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Shredded Document Reconstruction[1,3]

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A technical note that discusses one method of reconstructing shredded documents. Along with the preferred method and procedures of reconstructing shredded documents, a short history of paper shredders and different types of paper shredders are presented.

KEYWORDS: Shredded documents, document reconstruction, paper shredder, 3M Tape

INTRODUCTION

The first American patent for a paper shredder idea was submitted by Abbot A. Low in 1908 for his "Waste Paper Receptacle." It was never manufactured [1]. Low was second only to Thomas Edison in the number of patents submitted by a single individual.

The first mechanical paper shredder was created by German Adolf Ehinger in 1935. As an anti-Nazi, Ehinger was confronted by German authorities when they found subversive literature in his trash. Inspired by the hand-cranked pasta machine (Figure 1), Ehinger's paper shredder was manually operated. He later added an electric motor. He started his company, EBA Maschinenfabrik, and introduced the cross-cut paper shredder in 1959 [2].

Paper shredders were used extensively by various governments during the cold war. In 1979, the American embassy in Iran was overrun by Iranian terrorists and all the shredded documents were seized. The Iranians enlisted Persian rug weavers to reconstruct the shredded documents and later published the reconstructed documents to the world. Subsequently, cross-cut shredders became very popular among US government agencies.

Figure 1. Hand-operated pasta making machine.

Paper shredding gained notoriety again in 1987 when Oliver North testified before the Congress about the Iran-Contra affair. North admitted that he and his secretary shredded numerous documents. Incidentally, North used a Schleicher Intimus 007 S cross-cut shredder, possibly influencing that company's sales increase by about 20 % in 1987 [3].

The US Federal Trade Commission (FTC) estimates that millions of identity theft cases oc-

[1]Paper was originally prepared for presentation at the Annual Meeting of the Southeastern Association of Forensic Document Examiners (SAFDE), Peachtree City, GA, 17 April 2008. The information was brought up to date, although the procedure is virtually the same.
[2]The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army (DA) or the Department of Defense (DoD).
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cur every year and recommends that individuals shred important and identifying documents before disposal [4]. Paper shredders have now become a common household appliance.

Types of Shredders

The diversity of shredder models on the market is extensive. They range from small, inexpensive household units, to heavier-duty office machines, to massive commercial units on trucks capable of shredding millions of documents an hour. Various manufacturers refer to the various types and grades of shredders by different names. The three most common shredder grades encountered in the forensic document examination arena are listed below.

1. **Strip-cut** shredders use rotating blades to cut documents into narrow strips of paper. These strips are as long as the paper being shredded and generally range from 1/16 inch to 1/8 inch in width (other sizes are possible) (Figure 2).

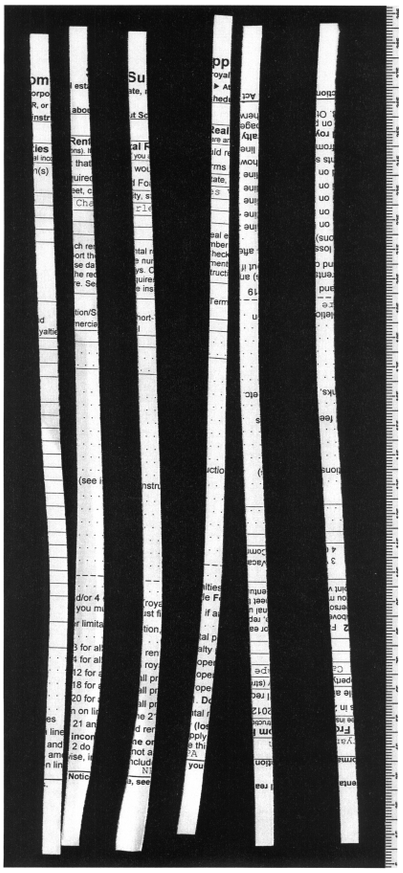

Figure 2. Strip-cut shredding.

