

Validation of Vinyl Static Cling Film for the Collection and Preservation of Dust Impressions

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This article originally appeared in the July/August 2011 issue of the Journal of Forensic Identification (Vol.61, No 4, Pg 317-332). It provides research data for a reasonable alternative to some of the products we currently use for collecting and preserving dust impressions.

Abstract: *The use of vinyl static cling film (VSCF) to collect dust impressions on a variety of surfaces is compared to the use of an electrostatic dust lifter (ESDL). The VSCF produces slightly better results and provides a more economical method of collecting dust prints.*

Introduction

Vinyl static cling films (VSCF) are used as signs, decals, window graphics, door coverings, and protective masking. VSCF is manufactured in all sizes, colors, and degrees of opacity. “Static cling vinyl is a special formulation of polyvinyl chloride (PVC) to which a large amount of plasticizer (a liquid) has been added” [1]. Plasticizers are additives that soften the final product, increasing its flexibility [2]. It is the plasticizers that also give VSCF its ability to stick to smooth, glossy surfaces like glass and metal without an adhesive and without leaving any residue. It is the interaction of the different molecular structures of the PVC and the plasticizers that create what chemists refer to as van der Waals forces [3]. This is the intermolecular attraction of polar molecules that induce weak electrostatic forces [4], generating the “cling” between the VSCF and other surfaces. It is obvious that this attraction also applies to dust particles, because the VSCF will pick up and hold the dust impressions. A search of the literature revealed no research conducted in the use of VSCF for the use of collecting and preserving impression evidence in dust.

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Dust impressions can be created when an object, such as a shoe or tire, tracks across a surface, transferring dust from the object to the surface. They can also be created when the object removes dust from a surface, creating a negative impression. Lifting the impression is a way of transferring the dust impression from its original surface to a surface that will provide better contrast. The lift provides improved visibility of the impression's features through improved contrast and also provides a means to recover, transport, and preserve the impression.

Equipment and materials that are used to collect dust impressions can be expensive and are often unavailable to crime scene officers. Electrostatic dust lifters (ESDL) can range in price from \$500 to \$600 (USD), and the mylar film can cost about \$1 (USD) per sheet. Rubber gelatin lifters in a size large enough to lift a footwear impression in dust can cost about \$7 (USD) per sheet. Although these products are useful and effective for the collection of dust impressions, their cost and availability can make their use prohibitive.

Electrostatic dust lifters use a high voltage source to create a static charge on the lifting film that causes the dust or residue particles composing the footwear to transfer to the underside of the lifting film [5]. The output from electrostatic dust lifters is potentially lethal [6], and this method, when used on a conductive surface, can pose a safety and health risk to the user. Dust impressions on surfaces (e.g., vehicle hoods) can be challenging to collect. Electrostatic dust lifters can be used on conductive metal surfaces with the application of automotive window tinting film between the surface and the lifting film [7]. This adds to the expense. Window tint film (Axius Professional Limo Dark Tint, Axius Auto Shade, Moorpark, CA) currently costs about \$8 (USD) for a 2' x 6.5' sheet. Gelatin lifters can be used on conductive surfaces. However, if the surface is very hot (e.g., a vehicle hood on a warm day), the gelatin may melt, thus damaging the impression. Gelatin lifters can dry out or be damaged in extreme heat. Impressions collected with a gelatin lifter may also lose detail over time because of the residue being absorbed or obscured by the gelatin [5].

VSCF was tested to determine whether it would be a practical and cost-effective means of collecting and preserving dust impressions. A sheet of film 9" x 12" can be purchased for less than \$1 USD, making it much more cost-effective than electrostatic dust lifters or gelatin lifters. VSCF is available in a variety of colors to provide a variety of background contrast with different colored matrices.

Materials and Methods

Three trained footwear examiners participated in the study. Each independently followed an established set of guidelines and procedures in conducting this study (Appendix). Their results were then compiled and averaged at the conclusion of the study.

