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FOOTWEAR/TIRE TRACKS
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FOREWORD

The body of knowledge which comprises forensic science is a compilation of procedures adapted from other disciplines that encompass many of the physical and natural sciences. During the history of forensic science, a multitude of scientists have greatly contributed to the protocols, methods and procedures that have become a routine part of analysis. Every effort has been made in this manual to give proper recognition to the authors of specific procedures; however, in some instances, the original source of forensic procedures has been lost in antiquity. For others, the general procedures belong to the public domain and are recorded in many basic references concerning forensic science. In addition, many of the procedures described in this manual have been adapted from standard laboratory practices, and the citation of thousands of references which deserve credit for aiding in the development of these procedures is neither practical nor possible. To all those scientists who have contributed to the knowledge of forensic science contained herein, we do extend collective recognition and gratitude.

Procedures manuals which offer reliable information that is then combined with corresponding training manuals serve as the foundation for effective quality management of analyses. Extensive effort has been made to ensure that the routine procedures described herein will produce accurate and valid analytical results. However, not all possible analyses that may be encountered in casework can be appropriately covered in a procedures manual, nor can all possible variations to a described procedure be included. Therefore, this manual is written with the understanding that minor variations that do not significantly alter the described procedure may be used. An analyst may use a non-routine procedure not specifically stated in this manual, provided all the following conditions are met:

1. The procedure used is based upon documented and scientifically accepted practice.

2. A notation is made on the worksheet indicating the procedure followed is not specified in the procedures manual.

3. The analyst also indicates on the work sheet why the particular procedure was selected over a procedure contained in this manual. Rationale must be detailed sufficiently to withstand close scrutiny by independent examiners.

4. The analyst provides documentation showing that the non-routine procedure had been tested prior to application with evidence. Test criteria shall include test samples that approximate the characteristics of the evidence, the results obtained with the routine procedure, and the results obtained with the non-routine procedure. Documentation will also include related data concerning the non-routine procedure's sensitivity, precision and possible sources of error.

5. The non-routine procedure used will be recorded to a standard such that another scientist of similar skills and experience can understand fully the procedure used and the results obtained.

Additionally, there may be procedures which pertain to all sections. Such is the case with laboratory reagents. In order to standardize the testing and monitor the shelf life of reagents used by analytical sections, the Forensic Sciences Command has developed protocols which are universal for all sections. These protocols regarding reagent expiration and testing are found in the Command Quality Manual.

INTRODUCTION

In theory, any contact between the source of an impression and a surface results in a transfer of material between the two objects. Successful detection of that transfer to reveal a suitable impression requires that the surface is receptive for a deposit or receptive to accepting an impression. General procedures for impression evidence examination are usually divided into two categories, those for porous and those for non-porous surfaces. Each contains an enormous variety of materials with individual properties that may enhance or diminish the effectiveness of a particular technique.

The purpose of this manual is to provide the footwear/tire track examiner with a basic set of useful procedures for the examination of footwear/tire track evidence.

It is arranged according to protocols for various types of substrate materials and residues encountered in footwear/tire track impression processing. This Procedures Manual cannot list every substrate an examiner will encounter in casework and all procedures are subject to revision as new techniques or research reveals improvements.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - POROUS

METHOD: CHEMICAL PROCESSING OF POROUS ITEMS

PROCEDURE: PHYSICAL DEVELOPER

Reviewed by:

_____

Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Physical developer is a product of British Home Office research and was devised specifically for the examination of wetted or water soaked porous items. This technique utilizes silver nitrate in an unstable ferrous/ferric redox solution in combination with a detergent solution. Physical developer deposits freed silver from the solution on any non-water soluble waxy, oily, or fatty material that may be present in the footwear impression. Physical developer is not affected by prior treatment with and can be used sequentially with iodine fuming. Physical developer is usually used after iodine fuming has been employed.

Physical developer requires special care and exact adherence to procedures. Some glassware and utensils must be dedicated to the technique and reagent contamination must be avoided. Several chemicals must be purchased from sole source vendors due to required purity. In spite of these obstacles, the results often obtained from physical developer can be productive.

OTHER RELATED PROCEDURES:

Iodine Fuming

SAFETY CONSIDERATIONS

Chlorine Bleach, Household
Citric Acid
Ferric Nitrate
Ferrous Ammonium Sulfate
Maleic Acid
n-Dodecylamine Acetate*
Photofix i.e., Polymax Fixer
Silver Nitrate
Synperonic N*

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Chlorine Bleach, Household	2	0	1	
Citric Acid	2	1	0	
Ferric Nitrate	2	0	3	oxy
Ferrous Ammonium Sulfate	1	0	0	
Maleic Acid	2	0	0	
n-Dodecylamine Acetate	3	1	2	
Photofix-Polymax Fixer	1	0	0	
Silver Nitrate	1	0	0	
Synperonic N*	1	0	0	

Warning! Toxic! n-Dodecylamine Acetate is possibly toxic via oral, inhalation or absorption. Consider a severe hazard.

Warning! Citric Acid causes severe eye irritation, causes irritation to the skin, respiratory tract, and gastrointestinal tract.

PREPARATIONS

Stock Detergent Solution:

1. Pour one liter of distilled water into a 1500 milliliter beaker containing a large magnetic stir bar previously rinsed with distilled water.
2. Add 2.7 grams 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 grams of Synperonic N. Place the weigh boat in the solution as the Synperonic N will adhere to the weigh boat.
4. Stir for thirty minutes.
5. Remove the weigh boats.
6. Pour the solution into a one liter glass bottle, transferring any material not yet dissolved. This solution must not be used for at least 24 hours. At this time there should be no visible solids.

Note: One liter of the stock detergent solution is sufficient to make 25 liters of Physical Developer working solution.

Maleic Acid Prewash:

1. Pour one liter of distilled water in a 1500 milliliter beaker.
2. Add 25 grams of Maleic Acid and a large magnetic stir bar rinsed with distilled water.
3. Stir with magnetic stirrer until all solids are dissolved.

Silver Nitrate Solution:

1. Pour 50 milliliters of distilled water into a 100 milliliter beaker.
2. Add 10 grams of silver nitrate and stir for one minute. If using a magnetic stir bar, you must rinse with distilled water. The chlorine in tap water would combine with the silver nitrate and form a milky colored solution (silver chloride), rendering the solution unusable. Never use tap water for any of the working solutions.

Buffered Ferrous/Ferric Redox Solutions**:**

1. Pour 900 milliliters of distilled water in a 1500 milliliter beaker.
2. Rinse a large magnetic stir bar with distilled water and place in the beaker and stir.
3. Add the following chemicals in the order given making sure the chemicals are dissolved before adding the next chemical:
   30 grams of Ferric Nitrate
   80 grams of Ferrous Ammonium Sulfate
   20 grams of Citric Acid
4. Stir until all chemicals are dissolved and then stir an additional five minutes.

Combining the Component Solutions for Physical Developer:

1. To the Redox Solution add 40 milliliters 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.

Note: Steps one and two must be performed in this order, otherwise the silver will fall out of the suspension.

The Physical Developer is now ready for use. This prepares approximately one liter and should be sufficient to process approximately 15 to 20 pieces of paper. The combined working solution is unstable and cannot be stored. The solution is to be prepared on an as needed basis.

Photofix Rinses:

Rinse 1:

1. Four or five drops of fixer per liter of tap water in a glass or plastic tray.

Rinse 2:

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

Bleach Solution:

1. The bleach solution is made by diluting household bleach at a ratio of 1:1 with tap water.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the Physical Developer Procedure consist of placing test impressions on porous items to make test strips. The test strips are then immersed in the working solution. If the test impressions are visualized, the working solution can be used to process evidence. This testing procedure must be done for each working solution at the time the solution is made. Since the depletion of the working solution is unpredictable, test impressions should be used frequently to ensure the working solution is working properly. Documentation of this process must be done in the form of a reagent log for each working solution.

Weak impressions resulting from insufficient reactive material (due to exhaustion of chemicals in solution) may benefit from additional processing with the physical developer solution. The item to be re-treated should not be subjected to fixing with photographic fixer and/or bleaching as these treatments will affect the success of the retreatment. Frequent use of test impressions is recommended to ensure proper reagent reactivity.

PROCEDURE OR ANALYSIS

The procedure for Physical Developer involves three stages: a prewash, reagent development and rinse. An acid prewash is used to neutralize calcium carbonate from paper items prior to treatment with Physical Developer. The rinse stage essentially removes contaminants and stabilizes the reactions.

All equipment associated with the prewash and reagent must be dedicated. Trays must be of glass and must be scrupulously cleaned. Beakers for mixing solutions should be labeled according to the type of solution and should not be used for any other purpose. Plastic or bamboo tongs without serrated edges should be employed for item handling. 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 cannot be used. After the prewash, any contact of glove to surface must be avoided.

Step 1 - Maleic Acid Prewash:

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

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 prewash.
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. Therefore the examiner should monitor the development very closely to avoid over processing and obliteration of weaker impressions. Remove the item when optimum contrast is observed.

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.

Photofix Rinse:

1. After sufficient development in the physical developer solution, the item is placed in the first photofix rinse for 30 seconds.
2. Transfer the item into the second photofix rinse (standard photofix solution) for three minutes.
3. Wash the items in running water for three to five minutes.

Step 4 - Drying:

1. Allow the items to dry while lying flat. The items can be blotted carefully to speed the drying process if the item is not fragile.
2. Impressions developed with physical developer are relatively stable. However, in most instances all developed impressions should be photographed.

Step 5 - Bleach Solution:
(Optional: to be used only when trying to improve the contrast of darker impressions by making the background lighter).

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.
3. Photograph any improved impressions.

INTERPRETATION OF RESULTS:

Processing of the porous items with physical developer is similar to photographic development. Evidence impressions appear as dark gray in color. 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 reactive material present in the item or exhaustion of the chemicals necessary to cause the reaction. Frequent use of test impressions is essential to ensure proper reagent reactivity. Weaker impressions may benefit from additional processing with the physical developer solution. The item to be re-treated should not be subjected to fixing with photographic fixer and/or bleaching as these treatments will affect the success of the retreatment.

Articles which appear too fragile for the maleic acid prewash, such as charred papers or extremely water soaked items, may be introduced directly into the physical developer working solution. Such evidence should be treated one item at a time and the solution must be checked carefully for the effects of contamination. The use of plastic canvas as described by Clarence Phillips, et al may help when the items are too fragile to manipulate by other means. Usually contamination will precipitate the silver from the working solution in the form of dark reddish brown particles. Contaminated solutions must be discarded and the evidence cannot be processed using contaminated solutions.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000 pp 147-152.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - POROUS

METHOD: CHEMICAL PROCESSING OF POROUS ITEMS

PROCEDURE: ZINC CHLORIDE

Reviewed by:

_____

Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

While numerous metal salt sodium solutions will cause a color change of ninhydrin-developed impressions, zinc chloride is selected when the possibility of increased contrast is essential and laser examination would benefit the analysis. The reaction between ninhydrin and zinc chloride causes the color change. The resulting fluorescence is weak but observable when illuminated with excitation light in the range of 450 to 530 nanometers, peaking at 488 nanometers. The effectiveness of light absorption and emission depends upon a series of factors that include light intensity, humidity and temperature.

OTHER RELATED PROCEDURES:

Ninhydrin
Physical Developer

SAFETY CONSIDERATIONS

Ethanol
Glacial Acetic Acid
Isopropanol
Methanol
Zinc Chloride

see Appendix IV: General Instrumentation
Forensic Light Sources

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Ethanol	0	3	0	
Glacial Acetic Acid	3	2	0	
Isopropanol	1	3	0	
Methanol	1	3	0	
Zinc Chloride	3	0	1	
Vertrel XF	1	0	1	
Petroleum Ether	2	4	0	
HFE 7100	1	0	0	

Warning! Flammable! Ethanol, Isopropanol, Methanol and Petroleum Ether vapors can ignite readily at room temperatures. Consider a severe hazard.

PREPARATIONS

A 2% zinc chloride solution is generally adequate to produce the desired color change and introduce sufficient zinc for forensic light source excitation. The choice of solvent is determined by the substrate being processed. Substrates that have a potential for ink run or destruction by either ethanol or methanol should be processed with a zinc chloride solution with HFE 7100.

Ethanol or Methanol:

1. Completely dissolve 2 grams of zinc chloride in 100 milliliters of the selected solvent.

HFE 7100 or Vertrel XF

1. Mix 5 milliliters of isopropanol with 25 milliliters of ethanol.
2. Add 5 milliliters of glacial acetic acid and mix.
3. Add 2.3 grams of zinc chloride to the solution and continue stirring until all crystals are dissolved.
4. Add 100 milliliters of HFE 7100 or Vertrel XF.

INSTRUMENTATION

Environmental chambers will be used to control the heat and relative humidity that the item of evidence is submitted to after processing. The chambers are to be checked periodically with a hygrometer and thermometer to ensure that the chamber is maintaining the proper level of relative humidity and temperature.

A forensic light source using excitation light of the proper wavelength can be used to illuminate the evidence and produce the desired fluorescence.

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

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the zinc chloride procedure consist of spraying ninhydrin developed test impressions with the zinc chloride solution. Once properly exposed to the zinc chloride solution, the reaction is noted by a color change from purple ninhydrin developed impressions to a red or orange color. The test strips are then subjected to the proper level of heat/humidity. If the test impressions are visualized by the proper wavelength of light, the working solution can be used to process evidence. Documentation of this process must be done in the form of a reagent log or the examiner's notes for each working solution.

PROCEDURE OR ANALYSIS

All applications should be done in a fume hood.

1. Spray the ninhydrin treated surface with an extremely light spray of zinc chloride solution. Avoid a visible wetting of the surface as ninhydrin impressions may be diffused by the solvent.

2. After initial exposure to the zinc chloride solution, the ninhydrin impressions will change color from purple to red or orange. If the color change is not noted, successive light applications of the zinc chloride solution may be required. Once the color change is noted, no additional application is needed.

3. The item is then placed in an environmental chamber for a few minutes. The settings should not exceed 80 degrees centigrade and 80% relative humidity.

4. The item is then examined for fluorescence with a forensic light source set for the appropriate wavelength.

5. Any observed fluorescence should be photographed using the appropriate film and filters.

INTERPRETATION OF RESULTS:

Zinc chloride generally hastens the fading of ninhydrin on contact. Such fading will not normally affect fluorescence with laser or alternate light source illumination. However, luminescence is often faint and may present difficulty in the evaluation of the impression and in photographic preservation.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Menzel, E. Roland. Fingerprint Detection with Lasers, Second Edition, Marcel Dekker, NY, 1999, pp. 3, 180-182, 199.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - POROUS

METHOD: CHEMICAL PROCESSING OF POROUS ITEMS

PROCEDURE: SILVER NITRATE

Reviewed by:

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Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Silver Nitrate reacts with sodium and potassium chloride to form silver chloride, a compound more photosensitive than silver nitrate. This procedure is particularly destructive in both general chemical reaction and the amount of water immersion required. Silver nitrate does not yield consistently high success on porous items, is expensive, and prohibits effective forensic light source examinations and therefore should be avoided when processing routine paper or porous items. Yet with certain surfaces, such as raw or unfinished wood and wax-impregnated papers, it is one of the most effective procedures currently available.

OTHER RELATED PROCEDURES:

Iodine Fuming
Ninhydrin
Zinc Chloride
Physical Developer

SAFETY CONSIDERATIONS

Ethanol
Glacial Acetic Acid
Isopropanol
Methanol
Silver Nitrate

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Ethanol	0	3	0	
Glacial Acetic Acid	3	2	0	
Isopropanol	1	3	0	
Methanol	1	3	0	
Silver Nitrate	1	0	0	oxy

Warning! Flammable! Ethanol, Isopropanol and Methanol vapors can ignite readily at room temperatures. Consider a severe hazard.

PREPARATIONS

Concentrations of silver nitrate solutions vary from 1 to 10%. A 3% solution is acceptable for most processing, but higher concentrations may be necessary for wood items. Three separate preparations of silver nitrate are available depending on the substrate to be processed. Aqueous silver nitrate solutions are adequate for wood items. Alcohol based solutions are preferred for wax impregnated papers.

Silver nitrate solutions should be prepared in small amounts according to immediate need. Silver nitrate is a white-crystalline substance that must be stored in dark containers. Working solutions are light sensitive as well and should not be stored for future use.

Preparation for Raw Wood:

1. Mix 5.0 grams of silver nitrate in 100 milliliters of distilled water and stir until the crystals are completely dissolved.
2. Add 1 milliliter of glacial acetic acid and completely mix.

Preparation for Wax Impregnated Papers:

1. Mix 3.0 grams of silver nitrate in 10 milliliters of distilled water and stir until the crystals are completely dissolved.
2. Then add 90 milliliters of ethanol and 1 milliliter of glacial acetic acid and mix completely.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the silver nitrate procedure consist of placing test impressions on a paper test strip and exposing the item to the silver nitrate working solution using the appropriate application device. Test impressions can be made by placing oily (sebaceous) footwear impressions on a piece of paper and applying the silver nitrate solution. If the test impressions are visualized, the silver nitrate solution is working properly and can be used on evidence. Documentation of this process must be done in the form of a reagent log or in the examiner's notes for each working solution. Due to the instability of the working solution, especially when exposed to light, storage of working solutions is not recommended.

PROCEDURE OR ANALYSIS

All applications should be done in a fume hood.

1. The silver nitrate solution is applied to the item to be processed by immersing, brushing, swabbing or thoroughly spraying the item.
2. The item is then blotted dry to remove all excessive liquid. Development requires that the item is completely dry before the next step.
3. The item is then exposed to light from a photo flood or UV light source. Sunlight may be used but care must be exercised to control this exposure to avoid the silver halide from developing too quickly.
4. The developed impressions are then photographed taking care not to overexpose the item to light which will continue to darken the impressions and substrate.

INTERPRETATION OF RESULTS:

Silver chloride impressions will darken and when less than optimum intensity is reached, the item must be removed from the light source and photographed.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Cassidy, Michael J. Footwear Identification, Lightning Powder Co., Inc. in cooperation with the Royal Canadian Mounted Police, 1995, pp. 59-61.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - POROUS

METHOD: CHEMICAL PROCESSING OF POROUS ITEMS

PROCEDURE: NINHYDRIN

Reviewed by:

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Brian Mayland
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INTRODUCTION

Ninhydrin, or triketo-hydrindene 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 with older deposits with even minute amounts of amino acids. While ninhydrin can be used on any surface, normally processing is confined to porous items which have not subsequently become water-soaked or do not contain inherent animal proteins.

Petroleum ether had been recommended as the solvent for ninhydrin processing, but several concerns make petroleum ether a less than ideal alternative. The use of petroleum ether as a solvent for processing impression evidence has several disadvantages which include inflammability, fiber swell, and ink run. In addition, ninhydrin is of limited solubility in petroleum ether, and a small amount of glacial acetic acid must be added to the solution to facilitate solubility. The addition of acetic acid increases the polarity of the solution and the likelihood of ink run for some substrates.

A comprehensive experiment compared HFE-7100 and Vertrel XF with petroleum ether in relation to productivity, clarity/contrast of the developed detail and ink run. In all of these categories HFE-7100 and Vertrel XF were found to be equal or superior to petroleum ether.

OTHER RELATED PROCEDURES:

Physical Developer

Silver Nitrate
Zinc Chloride

SAFETY CONSIDERATIONS

Acetone
Ethanol
Ethyl Acetate
Glacial Acetic Acid
HFE-7100 (methoxy-nonafluorobutane)
Vertrel XF (HFC 4310mee/2,3-dihydrodecafluoropentane)
Methanol
Ninhydrin
Petroleum Ether

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Acetone	1	3	0	
Ethanol	0	3	0	

Ethyl Acetate	1	0	0	
Glacial Acetic Acid	2	2	1	
HFE 7100	1	0	0	
Methanol	1	3	0	
Ninhydrin	2	0	1	
Petroleum Ether	1	4	0	
Vertrel XF	1	0	1	

Danger! Extremely Flammable! Petroleum Ether. Can vaporize quickly. Readily forms flammable mixtures in air. Consider an extreme hazard!

Warning! Flammable! Acetone, Ethanol and Methanol vapors can ignite readily at room temperatures. Consider a severe hazard.

PREPARATIONS

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. Ethanol, methanol and acetone have high damage potential but are acceptable for non-document porous material. Health and safety risks with these solvents require proper handling.

Recommended Preparation - 0.5% concentration:

HFE-7100:

1. Dissolve 5.0 grams of ninhydrin in 45 milliliters of ethanol.
2. When crystals are completely dissolved, slowly add 2 milliliters of ethyl acetate.
3. Slowly add 5 milliliters of glacial acetic acid.
4. Add 1 liter of HFE-7100.
5. Allow to stand for five to ten minutes. Two separate layers will form. Discard the top layer. A large separatory funnel can be used to facilitate the separation of the two solutions.

Vertrel XF:

1. Dissolve 5.0 grams of ninhydrin in 15 milliliters of ethanol.
2. When crystals are completely dissolved, slowly add 5 milliliters of ethyl acetate.
3. Slowly add 5 milliliters of glacial acetic acid.

