# LATENT PRINT

# ANALYTICAL METHODS

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# Revision History

| Revision # | Description of Changes |
|---|---|
| 1 | Ready for Qualtrax – no content changes |
| 2 | Formatting and grammatical changes throughout; content changes to sections: General Latent #1 - 5.1; Lifting Methods #5 - 4.16, 4.18; Taking Known Exemplars #9 - 4.1.2.4, 4.4.3.3; 1, 8 Diazfluoren-9-one (DFO) #12 - 4.7; 1, 2 Indanedione #14 - 5.2.1; Ninhydrin #17 - 4.1.6; Physical Developer #19 -3.2; 5.1.1, 5.1.3; RAM#20 - 5.3.1; Digital Imaging Procedure #23 - 4.1.3.1, 4.1.4.2, 4.1.5; Friction Ridge Examination Methodology #24 - 4.1.8, 4.1.11, 4.2.4; and ABIS #25 - 4.4.7, 4.4.8, 5.4.3. Moved section 1, 2 Indanedione #14 -4.5 to 5.1.1. Added sections: Lifting Methods #5 - 4.1.7; Digital Imaging Procedure #23 - 4.1.3.2, 4.3.2 and ABIS #25 - 1.12, 1.13. Added methods 1, 2 Indanedione Thermal Paper (TP) #15 and method ThermaNin #18. Deleted sections: ABIS #25 - 5.1.2 and 5.2.2. |
| 3 | Fix revision # on Revision History and correct incorrectly numbered footers. |
| 4 | Correct numbering in methods 1, 4, and 11; minor wording and grammatical changes throughout; content changes to sections: General Latent #1- 2.1.3 and 4.2; Krimesite Imager #3-3.0; Powder Detection Methods #6-2.3.2; Small Particle Reagent #7- 4.2 and 5.1.2; Cyanoacrylate Ester #11-4.4; 1, 2 Indanedione #14-2.1; Digital Imaging Procedure #23 -4.1.3.2; and Friction Ridge Examination Methodology #24-1.7, 4.1.1.2, 4.1.3, and 4.1.9. |
| 5 | Minor wording and grammatical changes and numbering correction throughout. Content changes/additions to General Latent #1 – 1.5, 2.1, 2.1.4, and 4.4; Lifting Methods #5 - 4.1.5; Sticky-Side Powder #8 – 2.5; 1,8 Diazafluoren-9-one – 4.6.2; Leucocrystal Violet #16 – 2.4 and 3.2; Ninhydrin #17-4.1.4; RAM #20 – 4.3; Rhodamine 6g #21 - 1.2, 4.5, and 5.1.1; Digital Imaging Procedure #23 – 4.1.1.5; Friction Ridge Examination Methodology #24 – 4.1.8 and 4.4.1; and ABIS #25 – 4.1.1, 4.4.6.3 and 4.4.7. |
| 6 | Minor wording, grammatical changes, and numbering correction throughout. Content changes to General Latent #1 – 1.9, 5.1; Alternate Light Source #2 – deleted 1.5, 1.6, 4.6; Krimesite Imager #3 – 5.3.4; Lifting Methods #5 – 3.0; Small Particle Reagent #7 – 5.3.1; Sticky-Side Powder #8 5.2.1; Cyanoacrylate Ester #11 – 4.1.3, 4.3.14, 4.4.10; DFO #12 - 4.6.1; 1, 2, Indanedione #14 – 2.1, 2.2, 4.2; 1, 2 Indanedione Thermal Paper – 4.2; Leucocrystal Violet #16 - deleted 2.2; Ninhydrin #17 – 4.2.3, 4.2.3.3; ThermaNin #18 – 5.1.3; Physical Developer #19 – 3.1, 4.5; RAM |

