

Department of Forensic Science

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IMPRESSIONS - FOOTWEAR AND TIRE TREAD PROCEDURES MANUAL

FORENSIC SCIENCE

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1 INTRODUCTION

- 1.1** Any time two objects come into contact, there is the potential for impression evidence. These procedures apply to the preservation, recovery and examination of footwear and tire tread impressions on a variety of surfaces.
- 1.2** Three-dimensional and two-dimensional impressions are customarily submitted for examination/comparison. Preservation of the impression will differ depending upon the type of impression, the substrate and the receiving surface.
- 1.2.1** Two-dimensional impressions can occur when there is transfer of materials (trace or residue) between the footwear or tire and the surface. The resulting impression has a visible length and width, but not significant depth.
- 1.2.1.1** A negative impression occurs when the footwear or tire comes in contact with a surface heavily coated with loose material such as dust or dirt. The footwear or tire will strike the surface and the dust or dirt will cling to the sole or tread.
- 1.2.1.2** A positive impression occurs as a result of residue being deposited from a footwear or tire to a surface resulting in a positive impression. This will include impressions made by the transfer of ordinary residue which footwear accumulate, or impressions made after stepping in blood, grease or other fluids.
- 1.2.2** Three-dimensional impressions occur when a footwear or tire comes in contact with a soft receiving surface. The impression is then impressed into the substrate (dirt, mud, etc.). The resulting impression has a visible length, width and depth.
- 1.3** Short term storage is used when evidence is in the process of examination. The length of time evidence may remain in short term storage is thirty (30) days. After this time period, evidence must be placed into long term storage according to the Quality Manual.
- 1.4** The Department's laboratory facilities provide sufficient environmental conditions to conduct all tests listed in the Procedures Manual with no further consideration required.
- 1.5 Examination Documentation**

Contemporaneous notes shall be taken utilizing the appropriate worksheets for all evidence submitted for impression examination and shall include the following:

- Laboratory Case Number
- Examiner's original initials
- Date(s) of laboratory activities
- Description of packaging in which evidence was received
- Item and sub-item numbers
- Description of evidence examined
- Examinations/tests performed, to include the sequence in which they were done and the result of each
- Number of impressions recovered from each item
- Result of the analysis of each impression, submitted and/or created
- Result of each impression compared
- Subsequent dates evidence was processed and transferred to/from photo if different from the start date
- Verification documentation
- All pages of notes shall contain the lab number and the examiner's original initials

Examination documentation shall include each examination activity conducted, the sequence of those activities, and the result of each. Activities can include the development techniques, quality control checks, the preservation technique (lifting and/or digitally capturing), database searches conducted to include the result, source of known test impressions (if applicable), comparisons conducted, and the conclusions reached. Documentation shall be

sufficient enough that in the absence of the examiner, another competent examiner could evaluate what was done and interpret the data.

1.6 Cross Comparison / Inter-Related Cases

- 1.6.1 It is acceptable for comparison documentation to be retained in one case file and include information in other case files indicating which case file contains the complete comparison documentation. It is not required to duplicate the comparison documentation. This approach is only acceptable for cases which were submitted in the same calendar year.
- 1.6.2 Comparison documentation shall reside in the case file associated with the questioned impression(s). If comparing a questioned impression to a questioned impression the comparison documentation shall be retained in one casefile, not both.
- 1.6.3 The examination documentation associated with the items shall reside in the case file under which they were submitted. For Example: The documentation associated with known footwear, tire or known standard shall reside in the case file associated with that submission.
- 1.6.4 The documentation associated with the questioned impression shall reside in the case file under which it was submitted.
- 1.6.5 The CoA shall contain details related to where the supporting examination documentation is retained.

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2 DEVELOPMENT TECHNIQUES

2.1 Chemical Processing of Porous Items

Porous items such as paper, cardboard, and unfinished wood allow impression residues to be absorbed into the material allowing for the application of chemical reagent that react with specific compounds found in the residue rendering details visible. Writing or markings on documents shall be recorded via photocopying, digitally scanning or digitally photographing prior to the application of any chemicals. The CoA shall inform the customer that the writing or markings were preserved as part of the examination documentation.

2.1.1 Ninhydrin

Ninhydrin, or triketohydrindene hydrate, is an extremely sensitive indicator of alpha-amino acids, proteins, peptides and polypeptides. The reaction produces a violet to blue-violet coloring of these substances and is effective even with older deposits and/or minute amounts of amino acids. While ninhydrin can be used on any surface, processing normally is confined to porous items which are not water-soaked and do not contain inherent animal proteins.

Ninhydrin is readily soluble in most organic solvents. Working solutions of ninhydrin are governed by the nature of the solvent and the strength of the solution. Concentrations of the ninhydrin solution may vary according to application, but generally a 0.5% to 1.0% weight to volume mixture produces the best results. A 0.5% concentration is recommended for routine porous item processing. Any of the listed solvents may be used at the examiner's discretion. Commercially prepared ninhydrin may be used; no specific preparation is needed.

Recommended Preparation - 0.5% concentration:

2.1.1.1 Petroleum Ether Formula

Chemicals Required:

- 10 g Ninhydrin
- 60 mL Methanol
- 80 mL 2-Propanol (Isopropyl Alcohol), 1860 mL Petroleum Ether

Directions:

1. Dissolve Ninhydrin crystals in Methanol.
2. Add 2-Propanol to Ninhydrin/Methanol solution and stir.
3. Add Ninhydrin, Methanol, 2-Propanol solution to Petroleum Ether and stir.

2.1.1.2 Acetone Formula

Chemicals Required:

- 25 g Ninhydrin
- 4L of Acetone

Directions:

Dissolve Ninhydrin crystals in Acetone.

2.1.1.3 Heptane Formula

Chemicals Required:

- 33 g Ninhydrin

- 220 mL Ethyl alcohol (use Absolute Ethanol, DO NOT use Denatured Ethanol)
- 4L Heptane

Directions:

1. Dissolve Ninhydrin in Ethyl alcohol.
2. Remove 220 mL of Heptane from bottle.
3. Add Ninhydrin, Ethanol mixture to Heptane and stir.

2.1.1.4 Test Strips Preparation

Chemicals/Materials Required:

- 1 gram Norleucine
- 100 mL warm reverse osmosis (R/O) or deionized (DI) water
- blotter papers

Directions:

1. Dissolve Norleucine in R/O or DI water until clear.
2. Saturate blotter papers and air dry.
3. Cut papers in small pieces

2.1.2 Physical Developer

Physical Developer is specifically for the examination of wet or water soaked porous items. This technique utilizes silver nitrate in an unstable ferrous/ferric redox solution in combination with a detergent solution. Unlike the conventional silver nitrate procedure which reacts with the chlorides of palmar sweat, physical developer precipitates silver from the solution to any non-water soluble sebaceous material that is present in residue. Although this technique was developed for water soaked items it can be used on any porous item, whether water soaked or not.

Since Physical Developer is an immersion process of high sensitivity, the reagent penetrates the porous material to detect any lipids which may be present. This reaction with residue other than palmar sweat increases the usefulness of physical developer as a post-treatment to items processed with ninhydrin. However, Physical Developer cannot be used after the conventional silver nitrate procedure.

2.1.2.1 Stock Detergent Solution

1. Pour 1 L of R/O or DI water into a large beaker containing a large magnetic stir bar previously rinsed with R/O or DI water. Never use tap water for any of the working solutions.
2. Add 2.7 g of n-Dodecylamine Acetate and stir with a magnetic stirrer. If some of the detergent sticks to the weigh boat the weigh boat can be immersed in the solution.
3. Add 4 g of a surfactant. Place the weigh boat in the solution as the surfactant will adhere to the weigh boat.
4. Stir for thirty minutes.
5. Remove the weigh boat(s).
6. Pour the solution into a 1 L glass bottle, transferring any material not yet dissolved. This solution must not be used for at least 24 hours. If solids are present after 24 hours, discard and remix.

*1 L of the stock detergent solution is sufficient to make 25 L of Physical Developer working solution. The Detergent Stock Solution has an indefinite shelf life.

2.1.2.2 Maleic Acid Pre-Wash

1. Pour 1 L of R/O or DI water in a 1500 mL beaker.
2. Add 25 g of Maleic Acid and a large magnetic stir bar rinsed with R/O or DI water.
3. Stir with a magnetic stirrer until all solids are dissolved.

2.1.2.3 Silver Nitrate Solution

1. Pour 50 mL of R/O or DI water into a 100 mL beaker.
2. Add 10 g of silver nitrate and stir until dissolved.
3. Stir until dissolved.

2.1.2.4 Buffered Ferrous/Ferric Redox Solution

1. Pour 900 mL of R/O or DI water in a 1500 mL beaker.
2. Rinse a large magnetic stir bar with R/O or DI water and place in the beaker and stir.
3. Add the following chemicals in the order given, making sure each chemical is dissolved before adding the next chemical:
 30 g of Ferric Nitrate
 80 g of Ferrous Ammonium Sulfate
 20 g of Citric Acid
4. Stir until the Citric Acid is dissolved and then stir an additional five minutes.

2.1.2.5 Combining the Component Solutions for Physical Developer

1. To the Redox Solution add 40 mL of the Stock Detergent Solution and stir.
2. Examine the Silver Nitrate Solution to ensure that all solid material has dissolved. Stir again if needed. Add the entire Silver Nitrate solution to the redox/detergent solution and stir for two minutes.

*Steps 1 and 2 must be performed in this order; otherwise the silver will fall out of suspension.

The Physical Developer is now ready for use. This prepares approximately 1 L and is sufficient to process about one hundred checks. The combined working solution is unstable and cannot be stored.

2.1.2.6 Polymax Fixer Rinses

Rinse 1: Add four or five drops of Polymax fixer per L of tap water in a glass or plastic tray.

Rinse 2: Prepare a normal photofix solution with tap water in a glass or plastic tray (one part photographic fixer to nine parts tap water).

2.1.2.7 Bleach Solution

Prepare the bleach solution by diluting household bleach at a ratio of 1:1 with tap water

2.1.3 Oil Red O

Oil Red O (ORO) is a fat-soluble dye that is sensitive to the lipid component of residue. Staining with ORO will produce a dark red to brown coloring of lipids and fats on porous surfaces. ORO is insoluble in water, as are the lipids it stains, enabling it to be used on porous items that have been wet. This makes it a viable alternative to ninhydrin, which reacts with water-soluble amino acids. ORO is moderately soluble in ethanol and methanol. The working solution is non-destructive to the porous item, but use of methanol in the working solution may damage inks or printing on documents. A water rinse neutralizes the pH of the porous surface, which prevents weakening and damage.

