24. LATENT FINGERPRINT DEVELOPMENT

A. Introduction

Fingerprints originate from the inner layer of the skin called the dermis and begin forming on the hands and feet of a fetus in the womb. Barring injury, this friction ridge detail remains unchanged throughout a person's life. Fingerprints are considered valuable evidence at a crime scene because they are unique; no two people have been found to have the same fingerprints. The purpose of fingerprint development is to obtain possible prints that can be compared or entered into AFIS in order to link subjects to the scene or items of evidence.

B. Types of fingerprints

(1) Latent Fingerprints: The term latent means hidden or concealed. A latent print, in its original form, cannot be seen and must be developed or enhanced to make it visible.

(2) Patent Fingerprints: Patent fingerprints are those that can be seen without using development techniques. They occur when the skin surface is contaminated with a foreign substance, such as dirt, blood, or oil and the substance is transferred to the surface touched.

(3) Plastic Fingerprints: Plastic fingerprints are three-dimensional impressions that are caused by touching some semisolid substance, such as putty, butter, wax, or grease. The impression formed in the substance is a negative image, meaning the friction ridges will correspond to the depressions seen in the impression.

C. Chemical/Powder Sequencing Guidelines

(1) Although many acceptable procedures may exist to perform a particular examination, considerable variation in evidence items require that Crime Scene Specialists have the flexibility to exercise discretion in selecting the method most appropriate to process the item of evidence at hand.

(2) If a Specialist encounters a surface type not addressed in this manual or they have not had experience processing the surface type, the Specialist will determine the best analytical procedure for the surface type and must perform the procedure on simulated evidence prior to processing the case.

(3) When processing an item of evidence with chemicals, care should be taken to use the proper chemicals with the proper type of evidence/surface in order to produce the best quality latent print.

(4) Some chemicals must be used in proper sequence in order to provide proper reactions. Latent prints developed through a chemical process should be comparatively photographed before the item is processed with any additional chemicals.

(5) Care should be taken to ensure the chemical or physical processing of the items of evidence will not interfere or hamper the evaluation of other disciplines (e.g., trace or biological evidence collection).

(6) If a latent print is chemically developed and it results in an enhancement of the print, it must be comparatively photographed before the specialist proceeds to the next step.

(7) Quality control measures used in determining reagent effectiveness have been included for those reagents requiring this testing, e.g. cyanoacrylate fuming. For those reagents which do not require this testing, no quality measures have been specified (e.g. black powder).

(8) Safety concerns, processing conditions, and application guidelines are included for each reagent used in the processing of evidence.

D. Chemical Processing

(1) Amido Black

Amido Black is a dye, which stains protein in blood to produce a blue-black color reaction. It will not detect the normal constituents of latent fingerprints and therefore must be used in sequence with other techniques when blood contaminated latent fingerprints are examined. This is not a blood specific stain, but rather a protein stain, which means it will stain both animal and plant proteins

(a) Conditions

- Amido Black can be used on porous and non-porous items. It is also absorbed by some porous surfaces and may produce a high background color. It will stain all the blood to a consistent blue-black color. If thin deposits or a thin film of blood exists between the ridge impressions in the print, all detail may be lost after staining.
- The Amido Black process can interfere with forensic examinations for handwriting, ink, paper and indented impressions, body fluids, fibers, hairs, paint, and most other forensic examinations. Cyanoacrylate fuming may be detrimental to this process.
- Amido Black is not intended for use in blind or generic crime scene searches. It must strictly be utilized for the enhancement of blood impressions that are visible to the Investigator or Specialist.

(b) Safety

- Use Amido Black in a well-ventilated area (e.g. outside) or if used for long periods of time or on large items, in a fume cupboard. When applying Amido Black in the field the use of a respirator is recommended.
- Wear neoprene or other chemically impervious gloves. Use Universal Precautions.
- Always wash hands after processing with Amido Black.

(c) Controls

- The control is a known blood fingerprint standard (prepared by a laboratory technician or trained designee).
- The control area is tested by applying the reagent as directed.
- If friction ridge detail is visible as a blue/black color, the control is considered to have a “positive” or “acceptable” reaction and is recorded as such in the Specialist’s notes. Subsequently the background on the known blood fingerprint should be a light blue color and would mean a negative result which would complete the control results for the test.
- No chemicals are placed on any evidence until the control process has been completed.