| | |
|---|---|
| | #20 – 3.1, 4.3; Rhodamine 6G #21 – deleted 5.1.2; Digital Imaging Procedure #23 – 4.2.3; Friction Ridge Examination Methodology #24 – 4.2.4.1, 4.3.1-4.3.3; ABIS #25 – 4.1.1, 4.1.4, 4.1.5, 4.1.7, 4.3.4, 4.4.5, 4.10.6, 4.12.3, 5.1.1, 5.2 |
| 7 | Convert to pdf following automated conversion system error - no other changes were made |
| 8 | Minor wording, grammatical changes, and numbering correction throughout. Content changes to General Latent #1 – 1.3, 1.9, 4.2.1, 5.1; Krimesite Imager #3 – 2.6; 1, 8 DIAZAFLUOREN-9-ONE (DFO) #12 – 1.1, 5.2.2; 1,2 Indanedione Thermal Paper (TP) #15 – 5.1.2; Leucocrystal Violet #16 – 1.1, 5.3.2; Ninhydrin #17 – 4.1.4, 4.2.3.2, 4.2.4, 5.3.2; ThermaNin #18 – 5.1.3; RAM #20 – 4.3, 4.5; Digital Imaging Procedure #23 – 1.8, 4.1.6.3, 4.3.1; ABIS #25 – 1.14, 4.1, 4.4.8 |
| 9 | Removed Krimesite imager #3, renumbered remaining sections. Updated background/references throughout; updated scope of methods #13, 15-18, 21. Content changes to methods #2, section 4.1 & 4.2; #5, section 5.2.1; #8, section 4.2.2 & 4.2.6; #9, section 2.3 & 5.2.2; #10, sections 4.4.4, 4.4.10 & 5.3.3; #11, section 5.2.2; #12, section 4.7; #13, section 4.2; #14, section 3.1, 5.3.4; #15, section 4.2, 4.6, 5.3.1, add 5.3.2; #16, sections 4.1.4, 4.1.6, 4.2.2, 4.2.7, 5.3.2; #17, section 5.3.5; #18 modified to included maleic acid; #19, section 4.4, 4.5; #20, section 4.5; #21, section 3.3; #22, section 4.2.3, 4.4.1, 5.1.1.1-5.1.1.5, 5.2.2, 5.3.2; #23, section 4.1.2.2.1, 4.1.3, 4.5.3; #24, section 4.3.2, 4.4.1, 4.4.1.3, 4.4.2.1, 4.4.3.4, 4.4.5, 5.1, 5.2.1, & remove 4.4.5.1. |
| 10 | Minor wording, grammatical changes, and numbering correction throughout. Changed references from ABIS to MBIS throughout. Content changes to General Latent #1, section 5.1; Amido Black, section 1.3; and MBIS#24 updates throughout. |
| 11 | Minor wording, grammatical changes and numbering correction throughout. Content changes to methods #1, sections 1.1, 1.4, 1.5, 2.3.2.3, 5.1; #4, section 4.1.4; #5, sections 2.1, 2.6; #6, section 1.1; #7, section 1.1; #8, sections 2.1, 2.2, remove 3.2, 4.2, & 5.2.1-5.2.3; #10, sections 1.8, 3.1, 3.2, 4.1, remove 4.4; #13, sections 5.3.3-5.3.5 & 5.3.8; #14, sections 3.3, 5.2.2; #15, remove 1.4; #16, sections 3.4, 4.1.6, 4.2.3; #17, section 3.3; #21, section 4.7; #22, sections 4.1.6.3, 4.4.2, 4.4.4; #23, sections 1.11, 4.1.1, 4.1.1.1-4.1.1.4, 4.1.2.2, 4.1.2.2.1, 4.1.3, 4.1.5, 4.1.9, 4.2.4.1-4.2.4.2, 4.3.1, 4.3.1.1, 4.3.2.1; 4.3.2.2.3, 4.3.3.1-4.3.3.2, 4.5.1; #24, sections 4.1.6, 4.1.7, 4.3.3, 4.3.3.2, 4.4.3.1-4.4.3.3, 4.4.3.6, 4.4.4, 5.2.1, 5.4.1, 5.4.2, 5.5.1. |
| | |

# General Latent #1

## 1.0 Background/References

1.1 The discipline of Latent Print Analysis is the process of assessing the data in two impressions and determining if that evidence is in support of having originated from the same source or a different source of friction ridge skin.

