

## TECHNICAL NOTE

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### Erasable Ink: Its Ease of Erasability and Its Permanence

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**ABSTRACT:** The following study takes a six-month look at the use of "erasable ink" on various types of paper using different types of erasers. In the examination of questioned documents, it is important to be able to identify if or when erasures or alterations have been made on a certain document. In recent years it has become easier for individuals of average ability to alter a document through the use of erasable ink. It is important for the document examiner to be able to identify if and when these inks have been used. By being familiar with the permanence that these inks gradually attain on various types of paper, the possibility of an erasure or alteration going undetected will be reduced. A practical evaluation, and update of different erasable inks, their erasability, and their permanence will be discussed.

**KEYWORDS:** questioned documents, inks, erasures, alterations

The purpose of this study was to examine pens that contain erasable inks, attempt to analyze and compare these inks, evaluate how they react on different types of papers, and determine what effect various erasers might have upon their permanency.

The study began in February 1983 using five different pens that were then available for purchase. The pens tested were:

- (1) "Eraser-mate" pen with black ink,
- (1) "Eraser-mate" pen with blue ink.
- (1) "Eraser-mate" pen with red ink,
- (1) "Scripto" erasable black ink, and
- (1) "Scripto" erasable blue ink.

Since the completion of this study there have been additional erasable ink pens appearing on the market. I was able to obtain two "Replay" pens from Australia. Although these pens are manufactured by the Paper-Mate company, they contain different ink than was found in the "Eraser-mate" pens used in my experiments. The "Replay" pens can be purchased with either black or blue erasable ink. Bic has also entered the market by introducing an erasable ink pen. A representative of the company stated that they are presently distributing their pen only in

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blue ink. However, their future plans are to manufacture their erasable ink pens in several different colors.

The ink from these three recent pens (Replays and Bic) were analyzed using thin-layer chromatography (TLC), and found to be of a different composition than the five originally examined. Since these three pens were unavailable when this study began, I did not include them in my research.

There are numerous types, kinds, and quality of paper available today, and I chose what I considered to be a cross sample of six different types that are in fairly common use today. These include:

1. 50% cotton English Bond Paper by Fox River, frequently used as stationary or letterhead paper.
2. "Accuracy" white, lined pad, generally used as a note pad or legal pad.
3. "Xerox® 4024" white, smooth surface paper, designed for use in several types of reproducing machines.
4. "Safety-paper" obtained from Rocky Mountain Bank Note Co., used in the printing of both personal and business checks.
5. American Express Company provided travelers cheques that were manufactured from three different plants. It was found that those coming from one plant were significantly different than those coming from the other two.
6. "Racerace Bond" paper, 25% cotton, by Southworth, specifically designed to use when erasures are anticipated. Note that this paper was only used in evaluating the erasers tested, and not the inks.

I presently have in my possession over 50 different types of erasers that are easily obtained from most office supply stores. Because of the fact that there are so many different types of erasers, I again chose what I considered to be a fair cross sample of erasers that are fairly accessible in most geographic areas. These include:

- (1) "Eberhart" 4821 gum pencil eraser,
- (2) "Fantastik" pencil eraser,
- (3) "Eberhart" 813 soft pink pencil eraser,
- (4) "Eberhart" 827 abrasive ink eraser,
- (5) "Faber-Castell" 7099B eraser stick,
- (6) "Faber-Castell" 7066B eraser,
- (7) "Magic-Run" 869 nonabrasive eraser,
- (8) "Faber-Castell" 7092 ink eraser,
- (9) "Faber-Castell" 7092 pencil eraser, and
- (10) "Eraser-mate" pen with the soft grey eraser on the tip.

The study began by analyzing all five inks using routine TLC procedures. Several thin-layer chromatograms were run on the five inks being studied with silica-gel plates. Both methanol and pyridine were used for dissolving the ink off the paper with about equal results. Two plates were also run by placing a small pindot of ink directly on the plate itself. The vehicles used for separating the constituents of the ink samples to facilitate comparison were:

ethyl acetate, 70 parts;  
ethyl alcohol, 35 parts; and  
distilled water, 30 parts.

The results of this procedure revealed no real "color" separation as is normally found in other types of inks, but nevertheless there was a noticeable separation of dots that took place in each of the five inks examined.

I next assumed the inks under a homemade video-spectral comparator that was modeled after one originally designed by Gerry Richards of the FBI [1]. I found that both of the blue

inks became invisible when viewing them through an 88A Wratten filter. By placing a copper-sulfate filter over the main light and an 88A filter over the lens, it was observed that both the "Eraser-mate" red and blue ink luminesced.

An interesting phenomenon occurred involving the "Eraser-mate" blue ink. When the blue ink was first examined under the copper-sulfate filter I was unable to detect any luminescence of the ink. However, with the passing of time (four to five days) the ink started to luminesce, and its intensity increased until it appeared to stabilize in about six to eight weeks. Another observation involving this same blue ink occurred about one month after it was placed on the paper. There was only a slight luminescence of the ink until attempts were made to erase it. At that time the intensity of the luminescence increased dramatically. It appears as if rubberized dyeing material has a tendency to overlap or hide the carrying agent found in the ink, and that it is the carrying agent that actually luminesces. While the carrying agent is absorbed into the paper, the rubberized coloring material lays on the surface. When this rubberized material is removed by erasing, it exposes the carrying agent and thus the luminescence is more visible.