2. **Cross-cut** shredders use contra-rotating blades to cut documents into small pieces, generally smaller than one inch long and 1/8 inch wide. Also called a confetti shredder (Figure 3).
3. **Micro-cut or High-security** shredders reduce documents to tiny particles and dust, making manual reconstruction virtually impossible (Figure 4).

METHODS AND MATERIALS

Research of papers on this topic identified works by Schuetzner & Comella [5], Vail [6], Brassil [7] and Olson [8]. Brassil [7] addressed the identification of a particular shredding machine based on blade defects. Vail [6] and Olson [8] dealt with the procedure of document reconstruction. Their techniques of employing glue, glass or acetate sheets, pins, and cellophane tape to manually reconstruct shredded documents are sound. Another method is discussed here.

Experimentation over several years at the Army laboratory has produced a useful protocol

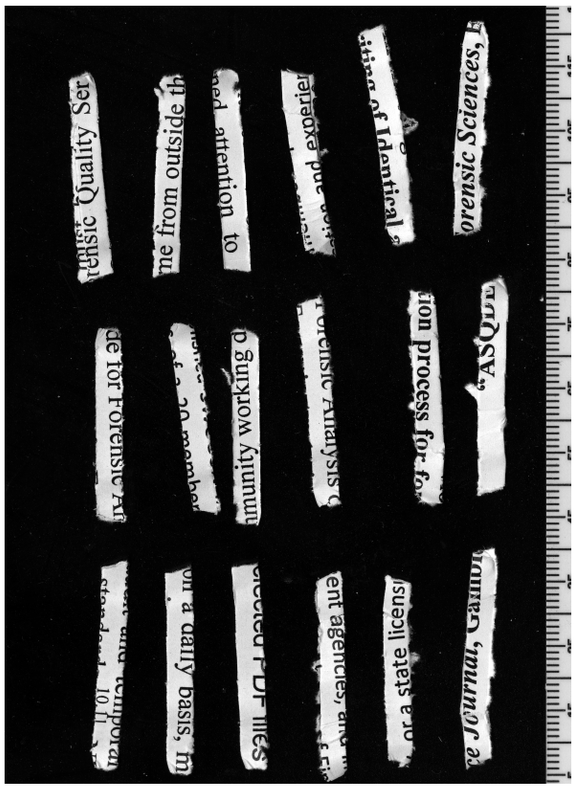

Figure 3. Cross-cut shredding.

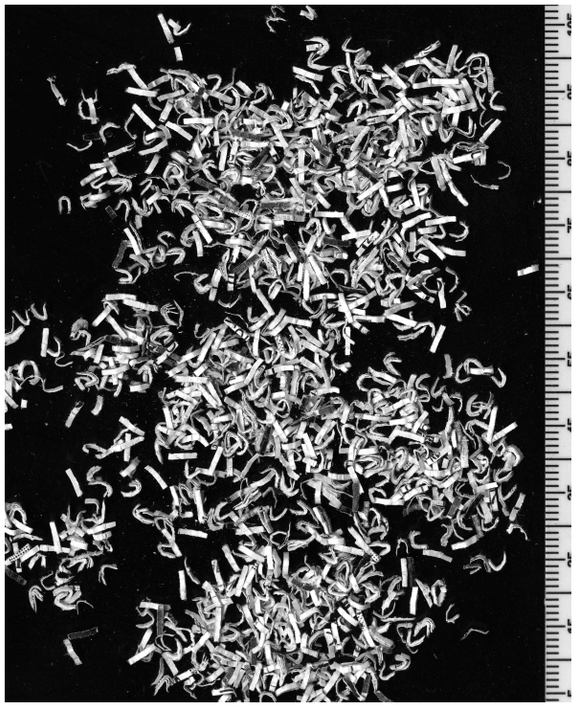

Figure 4. Micro-cut shredding.

to deal with these cases. Recommended equipment includes:

1. Foam board (various sizes)
2. Low-tack/high-tack, double-sided adhesive sheeting (3M 9415PC) (Figure 5)
3. Scalpels
4. Tweezers
5. ESDA adhesive lifters (or other transparent adhesive film at least 11″x17″)
6. Large sheets of transparent polymer film
7. Ultraviolet (UV) light source

Investigators collecting and handling shredded documents should be advised to immobilize (prevent shifting) the shredded material as much as possible. This is to keep the multiple shredded pieces of each document close together. Keeping parts of the same documents closer together makes reconstruction much easier. All handling of the shredded material should minimize disturbance of the shredded material layers.

In preparation for reconstruction, affix pieces of the low-tack/high-tack, double-sided adhesive sheets to pieces of foam board, with the high-tack side down and the low-tack side facing up (Figure 6). Several boards should be prepared and placed in a large open area for the duration of the reconstruction effort. The low-tack/high-tack, double-sided adhesive sheeting can be ordered in rolls at varied widths and is an ideal adhesive to stabilize shreds during reassembly.

Preliminary examination of the shredded material should involve an attempt to sort the paper into like groups. Distinguishable features for consideration during sorting include [5]:

1. Paper color
2. Size
3. Texture
4. Paper with printed lines
5. Images (pictures, frames, etc.)
6. Strips having entries on one or both sides
7. Handwriting
8. Fonts

Other common non-document trash materials should be extracted for return to the submitter as appropriate. Initial coordination with submitters should also determine if all the shredded material needs to be reconstructed. If only certain documents are needed, the submitter should provide samples of the target documents for reference during the reconstruction process.

Shredded pieces are manually positioned on the low-tack adhesive surfaces on the foam board (Figure 7). The low-tack adhesive permits the pieces to be moved as needed, with little or no damage. As the shredded pieces are laid out flat on the foam board, associations begin for document reassembly (Figure 8). As more documents are reassembled, more foam board will generally be needed.

UV light can help distinguish different papers that otherwise look the same with the naked eye. A portable UV source works best, since the foam board is too large for most table top UV instruments.

Cases involving several copies of similar documents are more difficult. When there are only slight differences in the shredded pieces of similar documents, constant reassessment and reassembly may be needed. A scalpel and/or tweezers can assist in the repeated placing, removal and reaffixing of the shredded papers.

Shredder "jams" are common and can produce mangled, irregular shapes (Figure 9). The angle at which paper is placed into a shredder, and the condition of the paper prior to shredding, can both produce irregular shredded pieces.

The reconstruction of irregular shredded pieces can be much more difficult than straight strips. Cross-cut shredded documents also create a great

3M

Repositionable Tapes

665 • 666 • 9415PC • 9416 • 9425 • 9425HT • 9449S

Technical Data **January, 2011**

Product Description 3M™ Repositionable Tapes are double coated tapes that are ideal for applications where one or both parts need to be repositioned or removed easily.

Construction

Product	3M™ Repositionable Tape 665	3M™ Repositionable Tape 666	3M™ Repositionable Tape 9415PC	3M™ Repositionable Tape 9416	3M™ Repositionable Tape 9425	3M™ Repositionable Tape 9425HT	3M™ Repositionable Tape 9449S
Adhesive Type:							
Faceside[1]	400	1070	400	400	420	420	1000
Backside[2]	1070	400	1000	1000	1050	1050	–
Carrier:	0.0014 in. (0.036 mm) UPVC	0.0014 in. (0.036 mm) UPVC	0.001 in. (0.025 mm) Clear Polyester	Tissue	0.0014 in. (0.036 mm) UPVC	0.001 in. (0.025 mm) Clear Polyester	None
Release Liner:	None	White Polyethylene	70# White Polycoated Kraft	70# White Polycoated Kraft	58# Natural Polycoated Kraft	58# Natural Polycoated Kraft	55# Densified Kraft Paper
Thickness:							
Tape	0.0035 in. (0.089 mm)	0.0035 in. (0.089 mm)	0.002 in. (0.050 mm)	0.002 in. (0.050 mm)	0.0058 in. (0.15 mm)	0.0054 in. (0.13 mm)	0.0004 in. (0.01 mm)
Liner	–	0.003 in. (0.076 mm)	0.0056 in. (0.14 mm)	0.0056 in. (0.14 mm)	0.0042 in. (0.10 mm)	0.0042 in. (0.10 mm)	0.0025 in. (0.063 mm)
Tape Color:	Clear	Clear	Translucent	White	Clear	Clear	Translucent

