



Standard Guide for Examination of Documents Produced with Toner Technology¹

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1. Scope

1.1 This guide provides procedures that should be used by forensic document examiners (Guide E 444) for examinations of documents produced with toner technology, and related procedures.

1.2 These procedures are applicable whether the examination is of 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 used 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 photocopiers, printers, facsimile devices, and multifunction devices using toner 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

E 444 Descriptions of Scope of Work Relating to Forensic Document Examiners

E 1658 Terminology for Expressing Conclusions of Forensic Document Examiners

E 1732 Terminology Relating to Forensic Science

E 2195 Terminology Relating to the Examination of Questioned Documents

E 2291 Guide for Indentation Examinations

F 221 Terminology Relating to Carbon Paper and Inked

Ribbon Products and Images Made Therefrom

F 909 Terminology Relating to Printers

F 1125 Terminology of Image Quality in Impact Printing Systems

F 1156 Terminology Relating to Product Counterfeit Protection Systems³

F 1424 Test Method for Estimating Toner Usage in Full-Color Copiers Utilizing Dry Mono-or-Dual-Component Toners

F 1434 Practice for Estimating the Performance of a Fuser Oil in an Electrostatic Copier or Printer

F 909 Terminology Relating to Printers

F 1457 Terminology Relating to Laser Printers

3. Terminology

3.1 For definitions of terms in this guide, refer to Terminologies E 1658, E 1732, and E 2195.

3.2 *Definitions:*

3.2.1 *aliasing, n*—see *pixilation*.

3.2.2 *black write, n*—process in electrostatic printing in which the photoconductive element is charged with a charge of the same sign as that of the toner. A light beam, used like a “stylus” is used to discharge only those areas that are to receive toner to form the image. In the development process, the charged background areas repel the like charged toner to the discharged areas on the photoconductor. **F 909**

3.2.3 *bridging, v*—clumping of toner that causes a hollow area in the toner supply that prevents the free flow of toner to the dispenser auger. **F 1457**

3.2.4 *corona, n*—device used to place a uniform electrical charge on the surface of a xerographic photoreceptor. **F 1457**

3.2.5 *dielectric printing process, n*—nonimpact printing technique in which specially treated paper consisting of a conductive base layer coated with a nonconductive thermoplastic material is used to hold an electric charge usually applied directly by a set of electrode styli. The electric charge corresponds to the latent image of the original. Following the charging step, the paper is imaged by a toner system similar to that of electrostatic copying devices. This technique is sometimes called electrographic, and is currently used on general

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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 Withdrawn.

purpose non impact printers, plotting and facsimile devices.

F 909

3.2.5.1 *Discussion*—Bridging is a different phenomenon from the image quality bridging as defined in Terminology **F 1125**.

3.2.6 *dry toner*, *n*—material in a dry developer system which when deposited on a substrate by the field of an electrostatic charge pattern, becomes the visible record.

F 1457

3.2.7 *dual-component development*, *n*—mixture of dry toner and iron oxide developer that is used for developing electrostatic images in copiers.

F 1424

3.2.8 *electrophotographic printer*, *n*—nonimpact printing technique that is similar to the technology used in a typical office copier, which forms a copy by attracting toner particles to a static charge on the surface of a photoconductor, then transferring the toner image to the surface of a sheet of paper. In the normal office copier, the charged image (latent image) of the original document is formed on the photoconductor simply through exposure of the photoconductor to reflected light from the document. In an electrophotographic printer, the image is formed by a light source (laser, LED, LCS, laser diode, or other controlled light source) that erases or discharges a static image charge on the photoconductor according to information being supplied through the input data stream. Each bit of data can be related to a character shape in the memory of the printing system, and in most cases characters are formed by a dot matrix method similar in concept to that of the matrix printer. Paper can be sheet or roll—fed or continuous form. **F 909**

3.2.9 *full-color copiers*, *n*—copiers that can reproduce color originals containing gradations of color. Full-color copiers may have up to four individual color developing units containing four different color toners. These colors are frequently cyan, magenta, yellow, and black. The original is scanned by means of an analog system using a series of color filters or by means of a digital scanning process. The full-color copier may require up to four scans to read the original. The copier individually applies one or more color toners to a transfer drum/belt or photoconductor, or both, which is in turn deposited on the paper. **F 1424**

3.2.10 *fuser roll*, *n*—heated roller that contacts the paper and toner directly and is part of the fuser unit. **F 1434**

3.2.11 *glitch*, *n*—print defect that displaces the laser scan line so that it appears to start and stop late. **F 1457**

3.2.12 *gripper bar*, *n*—metal bars used in delivery systems to grasp individual sheets, directing them through the system in a toner device.

3.2.13 *image area*, *n*—that portion of the page that is printed, including the space between letters and lines. (See *percent coverage* and *maximum image area*.) **F 1457**

3.2.14 *image density*, *n*—contrast between image and background as measured by densitometer. **F 221**

3.2.15 *image*, *n*—optical counterpart of an object produced by means of an image producing device. **F 221**

3.2.16 *imaging drum*, *n*—photoreceptive drum coated with a charge-sensitive material used in the image transfer systems of toner devices.