(d) Procedure

- Ensure comparative quality photographs have been taken of fingerprints already visible before beginning treatment. Amido Black may not enhance ridge structure that is not already visible.
- Fingerprints contaminated with blood are enhanced with Amido Black by first stabilizing or fixing the blood with Methanol. Apply Methanol carefully with a wash bottle above the fingerprint and allow it to run down over the print. Do not apply the Methanol directly to the print, as this may cause destruction to the friction ridge detail.
- Next apply the Working Solution carefully using a wash bottle above the fingerprint and allow it to run down over the print. Do not apply the mixture directly to the print, as this may cause destruction to the friction ridge detail.
- Apply the Working Solution until the fingerprints become a blue-black color. Apply the Working Solution cautiously until print is enhanced. This may take several applications of the solution.
- Then apply the Acetic Acid-Methanol Fixing Solution with a wash bottle above the fingerprint, allowing it to run down over the print.
- Next the Acetic Acid-RO Water Rinse Solution is applied with a wash bottle above the fingerprint, allowing it to run down over the print. Apply this solution until dye has been removed from the background and greatest contrast is achieved between the fingerprint and the background.
- Allow the evidence to dry at room temperature (if possible).
- Comparatively photograph the enhanced detail using scale and case identifying information (e.g. IR#, date, serial number, latent number, and scene identifier).
- Discard used solution in a chemical waste disposal bottle per Laboratory Services Bureau policy.
- Test results and the general locations of the surfaces/items tested will be documented in the Specialist's notes. Control results, expiration dates, and lot numbers will also be documented in the notes

(2) Cyanoacrylate Fuming (CA)

Cyanoacrylate ester (Ethyl or Methyl Cyanoacrylate) is sold under the commercial name of Superglue. The vapor can polymerize on some latent fingerprints to produce a white deposit. This polymerization is thought to be catalyzed by the water and possibly some other constituents of latent fingerprints. The effectiveness of the process is very dependent on the age of the fingerprints and the processing conditions. This method will develop fingerprints on most non-porous material, but in many cases is less sensitive than other techniques. The contrast of developed fingerprints may sometimes be improved by application of dyes or powders.

(a) Conditions

- CA fuming can interfere with forensic examinations for handwriting, ink, paper and indented impressions, body fluids, fibers, paint and most other forensic examinations including firearms.

(b) Safety

- The Cyanoacrylate vapor is believed to be non-toxic but is irritating to the respiratory system in concentration above 2 parts per million; this is about the minimum level at which it can be detected by smell. If areas of skin become bonded together it is usually possible to separate them by soaking them in warm water. If this proves too difficult or if the eyes are affected medical attention should be sought.
- Methyl 2-Cyanoacrylate is a human eye irritant, and when heated to decomposition (~400 degrees F) it emits toxic fumes of cyanide gas.
- Non-porous gloves should be worn when using Superglue or preparing or using any associated dye staining solutions. Eye protection should be worn if there is any risk of splashing solutions into the eyes. Superglue should be used in a chamber with a well fitting door or lid and used in a fume cupboard, or conduct processing in an airtight processing chamber with a built in extraction system. A 'tent' can be constructed and used for processing items in the field. The inside of a vehicle can also be processed with Cyanoacrylate.

(c) Controls

- The control used in this process will be a piece of plastic tape with a latent print placed on it.

(d) Procedure

- The evidence to be examined and a control are placed in the isolating structure/tent or vehicle and a container of hot water is introduced into the isolating structure/tent or vehicle to increase the relative humidity. The optimum humidity is approximately 65%.
- A hot plate is placed inside the isolating structure/tent or vehicle and a small aluminum dish is placed on it. When the hot plate has warmed for a few minutes, a small quantity of Cyanoacrylate (approximately the size of a quarter) is poured into the dish and the isolating structure/tent or vehicle is closed and sealed. The Cyanoacrylate will vaporize vigorously within several seconds and produce a white "smoke".
- The fuming process should be visually monitored to ensure that the process is proceeding normally, and that no fires or other hazards develop. Occasionally some latents will develop rapidly, and can over-develop. The fuming process should be allowed to continue until all latent prints are developed. The time required will vary from three (3) to fifteen (15) minutes or longer depending upon the type of surfaces being examined, the amount of Cyanoacrylate used, and the relative humidity within the cabinet, 'tent', or vehicle.
- When the fuming process is completed, the control will show a thin white or translucent coating on the friction ridge detail. This reaction is considered a "positive" or "acceptable" reaction for the control. The remaining Cyanoacrylate

vapors should be vented for at least fifteen (15) minutes. After the evacuation period the evidence may be removed and further processed to develop any latent prints. The results of the control strip reaction will be recorded in the Specialist's notes.

