Larry L. Flinn,[1] *M.S.*

Collection of Fiber Evidence Using a Roller Device and Adhesive Lifts

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ABSTRACT: The potential for transfer of fiber evidence during the commission of a crime and the use of such evidence in criminal investigations have been well established. One of the accepted methods for collection of fiber evidence is the use of adhesive lifts, generally adhesive tape. A procedure is described for the preparation of adhesive lifts and for a roller device with which these lifts are employed. Use of the roller and lifts can substantially reduce the time associated with the collection of fiber evidence from clothing, bedding, and other items in the laboratory and at crime scenes.

KEYWORDS: criminalistics, fibers, adhesive tapes, fiber evidence, fiber collection, tape lifts, adhesive lifts, lift preparation apparatus, roller collection device

The use of adhesive lift methods for the collection of fiber evidence is standard practice in many forensic science laboratories. Frei-Sulzer [*1,2*] is generally credited with suggesting that adhesive tape be employed for this purpose. Pounds [*3*] evaluated a number of fiber recovery methods, including tapes with high and low adhesive properties. In the case of the high adhesive tape, its efficiency was studied by reversing it onto a roller, which was then rolled over the area from which collections were to be made. No additional details on the roller were provided. Choudhry [*4,5*] has described the preparation and use of adhesive lifts (referred to by Choudhry as adhesive beds) prepared from polyester film and double-coated tape. These lifts incorporated a grid system as an aid in microscopic searches, as was originally proposed by Grieve and Garger [*6*]. Fong [*7*] has previously suggested a roller device consisting of a paint roller frame fitted with an acrylic nap roller. To prepare it for use, the roller must first be fitted with a polyethylene bag, then wrapped with a spiral of double-coated tape.

The method which follows describes the construction of a roller collection device that employs adhesive lifts. In addition, an apparatus is described which permits these lifts to be produced in quantity and which offers an improvement over the preparation method outlined by Choudhry [*4*]. The prepared lifts are available for immediate use and can be quickly installed on and removed from the roller device. As a result, the roller method speeds the fiber collection process considerably in comparison with tape lifts or adhesive lifts used alone.

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[1]Supervisory chemist, United States Army Criminal Investigation Laboratory—CONUS, Fort Gillem, Forest Park, GA.