4. Add 1 liter of Vertrel XF.

5. Allow to stand for five to ten minutes. Two separate layers will form. Discard the top layer. A large separatory funnel can be used to facilitate the separation of the two solutions.

Petroleum Ether:

1. Dissolve 5.0 grams of ninhydrin in 20 milliliters of ethanol or methanol.

2. When crystals are completely dissolved slowly, add 10 milliliters of glacial acetic acid. (Optional - glacial acetic acid may cause inks to run.)

3. Add 1 liter of petroleum ether.

4. Allow to stand for five to ten minutes. Two separate layers will form, a large pale yellow layer on top and a smaller darker yellow layer on the bottom. The darker layer is discarded and the lighter yellow solution is the working solution to be used on evidence. A large separatory funnel can be used to facilitate the separation of the two solutions.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

Environmental chambers will be used to control the heat and relative humidity that the item of evidence is submitted to after processing. The chambers should be checked periodically with a hygrometer and thermometer to ensure that the chamber is maintaining the proper level of relative humidity and temperature.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the Ninhydrin Procedure consist of placing test impressions on porous items to make test strips. The test strips are then immersed in the working solution and subjected to the proper level of heat/humidity. If impressions are visualized, the working solution can be used to process evidence. Documentation of this process must be recorded in the examiner's work notes or in a reagent log.

Per QM-14 in the Quality Manual, the Ninhydrin working solution may be stored up to one year, at which time it will be discarded or re-authenticated. If it is re-authenticated, test prints will be run in the same manner as listed above. If impressions are visualized the working solution can be used to process evidence for up to one additional year. The examiner must indicate their initials, the new expiration date, and that the reagent has been re-authenticated on the working solution bottle. Any working solution that will be retained in the laboratory must be entered into the Laboratory Asset Management area of LIMS.

Ninhydrin coloration is not permanent and while some impressions have remained visible for years, others have faded in a matter of days. Photographic preservation (using appropriate techniques to promote contrast) is essential and should be accomplished as soon as possible.

PROCEDURE OR ANALYSIS

All applications should be done in a fume hood. Dipping - the preferred method of application:

1. In a tray large enough to accommodate the evidence, pour enough working solution to cover all of the items.

2. Completely immerse each item to be processed in the working solution until the item is completely saturated, usually five seconds or less. The item can be manipulated using tongs or forceps.

3. Remove and allow the item to dry completely.

4. Place the item in the heat/humidity chamber at no greater than 80 degrees Celsius and between 60% and 80% relative humidity.

5. Check the item periodically to monitor the impression development. Care should be taken not to saturate the item with water vapor.

6. Remove the item from the heat/humidity chamber and photograph any developed impressions.

   Alternate methods of application: Brushing and Spraying:

   Larger items which will not fit conveniently into processing trays should be painted with the ninhydrin solution using a soft bristle brush. Two inch to four inch nylon paint brushes are adequate. Care must be taken to apply an even and thorough amount to all surfaces.

   Spraying methods should be avoided except for very small items involving brief exposure. The health and safety risks from the use of aerosols are unwarranted when other methods are available. Use of spraying as an application technique is only appropriate in a fume hood and when using appropriate PPE.

INTERPRETATION OF RESULTS:

Ninhydrin coloration is not permanent, and while some impressions have remained visible for years, others have faded in a matter of days. Photographic preservation is essential and should be accomplished as soon as possible.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, p169-173.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: POWDERS AND PARTICULATES

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Fingerprint powders and particulate developers are very fine particles with an affinity for moisture throughout a wide range of viscosity. Grease, oil, and most contaminants that coat the surface of footwear or tires possess sufficient moisture and viscosity to attract and bind the fine particles together. Contact between footwear or tires and a non-porous surface will sometimes result in a transfer of the coating to that surface. The non-absorbency of the surface prevents penetration by the deposited moisture. All fingerprint powders and particulate developers are indiscriminate in adhesion to moisture. Surfaces coated with residue in addition to suspected evidence impressions will attract powders and particulate developers throughout the surface.

Powder or particulate application is the effort to produce or improve the appearance for preservation. The most effective agent in terms of adherence to moisture, non-adherence to dry surfaces, particle size, shape, uniformity, and intensity of color is carbon. Carbon is black, and as a result, black powders and particulate developers which contain carbon will consistently produce the best results. Other colored powders and particulate developers may be required due to the substrate encountered, but should be restricted to absolute necessity.

Magnetic powders are powder-coated, fine, iron filings subject to magnetic attraction. These adhere to moisture to a lesser degree than carbon powders, but can be applied with less destructive force to the surface.

Particulate developers are substances which produce extremely fine particle residue upon burning. Materials with a high hydrocarbon content such as camphor, pine knots, or crumbled masking tape burn slowly and release soot in large quantities. Fine particulate carbon soot adheres extremely well to more viscous moisture while heat from the flame softens the residue. White or light-colored soot may be produced by burning magnesium ribbon.

Most commercial black fingerprint powders have a high carbon base. According to the manufacturer's particular formula and production methods, the carbon base may be from a variety of sources, including lamp black, bone, or wood charcoal. Ground carbon alone cannot match the adhesion ability of fine particle carbon soot, but commercial powders contain milled carbon of highly uniform size and shape along with additional ingredients to preserve the milled condition and retard air moisture absorption.

OTHER RELATED PROCEDURES:

Cyanoacrylate Ester

SAFETY CONSIDERATIONS

Commercially Prepared Powders
Camphor
Magnesium Ribbon

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

Traditionally, powders have been used with little regard for safety. Many commercial powders do pose a potential health risk and vary in their overall effectiveness. Some powders have been found to contain fluoranthene and pyrene, polynuclear aromatic hydrocarbons known to be carcinogens. Lead, manganese, nickel, aluminum, iron, and actinium have all been found in commercial preparations. The effects of these chemicals range from carcinogenic and/or affecting the central nervous system to being radioactive. Powders applied in a laboratory environment or in the field require appropriate safety precautions. Ventilation systems, filter masks, or respirators are essential. The examiner should contact the manufacturer for the MSDS or chemical make-up of the specific powder they are using and take the appropriate safety precautions when using that powder.

PREPARATIONS

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

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the Powders and Particulates consist of insuring that the powders or materials being used are in the proper condition. Powders should not be exposed 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 to work from. This will minimize the moisture content as well as reduce any contamination of the stock container with substances from the item being processed. Powders may also be kept in desiccators designed to reduce the moisture in the atmosphere in the enclosed desiccator unit.

PROCEDURE OR ANALYSIS

Standard Powders:

Powders may be applied by various means, but the preferred procedure for most items is the use of a brush. Fiberglass brushes are the easiest to use and maintain while permitting application over a wider area. Powders are more effective if applied in very small amounts. While some examiners prefer pouring a supply of powder into a secondary container or a piece of paper, direct contact between brush and powder container is acceptable. Only the ends of the brush bristles should be coated with the powder and the brush should be gently tapped several times to remove all but a minimum amount.

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 evidence impression 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. Except on highly polished surfaces, excessive brushing is rare with a fiberglass brush. However, at the first indication that the impression is being removed, all further brushing must cease.

Extraneous residue on the surface may cause a general painting effect which obscures some 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 the evidence impression and the background.

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 and is lighter and more delicate than the fiberglass brush. However, the particle size, larger than standard powder, has a tendency to paint some surfaces. Excessive powder can sometimes be removed by passing the magnetic wand without powder near the surface. Since the magnetic attraction holding the iron particles is relatively weak, the supply can be depleted quickly. Surface areas examined generally must be processed more slowly with magnetic powders and great care must be exercised to prevent actual contact between the end of the wand and the surface.

Particulate/Soot Powders:

Particulate developers such as camphor are ignited and the surface exposed to the rising soot. The surface must not be placed in the flame and must be moved to insure an even coating of particulate material. Excessive coatings need to be avoided. When the surface contains an adequate, even layer of soot, the surface is lightly brushed, preferably with a fiberglass brush dedicated for use with particulate developers, until the non-adhering soot is removed. This technique can only be applied to surfaces that will not be affected by the heat from the ignited camphor. Surfaces such as plastics are not to be processed using this technique due to the extreme heat produced and the potential for damage to be caused.

INTERPRETATION OF RESULTS:

Powder and particulate-developed evidence impressions must be properly preserved. Experiments have revealed that the developed evidence impressions have a weaker adhesion to the surface than undeveloped and, as a result, are more susceptible to damage from accidental contact. Two methods of preservation are normally afforded the powder or particulate-developed impression: photography and lifting.

Photographic preservation of the developed impressions on the item affords the best procedure in terms of minimal damage and complete documentation. Lifting is also an approved procedure but caution needs to be taken when lifting to insure that the lift will be successful. If the lift cannot be made with confidence that it will be successful, the developed impression should be photographed prior to lifting.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 126, 144.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: SMALL PARTICLE REAGENT

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Small particle reagent (SPR) was devised and refined by the British Home Office as an effective procedure for processing wet surfaces. Surfaces, both porous and non-porous, which are wet at the time of an evidence impression deposit or become wet after deposit, seldom retain sufficient water soluble material for conventional processing methods. Non-porous 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 or particulates.

Molybdenum disulfide is a lipid-sensitive reagent. Refinement in the surfactant solution has improved the uniformity of suspension. SPR is very effective in the secondary treatment of cyanoacrylater ester developed impressions by adhering to faint impressions generally better than powders and particulates. Molybdenum disulfide is produced in various particle sizes. Smaller particle sizes are more effective.

OTHER RELATED PROCEDURES:

Cyanoacrylate Ester Fuming Powders and Particulates

SAFETY CONSIDERATIONS

Molybdenum Disulfide
Tergitol 7 (liquid form) or Niaproof (Sodium 7-ethyl-2-methyl-4-undecyl sulfate)

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Molybdenum Disulfide	2	0	0	
Tergitol 7	2	1	0	
Niaproof	NLF	NLF	NLF	

*NLF = No Listing Found

PREPARATIONS

Surfactant Stock Solution:

1. Dissolve 8 milliliters of Tergitol 7 or Niaproof (if Tergitol 7 is no longer available) in 500 milliliters of distilled water. This will make approximately 10 liters of working solution.

SPR Suspension - Working Solution:

1. Add 10 grams of molybdenum disulfide to 50 milliliters of the surfactant stock solution. Add the molybdenum disulfide slowly and stir continuously.

2. The mixture should be a creamy consistency free of any dry powder.

3. While stirring continuously add the mixture to 900 milliliters of distilled water.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

Powders, such as molybdenum disulfide, work by adhering to evidence impression residue. Due to their inherent ability to adhere and discolor these materials, there is no need for test impressions to be done prior to evidence application.

PROCEDURE OR ANALYSIS

Immersion Technique:

1. Shake the working solution well and place in a shallow tray such as a photographic tray. Pour enough of the working solution in the tray to cover the item to be processed.

2. Stir the solution again and before each item is placed into the solution.

3. Place the item to be processed 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 30 seconds.

5. The item is then turned over again. Allow the solution to settle for 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.

9. All suitable impressions are to be photographed and can subsequently be lifted.

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. For outdoor application of very large items, a garden sprayer can be used. Generally, a light to moderate flow of rinse water will not dislodge the molybdenum disulfide particles.

INTERPRETATION OF RESULTS:

SPR lifts easily from dried, processed, nonporous surfaces. All developed impressions are to be photographed prior to lifting. Faint impressions may benefit from a reprocessing of the item. The intense black color generally facilitates photographic preservation.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Lee, Henry C. and Gaensslen, R. E., eds, Advances in Fingerprint Technology, Second Edition, CRC Press, 2001, pp. 31, 113-115.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: CYANOACRYLATE ESTER FUMING

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Cyanoacrylate esters are the active ingredients in super bond adhesives and are generally available according to the type of alcohols used in manufacturing. Most cyanoacrylates are methyl or ethyl esters. Regardless of type, the esters volatilize into long chain molecules with a positive electrical charge. In an atmosphere of relatively high humidity, the cyanoacrylate ester molecules are attracted to evidence impression residue and polymerize upon the deposit.

Properties of the polymer are dependent upon the type of cyanoacrylate ester used. Both ethyl and methyl esters produce a visible white coating. Ethyl ester polymers are softer and less durable while methyl ester polymers can usually only be removed with solvents. However, the durable, hard property of the methyl ester appears to inhibit dye applications, especially with Rhodamine 6G.

Locktite products contain a cyanoacrylate ethyl ester and have proved to be quite effective for fuming. Locktite 495 Super Bonder provides a liquid useful for heat acceleration techniques while Hard Evidence is a gel which reacts to exposure to air. Any product containing ethyl ester generally will be more effective when subsequent dye applications are indicated. Cyanoacrylate ester fuming is highly effective with nonporous items.

OTHER RELATED PROCEDURES:

Powders and Particulates
Small Particle Reagent
Rhodamine 6G
Ardrox

SAFETY CONSIDERATIONS

Cyanoacrylate Ester

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

Rapid volatilization presents very serious health risks. High heat volatilization can produce hydrogen cyanide which is toxic even in small concentrations. Lower temperatures appear relatively safe and only increase development time by a matter of minutes. Chemically produced vapors are highly irritating and repeated contact with moist eyes can result in polymerization on the eye itself. Contact lens wearers are especially cautioned to avoid prolonged exposure to the fumes.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Cyanoacrylate Ester (superglue)	2	0	0	

PREPARATIONS

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

INSTRUMENTATION

Cyanoacrylate Fuming Chambers

See Appendix IV - General Instruments.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for cyanoacrylate ester fuming procedure require the use of test impressions. Aluminum foil, black lift cards, and microscope slides are convenient substrates when deliberately deposited with a test impression composed of sweat and/or sebaceous oil and placed near the evidence. Processing should be terminated when test impressions have reached optimum development; however, all items should be watched carefully as faster or slower development may occur. Exposure of surfaces to a high concentration of fumes can result in overdevelopment which obscures impressions due to total surface polymerization. Test impressions must be done with each batch of items processed. Documentation of the test impressions must be done in the form of a log or in the examiner's work notes.

PROCEDURE OR ANALYSIS

Volatilization of cyanoacrylate ester at normal room temperature is relatively slow but is a viable procedure for evidence processing. Vapors must be contained and a tank or plastic enclosure is most often used. 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 usually will improve the fuming results. Development time will vary with the temperature, humidity, and the substrate being processed. Development of fuming cabinets which control the heat and humidity of the chamber have shown good results and can be used to more precisely control the fuming process.

Application of heat greatly accelerates volatilization. Metal blocks or a hot plate can serve as the heat source but caution must be used not to overheat to the point where cyanide vapors can be produced. An aluminum dish or shaped foil is placed on the hot surface and the adhesive poured onto the aluminum. A cup of warm water is placed in the enclosure. Volatilization can be very rapid and development may be accomplished in as little as 10 minutes. Care must be taken to closely observe the process to insure that the item is not overdeveloped.

An alternative, which offers rapid development time with minimum health risk, is to use a light bulb as the heat source. A standard light receptacle is added to the processing tank with a wire loop support fashioned to hold a watch glass approximately 1-inch above the light bulb. The adhesive is dropped onto the watch glass. A cup of warm water is placed in the enclosure. Once the container is covered tightly, the light is turned on. Rapid volatilization does not begin until the heat from the bulb penetrates the watch glass. Natural convection currents aid dispersal of the fumes and development is generally accomplished in about 15 minutes.

A convenient and effective method is the use of an exclusive product, Locktite Hard Evidence. Cyanoacrylate esters are mixed in a gel with chemicals that produce fairly rapid but controlled volatilization upon exposure to air. The product is available in pouches which are easily peeled open to commence the volatilization, but which can be resealed to stop the reaction. Each pouch will produce fumes for ten to fifteen hours dependent upon ambient temperature; however, volatilization slows with exposure so that more time must be allowed for pouches approaching exhaustion. Hard Evidence does have a shorter shelf life than liquid cyanoacrylate ester compounds. Pouches anticipated to be stored for longer than six months should be refrigerated, but not frozen, and allowed to reach room temperature before use. However, previously opened pouches should not be refrigerated. Opened pouches which may not be used again for some time should additionally be sealed with tape to prevent gradual release of fumes.

INTERPRETATION OF RESULTS:

Photographic preservation of all suitable polymerized impressions is recommended prior to any additional processing. 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. Fluorescent dye and/or Ardrox P133D application is generally effective after powder or particulate application as the liquid dye solution will normally wash away the particulate remnants. However; vinyl, rubber, and hard plastics may not be receptive to any powder or particulate method.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: GELATIN LIFTING

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Gelatin lifters permit the lifting of some evidence impressions when the electrostatic lifter is unavailable or is unsuccessful. Gelatin lifters are relatively thick and come in clear, black, or white gelatin on cloth, plastic, or canvas backing with a clear plastic cover sheet. Gelatin lifters can be used on porous and non-porous surfaces for lifting original impressions or those that have been dusted with powder. If the electrostatic lifter is available, it should be used prior to the gelatin lifter.

OTHER RELATED PROCEDURES:

Electrostatic Dust Lifter

Powders and Particulates

SAFETY CONSIDERATIONS

No specific safety considerations known.

PREPARATIONS

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

INSTRUMENTATION

Fingerprint Roller

MINIMUM STANDARDS AND CONTROLS

Caution should be exercised to make sure the evidence impression is not consumed or obscured by the gelatin lifter. The examiner may test the gelatin lift on a small portion of the evidence impression or on a similar, less suitable associated fragment or impression. Suitable lifted impressions which are to be used for comparison are to be photographed.

PROCEDURE OR ANALYSIS

The clear plastic cover sheet is removed exposing the gelatin lifting surface. The gelatin lifter is placed over the evidence impression with the gelatin side facing the impression. The gelatin lifter can be applied either with a fingerprint roller from one end of the impression to the other or by bending the lifter in the center having it touch the center of the impression and letting the sides settle across the impression. In both instances, try to avoid air pockets or excessive pressure with the fingerprint roller. Leave the gelatin lifter in place on the impression for approximately one minute. Remove the gelatin lifter from the evidence impression, photograph any suitable impressions in accordance with Minimum Standards and Controls of this procedure, and cover with the clear plastic cover sheet.

INTERPRETATION OF RESULTS

Any evidence impressions lifted with the clear or white gelatin lifters will most likely be readily visible. Some evidence impressions lifted with black gelatin lifters may only be visible in darkened rooms with oblique lighting. It has also been found to benefit viewing the lifted impressions with bright lights positioned above the lifter surface. It is important to remember that the gelatin lift has been turned over to be photographed and as such is a reverse image of the original impression.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000., pp. 16, 116-119, 121-122, 144, 296.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: ARDROX

Reviewed by:

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Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Ardrox P133D was developed to detect small fractures in construction materials and possesses certain properties that can be successfully utilized on footwear/tire impressions. Ardrox P133D readily penetrates and remains in minute openings, yet is easily rinsed from surrounding surfaces, and is highly luminescent with long wave ultra violet light excitation.

Ardrox P133D staining was developed as a means of enhancing cyanoacrylate ester polymerized impressions. The properties of Ardrox are highly complementary to the cyanoacrylate ester process and may yield results that equal or surpass those of the Rhodamine 6G procedure. However, instances have occurred when Rhodamine 6G revealed impressions that were not stained by Ardrox P133D with UV excitation. This lack of consistency currently delegates Ardrox P133D as an additional processing technique, not as a replacement for dye and laser examination.

Ardrox P133D is also luminescent when the excitation light of appropriate wavelength from a forensic light source is used. The effectiveness of Ardrox P133D and UV excitation may justify the omission of dye and laser examination on a case by case basis when the laser is unavailable. However, since the two procedures are compatible, use of Ardrox staining as an additional technique to be utilized in conjunction with the laser dyes, whenever possible, is recommended.

OTHER RELATED PROCEDURES:

Cyanoacrylate Ester Fuming

Rhodamine 6G

SAFETY CONSIDERATIONS

Ardrox
Isopropanol
Methanol
Methyl Ethyl Ketone

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Ardrox	2	1	0	
Isopropanol	1	3	0	
Methanol	1	3	0	
Methyl Ethyl Ketone	1	3	0	

Warning! Flammable! Isopropanol, Methyl Ethyl Ketone and Methanol vapors can ignite at room temperatures. Considered a severe hazard.

PREPARATIONS

The examiner can choose from three preparations of Ardrox solutions. The preparation chosen is primarily dependent on the reaction of the substrate to the solvent used for dilution of the Ardrox. A 1% or 2% Ardrox in methanol or isopropanol is productive for most surfaces, with 1% Ardrox in methanol being the preferred preparation for most applications.

Substrates that react with the methanol preparation can be treated with Methyl Ethyl Ketone (MEK) preparation. Undiluted Ardrox can also be used to process items when the substrate reacts with the solvents.

Methanol/Isopropanol:

1. Mix 5.0 milliliters of Ardrox with 500 milliliters of methanol or isopropanol.

MEK

1. Mix 1.0 milliliters of Ardrox in 9.0 milliliters of isopropanol.
2. Add 15.0 milliliters of methyl ethyl ketone.
3. Add 75.0 milliliters of distilled water and mix.