For the purpose of this study, black 9" x 12" VSCF sheets (Arrowhead Forensics, Lenexa, KS) and electrostatic dust lifter sheets (Forensic Source, Jacksonville, FL) were used. The ESDLs used in the study were the PathFinder Electrostatic Dust Mark Lifting Device (Bradenburg, West Midlands, U.K.).

Footwear impressions in dust from left and right shoes were placed on plastic, glass, paper, linoleum flooring, metal at room temperature, hot metal, cold metal, bare wood, and finished wood (Figures 1–6). The dust was applied to the shoes by walking across a concrete floor for several paces, then stepping onto the prepared surfaces. One impression of the pairs was lifted using ESDL and one was lifted using the VSCF. The lifts were stored in manila folders or boxes. Observations and comparisons were made immediately after the lifts were created, at a three-month interval, and at a six-month interval (Figures 7, 8). At each interval, the quality of the impressions was evaluated and rated using the same scale (Appendix). The lifts were visually compared to each other for this quality rating. This analysis was based on each examiner's interpretation of the rating scale. At the conclusion of the six-month study, the analysts' results were compiled and averaged. Photographs were taken at consistent lighting and exposure settings to document the conditions of the impressions.

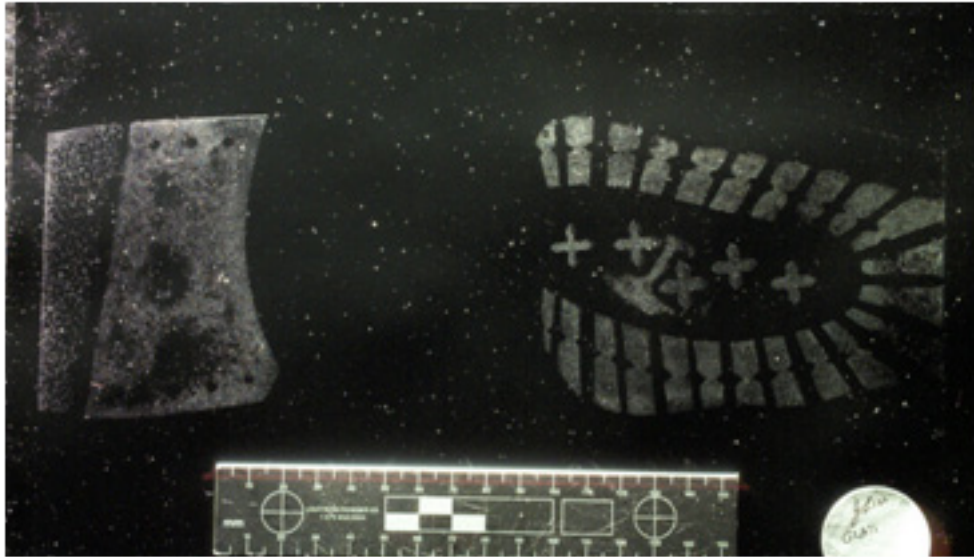


Figure 1
A VSCF dust lift of a footwear impression on glass.