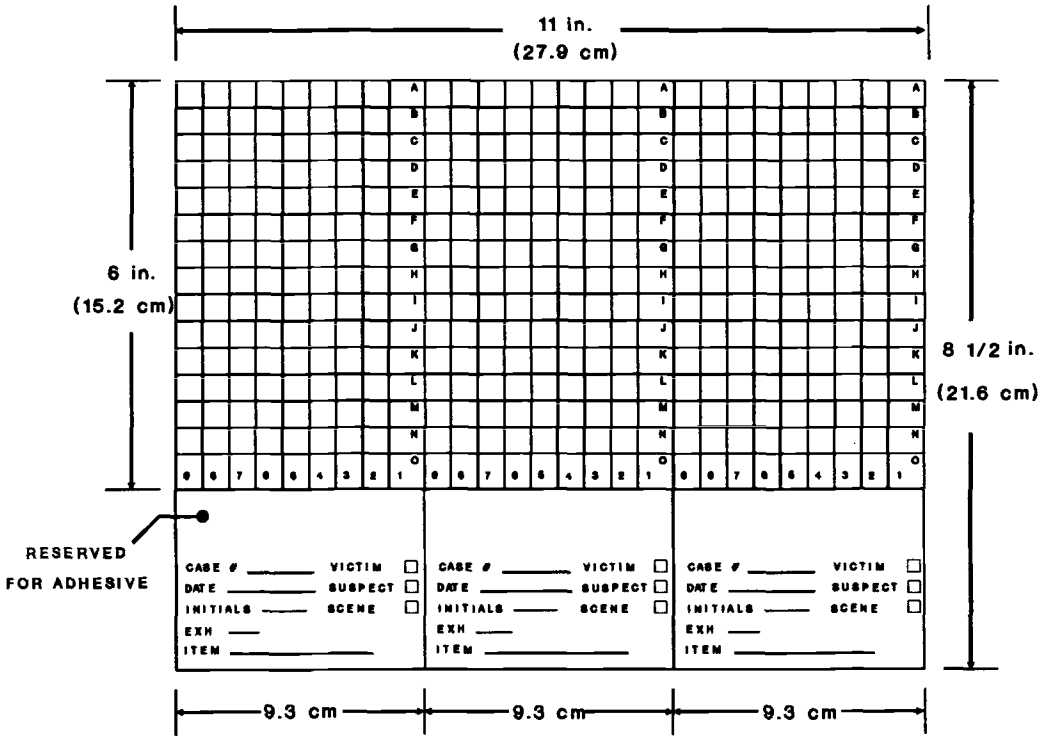

FIG. 1—*Master lift pattern consisting of three individual lifts.*

Materials and Methods

Preparation of Adhesive Lift Substrates

A master lift pattern (Fig. 1) was prepared by producing the design for three individual lifts on a single sheet of 8½ by 11-in. (21.6 by 27.9 cm) white bond paper. The design for each individual lift incorporates a grid pattern consisting of 0.39-in. (10-mm) squares flanked on one side and along one end by 0.39 by 0.51-in. (10 by 13-mm) blocks containing alphanumeric characters. A portion of each lift is reserved for recording case information. The length of the grid pattern on each individual lift [6 in. (15.2 cm)] corresponds to the circumference of the roller described in this paper. The master lift pattern is reproduced on 4-mil [0.004-in. (0.10-mm)] transparent polyester sheets[2] using a conventional photocopy machine. These sheets have the same dimensions as the master lift pattern.

Construction of an Apparatus for Preparing Adhesive Lifts

An apparatus for preparation of the adhesive lifts was constructed using ⅛-in. (3.2-mm)-thick acrylic sheeting and ½-in. (1.3-cm)-thick plywood. Using a power table saw, the acrylic sheeting was cut to produce four pieces with the following dimensions: A, 27.9 by 39.4 cm; B1 and B2, 4.5 by 39.4 cm; and C, 4.5 by 27.9 cm (Fig. 2). It is important

[2]Technifax Diazochrome KBK-P, James River Graphics, South Hedley, MS. These transparencies originally have a yellow coloration, which must be removed either before or after the lift design has been transferred to them. This is accomplished by exposing them to light from a light box until all color disappears. Ordinary colorless transparencies designed for use in photocopiers could be substituted and offer the advantage of not having to be decolorized.

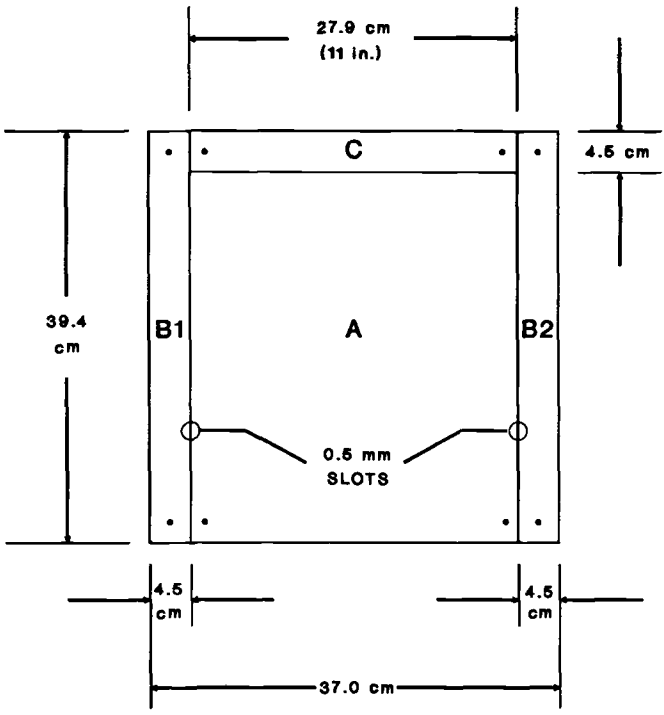

FIG. 2—*Diagram showing dimensions of the lift preparation apparatus.*

to note that the width of A and the length of C must be the same as the length of the polyester transparencies [11 in. (27.9 cm)]. The edges of the acrylic pieces were smoothed using 180 and 220-grit garnet abrasive paper. Pieces A, B1, and B2 were secured with screws to a piece of plywood measuring 37.0 by 39.4 cm, while leaving a space of approximately 0.5 mm between A and B1 and between A and B2. C was then secured to A in the same manner, ensuring that its length was perpendicular to the sides of A (Fig. 2). In order to hold the polyester transparencies in place while preparing the adhesive surface, two strips of double-coated posting tape[3] were placed across the width of A. Although the exact positions of these strips are not critical, they should be centered at approximately 7 and 18 cm, respectively, from the edge of C.

Preparation of Adhesive Lifts

A polyester transparency with a lift design is positioned on the preparation apparatus so that the grid pattern is against the fence created by C and the two outer edges are flush with the edges of A. The design surface should be up. The adhesive surface is prepared using strips of double-coated tape[4] dispensed from a roll tape dispenser. Using the fence, C, as a guide, a length of tape measuring approximately 13 to 14 in. (33.0 to

[3]Scotch Post-it® roll, No. 561, 1-in. (2.54-cm) width, 300-in. (762-cm) length, Commercial Tape Division/3M, St. Paul, MN. Contact with a 3M representative indicated that this tape is no longer available. There are other commercial double-coated tapes which should provide acceptable alternatives.