Undiluted Ardrox

1. No preparation is required.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

High Intensity Ultra Violet Light Source
Forensic Light Source
Laser

Items treated with the Ardrox solution can be examined with any long wave UV light source, or with the blue light of a laser of forensic light source. In most cases, UV illumination is preferable to laser or xenon arc excitation, particularly to facilitate photography. Low wattage black light bulbs are available that fit standard fluorescent light desk lamps and provide adequate illumination for Ardrox luminescence. These bulbs also create a large area of light with even output. High intensity UV sources, such as 100 watt mercury vapor lights, offer a higher degree of illumination that can be directed and may provide the best source of illumination for increased luminescence.

Proper safety precautions including avoiding skin exposure and proper eye protection with appropriate optical densities should be utilized when operating ultraviolet light sources, lasers or forensic light sources. Consult the appropriate users manuals for the safe use and appropriate eye protection for the specific piece of equipment being utilized.

MINIMUM STANDARDS AND CONTROLS

Dye stains, such as Ardrox, work by discoloring evidence impressions developed with cyanoacrylate ester. The control is the observation of fluorescence.

Per QM-14 in the Quality Manual, the Ardrox working solution may be stored up to one year, at which time it will be discarded or re-authenticated. Re-authentication can be accomplished by viewing a treated test print with the appropriate light source and noting its fluorescence. If the desired fluorescent properties are observed, the working solution can be used to process evidence for up to one additional year. The examiner must indicate their initials, the new expiration date, and that the reagent has been re-authenticated on the working solution bottle.

Although Ardrox P133D and Rhodamine 6G may be used in any order, Ardrox staining is removed by methanol while Rhodamine 6G will not be removed by a water rinse. Since excessive background staining with Rhodamine 6G generally cannot be removed, the use of Ardrox staining before Rhodamine 6G may be beneficial.

Photography is the appropriate method of preservation for any impression developed using Ardrox.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

Undiluted Ardrox application:

1. Completely cover the item to be processed with undiluted Ardrox by immersion or by squirt bottle.

2. Allow the solution to remain on the item for several seconds.

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.

5. Photograph any impressions observed.

Ardrox, Methanol and Isopropanol formulas-application:

1. Apply the solution to the item to be processed by immersion or squirt bottle.

2. Allow the solution to remain on the item for several seconds 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 with the examination and photograph all developed impressions.

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.

6. Photograph any impressions observed.

INTERPRETATION OF RESULTS:

As with forensic light source dye visualized impressions, Ardrox P133D developed impressions usually appear as light impressions on dark backgrounds that must be preserved photographically. Visualized impressions can be photographed. A Wratten #47 filter may be used to facilitate the proper focus of the image when using UV illumination and a Wratten #2E filter will block reflected UV light that may cause unwanted flare or hot spots.

Although Ardrox P133D and Rhodamine 6G may be used in any order, Ardrox staining is removed by methanol while Rhodamine 6G will not be removed by a water rinse. Since excessive background staining with Rhodamine 6G generally cannot be removed, the use of Ardrox staining before Rhodamine 6G may be beneficial.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. McCarthy, Mary M. “Evaluation of Ardrox as a Luminescent Stain for Cyanoacrylate Processed Latent Impressions;” Journal of Forensic Identification, 1990, 40, 2, 75-80.

2. Lee, Henry C. and Gaensslen, R. E., eds, Advances in Fingerprint Technology, Second Edition, CRC Press, 2001, pp. 121-124.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION - NON-POROUS

METHOD: CHEMICAL PROCESSING NON-POROUS

PROCEDURE: RHODAMINE 6G

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

_____

Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Rhodamine 6G, like ardrox and zinc chloride, is a supplemental processing procedure designed to enhance faint or indistinct evidence impressions developed by another technique. Rhodamine 6G is used after cyanoacrylate ester fuming. Rhodamine 6G has an affinity for adhesion to polymerized impressions even at levels below visual observation. Excitation of Rhodamine 6G with the 488 nm, 510 nm or 514.5 nm lines of the laser produces extremely bright fluorescence at about 550 nm.

OTHER RELATED PROCEDURES:

Cyanoacrylate Ester Fuming Ardrox

SAFETY CONSIDERATIONS

Rhodamine 6G Methanol
Isopropanol Synperonic N

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Rhodamine 6G	1	1	1	
Isopropanol	1	3	0	
Methanol	1	3	0	
Synperonic N	1	0	0	

Warning! Flammable! Isopropanol and Methanol vapors can readily ignite at room temperatures. Considered an extreme hazard.

Rhodamine 6G is classified as "an animal positive experimental carcinogen." Nancy Masters indicated in her review of Rhodamine 6G in latent print usage that this chemical has not been indicated as a human carcinogen and is in fact used in cosmetics, soaps and perfumes. This chemical is toxic however and should be handled using appropriate laboratory safety equipment. Since this chemical is soluble in water absorption can occur through ingestion or inhalation. Inhalation levels have not been established but are to be avoided in any amounts.

PREPARATIONS

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. A 0.01% to 0.001% Rhodamine 6G in methanol or isopropanol, weight to volume, is productive for most surfaces with methanol being the preferred solvent. Working solutions of Rhodamine 6G should be prepared in small amounts. Weaker solutions are recommended from the viewpoint of health risk and degree of background fluorescence. Aerosol spraying or fuming with Rhodamine 6G has been attempted with no consistent improvement in results, and due to increased health risk, are not recommended. Aqueous Rhodamine 6G solutions should be used when methanol or other organic solvents will be destructive to the surface being treated.

Methanol/Isopropanol formula:

1. Dissolve 0.1 grams of Rhodamine 6G in 1.0 liter of methanol or isopropanol.

Aqueous Formula:

1. Dissolve 0.1 grams of Rhodamine 6G in 1.0 liter of distilled water.

2. Add 3-6 drops of Synperonic N and gently stir

   *The Synperonic N is a surfactant which allows for a sheeting or more even covering of the item with the working solution.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

Forensic Light Source

Forensic light sources can be used to illuminate the evidence and produce the desired fluorescence.

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

MINIMUM STANDARDS AND CONTROLS

Dye stains, such as Rhodamine 6G, work by discoloring impressions developed with cyanoacrylate ester. The control is the observation of fluorescence.

Per QM-14 in the Quality Manual, the Rhodamine 6G working solution may be stored up to one year, at which time it will be discarded or re-authenticated. Re-authentication can be accomplished by viewing a treated test print with the appropriate light source and noting its fluorescence. If the desired fluorescent properties are observed, the working solution can be used to process evidence for up to one additional year. The examiner must indicate their initials, the new expiration dateand that the reagent has been re-authenticated on the working solution bottle.

If the impressions are faint, repeated applications of the Rhodamine 6G solution may be attempted. If repeated applications of the dye solution fail to improve the fluorescence, the Rhodamine 6G concentration may be increased.

Photography is the appropriate method of preservation for any impression developed using Rhodamine 6G.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

1. Apply the solution to the item to be processed by immersion or squirt bottle.

2. Rinse the item with methanol and allow to dry.

3. Examine the item with the forensic light source at the appropriate wavelength using the appropriate filters.

4. Photograph any impressions observed.

INTERPRETATION OF RESULTS:

If the impressions are faint, repeated applications of the Rhodamine 6G solution may be attempted. If repeated applications of the dye solution fail to improve the fluorescence, the Rhodamine 6G concentration may be increased. Photographic preservation incorporating orange filters as used in the evidence examination or a Wratten #21 filter prove quite successful with even faint fluorescence.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Menzel, E. Roland. Fingerprint Detection with Lasers; Second Edition, Marcel Dekker: New York 1999, pp. 162-164.

2. Bodziak, William J. Footwear Impression Evidence: Detection, Recovery and Examination. 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: NON-DESTRUCTIVE POROUS/NON-POROUS

PROCEDURE: INHERENT LUMINESCENCE

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

The use of forensic light sources in conjunction with various chemical techniques and dyes have proven very effective in visualizing evidence impressions. Substances found in evidence impression residue may luminesce when illuminated by the proper wavelength of light and viewed with the appropriate filters. Various contaminants may become part of evidence impression residue and may inherently luminesce as well. Additionally, certain materials such as Styrofoam and galvanized or zinc plated metal are observed to consistently produce impressions that will luminesce without the application of chemical processing or dyes. This inherent luminescence allows for examination of items that may be destroyed by other techniques.

OTHER RELATED PROCEDURES:

Rhodamine 6G

Zinc Chloride

SAFETY CONSIDERATIONS

Forensic Light Source

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

PREPARATIONS

No specific preparations required.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

Forensic Light Source

MINIMUM STANDARDS AND CONTROLS

Not applicable.

PROCEDURE OR ANALYSIS

The procedure for this technique consists of examining the item with forensic light sources using appropriate filtration. In most cases a Wratten #21 filter or the orange laser filters are appropriate for examination. Some success may be seen with the use of ultraviolet light sources and the various wavelengths produced by forensic light sources. The examiner must choose the appropriate filters and eye protection for these light sources and the wavelengths selected. All observed suitable impressions must be photographed using the appropriate filters.

INTERPRETATION OF RESULTS:

Items can be examined for inherent luminescence without destruction of the item. In addition many surfaces should be routinely examined using this technique as it has been shown to produce consistent results. The item being examined may luminesce and this background luminescence may improve the contrast of visible impressions. This non-destructive process is a relatively simple technique that has been proven to be very successful in producing positive results.

REPORT WORDING

See Appendix I - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: NON-DESTRUCTIVE POROUS/NON-POROUS

PROCEDURE: IODINE FUMING

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Iodine is a sensitive indicator of various waxes and oils which are sometimes present in evidence impression residue. Iodine is absorbed by the oily material which assumes the reddish-brown color. While absorption is quite rapid and can be most pronounced, no chemical change occurs to either substance. When exposure to the iodine ceases, the oily material releases the iodine molecules slowly. The color begins to fade and after several hours, the iodine may be completely dissipated. Return exposure will most often repeat the process while maintained exposure prevents dissipation. Generally, iodine dissipates with no trace of exposure or damage to the article. Iodine is a good procedure to use on evidence impressions of wet origin and, if used, should be done before physical developer, ninhydrin, or silver nitrate.

Iodine is effective with relatively fresh oily deposits, but for those older than two weeks, the reaction may not occur or be too faint for recognition. A chemical breakdown of the oily material appears to inhibit absorption. Iodine is normally not destructive and may detect deposits with insufficient amino acids for effective ninhydrin reaction. The application of 7,8-benzoflavone may be used to intensify weak iodine discolorations of impression residue.

Iodine is toxic and very corrosive to nearly all metals. It can be used to process nearly all types of surfaces, but is normally used with porous items.

OTHER RELATED PROCEDURES:

7,8-benzoflavone

SAFETY CONSIDERATIONS

Iodine

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Iodine	3	0	0	

PREPARATIONS

No specific preparation of the iodine crystals is required.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

Fuming Cabinets
Iodine Gun

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the iodine procedure consist of placing an oily impression on a paper test strip and exposing the item to the iodine fumes using the appropriate application device. If the test impressions are visualized, indicated by a reddish-brown discoloration in the area of the test impression, the crystals/application technique can be used to process evidence. This procedure must be done for each new application. Documentation of the test impressions must be done in either a reagent log book or in the examiner's notes.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

Iodine is most effectively utilized with vapors from sublimating crystals. Direct contact of iodine crystals to actual items should be avoided. Sublimation occurs at low temperature, but heat accelerates the action. Confined vapors provide for the best reaction and the least health risk.

1. Fuming Cabinet:

   Cabinets which permit adequate space for evidentiary items, fume containment, and gentle heat to accelerate sublimation are sometimes used. While there are commercially available cabinets, one can be easily constructed of wood and glass which may be more effective and less susceptible to the corrosive nature of iodine vapor. See Appendix IV - General Instrumentation.

2. Iodine Fuming Gun:

   Large or immobile items can also be processed with direct iodine vapor from a source most commonly called an iodine fuming gun. This device creates vapors within a tube which are directed toward the surface to be examined by forced air movement, either by a compressed air source or the use of a squeeze bulb. Because the residue is exposed to the vapors for a brief duration, any iodine absorbed is released immediately and demands prompt preservation. Iodine fuming guns are readily available from nearly all suppliers, but also may be simply assembled using Gooch or thistle tubes, rubber stoppers, and tubing. See Appendix IV - General Instrumentation.

3. Zip Lock Plastic Bag:

   A highly practical alternative to a fuming cabinet is a zip lock transparent plastic bag. A small amount of iodine crystals are poured into the bag, the item inserted and the bag sealed.

The crystals are held between the fingers or grabbed by the hand to provide additional heat to hasten sublimation. The bag may be periodically shaken to improve the distribution of iodine vapors, but close contact of crystals to the item should be minimized. Oily impressions will discolor in a matter of minutes.

INTERPRETATION OF RESULTS:

All iodine developed evidence impressions are transitory and once removed from exposure to the iodine fumes must be preserved as quickly as possible using appropriate photographic preservation techniques. Procedures to increase stability have been devised, but these require a chemical reaction which can inhibit subsequent processing procedures. Photography is the primary means of preservation when other processing will be attempted on the item of evidence. Chemical means of preservation are very limited in their benefit and application in routine evidence processing. These chemical techniques also require photographic preservation. The use of stabilizing agents, such as 7,8- benzoflavone, are primarily confined to instances where increased contrast with the substrate is required.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 159-160.

2. Cassidy, Michael J. *Footwear Identification*, Lightning Powder Co., Inc. in cooperation with the Royal Canadian Mounted Police, 1995, pp. 53-54.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: NON-DESTRUCTIVE POROUS/NON-POROUS

PROCEDURE: 7,8-BENZOFLAVONE

Reviewed by:

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Forensic Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Iodine fuming of oily material may produce faint or incomplete reactions due to the age of the evidence impression. Additional exposure to iodine may fail to intensify such reactions. 7,8-benzoflavone acts as a catalyst which bonds iodine to the detected oily matter and effects a color change from reddish brown to an intense blue-black. Often, added detail is revealed and previously visible impressions are more distinct. The addition of 7,8-benzoflavone negates the transitory characteristics of iodine-developed impressions and also allows for subsequent processing with ninhydrin, zinc chloride and/or physical developer.

OTHER RELATED PROCEDURES:

Iodine Fuming

SAFETY CONSIDERATIONS

7,8-Benzoflavone

Cyclohexane
Methylene Chloride

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
7,8-Benzoflavone	1	1	1	
Cyclohexane	1	3	0	
Methylene Chloride	3	1	1	2

Warning! Flammable! Cyclohexane Vapors can ignite at room temperatures and is considered a severe hazard.

PREPARATIONS

1. Mix 0.3 grams of 7,8-benzoflavone in 10 milliliters of methylene chloride and stir until the crystals are completely dissolved.

2. Add 90 milliliters of cyclohexane and thoroughly mix.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for 7,8-benzoflavone consist of placing an oily impression on a paper test strip and exposing the item to the iodine fumes using the appropriate application device. If the test impressions are visualized, indicated by a reddish-brown discoloration in the area of the test impression, the 7,8-benzoflavone is applied. The color change from reddish-brown to an intense blue-black indicates the 7,8-benzoflavone is working correctly and can be used on evidence. This testing procedure must be done for each working solution at the time the solution is made and can be verified with each use. Documentation of this process must be done in a reagent log book or in the examiner's notes

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

1. Articles which have displayed some reaction to iodine are re-exposed until maximum intensity is reached.

2. Then the area is lightly sprayed with the 7,8-benzoflavone solution.

3. An immediate color change will be noted. Drying time for most items is very rapid.

4. The developed suitable impressions are then photographed.

INTERPRETATION OF RESULTS:

The 7,8-benzoflavone bond with iodine to oily material is relatively stable, but all suitable evidence impressions must be photographed as soon as possible. The bond is destroyed by acetone and other organic solvents so that subsequent ninhydrin processing usually removes any 7,8-benzoflavone impressions.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence.* Elsevier Science Publishing Co., Inc., New York, NY, 1990 p.141-143.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: BLOOD PROTEIN ENHANCEMENT POROUS/NON-POROUS

PROCEDURE: NINHYDRIN

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Ninhydrin is a protein indicator which reacts with amino acids. Ninhydrin is also sensitive to the proteins present in blood. Ninhydrin can be used on any surface, but should primarily be used on porous items. Non-porous items are in most instances better processed by using one of the other blood protein enhancement techniques listed below. A positive reaction produces a violet to blue-violet coloring and is effective with even minute amounts of blood.

OTHER RELATED PROCEDURES:

Amido Black
Coomassie
Crowle's Staining Solution

SAFETY CONSIDERATIONS

See Chemical Processing of Porous Items - Ninhydrin - FW-IA-6.

PREPARATIONS

See Chemical Processing of Porous Items - Ninhydrin - FW-IA-6.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

See Chemical Processing of Porous Items - Ninhydrin - FW-IA-6.

PROCEDURE OR ANALYSIS

Depending on the method of application, appropriate caution should be exercised. Personal protective equipment should be considered to avoid exposure to dangerous chemicals. All applications will be done in a fume hood if possible. A small area away from the footwear impression should be tested to see if the substrate reacts.

INTERPRETATION OF RESULTS:

Ninhydrin coloration is not permanent, and while some impressions have remained visible for years, others have faded in a matter of days. Photographic preservation is essential and is to be accomplished as soon as possible.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence, Detection, Recovery and Examination.* Second Edition, CRC Press, 2000, p. 169.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: BLOOD PROTEIN ENHANCEMENT POROUS/NON-POROUS

PROCEDURE: AMIDO BLACK

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Amido Black or naphthalene black 10B is a protein indicator particularly sensitive to those proteins present in blood. While other techniques for the enhancement of blood impressions are available, they may pose serious health hazards or display a reaction for short durations. Amido Black is a safer, permanent procedure which can be used on porous or non-porous surfaces. Amido Black does prevent subsequent serological examination and therefore may only be used after serological examination of the evidence. However, Amido Black can be applied after cyanoacrylate fuming in many cases.

OTHER RELATED PROCEDURES:

Coomassie Staining Solution
Crowle's Staining Solution
Ninhydrin

SAFETY CONSIDERATIONS

Amido Black
Glacial Acetic Acid
Methanol

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Amido Black	2	1	0	
Glacial Acetic Acid	3	2	0	
Methanol	1	3	0	

Warning! Flammable! Methanol vapors can readily ignite at room temperatures and are considered an extreme hazard.

PREPARATIONS

Amido Black Working Solution

1. Dissolve 2.0 grams of Amido Black 10B in 100 milliliters of acetic acid.

2. Add 900 milliliters of methanol and thoroughly mix.

Rinse #1

1. Mix 100 milliliters of glacial acetic acid with 900 milliliters of methanol.

Rinse #2

1. Mix 50 milliliters of glacial acetic acid with 950milliliters of distilled water.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for Amido Black 10 B consists of testing a small area on the evidence, which is not critical to analysis, to insure that the substrate will not be adversely affected by the working solution. Additionally, any blood proteins in these areas will be stained a dark blue-black. Dye stains, such as Amido Black, work by discoloring evidence impressions that are composed of blood proteins. The control is the observation of the dark blue-black color.

Amido black is extremely stable; however, developed impressions should be photographically preserved. Dried impressions which lose contrast may be reimmersed in the second rinse solution and photographed.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

1. Blood proteins must be fixed prior to Amido Black application. This can be accomplished by:

    - Baking the item at 100°C for 30 minutes. Heat-sensitive items may be baked at a lower temperature for a longer time or another fixing technique attempted.

    - Fixing with methanol if the blood proteins are dried.

2. Amido Black 10B working solution is applied to the item by immersing the item in the working solution in a large tray, ensuring complete coverage of the area to be examined, or by using a squirt bottle.

    - The working solution should be agitated before evidence application as well as during the immersion process.

3. The item is then rinsed with the first rinse solution followed by the second rinse solution until optimum contrast has been observed.

4. The developed suitable impressions are then photographed.

INTERPRETATION OF RESULTS:

The blood impressions will be intensified and additional detail not previously visible may be revealed. Amido Black is extremely stable; however, developed suitable impressions are to be photographically preserved. Dried impressions which lose contrast may be reimmersed in the second rinse solution and photographed.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 165-168.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: BLOOD PROTEIN ENHANCEMENT POROUS/NON-POROUS

PROCEDURE: COOMASSIE STAINING SOLUTION

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Coomassie Brilliant Blue R250 is a protein stain which is sensitive to the proteins in blood. 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. No serological analysis can be conducted after the staining procedure; however, Coomassie Brilliant Blue R250 can be applied after cyanoacrylate fuming in many cases.

OTHER RELATED PROCEDURES:

Amido Black 10B

Crowle's Staining Solution

SAFETY CONSIDERATIONS

Coomassie Brilliant Blue R250

Glacial Acetic Acid

Methanol

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Brilliant Blue	1	1	0	
Glacial Acetic Acid	3	2	0	
Methanol	1	3	0	

Warning! Flammable! Methanol vapors can readily ignite at room temperatures and are considered an extreme hazard.