2.1.3.1 ORO Staining Solution

Chemicals Required:

- 1.54 g Oil Red O powder
- 770 mL methanol
- 9.2 g NaOH (sodium hydroxide)
- 230 mL deionized water

Directions:

1. Dissolve ORO powder in Methanol and stir
2. Dissolve NaOH in water and stir
3. Add NaOH solution to ORO solution and stir
4. Filter combined solution and store in brown bottle away from light

2.1.4 DFO (1, 8-Diazafluoren-9-one)

DFO reacts with amino acids in perspiration, and once the reaction is completed, the developed impressions will fluoresce using an ALS. When sequential processing, DFO shall be done prior to using Ninhydrin.

2.1.4.1 DFO Stock Solution

Chemicals Required:

- 1 g DFO
- 200 mL Methanol
- 200 mL Ethyl acetate
- 40mL Glacial acetic acid

Directions:

Combine the ingredients and stir for approximately 20 minutes or until the DFO is dissolved.

2.1.4.2 Working Solution

Dilute the stock solution to 2L with petroleum ether and store in a dark bottle.

2.1.5 Instrumentation

2.1.5.1 Ninhydrin

A humidity chamber or a steam iron may be used to control the heat and relative humidity to accelerate the development of an impression after processing.

2.1.5.2 Physical Developer

All glassware and utensils must be dedicated to the technique and reagent contamination must be avoided.

2.1.5.3 Oil Red O

A shaker table is recommended during staining to ensure the entire item remains immersed.

2.1.5.4 DFO

A laboratory oven, heat press, or dry iron is recommended.

2.1.6 Minimum Standards and Controls

This testing procedure must be performed for each working solution at the time the solution is made. Documentation of this process must be done in the form of a reagent log for each batch to include a batch number, established by month/day/year (060404). If additional batches are made on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number must be placed on the original/working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation.

2.1.6.1 Ninhydrin

Apply the solution to a test strip, allow to air dry and subject strip to heat and humidity. If the test strip turns purple the working solution can be used to process evidence. Reagent shall be stored in a dark bottle and have a shelf life not exceeding one (1) year.

2.1.6.2 Physical Developer

Make a test strip by placing an impression on a porous item similar to the evidence to be processed. Follow the procedure below to process the test strip. If the test impression is visualized, the working solution can be used to process evidence. The combined working solution shall be discarded after use.

2.1.6.3 Oil Red O

Apply a test impression using natural sebaceous residue wiped from the forehead or nose to a strip of porous material (white printer paper). Immerse the test strip in the staining solution for up to 90 minutes. If a red to brown impression is developed (may only take a few minutes), the staining solution can be used to process evidence. Reagent shall be stored in a dark bottle and have a shelf life not exceeding one (1) year.

2.1.6.4 DFO

Apply a test impression on a porous item similar to the evidence to be processed. Follow the procedure listed below to process the test strip. If the test impression is visualized, the working solution can be used to process evidence. Shelf life (working solution) shall not exceed six (6) months.

2.1.7 Procedure or Analysis

2.1.7.1 Ninhydrin

2.1.7.1.1 Completely saturate each item to be processed.

2.1.7.1.2 Remove and allow the item to dry a minimum of 1 hour before application of heat or steam.

2.1.7.1.3 Place the item in the heat/humidity chamber at no greater than 80 degrees Celsius/176 degrees Fahrenheit and between 60% and 80% relative humidity; or the item may be steam ironed. A certified hygro-thermometer must be utilized to monitor the heat/humidity levels in the chamber.

2.1.7.1.4 Check the item periodically to monitor the impression development. Avoid saturating the item with water vapor.

2.1.7.1.5 After a minimum of 12 hours, review the evidence and document any additional impressions that developed.

2.1.7.1.5.1 It is acceptable to deviate from the minimum waiting time if a case requires expeditious processing. The reason for the deviation shall be documented in the notes.

2.1.8 Physical Developer

The procedure for Physical Developer involves three stages; a pre-wash, reagent development, and rinse. Since the working reagent is unstable, a pre-treatment wash is necessary, unless the items to be processed are too fragile, to avoid the introduction of contaminants to the reagent. The rinse stage essentially removes contaminants and stabilizes the reaction.

All equipment associated with the pre-wash and reagent must be clean and dedicated to this specific preparation. Utilize plastic or bamboo tongs without serrated edges for item handling.

2.1.9 Rinse trays can be the plastic photographic type, but must be clean. Physical Developer reacts with even trace amounts of various rubber products so that rubber tipped tongs must not be used. Similarly, certain gloves will leave marks upon the evidence which will attract silver deposits. After the pre-wash any contact of glove to surface must be avoided.

2.1.9.1 Step 1 - Maleic Acid Pre-wash

1. Pour enough maleic acid pre-wash solution in a glass tray to cover the item to be processed.
2. Immerse the item in the solution for five to ten minutes or until bubbles are no longer given off.

2.1.9.2 Step 2 - Physical Developer Solution

1. Pour enough Physical Developer solution in a glass tray to cover the items to be processed.
2. Drain the items of excess pre-wash.
3. Immerse the items in the working solution and gently rock the tray.
4. Keep the items separated and be careful not to crease or handle the items extensively.
5. The processing time will vary and can be as little as one minute or up to twenty minutes. Monitor the development very closely to avoid over processing and obliteration of weaker impressions. Remove the item when optimum contrast is observed.

2.1.9.3 Step 3 - Rinse

Two types of rinses are available. The items can be rinsed in a tray of tap water with a constant gentle flow of water into the tray or a two step photofix rinse can be employed.

2.1.9.4 Photofix Rinse

1. After sufficient development in the physical developer solution the item is placed in the rinse 1 solution for 30 seconds.
2. Transfer the item into rinse 2 solution for three minutes.
3. Wash the items in running tap water for three to five minutes.

2.1.9.5 Step 4 - Drying

1. Allow the items to dry while lying flat. The items can be blotted carefully with blotter paper to speed the drying process if the item is not fragile.
2. Impressions developed with Physical Developer are relatively stable.

- 2.1.9.6 Step 5 - Bleach Solution (optional: to be used only when trying to improve the contrast of darker impressions).

Only proceed with this step after all impressions developed previously have been photographically preserved.

1. Place the item in the bleach solution for two to three minutes.
2. Rinse the item in running tap water for two to three minutes.

2.1.9.7 Oil Red O

- 2.1.9.7.1 Immerse each item to be processed in the ORO staining solution. Impressions generally develop between five and ninety minutes, depending on lipid content. Place the tray with the staining solution and items on a shaker table to ensure immersion.

- 2.1.9.7.2 Remove the item from the ORO staining solution and drain.

- 2.1.9.7.3 Immerse in a tray of continuously running deionized water to neutralize the pH of the porous substrate.

- 2.1.9.7.4 Remove the item from the water and dry completely.

2.1.9.8 DFO

- 2.1.9.8.1 Items to be processed may be dipped or sprayed.

- 2.1.9.8.2 Once processed with DFO, the item must be dried in an oven at approximately 100 degrees C for 20 minutes.

- 2.1.9.8.3 If an oven is not available, a dry iron (steam iron with steam turned off) may be used.

- 2.1.9.8.4 View using an ALS with appropriate goggles.

2.1.10 Interpretation of Results

Digitally capture all impressions that may be of value for comparison.

2.1.10.1 Ninhydrin

Ninhydrin coloration is not permanent, and while some impressions have remained visible for years, others have faded in a matter of days.

2.1.10.2 Physical Developer

Processing of the porous items with Physical Developer is similar to photographic development. Impressions appear as dark gray images which increase in contrast. The depletion of the working solution is unpredictable due to the inherent instability of the reagent. The failure to produce an image may be due to insufficient or no reactive material present in the item or exhaustion of the chemicals necessary to cause the reaction. Positive controls must be used with each run. Weaker impressions may benefit from additional processing with the physical developer solution. Do not utilize the photographic fixer and/or bleaching solution if the item requires retreatment.

Articles which appear too fragile for the maleic acid pre-wash, such as charred papers or extremely water soaked items, may be introduced directly into the physical developer working solution. Treat such items individually and check the solution for contamination prior to processing additional items. Usually contamination will precipitate the silver from the working

solution in the form of dark reddish brown particles resembling curds. Contaminated solutions must be discarded.

2.2 Powders

Fingerprint powders are very fine particles with an affinity for moisture throughout a wide range of viscosity.

Magnetic powders are powder-coated, fine iron filings subject to magnetic attraction.

Fluorescent powders were developed specifically to be luminescent - excited by light sources emitting blue-green light.

2.2.1 Preparations

No specific preparations are needed as the powders and materials being used are commercially prepared.

2.2.2 Instrumentation

No specific instrumentation is involved in powder processing.

2.2.3 Minimum Standards and Controls

The Standards and Controls for the Powders consist of insuring that the powders being used are in the proper condition. Do not expose powders to high humidity or moisture. Powders may clump if exposed to excessive moisture or contaminants. Moisture content and contaminants may be minimized by keeping the stock container closed as much as possible and using containers with small amounts of powder. This will minimize the moisture content as well as reduce any contamination of the stock container with substances from the item being processed. The date the container is opened is to be used as the batch number, established by month/day/year (060404). If additional containers are opened on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number shall be placed on the original and working container and in the examiner's notes. Shelf life is indeterminable; however, if clumping of the powder is observed, it shall be discarded.

2.2.4 Procedure or Analysis

2.2.4.1 Standard Powders

Coat the ends of the brush bristles with powder and gently tap several times to remove excess powder.

With the brush handle in a nearly perpendicular position to the surface, the bristle ends are lightly and delicately moved over the surface. Discoloration of the residue will usually appear immediately. With a fiberglass brush and a proper amount of powder, the impression will develop in density with each light pass until no further development can be observed. Even slightly excessive amounts of powder will cause a fill to occur in the fine detail. This fill must be removed with continued brush strokes until the is as free of extraneous powder as possible.

Extraneous residue on the surface may cause a general painting effect which obscures detail. A lift made of the area can sometimes remove the extraneous material and permit a second application of powder. This second application may offer better contrast between impression deposit and the background.

2.2.4.2 Magnetic Powders

Magnetic powder must be applied with a magnetic application device. Wands which contain a movable magnet attract the powder when the magnet is depressed and release the powder when

it is raised. Contact between powder and surface is completed without bristles. Excessive powder can sometimes be removed by passing the magnetic wand without powder near the surface.

2.2.4.3 Fluorescent Powder

Fluorescent powders are applied in the same manner as standard powders. It is not recommended to make a lift of the impression but view with a light source. If lifting is desired, process with black powder and then lift.

2.2.5 Interpretation of Results

Powder developed impressions which may be of value for comparison must be properly preserved. Two methods of preservation are normally afforded the powder developed impressions: photography and lifting.

Digitally capture impressions prior to lifting, if necessary, due to difficult or unusual surface condition.

Lifting can be accomplished with tape or Mikrosil Casting Putty (follow the instructions provided by the manufacturer).

2.3 Small Particle Reagent

Small Particle Reagent (SPR) is an effective procedure for processing wet surfaces. Surfaces, both porous and nonporous, which are wet at the time of deposit or become wet after deposit, seldom retain sufficient water soluble material for conventional processing methods. Nonporous items which have been allowed to dry offer some potential if the deposit contains non-water soluble oily matter, but the drying process lessens the possibility of adequate adhesion for powders.

