

Sequencing Writing Impressions and Laser Printing or Inkjet Printing Using the ESDA

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This study investigated the possibility of determining the sequence of writing impressions and inkjet or laser printing using the Electrostatic Detection Apparatus (ESDA). It was found that the sequence of impressions and inkjet printing could be determined with a high degree of confidence. The sequence of impressions and laser printing could not be determined in the study.

The Electrostatic Detection Apparatus (ESDA) has long been an established instrument in the document examiner's laboratory. It has continuously proved its worth in detecting indented impressions in paper. In a number of high profile cases in the United Kingdom, evidence found with the use of the ESDA was pivotal in the overturning of several sentences and dismissal of some cases (Giles, 1991 and Foster and Freeman, 1997/1998).

Previous studies have utilized ESDA technique to determine the sequence of impressions and ink lines made by various writing instruments. Radley found that with ball pen writing and impressions, the sequence of impressions across the writing could be determined with a high degree of confidence, whilst the converse could not (Radley, 1993). With fiber tip, porous tip, rollerball pens, and impressions, he found the sequence could be determined, though with some caveats (Radley, 1995). Giles concluded that with ball pen writings and impressions, the sequence of writing over impressions could be clearly detected whilst the opposite sequence was not (Giles, 1993). With highlighter ink and impressions, Allen determined that it is possible to determine the sequence with confidence (Allen, 1997).

With the proliferation of inkjet and laser printers for business and personal use, documents printed by these methods have come into question on several occasions. Page substitution or alterations in a multi-page contract, for example, are some of the possibilities that may be involved.

This paper examines the use of the ESDA technique to determine the sequence of writing impressions and printing from an inkjet or laser printer.

Methods and Materials

Impressions were made on blank pages which were then subjected to printing from an inkjet or a laser printer. Impressions were also made on other pages already bearing printing from these printers. The type of paper used was Xerox 4200DP 20lb (75 gsm) which is commonly used in inkjet and laser printers.

The inkjet printer used was a Hewlett Packard DeskJet 520 using an HP 51626A print cartridge, and the laser printer used was a Hewlett Packard Laser Jet 6P.

The pages were then processed using the ESDA technique. The cascade method was used to develop the ESDA lifts.

Results

Inkjet printing over impressions

The dark lines of the impression were broken wherever they were intersected by the printing (Figure 1). No false negatives were noted.

Impressions over Inkjet printing

Once the inkjet printing was presumably dry (2 hours after printing), the dark lines of the impressions were unbroken over the printing (Figure 2). However, in a timed experiment, impressions made up to 5.5 minutes after printing appeared as broken dark lines at intersection points. It was noted that not all points were broken along the same lines, particularly at the latter stages of the experiment.

Laser printing and impressions

In both possible sequences, the dark impression lines were broken at intersection points with the laser printing (Figures 3 and 4).

Discussion

The inkjet/impressions results were similar to the effect found by Radley (1995) with impressions/fiber tip, porous tip, and roller ball pen inks. This was expected since water is a significant constituent of the inkjet ink used in the printer (Personal communication with J. Urlaub, Formulabs, Escondido, CA). An unbroken dark line in

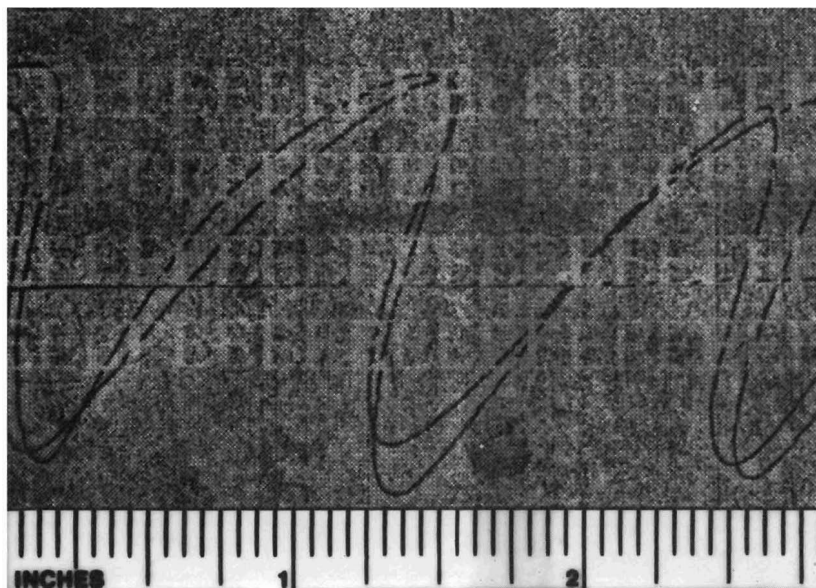


Figure 1. ESDA lift of inkjet printing over impressions.