PREPARATIONS

Coomassie Working Solution:

1. Dissolve 0.44 grams of Coomassie Brilliant Blue R250 in 200 milliliters of methanol.

2. Add 200 milliliters of distilled water and 40 milliliters of glacial acetic acid.

Destaining Solution:

1. Mix 200 milliliters of methanol with 200 milliliters of distilled water.

2. Add 40 milliliters of glacial acetic acid.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the Coomassie Staining Solution consist of testing a small area on the evidence that is not critical to analysis to insure that the substrate will not be adversely affected by the working solution. Additionally any blood proteins in these areas will be stained a dark blue. Dye stains, such as Coomassie, work by discoloring impressions that are composed of blood proteins. The control is the observation of the dark blue color.

While stained impressions are relatively stable, photographic preservation of developed impressions is recommended. Dried impressions which lose contrast may be reimmersed in the destaining solution and photographed.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

Application by immersion:

1. The article is immersed in the staining solution and removed after 2 minutes of agitation:
    - The working solution should be agitated before evidence application as well as during the immersion process.

2. It is then transferred to a destaining 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 destaining can be performed until optimum intensity is reached.

4. All developed suitable impressions are to be photographically preserved.

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. Application of the staining solution is followed by applying the destaining solution.

3. All developed suitable impressions are to be photographically preserved.

INTERPRETATION OF RESULTS:

The blood impressions will be intensified and additional detail not previously visible may be revealed. While stained impressions are relatively stable, photographic preservation of developed impressions is recommended. Dried impressions which lose contrast may be reimmersed in the destaining solution and photographed.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Lee, Henry C. and Gaensslen, R. E., eds., Advances in Fingerprint Technology, Second Edition, CRC Press, 2001, pp. 144-145, 147.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: BLOOD PROTEIN ENHANCEMENT POROUS/NON-POROUS

PROCEDURE: CROWLE'S STAINING SOLUTION

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Crowle's Staining Solution is a protein indicator which reacts with the proteins in blood. It can be used for enhancement of blood prints on both porous and non-porous items. Crowle's solution is similar in reaction to Coomassie but contains no organic solvents. No serological analysis can be conducted after the staining process. However, Crowle's Staining Solution can be applied after cyanoacrylate fuming in many cases.

OTHER RELATED PROCEDURES:

Amido Black 10B

Coomassie Staining Solution

SAFETY CONSIDERATIONS

Coomassie Brilliant Blue R250

Crocein Scartlet 7B

Glacial Acetic Acid

Trichloroacetic Acid

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Coomassie Brilliant Blue R250	1	1	0	
Crocein Scarlet 7B	2	1	0	
Glacial Acetic Acid	3	2	0	
Trichloroacetic Acid	3	1	1	

PREPARATIONS

Crowle's Staining Solution:

1. Dissolve 2.5 grams of Crocein Scarlet 7B in 50 milliliters of Glacial Acetic Acid.
2. Add 1.5 grams of Coomassie Brilliant Blue R250 and thoroughly mix.
3. Add 30 milliliters of Trichloroacetic Acid.
4. Dilute with 1000 milliliters of distilled water.

Destaining Solution:

1. Mix 3 milliliters of Glacial Acetic Acid with 1000 milliliters of distilled water.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for Crowle's Staining Solution consist of testing a small area on the evidence that is not critical to analysis to insure that the substrate will not be adversely affected by the working solution. Additionally, any blood proteins in these areas will be stained a dark reddish color. Dye stains, such as Crowle's, work by discoloring impressions that are composed of blood proteins. The control is the observation of the color change.

While stained impressions are relatively stable, photographic preservation of developed impressions is recommended. Dried impressions which lose contrast may be reimmersed in the destaining solution and photographed.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

Application by immersion:

1. Items are processed, whenever possible, by total immersion in the staining solution in a large tray.
    - The working solution should be agitated before evidence application as well as during the immersion process.
2. Full development will take from 2 to 30 minutes; however, after 2 minutes the article may be removed and checked for impression development.
3. The item is then placed in the destaining solution and agitated.
4. Additional development may be accomplished by a return to the staining solution as often as required to obtain optimum development. Agitation during the staining and destaining procedures is necessary to insure even and thorough contact.
5. All developed suitable impressions must be photographically preserved.

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. Application of the staining solution is followed by applying the destaining solution until optimum contrast is achieved.

3. All developed suitable impressions are to be photographically preserved.

INTERPRETATION OF RESULTS:

The blood impressions will be intensified and additional detail not previously visible may be revealed. While stained impressions are relatively stable, photographic preservation of developed impressions is recommended. Dried impressions which lose contrast may be reimmersed in the destaining solution and photographed.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence*, Elsevier Science Publishing Co., Inc., New York, NY, 1990 p.152-153.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: FOOTWEAR/TIRE TRACK IMPRESSION VISUALIZATION SPECIALIZED PROCESSING TECHNIQUES

METHOD: BLOOD PROTEIN ENHANCEMENT POROUS/NON-POROUS

PROCEDURE: LEUCO CRYSTAL VIOLET

Reviewed by:

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Brian Mayland
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INTRODUCTION

Leuco Crystal Violet is a clear solution which produces a dark violet color when it comes into contact with even faint traces of blood. This violet colored dye occurs through the catalyzed oxidation by peroxide when Leuco Crystal Violet and hydrogen peroxide come into contact with hemoglobin or its derivatives. Since crystal violet has an affinity for proteinaceous substrates, it will bind to the protein that has been fixed by 5-sulfosalicylic acid. This fixing limits leaching or running of the impression. Leuco Crystal Violet is capable of enhancing visible impressions and can readily develop undetected blood impressions. Impressions treated with Leuco Crystal Violet will both fluoresce and luminesce under a variety of wavelengths in both the ultraviolet and infra-red spectra.

OTHER RELATED PROCEDURES:

Amido Black 10B

SAFETY CONSIDERATIONS

5-Sulfosalicylic Acid
Leuco Crystal Violet
Hydrogen Peroxide
Sodium Acetate

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
5-Sulfosalicylic Acid	2	1	0	
Hydrogen Peroxide	1	0	1	oxy
Leuco Crystal Violet	2	1	0	
Sodium Acetate	1	0	0	

5-Sulfosalicylic Acid may be harmful if inhaled, ingested, or by skin absorption. Causes eye and skin irritation. Irritating to mucous membranes and upper respiratory tract.

Hydrogen Peroxide may cause irritation or burns to skin and eyes on contact. May cause respiratory tract irritation or pulmonary edema if inhaled. May cause burns to gastrointestinal tract and severe gastrointestinal tract irritation if swallowed.

Leuco Crystal Violet may be harmful if inhaled, ingested, or by skin absorption. Causes eye and skin irritation. Irritating to mucous membranes and upper respiratory tract.

Sodium Acetate may be irritating to eyes, skin, and mucous membranes. Inhalation of dust may cause irritation with coughing and shortness of breath. Ingestion may cause abdominal pain and vomiting.

PREPARATIONS

1. Combine 10g of 5-sulfosalicylic acid with 500 mL 3% hydrogen peroxide (the 3% hydrogen peroxide sold in 473 mL bottles in pharmacies can be used as well as the bottle).

2. Dissolve 1.1g of Leuco Crystal Violet in 3 mL of the 5-sulfosalicylic acid/3% hydrogen peroxide solution. (Note: If the Leuco Crystal Violet crystals have turned yellow, they are too old and the resultant solution will not be effective. They are not to be used.)

3. Shake/stir for 3 minutes. Pour solution back into original 5-sulfosalicylic acid/3% hydrogen peroxide solution.

4. Dissolve 4.4g of sodium acetate in 30 mL of the 5-sulfosalicylic acid/3% hydrogen peroxide/Leuco Crystal Violet solution.

5. Shake/stir for 3 minutes. Pour solution back into the 5-sulfosalicylic acid/3% hydrogen peroxide/Leuco Crystal Violet solution.

6. Shake/stir thoroughly.

This solution will last approximately 3 months if refrigerated. The solution is to be stored in amber glassware. If a working solution is to be retained, it must be logged into the Laboratory Asset Management area in LIMS.

A manufactured working solution kit may also be used. The kits should be labeled with expiration dates before and after mixing according to the manufacturer's specifications as well as being logged into the Laboratory Asset Management area in LIMS.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for the Leuco Crystal Violet solution consist of testing a small area on the evidence, which is not critical to the analysis, to insure that the substrate will not be adversely affected by the working solution. Additionally, any traces of blood in these areas will produce a dark violet color. The control is the observation of the dark violet color.

The Leuco Crystal Violet solution may discolor some substrates over time; however, this does not occur immediately. Impressions developed with Leuco Crystal Violet should be photographed as soon as possible.

PROCEDURE OR ANALYSIS

All applications are to be done in a fume hood when possible.

Apply the Leuco Crystal Violet solution to the impression or questioned item by spraying with an aerosol or pump sprayer, by soaking the impression or questioned item in Leuco Crystal Violet, or by cascading the Leuco Crystal Violet over the item surface with a squeeze bottle. Rinse the area with water approximately two to three minutes after the reagent has been applied. If spraying large carpeted surfaces, rinsing may not be possible or practical and may be omitted. Any enhanced suitable impressions are to be photographed.

INTERPRETATION OF RESULTS:

A positive reaction to even faint traces of blood will result in a dark violet reaction. Impressions may appear after application of Leuco Crystal Violet which were not originally visible. Enhanced suitable impressions are to be photographed before any additional enhancement is attempted.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp 160-163.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: MISCELLANEOUS PROCEDURES

METHOD: CASTING

PROCEDURE: DENTAL STONE

Reviewed by:

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Forensic Scientist Aimee Stevens Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Dental stone casting allows the convenience of having a three-dimensional impression for comparison to shoes or tires. Although photography of the cast can be done to preserve what was visualized, it is not necessary in order to perform a comparison. Dental stone is a gypsum cement which has been modified for use in the dental industry. It has the useful qualities of being hard, durable, easy to clean without loss of detail, inexpensive, and it does not have a limited shelf life. The primary use of dental stone would be at a crime scene to collect evidence impressions. However, it may be necessary for the footwear examiner to make casts of test impressions for comparison to a submitted cast.

OTHER RELATED PROCEDURES:

Photography

Silicone Casting

SAFETY CONSIDERATIONS

Calcium Sulfate

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Calcium Sulfate	1	0	0	

Calcium Sulfate may be harmful if inhaled or ingested. May cause eye and skin irritation.

PREPARATIONS

Generally, two pounds of dental stone is sufficient to cast a full sized footwear impression. Obviously, a greater amount may be needed to cast a larger tire impression. For the sake of convenience, the dental stone powder can be stored in zip-lock bags in pre-measure two pound portions. The zip-lock bags can also be used to mix the dental stone by pouring the desired amount of water into the bag, closing the bag, and mixing by hand for three to five minutes. The amount of water to be added depends on the consistency ratio of the particular brand of dental stone being used. This information may be on the side of the original container or may be available from the supplier. The chart below (from "Footwear Impression Evidence Detection, Recovery, and Examination" by William J. Bodziak) can be used as a guide.

Consistency	Oz. Water per 2 lb bag
26	8
30	9.2
35	10.8
40	12.3
45	13.8
50	15.4
55	16.9
60	18.4

These amounts may result in a mixture which is too thick to pour easily. If so, an extra ½ ounce of water can be added to the mixture. Properly prepared dental stone should have the viscosity of pancake batter.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

The Standards and Controls for dental stone consist of insuring that the dry powder is stored in a manner to avoid contamination or accidental introduction of moisture. Due to its inherent property of drying through the evaporation of moisture, no test impressions need to be made to insure the dental stone will harden. One should practice using dental stone to become familiar with its use prior to applying the technique to potentially valuable evidence impressions.

PROCEDURE OR ANALYSIS

MIXING

Zip-Lock Bag Method

1. Two pounds of dental stone powder is weighed and placed in a zip-lock bag.

2. Add the appropriate amount of water to the dental stone powder in the zip-lock bag. Refer to the chart on page 3 of this procedure or to the suppliers directions. An extra ½ ounce of water may be added to improve the consistency of the dental stone.

3. Close the zip-lock bag tightly and mix the dental stone and water thoroughly for three to five minutes by massaging the bag by hand.

Bucket Method

1. Determine the desired amount (in pounds) of dental stone needed.

2. Determine the appropriate amount of water needed. Refer to the chart on page 3 of this procedure or to the suppliers directions. An extra ½ ounce of water for every two pounds of dental stone may be added to improve consistency of the dental stone. Pour the desired

amount of water into the mixing container.

3. Slowly add the dental stone to the water while stirring continuously. Stir for three to five minutes. The use of an electric drill with a paint mixing attachment will aid the mixing process and provide for a better cast.

Casting

1. Casting of impressions in fine, powder-like soil or in sand may result in better cast detail if a fixative is applied to the impression prior to casting. Some materials which have been used successfully include hair spray, aerosol varnish or lacquer, automotive paint primer, and commercially available dust and dirt hardener. The fixative should be applied very lightly and gradually, allowing each coat to dry before another application is made. The fixative should be allowed to dry thoroughly before the dental stone is applied. Some are of the opinion that such fixatives damage the original impression. Examiner discretion is advised.

2. Pour the dental stone into the impression by starting on one side or at one end and allowing the casting material to flow into the impression. The weight of the casting material is sufficient to destroy the impression if it is carelessly poured into the patterned area. Enough dental stone should be poured into the impression to completely fill the impression and overflow the edges slightly.

3. Allow the cast to remain undisturbed for approximately thirty minutes. Colder ambient temperatures may require longer drying times. Cold temperature drying can be aided by parking a running vehicle with the engine block over the cast or by adding a small amount of potassium sulfate to the dental stone during mixing or by sprinkling the small amount of potassium sulfate on the cast after it has been poured. The addition of the potassium sulfate sufficiently accelerates the drying that when pouring multiple casts, the dental stone may harden before the task can be finished.

4. After the cast has dried, it should be carefully lifted from the impression. Lifting from one end may result in the cast breaking. It may be necessary to excavate the area around the cast to avoid fracturing. The cast should then be allowed to dry for approximately forty-eight hours before cleaning is attempted.

Cleaning

When the cast is lifted from the impression area, it will frequently pick up some of the substrate from the cast area. The soil can be gently removed from the surface of the cast. Running water and a soft bristle brush can be used to aid removal. It has been reported that soaking the cast for one hour in a saturated solution of potassium sulfate may help loosen clinging soil.

INTERPRETATION OF RESULTS:

A properly prepared dental stone cast should accurately depict the original impression. The cast can then be photographed with a scale either as a record photograph or a more detailed photograph which can be used to demonstrate points of comparison. Comparison can be made directly to the known standard (shoe or tire) without test impressions being made. Test impressions of the known standard can be made if desired.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery, and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000 p.71-87.

2. Cassidy, Michael J. Footwear Identification, Lightning Powder Co., Inc. in cooperation with the Royal Canadian Mounted Police, Ottawa, Ontario, 1995, p. 18-26.

3. McDonald, Peter, Tire Imprint Evidence, CRC Press, Inc.; Boca Raton, FL., 1993.

4. Nause, Lawren. *Forensic Tire Impression Identification*, Canadian Police Research Centre, 2001, P46-54

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: MISCELLANEOUS PROCEDURES

METHOD: CASTING

PROCEDURE: SILICONE CASTING

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Sometimes, conventional lifting tapes and films are not suitable for lifting impressions from textured or uneven surfaces because they do not allow a complete lift to be made. In these instances, some silicone-based casting materials work well, especially for lifting powdered impressions. As discussed in Appendix III, silicone casts can also be useful for making test impressions of known standards (shoes or tires). Silicone casting materials are available in a variety of different colors and textures. Proper use of fingerprint powders and colors of silicone can provide good contrast and enhancement of evidence impressions for comparison. Examples of casting materials are Mikrosil, Dow Corning Silicone Rubber, Silmark, Durocast, AccuTrans and Reprosil, or similar extrusion gun products.

OTHER RELATED PROCEDURES:

Photography
Dental Stone Casting
Powders and Particulates

SAFETY CONSIDERATIONS

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution should be exercised and the use of personal protective equipment should be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

NFPA LISTING				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Contact Hazard**
Silicone	NLF	NLF	NLF	

*NLF = No Listing Found

Ingestion may be harmful. May cause mild skin and eye irritation. May cause mild respiratory irritation. May cause allergic reaction to some people.

PREPARATIONS

Preparation of silicone casting materials vary by manufacturer and type of product being used. Consult directions provided by the manufacturer. Generally, silicone casting materials are comprised of a liquid or past base material and an activator or hardener. The casting material is prepared by mixing the appropriate amounts of casting material and hardener thoroughly. This can be done in a clean weigh boat, on a clean piece of cardboard, or the materials are mixed automatically in an extrusion gun as provided by some types of casting material.

INSTRUMENTATION

See Appendix IV - General Instrumentation.

MINIMUM STANDARDS AND CONTROLS

Due to inherent hardening property of properly mixed silicone rubber casting materials, no standards and controls are necessary. Storage directions as provided by the manufacturer should be followed to assure proper usefulness of the material. Some silicone rubber casting materials and their activator/hardener may have a relatively short shelf life and need to be checked periodically.

PROCEDURE OR ANALYSIS

Procedures for use of silicone casting material may vary by product. The manufacturer's directions should be followed closely. Generally, these directions are to mix an amount of the silicone casting material with a designated amount of activator/hardener. The resulting mixture is then applied to the desired item by pouring or by spooning and levelling with a flexible spatula or wooden tongue depressor. The silicone casting material is then left in place until it hardens. This may take a few minutes to a few hours depending on the material used, the thickness of the cast, the amount of casting material used, and atmospheric conditions.

INTERPRETATION OF RESULTS:

A properly prepared silicone cast will be thoroughly dry and have as few air bubbles as possible. The cast should present an accurate depiction of the lifted impression. The cast can then be photographed with a scale either as a record photograph or a more detailed photograph which can be used to demonstrate points of comparison. Comparison can be made either directly to the known standard or a photograph of the cast can be compared to test prints of the known standard.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery, and Examination.* 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000.

2. Hilderbrand, Dwane S., "Footwear, The Missed Evidence," Second Edition, Staggs Publishing, 2007.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: MISCELLANEOUS PROCEDURES

METHOD: ELECTROSTATIC TECHNIQUES

PROCEDURE: ELECTROSTATIC DUST LIFTING

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
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Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

In 1970, Kato Masao, a Shikoku, Japan police officer, developed a machine which used static electricity to assist lifting latent footwear impressions. This machine was somewhat cumbersome and required being plugged into a main current source to operate. In 1981, England's Metropolitan Police Laboratory developed a portable high-voltage electrostatic lifting device that could operate on rechargeable batteries. Today there are a variety of electrostatic lifting devices available from multiple forensic supply companies.

When the high-voltage source is turned on, it creates a static charge on the lifting film. Some of the dust or residue particles of the evidence impression transfer to the lifting film. Since the film is in direct contact with the evidence impression, the transferred impression on the lifting film will be the same size as original impression. It is important to remember that the electrostatic lift has been turned over to be photographed and as such is a reverse image of the original impression.

OTHER RELATED PROCEDURES:

Gelatin Lifters
Iodine Fuming
Ammonium Thiocyanate
Physical Developer
Powders and Particulates
7,8-Benzoflavone
Potassium Thiocyanate

SAFETY CONSIDERATIONS

Consult your instrument's manual for proper use and specific hazards.

PREPARATIONS

The electrostatic lifting device should be charged. This usually requires plugging in the battery charge overnight.

INSTRUMENTATION

Electrostatic Lifter
Light Source
Fingerprint Roller

MINIMUM STANDARDS AND CONTROLS

Not all impressions can be successfully lifted with the electrostatic lifter. It is most effective on dry dust or dry residue impressions on surfaces that are relatively clean. If the impressions were wet or became wet or damp, electrostatic lifting may not work. To test if the battery is sufficiently charged, make a dusty test impression on a piece of paper and attempt to lift the test impression. Suitable lifted impressions which are to be used for comparison are to be photographed.

PROCEDURE OR ANALYSIS

Method A – Using the Ground Plate

Lifting dust prints from thin movable objects such as: fabrics, cardboard, newspapers and magazines.

Method B – Lifting a Dust Print from a Metal Object

Method C – Using the Antenna Ground

Lifting dust prints from: floors, doors, tables, counters, carpets and concrete.

Consult the instructions for the specific device you have

Photograph any suitable impressions in accordance with Minimum Standards and Controls of this procedure

INTERPRETATION OF RESULTS:

Successfully lifted evidence impressions can be visible with available lighting but are best viewed in a darkened room with oblique lighting. Lifted evidence impressions which are extremely dusty, to the point where the impression is very obscured, can be improved by lifting the same area a second time. The first electrostatic lift frequently picks up an excess of loose dirt and dust. The second electrostatic lift benefits from having the excess material removed and may show more detail than the first lift.