Molybdenum disulfide is a lipid-sensitive reagent. SPR is very effective in the secondary treatment of cyanoacrylate ester developed impressions by adhering to faint impressions generally better than powders. Molybdenum disulfide is produced in various particle sizes. Smaller particle size is more effective.

2.3.1 Preparations

2.3.1.1 Surfactant Stock Solution

Dissolve 8 mL of surfactant, such as Photo-Flo or an equivalent, in 500 mL of R/O or DI water. This will make approximately 10 L of working solution.

2.3.1.2 SPR Suspension - Working Solution

1. Add 10 g of molybdenum disulfide to 50 mL of the surfactant stock solution. Add the molybdenum disulfide slowly and stir continuously.
2. A creamy mixture, free of dry powder is ideal.
3. While stirring continuously, add the mixture to 900 mL of R/O or DI water.

2.3.2 Minimum Standards and Controls

Molybdenum disulfide works by adhering to residue. Place an impression on a non-evidentiary item and process with the SPR. This testing procedure must be performed for each working solution at the time the solution is made or when a commercially purchased bottle is opened. Documentation of this process must be done in the form of a reagent log for each batch to include a batch number, established by month/day/year (060404). If additional batches are made on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number must be placed on the original/working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation. Shelf life shall not exceed one year.

2.3.3 Procedure or Analysis

2.3.3.1 Immersion Technique

1. Shake the working solution well and place in a shallow tray such as a photographic tray that will allow for the item to be completely submersed in the solution.
2. Stir the solution again and before each item is placed into the solution.
3. Place the item to be processed in the liquid to lie as flat as possible in the tray.
4. Allow the item to remain in the suspension and the molybdenum particles to settle on the item for approximately 30 seconds.
5. The item is then turned over and again allowed to set for approximately 30 seconds.
6. This procedure is continued until all surfaces have been exposed to the solution.
7. The item is then placed into a tray of clear tap water. The tray can be rocked or a flow of tap water can be established in the tray. The excess SPR will readily be removed.
8. The item is allowed to dry.

2.3.3.2 Wash Bottle Application

1. Spray a flow of SPR over the surface of the item.
2. Wash the surface with a light to moderate flow of clear tap water.

Larger items may be processed using a wash bottle to spray a flow of SPR over the surface. Generally light to moderate flows of rinse water will not dislodge the molybdenum disulfide particles.

2.3.4 Interpretation of Results

Digitally capture all impressions that may be of value for comparison.

SPR lifts easily from dried, processed, nonporous surfaces. Faint impressions may benefit from a reprocessing of the item. The intense black color generally facilitates photographic preservation. When SPR is used as a secondary technique after cyanoacrylate ester fuming, the results are sometimes superior to powders in both adhesion and clarity of detail.

2.4 Cyanoacrylate Ester Fuming

Cyanoacrylate esters are the active ingredients in the super bond adhesives and are generally available according to the type of alcohols used in manufacturing. Most cyanoacrylates are methyl or ethyl esters. In an atmosphere of relatively high humidity, the cyanoacrylate ester molecules are attracted to residue and polymerize upon the deposit.

Cyanoacrylate ester fuming is highly effective with nonporous items made of plastics or metal.

2.4.1 Preparations

No specific preparations are needed as the cyanoacrylate materials being used are commercially prepared.

2.4.2 Instrumentation

Cyanoacrylate Fuming Chambers, Atmospheric and Vacuum

2.4.3 Minimum Standards and Controls

Non-evidentiary items such as aluminum foil, film leaders, or pieces of plastic bags are acceptable substrates for test impressions and placed near the evidence in the fuming chamber. Terminate the

processing once the test impressions reach optimum development. The batch number for cyanoacrylate ester will be established by the date opened, such as (060404). If additional bottles are opened on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number must be placed on the working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation. The shelf life is indeterminable and may be used as long as it remains in a semi-liquid state and has a positive reaction with the test strip.

2.4.4 Atmospheric Chamber

Volatilization of cyanoacrylate ester at normal room temperature is relatively slow but is a viable procedure for evidence processing. Vapors must be contained. A ratio of two drops of adhesive for every gallon of capacity or volume with relatively high humidity is usually effective. Polymerization may be retarded or prevented by low humidity. The addition of a cup of lukewarm water can improve the fuming results. Development time will vary with the temperature, humidity and the substrate being processed.

Application of heat greatly accelerates volatilization. Place the cyanoacrylate ester liquid in an aluminum dish and use a hot plate as the heat source. A cup of warm water may be placed in the enclosure. Volatilization can be very rapid and development may be accomplished. Care must be taken to closely observe the process to ensure that the item is not overdeveloped.

2.4.5 Vacuum Chamber

A vacuum chamber using humidity and cyanoacrylate vapors at 37°C is a highly sensitive system to develop impressions on the inside of polyethylene bags, hand guns, long guns, gas cans, etc. Vacuum chambers are particularly effective on evidence that has a soot or oil film on the surface.

2.4.6 Interpretation of Results

Digitally capture all impressions that may be of value for comparison. Once the impressions are recorded, further processing sometimes reveals impressions in which polymerization was too indistinct for visual notice or did not occur. Powders and particulate developers are effective and often permit additional photographic and lifting preservation. Small Particle Reagent will sometimes adhere to faint impressions when powders will not. Dye application is generally effective after powder, particulate, or SPR application as the liquid dye solution will normally wash away the particulate remnants. However, vinyl, rubber, oily guns, and hard plastics, especially those used in cash register drawers, may not be receptive to any powder.

2.5 Dye Stains

Dye staining enhances impressions developed with cyanoacrylate ester. The dye stain is applied to the object and visually examined utilizing an alternate light source. Each dye stain listed below will have different preparation steps and optimum viewing parameters.

View the evidence under different wavelengths of light with various goggles to determine which combination provides the best contrast for viewing and capturing the impressions.

2.5.1 Preparations

2.5.1.1 Ardrex

Ardrex is a commercially available liquid that can be used undiluted or a working solution can be made as described below.

Working Solution

Combine ingredients in the order listed.

- 2 mL Ardrex
- 10 mL Acetone
- 25 mL Methanol
- 10 mL Isopropyl alcohol
- 8 mL Acetonitrile
- 945 mL Petroleum ether

2.5.1.2 Basic Yellow 40

Basic Yellow 40 is a commercially available powder that is mixed with a solvent to create a working solution.

Working Solution

Combine the ingredients and continue to stir the solution until all of the powder is dissolved.

- 3g of Basic Yellow powder concentrate
- 1 L of methanol

2.5.1.3 Rhodamine 6G

The examiner can choose from two preparations of Rhodamine 6G solutions. The preparation chosen is primarily dependent on the reaction of the substrate to the solvent used. Utilize aqueous Rhodamine 6G solutions when methanol or other organic solvents will be destructive to the surface being treated.

If a balance is not available capable of measuring to the accuracy of the below formula, it is acceptable to prepare a stock solution of 0.48 g per L of methanol. A working solution is then prepared by diluting 10 mL of stock solution with 1 L of methanol.

Methanol Working Solution

Combine the ingredients and continue to stir the solution until all of the powder is dissolved.

- 0.0048 g of Rhodamine 6G
- 1 L of methanol

Aqueous Working Solution

Combine the ingredients and continue to stir the solution until all of the powder is dissolved.

- 0.0048 g of Rhodamine 6G
- 1 L of R/O or DI water
- 3-6 drops of a surfactant which allows for a sheeting effect or more even covering of the item with the working solution.

2.5.1.4 MBD (7-(P-Methoxybenzylamino-4-Nitrobenz-2-Oxa-1,3-Diazole))

Two MBD formulas are available for use. The first does not require the preparation of a stock and working solution; the solution is used as prepared. The second listed formula requires the preparation of a stock solution and working solution described below. The working solution is applied to the item either by spray, immersion, or squirt bottle.

Formula #1

Combine the ingredients and continue to stir the solution until all of the powder is dissolved.

- 0.12 g MBD
- 4L of methanol

Formula #2

Stock Solution

Combine the ingredients and continue to stir the solution until all of the powder is dissolved.

- 1 g MBD
- 1 L Acetone

Working Solution

Combine the ingredients in the order listed. Do not place on a magnetic stirrer.

- 10 mL MBD stock solution
- 30 mL Methanol
- 10 mL Isopropanol
- 950 mL Petroleum ether

2.5.1.5 RAM (Rhodamine 6G, Ardrex and MBD 10)

RAM is a mixture of Rhodamine 6G, Ardrex, and MBD 10. RAM has been found to be effective on various colors of nonporous surfaces.

The working solution contains Ardrex, Isopropanol, Acetonitrile, and Petroleum ether, as well as the two stock solutions. The first stock solution contains Rhodamine 6G and methanol and the second stock solution contains MBD and acetone. The RAM solution has been found to be stable for approximately 30 days, after which the solution begins to separate. Shake the solution prior to use to ensure it is properly homogenized.

Combine in the order in which they are listed:

Rhodamine 6 G Stock Solution

- 1 g Rhodamine 6G dissolved in
- 1 L Methanol

MBD Stock Solution

- 1 g MBD dissolved in
- 1 L Acetone

Working Solution

- 3mL Rhodamine Stock Solution
- 2 mL Ardrex
- 7 mL MBD stock Solution
- 20 mL Methanol
- 10 mL Isopropanol
- 8 mL Acetonitrile
- 950 mL Petroleum ether

2.5.1.6 MRM 10

MRM 10 is a mixture of MBD, Rhodamine 6G, and Basic Yellow and has been found to work well on various colored nonporous surfaces. The working solution contains Methanol, Isopropanol, Acetonitrile, and Petroleum ether as well as three different stock solutions. The first stock solution (A) contains Rhodamine 6G and Methanol. The second stock solution (B) contains Basic Yellow 40 and Methanol. The third stock solution (C) contains MBD and Acetone.

Combine in the order in which they are listed:

Stock Solution A

- 1 g Rhodamine 6G powder dissolved in 1 L of Methanol

Stock Solution B

- 1 g Basic Yellow 40 dissolved in 1 L of Methanol

Stock Solution C

- 1 g MBD powder dissolved in 1 L of Acetone

Working Solution

- 3 mL Stock Solution A
- 3 mL Stock Solution B
- 7 mL Stock Solution C
- 20 mL Methanol
- 10 mL Isopropanol
- 8 mL Acetonitrile
- 950 mL Petroleum ether

2.5.2 Instrumentation

High Intensity Ultra Violet Light Source
Alternate Light Source

Proper safety precautions including avoiding skin exposure and proper eye protection with appropriate optical densities must be utilized when operating ultraviolet light sources or alternate light sources. Consult the appropriate user's manuals for the safe use and appropriate eye protection for the specific piece of equipment being utilized.