The ten erasers were initially tested to see how well they erased the inks on the different papers sampled. It was found when using the "Racerace" paper that all of the erasers tested were very effective in removing the erasable ink. However, when these same tests were conducted on the "English Bond" paper there was a very noticeable difference between the erasers used. Generally speaking it was found that pencil erasers removed the erasable ink significantly better than did ink erasers. As a result of these tests it was concluded the two erasers best suited to remove erasable-type inks were the "Eberhart" 813 soft pink pencil eraser, and the eraser found on the end of the "Eraser-mate" pen. The erasers least suited to remove erasable ink were those abrasive-type erasers that are designed for removing permanent inks.

The next portion of the experiment consisted of writing the name "George Morton" a total of 41 times with each pen on each of the different papers tested. This involved the assistance of several people within the lab to complete this task within an acceptable time frame. The next step was to erase these signatures at predetermined intervals:

- (1) immediately (within 5 min).
- (2) 1-h intervals for the first 8 h,
- (3) 24-h intervals for the first five days, and
- (4) weekly intervals for a total of 26 weeks.

The actual erasing of the ink was conducted in such a manner so as to exert only enough pressure to remove the ink, but not enough to disturb the surface of the paper to any noticeable degree. It was felt that if the surface of the paper was disturbed, it would be relatively easy for most document examiners to detect an erasure as having taken place. However, if the surface of paper were not disturbed it would be more difficult to detect an erasure. With these guidelines in mind, I began the six-month experiment. The results of the experiment turned out to be predictable in many ways, but there was some other aspects that turned out different than expected.

The findings of this experiment were very similar on all of the papers examined except the travelers cheques. It was found that when any of the erasable-type inks were placed on any of these four papers, it was impossible to erase them completely so as not to be detectable. Even when the erasures were conducted immediately, traces of ink could still be observed under the microscope, and frequently noticeable with just the naked eye. The results remained about the same even after the ink had remained on the paper for 1 h.

The ink appeared to become more and more permanent the longer it remained on the paper. After a period of one week it appeared to be so permanent that attempts to erase were not effective. However, the results were not consistent on all four of the papers, as it was found that the "Accuracy" note pad paper actually erased better after one week than did the other papers tested in this group. The bond paper and the "Safety-paper" did not erase completely, even when attempts were made immediately after placing the ink on the paper.

This aspect of the study indicated that erasable-type inks are not completely erasable when used on any of the four papers tested, and that there is a noticeable ink residue that remains on the papers.

The final documents evaluated included three types of American Express travelers cheques. The testing results on these documents were considerably different than the results obtained on the other papers examined. It was found that when the red ink from the "Eraser-mate" pen was placed on these cheques it was extremely difficult to erase without causing the "VOID" impression to appear on the cheque. It was also observed that a residue of red ink was easily noticeable even with a cursory examination.

The results of the tests conducted on the two black and two blue inks were extremely different than those conducted on the red ink. The inks from these four pens reacted very similar to each other on all three types of cheques, and therefore they can be discussed together. For the purpose of clarity, the three types of travelers cheques will be categorized into Cheque-A, Cheque-B, and Cheque-C.

Cheque-A and Cheque-B (same results): when the ink was immediately erased it left no detectable ink residue. One hour later there were still no signs of erasures except in those instances where the pen happened to be pushed hard enough to leave indentations. About four to five days after originally writing on these cheques the ink became more permanent. Although the top layer of ink could still be readily removed there was enough ink residue on the cheques for observation under the microscope. Even after six months, the ink was not completely permanent, and much of the signature could still be erased. At this point I discontinued further study, because there was enough of the ink residue left on the paper to be readily detectable.

Cheque-C: this category of cheque was different than either of the other two categories examined. When the erasable ink was placed on this cheque it was possible to erase it with no visible signs of erasure. This factor held true not only when the signature was immediately erased from the cheques, but also at the completion of the 26-week testing period. If the writer pushed hard enough to leave indentations in the paper, these indentations were visible, but none of the ink residue was left behind. It was also found that with a little practice the pens could be used in such a manner so that little, if any, indentations could be detected on these cheques (even if examined using the electrostatic detection apparatus [ESDA]).

The final results of this six-month study indicated:

1. Soft rubber pencil erasers are more effective in removing erasable ink than are abrasive type ink erasers.
2. The use of erasable ink is generally easy to detect on most types of papers, and it becomes fairly permanent within a few days.
3. When used on papers or a printing process similar to that used on the American Express travelers cheques, it is frequently possible to erase a signature completely for a period of up to six months with no visible signs of erasure.

With the advent of the "ballpoint pen" many document examiners feared the consequences that this new device would have on the questioned document profession. However, with the passing of time we can see that their fears were not valid. Similarly many of today's document examiners have expressed fears about the "erasable ink pen." However, with experimentation and proper education we will also find many of our initial fears unjustified. The use of erasable ink pens should not cause undue concern for today's document examiners. In almost all instances a close examination can reveal ink residue that is left behind after erasures are made, thus indicating that an alteration has occurred on a particular document.

## Reference

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