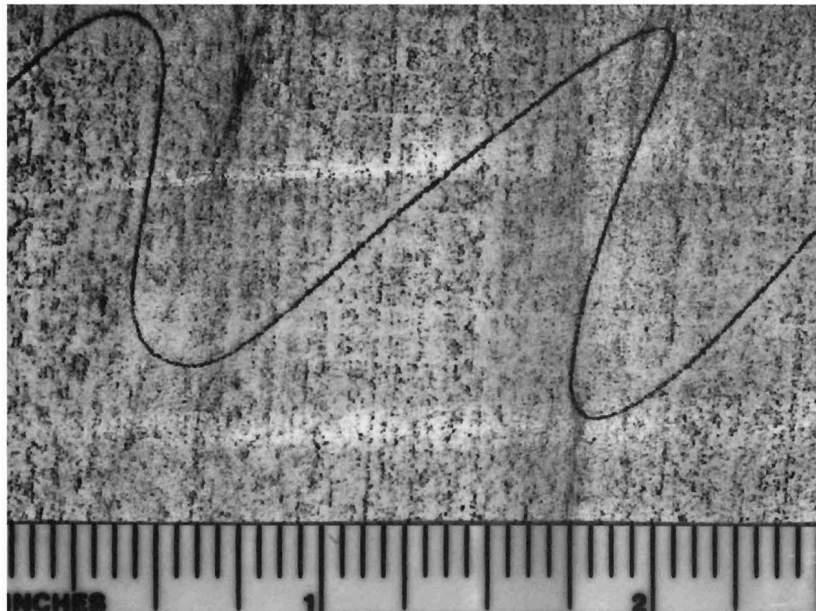


Figure 2. ESDA lift of impressions made over "dry" inkjet printing.

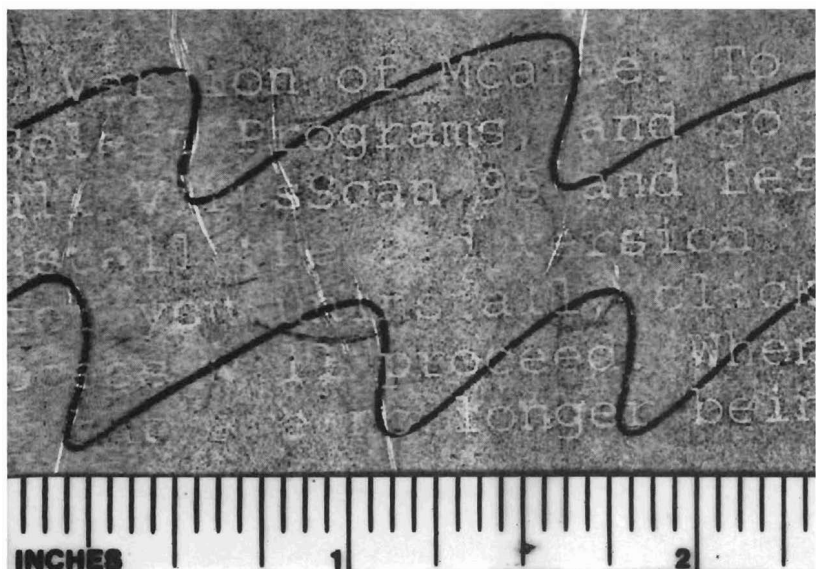


Figure 3. ESDA lift of impressions over laser printing.



Figure 4. ESDA lift of laser printing over impressions.

the ESDA lift could be taken as conclusive proof that the writing impression came after the inkjet printing.

A broken line, however, must be interpreted with some caution. Whilst a broken line normally indicates that the inkjet printing came after the impressions, it must be recognized by the examiner and made clear in any report that a similar result can occur if the impression was made over the printing whilst the ink was still wet. The drying time of the ink is dependent on the ink formula, ambient conditions, and media type (Personal communication with J. Urlaub).

The laser printing/impressions results could also be predicted since the toner lies on the paper and would eradicate any impressions already on the paper. The heat and/or pressure fusing processes may aid in destroying the impressions. ESDA lifts of the reverse sides of the papers used in these tests revealed no significant information.

The sequence of the laser printing and writing impressions was not determined with the use of the ESDA technique. These experiments were limited as only one type of inkjet ink, one type of paper, and one type of laser printer was used. As in all sequence of stroke determinations, examinations of several intersections should be done before any conclusion is drawn. Tests should be carried out using machines and materials similar to those in question in similar conditions to the purported event.

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References

Allen, M. (1997). Using ESDA to sequence highlighter ink and impressions. *International Journal of Forensic Document Examiners* 3(1): 49-51.

Foster and Freeman News. (1997/1998). *Changing the course of justice with ESDA*. 3.

Giles, A. (1993). Extending ESDA's Capability: The determination of the order of writing and impressions using the technique of Electrostatic Detection. *Forensic Science International* 59: 163-168.

Giles, A. (1991). Making a good impression. Presented at the 49th Annual General Meeting of the American Society of Questioned Document Examiners.

Radley, RW. (1995). Determination of Sequence of Intersecting ESDA Impressions and Porous Tip, Fiber Tip and Rollerball Pen Inks. *Science and Justice* 35(4): 267-272.

Radley, RW. (1993). Determination of Sequence of Writing Impressions and Ball Pen Inkstrokes using the ESDA technique. *Journal of the Forensic Science Society* 33(2): 69-72.