2.5.3 Minimum Standards and Controls

The selected dye stains to be used on evidence shall be applied to a test impression previously deposited and developed with cyanoacrylate ester. A positive reaction is the observation of an impression fluorescing while viewed with an alternative light source. This testing procedure must be performed for each working solution at the time the solution is made. Documentation of this process must be done in the form of a reagent log for each batch to include a batch number, established by month/day/year (060404) when originally opened. If additional containers are opened on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number shall be placed on the original and working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation.

Shelf life:

Ardrox working solution must not exceed six months.

Basic Yellow 40 working solution must not exceed six months.

Rhodamine 6G stock solution is indefinite; working solution must not exceed six months.

MBD stock solution is indefinite; working solution must not exceed six months.

RAM working solution may separate after 30 days; if after stirring or shaking the solution it still separates, discard the solution. The working solution must not exceed six months.

MRM 10 working and stock solutions must not exceed six months.

2.5.4 Procedure or Analysis

2.5.4.1 Ardrox

Undiluted Ardrox application

1. Completely cover the item to be processed with Ardrox by immersion or by squirt bottle.
2. Allow the liquid to remain on the item for about ten minutes.
3. Rinse the item under tap water until no yellow color remains.
4. Allow the item to dry and examine with the appropriate light source.

Ardrox working solution application

1. Completely cover the item to be processed with Ardrox prepared solution by immersion or by squirt bottle.
2. Allow the solution to remain on the item for several minutes to insure proper adherence of the Ardrox to the cyanoacrylate developed impressions.
3. Examine the item using the appropriate light source without rinsing to determine if background staining has occurred. If not, proceed to step 5.
4. If background staining is observed and prevents adequate photographic preservation expose the item to a light tap water rinse.
5. Allow the item to dry completely and examine with the appropriate light source.

2.5.4.2 Basic Yellow 40

1. Apply the solution to the item to be processed by immersion, brush method, or squirt bottle.
2. Allow at least one minute for the dye to set.
3. Rinse the item thoroughly under running water. An alternative is to rinse the item in a solution of Kodak Photo-Flo 200 parts water to 1 part Photo- Flo.
4. Allow the item to dry completely and examine with the appropriate light source.

2.5.4.3 Rhodamine 6G

1. Apply the solution to the item to be processed by immersion or squirt bottle.
2. Allow the item to dry completely and examine with the appropriate light source.

2.5.4.4 MBD

1. Apply the solution to the item to be processed by immersion or squirt bottle.
2. Allow the item to dry completely and examine with the appropriate light source.

2.5.4.5 RAM

1. Apply the solution to the item to be processed by immersion or squirt bottle.
2. Allow the item to dry completely and examine with the appropriate light source.

2.5.4.6 MRM10

1. Apply the solution to the item to be processed by immersion or squirt bottle.
2. Allow the item to dry completely and examine with the appropriate light source.

2.5.5 Interpretation of Results

Digitally capture impressions for analysis.

2.6 Blood Protein Enhancement

Enhancement of impressions believed to be deposited in blood can be done through the application of a solution that results in a color change when in contact with alpha amino acids or proteins present in the blood. Ensure the stain is dry prior to the application of a solution. Application of a blood protein solution may prevent a serological exam of the evidence after staining.

2.6.1 Preparations

2.6.1.1 Ninhydrin

See Chemical Processing – Porous Items

2.6.1.2 Amido Black

Amido Black is used to enhance impressions that have been deposited in blood or other protein based substances. Caution must be used when applying the methanol-based formula to painted surfaces. The formula may destroy the impression as well as the surface beneath.

Methanol Based working solution

- 2g Amido Black dye (Naphthol blue black)
- 100 mL Glacial acetic acid
- 900 mL Methanol

Combine the ingredients and mix using a stirring device for approximately thirty minutes until dye is dissolved.

Rinse Solution

- 100 mL Glacial acetic acid
- 900 mL Methanol

Combine the above ingredients.

Water Based Working solution

- 500 mL R/O or DI water
- 20 g 5-Sulfosalicylic Acid
- g Amido Black (Naphthol blue black)
- g Sodium carbonate
- 50 mL Formic Acid
- 50 mL Glacial Acetic Acid
- 12.5 mL Kodak Photo-Flo 600 solution (or equivalent surfactant)

Combine the above ingredients in the order listed using a stirring device to mix well. Dilute this mixture to 1 L using R/O or DI water.

2.6.1.3 Coomassie Brilliant Blue R250

Coomassie Working Solution:

- Dissolve 0.44 g of Coomassie brilliant blue R250 in 200 mL of methanol.
- Add 200 mL of R/O or DI water and 40 mL of glacial acetic acid.

Destaining Solution:

- Mix 200 mL of methanol with 200 mL of R/O or DI water.
- Add 40 mL of glacial acetic acid.

2.6.1.4 Leuco Crystal Violet

Option #1:

- Solution A - dissolve 10g of 5-Sulfosalicylic Acid in 100 ml R/O or DI water.
- Solution B - add Solution A to 400 ml 3% Hydrogen Peroxide.
- Working Solution - add 0.75 g Leuco Crystal Violet dye to Solution B stirring the mixture vigorously.

Option #2:

- Dissolve 10 g of 5-Sulfosalicylic Acid in 500 mL 3% Hydrogen Peroxide.
- Dissolve 3.7 g Sodium acetate and 1.0 g Leuco Crystal Violet dye, stirring the mixture vigorously.

Option #3:-

- Purchase premixed "Aqueous Leuco Crystal Violet" kit from approved vendor.

2.6.2 Minimum Standards and Controls

Make an impression on a non-evidentiary surface that is similar to the evidence surface, by placing a small amount of animal or synthetic blood (no human blood) on the item and allowing the blood to dry. Apply the selected solution to the item and if a blue-black stain (violet for Leuco Crystal Violet) is observed, the solution is working properly. Documentation of this process must be done in the form of a reagent log to include a batch number, established by month/day/year (060404). If additional batches are made on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number shall be placed on the working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation.

Shelf life:

Ninhydrin must not exceed one year.

Amido Black and Coomassie Brilliant Blue are indefinite.

Leuco Crystal Violet working solution must not exceed three months, stock solutions must not exceed one year.

2.6.3 Procedure or Analysis

2.6.3.1 Ninhydrin

Porous items can be processed with ninhydrin.

See Chemical Processing – Porous Items

2.6.3.2 Amido Black

Amido black is a permanent procedure which can be used on porous or non-porous surfaces.

Application of the methanol based solution can be done by dipping, spraying or using a squirt bottle. Leave the solution on the specimen for approximately 30 seconds to 1 minute, and then apply the rinse. These steps can be repeated to improve contrast. Apply the final rinse of R/O or DI or tap water.

Application of the water based solution can be done by dipping or using a squirt bottle. Leave solution on specimen for 3 to 5 minutes, and then rinse with tap water. These steps can be repeated to improve contrast.

2.6.3.3 Coomassie Brilliant Blue

Coomassie may be used to enhance blood impressions on porous or non-porous items. Blood impressions do not require heat fixing of the proteins although residue must be dry prior to application. Coomassie's Brilliant Blue R250 can be applied after cyanoacrylate fuming in many cases (see McCarthy and Grieve, 1989).

Application by immersion:

1. The article is immersed in the staining solution and removed after 2 minutes of agitation. Note: Agitate the working solution prior to application as well as during the immersion process.
2. Immerse the item in de-staining solution. After 1 minute, the solution is agitated until the background discoloration fades.
3. Faint reactions will require a return to the staining solution for longer exposure. Repeated staining and de-staining can be performed until optimum intensity is reached.

Application by squirt bottle:

1. Repeated flows of staining solution can be poured or applied by squirt bottle over large surfaces for about 5 minutes or until maximum contrast is observed. Agitate the working solution before application to the evidence.
2. Apply the de-staining solution.

2.6.3.4 Leuco Crystal Violet

Aqueous Leuco Crystal Violet can be applied to porous or nonporous surfaces, such as paper, metal, plastics or glass. Aqueous Leuco Crystal Violet is best applied by either submersion or by washing the solution over the surface in question. It is NOT recommended to spray Aqueous Leuco Crystal Violet except in the case of carpeting to observe footwear impressions or other marks in blood. The development will begin to occur within 30 seconds. Then, blot with paper towels to remove the excess reagent. Begin by spraying lightly with a fine mist to avoid overdevelopment when used on carpeting.

2.6.3.5 Interpretation of Results

Digitally capture all impressions that may be of value for comparison.

2.6.3.5.1 Ninhydrin

The blood impressions as well as other protein based impressions will be intensified and additional detail not previously visible may be revealed. Coloration is not permanent, and

while some impressions have remained visible for years, others have faded in a matter of days.

2.6.3.5.2 Amido Black and Coomassie Brilliant Blue

The blood impressions will be intensified and additional detail not previously visible may be revealed. Dried impressions which lose contrast may be re-immersed in the second rinse solution and re-photographed.

2.6.3.5.3 Leuco Crystal Violet

Other blood enhancement techniques such as Amido Black may be applied after this technique. The use of Aqueous Leuco Crystal Violet followed by Physical Developer is also an option. Digitally capture any impressions developed with each process before treating the evidence with a new process. The Physical Developer may or may not enhance the bloody impressions, but it may develop other impressions. Each chemical reacts with different components of the blood residue.

2.7 Adhesive Surface Processing

Enhancement of impressions deposited on an adhesive surface can be done through the application of a solution that results in a color change when in contact with skin cells or other residues left in the adhesive material as a result of handling.

2.7.1 Preparations

2.7.1.1 Gentian Violet

Working Solution

- 1 g Gentian Violet
- 1 L R/O or DI water

2.7.1.2 Sticky side powder

Combine Photo- Flo 200 (or suitable surfactant) with tap water at a ratio of 1:1.

Add Sticky Side Powder or other powder to the solution and stir until the mixture is the consistency of a thin paint.

2.7.1.3 Commercially available products such as Wetwop™ or TapeGLO

No preparation is necessary for this pre-mixed solution.

2.7.1.4 Minimum Standards and Controls

Deposit an impression on the adhesive side of tape or surface similar to evidentiary item. Apply the solution and if an impression appears the solution is working properly. This testing procedure must be performed for each working solution at the time the solution is made. Documentation of this process must be done in the form of a reagent log for each batch to include a batch number, established by month/day/year (060404). If additional batches are made on the same day, add an alpha character to the batch number (060404a, b, c, etc.). The batch number shall be placed on the working container. A performance check shall be completed for each case. The result of the check and the batch number will be included in the examination documentation. Gentian Violet and Wetwop shelf life is indefinite. Prepare sticky side powder as needed.

2.7.1.5 Procedure of Analysis

2.7.1.5.1 Gentian Violet

Immerse item to be processed in the working solution in a large tray.

Allow the item to remain completely immersed for approximately 30 seconds while agitating.

Remove the item from the working solution and rinse excess stain from the item by washing with a gentle flow of cold tap water.