[4]Scotch double-coated tape, No. 665, 1-in. (2.54-cm) width, 36-yd (32.9-m) length, Commercial Office Supply Division/3M, St. Paul, MN.

35.6 cm) is secured across the grid pattern so that one edge of the tape and the edge of the transparency coincide. The ends of the tape span the slots on either side of A and are secured to B1 and B2. Subsequent tape strips of similar length are placed parallel to each preceding strip, ensuring that there is an overlap of 3 to 5 mm with the preceding strip. This procedure is continued until the grid portions of the lifts have been covered. The last tape strip added should extend beyond the grid area at least ¾ in. (1.9 cm). The adhesive area created by this last strip of tape is essential for installing the lift on the roller device.

A piece of flexible polyester sheeting (0.20 mm thick) is placed over the adhesive surface, and pressure is applied to ensure that the tape strips are securely bonded to the transparency. A roller such as the one described in this paper is useful for this purpose. The polyester sheeting is then stripped off of the adhesive surface, and the excess tape is trimmed from the edges of the transparency by running a scalpel blade (a No. 6 dental knife with a No. 25 blade) down the slots on either side. The transparency is then removed from the device and cut into three individual lifts using a paper trimmer. For storage and protection, each lift is immediately placed into one half of a 9 by 11-in. (22.9 by 27.9-cm) transparent acetate document protector (cut in half across its width). Approximately 34 to 37 individual lifts can be produced from one 36-yd (32.9-m) roll of 1-in. (2.54-cm)-width double-coated tape.

The lifts can be prepared for use without the roller by terminating the edge of the last strip of tape at the boundary between the grid pattern and the area reserved for case information. The excess tape which builds up on the surfaces of B1 and B2 of the lift preparation apparatus should occasionally be removed.

Preparation of the Roller Device

The materials required for construction of the roller device (Fig. 3) include the following: 1½-in. (3.8-cm) Schedule 40 polyvinyl chloride (PVC) pipe; a piece of 1-in.-thick No. 2 pine [1 in. (2.54 cm) nominal, ¾ in. actual (1.9 cm)]; 9-gage steel wire (3.8-mm diameter); and acrylic caulking compound. The PVC pipe for the roller was cut to a length equal to the width of the individual lifts (9.3 cm). The cut edges were smoothed using 120 and 220-grit garnet abrasive paper. As previously noted, the length of the grid pattern on the adhesive lifts must be identical to the circumference of the roller, in this case 6 in. (15.2 cm). The wooden end plugs were made using an electric drill fitted with a 1⅝-in. (4.1-cm) hole saw. This saw produces a 1½-in. (3.8-cm) circular wooden plug. The saw arbor consists of a drill bit which simultaneously produces a ¼-in. (0.64-cm) hole in the center of the plug (Fig. 3*a*). A bead of acrylic caulk was placed around the inner circumference of each end of the pipe, and the wooden plugs were inserted so that the outer surface of each was recessed slightly in the pipe. The roller device was completed by bending a length of wire (approximately 60 cm) into a handle (Fig. 3*b*) and inserting the two ends into the holes in the end plugs. An indexing line was drawn with a marking pen along the length of the pipe, parallel to the pipe axis, to aid in positioning the adhesive lifts (Fig. 3*c*).

Using the Roller Device with Adhesive Lifts for Fiber Collections

An adhesive lift is removed from its lift protector and the end opposite the grid pattern is positioned along the indexing line on the roller, adhesive surface outward, and secured with a short length of adhesive tape. The edges of the lift should be flush with the ends of the roller. The lift is then wrapped around the roller, and its extreme end is secured by the adhesive surface, which lies just outside of the grid area. If positioned properly, the roller surface is entirely covered by the grid design on the lift. Fiber collections are

