area on a page occupied by all the printed information. **F1457**

3.1.10 *image density, n*—contrast between image and background as measured by densitometer. **F221**

3.1.11 *image, n*—optical counterpart of an object produced by means of an image producing device. **F221**

3.1.12 *ink jet printer, n*—nonimpact printer in which the characters are formed by projecting droplets of ink onto a substrate. **F909**

3.1.13 *landscape mode, adj*—printer output orientation in which printed lines run parallel to the direction of movement of the paper. **F1457**

3.1.14 *maximum print position, n*—rightmost point at which the printer can mark the paper. **F1457**

3.1.15 *nonimpact printer, n*—printer in which image formation is not the result of mechanical impacts. Examples are thermal printers, electrostatic printers, electrophotographic printers, and inkjet printers. **F909**

3.1.16 *offset, n*—unintentional transfer of ink (as from a freshly printed substrate). **F1857**

3.1.17 *piezoelectric, n*—ink jet technology where the electrically stimulated deformation of a crystal causes the expulsion of the droplets from the ink chamber.

3.1.18 *pixelation, n*—stairstepped or jagged effect resulting from analog to digital conversion.

3.1.19 *platen, n*—flat plate or roller used as a support for printing or copying a document. **F1156**

3.1.20 *portrait mode, adj*—printer output orientation in which print lines run perpendicular to the direction of movement of the paper. **F1457**

3.1.21 *printhead, n*—printing device of an ink jet printing system.

3.1.22 *printer output area, n*—maximum area on the page to which the printer will print. **F1457**

3.1.23 *raster output scanner, n*—output peripheral, either stand alone or within a printer, that converts computer data into a bit mapped image, which is sent to the host for storage or a printer for output. **F1457**

3.1.24 *slit glass, n*—alternate scanning surface found in some digital photocopiers used in conjunction with an automatic document feeder.

3.1.25 *smudge, n*—tendency of an image to smear or streak onto an adjacent area when rubbed; involves the redeposition of abraded material. **F221**

3.1.26 *thermal impulse, n*—ink jet technology where the rapid expansion of a bubble in the ink created by localized electrical heating expels the droplets from the ink chamber.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *banding, n*—uniform density variations or voids in a given color which appear in the direction that the printhead travels. **F1857**

3.2.2 *bleed, n*—ink feathering of one color into an adjacent color over time. **F1857**

3.2.3 *circularity, n*—ratio of a single ink dot height divided by its width with 1.0 being a perfect circle. **F1857**

3.2.4 *feathering, n*—ink spread over substrate causing fuzzy edges, spidery lines and poor print quality. **F1857**

3.2.5 *liquid ink jet device, n*—device in which the ink supply is in fluid (for example, solvent or aqueous) form.

3.2.6 *mottling, n*—nonuniformity of image density which follows patterns in the substrate or by non-uniform ink-substrate interaction. **F1857**

3.2.7 *satellite, n*—extraneous or undesirable ink droplets. (See also *spatter*, *spray*) **F1857**

3.2.8 *spatter, n*—type of extraneous or undesirable ink droplet originating when a portion of an ink droplet strikes the intended area and is deflected to an unintended area. **F1857**

3.2.9 *spray, n*—type of extraneous or undesirable ink dot near the printed zones which originate from the printhead. **F1857**

4. Significance and Use

4.1 The procedures outlined here are grounded in the generally accepted body of knowledge and experience in the field of forensic document examination. By following these procedures, a forensic document examiner can reliably reach an opinion concerning whether two or more documents produced with ink jet technology are from the same device, whether a particular device created the document, or the determination of the make or model of a device.

5. Interferences

5.1 Items submitted for examination may have inherent limitations that can interfere with the procedures in this guide. Limitations should be noted and recorded.

5.2 Limitations can be due to the generation of the document(s), limited quantity or comparability, or condition of the items submitted for examination. Such features are taken into account in this guide.

5.3 The results of prior storage, handling, testing, or chemical processing (for example, for latent prints) may interfere with the ability of the examiner to see certain characteristics. The effects can include, but are not limited to, partial destruction of the substrate, stains, and deterioration of the ink. Whenever possible, document examinations should be conducted prior to any chemical processing. Items should be handled appropriately to avoid compromising subsequent examinations.

5.4 Consideration should be given to the possibility that various forms of manipulation and duplication of ink jet-produced items can be generated by computer, scanner, digital camera, graphic pad or other means.

5.5 Some ink supply units are interchangeable between different brands or models of machines. Some ink units are refillable and ink from suppliers other than the original manufacturer may be used.

5.6 Some multi-function devices utilizing toner technology can operate in either printing or copying mode, at different