This process may be repeated until optimum contrast is reached between the impressions developed and the background.

2.7.1.5.2 Sticky Side Powder or Wetwop™ or TapeGLO

Immerse item to be processed in the working suspension or paint the mixture on the sticky side of the tape using a soft bristled brush.

Allow the suspension to remain on the item for approximately 10 seconds.

Remove the item from the suspension and rinse excess suspension from the item by washing with a gentle flow of cold tap water.

This process may be repeated until optimum contrast is reached between the impressions developed and the background.

2.7.1.6 Interpretation of Results

Digitally capture all impressions that may be of value for comparison. Stained impressions which fade as the tape dries may be improved by immersing the tape in a tray of clear water and photographing the impressions while the tape is submerged.

3 PRESERVATION TECHNIQUES

3.1 Introduction

- 3.1.1 All lifts, photographs, digital media, images and negatives received from an outside agency shall be treated as evidence and returned to the submitting agency.
- 3.1.2 Submitted Digital Media
 - 3.1.2.1 At least one employee in each laboratory that receives evidence on non-Commonwealth of Virginia (COV) owned removable media will be issued a separate account with restricted network privileges.
 - 3.1.2.2 Removable media includes, but is not limited to; CDs, DVDs, SD cards or USB drives. Consult the IT staff if assistance is needed related to the definition of removable media.
 - 3.1.2.2.1 It is not required to complete a scan on digital media that was created by a DFS laboratory and is received with original seals intact.
 - 3.1.2.3 Prior to putting the media into a COV networked computer, the examiner will verify the virus signature file on the computer is the latest available from the vendor.
 - 3.1.2.4 The examiner will then log into the network with the restricted account and run a full virus scan on the contents of the media.
 - 3.1.2.4.1 If the scan is not completed in the presence of the assigned examiner, an appropriate chain of custody shall be documented per the QM.
 - 3.1.2.5 If the scan indicates that the media is “clean”, the employee will log in with their normal user account and proceed with the examination.
 - 3.1.2.6 If the scan indicates the media is “not clean”, the examiner will contact the IT staff for guidance.
 - 3.1.2.7 Examination documentation shall include the result of the scan.
- 3.1.3 For submitted digital media create and retain a contact sheet with each file name and its associated sub-item designation. Document on the printed contact sheet a brief description of images and if they were examined.
- 3.1.4 All lifts and images made of impressions, developed by the Laboratory on items of evidence shall be treated as evidence and returned to the submitting agency.
 - 3.1.4.1 Digital media (CD or DVD) containing original impressions shall be designated DM1, DM2, etc.
 - 3.1.4.2 For instances where impressions were developed on more than one item, the digital media shall be returned with the first item on which the impressions were developed.
 - 3.1.4.3 The examiner shall verify and document that the appropriate images are on the media.
 - 3.1.4.4 The packaging for the digital media shall be sealed and labeled with the FS lab number, examiner’s initials and items numbers associated with the impressions.
- 3.1.5 Lifts shall be sub-itemed according to the evidence from which the impression was removed. These sub-items shall be added to the RFLE and created in LIMS.

- 3.1.6 Photographs or digital images which serve as examination documentation shall be retained. Original and clarified images shall be retained on a CD/DVD with the case file in order to preserve the history log of clarification steps.
- 3.1.7 Digitally capture all impressions prior to lifting.

3.2 Digital Imaging

3.2.1 Introduction

Footwear and tire impression evidence may have inherent limitations due to substrate features, quality of the original impression, and method of collection, that affect the quality of the digital capture obtainable.

3.2.2 Instrumentation

Materials and equipment utilized may include all or some of the following, as determined necessary by the photographer, based on the evidence submitted.

- Digital cameras
- Lenses
- Scales
- Tape measures
- Scanners
- Filters
- Appropriate light sources
- Cabling appropriate for the equipment used
- Appropriate output media and printers
- A variety of storage media
- Angle finder / leveling device
- Tripod or copy stand

3.2.3 Minimum Standards and Controls

3.2.3.1 A rigid L-shaped or 90° scale shall be placed along the length of the impression on the same plane as the bottom of the impression. For long tire impressions, in addition to a rigid scale, a long tape measure may be placed along the full length of the impression being captured.

3.2.3.2 All images shall include the following, either in the image or electronically associated with the file.

- Scale
- FS Lab #
- Examiner and photographer initials
- Item / sub-item designation

3.2.4 Procedure

3.2.4.1 Capture

3.2.4.1.1 It is not necessary to capture footwear and tire impressions at 1000ppi. It is acceptable to capture small areas at 1000 ppi if necessary due to the quality of the impression.

3.2.4.1.2 For digital camera capture utilize the TIFF Large setting.

3.2.4.1.3 For scanning utilize 24 bit color or 8 bit gray scale settings.

- 3.2.4.1.4 If the entire lift, cast or object is captured it is not necessary to mark the area of interest on the evidence. If sections of the lift, cast or object are captured, either through photography or scanner, then the area of interest shall be indicated by marking the item of evidence with a bracket or outline and the impression designation. The impression designation is the number followed by the letters FW, TT or PI and the impression #.

3.2.4.2 Clarification

- 3.2.4.2.1 The original and the final version of the image shall be retained with the examination documentation. The images shall be saved to a CD/DVD to allow for the retention of the history log file of the clarification techniques used.

- 3.2.4.2.2 If utilizing Adobe Photoshop to clarify an image, the below log options shall be set as follows:

- Choose Edit>Preferences>General
- Check the “History Log” option (a checkmark must appear in the check box to enable the History Log)
- Select “Both” for “Save Log Items To” option
- Select “Detailed” option for the “Edit Log Items”
- Click OK to save settings

3.2.5 Interpretation of Results

Compare captured image to original impression to ensure necessary detail is present.

3.3 Electrostatic Dust Lifter

3.3.1 Introduction

Electrostatic dust lifters allow for impressions to be lifted from various surfaces and preserved for examination. The electrostatic dust lifter can be used at the crime scene as well as in the laboratory. It is used primarily to lift dry origin impressions.

3.3.2 Preparation

The unit must be adequately charged before each use or contain a battery, and a good supply of lifting film should be stocked.

3.3.3 Instrumentation

There are several versions of electrostatic dust lifters manufactured by different companies. Some of the units are equipped with a convenient carrying case, capable of storing an adequate supply of lifting film, a roller, flashlight and a measuring device, for your convenience. Some units are smaller hand-held units and are just as effective.

3.3.4 Minimum Standards and Controls

If required, the electrostatic units must be sufficiently charged prior to use. Observation of the mylar being compressed during use will serve as a positive indication. The lifting film must be free of dust and other contaminants prior to use.

3.3.5 Procedure

- 3.3.5.1 Locate the impression to be lifted.

- 3.3.5.2 Cut a piece of lifting film that is larger than the impression.
- 3.3.5.3 Place the lifting film over the impression, black side down against the impression and the metalized side will face up.
- 3.3.5.4 Ensure the unit is properly grounded per the instructions of the particular unit.
- 3.3.5.5 Place the probe on the lifting film to charge the lifting film. Use a roller to smooth the lifting film allowing it to come in contact with the impression.
- 3.3.5.6 Turn off the unit and wait several seconds for the film to discharge. Remove the film from the evidence by lifting one end and rising to the other end. Do not slide the film across the evidence.
- 3.3.5.7 Photograph the impressions that are present on the lifting film to preserve the impression. Caution must be exercised when handling and packaging the lifting film to avoid destroying the dust impression.

3.3.6 Interpretation of Results

If the impressions are faint, photography can enhance and preserve the impression using various photographic techniques.

3.4 Lifts/Casts

3.4.1 Introduction

Adhesive coated materials or tapes can be used to lift impressions from surfaces. Lifts can be made of dust or residue impressions, wet origin impressions, and impressions developed with fingerprint powder.

3.4.2 Preparation

The substrate, components of the impression, and environmental conditions should be considered prior to selecting a lifting method.

3.4.3 Equipment

- Gelatin lifters
- Static lifts
- Adhesive lifters
- Fingerprint lifting tape
- Dental stone or other casting material
- Silicone (such as Mikrosil™)

3.4.4 Minimum Standards and Controls

- 3.4.4.1 Ensure the lifting material is free from foreign material prior to applying to the impression.
- 3.4.4.2 Label the lifts and casts with the case number, item number, date and initials.
- 3.4.4.3 All lifts and casts shall be digitally captured and compared to the original to ensure all detail was captured adequately.
- 3.4.4.4 All lifts and casts shall be treated as evidence and handled according to the Quality Manual.

3.4.5 Procedure - Gelatin Lifters

3.4.5.1 Select the appropriate color of lifting material.

3.4.5.1.1 White gel lifters provide greater contrast with impressions enhanced with dark colored powders or residue impressions.

3.4.5.1.2 Black gel lifters provide greater contrast with light colored powders or residue impressions.

3.4.5.1.3 Clear gel lifters normally do not provide good contrast.

3.4.6 Procedure – Adhesive Lifters

3.4.6.1 Adhesive lifters are an option for lifting impressions developed with dark colored powder, however they are not recommended for lifting dust or residue impressions.

3.4.6.1.1 White backgrounds are recommended for clear adhesive lifters.

3.4.6.1.2 Clear adhesive on a clear background is not recommended.

3.4.6.2 Cut the lifting material to a size that will adequately cover the area of interest. It is preferable to lift the entire impression with one piece of lifting material.

3.4.6.3 Lift the impression and adhere the appropriate backing or protective material.

3.4.6.4 Digitally capture without the acetate cover, whenever possible.

3.4.7 Procedure – Static Lifts

3.4.7.1 Recommended for lifting dust impressions.

3.4.7.1.1 Peel off white backing to activate the charge.

3.4.7.1.2 Lay lift over impression, holding or taping one end down.

3.4.7.1.3 Apply pressure evenly using a roller or hand.

3.4.7.1.4 Lift and store in a manila folder or tape inside a cardboard box.

3.4.8 Procedure – Rigid Casting

3.4.8.1 Dental stone or other similar material can be used to lift impressions such as mud and tire residues from surfaces such as concrete and tile.

3.4.8.1.1 Mix according to instructions or recommended ratio for the product.

3.4.8.1.2 Place a cardboard frame around the impression.

3.4.8.1.3 Pour a thick layer of dental stone over the impressions area and lift when dry.

3.4.8.1.4 Do not clean cast of a 2-dimensionl residue impression.

3.4.9 Procedure – Flexible Casting

3.4.9.1 Silicone such as Mikrosil™ can be used to lift impressions enhanced with powder from any surface, particularly textured surfaces.

- 3.4.9.1.1 Mix according to instructions and apply an even coating of the material over the impressions and lift when material has cured. Consult the manufacturer's recommendation for curing times.