REPORT WORDING

See Appendix I. - Report Wording.

MINIMUM QUALITY STANDARDS AND CONTROLS

See Appendix II - Minimum Quality Standards and Controls.

REFERENCES

1. Bodziak, William J. *Footwear Impression Evidence: Detection, Recovery, and Examination*. 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000 p.101-116.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

PROTOCOL: Footwear/Tire Track Impression Comparison

METHOD: Analysis, Comparison and Verification

PROCEDURE: OBSERVATION

Reviewed by:

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Forensic Scientist Aimee C. Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

INTRODUCTION

Footwear and Tire Track examination and comparison is conducted by preparing the evidence (including processing or enhancing the impressions when necessary), analyzing the impressions in questioned items and standards provided, and then visually comparing unknown impressions to known standards.

INSTRUMENTATION

Magnifier – see Appendix IV: General Instrumentation

PROCEDURE

Examiners may prepare evidence by cleaning casts, preserving any relevant physical evidence, photographically documenting impressions or printing agency provided images. Unknown impressions shall be analyzed for suitability. Analysis of all suitable impressions shall include documentation of quality, clarity, class characteristics (including outsole pattern design and noise treatment sequencing) and characteristics of use (including wear and randomly acquired characteristics) prior to analysis of known standards. If reference materials are used, a copy of the relevant information, the procurement date and the source must be added to the notes.

The presence of similar class characteristics between unknown impressions and known standards will lead the examiner to a comparison. This would include visual comparison of design features and wear patterns and an evaluation of randomly acquired characteristics. Test impressions (See Appendix III : Test Impression Methods) or the standard itself may be used in the comparison process. In the event of significant non-correspondence of class characteristics between the unknown impression and known standard, test impressions are not necessary.

When provided with appropriate known standards, examiners must apply the procedure to all suitable impressions unless examination is deferred and appropriate notation is made on the worksheet. In the event that there are numerous unknown impressions, the knowns may be screened for class characteristics before full analysis of the unknowns in order to streamline the examination.

Findings from comparisons based on the above procedure may include:

Identification : This is the highest degree of association expressed by a footwear and tire impression examiner. The unknown impression and the known footwear or tire share agreement of class and randomly acquired characteristics of sufficient quality and quantity.

Consistent/Similar Pattern Size and Design (with no Identification or Elimination made): The class characteristics of both design and physical size must correspond between the unknown impression and the known footwear or tire.

Correspondence of general wear may also be present. There is not sufficient quality and quantity of randomly acquired characteristics to warrant an Identification finding and no significant differences that would warrant an Elimination finding.

Similar Pattern Elements : Some similar class characteristics were present; however, there were significant limiting factors in the questioned impression that did not permit a stronger association between the questioned impression and the known footwear or tire. These factors may include but were not limited to: insufficient detail, lack of scale, improper position of scale, improper photographic techniques, distortion or significant lengths of time between the date of the occurrence and when the footwear or tires were recovered that could account for a different degree of general wear. No confirmable differences were observed that could exclude the footwear or tire

Elimination : This is the highest degree of non-association expressed in footwear and tire impression examinations. Sufficient differences were noted in the comparison of class and/or randomly acquired characteristics between the questioned impression and the known footwear or tire.

All Findings of Identification or Eliminations made utilizing factors other than class characteristics (i.e. wear, randomly acquired characteristics) must be verified by another qualified examiner utilizing the procedure as outlined above.

MINIMUM STANDARDS AND CONTROLS

Examiners will take a proficiency test annually. This test will involve examiners performing analysis and comparisons of footwear or tire track impressions. If an examiner successfully completes this test, he or she will be deemed qualified to perform analysis and comparisons of footwear and tire track impressions in case work.

Minimum Standards and Controls – See Appendix II : Minimum Quality Standards and Controls

REFERENCES

1. ANSI/ASB Standard 137, First Edition 2023 : Standard for Examination and Documentation of Footwear and Tire Impression Evidence

2. Scientific Working Group for Shoeprint and Tire Tread Evidence (SWGTREAD) : Range of Conclusions Standard for Footwear and Tire Impression Examinations (03/2013)

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX I: REPORT WORDING

Reviewed by:

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Forensic Scientist Aimee C. Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

APPENDIX I

REPORT WORDING GUIDELINES

Report wording is contained and documented within the LIMS and is controlled and modified through the issuance of section memos should new wording be necessary.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX II: MINIMUM QUALITY STANDARDS AND CONTROLS

Reviewed by:

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Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

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Brian Mayland
Patterned Evidence Program Manager

APPENDIX II

MINIMUM QUALITY STANDARDS AND CONTROLS

I. Chemical Processes
   A. Standards
      1. Reagent solutions will be kept in appropriate containers in ventilated areas as required. The containers will be labeled with the type of solution contained, preparer's initials, date prepared and the expiration date. See Quality Manual section QM-14 D.
      2. Footwear examiners may opt to use Latent Print section chemicals for processing purposes. These chemicals are subject to preparation and authentication as laid out in the Latent Print Procedures Manual.
      3. Minimum Standards and Controls for each specific chemical procedure can be found in the section of the Footwear/Tire Track Procedures Manual which is dedicated to the chemical procedure.
   B. Controls
      1. Exact chemical concentrations are critical to analyses in some forensic sciences; however, in footwear/tire track examinations, the chemicals used merely help visualize detail to be used for comparison purposes. They do not alter the types of characteristics present or change their relative positions. A slightly weaker or stronger solution than usually employed may differ slightly from the norm in contrast produced.
      2. Working solutions of chemical reagents, unless specifically noted otherwise, will be tested against a similar surface bearing a known impression after the reagent is mixed. The test impression must be documented in the examiner's work notes.
      3. Any chemicals or working solution that will be retained in the laboratory must be entered into the Laboratory Asset Management area of LIMS. See Quality Manual section QM-14 E.
      4. In the event that Latent Print section chemicals are utilized for casework, documentation of the chemicals/procedures used shall be noted in the appropriate section of the LIMS matrix Physical Evidence Panel (see VIII.2.e.ii.13)

II. Powder Processes
   A. Standards
      1. Commercial stock containers should be used to refill working powder containers for daily use.
      2. Individual hair (or fiber) brushes should be used for difference colors or types of powders.
   B. Controls

1. Contaminated powders should not be returned to the stock containers.
2. Magnetic/conventional powder mixtures may be replenished by periodic addition of conventional (nonmagnetic) powder to produce an approximate 50/50 ratio.
3. A “60 mesh sieve” can be used when deemed necessary to periodically purge magnetic and conventional working powder stocks of undesirable contaminants and large powder particles. Mortar/pestle grinding may be used as an alternative technique.

III. Test Impressions and Casts

A. Standards

1. Test impressions will be used for comparison in most two-dimensional questioned impression cases when the known exhibit cannot be readily eliminated.
2. While many casts can be directly compared to the known exhibit, test impressions and casts are appropriate when they assist an examiner in making comparisons.
3. All test impressions will be sub-itemized and returned to the submitting agency. Minimum information to be recorded on test impressions includes :
    a. Case Number
    b. Source Item Number/Sequence Number
    c. Initials of Examiner
    d. Date test impressions were created

The sub-item number may also be recorded on the test impressions, but minimally be recorded on the test impression packaging. Test impressions shall be scanned for retention on the secure server. These scans are subject to requirements laid out in Appendix VI : Minimum Digital Imaging Standards & Controls, section II.d.

B. Controls

1. Test impressions should be produced in a manner appropriate for comparison to the submitted evidence according to processes laid out in Appendix III : Test Impression Methods.

IV. Preservation of Impressions

A. Standards

1. All suitable impressions will be photographed prior to the application of any processing technique, including lifting.
    a. All digital images (both original and edited) used for analytical work will be saved to a secure server for the purposes of preservation and possible re-analysis.
    b. Impressions that may degrade or be destroyed should always be photographically preserved and the images saved to a secure server.

2. Impressions visualized by lifting or other processing techniques will be preserved. In the event two or more processing techniques visualize the same impression, preservation of each technique is needed.
3. In the event that no standards are submitted for comparison, the examiner may opt to photograph impressions for preservation without completing a full examination. All photographs taken for the purpose of preservation will be saved to a secure server so that they may be utilized for further examination in the event that standards are submitted at a later date.

B. Controls
1. At least one method of preservation must be used for each non-duplicate suitable impression developed. Digital or printed images will be checked against the photographed exhibits for sharpness, contrast, and accurate reproduction of detail.

V. Information to be Included on Lifts and Photography
A. Standards
1. Each lift and photograph received from an agency which is used as the source of an impression upon which an evaluation or comparison is based will include the following minimum information :
a. Laboratory Case Number
b. Item Number
c. Initials of the examiner
d. The date the lift or photograph was received or generated
e. Image name if available

B. Controls
1. Examiners are responsible for insuring that all information as required in Standards for Information to be Included on Lifts and Photographs is included on all lifts and photographs.
2. The above information may be physically written on the item, appear visually in the image, or be embedded in the metadata of an image file. Appropriate methods for electronically documenting the above information include:
a. File Creation date embedded in the image file
b. Case Number and Item Number embedded in the file name
c. File owner/creator embedded in the image file.
d. Electronic audit trail

VI. Control (Possession) of Lifts and Photographs After a Case Has Been Completed
A. Standards

1. All lifts and photographs received from an outside agency will be returned to the submitting agency. Images supplied by an agency will be retained on a secure server.
2. All preserved suitable impressions, including lift and printed images, will be sub-itemized and returned to the submitting agency. All digital images will be retained on a secure server. Sub-items created by the examiner shall be listed on the report.

B. Controls
1. Any lifts or printed images being returned to the agency will minimally be marked as laid out in section V.A.1. The sub-item number may also be included in the markings on the item, but must be minimally present on the outer packaging.

VII. Photography
A. Standards
1. Photography of impression evidence is appropriate when needed to assist an examiner in evaluation and comparison work.
2. All photographs generated by the laboratory for comparison purposes will contain the following information :
    a. Laboratory Case Number
    b. Item Number
    c. Initials of the examiner
3. Photographic prints/images will include an appropriate photographic scale that may be used for scaling purposes when calibrating images in an appropriate processing application.
4. Record photographs need not include a photographic scale.

B. Controls
1. Photographic prints/images will be checked against the photographed exhibits for sharpness, contrast and accurate reproduction of detail.
2. All images generated during casework will be retained on a secure server. Additional images should also be retained within reason.
3. Each laboratory's Footwear/Tire Track section will maintain a certified ruler. The certified ruler will be re-certified (or a new one purchased if more cost effective) as prescribed in the Quality Manual (QM-11 section F.1.d). Prior to use, the bureau scale or other appropriate photographic scale utilized for casework will be checked against the certified ruler. Documentation of this check will be made in the case notes as outlined in section VIII. All certified rulers will be tracked in the Laboratory Asset Management (LAM) area of LIMS.

VIII. Worksheets and Laboratory Information Management System (LIMS) Matrix Panels
A. Standards
1. Worksheets in the Footwear/Tire Tracks Section are considered the output that can be printed after LIMS matrix panel information is filled out. The LIMS

matrix data entry screens in the Footwear/Tire Tracks Section listed below are used to document information regarding specific items of evidence and will be referred to as "panels" on the following pages. Footwear/Tire Track matrix panels are Item driven. The item to be discussed must be chosen from the drop down menu at the top of each panel in order to properly populate the report and notes packet. The data entry fields in the LIMS that are indicated with a red asterisk (*) are mandatory in order for a worksheet and report to be generated. If no data exists for a particular mandatory field, an entry must still be made (e.g. "Unknown", "Not Applicable", etc.) The LIMS system is set up to alert the analyst when a mandatory field has been left blank before the case can be completed. While not marked with an *, any "Designator" fields MUST be filled out in order for notes to generate properly. All other non-mandatory fields can be left blank and do not need to be addressed if no relevant information is noted.

2. Panels and fields in the Footwear/Tire Track Matrix should be utilized and filled out as described below:
    a. Known Footwear Panel – a Known Footwear Panel will be completed in all footwear cases where known footwear standards are received
        i. Main Panel
            1. Select Item : choose the item from the dropdown that reflects the correct item of the known footwear
            2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
            3. Repackaging* : briefly describe how the item was repackaged
            4. Lab Mark* : Record any lab marks placed on the evidence
            5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, other items received with the footwear standards that are not related to footwear examination
            6. Additional Clothing/Personal Items Not Examined check box : checking this box will generate a report remark indicating that any additional items contained in the package with the submitted footwear standards were not examined. Check this box any time additional items (clothing or personal items) are received in the same package as the standards
            7. Images Stored on a Secure Server : checking this box indicated that any images associated with the panel are stored for future use on a secure server
        ii. Entries

1. Shoe Type* : choose from the drop down or type in information if an appropriate choice is not available
2. Brand* : type in the brand name of the submitted standards. If the brand cannot be determined, type in "Unknown" or another appropriate response. This information will populate to the report.
3. Model : Type in the shoe model if known. This information will populate to the report.
4. Size* : Type in the shoe size of the submitted standard. If the size cannot be determined, type in "Unknown" or another appropriate response. This information will populate to the report.
5. Color : notes about color or markings on the shoes may be made here
6. Outsole Pattern Design Description : notes about the outsole pattern design may be made here
7. Number of Test Impressions* : Type in the total number of test impressions made or the number for each shoe based on the choice you make in the "Test Impressions Of" dropdown field (see 9 below)
8. Sub-Itemized as : This response should correspond to the sub-item created for the test impressions
9. Test Impressions Of : Choose the appropriate response to correspond with the "Number of Test Impressions: field (see 7 above)
10. Method(s) : choose the appropriate choice(s) to reflect the method used to make test impressions. Type in the field if an appropriate choice is not available.
11. Notes : Any additional notes about the submitted standards may be added here, including references to images or specific details about characteristics of use (wear, randomly acquired characteristics, etc.) that might be used for comparison purposes
12. Report Remarks : In the event that no Comparison panel is used in the case (i.e. there are only known standards in the current case with Impression evidence in another case), choose the appropriate statements that will populate to the report. As many statements as are needed may be chosen. Typed additions may be made, but care mut be taken to use proper grammar as these statements will populate directly to the report.

b. Known Tire Panel – a Known Tire Panel will be completed in all tire cases where known tire standards are received

i. Main Panel
    1. Select Item : choose the item from the dropdown that reflects the correct item of the known tire(s)
    2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
    3. Repackaging* : briefly describe how the item was repackaged
    4. Lab Mark* : Record any lab marks placed on the evidence
    5. Additional Information : may be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
    6. Images Stored on a Secure Server : checking this box indicates that any images associated with the panel are stored for future use on a secure server

ii. Entries
    1. Number of Tires : type in the number of tires that you are discussing in the entry. If you have four of the same tire for an examination in an item, you may discuss them all in one entry. This information will populate to the item description in the report.
    2. Brand* : Choose the correct brand name of the submitted standards. You may edit the selections provided or type another appropriate brand response in this field. This information will populate to the item description in the report.
    3. Model : You may type in the model if known. This information will populate to the item description in the report.
    4. Size* : Type in the size of the tire standard. If the size cannot be determined, type in “Unknown” or another appropriate response. This information will populate to the item description in the report.
    5. Tread Design/Noise Treatment : Discuss the elements of the tread design, describe features such as the number of ribs, element shapes/sizes and type in the sequencing
    6. Number of Test Impressions* : choose the number of test impressions made from the dropdown. You may type in a number not listed in the dropdown.
    7. Method(s) : choose the appropriate choice(s) to reflect the method used to make test impressions. Type in the field if an appropriate choice is not available.

8. Notes : Any additional notes about the submitted standards may be added here, including references to images or specific details about characteristics of use (wear, randomly acquired characteristics, etc.) that might be used for comparison purposes.
9. Report Remarks : In the event that no Comparison panel is used in the case (i.e. there are only known standards in the current case with Impression evidence in another case), choose the appropriate statements that will populate to the report. As many statements as are needed may be chosen. Typed additions may be made, but care must be taken to use proper grammar as these statements will populate directly to the report.

c. Agency Test Impression Panel
   i. Main Panel
      1. Select Item : choose the item from the dropdown that reflects the correct item of the agency test impression
      2. Packaging* : document the general condition of the packaging as it was received, including the condition of the seals
      3. Repackaging* : briefly describe how the item was repackaged
      4. Lab Mark* : Record any lab marks placed on the evidence
      5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
      6. Images Stored on a Secure Server : checking this box indicated that any images associated with the panel are stored for future use on a secure server
      7. Scale Checked Against Certified Ruler : checking this box indicates that any scales used in analytical photography performed at the laboratory were compared to a certified ruler to ensure accuracy
      8. Certified Ruler Drop Down : Choose the certified ruler that you used to check your scales. Only rulers in the LAM for each laboratory will populate the drop down.
   ii. Entries – if multiple pieces are received in one item, each should have a separate entry
      1. Test Designator : if there are multiple test impressions (or sets of test impressions) within an item, you should give them separate designators according to the designator rules laid out in Section IX.

2. Type of Impression* : Choose the appropriate response from the dropdown. In the event that a test impression not fitting one of these categories is submitted, you may type in this field. This information will populate to the item description in the report.
3. Related to Physical Item #* : Type in the item number of the standard that the test impression is related to. This information may come from the agency or your own examination. If the related Item # is unknown or the related item has not been submitted, type an appropriate response in this field.
4. Method : choose from the provided methods in the dropdown or type in an appropriate response
5. Notes : Discuss the test impressions, their relationship to the submitted standards, how they are stored or any other necessary information
6. Results* : Choose from the provided responses in the dropdown. If neither choice is appropriate, you may type in your own response. This information will populate to the report, so proper grammar must be used.

d. Image Storage Device Panel
    i. Main Panel
        1. Select Item : choose the item from the dropdown that reflects the correct item of the image storage device
        2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
        3. Repackaging* : briefly describe how the item was repackaged
        4. Lab Mark* : Record any lab marks placed on the evidence
        5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
        6. Total Numb er of Images* : Enter the total number of images present on the image storage device. This information will populate to the item description on the report.
        7. Total Number of Scaled Images with Impressions : Enter the number of images present that have footwear impressions and a proper scale.
        8. Additional Information : May be used to record additional notes about packaging, lab mark information,

notes about images that will not be printed or used for analytical purpose, etc.

9. Images Stored on a Secure Server : checking this box indicates that any images associated with the item in the panel are stored for future use on a secure server.

ii. Entries

1. Type of Device* : Use the dropdown menu to choose the type of device. If the type of device is not listed, you may type in this field. This information will populate to the item description in the report.
2. Device Designator : If there are multiple devices within an item, you should give them separate designators according to the designator rules laid out in Section IX.
3. File Name(s)* : All of the file names of images containing impressions in this item should be listed here. If all full image names cannot be accommodated by character count, you may enter a range (IMG_001 through IMG_200) or add image names in notes ("See Notes" or other appropriate response entered in this field).
4. Notes : Discuss issues noted in images including, but not limited to, substrate, surface, issues with photography, processing/printing, additional marking made on images and whether or not printed images were scanned into the file.
5. Number of Impressions* : Choose the number of impressions present. If the number is zero, no further note-taking is required for this item. Choosing "0" will populate the report with an appropriate statement. You may type in this field if the number of impressions is greater than 10.
6. Labeled As : All impressions will be labeled in a standard manner as discussed in the designator rules laid out in Section IX. This field must be used when the number of impressions is not "0" or "Unknown".
7. Report Remarks : This field may only be used if "Unknown" is chosen in the "Number of Impressions" field. Proper grammar must be used as text in this field will populate directly to the report. This field should NOT be used if the number of impressions has been recorded as anything other than "Unknown". Pre-written selections are also available in this field in the event that no Comparison Panel is needed in the case.

e. Physical Evidence Panel
    i. Main Panel
        1. Select Item : choose the item from the dropdown that reflects the correct item
        2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
        3. Repackaging* : briefly describe how the item was repackaged
        4. Lab Mark* : Record any lab marks placed on the evidence
        5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
        6. Images Stored on a Secure Server : checking this box indicates that any images associated with the item in the panel are stored for future use on a secure server
        7. Scale Checked Against Certified Ruler : check this box to confirm that all scales used in analytical photography performed at the laboratory have been compared to a certified ruler to ensure accuracy
        8. Certified Ruler Drop Down : Choose the certified ruler that you used to check your scales. Only rulers in the LAM for each laboratory will populate the drop down.

    ii. Entries
        1. Evidence Designator : If there are multiple physical evidence items within an item, you should give them separate designators according to the designator rules laid out in Section IX.
        2. Description of Item* : Give a brief description of the item that was submitted. This information will populate to the item description field of the report.
        3. Number of Record Shots : The total number of non-analytical images that were taken of the item and stored on the secure server.
        4. Number of Analytical Images : The total number of analytical images with a proper scale that were taken of the item and stored on the secure server. Not necessarily the same as the number of images that were printed for comparison purposes.
        5. Notes (if no processing done) : This area is for general notes about the item submitted, a discussion of analytical images printed (taken before any processing of the item was done), how they were sub-itemized, and

visible impressions and features of the items. This area can be used exclusively when no physical or chemical processing is done on the item or if impressions can be visualized before processing is done.