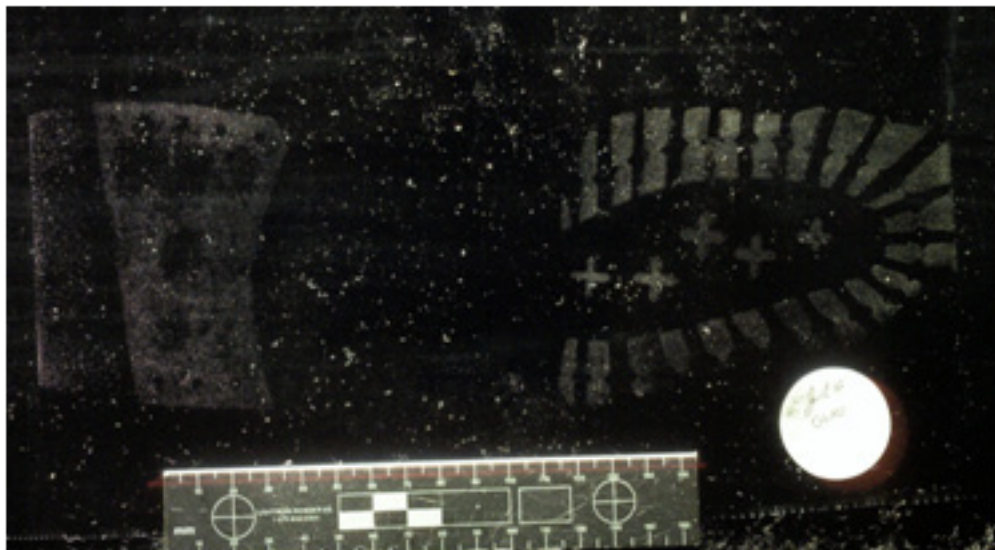


Figure 2
An ESDL dust lift of a footwear impression on glass.

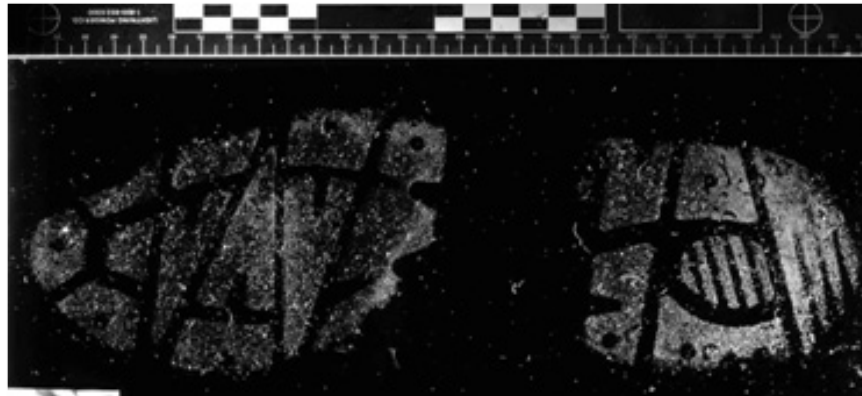


Figure 3
A VSCF dust lift of a footwear impression on vinyl flooring.

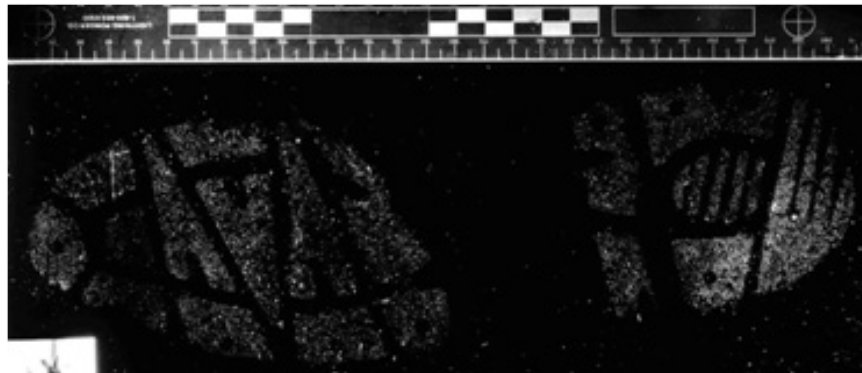


Figure 4
An ESDL dust lift of a footwear impression on vinyl flooring.



Figure 5
A VSCF dust lift of a footwear impression on paper.



Figure 6
An ESDL dust lift of a footwear impression on paper.



Figure 7
The VSCF lift in Figure 5 after six months of storage.



Figure 8
The ESDL lift in Figure 6 after six months of storage.