- In lieu of a heating element, cellulose accelerator pads can also accelerate Cyanoacrylate vaporization. The pads are composed of pure cotton gauze, which has been saturated with a sodium hydroxide solution and allowed to dry. The Cyanoacrylate is deposited on the treated gauze pad and placed within the isolating structure/tent or vehicle. The quantity of Cyanoacrylate used is not critical; however, an amount sufficient to saturate the gauze pad is recommended. The Cyanoacrylate will begin to vigorously vaporize within a few seconds. Plain cotton may also be used as a field expedient accelerant.
- For processing the interior of vehicles, place a container(s) of hot water and control items inside the vehicle. A hot plate or accelerator pads with Cyanoacrylate will then be placed inside the vehicle. Place sealing tape on all of the door window edges. Monitor the development of the control prints. This procedure will take anywhere from four (4) to twelve (12) minutes to complete, depending on the ambient temperature and humidity.
- For maximum results follow the Cyanoacrylate process with additional fluorescent dyes, fluorescent powders, or regular powders.
- Test results and the general locations of the surfaces/items tested will be documented in the Specialist's notes. Control results, expiration dates, and lot numbers will also be documented in the notes

(3) Leuco-Crystal Violet (LCV)

LCV is a blood enhancement reagent that reacts by a peroxidase like activity due to the heme molecule of blood. Unlike Amido Black, a protein-based dye stain, LCV reacts by a chemical change that occurs when the reagent is oxidized by blood that causes it to become dark blue in color. Background discoloration is non-existent if applied properly.

LCV can be used on porous and non-porous evidence.

(a) Conditions

- Cyanoacrylate fuming may be detrimental to this process. Avoid allowing the reagent to set on the blood stain for an extended period of time. Excess blood can be dissolved and suspended in the reagent and slight background staining can occur.
- No rinsing is necessary.

(b) Safety

- Wear neoprene or other chemically impervious gloves and chemical safety goggles. This technique is used on items containing blood, so employ Universal Precautions.
- Always wash hands after applying this chemical.

(c) Controls

- The positive control used in this process is a known blood standard. A negative control is an item or swab with no blood present.

- The control area is tested by applying the reagent as directed (spray).
- Appearance of a blue/purplish color is considered to have a "positive" or "acceptable" reaction and is recorded as such in the Specialist's notes. The negative control should have no visible immediate reaction.
- Controls must be completed successfully before use.

(d) Procedure

- Ensure comparative quality photographs have been taken of fingerprints already visible before beginning treatment.
- Since the LCV solution does not react with the normal constituents of latent prints, a Specialist may need to process with powders and/or other chemicals before processing with the LCV.
- Prepare LCV working solution

(i) ▪ Pour Solution C (LCV powder) into Solution B (Hydrogen Peroxide).

(ii) ▪ Pour part of Solution A (5-Sali Solution) into Solution C's empty bottle and then empty into Solution B in order to ensure all powder is removed.

(iii) ▪ Pour remainder of Solution A into Solution B and gently shake until all powder is dissolved.

(iv) ▪ Pour the working solution into the aerosol bottle.

- Apply LCV to possible bloodstain by spraying above desired area.
- On non-porous evidence, allow the LCV to develop for approximately five (5) to ten (10) seconds. Remove excess reagent from evidence by absorbing with a paper towel or by pouring it off.
- On porous evidence, allow LCV to absorb until proper development.
- Allow to dry at room temperature (if possible).
- Comparatively photograph the enhanced detail utilizing a scale and case identifying information.
- LCV may also be used to enhance other types of blood prints, such as shoeprints, or other marks such as blood wipes.
- Test results and the general locations of the surfaces/items tested will be documented in the Specialist's notes. Control results, expiration dates, and lot numbers will also be documented in the notes

(4) Small Particle Reagent (SPR-Molybdenum Disulfide)

SPR is a suspension of fine molybdenum disulfide particles in detergent solution. It adheres to the fatty constituents of latent fingerprints to form a gray or white deposit (depending on whether you are using the black or white SPR). SPR is utilized through a spray application.

(a) Conditions

- The spray application method can be used on all non-porous surfaces including those which are wet.