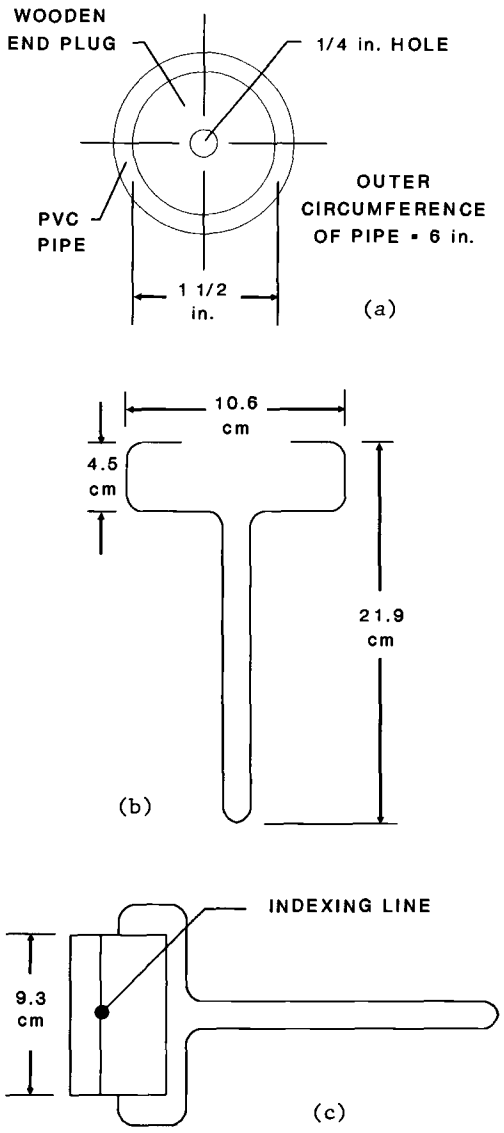

FIG. 3—*Roller collection device*: (a) *end view of the roller with an end plug,* (b) *wire handle (dimensions approximate), and* (c) *completed roller device with indexing line for positioning of the lift.*

made by rolling the adhesive surface over the area from which fibers are to be recovered. The amount of pressure exerted on the roller should be governed by the type of surface or fabric from which collections are being made. In general, more pressure is used on fabrics constructed from continuous-filament yarns and progressively less pressure is used as the sheddability of the fabric increases. The lift should be changed whenever it is apparent that the adhesive has lost its tack. Upon removal from the roller, the appropriate case information is recorded and the lift is returned to the lift protector.

Recovery of Fibers from Adhesive Lifts

Using a stereomicroscope, the lift (adhesive surface up) is searched for target fibers while remaining in its protective storage container. Depending upon the color of the target fibers sought, a piece of colored paper (white, black, or a color contrasting with that of the target fibers) is placed beneath the lift as a background to aid in the search. The locations of target fibers are indicated by using a marking pen to record their locations on the surface of the lift protector. When the searching of the lift is complete, these markings are then transferred by tracing them onto the rear surface of the lift. The lift is then removed from its protector and each target fiber is collected from the adhesive surface using a pair of fine-tipped forceps. If necessary, the tips of the forceps can be moistened with a drop of xylene or Shandon xylene substitute.[5] The solvent will soften the adhesive sufficiently to allow easy removal of the fibers for further examinations. The grid and grid coordinates are used to ensure that the lift has been thoroughly searched, to relocate a position where a search was previously terminated, and to record the position of fibers or other material that may be of potential interest. Upon completion of the search process, the lift is returned to its storage container. Ultimately, the lifts are heat-sealed into bags and stored, when possible, with the item from which the collection originated.

Discussion

We have used this method in our laboratory for several years and have found that it has substantially reduced the time required for collecting fiber evidence. The adhesive lifts are prepared in bulk using an "assembly line" process, with one person preparing the adhesive surfaces and a second person cutting the transparencies into individual lifts and securing them in document protector halves. No obvious deterioration of the printed pattern or adhesive properties has been observed for lifts that have been stored in excess of three years.

A number of precautions are taken in order to prevent accidental contamination of the lifts during their preparation. These include using adhesive tape to remove any fibers or other material from the lift preparation apparatus, tape dispenser, paper trimmer, and polyester sheeting used to apply pressure to the adhesive surface. In addition, the entire operation is carried out on a surface that has been previously covered with clean paper. The individuals preparing the lifts wear clean, full-length white cotton or cotton-polyester laboratory coats. Partially used rolls of double-coated tape and unused lift substrates are stored in clean plastic bags until needed.

In order to prevent accidental contamination of evidence, the author recommends that each separate collection area in the laboratory have a specific roller assigned to it and that each roller be marked to identify its assigned area. This will help ensure that the same roller will not be used to collect fibers from items originating from different sources within the same case (the victim's and subject's items, for example). Prior to their use, the roller devices are checked under a stereomicroscope for adhering fibers or other contaminants. A short length of adhesive tape can be used to remove any contaminants that might be present. When not in use, the roller devices are stored in clean, Ziploc plastic bags.

The lift patterns, the lift dimensions, the lift preparation apparatus, and the roller collection device can all be modified to meet individual requirements.

[5]Shandon, Inc., 171 Industry Drive, Pittsburgh, PA.

Summary

Construction of an apparatus for preparation of adhesive lifts and a roller device that employs these lifts is described. The lifts can be prepared in quantity to make them available for immediate use. Use of the lifts in conjunction with the roller considerably reduces the time required for collection of fiber evidence. The roller method offers particular advantages for collection of fibers from bedding and larger items of apparel in the laboratory. In addition, collections at crime scenes can be made rapidly from large surfaces or areas and from items not easily transportable to the laboratory.

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Address requests for reprints or additional information to
Larry L. Flinn
U.S. Army Criminal Investigation Laboratory—CONUS
Fort Gillem
Forest Park, GA 30050-5000