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4 KNOWN STANDARDS

4.1 Introduction

Various techniques are non-destructive and not sequence dependent; it is at the examiner's discretion to choose the appropriate technique, and continue to apply additional techniques as necessary to maximize results. The recording of known standards for footwear and tire tread design can be accomplished using these procedures. Known standards provide a recording of the characteristics already present on the outsole of a footwear or tire. The quality of the comparison directly relates to the quality of the known. It is not required to create known standards if the images of the outsole or tire tread are sufficient for comparison.

4.2 Preparation

Prior to making known standards, preserve trace evidence and digitally capture the original condition of the outsole or tire.

4.2.1 Dental Stone

Mix according to instructions or recommended ratio for the product.

4.2.2 No specific preparations are needed for the other standards as the materials being used are commercially prepared.

4.3 Equipment

- Gelatin Lifters
- Adhesive Film
- Latent Print Lifting Tape
- Fingerprint Powder
- Hinge Lifters
- Indenticator ® or other inkless techniques
- BIO-FOAM®
- Dental Stone
- WD-40
- Petroleum jelly
- Silicone Wipes
- Chart Board

4.4 Minimum Standards and Controls

Ensure powders, dental stone, and lifting materials are suitable prior to their use. Powders should be free flowing, not caked, and the lifting materials should be flexible, not rigid.

Label all lifts with case number, item number, date, initials and designation of right or left footwear (as applicable).

All known standards shall be treated as evidence and handled according to the Quality Manual.

4.5 Procedure

4.5.1 A minimum of two known standards shall be created using two different methods. (e.g., dynamic vs. static, gel lifter vs. adhesive lifter).

4.5.1.1 Document the comparison of the known standards to each other and the known item to confirm the characteristics are reproducing.

4.5.1.2 Verification is not required for standard to standard comparison.

4.5.2 Footwear Known Standards

4.5.2.1 Footwear known standards should record fine detail with good contrast and be suitable for use in the comparison process.

4.5.2.2 Document the footwear brand, model, size and tag information, if available, in the examination documentation.

4.5.2.3 Initial known standards should be made of the entire footwear.

4.5.2.4 Excess dirt should be removed from the footwear with care so as not to damage the outsole.

4.5.2.5 Prior to wearing the footwear in any of the collection techniques, consider contamination issues.

4.5.2.6 Gel Lifter or Adhesive Film and fingerprint powder

- Prior to the application of the black powder a releasing agent may be applied to the footwear, such as WD-40.
- Apply a coat of black fingerprint powder to the outsole of the footwear.
- Remove excess powder by gently tapping footwear.
- Remove protective cover from adhesive sheet.
- Lay adhesive side up on the surface where the impression will be made.
- Make an impression, while wearing the footwear, by stepping onto the adhesive film. If necessary, press the adhesive against the footwear sole to obtain a complete recording of the outsole.
 - It is acceptable to press the adhesive film against the footwear outsole while not wearing the footwear.
 - Avoid stretching or applying excessive pressure to the gel which would distort the impression
- Cover the impression with a protective sheet.

4.5.2.7 Identicator® or other inkless technique

Make an impression by pressing the footwear onto the inkpad and then onto the treated paper.

4.5.2.8 Silicone spray, wipes or other suitable substance and magnetic fingerprint powder

- Coat the outsole of the footwear with the selected substance.
- Make an impression on a chosen surface.
- Develop the resulting impression with magnetic powder.

4.5.2.9 BIO-FOAM® and dental stone

- Make an impression in BIO-FOAM®
- Use the resulting impression for comparison to three-dimensional impressions.
- The BIO-FOAM® impression can be filled with dental stone for comparison to submitted casts.

4.5.3 Tire Known Standards

4.5.3.1 Known standards should record the area of interest.

4.5.3.2 Excess dirt should be removed from the tire with care so as to not damage the tread.

4.5.3.3 Methods for making tire impressions should record fine detail with good contrast and be suitable for use in the comparison process.

4.5.3.4 Document tire brand, make, size, DOT number, and other relevant information in the examination documentation.

4.5.3.5 Petroleum jelly or silicone wipes on chart board with magnetic fingerprint powder

- Prepare two pieces of chart board, each of sufficient length to record a full rotation of the tire.
- Apply a light coat of chosen substance on the tire surface.
- Roll the tire over chart board.
- Label the chart board with relevant information regarding tire, position and direction of travel.
- Develop the impression with magnetic fingerprint powder.

4.5.4 Known standards for elimination can include any of the methods listed above, or any other method suitable for recording design detail. Photography is suitable to record the design detail for some elimination conclusions.

4.5.4.1 Proposed significant deviations from methods of recording known standards in this manual must be presented to the TRT for evaluation and Program Manager for approval.

4.6 Interpretation of Results

Compare known standard to actual item to ensure adequate detail was captured for comparison purposes.

5 IMPRESSION EXAMINATION

5.1 Introduction

Two-dimensional impressions are those impressions which, for all practical purposes, have the dimensions of length and width, but not a significant depth. The procedure for examining two-dimensional impressions already preserved at the crime scene usually involves photographs, lifted impressions, or the evidence itself. Three-dimensional impressions are those impressions with the dimensions of length, width and depth. Impressions shall be digitally captured and images retained as examination documentation.

Impression examinations are conducted using the analysis, comparison, evaluation and verification methodology, utilizing both qualitative and quantitative analysis.

The right and left footwear shall be treated as separate objects and the results shall be recorded for each analysis, comparison and evaluation separately, as applicable.

If it is not possible to examine the original evidence, then examinations may be performed with the examination documentation images existing in the case file after a protocol deviation is approved as outlined in the Quality Manual.

Impressions captured for analysis shall be designated by a number. When possible, multiple and overlapping impressions shall be designated by a separate impression number for each impression.

5.2 Equipment

- Alternate Light Source or other light sources
- Electrostatic Lifting Device
- Digital Capture Equipment
- Calipers, rulers

5.3 Procedure

5.3.1 Use appropriate lighting to examine lifts or casts. Lighting may include, but is not limited to, oblique lighting, alternate light sources, or ambient light.

5.3.2 Dental Stone Casts

Clean with a soft brush and water to remove extraneous material, taking care not to damage the cast impression; a saturated solution of Potassium Sulfate may be used to remove or dislodge debris adhered to the cast. Casts should be photographed and printed natural size.

5.4 Analysis

Examine the questioned footwear or tire impressions prior to the knowns to determine if there are sufficient gross design features and clarity to conduct a comparison.

5.4.1 Document the following:

5.4.1.1 Full or Partial impression.

5.4.1.1.1 Full footwear impression; toe to heel with the medial and lateral sides visible.

5.4.1.1.2 Full tire impression; shoulder to shoulder visible. Record the number of Ribs and Grooves.

5.4.1.1.3 Partial footwear impression; Toe, Forefoot Arch area, Heel or Unknown.

5.4.1.1.4 Partial tire impression; number of Ribs and Grooves.

5.4.1.2 Design elements.

5.4.1.3 Quality of the impression.

5.4.1.3.1 Excellent - little to no distortion, characteristics are clearly defined, high clarity

- Footwear - able to determine right footwear or left footwear and the area of outsole
- Tire - discernable characteristics, discernable noise treatment, shoulder to shoulder, sipes present

5.4.1.3.2 Moderate – slightly distorted, characteristics discernable

- Footwear – able to determine area of outsole
- Tire – partial noise treatment, discernable elements in the ribs and visible grooves

5.4.1.3.3 Limited – heavily distorted, characteristics are difficult to determine, improper recovery technique

- Footwear - unable to determine area of outsole
- Tire – elements are not clearly defined, able to determine distinct ribs and grooves

5.4.1.3.4 Poor – lacks quantity and quality of class characteristics

5.4.2 Possible analysis conclusion

5.4.2.1 Value for Comparison – Sufficient characteristics to allow for a full range of conclusions.

5.4.2.2 Not of Value for Comparison – Lacks reliable characteristics needed to draw a comparison conclusion.

5.4.2.3 Limited Specificity for Comparison - Lacks specificity of characteristics present in the impression for comparison conclusions other than limited association based on design or exclusion.

5.5 Comparison

5.5.1 Visually compare questioned impressions with known item.

5.5.2 Visual comparison of design

5.5.2.1 If design is different, document, discontinue these procedures, and report accordingly.

5.5.2.2 If design is similar, prepare a known standard and continue with these procedures.

5.5.3 Comparisons of the questioned impressions are done with an image of the known item, known standard(s) and overlays of the known standard.

5.5.3.1 The image(s) of the known item shall accurately depict all characteristics that support the conclusion.

5.5.4 Visual comparison of specific physical size and shape of design

5.5.4.1 Document the size and shape of design features present.

5.5.4.2 If specific design and/or physical size and shape of design, to include noise treatment (pitch sequence) of tires, are different, document, discontinue these procedures, and report accordingly.

5.5.4.2.1 If physical size is different, consider scaling, perspective and other issues.

5.5.5 Visual comparison of wear marks

5.5.5.1 Document the degree of wear, general wear, holes, position and orientation of wear, specific location of wear, and tears, if present.

5.5.5.2 If the position and degree of wear are different, document and evaluate possible wear changes between date of crime and date footwear or tires were recovered.

5.5.5.3 If the position and degree of general wear corresponds, continue with procedure.

5.5.6 Visual comparison of randomly acquired characteristics

5.5.6.1 Document randomly acquired characteristic such as; cuts, scratches, tears, holes, stone holds, abrasions and the acquisition of debris from random events, if present.

5.5.6.1.1 Documentation shall include the position, orientation, size and shape of the randomly acquired characteristics that contribute to the conclusion.

5.5.6.1.2 Due to varying circumstances, not all randomly acquired characteristic will reproduce in every impression. Therefore, the absence of a randomly acquired characteristic is not a basis for elimination and does not preclude identification.

5.6 Evaluation - Conclusions

The following conclusions and descriptions are meant to provide context to the levels of opinions reached in impression examinations.

5.6.1 Elimination (definite exclusion)

Sufficient differences were noted between characteristics. Known footwear or tire was not the source and did not make the questioned impression.

5.6.2 Indications of non-association

The questioned impression contains dissimilarities when compared to the footwear or tire, however, certain details or features were not sufficiently clear to permit elimination.

5.6.3 Limited association of class characteristics

Some similar class characteristics are present; however, there are significant limiting factors in the questioned impression that do not permit a stronger association between the impression and a known. Factors may include, but are not limited to, insufficient detail, lack of scale, improper position of scale, improper photographic techniques, distortion or significant lengths of time between the date the incident occurred and when the footwear or tires were recovered that could account for a different degree of general wear. Some association is observed, however details available for comparison preclude a more discriminating conclusion. No confirmable differences were observed that could eliminate the footwear/tire.

5.6.4 Association of class characteristics

The class characteristics of design, physical size and shape correspond between the questioned impression and the known footwear/tire. Correspondence of general wear may be present. The known footwear/tire is a possible source of the questioned impression; however, other footwear/tires with the same class characteristics are included as possible sources.