1.2 It is a discipline based on the development and comparison of multiple levels of detail such as pattern type, ridge characteristics (also known as minutiae), ridge shapes, etc. between a latent print and a known print.

1.3 An impression that contains sufficient quality and quantity of friction ridge features can be identified to, or excluded from, a source.

1.4 The principles behind latent print evidence are that friction ridge skin is highly discriminating and friction ridge skin is generally persistent, in that the friction ridge arrangement stays relatively consistent throughout a person's life.

1.5 It is the combination of discriminating features and persistence that allow for a source conclusion.

1.6 This Analytical Method defines both technical procedures for processing the majority of evidence encountered by the Latent Print Discipline and comparison methodology.

1.7 Idaho State Police Forensic Services – Quality/Procedure Manual Section on NORMATIVE REFERENCES.

1.8 The United States Department of Justice - Uniform Language for Testimony and Reports for the Forensic Latent Print Discipline – ULTRs are published at https://www.justice.gov/olp/uniform-language-testimony-and-reports

1.9 Forensic Science International Vol. 294, 2019. "Measuring the water content in freshly-deposited fingermarks," Pages 204-210. Or Keisar, Yair Cohen, Yacov Finkelstein, Natalie Kostirya, Roey Ben-David, Albert Danon, Ze'ev Porat, Joseph Almog.

*Additional references are listed within individual procedures.

## 2.0 Scope

2.1 These methods will describe procedures and techniques that are *routinely* used in the examination of evidence. These methods cannot be expected to address each and every situation or type of evidence encountered.

2.2 The individual analyst must exercise sound judgment in selecting the methods at their disposal which will best suit the requirements of the evidence submitted in a specific case; therefore, these procedures are designed to accommodate the majority of evidence encountered.

2.3 For the purpose of this manual, latent print methods are divided into four categories: light based processing methods, physical processing methods, chemical processing methods, and comparison methods.

2.3.1 LIGHT BASED METHOD (Method#2)

2.3.1.1 Latent prints may be visualized through the use of various angles and wavelengths of light.

2.3.1.2 Visualization of latent prints through the use of forensic lighting methods is non-destructive and should be attempted prior to other processing methods.

2.3.2 PHYSICAL METHODS (Methods #3-8)

2.3.2.1 The development of latent prints through the use of physical methods does not involve a chemical reaction between the impression and the method used.

2.3.2.2 Physical methods encompass dusting and other discoloration methods often relying on the adhesive quality of certain latent prints.

2.3.2.3 The taking of known exemplars from an individual shall be considered a physical method for the purposes of this manual.

2.3.3 CHEMICAL METHODS (Methods #9-21)

2.3.3.1 The development of latent prints through the use of chemical methods occurs because of a chemical reaction between the latent print residue components and the reagent.

2.3.4 COMPARISON METHODS (Methods #22-24)

2.3.4.1 Latent prints are often stored, processed, and charted through the use of digital imaging software and storage solutions.

2.3.4.2 Latent prints are routinely entered into and searched against large databases of biometric data in an effort to find the originating source.

2.3.4.3 Latent prints are examined and compared using ACE-V methodology.

## 3.0 Equipment/Reagents

3.1 N/A

## 4.0 Procedure

4.1 Latent print evidence is processed according to the nature of the substrate (surface) to be processed.

4.1.1 Substrate types include porous, semi-porous, and non-porous.

4.1.2 Consideration should be given to the color and texture of the surface in order to determine which technique will provide suitable contrast.

4.1.3 Processing is generally carried out in a sequential manner employing methods appropriate to the substrate type.

4.1.4 ISP Forensic Services Latent Section reserves the right to process evidence items as a whole when items are not listed and/or submitted individually (e.g. bag of miscellaneous items).

4.2 Latent print evidence is also processed with regards to the composition of the latent print matrix. For example, a latent print may be composed of perspiration, blood or other contaminant, or a combination thereof.

4.2.1 Eccrine sweat glands are most concentrated on the palmar portion of the hands and plantar portion of the feet. Secretions from these glands consist ~20-70% water content with the remainder as solids (organic substances and inorganic salts).