3.2.17 *landscape mode*, *adj*—printer output orientation in which printed lines run parallel to the direction of movement of the paper. **F 1457**

3.2.18 *laser printer*, *n*—nonimpact printer that uses a laser light source driven by digital signals to create images on a photoconductor. (See *electrophotographic printer*.) **F 909**

3.2.19 *liquid toner*, *n*—toner material composed of carbon particles or colorants suspended in a liquid carrier.

3.2.20 *maximum image area*, *n*—portion on a page that can be printed. (See *percentage coverage* and *image area*.) **F 1457**

3.2.21 *maximum print position*, *n*—rightmost point at which the printer can mark the paper. **F 1457**

3.2.22 *monocomponent development*, *n*—single component dry toner used for developing electrostatic images in copiers. **F 1424**

3.2.23 *nonimpact printer*, *n*—printer in which image formation is not the result of mechanical impacts.

3.2.23.1 *Discussion*—Examples are thermal printers, electrostatic printers, electrophotographic printers, and ink jet printers. **F 909**

3.2.24 *nonrecirculating system*, *n*—fuser oil application system in which none of the fuser oil that has been removed from the reservoir is returned. **F 1434**

3.2.25 *overtoneing*, *n*—any of the conditions occurring in the developing unit when the toner concentration is too high. **F 1457**

3.2.26 *percent coverage*, *n*—ratio of the area actually covered by the ink (or print material) to the area of the page times one hundred. (See *image area* and *maximum image area*.) **F 1457**

3.2.27 *picker bar*, *n*—metal bars used in the delivery system to remove individual sheets of paper from the photoconductive drum in a toner device.

3.2.28 *pitting*, *n*—small defects in the surface of the photo-receptor that produce spots or voids on the printout. **F 1457**

3.2.29 *pixelation*, *n*—stair stepped or jagged effect resulting from analog to digital conversion.

3.2.30 *platen*, *n*—flat plate or roller used as a support for printing or copying a document. **F 1156**

3.2.31 *portrait mode*, *adj*—printer output orientation in which print lines run perpendicular to the direction of movement of the paper. **F 1457**

3.2.32 *printer output area*, *n*—maximum area on the page to which the printer will print. **F 1457**

3.2.33 *printer*, *n*—output unit that produces durable hard-copy record of data in the form of a sequence of discrete graphic characters belonging to a predetermined character set. **F 909**

3.2.34 *printing module*, *n*—those components in the laser printer that together drive the laser scanner, create the image on the page, deliver the page to the stacker. **F 1457**

3.2.35 *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. **F 1457**

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

3.2.37 *smudge, n*—tendency of an image to smear or streak onto an adjacent area when rubbed; involves the redeposition of abraded material. **F 221**

3.2.38 *white write, n*—process in electrostatic printing where the photoconductive element is charged with a charge of the opposite sign as that of the toner. A light beam, acting like a “charge eraser” is used to discharge all areas of the photoconductor that are not to receive toner to form the image. The toner is attracted to the remaining charged areas of the photoconductor when the latent electrostatic image is developed. **F 909**

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 toner 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. 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.

5.2 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 paper, stains, and deterioration of the toner. Whenever possible, document examinations should be conducted prior to any chemical processing. Items should be handled appropriately to avoid compromising subsequent examinations. Consideration should be given to the possibility that various forms of manipulation and duplication of toner-produced items can be generated by computer or other means. Some toner supply units are interchangeable between different brands or models of machines. Some toner units are refillable and toner from suppliers other than the original manufacturer may be used.

5.3 Some multifunction devices using toner technology can operate in either printing or copying mode, at different resolutions and can produce both multi-color (for example, CYMK) black or monochrome (for example, one color black). These various outputs from one machine have many significant differences among them.

6. Equipment and Requirements

6.1 Appropriate light source(s) of sufficient intensity to allow fine detail to be distinguished.

NOTE 1—Natural light, incandescent or fluorescent sources, or fiber

optic lighting systems are generally used. Transmitted illumination, side lighting, and vertical incident lighting may be useful in a variety of situations.

6.2 Magnification sufficient to allow fine detail to be distinguished.

6.3 Rulers in S.I., U.S. Customary Units, printers’ measure, and desktop publishing units.

6.4 Other apparatus as appropriate (for example, measuring grids and magnetic detectors).

6.5 Imaging or other equipment for recording observations as required.

6.6 Reference materials that aid in the determination of a manufacturer.

6.7 Sufficient time and facilities to complete all applicable procedures.

7. Procedures

7.1 All applicable procedures shall be performed and noted when appropriate. These procedures need not be performed in the order given. Examinations performed, relevant observations, and results shall be documented.

7.2 At various points in these procedures, a determination that a particular feature is not present or that an item is lacking in quality or comparability may indicate that the examiner should discontinue or limit the procedure(s). It is at the discretion of the examiner to discontinue the procedure at that point and report accordingly or to continue with the applicable procedures to the extent possible. The reasons for such a decision shall be documented.