(b) Safety

- Wear latex or sterile gloves and chemical safety goggles.
- Use in an area with good general ventilation. Molybdenum is toxic.
- Always wash hands after applying this chemical.

(c) Control

- The control used in this process is a piece of clear plastic tape with known latent prints placed on the non-adhesive side.
- Apply the reagent according to procedure.
  - A “positive” or “acceptable” reaction will yield a gray or white deposit on the known latent prints. A negative reaction would be indicated by no reaction with the tape itself. The results will be recorded in the Specialist’s notes.
- No chemicals are placed on any evidence until the control process has been completed.

(d) Spray Procedure

- The working solution will consist of one vial of SPR (either black or white depending on substrate coloration) and 6 oz of RO water mixed at the time of application by the Specialist. The working solution will expire one year from creation and can be utilized until consumed.
- The Specialist may utilize either black or white SPR based on the background coloration of the surface being processed in order to provide the best contrast.
- If being used outside during the rain, shelter the area to be treated from direct rainfall.
- Shake container of working solution and adjust nozzle to fire a cone-shaped spray.
- Spray area to be examined starting at the top and working downwards. If signs of fingerprint development appear, continue spraying just above the relevant area until there is no more buildup of the gray or white deposit. As the solution drains away, a gray or white powder will be left adhering to the surface. More powder will remain on fingerprints or other areas of contamination.
- If it is necessary to remove excess powder from developed fingerprints, spray water gently above the developed fingerprints with a second unit filled with water. The water will drain away carrying with it the excess powder. Do not spray the developed fingerprints directly as this may damage them.
- Comparatively photograph useable fingerprints utilizing a scale and case identifying information. Fingerprints, once completely dry, may be lifted with fingerprint tape.
- If the fingerprints developed are faint or contain insufficient detail it may be beneficial to repeat the treatment with SPR.

- Test results and the general locations of the surfaces/items tested will be documented in the Specialist's notes. Control results, expiration dates, and lot numbers will also be documented in the notes

E. Powder Processing

Fingerprint powder is best applied on smooth, dry, nonabsorbent surfaces. The powder adheres to moisture and oily components of friction skin deposits. Powdering is an insensitive detection method and only relatively recently deposited fingerprints are normally developed. There is a multitude of powders and brushes available.

(1) Conditions

(a) It is important to be cognizant of using too much powder.

(b) Powders can be used on various surfaces, primarily non-porous.

(2) Safety

(a) Wear latex or nitrile gloves. Safety goggles are optional but help protect your eyes from airborne powder particulates. Other PPE can be worn (e.g. sleeves).

(b) Some powders are quite toxic if they contain polynuclear aromatic hydrocarbons or cadmium. These chemicals have been identified as carcinogens.

(c) Most fluorescent powders are non-toxic. Always consult the MSDS on any powder before use to determine possible toxicity.

(d) Always wash hands after using powders.

(3) Control: N/A

(4) Procedure

(a) A small amount of powder should be used until the latent print becomes visible, then apply additional powder, if needed, in order to enhance the latent to its best quality.

(b) Once developed ridge detail is obtained, the Specialist may photograph the detail utilizing a scale and case identifying information and/or lift the detail utilizing good quality, clear fingerprint lifting tape and place it onto a latent lift card.

(c) Processing results and the general locations of the surfaces/items processed will be documented in the Specialist's notes. Lot numbers as well as expiration dates (if applicable) will also be documented in the notes

(5) Traditional Fingerprint Powders (e.g. Black Powder)

(a) Regular fingerprint powders consist of both resinous polymer for adhesion and a colorant for contrast.

(b) Clean techniques will be utilized to include using a minimum of one new fingerprint brush per scene location.

(c) Generally, fingerprint powder is applied to the surface bearing the possible latent print with a fingerprint brush. These brushes are distinguished according to the types of fibers used to make them.

(d) Pour a small amount of powder into a new clean container. Tap your fingerprint brush into the new clean powder container to add powder to your brush.

(e) Lift the brush up so it is not touching the powder and twirl the brush to remove any excess powder. You want as little powder as possible on the brush. Too much powder

can drown out the friction ridge detail in the fingerprint. More powder can always be added to the brush if needed.

(f) Then using circular motions, twirl the brush gently across the item you are processing. Be careful not to apply too much pressure as this may smear or wipe the latent print off the item. If the surface is rough and the likely potential exists to lose the evidence the print should first be comparatively photographed.