4.2.2 Latent prints may also consist of fats and oils (sebum) secreted by the sebaceous glands. These glands are most concentrated on the nose, ear, and groin areas. They are not located on the palmar portion of the hands and plantar portion of the feet, but sebum may be transferred to these areas via contact with other portions of the body.

4.2.3 Fats, oils, and other contaminants may also be transferred to friction ridge skin by contact with sources external to the body.

4.3 Latent print processing generally proceeds from the least detrimental technique to the most detrimental technique.

4.4 Impressions developed in the lab and deemed suitable for further analysis shall be marked and preserved.

4.4.1 Fingerprints of known orientation may be marked with an arc above the print.

4.4.2 Palm prints and fingerprints of indeterminate orientation may be marked with a line or partial bracket.

4.4.3 Upon marking, latent prints will be given a unique identifier consisting of the item number followed by the latent number (i.e. 1.1).

## 5.0 Comments

### 5.1 QUICK REFERENCE SEQUENTIAL PROCESSING GUIDE

*Processing steps indicated by bold typeface are a base requirement that shall be conducted when processing a specific evidence type.* Other types of evidence, not included in this guide, may require different processing steps. In addition, some evidence may have a combination of surface types. Non-routine and combination types of evidence should be considered as they are encountered. *If the base requirement is not performed or additional steps are added to the sequence, the analyst shall have adequate documentation in their notes to justify the necessity of the change. Justification shall be to the extent that another qualified analyst would come to the same conclusion (e.g. not processing the adhesive side of a label when there is no evidence it was accessed by the subject or not proceeding with powder processing due to excessive adhesion to the background).*

*When changes to processing necessitate not following the recommended sequence and/or require the elimination of two or more base requirements (excluding* **VISUAL** *examinations), or the addition of two or more methods, the analyst shall contact the discipline lead to request a deviation as defined by the ISPFS Quality Procedure Manual. Documentation of the approved deviation is required in the case record.*

GENERAL EVIDENCE:

POROUS:

1. **Visual**: White light
2. Alternate Light Source (ALS)
3. Iodine Fuming
4. Visual:  White light
5. 1,8 Diazafluoren-9-one (DFO)
6. Visual: ALS
7. **Ninhydrin**
8. **Visual:** White light
9. 1,2 Indanedione
10. Visual: ALS
11. Physical Developer
12. Visual: White light

NON-POROUS:

1. **Visual**: White light
2. ALS
3. **Cyanoacrylate Fuming**
4. **Visual:** White light
5. **Dye Stain(s)**
6. **Visual: ALS**
7. **Powders:** Luminescent or non-luminescent
8. **Visual:** White light and/or ALS

BLOOD EVIDENCE:

POROUS:

1. **Visual**: White light
2. ALS/UV (background luminescence)
3. **Ninhydrin** or **Leucocrystal Violet (LCV)** or **Amido Black/De-stain**
4. **Visual:** White light

NON-POROUS:

1. **Visual**: White light
2. ALS/UV (background luminescence)
3. **Cyanoacrylate Fuming**
4. **Visual:** White light
5. **Amido Black/De-stain** or **Leucocrystal Violet (LCV) or Ninhydrin**
6. **Visual:** White light
7. **Dye Stain**
8. **Visual: ALS**
9. **Powders:** Luminescent or non-luminescent
10. **Visual:** White light/ALS

GLOSSY PAPER/GLOSSY CARDBOARD/PHOTO PAPER:

**Glossy Side**

1. **Visual**: White light
2. ALS
3. Iodine
4. **Cyanoacrylate Fuming**
5. **Visual:** White light
6. **Powders:** Luminescent or non-luminescent
7. **Visual:** White light/ALS
8. 1,8 Diazafluoren-9-one (DFO) or Ninhydrin or 1,2 Indanedione
9. Visual: White light or ALS
10. Physical Developer
11. Visual: White light

**Non-glossy side** - process as for porous evidence

THERMAL PAPER:

1. **Visual**: White light
2. Alternate Light Source (ALS)
3. Iodine Fuming
4. Visual: White light
5. **ThermaNin or 1,2 Indanedione Thermal Paper**
6. **Visual: White light or ALS**
7. Physical Developer
8. Visual: White light