7.3 Determine whether the submitted questioned document(s) was produced with toner technology. If not, discontinue examination and report accordingly.

7.4 Determine whether the examination is a comparison of a questioned document(s) to a known document(s), a comparison of a questioned document(s) to a questioned document(s), or is another type of examination of a questioned document(s) (for example, to determine date limitations or class of machine).

7.5 Determine whether the questioned document(s) is suitable for examination, or comparison, or both. If it is not suitable, discontinue the procedure and report accordingly. Factors that affect the suitability include clarity, detail, or condition of the document.

7.6 If no known document(s) or device(s) was submitted, go to 7.11.

7.7 If a known document(s) is submitted, determine whether the known document(s) is suitable for examination, or comparison, or both. If it is not suitable, discontinue the procedure and report accordingly. Factors that affect the suitability include clarity, detail, or condition of the document.

7.8 If the original is not submitted, evaluate the quality of the best available reproduction to determine whether significant details have been reproduced with sufficient clarity for comparison purposes and proceed to the extent possible. If the reproduction is not of sufficient clarity for comparison purposes, discontinue these procedures and report accordingly.

7.9 If a device is examined, its condition should be noted. Service records should be requested and pertinent information noted and recorded.

7.9.1 *Discussion*—Consultation with a qualified technician may be advantageous or necessary.

7.9.2 Note the capabilities, features, and settings of any variable features on each device examined. If the device has internal memory, retain or recover any stored information.

7.9.3 Note visible external components of the device such as the platen, slit glass, collators and cover/automatic document feeder that may contain physical evidence, obstructions, debris, correction fluid, marks, or scratches.

NOTE 2—Before taking exemplars, consideration must be given to the possible destruction or loss of physical evidence within the device (for example, fragments torn from the questioned document).

7.10 Prepare appropriate exemplars, taking into consideration the features of the device and possible chemical toner examinations.

7.10.1 Note damage to easily accessible internal components of the device such as the fuser rollers or imaging drum.

7.10.2 If applicable, take additional exemplars.

7.10.3 If none of the exemplars are suitable for comparison and no others are obtained, discontinue these procedures and report accordingly.

7.11 Examine the questioned item(s), or the questioned and known item(s).

7.11.1 Examination(s) for indentations (Guide E 2291) may be performed for the purpose of visualizing indented writing or physical characteristics such as marks from the paper transport mechanism.

7.11.2 Various illumination techniques (color filtered, infrared, or ultraviolet) may be used to provide additional information, such as security features or stains.

7.11.3 Examination(s) for alterations may be performed.

7.11.4 Identification of the typestyle(s) may provide useful information (for example, dating information).

7.11.5 Compare class characteristics (for example, paper type, paper supply system, toner type, marks caused by mechanics, color capability). If significant unexplainable differences exist, discontinue and report accordingly.

NOTE 3—Some toner supply units are interchangeable among different brands or models of machines and some units are refillable.

7.11.5.1 If possible, classify the device used to produce a questioned document(s). When identifying a manufacturer of a questioned item(s), refer to laboratory and published industry resources. If necessary, contact the device manufacturer or distributor for further information.

7.11.6 Compare individualizing characteristics such as security features, wear and damage defects, misalignments,

reproducible marks, voids, and improper or extraneous toner transfer. Perform and note critical measurements, where needed.

7.11.6.1 *Discussion*—Marks may not appear on every successive page but will often appear in the same position relative to one or more edges of the sheet (assuming the same paper orientation). Two or more marks with a similar cause usually maintain a fixed spatial relation to each other and/or to the image area of the copy.

NOTE 4—Successive copying on the same machine can make marks slightly out of register. Doubling or tripling of a pattern of dots or marks indicates, respectively, two or three generations of copies on the same machine. Copies from more than one device will usually bear the distinctive marks of each machine.

7.12 Evaluate similarities, differences, and limitations. Determine their significance individually and in combination.

7.13 Reach a conclusion according to the criteria set forth in Section 8.

8. Report

8.1 Conclusion(s), opinion(s), or findings resulting from the procedures in this guide may be reached once sufficient examinations have been conducted. The number and nature of the necessary examinations is dependent on the question at hand.

8.2 The bases and reasons for the conclusion(s), opinion(s), or findings should be included in the examiner's documentation and may also be included in the report.

8.3 *Identification*—If there are no significant differences between two or more items and there is agreement in significant individualizing characteristics, identification is appropriate. There may be limitations.

8.4 *Elimination*—If significant differences between two or more items are found at any level of the analyses, an elimination may be appropriate. There may be limitations. There may be similarities.

8.5 *Qualified Opinions*—When there are limiting factors and the examination reveals similarities or differences of limited significance between two or more items, the use of qualified opinions can be appropriate. This opinion requires explanation of the limiting factors.

8.6 *No Conclusion*—When there are significant limiting factors, a report that no conclusion can be reached is appropriate. This opinion requires explanation of the limiting factors.

9. Keywords

9.1 facsimile devices; forensic sciences; photocopiers; questioned documents; toner

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