Results and Discussion

The observations made immediately after the lifts were created showed that the VSCF produced slightly superior contrast and detail than the ESDL (Table 1). The results of the VSCF were markedly superior to ESDL on the room temperature and hot metal surfaces. They were also markedly superior on the plastic surfaces. It seemed that the ESDL did not ground well on the plastic surfaces and therefore did not generate a sufficient electrostatic charge to lift the dust impressions sufficiently.

There was very little change in the ratings when the lifts were observed and compared after three months of storage (Table 2). One examiner observed an improvement in the contrast and detail of the VSCF lift from the plastic surface. In the examiner's initial observation, he rated this lift at zero, meaning he observed no difference in contrast and detail between the VSCF and the ESDL. At the three-month interval, he rated it at +2. The same examiner also noted an improvement in contrast and detail in the VSCF lift from the vinyl floor surface. In his initial observation, he rated this lift +1, and at the three-month interval, he rated it +2. The reason for this improvement is unclear, but an improvement in contrast and detail was observed when comparing the lifts from the plastic surface and the vinyl floor surface after the interval.

There was also very little change in the ratings when the lifts were observed and compared after six months of storage (Table 3). One examiner did note an improvement in his VSCF lift from the plastic surface. On his initial observation and after three months, he rated the VSCF lift from plastic at +1. Upon examining it at the six-month interval, he rated it +2.

No deleterious change was observed from the immediate observations after the lifts were created to six months later after being stored in manila folders or boxes. Overall, the VSCF registered finer detail than the ESDL. Edges of footwear outsole design elements and fine individual detail generally appeared more clearly defined in the VSCF lifts. The VSCF lifts were also less glossy and reflective than the ESDL lifts and therefore had less specular highlights when photographed. A slight increase in background dust could be observed on all of the lifts after three months and even more after six months of storage.

It should be noted that the material safety data sheet for the vinyl static cling film used in this study states that the vicat-softening point of the film is 70 °C (158 °F). The metal plate used in the study was heated in an oven at 170 °F for 20 minutes. No softening, stretching, or shrinking of the VSCF used on the hot metal surface was observed.

Conclusion

The use of VSCF is an effective, affordable, and simple method for the lifting of dust impression evidence at crime scenes and off of evidence. The results of the study show that on some surfaces it performs better than electrostatic dust lifters. It can be packaged and preserved well in simple manila folders, which can in turn be packaged and sealed in paper bags or larger manila envelopes. VSCF can be used on virtually any surface, with no threat to the health or safety of the user. The matte surface of the VSCF is also less reflective than that of ESDL film and photographs well with less specular highlights. Because of the affordability and ease of use, it may also be likely that the use of VSCF for lifting and preserving dust impressions at crime scenes may result in more footwear and tire track evidence being collected and preserved. Examinations and comparisons may also yield more favorable results because of improved detail and contrast when VSCF is used to collect and preserve dust impressions.

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Appendix

Instructions to Participants

The purpose of this study is to test vinyl static cling film as a practical method for the lifting of dust impressions at crime scenes and in the forensic laboratory. We will be using the vinyl static cling film and electrostatic dust lifters (ESDL) to lift dust footwear impressions off of various surfaces. We will be storing these impressions in a variety of methods and photographing them at numerous time intervals.

Gelatin lifters will not be used in this study mainly due to the expense involved. It may not be practical or even possible for our departments to purchase additional gelatin lifters for the study, and the fact that dust impressions on gelatin lifters deteriorate over time is well documented (Bodziak's book, second edition, page 122). It is my hope that in the end we will have validated a simple, practical, and inexpensive method for the recovery and storage of dust impressions. This will take some time and effort on your part, and your participation in the study is greatly appreciated.