6. Physical : Multi Selector Box – this is not a mandatory field and should only be used if physical processing techniques are utilized. You may select any/a;; choices that reflect the processing techniques utilized or type in other approved processes not on the list.
7. Number of Record Shots : The total number of non-analytical images that were taken of the item after physical processing and stored on the secure server.
8. Number of analytical images : The total number of analytical images with a proper scale that were taken of the item after physical processing and stored on the secure server. Not necessarily the same as the number of images that were printed for comparison purposes.
9. Physical Processing Notes : This notes area is for observations made after processing an item physically. This area should NOT be used if no physical processing techniques were applied to the item.
10. Chemical : Multi-Selector Box – This is not a mandatory field and should only be used if chemical processing techniques are utilized. You may select any/all choices that reflect the processing techniques utilized or type in other approved processes not in the list.
11. Number of Record Shots : The total number of non-analytical images that were taken of the item after chemical processing and stored on the secure server.
12. Number of Analytical Images : The total number of analytical images with a proper scale that were taken of the item after chemical processing and stored on the secure server. Not necessarily the same as the number of images that were printed for comparison purposes.
13. Chemical Processing Notes : This notes area is for observations made after processing an item chemically. This area should NOT be used if no chemical processing techniques were applied to the item.
14. Number of Impressions* : choose the number of impressions present from the drop down. If the number is zero, no further note-taking is required for this item. The proper report remark will automatically populate to the report. You may type in this field if the number if

greater than 10. If the total number is Unknown, you may generate a report remark to explain.

15. Labeled As : All impressions will be labeled according to the designator rules laid out in Section IX. This field must be used when the number of impressions is not "0" or "Unknown".
16. Report Remarks : This field may only be used in "Unknown" is chosen in the "Numb er of Impressions" field. Proper grammar must be used as text in this field will populate directly to the report. This field should NOT be used if the number of impressions has been recorded as anything other than "Unknown"/ Pre-written selections are also available in this field in the event that no Comparison Panel is needed in the case.

f. Cast Panel
   i. Main Panel
      1. Select Item : choose the item from the dropdown that reflets the correct item
      2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
      3. Repackaging* : briefly describe how the item was repackaged
      4. Lab Mark* : Record any lab marks placed on the evidence
      5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
      6. Images Stored on a Secure Server : checking this box indicates that any images association with the panel are stored for future use on a secure server
      7. Scale Checked Against Certified Ruler Check Box : Check to confirm that all scales used in analytical photography performed at the laboratory have been compared to a certified ruler to ensure accuracy
      8. Certified Ruler Drop Down : Choose the certified ruler that you used to check your scales. Only rulers in the LAM for each laboratory will populate the drop down.

   ii. Entries
      1. Cast Designator : if there are multiple casts within an item, you should give them separate designators according to the designators laid out in Section IX. If

there is only one cast in an Item, you should use the Item number as the designator
2. Size : add any measurement taken in this field
3. Number of Record Shots : The total number of non-analytical images that were taken of the item and stored on the secure server.
4. Number of Analytical Images : The total number of analytical images that were taken of the item with a proper scale and stored on the secure server. Not necessarily the same as the number of images that were printed for comparison purposes.
5. Notes : Used to discuss visible impressions, cast quality, etc., as well as any analytical images printed for comparison purposes and how they were labeled and sub-itemized.
6. Number of Impressions* : Drop Down Menu – Choose the number of impressions present. If the number is zero, no further note-taking is required for this item. The proper report remark will automatically populate to the report. You may type in this field if the number is greater than 10. If the total number is unknown, you may generate a report remark to explain.
7. Labeled As : All impressions will be labeled according to the designator rules laid out in Section IX. This field must be used when the number of impressions is not "0" or "Unknown".
8. Report Remarks : This field may only be used if "Unknown" is chosen in the "Number of Impressions" field. Proper grammar must be used as text in this field will populate directly to the report. This field should NOT be used if the number of impressions has been recorded as anything other than "Unknown". Pre-written selections are also available in this field in the event that no Comparison Panel is needed in the case.

g. Lift Panel
    i. Main Panel
        1. Select Item : choose the item from the dropdown that reflects the correct item
        2. Packaging* : document the general condition of the packaging as it was received including the condition of the seals
        3. Repackaging* : briefly describe how the item was repackaged

4. Lab Mark* : Record any lab marks placed on the evidence
5. Additional Information : May be used to record additional notes about packaging, lab mark information, more detailed description of the item, damage, etc.
6. Images Stored on a Secure Server : checking this box indicates that any images associated with the panel are stored for future use on a secure server
7. Scale Checked Against Certified Ruler Check Box : Check to confirm that all scales used in analytical photography performed at the laboratory have been compared to a certified ruler to ensure accuracy
8. Certified Ruler Drop Down : Choose the certified ruler that you used to check your scales. Only rulers in the LAM for each laboratory will populate the drop down.

ii. Entries

1. Lift Designator : If there are multiple lifts within an item, you should give them separate designators according to the designator rules load out in Section IX. If there is only one lift in an Item, you should use the Item number as the designator.
2. Type* : Choose the type of lift that you have received from the drop down list. You may type in this field if your list is not adequately described by the provided options. This information will populate to the item description on the report.
3. Color* : Enter the color description of the lift (i.e. white, black, clear). This information will populate to the item description on the report.
4. Size : add any measurements taken in this field
5. Number of Record Shots : The total number of non-analytical images that were taken of the item and stored on the secure server
6. Number of Analytical Images : The total number of analytical images that were taken of an item with a proper scale and stored on the secure server. Not necessarily the same as the number of images that were printed for comparison purposes.
7. Notes : Used to discuss visible impressions (before and after photography), imaging processes used, analytical images printed for comparison purposes and how they were labeled and sub-itemized

8. Number of Impressions* : Choose the number of impressions present from the dropdown. If the number is zero, no further note-taking is required for this item. The proper report remark will automatically populate to the report. You may type in this field if the number is greater than 10. If the total number is unknown, you may generate a report remark to explain.
9. Labeled As : All impressions will be labeled according to the designator rules laid out in Section IX. This field must be used when the number of impressions is not "0" or "Unknown".
10. Report Remarks : This field may only be used if "Unknown" is chosen in the "Number of Impressions" field. Proper grammar must be used as text in this field will populate directly to the report. This field should NOT be used if the number of impressions has been recorded as anything other than "Unknown". Pre-written selections are also available in this field in the event that no Comparison Panel is needed in the case.

h. Impression Panel – all impressions listed in the Number of Impressions fields in evidence panels will be discussed in this panel. All labeled impressions found on evidence items should be listed and discussed here.
    i. Entries : The number of entries present should reflect the total number of impressions accounted for and labeled in the evidence panels.
        1. Impression Number : The label given to each impression in the corresponding evidence panel. These labels should follow the designator rules laid out in Section IX.
        2. Type of Impression : Choose the appropriate descriptions from the multi-selector box, all or as many as necessary, or type in the box to add descriptors not in the list.
        3. Pattern Description : This field should describe visible attributes, including but not limited to : class characteristics (pattern, design features), characteristics of use (wear, randomly acquired characteristics), and limitations (substrate, matrix, movement)

i. Comparison Panel – all comparison documentation and results will be entered into the panel. The entries populate the results chart in the report.

i. Report Remarks : Choose the appropriate statements that will populate to the report. As many statements as are needed may be chosen. Typed additions may be made, but care must be taken to use proper grammar as these statements will populate directly to the report.
ii. Impression Number* : The label for each impression as noted in the corresponding Impression Panel. The labels should follow the Footwear/Tire Track Evidence Designator Rules (Section IX).
iii. Compared to* : The number for the standard to which the impression was compared. Choose thee corresponding item from the drop down menu (case items as well as Big View items should populate.
iv. Left/Right/Tire : Indicate which shoe (or both) or tire was compared to the impression.
v. Method* : Choose the method in which the comparison was conducted. You may choose from the list or type directly in the field.
vi. Results* : Choose the correct result of your comparison (See Section V : Observation of the Footwear/Tire Track Procedures Manual). In most instances, only one box should be checked; however, in some cases (i.e. deferral), multiple selections may be warranted. You may not type in the box.
vii. Deferral Reason : This field may only be used in cases where the Results field states “Further Examination Deferred”. Choose a reason for the deferral from the provided list. You may type a different statement in this box, but proper grammar must be used as this will populate directly to the report .The typed information will follow the generic statement “Further examination of impression #X is being deferred due tro…”
viii. Results Justification* : Place documentation of your identification or other Findings here. (i.e. Identification used image 123 and test impression 6 Right #2. Test indexed on image 123 in red and areas used for identification circled in red on test impression 6 Right #2.) ALL identifications made MUST have some statement of what areas were used for identification and how they were documented. ALL Findings MUST have some type of documentation about how/why they were reached. This area may also be used for notes on interference, accounting for any differences in pattern size, differences in patterns for eliminations, discussions of presence or lack of randomly acquired characteristics, etc.
ix. Verification* : “YES” should be chosen when the results box states “Identification”. “YES” might also be chosen if an elimination was made on characteristics of use (wear patterns,

randomly acquired characteristics) where a verifier is warranted. For all other results, choose "Not Applicable". The verifier will click the Confirm button that appears when "yes" is chosen in the drop down and enter their credentials in order to complete the verification. The verifier may enter any comments at this time, including outlining an mark ups made in addition to those made by the original examiner.

B. Controls
   1. Examiners are responsible for insuring all appropriate information outlined above is recorded in the appropriate matrix panel for each item examined.

IX. Footwear / Tire Track Evidence Designator Rules
   A. Standards – All items shall be labeled according to the rules below.
      1. All items shall be labeled with a numeric designator that begins with the Division of Forensic Services item number. For a single piece of evidence in an item, the designator will be the item number.
      2. When there are multiple pieces of evidence in one item, the pieces shall be labeled with a sub-designator
         a. Example : Item #1 is two gel lifts. The lifts should be sub-designated as 1-1 and 1-2
      3. Impressions on Items shall also be designated with numeric designators
         a. Example 1 : Item #1 is one gel lift with two impressions. The impressions should be sub-designated as 1-1 and 1-2
         b. Example 2 : Item #1 it two gel lifts that have been sub-designated as 1-1 and 1-2. Gel lift 1-1 has one impressions. The impression should be designated as 1-1-1. Gel lift 1-2 has two impressions. The impressions shall be designated as 1-2-1 and 1-2-2.

   B. Controls
      1. Examiners are responsible for insuring that all items and impressions are labeled according to the rules outlined above.

X. Data Rejection
   A. Standards
      1. If/when an observation, data or calculation is rejected, the reason(s), date and individual taking the action shall be recorded in the technical record. This includes rejection by the analyst, reviewer or verifier. During examination, an analyst's note-taking in LIMS records the identity of the individual taking the action and date of rejection observations. Any rejections or comments by the verifier shall be recorded in the notes box of the verification screen, ensuring that LIMS records the date and the identity of the individual taking the action.

      2. Analysts should retain all images taken in the laboratory on the secure server, whether analytical or record images. In the event that images are not retained, the analyst must document the reason that images were not retained in detail (i.e. not

in focus, poor lighting). If images taken and retained in the secure server are not used for examination purposes, the reasons that these images were not utilized must be documented in detail (i.e. multiple images taken of the same evidence item, Image X was deemed to be the best representative image based on visibility of impression). If printouts are created for the sole purpose of checking scaling accuracy, these printouts do not need to be retained. Documentation of these printouts should be made in the notes (i.e. image printed to check scaling accuracy, not retained).

3. Analysts shall retain all images submitted by an agency on the secure server. Analysts should provide basic information about the contents of each image submitted (i.e. Images A, B and C are overall crime scene images with no visible footwear impressions. Images D and E are overall crime scene images that contain footwear impressions; however, they are not suitable for analytical comparison purposes. Images F and G are analytical quality photographs of the same impression with different lighting). If there are analytical quality photographs that will not be used for examination purposes, the reasons that these images were not utilized must be documented in detail (i.e. multiple images taken of the same evidence, item, Image X was deemed to be the best representative images based on visibility of impression).

4. If items are examined and found to have no impressions, detailed documentation must be provided (i.e. Examination of the gel lift in Item 1 revealed no footwear impressions. Dust and debris were present, but no pattern was noted.)

5. During the technical review process, all original and corrected versions of the analyst's original observations are stored in LIMS. Any changes to be made by the original analyst will be noted in the "Reject Findings" reviewer box. Rejected data is retained in the technical record through LIMS Audit Trail or the attachments

B. Controls

1. Examiners, verifiers and technical reviewers are all responsible for ensuring that adequate documentation is provided for rejection of observations, data or calculations.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX III: TEST IMPRESSION METHODS

Reviewed by:

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Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

_____

Brian Mayland
Patterned Evidence Program Manager

APPENDIX III

TEST IMPRESSION METHODS

Test impressions for known footwear and tires shall record the characteristics on the outsole or tread. Test impressions shall record fine detail with appropriate contrast and/or three-dimensional features of accurate size, shape and clarity. Other evidence should be considered prior to making test impressions, such as biological materials or trace evidence. Creating test impressions may damage other types of physical evidence present on the footwear outsole or tire tread. Before creating test impressions using known evidence standards, the examiner shall preserve any relevant physical evidence and document the original condition of the shoes/outsoles or tire/tread design both photographically and in the Known Footwear or Known Tire Panel. Examiners should choose the method of creating test impressions based on a prior evaluation of the submitted unknown impressions and any mitigating case circumstances. Multiple test impressions can and should be created as the situation warrants.

The test impression methods mentioned in this appendix are not intended to be an all-inclusive or a restrictive list of test impression methods. Instead, it is a compilation of commonly used techniques that the footwear/tire track examiner would be most likely to use in routine casework. The occasion may arise where the examiner will need to improvise and use an unusual, new, or seldom used technique to make a reliable comparison between known standards and questioned impressions.

At least two test impressions should be made of each footwear outsole deemed to be relevant for comparison purposes. Additional test impressions or test impressions of specific areas on the outsole can be made if necessary. At least one full rotational test impression should be made of each tire deemed to be relevant for comparison purposes. Additional test impressions or test impressions of specific areas of tread can be made if necessary. Stone holds or other objects in the outsole should not be removed, but excess dirt can be carefully removed. If deemed necessary, additional test impressions may be created prior to the removal of excess dirt. Any stone holds or objects in the outsole that are unintentionally removed during the process of creating test impressions should be maintained in the test impression if possible and documented in the examiner's notes.

Test impressions will be scanned for retention on a secure server. Test impressions that cannot be practically scanned (casts, Biofoam) will be photographed for retention on a secure server. All test impressions will be sub-itemized and returned to the agency. These processes will be documented in the examiner's notes. The number of test impressions created, their sub-item designation and the method used to create the test impressions must be documented in the designated areas in the Known Footwear or Known Tire Panel at the time of their creation. Test impressions should minimally be marked with a case number, source item number, sequence (i.e. Test #1) and orientation if needed (right, left, tire location on car), the creating examiner's initials and the date of creation. The sub-item number may also be recorded on the test impression, but must minimally be on the direct packaging for the test impression.

Footwear Test Impression Methods

Two-Dimensional

Black Ink (Fingerprint or Printer's Ink)

- Apply to the footwear outsole directly with a fingerprint roller, applying to a flat surface (press standard or step) or pressing the standard to or stepping on a large ink pad.
- Press standard or step on white paper, card stock, clear adhesive lifter or roller transport film to create test impression
- Clear transparencies may be created from white paper or card stock by photocopying the tests onto clear overhead transparencies. It should be noted that minor distortions or size discrepancies may be associated with transparencies made on photocopiers. These may not be significant enough to hinder an accurate comparison, but the possibility of these limitations should be kept in mind and documented in the Known Footwear Panel notes. The original test impression should always be referenced for accuracy when doing comparisons with an overlay created using a photocopier.

Fingerprint Powder and Clear/White Adhesive, Clear White Gelatin Lift or Roller Transport Film

- Apply a heavy coat of fingerprint powder to the footwear outsole
- Remove any excess by tapping the side of the footwear on a hard surface
- Either step on the chosen media while wearing the footwear (a semi-soft surface such as newspaper or firm foam can be laid under the media) or by pressing the media to the powdered outsole surface/pressing the footwear to the media
- Care should be taken to make sure that the entirety of the outsole surface to be recorded is pressed firmly against the media in order to record a complete and accurate representation
- Lifters, either adhesive or gelatin, should have their protective cover carefully reapplied in order to protect the impression
- If using roller transport film, the film should be dampened prior to use and the impression allowed to fully dry

Oil Residue

- Coat the surface of the footwear outsole with a thin coat of petroleum jelly, clear shoe polish or another oil product such as WD-40

- Step or press the standard onto a clean piece of paper
- Process the impression using magnetic fingerprint powder and an appropriate brush
- Different colors of paper or fingerprint powder may be used as appropriate to the situation

Three-Dimensional

Biofoam

- Biofoam is most effective for reproducing class and wear characteristics and may not accurately capture small details and randomly acquired characteristics
- Step or press the outsole into the Biofoam material

Outsole Casting

- Outsole casting is most effective when used on specific small areas of the outsole. Full casting of an outsole, especially with a very liquid material may require building a dam around the outsole with masking tape prior to the casting attempt
- Any of the silicone casting materials mentioned in the Silicone Casting procedure section in this manual (IVA-2), modeling clay or MikroTrack may be used for outsole casting.
- Non-permanent methods of casting like modeling clay or MikroTrack require thorough photographic documentation in order to be used for comparison purposes.
- Dental stone may be used to cast test impressions made using the above methods, or tests made by stepping in dirt or mud with the known standards. The Dental Stone Casting procedure section in this manual (IVA-1) should be followed in order to produce quality casts.

Tire Test Impression Methods

- Tire impressions will ideally be made while the tires are installed on the vehicle. The vehicle should be put in neutral and pushed, not driven.
- For all methods, the tread wear indictors shall be marked on the sidewalls of the tire, creating sections. These sections shall be marked on the test impression media as the impression is being made so that features can be correctly and easily correlated between the tire and the test impression.
- Test impressions should minimally record one full and continuous rotation of the tire. Continuing an impression by re-recording at least the first two segments will ensure the entire noise treatment pattern is collected.

- Multiple people MUST be involved in collecting known tire impression mounted on a vehicle. One person will put the vehicle in neutral, steer and stop the vehicle. A second person will create the test impression and transfer markings to the impression media being used. A third person will push the vehicle.

- In the event that three-dimensional tire test impressions are deemed necessary, the casting methods listed above for Footwear Test Impressions may be adapted for utilization with tires considering the information outlined below.

Printer's Ink with chart board/clear film

- Chart board will be used for both options as a clean, flat surface is needed to properly transfer noise treatment pattern, wear and randomly acquired characteristics.

- If using clear film, tape it on top of the chart board, lining the board/film up with the tire and intended path of the vehicle

- The person creating the impression should use a fingerprint roller to apply ink to the surface of the tire, which will then be rolled over the board/film. The people pushing/steering the vehicle shall listen to the direction of the person creating the impression in terms of speed, stopping and starting. The person creating the impression shall also transfer the tread wear indictor positions to the impression media so that segments are accurately marked on the test impression.

- Alternately, ink may be rolled onto extra sections of chart board which the vehicle will be rolled over prior to being rolled over the test impression media.

Oil Residue Method

- Lay out chart board, or butcher paper taped over chart board, lining the board/paper up with the tire and intended path of the vehicle

- The person creating the impressions should apply a thin coat of the chosen oil product (petroleum jelly, clear shoe polish, WD-40, etc) to the surface of the tire which will then be rolled over the board/paper. The people pushing/steering the vehicle shall listen to the direction of the person creating the impression in terms of speed, stopping and starting. The person creating the impression shall also transfer the tread wear indicator positions so that segments are accurately marked on the test impression.

- When the full circumference of the tire has been recorded, the impression should be developed using magnetic fingerprint powder and an appropriate brush.

- Different colors of paper or fingerprint powder may be used as appropriate to the situation

Limitations

Test impressions may not always fully reproduce all characteristics on a tire or footwear outsole due to inherent variability in the impression making process. Limitations may include substrate features, method of collection and an inability to reproduce the conditions under which an unknown impression was made. Multiple impressions are encouraged when possible in order to accurately depict features present on a known standard. When considering methods for making test impressions, the possibility of needing to use another method and the materials used in those methods should be taken into account.

REFERENCES

1. ASNI/ASB Best Practice Recommendation 021, 1st Ed.2019 **:** Best Practices for the Preparation of Test Impressions from Footwear and Tires (Organization of Scientific Area Committees Registry)

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX IV: GENERAL INSTRUMENTATION

Reviewed by:

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APPENDIX IV

GENERAL INSTRUMENTATION

GENERAL PROCESSING EQUIPMENT

Impression evidence examination equipment utilizes an increasing array of items which include those specifically designed for residue detection and those modified or adapted for the specialized needs of evidence processing.