Note 1: Faceside adhesive is on the interior of the roll, exposed when unwound.
Note 2: Backside adhesive is on the exterior of the roll, exposed when liner is removed.

Figure 5. 3M data sheet.

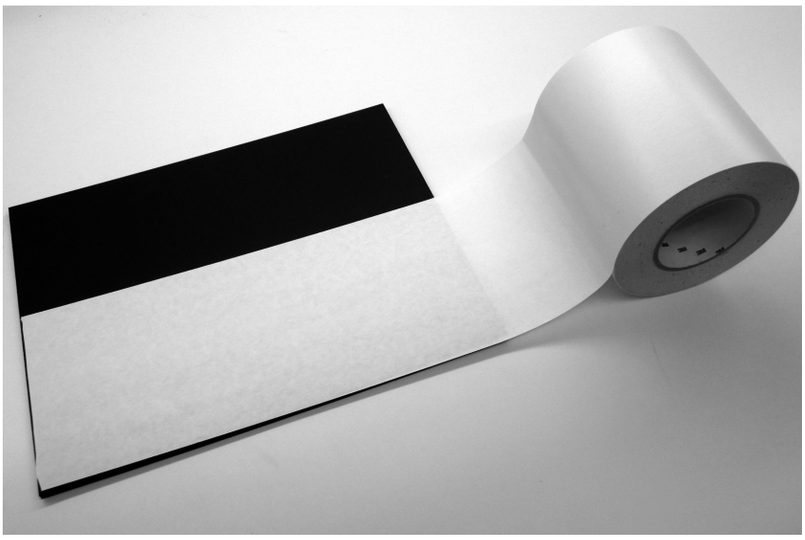

Figure 6. Applying 3M low-tack/high-tack tape to form board.

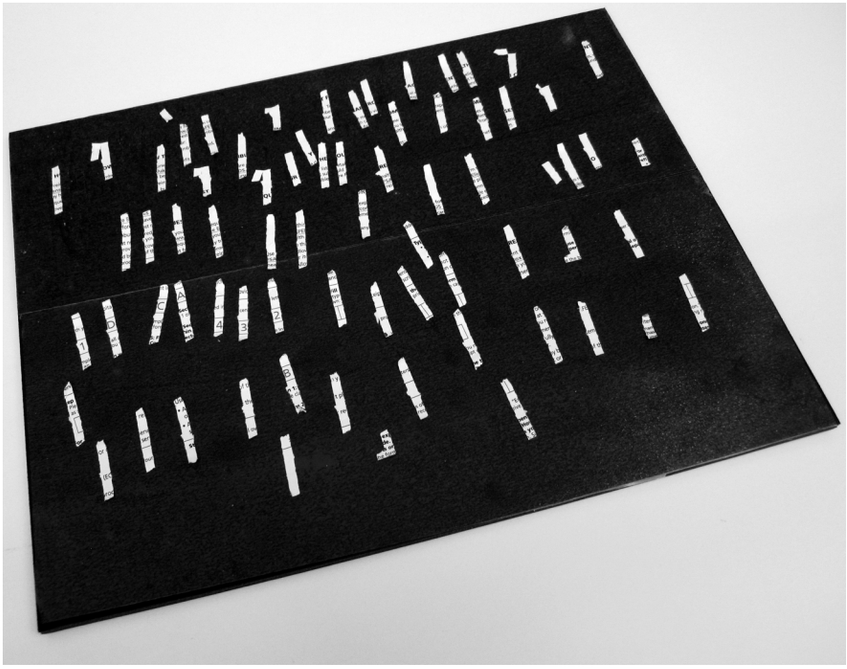

Figure 7. Cross-cut shreds applied to the low-tack/high-tack tape.