5.6.5 High degree of association

Observable correspondence of class characteristics with the existence of 1) wear that by virtue of its specific location, degree and orientation, make it unusual and/or 2) one or more randomly acquired characteristics. The characteristics observed exhibit strong associations indicating the known footwear/tire is the source of the impression but are insufficient for identification. Other footwear/tires with the same characteristics could be included as the possible source only if they also display the same wear and/or randomly acquired characteristics observed in the questioned impression.

5.6.6 Identification

The questioned impression and the known footwear/tire share sufficient agreement of observable class and randomly acquired characteristics to conclude the known footwear/tire was the source of the questioned impression.

5.6.7 Inconclusive

Insufficient detail is present in the questioned impression and/or known standard to reach a conclusion of identification, exclusion or association.

5.7 Documentation Requirements

5.7.1 Uniquely label each area of interest that was analyzed. See below for examples.

1FW1 would be used for Item 1 Footwear Impression 1
2TT2 would be used for Item 2 Tire Track Impression 2
3PI3 would be used for Item 3 Pattern Impression 3

5.7.2 Document characteristics observed during the examination process that support conclusions using the appropriate worksheet(s).

5.7.3 Annotate images, labeling characteristics that support the conclusion.

5.7.4 The examiner shall label the images used to perform the comparison with the conclusion, date the examination was complete and their initials.

5.7.5 The following are suggested formats for annotations:

- a circle is drawn around a specific feature with a written explanation of the feature and its association or non-association with a known source
 - the written explanation should include the description of the class characteristics such as design, size or wear
- draw an outline around or brackets on each side of each impression to indicate the area that was analyzed and examined to render the reported conclusion

5.7.6 If known footwear/tires are excluded as a source of the questioned specimen, an examination quality recorded copy of the outsole design or tread pattern must be maintained in the case documentation.

5.7.7 Examination documentation must acknowledge impressions which were not analyzed, compared or evaluated.

5.8 Verification

Verification is the independent analysis, comparison and evaluation of a questioned impression with an image of the known item, the known standard and known overlays. The primary examiner shall provide unmarked examination quality images.

5.8.1 All comparison conclusions shall be verified by another examiner.

5.8.1.1 Verifications shall be documented on the applicable Impression Verification form(s).

5.8.1.2 The verifying examiner shall mark the characteristics used to render the conclusion on the images of the known and questioned impressions.

5.8.1.3 The verifying examiner shall label the images used to perform the comparison with the conclusion, date the examination was complete and their initials.

5.8.2 Verifications must be completed prior to communicating the information to the submitting agency, either verbally or in writing.

5.9 Review of “No Value” and “Limited Specificity” Impressions

5.9.1 A qualified examiner shall review all impressions that the examiner deemed No Value or Limited Specificity for Comparison. The review shall be documented in the examination documentation to include agreement/disagreement, date of review, and reviewer's initials.

6 FOOTWEAR AND TIRE TREAD REFERENCE MATERIAL

6.1 Introduction

- 6.1.1 Footwear and tire tread reference material can be used to determine the manufacturer's name and model associated with an unknown impression.
- 6.1.2 The examination documentation shall include the specific reference material used to reach the reported conclusion.
- 6.1.3 The results of the all searches shall be included on the CoA and the information retained as examination documentation. If the search results in a possible manufacturer, a printout shall be included with the examination documentation and provided with the CoA.
- 6.1.4 It is not required to search an impression that contains a common class characteristic that would yield results that lack specificity to determine a manufacturer.

6.2 Procedures

6.2.1 Tread Design Guide

- 6.2.1.1 The information is categorized alphabetically by manufacturer and is divided into tire types (i.e., passenger tires, small highway and light truck tires, medium and large highway truck tires, off-the-road, agricultural, ATV, motorcycle and truck retread designs).

6.2.2 SoleMate®

- 6.2.2.1 The selection of the shape coding in the SoleMate ® software can affect the result of the search. If a potential match is not located, additional searches shall be performed.

- 6.2.2.1.1 A minimum of three searches shall be performed when a potential match is not found.

- 6.2.2.2 A printout depicting the search parameters and potential matches for each search shall be retained in the casefile.

- 6.2.2.3 If a potential match is not located in the SoleMate ® database, another qualified examiner shall perform at least one search.

- 6.2.2.3.1 In an instance where the second examiner locates a potential match, the first examiner will review the search results and report the appropriate conclusion.

- 6.2.2.3.2 Documentation associated with the second examiner's search shall be retained in the casefile.

6.2.3 Retail re-sellers

- 6.2.3.1 On-line or physical stores are acceptable resources to locate a manufacturer of an unknown footwear outsole and tire tread patterns.

- 6.2.3.2 Websites searched and the results shall be included in the examination documentation.

7 REPORT WORDING

7.1 Introduction

Utilize the following report formats to the extent possible when reporting results to ensure consistency within the section. Specific report language cannot be provided to address all situations; the following examples should be used when appropriate. When drafting report wording for evidence types not listed or when specific examples do not appear for a particular type of evidence, look first to existing wording that may be applied to the current situation. If a situation is so unusual that appropriate report wording is not available in the manual, it is expected that the Section Supervisor / Examiner shall consult with other Section Supervisors / Examiners for wording that may have been previously applied to the situation, with the Physical Evidence Program Manager and/or the Director of Technical Services.

The Certificate of Analysis (CoA) shall include in the report statement the types of examinations that were conducted to reach the stated conclusions.

7.2 Guidelines

- 7.2.1 CASE INFORMATION:** Agency name, name of investigating officer, laboratory case number, agency case number, victim(s), suspect(s), and additional information found on the Request for Laboratory Examination form.
- 7.2.2 EVIDENCE SUBMITTED:** A listing and description of items as received from an agency.
- 7.2.3 RESULTS:** A summary of the pertinent information relating to the examination, analysis and conclusions of Items listed. The **COMPARISON RESULTS** section of the CoA shall be sub-sectioned into the following three parts, as applicable:
- If no impressions were recovered, it is not required to include the **ANALYSIS** and **COMPARISON RESULTS** section.
 - If after analysis there are no impressions of value for comparison, it is not required to include the **COMPARISON RESULTS** section.
- 7.2.3.1 PROCESSING AND EXAMINATION:** This section details the processing examinations (e.g., visual, chemical and/or physical) and results for each item. The results shall include the number of impressions recovered or designated from each item.
- 7.2.3.2 ANALYSIS:** This section provides details related to the analysis conducted on each impression.
- The designated number is the Item number followed by the letters “FW”, “TT” or “PI” and a number which is sequential for the series of impressions captured on the item.
- Examples:
- Three footwear impressions are preserved on Item 3-5; the impressions would be designated 3-5 FW1, 3-5 FW2, and 3-5 FW3
 - Four tire track impressions are preserved on Item 5383; the impressions would be designated 5383 TT1, 5383 TT2, 5383 TT3, and 5383 TT4
- 7.2.3.3 COMPARISON RESULTS:** This section details the comparisons and evaluations of the impressions designated as of value for comparison in the Analysis section.

7.3 Wording Examples

The italicized portions in the proposed statements are examples.

There is no need to further describe the item beyond the number as that information is available in the evidence lists. It is acceptable to include the description again in the processing section if deemed necessary for clarification.

7.3.1 **PROCESSING AND EXAMINATION:** Statement of the processing and examinations performed on the Item(s)

7.3.1.1 The below can be used for an item that was visually examined with no processing techniques applied.

No patterned impressions were visible on *Item 1*.

No impressions of value for comparison are visible on *Item 2*, therefore no comparisons were made with *Item 3*.

Item 4 was visually examined, no impressions were located and no further processing was done due to the surface not being suitable.

7.3.1.2 The below can be used for an item that was physically and/or chemically processed with the intent to develop or clarify an impression.

Item 1 was visually examined and chemically processed. The *footwear* impression developed on *Item 1* may be of value for comparison. Known *footwear* or known standards should be submitted for comparison.

Item 1 was visually examined, chemically processed, viewed with an alternate light source and then physically processed. No impressions were observed or developed on *Item 1*.

7.3.1.3 The below can be used for submitted knowns.

Item 1 (known footwear/tire) was visually examined, digitally captured, utilized to create known standards (*sub item #s*) and used for comparison.

7.3.1.4 The below can be used when impression detail is visible but is of no value for comparison:

No impressions of value for comparison were observed and/or developed.

7.3.1.5 The below can be used when no impression detail is visible:

No impressions were observed and/or developed.

7.3.1.6 The below can be used when impressions are captured. The number of impressions captured shall be documented for each item processed:

One tire impression was lifted.

Two footwear impressions were digitally captured.

Five tire impressions were lifted and/or digitally captured.

7.3.1.7 The below can be used when impressions were captured or submitted, but were not analyzed.

The remaining impressions were not analyzed.

7.3.1.8 The below can be used for images on submitted digital media.

7.3.1.8.1 *Item 1*, disc, contained images designated *1A thru 1E*. The images were visually examined and not used for comparison.

7.3.1.8.2 *Item 1*, disc, contained images *1A thru 1E*. The images were visually examined and three contain impressions which were designated *1FW1, 1FW2 and 1FW3* for analysis. The remaining images did not contain impressions or were not suitable for analysis due to lack of visible detail.

7.3.2 **ANALYSIS:** Result statement for the analysis performed on each impression preserved and documented in the **PROCESSING AND EXAMINATION** section.

7.3.2.1 The below can be used when an impression is determined to be of value for comparison:

Item 1 – Three impressions of value for comparison have been designated *1 FW1, 1 FW3 and 1 FW5*.

7.3.2.2 The below can be used when preserved impressions were determined to be of no value for comparison:

Item 2 – the impressions captured were analyzed and determined to be of no value for comparison.

Item 2 – the impressions submitted were analyzed and lack sufficient detail for comparison.

7.3.3 **COMPARISON RESULTS:** Statements related to the comparison results of the impressions designated to be of value for comparison. This section shall be organized by impression number.

7.3.3.1 The *Item 2 tire* has been identified as being the source of the impression on *Item 1*.

7.3.3.2 The *footwear* impression on *Item 2* was not made by *Item 5*.

7.3.3.3 The *tire* impression on *Item 3* was not made by the *tire* producing the *Item 6* known standard.

7.3.3.4 Inconclusive

The comparison of *Item 5 footwear* impression to the *Item 6 left footwear* is inconclusive; the impression could not be associated with or excluded from the submitted footwear due to insufficient detail present in the impression.

7.3.3.5 Indications of non-associations

The impression in *Item 3* exhibits dissimilarities when compared to the *Item 6 left footwear*, however, certain details or features are not sufficiently clear to permit an elimination.

7.3.3.6 Limited association of class characteristics

The class characteristics present in the *tire* impression on *Item 5* are similar to those present in the *Item 6 tire*, however, due to *distortion* present in the known standard of *Item 6* a more discriminating examination cannot be performed. There are no confirmable differences that would exclude the *Item 6 tire* from being the source of the *Item 5* impression.