Equipment and supplies within the scope of the latent print discipline are the tools most commonly used for footwear/tire track procedures. Such tools are dependent upon the skill and purpose of the examiner using them. Individual preference which has selected an inferior tool used skillfully may have yielded results assessed as satisfactory; better tools applied with equal skill will add to overall success of the examination.

POWDERS AND PARTICULATE APPLICATION

Description:

Application of dry powders to a nonporous surface is a critical balance of sufficient coloring agent to adhere to the residue without obliterating the development of the pattern formations. This process is commonly called dusting and employs a brush or wand. Heat-generated particulate or suspension-deposited particles need no applicator. Selection of dry powder applicator is based upon the properties of materials used in the construction of the applicator and the damage potential of those materials.
Properties of all brush construction materials are utilized toward the movement of powder particles with the least possible damage to the evidence impression residue. A brush must deliver powder to the surface and remove excessive particles with extremely light drag and bristle stiffness. Natural bristle brushes composed generally of squirrel hair (labeled camel hair) are, in initial condition, very soft and pliable. Feather brushes offer naturally delicate applicators at the tips of the barbs and the usual presence of some down. Fiberglass brushes use collection of very fine glass strands while carbon filament brushes are composed of almost pure carbon strands. Magnetic wands are constructed of a permanent magnet attached to a movable rod inside an aluminum housing. The tip of the housing is very thin to permit magnetic attraction when the rod is depressed but thick enough to block attraction when the magnet is raised.

Method:

Synthetic brush materials are preferred due to resistance to contamination and ease of cleaning.

POWDER

Description:

For powders to be effective they must adhere to trace amounts of impression residue that contain a wide array of moisture content and viscosity.

Commercial powders are mixtures of various substances in specific proportions resulting in combined properties of moisture adhesion with dry surface release.
Nearly all commercial latent print developing powders are the product of careful experimentation and rigid quality control while some powders are still designed with higher regard to color contrast for photographic purpose than ability to adhere, most experienced examiners restrict powder usage to black and gray. Rainbow palette powders may facilitate subsequent photography but may fail to properly reveal all detail. Black and gray powders function better and generally provide ample contrast for adequate photographic preservation.

Magnetic powders are mixtures of ingredients with a high percentage of extremely fine iron filings. Nearly all manufacturers of fingerprint supplies offer magnetic powder. Black, silver, and grays are available. Magnetic powder has a larger particle size by design but the coarse nature of the powder seldom interferes with adhesion due to the extremely light forces exerted during application.

Biochromatic powders have been developed which offer photographic contrast regardless of substrate color. These powders are formulated with two main ingredients which produce a dark gray appearance. On light backgrounds, the powders appear almost black, but on dark surfaces have a silver-toned sheen. Tests have shown that most such biochromatic powders have less adhesion than good quality black or gray powders, and that convenience is obtained at the sacrifice of quality. Therefore, biochromatic powders are not recommended for general use.

Method:

Standard impression development powders are most effective on relatively smooth, non-porous surfaces which are dry except for the residue deposit. Textured surfaces or those possessing an inherent coating or film cause excessive, nonselective adhesion, a condition referred to as "painting." Magnetic powders may be used on most non-porous surfaces, but are particularly effective on textured items and certain plastics which tend to resist moisture adherence, such as sandwich and garbage bags. Magnetic powder has been used successfully on phonograph recordings and other ribbed surfaces, due primarily to the coarse particle size and the relative ease of excessive powder removal. However, on surfaces with a coating or film, magnetic powder exhibits a greater tendency to "paint" than standard powders.

Color selection is determined by the tone of the substrate. Except for very dark, dull backgrounds, black powder can be used successfully for photographic preservation as well as lifting. Due to the adhesion superiority of black powders, they should be used when sufficient contrast to background permits.

Powders are formulated to resist moisture absorption from humidity. Containers should be kept sealed between times of usage and the closed jar should be shaken vigorously prior to opening. Lumps which fail to disintegrate from shaking should be discarded. Powders which begin to cake indicate excessive moisture absorption and should be treated or discarded. Caked powders can be dried by spreading the contents on a piece of cardboard and placing in a low-temperature oven or a microwave oven at a lower power.

Powders can be stored in desiccators to reduce the amount of moisture the powders are exposed to and limit the amount of clumping.
Fiberglass brushes reduce the risk of powder supply contamination, but with surfaces displaying a coating suspected to be of a greasy or oily nature, the use of a secondary supply is highly recommended.
Magnetic powders are consumed very slowly in application, since excess recovery is easily accomplished with the magnetic wand. With no actual bristle contact involved, contamination of magnetic powder seldom occurs.

Safety Factors:

Any use of latent powders produces airborne particles which represent a certain degree of health risk. The effectiveness of powders to reveal evidence impression residue has prompted a competition among manufacturers which, in some cases, increased toxicity of some products with no apparent benefit in performance. The presence of lead in white powders a number of years ago created a major concern and ultimately the element was removed. Unfortunately, no adequate substitute has been discovered, and white powder is no longer recommended for processing.

Proper ventilation for the use of fingerprint powders in the laboratory can greatly reduce the quantity of airborne particles and possible inhalation. Fume hoods generally create excessive air movement and make application of powders to the item very difficult. Box-type systems which mount on the wall, similar to devices used by welders, may be effective provided motors and fans move sufficient amounts of air to pull airborne particle away from the examiner. Filter masks or respirators which can filter airborne particles can be used. Disposable masks are acceptable. Respirators with replaceable filter canisters are also effective. Care should be taken to ensure the filters chosen will be able to filter the correct particle size.

Powders applied in a laboratory environment require appropriate safety standards. Ventilation systems, filter masks, or respirators and immediate cleaning of contaminated skin and clothing are essential. A current Material Safety Data Sheet (MSDS) should be obtained for each powder in use in the laboratory. Disposal of old powders should be considered as some of the components have been removed from newer powders.

LIFTING MATERIAL

Description:

Powder and particulate-developed impression should be preserved. Photographic preservation is the first and most important method and once accomplished, may serve as the only preservation technique. Impression residue visualized by powders or particulate is more fragile and susceptible to damage than undeveloped deposits. Accidental contact with any other surface, even packaging, may obliterate or completely remove the developed impression. A second form of preservation exists which preserves the actual evidence, the use of lifting material.

Lifting materials provide a means of capturing the particles adhering to the developed impression, either to effect a transfer preservation or to protect the visualized impression on the surface.

Such lifting material is manufactured with an even coating of adhesive to provide specific degrees of tack or utilizes substances which possess an inherent adhesive quality. Lifting material is divided into transparent and opaque devices with each type designed for prescribed applications.

Opaque lifting materials utilize a natural low-tack quality which attracts the particles of a developed impression upon contact. While the tack is sufficient to successfully remove the particles in the arrangement of the residue outline, the removed particles can be disturbed on the surface. Opaque lifters are supplied with an acetate cover which is applied to the surface after transfer to protect the lifted impression. Opaque lifters are available in white and black in various precut sizes.

Transparent lifting material is more widely used and is available in many variations of the same basic principle: a clear, thin film with an even coating of adhesive designed to be free of defects. The simplest and most effective form is pressure wound produced in rolls and available in widths ranging from one to four inches. Four inch wide tape will usually be most useful for footwear/tire track impressions; however, narrower tapes can be used. The acetate film of lifting tapes can be either, clear and glossy, or frosted. Regardless of type, lifting tapes generally provide versatile and effective means to transfer powder or particulate-developed impressions to another surface specifically selected for the purpose of preservation. The clear glossy tape can be subject to air bubbles which may interfere with presentation of the impression pattern.

Method:

After photographic preservation, transparent lifting materials are generally used in routine lift preservation, while opaque lifting materials are restricted to developed impressions on curved surfaces or visible impressions created by the touching of a dusty surface. Transparent materials preserve impressions in the correct position of contact, while opaque lifters produce a position-reversed image. Such position-reversal complicates a comparison to test impressions which most often requires a photographic intermediate procedure to return to true position. However, the high degree of flexibility inherent in the material of opaque lifters permit successful transfer from round objects when acetate films will fail.

Opaque lifters are used by cutting out a section slightly larger than the area of the developed impression from the available sheet. The protective cover is removed and the exposed rubber section is placed gently but firmly onto the surface bearing the impressions. On round items, initial contact between the lifter and the surface is made at the approximate center of the impression; the material is gently shaped toward the edges. This is a difficult procedure which requires considerable practice to obtain uniform contact without lifter slippage and should only be attempted if photographic preservation is complete and secondary preservation is essential. On a curved surface, the lifter can be rolled from one side of the impression to the other in one slow, continuous motion. The lifter is then removed from the surface and any suitable lifted impressions should be photographed. The plastic protective cover should be replaced in a manner to minimize air bubbles.

With minimum practice, lifting tapes can be easily and effectively used. A small section of the tape end is folded over onto itself, adhesive to adhesive, to form a tab. The tape is then unrolled to a length slightly longer than the area to be lifted.

The tape is placed on the item surface at a spot adjacent to the impression and then the fingertip is run down the center of the tape toward the tab end. From this center anchor, the tape is rubbed toward the edges until the entire section of tape has thorough contact. The tape is removed by pulling the tab slowly from the item. Once disengaged from the item surface, the tape is placed on an appropriate backing in the same manner.

Use of any lifting material during low humidity conditions is sometimes hampered by a static electricity build-up on the acetate covers or tapes. This charge can create an attraction between lifting material and surface which may make control of the material prior to positioning over the developed impression very difficult. Contact of the non-adhesive side of the lifting material with a conductive metal immediately before positioning will dissipate the static charge.

Results:

Lifting material, especially tapes, and opaque lifters provide an excellent means of evidence preservation secondary to photographic preservation. Any deviation from the procedure of photographic preservation followed by lifting must be based upon sound and prudent reasoning. Any destruction of evidence by the lifting method without prior photography must be considered improper and inadequate procedure.

BACKING MATERIAL

Description:

Single layer transparent lifting materials used to remove a developed impression from the surface of deposit must be affixed to another surface for preservation. The type of preservation surface, commonly called backing material or lift cards, greatly affects the final condition and appearance of the completed lift. Generally, only two colors of backing material are required, white for dark powder-developed impressions and black for light powders. However, those examiners restricting powder usage to black and gray will need only white backing material.

While any white material may be used as a lift backing for some occasions, specific surface properties of the backing can add desired clarity and contrast. Absence of noticeable fibers or other defects, uniformity in color and high surface gloss will greatly aid in the observation of characteristics and facilitate evaluations and comparisons.

Commercial lift cards provide the most desired characteristics of lift backing. Available in both white and black, the backing surface is an opaque coating of resinous material that possesses high gloss, flexibility, and strength. Manufactured with superb quality control, these lift cards provide a background surface that offers the ultimate contrast to the developed powder or particulate impression.

Properly developed and lifted impressions placed on appropriate backing material can provide excellent conditions for impression evaluation and comparison. The use of recommended backing materials will produce the required contrast, clarity, and permanence for subsequent examination procedures.

IMAGE PROCESSING EQUIPMENT

Image processing requires a combination of input, processing and output devices. It functions best when all components are integrated and tested as an end to end system. Some common components include forensic image workstation, software, storage media, digital camera, flatbed scanner, and high resolution printing device. When properly integrated, the system is simple to use; however, it is highly specialized for forensic applications and requires advanced training, knowledge and skill.

FORENSIC IMAGE WORKSTATION

Description:
A forensic image workstation is a computer or laptop with a fast high end processor. The workstation requires large amounts of physical memory and a separate non-integrated video card. Separate physical memory and video memory allows the system to perform at peak efficiency without sharing resources. Shared resources increase the risk of conflicts and other hardware errors.

The workstation also has one or two high end computer monitors. When work space is a consideration, one monitor can be used provided it is large enough to display multiple images for comparison work. When space permits, dual monitors are preferred. Images can be displayed with other applications running simultaneously which facilitates note taking. The workstation has image processing software appropriate for forensic use. The software used in processing and analyzing digital images produces consistent results, tracks changes, and allows competent examiners to achieve comparable results. Other applications can run on the forensic image workstation such as e-mail, word processing, and laboratory information system provided the system is tested with these applications running and there are no errors.

Method:
Image enhancement is any process intended to improve the visual appearance of an image. Many digital imaging processing techniques have roots in traditional photography and/or mathematics. Some of the more common techniques include brightness and contrast, cropping, dodge and burn, hue and saturation, color adjustments and invert. More advanced techniques include sharpening, noise removal and pattern removal. These techniques are applied to larger portion of an image and not at the pixel level. They are documented in an audit trail. Techniques that change the image content are strictly prohibited.

The trained forensic scientist applies various processing techniques to improve the visual quality of the impression or to remove background interference which obscures detail. All original images are saved on a secure server (i.e. Foray's ADAMSweb) and processed through this program in an appropriate processing application (i.e. Adobe Photoshop). Through this process, each step of processing is tracked in the metadata of the image and the original and processed image are both saved on the secure server.

DIGITAL CAMERA

A digital camera used for impression evidence work is a professional style single lens reflex (SLR) camera. It can use CCD or CMOS technology.

Typical professional SLR cameras exceed 12 megapixels and have a sensor capable of capturing an area of 4 1/4 inches by 2 13/16 inches while maintaining the necessary image quality for impression evidence work Other unique features of the SLR cameras is that they can accommodate a variety of standard and macro lenses, have adjustable apertures and shutter speeds, can accommodate a variety of light sources including lasers and alternate light sources. SLR cameras can be used on a copy stand or are easily detached and portable for larger objects.

Method**:**
The digital camera is attached to a copy stand. Set the camera settings for the highest quality, no compression, RAW file format. Set white balance based on the lighting source. Properly place an appropriate scale and illuminate the subject with the proper lighting source. Frame the subject in the view finder or live preview window. Set the camera to subject distance in order to fill the frame and achieve comparison quality images. Larger items may be photographed in a series of smaller sections. Focus the camera. Take the picture and transfer it to the forensic image workstation. The camera can be attached to a forensic image workstation for live viewing and storage, or not. When the camera is not attached to a workstation, images can be stored on removable media and transported to a card reader on a forensic image workstation. All images produced in the laboratory shall be stored to the secure server.

FLATBED SCANNER

A digital flatbed scanner is used for images that are flat such as paper. They can make high resolution scans over larger areas (varies depending on the size of the scanner). The light source is contained in the scanner so the object is uniformly illuminated. Flatbed scanners must be connected to a forensic image workstation. Flatbed scanners can have transparency adapters which are used as a source of transmitted light for scanning negatives, transparent lifters and plastic bags. Flatbed scanners have adjustable resolutions. The resolution data is typically added to the metadata in the image file. Some imaging programs will read this meta data so there is no need to set the resolution in the image software.

Method**:**
Scans should be conducted at an appropriate ppi as outlined in Appendix VI: Minimum Digital Imaging Standards & Controls. Enhancement features offered in the scanning software will not be used for scanning of evidence items. All scan images produced in the laboratory shall be stored to the secure server.

HIGH RESOLUTION PRINTER

Description:
A high resolution printer is used to reproduce the finest detail in a footwear or tire track impression. Resolution is rated in dots per inch (dpi). A higher dots per inch value, will resolve finer detail. The number of dots per inch is not the only factor when printing a quality image. The size, pattern and color of the dots all have influence on the quality of the image. This makes inkjet technology a good choice. Some printers use combinations of cyan, yellow, magenta, and black (CMYK) to simulate shades of gray and color. Some inkjet printers have additional colors and grey inks beyond CMYK. Printer drivers can be developed to change the size and patterns of the ink dots.

Method:
See the manufacturer's recommendations for paper and ink type. Verify printer settings. The highest quality may not necessarily be the best setting. Set paper size. Print picture.

MAGNIFIERS

Description:

Optical fingerprint magnifiers provide between 4 and 5 power enlargement of impressions with 4.5X the most commonly available instrument. Generally, the optics consist of several elements, often coated, to magnify the viewed object with a minimum of distortion. Field of view is usually sufficient to observe characteristic relationships without repositioning the magnifier.

Method:

Magnifiers (including horseshoe base magnifiers, column-type magnifiers and binocular headbands) may be utilized in side by side or overlay comparison of physical items (i.e. printed images and physical test impressions).

Results:

High quality magnifiers are a helpful tool for footwear/tire track evaluations and comparisons. While occasionally photographic enlargements or image enhancement may be required to reach conclusions of impression suitability or other approved findings as defined in Section V : Observation, the use of standard fingerprint magnifiers will produce satisfactory results in routine examination procedures.

SPECIALIZED PROCESSING EQUIPMENT

In addition to basic equipment needs related to routine evidence processing, certain specialized apparatus can facilitate portions of various techniques, improve the consistency of results or enable examinations to a greater depth of analysis. Some are employed so infrequently that they cannot be defined as mandatory pieces of equipment while others have adequate, if more complicated, procedural alternatives. No one listing can supply a complete catalog of specialized equipment which may have some application to evidence processing on some occasion.

HEAT/HUMIDITY CHAMBERS

Description:

Environmental chambers or cabinets which permit adjustment of temperature and relative humidity are required to assure the maximum potential from selected processing procedures. Optimum heat and humidity levels can be maintained for post treatment development during ninhydrin processing and pretreatment of items to be processed with amido black.
Environmental chambers are available in various sizes, qualities, and prices. Basic design consists of an insulated cabinet containing heating and cooling elements combined with humidifying/ dehumidifying devices.

Cost is related to construction quality and tolerances of temperature/humidity settings. Evidence impression processing benefits from environmental control occur within a relatively broad range of temperatures and humidity fluctuations so that precise maintenance levels are not critical. Changes of +/- 10˚C or +/- 5% RH do not appear to affect the reliability of reactions except in terms of time requirements.
Adequate storage space and construction quality are important factors. Unreliable components and excessive condensation may present conditions in which evidence is damaged by the chamber. Unfortunately, large volume and component integrity are associated with high cost.

Method:

The need for humidity to produce effective ninhydrin-amino acids chemical reaction must be balanced with the solubility of the amino acids in water. Heat/humidity chambers should function at 70% RH in a temperature range from ambient to 80˚C. Higher temperature operation should not produce condensation which can diffuse amino acids. Dry, processed articles are placed in the prepared chamber. Slightly better results are obtained from exposing the items to a temperature of ambient or a little above with a relative humidity of 70%. An acceptable alternative is exposure to a temperature of 50˚ to 80˚C at 70% relative humidity for five minutes.

Results:

Heat and humidity at the prescribed ranges will produce uniformly consistent ninhydrin-amino acids chemical reactions with minimal residue diffusion and background discoloration. Developed suitable evidence impressions require photographic preservation.

FORENSIC LIGHT SOURCES

Description:

Routine examination and photographic requirements usually can be accomplished with the aid of incandescent lamps, such as photo flood lights or quartz lamps especially designed for camera illumination. These sources provide white light saturation ample for most tasks although they generate heat which may be detrimental to some types of sensitive evidence. Other light sources may provide facility and convenience for particular articles of evidence or may yield additional or superior evidence when applied toward photographic preservation. These include fluorescent light boxes, fiber optics illuminators, ultraviolet, fluorescent light sources and infrared viewing systems. In addition, lasers and alternate light sources may be utilized as a light source without regard toward actual evidence examination.

Utilization of forensic light sources generally improves the quality of photographic preservation of evidence impressions. Occasionally, such attempts toward best evidence recording reveals information not previously observed or removes interference which prohibited full visualization of suspected deposits. Application of specialized lighting when conventional illumination is unsuccessful may produce satisfactory preservation results.

Method:

Fluorescent light boxes with frosted glass or plastic diffusers provide an excellent back lighting source. Transparent or translucent items placed on the light box may reveal better detail and permit easier and more complete photographic recording than with reflected light.

Fiber optic illuminators provide a highly controlled, maneuverable light source which can easily be positioned to provide directed illumination with irregularly-shaped surfaces. Evidence impressions located in recesses, may be successfully illuminated when conventional lighting techniques would create masking shadows. Most fiber optic illuminators have irises which permit control of light intensity and have heat absorbing filters which permit illumination of sensitive materials. A fiber optics beam directed into the edge of some plastics produces an effect similar to fluorescence with impression residue.

Fluorescent illuminators, such as those that are used in microscopic examinations, provide a softer more diffuse light source. This type of light has been found to be very beneficial when photographing highly reflective surfaces such as chrome, plastics or metal plated objects. This type of lighting is very versatile in its applications and produces a very sharp, detailed image on the negative.

Ultraviolet and infrared viewing systems may be useful in reducing the interference of certain inks. Ultraviolet illumination may be utilized to create background fluorescence on surfaces such as cardboard or cloth to enhance chemically-developed evidence impressions. When used with Ardrox P133D staining, ultraviolet illumination, particularly from high intensity light sources, is highly productive.

Alternate light sources have vastly improved over the years and the intensity that can be delivered by these sources has also improved. Lasers are still superior in the amount of watts that can be delivered to illuminate a surface for fluorescent examinations. However, the advent of continuously tunable filtration in alternate light source systems shows great potential. This allows the examiner to fine tune the wavelength of light so that the impression fluoresces while any background fluorescence is minimized. This can improve the contrast with impressions that may show a weak fluorescence, and may be obliterated by background fluorescence, such as with some zinc chloride developed impressions. This ability to continuously fine tune the filtration provides an aspect not available with lasers.