- Jan LeMay

Part I

Creating the Impressions

Create one pair of dust impressions on the following surfaces using the same pair of shoes for each set of impressions:

- Metal – room temperature
- Metal – hot (vehicle hood in sun or equivalent)
- Metal – cold (place in refrigerator/freezer for one hour)
- Painted or finished wood
- Bare wood
- Plastic
- Glass
- Paper
- Vinyl or linoleum flooring

1. Clean the surface with a damp, lint-free cloth.
2. Step on the surface wearing a rubber outsoled left shoe creating a dust impression.
3. Beside this impression, step on the surface with the right shoe creating a second dust impression. Leave enough space between the impressions for the lifting materials.
4. Photograph the impressions. If possible photograph it in a darkened environment. Use oblique light and a photographic scale.

Part II

Lifting the Impressions

For each test impression made by a left shoe, lift with the vinyl static cling film. For each test impression made by a right shoe, lift with the electrostatic dust lifter.

1. To lift with the vinyl static cling film, remove the white paper backing from the film. Gently place the film over the impression using the side which was in contact with the white paper backing. Hold it in place with one hand to prevent any slippage, or hold in place with a strip of tape. With the other hand, use a clean ink roller to smooth out the film and remove any wrinkles or air bubbles. Carefully turn over the sheet of film.
2. Using the electrostatic dust lifter, follow the manufacturer's instructions and current department and laboratory procedures.
3. Fill out an adhesive label with your initials, date, and surface lifted from and place it on one corner of each of the lifts on the impression side.
4. Once each impression is lifted, photograph the lifter with the impression. Photograph in a darkened environment. Use oblique light and a black photographic scale.

Remember, as each lift is turned over, the impressions will be inverted. The left shoe lifts made with the vinyl film will appear as right shoes and the right shoe impressions lifted with the ESDL will appear as left shoes.

Part III

Observations and Comparisons

Relying on your training and experience, directly compare the two lifts off of each surface. Observe and compare the contrast of the lifts and the detail rendered in the lifts. Note any differences. Our objective is to compare the quality of the vinyl film lift to the quality of the ESDL. Rate the difference using the following numerical system:

- 0 You observe no difference in the quality of the two lifts.
- -1 You observe that the quality of the vinyl lift is slightly less than that of the ESDL.
- -2 You observe that the quality of the vinyl lift is markedly (strikingly noticeable) less than that of the ESDL.
- -3 You observe that the quality of the vinyl lift is very poor compared to that of the ESDL.
- +1 You observe that the quality of the vinyl lift is slightly greater than that of the ESDL.
- +2 You observe that the quality of the vinyl lift is markedly greater than that of the ESDL.
- +3 You observe that the quality of the vinyl lift is much greater than that of the ESDL.\

Part IV

Storage Methods

To compare the durability of the dust impressions on the two types of lifting films in storage, the two lifters of each type will be packaged differently, stored, observed, and documented at specific intervals to note any change in detail or contrast. Half of the lifts will be packaged in manila folders, which will be stored in paper bags. The other half will be stored taped down (and dust lift up) in cardboard boxes. It is preferred to use lined or coated cardboard boxes, as loose fibers in the cardboard boxes can cling to the lifters, thus distorting the impression.

1. Alternate packaging. Package a portion of the sheets of vinyl film in file folders and a portion in boxes. Do the same for the ESDL sheets.
2. Store in a location where they will be undisturbed.

After being stored for the specified period, remove the lifters and photograph them. Note any changes in your observations. Directly compare the impressions on the vinyl film to their counterparts on ESDL film. Rate your observations using the same scale as before, but note any difference from your previous rating in the additional column. For example, if your rating for the vinyl lift off of paper in your immediate observation was a +1, and after a period of storage your rating is a -1, the change is -2.

Observation Tables (1 each for initial, 3-month, and 6-month observations)

| Surface | Contrast | Detail | Change |
|-------------------|----------|--------|--------|
| Metal (room temp) | | | |
| Metal (hot) | | | |
| Metal (cold) | | | |
| Wood (finished) | | | |
| Wood (unfished) | | | |
| Plastic | | | |
| Glass | | | |
| Paper | | | |
| Vinyl Floor | | | |

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