(g) Determine which type of lifting tape to use (e.g. fingerprint tape or palm tape). Peel the tape back and apply to the surface with friction ridge detail.

(h) Using your finger or burnishing tool, slide the tape across the item making sure no air bubbles get trapped.

(i) Lift up the tape and place it on the blank side of a latent print card.

(j) Each latent fingerprint card will be identified with a number. If multiple lifts are taken of the same latent, they will be numbered the same with the indication of how many lifts were taken of the same latent (e.g. 1 of 2, 2 of 2, etc.). If a large latent print is observed, multiple strips of tape may be used to collect the entire print. If this is done, the lift cards should be taped together to reflect the orientation from the surface collected and numbered as one latent lift card.

(k) Fill out the case information on the latent card either by hand or by using a label maker program. If a label is attached to the card, the initials of the employee must be placed on the label. This will be in lieu of a signature. Also include a sketch and brief written description of where the print was located on the item processed.

(l) Lift cards should be marked with arrows for orientation/direction on the tape side of the card.

(6) Magnetic Powders

Magnetic powders are fine ferromagnetic powders that are applied by the use of magnetic applicator. It has been found that magnetic powders are particularly successful in the recovery of latent prints from surfaces such as leather, plastics, walls, and painted surfaces.

(a) Dip the magnetic applicator into the magnetic powder. Then lightly brush the powder over the area to be processed. Do not return excess powder to the powder container in order to avoid contamination.

(b) Determine which type of lifting tape to use (e.g. fingerprint tape or palm tape). Peel the tape back and apply to the surface with friction ridge detail.

(c) Using your finger or burnishing tool, slide the tape across the item making sure no air bubbles get trapped.

(d) Lift up the tape and place it on the blank side of a latent print card.

(e) Each latent fingerprint card will be identified with a number. If multiple lifts are taken of the same ~~a~~ latent, they will be numbered the same with the indication of how many lifts were taken of the same latent (e.g. 1 of 2, 2 of 2, etc.). If a large latent print is observed, multiple strips of tape may be used to collect the entire print. If this is done, the lift cards should be taped together to reflect the orientation from the surface collected and numbered as one latent lift card.

(f) Fill out the case information on the latent card either by hand or by using a label maker program. If a label is attached to the card, the initials of the employee must be placed

on the label. This will be in lieu of a signature. Also include a sketch and brief written description of where the print was located on the item processed.

(g) Lift cards should be marked with arrows for orientation/direction on the tape side of the card.

(h) If the magnetic brush becomes contaminated with foreign material (e.g. biological material), the applicator will need to be disinfected between uses.

(7) Fluorescent Powders

Many types of powders contain natural and/or synthetic compounds that fluoresce or phosphoresce upon exposure to ultraviolet light, laser light or other light sources.

(a) These types of fingerprint powders are useful for the visualization of latent prints deposited on multicolored surfaces that would present a contrast problem if developed with regular fingerprint powder.

(b) When processing an item of evidence with fluorescent powder, care should be taken not to apply too much powder. Only a very small amount of fluorescent powder should be applied to the brush.

(c) Use the Forensic Light Source to gauge the amount of powder being applied to the item and to view developed latents.

(d) Photograph latents using the Forensic Light Source and the proper filter. Include a scale and case information in the photographs.

(e) Refer to the latent print photography section of the protocol for specifics.

F. References

(1) Fisher, Barry A.J., *Techniques of Crime Scene Investigation*, 7th ed. Boca Raton, FL: CRC Press, 2004 (Chapters 6 pgs 93-106)

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(3) Olsen Sr, Robert, *Scott's Fingerprint Mechanics*, Springfield, IL: Thomas Books, 1978 (Chapter 2-3, 5, 9)

(4) Gardner, Ross M., *Practical Crime Scene Processing and Investigation*. Boca Raton, FL: CRC Press, 2005 (Chapters 9, pages 228-238)[*flow diagrams useful for section I as well]

(5) FBI (US DOJ), *The Science of Fingerprints*. Washington, DC: US Government Printing Office, 1988 (Chapters II, IX-XI, XIII - XV)

(6) Champod, Christophe, C. Lennard, P. Margot, and M. Stoilovic, *Fingerprints and Other Ridge Skin Impressions*, Boca Raton, FL: CRC Press, 2004 (Chapter 4, Appendix 4)

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