Using the alternate light sources is beneficial in that some substrate or residues may show more contrast using specifically filtered wavelengths of light as opposed to the broader spectrum of a basic fiber optic illuminator. This may provide a contrast that makes the photographic preservation simpler or may produce a contrast that could not be achieved by other means.

Lasers may be used in a similar manner to fiber optics illuminators, especially where high intensity, oblique lighting is required. Since the beam is applied as a light source rather than a means of luminescence excitation, no wide band pass filter is necessary.

CYANOACRYLATE FUMING CABINETS

Typically, cyanoacrylate fuming chambers are enclosures that can be sealed in order to contain the cyanoacrylate fumes and provide the appropriate environment for processing the evidence. Often these are containers such as aquariums with plexiglass lids or some other type of enclosure that has been manufactured by the user to accommodate the evidence to be processed; however, commercially manufactured fuming chambers are available. Humidity is usually provided for by placing a warm container of water in the enclosure. Heat for the volatilization of the cyanoacrylate ester is provide for by light bulbs, hot plates or other devices that produce appropriate levels of heat.

If properly sealed, with an adequate amount of cyanoacrylate ester and humidity, any container can be used to produce the desired results. Manufacturers of fingerprint supplies have produced several chambers that all can produce satisfactory results. The examiner must monitor the evidence to insure that items are not over exposed to the cyanoacrylate fumes.

IODINE FUMING CABINET

Iodine fuming cabinets, once a staple of latent print processing areas, have practically disappeared in most laboratories. The ineffectiveness of iodine vapor to visualize impression more than ten days after deposit and the effectiveness of ninhydrin to develop older impressions resulted in an almost total abandonment of iodine fuming. However, with the discovery of 7,8-benzoflavone enhancement of iodine-visualized impressions and the very low destructive potential of iodine, iodine fuming cabinets may be considered as a viable addition to evidence processing equipment.

Commercially manufactured cabinets are available which use an electric heater to speed the iodine crystal sublimation. An iodine fuming cabinet can be constructed using wood and glass which will function well without danger of corrosion. A diagram is included in this appendix that provides the general construction guidelines. Modification may be preferred, especially in the heat source and baseboard, to avoid safety and health risks. An electric bulb can be used in lieu of the alcohol burner, and that removes the need for asbestos. The essential design features are a sealed chamber with a well-fitting lid, at least one glass viewing window, and supports for a moveable device to hold items suspended in the vapor atmosphere.

IODINE FUMING GUN

A hand held enclosure which permits directed dispersal of sublimated iodine fumes is called an iodine fuming “gun.” The device is a glass tube which holds the iodine crystals through which air is passed. One method required blowing into the tube through rubber tubing where the heat from the breath combined with the heat from the hand increase the sublimation rate of the iodine crystals. However, since moisture mixed with the iodine vapors can react with starch sizing in paper to cause a permanent blue discoloration, calcium chloride is used as a desiccant. Commercially available iodine fuming guns generally are a single tube arrangement with the iodine and calcium chloride separated by glass wool or cotton. As the calcium chloride absorbs water from the breath, it hardens, and unless the tube is cleaned thoroughly after every use, the device may be rendered inoperable. An alternative design uses two tubes as illustrated in the appendix diagram. The separate calcium chloride tube must be cleaned after use, but if neglected, a substitute tube is easily

fashioned. The two tube gun also permits easier replacement of iodine crystals during lengthy examination.

The calcium chloride tube can be omitted if a squeeze-type air bulb is used. An air bulb also prevents any possible mishap resulting from accidental inhalation when using the gun requiring breath. Air bulbs with metal valves, however may be corroded with prolonged usage and become inoperable. Rubber valve air bulbs do not present this problem.

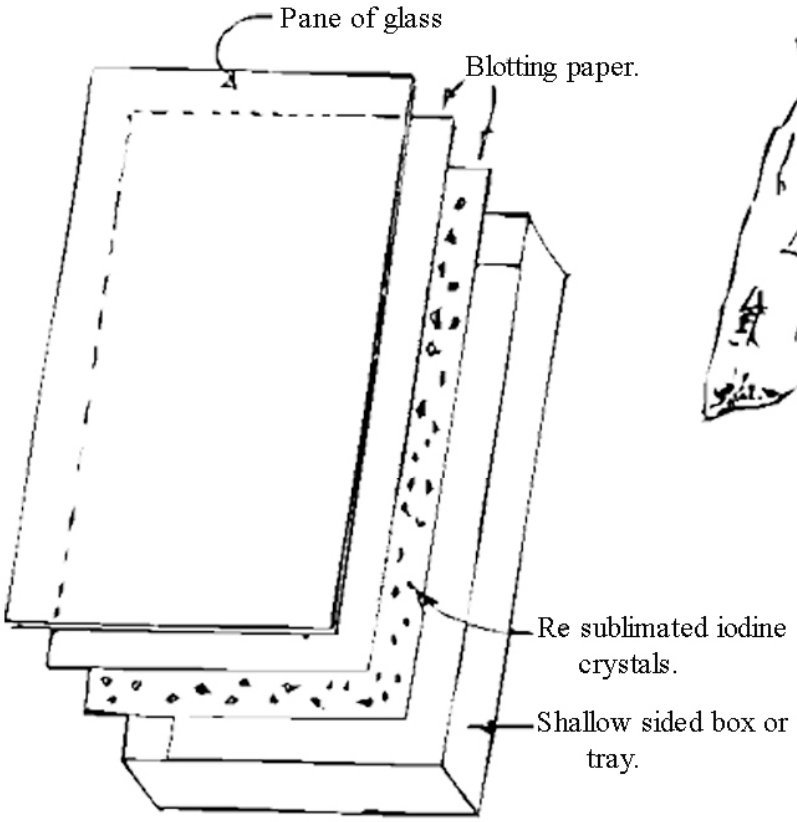
Iodine fuming guns are used by heating the iodine crystals with the hand or placing the gun near a burning light bulb until purple vapor can be seen in the glass wool. The exit port of the tube is placed near the area to be examined and air is padded into the tube because the vapors are not contained, reactions may fade quickly, so prolonged exposure is usually required.

SPRAYERS

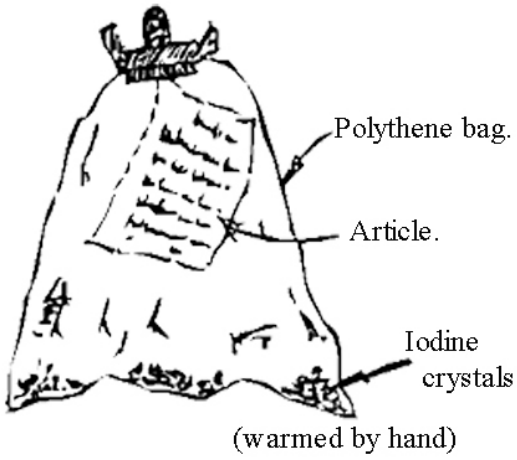
There are quite a variety of commercial sprayers available from numerous suppliers. Some sprayers consist of a metal canister which contains the propellant and a small plastic straw which fits on the bottom of the sprayer. The straw is then immersed into the container of the material to be sprayed. By pressing down on the directional button on the top of the sprayer, the material can be applied to the desired target. Other sprayers operate in much the same manner but come with glass or plastic containers which can be attached to the sprayer unit. The material to be sprayed is poured into the container and attached to the sprayer unit. Caution must be used to avoid using sprayers with metallic internal parts when using chemicals which react with metal ions such as 8-Hydroxyquinoline.

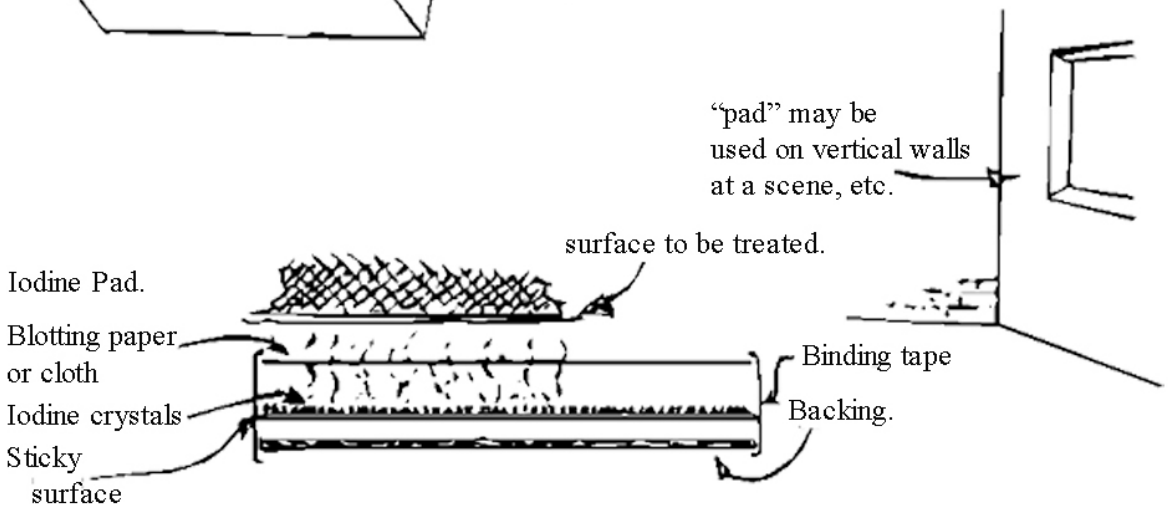
Diagrams of simple iodine fuming methods.

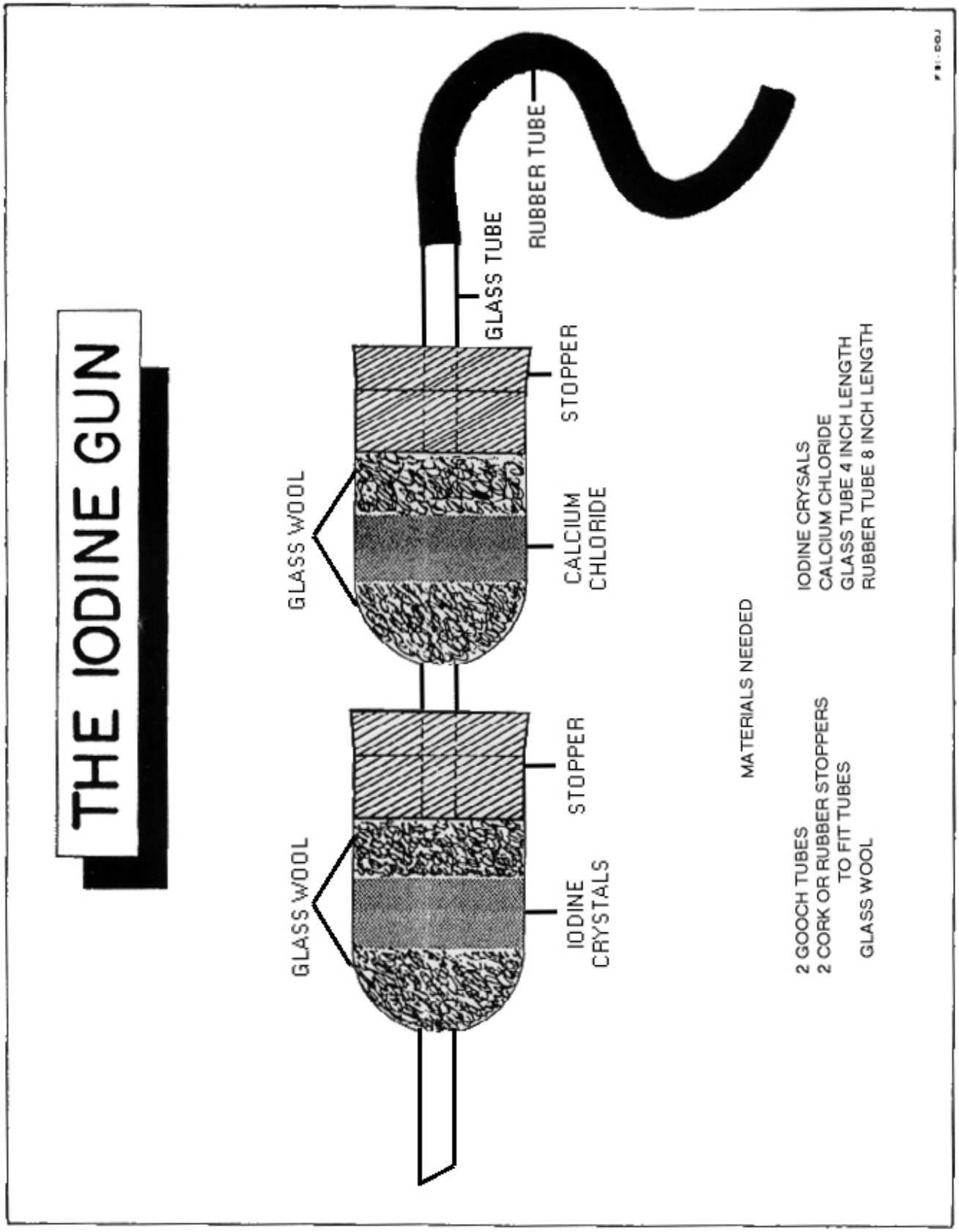
Iodine fuming box.



Polythene bag treatment.







ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX V: CLEAN TECHNIQUE PROCEDURE FOR NON-DNA PERSONNEL

Reviewed by:

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Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

_____

Brian Mayland
Patterned Evidence Program Manager

APPENDIX V

CLEAN TECHNIQUE PROCEDURE FOR NON-DNA PERSONNEL
INTRODUCTION

To minimize contact by analysis in other disciplines with potential DNA evidence, agencies will be required to inform the laboratory at the time of submission of the case if the case requires DNA analysis. This Clean Technique Procedure must be followed by any forensic scientist or evidence technician when handling evidence that has been designated for DNA analysis, but the evidence has not yet been to the DNA section for analysis. This situation will occur routinely due to things such as safety issues (like clearing a firearm) or preservation of evidence (micro/trace evidence critical as in EVH 26). Good communication with the submitting agency would help ensure that evidence needing DNA analysis goes to the DNA section first, so that non-routine situations requiring non-DNA scientists to handle DNA evidence is minimal and to comply with TCH 21. If, however, you open an exhibit which did not have a reasonable potential for DNA evidence and you see a potential body fluid stain that could be significant, immediately stop work and contact a DNA analyst for advice and assistance.

1. The analyst must wear a mask, lab coat with disposable sleeve covers or disposable lab coat and gloves while examining any potential DNA evidence.

   A. The gloves must either be sterile or the gloves must be bleached and then dried with a paper towel after the gloves are put on. Gloves must be changed between exhibits. Gloves must also be changed after handling non-evidence items prior to returning to casework. These non-evidence items may include but are not limited to, refrigerators/ freezers, biohazard waste bins, equipment, computers and telephones. Gloves should be changed following common sense and clean technique.

   B. The face mask must be worn over the nose and mouth to prevent the transfer of aerosols from both the nose and mouth of the analyst to the evidence. Whenever the mask is removed from the face it must be disposed of and a new mask used. For example, if an analyst removes the mask to talk on the phone, the mask must be disposed of, not hung around the neck or placed on the counter and reused.

   C. Lab coats must be fully buttoned or snapped.

2. First decontaminate the surface on which samples are to be processed with a 10% bleach solution. Wet the surface (counter top, lab bench, etc.) that will be utilized to examine evidence thoroughly with 10% bleach solution. Spread the 10% bleach solution across entire surface with a paper towel. Ensure surface is dry before examining evidence. Don't store beach solutions in open containers. Replace the bleach solutions daily with a fresh bleach solution.

3. All instruments which will be used to process forensic samples (e.g., forceps, scissors, scalpel/razor blades, pipetters and metal probes) must be decontaminated by autoclaving or rinsing with a 10% bleach solution. Caution: some surfaces may resist wetting and will

require addition of a detergent. In addition, these items may also be placed under an ultraviolet light source for at least 15 minutes. Note: UV light will not destroy DNA on surfaces that are not directly exposed to the light.

4. Place evidence samples in clean containers or on clean surface for processing. Large glassine weighing papers, butcher paper, or similar type clean disposable paper are suggested.

5. Use a 10% bleach solution to rinse or wipe instruments between samples. Instruments may be rinsed with distilled water. After rinsing with a 10% beach solution, use kimwipes or similar disposable type wipe to wipe the instrument. Use a new kimwipe or similar disposable type wipe each time.

6. Exhibits will be processed one at a time. Put away the previous exhibit before opening the next exhibit. Clean instruments, new gloves, and fresh paper must be used for each exhibit.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACK PROCEDURES MANUAL

APPENDIX VI: MINIMUM DIGITAL IMAGING STANDARDS & CONTROLS

Reviewed by:

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Forensic Scientist Aimee Stevens, Chairperson
Footwear/Tire Track Command Advisory Board

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Brian Mayland
Patterned Evidence Program Manager

APPENDIX VI

MINIMUM DIGITAL IMAGING STANDARDS & CONTROLS

I. Record Images – Images made for documentation purposes that will not be used for analytical purposes.
   a. File formats and resolution are not restricted for record images. Compression is allowed provided the necessary image quality is achieved.

II. Analytical Images – Images from which scientific analysis will be conducted.
   a. Images produced in the laboratory shall all be taken in the proprietary language of the camera (RAW format). Compression is not allowed.
   b. While a resolution of 1000 ppi is desirable, this cannot always be achieved due to the physical size of footwear and tire evidence. Images should be obtained at the highest possible resolution that can be achieved based on the evidence received. A minimum of 300 ppi is suggested. For capturing detail, smaller regions of interest can fill the frame for additional photographs in order to optimize resolution in these areas.
   c. While high resolution, uncompressed, RAW format images are preferred, images produced by submitting agencies may deviate from these criterion. Any deviation from these criterion shall be documented thoroughly in the case notes. This documentation shall include potential limitations created due to the quality of the submitted images.
   d. Images produced using a flatbed scanner should minimally be scanned at 600 ppi in TIFF format. In the event that a large area or item must be scanned and the file size at 600 ppi is prohibitive, the minimum resolution for scans shall not be lower than 300 ppi.

III. Original Image Requirements
   a. All original images (submitted by an agency or produced in the laboratory) shall be retained on a secure server (currently Illinois State Police Foray Authenticated Digital Asset Management System [ADAMS]).
   b. All original images produced in the laboratory shall contain a scale as outlined in the Footwear/Tire Track Procedures Manual, Appendix II : Minimum Standards & Controls.

IV. Processed Image Requirements
   a. Image processing and annotating will be performed in an appropriate processing application (currently Adobe Photoshop) on a working copy of the image through the secure server program (currently Illinois State Police Foray ADAMS).
      i. If needed, the image must be calibrated in an appropriate processing application.
      ii. Steps used in processing of the image shall be documented in the metadata of the image.

iii. All processed images depicting a suitable impression must be associated with the case number, item number and impression designation, date of capture and examiner identification. While most of these fields are present in the secure server program, item number and impression designation may need to be added in one of the following ways :
    1. visually appear in the image via physical presence on or next to the evidence item being photographed
    2. appear in a text layer of the image
    3. appear in the asset name
    4. appear on a scan of a marked up printed image associated with the original and processed images

iv. All processed images that do not depict a suitable impression or that have not been analyzed for suitability must be associated with the case number, item number, date of capture and examiner identification. While most of these fields are present in the secure server program, the item number may need to be added in one of the following ways:
    1. Visually appear in the image via physical presence on or next to the evidence item being photographed
    2. Appear in the asset name
    3. Be embedded in the file name or digital data of the image
    4. Be associated to the image file name via note-taking (for agency submitted images)

V. Adding Digital Images to LIMS
    a. Any images that will be entered to the matrix in LIMS must be exported in JPEG format. This file compression must be mentioned in the note-taking for the panel where the image will be added.
    b. Any images entered into LIMS shall NOT be used for future examination. Original and processed images from the secure server shall be used for any future examinations.
    c. Images exported in JPEG format for entry into LIMS do not need to be stored to the secure server.

REFERENCES

ANSI/ASB Best Practice Recommendation 050, 1st Ed 2021 : Errata 1, 2022 : Best Practice Recommendation for Photographic Documentation of Footwear and Tire Impression Evidence (Organization of Scientific Area Committees Registry)

Scientific Working Group on Imaging Technology (SWGIT). Section 5 – "Guidelines for Image Processing", Version 2.1 2010.01.15.

SWGIT. Section 11- "Best Practices for Documenting Image Enhancement", Version 1.3 2010.01.15.

International Association for Identification (IAI). Resolution 97-9, Recognizes that electronic/digital imaging is a scientifically valid and proven technology.1997

Witzke, David. "Advanced Forensic Digital Imaging Processing ", Foray Technologies. 2010. On-line User Manual version 2.0 Foray Technologies' Authenticated Digital Asset Management System (ADAMS) 2008.