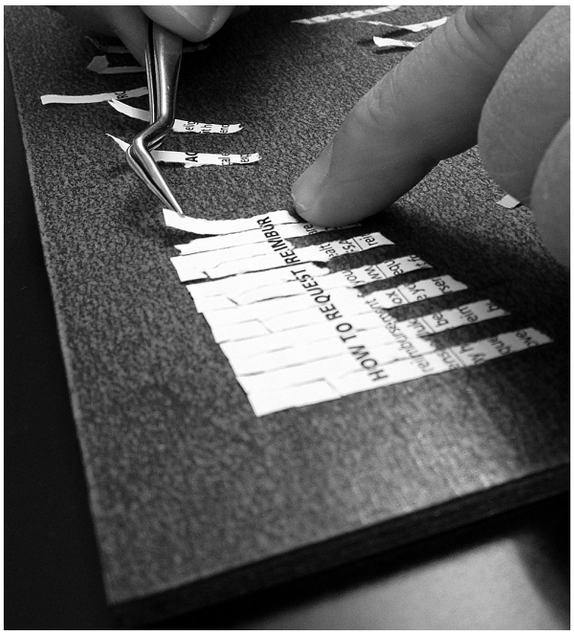

Figure 8. Shred assembly.

challenge. Care must be given to not disregard those very small pieces of paper debris on the bottom of evidence containers. The last piece of a document is sometimes hidden in these remains.

When reconstruction of a document is completed (which can involve only partial reconstruction), the pieces for each document can be transferred from the foam board onto a sheet of transparent film that has been covered with the low-tack/high-tack, double-sided adhesive sheets in a fashion similar to the foam board. After transferring the shredded pieces to the adhesive surface of the transparent film, cover the face of each reconstructed document with a piece of ESDA adhesive film. Both sides of the document are then visible. Variations of this procedure may be used as appropriate. Cutting foam board pieces apart that hold respective reconstructed documents can eliminate the step involving transferring reconstructed documents to transparent sheets when access to the back of reconstructed documents is not required. Not sealing the reconstructed documents in ESDA adhesive film may be appropriate as the lamination process can be permanent.

CONCLUSION

Some Federal agencies have automated systems that reconstruct shredded documents. All shredded material is scanned and a computer assists putting the puzzle together. Not everyone has

Figure 9. Debris caused from a defective strip shredder.

access to this technology, however, and will have to do it the old-fashioned, manual way. Though shredded document reconstruction is a tedious job, the equipment and systematic approach detailed here can make the job easier.

REFERENCES

1. Low, A. A. (1909). Waste-Paper Receptacle. US Patent 929969.

2. Paper-Shredder-Information.com. Accessed February 2014.

3. Business Notes OFFICE EQUIPMENT. *Time Magazine.* February 1988.

4. About Identity Theft. FTC.gov. Accessed March 2014.

5. Schuetzner, E. M. and Comella, K. (1997). The Shredded Paper Puzzle: The Reconstruction of Shredded Documents. Presented at the American Academy of Forensic Sciences meeting, New York, New York.

6. Vail, C. L. (1978). Reconstructing Shredded Documents. Antioch School of Law.

7. Brassil, J. (2002). Tracing the Source of a Shredded Document. HP Laboratories, Palo Alto, CA.

8. Olson, L. A. (2013). An "Ideal" Methodology for Manually Assembling Crosscut Shredded Documents. *Journal of the American Society of Questioned Document Examiners*. Vol. 16, No. 1, pp. 17-29.