7.3.3.7 Association of class characteristics

The general wear and class characteristics present in *Item 6 left footwear* correspond with design and physical size of the characteristics present in the *Item 8* impression, therefore *Item 6* is a possible source of the *Item 8* impression. Other footwear with the same class characteristics could have been the source of the *Item 8* impression.

7.3.3.8 High degree of association

The specific location, degree and orientation of the wear present in the *Item 9 tire* corresponds with the wear present in the *Item 10* impression. In addition to the wear correspondence there exist randomly acquired characteristics in both the *Item 9* tire and the *Item 10* impression that indicate a strong association that the *Item 9 tire* is the source of the *Item 10* impression but the characteristics are insufficient for an identification. Other *tires* with the same characteristics could be the source of the impression if they also display the same wear and randomly acquired characteristics observed in the impression.

7.3.4 Multiple Case Associations/ Cross-Comparisons

7.3.4.1 As requested, *Item 1* was compared to *Item 2* submitted under *FS Lab # C12-xxxx (Richmond PD Case# 12-yyyy)*.

- The comparison results, as outlined in the previous section, should be inserted here.

7.3.4.2 The three impressions submitted as *Item 1, 3 and 4* under *FS Lab #C12-xxxx* were previously reported as, *(insert comparison result)*. The below listed items were examined, compared to *Item 1* and *(insert comparison result)*.

The *Item 6* impression lift submitted by your agency case # *2012aaaa*, *FLS Lab # C12-xxxx*.
The *Item 54* impression lift submitted by *Hampton PD* case # *2012bbbb*, *FLS Lab # C12-yyyy*.

7.3.5 **TERMINUS STATEMENTS:** All reports shall conclude with an applicable statement listed in each of the below sections.

7.3.5.1 The following statement shall be included on all reports:

Date(s) of Testing: mm/dd/yyyy – mm/dd/yyyy

Supporting examination documentation is maintained in the case file. The above listed methods are those approved for use at the time of analysis. Current methods can be found in the Impressions – Footwear and Tire Tread Procedure Manual, which can be found at www.dfs.virginia.gov/documentation-publications/manuals/.

7.3.5.2 Request for known samples

The known *footwear* should be submitted for a conclusive comparison of the *Item 1* impression.

7.3.5.3 Reference collection search

The *Tread Typer* database was utilized to determine the manufacturer of the questioned *tire* impressions is *Firestone* or any other brand of *tire* with a similar *tread* design. An image of the *tire tread* design is enclosed.

A search of the *SoleMate footwear database* and *numerous retail websites* did not yield a result that would allow for the manufacturer of the questioned *footwear* impression to be determined.

IFWI was not suitable for manufacturer searching due to lack of specificity of characteristics present in the impression.

7.3.5.4 Photographs / digital images / known standards

The returned digital media, *Item DMI*, contains images of impressions captured from *Item 1, 3 and 6*. This item of evidence is being returned in *container 2* and should be retained. Should further comparisons be required, *DMI* must be resubmitted.

7.3.5.5 Disposition of evidence

Document the disposition in the CoA according to the Quality Manual.

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VIRGINIA
DEPARTMENT
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FORENSIC SCIENCE

8 QUALITY ASSURANCE

8.1 Introduction

The purpose of this section is to provide a uniform Quality Assurance Program for the Impression Section of the Virginia Department of Forensic Science. It is to establish a baseline or reference point of reliability and system performance.

8.2 Reagents

- 8.2.1 Chemicals and solvents used in reagents should be of at least Certified Analytical Reagent ACS grade. Water used in reagent preparation should be reverse osmosis (RO) or deionized (DI), unless otherwise noted.
- 8.2.2 Commercially purchased reagents are an approved alternative to laboratory prepared reagents. However, they still must meet the minimum QA/QC requirements for that particular reagent.
- 8.2.3 Stock solutions shall be labeled according to the Quality Manual and documented in the Reagent Preparation Log.
- 8.2.4 A performance check, ensuring the reagent is working as intended, shall be performed and appropriately documented in the examination documentation prior to use on evidence.
 - 8.2.4.1 The result of the check shall be recorded.
 - 8.2.4.1.1 “Positive” or “+” indicating the reagent is working as intended.
 - 8.2.4.1.2 “Negative” or “-” indicating the reagent is not working as intended.

8.3 Powders

- 8.3.1 Powders should be of a homogenous mixture, free of clumps and foreign debris. Contaminated powders shall not be returned to stock containers.
- 8.3.2 Individual hair (or fiber) brushes should be used for different colors or types of powders.

8.4 Evidence Handling

Evidence packaging and evidence shall be documented and marked as outlined in the Quality Manual.

8.5 Equipment

- 8.5.1 Balances
 - 8.5.1.1 Balances shall be calibrated by an outside vendor annually that is accredited to ISO/IEC 17025:2005 and whose scope of accreditation covers the calibration performed. New balances shall be calibrated prior to being placed into service. Calibration certificates shall be evaluated by the Section Supervisor, Group Supervisor, or designee prior to placing the balance into service.
 - 8.5.1.2 All balances shall be performance checked quarterly (every three months) for accuracy using ASTM Class 1 weights.
 - 8.5.1.2.1 Weights used to check balance accuracy shall be re-certified every three years by an ISO/IEC 17025:2005 accredited vendor whose scope of accreditation covers the certification performed.

8.5.1.3 Record the weight displayed on the balance using the Latent Print Balance Log form 241-F104.

8.5.1.4 If the accuracy of a weight is outside the acceptable range listed in the table below, ensure the balance is level and clean prior to rechecking. If, after these actions, the weight check is still outside the acceptable range it shall be taken out of service and labeled as such until maintenance and/or calibration is performed by a qualified vendor.

BALANCE TYPE	BALANCE EXAMPLES	CHECK WEIGHTS
Toploading (± 0.01) gram	Mettler PE 1600 Mettler PB302 Ohaus Scout Pro SP202 Sartorius BP21005	1.00 (± 0.02) gram, 10.00 (± 0.05) grams, 100.00 (± 0.05) grams
Toploading (± 0.001) gram	Ohaus Explorer Mettler PB303	0.100 (± 0.002) gram 1.000 (± 0.002) gram 100.000 (± 0.05) grams

8.5.1.5 Records of calibration and performance check shall be maintained in the equipment maintenance log.

8.5.2 Environmental Chambers

8.5.2.1 The certified hygro-thermometer used to monitor the chamber shall be calibrated annually.

8.5.2.2 Maintenance of the environmental chamber should be in conjunction with the manufacturer's specifications.

8.5.3 Alternate Light Source (ALS)

Maintenance of the light source should be in conjunction with the manufacturer's specifications.

9 ABBREVIATIONS

The following is a list of abbreviations and acronyms commonly used by examiners in the Impression Section of the Latent Print Section. This list has been generated to assist in the interpretation of case file notes and is not a standardized list of required abbreviations. The abbreviations are appropriate written in either lower or upper case and they are appropriate with or without punctuation such as periods. Common chemical formulas, chemical, mathematical and shorthand abbreviations are equally acceptable and will not be listed here.

Agency Case Number	ACN
Alternate Light Source	ALS
Amido Black	AB
Aqueous Leuco Crystal Violet	LCV
Association of Class Characteristics	ACC
Bearing the Name	BTN
Black Powder	BP, blk, pdr.
Blind Verification	BV
Brown	Brn, BN
Central Laboratory	C or CL
Compared	Comp.
Comparison(s)	Comp(s)
Container	Cont./C
Crimescope	CS
Designated	Desig.
Developed	Dev.
Digital	Dig.
Digital Media	DM
Disposition	Dispo.
Elimination	Elim.
Envelope	Env.
Eastern Forensic Photographer	E/FP
Evidence Receiving	ER
Excluded	Exc.
Facsimile	Fax
Fingerprint(s)	Fp(s), Fgpt.
Firearms Section	FX
Footwear	FW
Forensic Advantage, Case and Evidence	FACE
Forensic Photographer	FP
Gentian Violet	GV
Environmental Chamber/Cabinet	HC
High Degree of Association	HDA
Identification	Ø, ID.
Impression(s)	Imp(s)
Inconclusive	Inc.
Indications of Non-association	INA
Latent Print Section	LX
Left	L

Limited Association of Class Characteristics	LACC
Luma-Lite	LL
Magnetic	Mag.
Manila	Man.
Negative(s)	Neg(s)
Ninhydrin	Nin
No Value	NV
Northern Laboratory	N, NOVA
Of Value	OV
Pattern Impression	PI
Physical Developer	PD
Pick-up	PU
Possible	Poss.
Present	Pres.
Previous	Prev.
Print(s)	Prt(s).
Processed	Proc.
Randomly Acquired Characteristics	RACs
Received	Rec.
Registered	Reg.
Remaining	Rem.
Reported	Rept'd.
Retained	Retn'd.
Returned	Ret'd.
Reverse	Rev.
Reverse position	Rev. pos.
Reverse color	Rev. col.
Right	R
Schallamach	SM
Sealed Brown Box	SBB
Sealed Envelope	SE
Sealed Manila Envelope	SME
Sealed paper bag	SPB
Sealed brown paper bag	SBPB
Sealed plastic bag	SPLB
Sealed White Box	SWBX
Sealed yellow envelope	SYE
See Other Photo	SOP
Separate	Sep
Forensic Biology Section	SX
Silver Nitrate	SN
Submitted	Sub.
Small Particle Reagent	SPR
Superglue	SG, Cyano
Suspect	S or Susp.

Eastern Laboratory	T, EL
Tire Impression	TI
Tire Track	TT
Trace	TE
Victim	V or Vic.
Visible	Vis.
Wear	W
Western Laboratory	W

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10 REFERENCES

Bodziak, W.J. (2000) Footwear Impression Evidence, 2nd ed. Boca Raton, FL: CRC Press.

McDonald, P. (1989). Tire Imprint Evidence. Boca Raton, FL: CRC Press.

Music, D., & Bodziak, W.J. (1988). A Forensic Evaluation of the Air Bubbles Present in Polyurethane Shoe Outsoles as Applicable in Footwear Impression Comparisons. Journal of Forensic Sciences. 33(5). pp. 1185-1197.

Scientific Working Group for Shoe Print and Tire tread Evidence. (2005). Guide the Preparation of test impressions from Footwear and Tires.

http://treadforensics.com/images/swgtread/standards/current/swgtread_05_test_impressions_200503.pdf

Scientific Working Group for Shoe Print and Tire tread Evidence. (2007). Guide for Lifting Footwear and Tire Impression Evidence.

http://treadforensics.com/images/swgtread/standards/current/swgtread_12_lifting_200703.pdf

United States Department of Justice. (2000). FBI Processing Guide for Developing Latent Prints.

http://onin.com/fp/fbi_2000_lp_guide.pdf

United States Department of Justice. (2011). The Fingerprint Sourcebook. Washington, D.C.: U.S. Government Printing Office.

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