LEATHER:

1. **Visual**: White light
2. ALS
3. **Cyanoacrylate Fuming**
4. **Visual:** White light
5. **Powders**: Luminescent or non-luminescent
6. **Visual:** White light/ALS

PAINTED SURFACES:

1. Latex Paint: process as for porous evidence
2. Semi-gloss/enamel paint: process as for non-porous evidence

SEMI-POROUS (e.g. Rubber/Synthetic gloves):

1. **Visual**: White light
2. ALS
3. Iodine
4. Visual: White light
5. **Cyanoacrylate fuming**
6. **Visual**: White light
7. **Ninhydrin or 1,8 Diazafluoren-9-one (DFO) or 1,2 Indanedione**
8. **Visual:** White light or ALS

9. **Dye Stain**
10. **Visual: ALS**
11. **Powders:** Luminescent or non-luminescent
12. **Visual:** White light/ALS
13. Physical Developer
14. **Visual:** White light

TAPE:

Non-adhesive side of non-porous tape:

1. **Visual**: White light
2. ALS
3. **Cyanoacrylate Fuming**
4. **Visual**: White light
5. **Dye Stain**
6. **Visual: ALS**
7. **Powders**: Luminescent or non-luminescent
8. **Visual:** White light/ALS

Adhesive side of tape (consider method that contrasts with the color of the tape):

1. **Visual:** White light
2. ALS
3. **Gentian Violet** or **Small Particle Reagent** or **Sticky-Side Powder**
4. **Visual:** White light

OR

1. **Visual:** White light
2. ALS
3. **Cyanoacrylate Fuming**
4. **Visual:** White light
5. **Dye Stain**
6. **Visual:** ALS

VARNISHED WOOD:

1. **Visual**: White light
2. ALS
3. **Cyanoacrylate fuming**
4. **Visual:** White light
5. **Dye Stain (water based reagent if appropriate)**
6. **Visual:** ALS
7. **Powders:** Luminescent or non-luminescent
8. **Visual:** White light/ALS

WET SURFACES:

POROUS:

1. **Visual**: White light
2. ALS
3. Dry to room temperature
4. Visual: White light/ALS
5. **Physical developer**
6. **Visual:** White light

NON-POROUS:

1. **Visual**: White light
2. ALS
3. **Small Particle Reagent (SPR)**
4. **Visual:** White light

EXEMPLARS FROM HUMAN SKIN:

Decomposing and/or Macerated Friction Ridge Skin (water soaked)

1. Ink and/or powder lift method (if possible)
2. Photography

Mummified Friction Ridge Skin (dried)

1. Ink and/or powder lift method (if possible)
2. Photography
3. Casting
4. Attempt to re-hydrate (kit available)

Burned Friction Ridge Skin

1. Photograph
2. Ink

# Alternate Light Source #2

## 1.0 Background/References

1.1 Alternate light sources (ALS) are portable, multi-waveband, and tunable light sources that are used to enhance or visualize potential items of evidence. Latent impressions may be composed of various substances such as blood, perspiration, chemicals or other organic substances that react differently to various wavelengths of light. When a luminescent deposit is excited with a particular wavelength of light, the deposit absorbs the light and re-emits it at a different wavelength. The short-lived light being re-emitted is termed fluorescence. There are several alternate light sources available to analysts that adequately meet the needs described in this manual.

1.2 Advances in Fingerprint Technology, Henry Lee and R. E. Gaensslen, pages 90, 115-118.

1.3 An Introduction to Lasers, Forensic Lights, and Fluorescent Fingerprint Detection Techniques, E. Roland Menzel, (1991).

1.4 Friction Ridge Skin, James F. Cowger, (1983), pages 106-107.

1.5 Mini-CrimeScope Tunable Forensic Light Source Model MCS-400W Operation and Maintenance Instructions (2003).

1.6 Rofin Polilight PL400 Forensic Light source, Polilight PL400 Instruction Manual, Version 1 11/2001.

## 2.0 Scope

2.1 The ALS is used to attempt to create contrast between an impression and the substrate.

2.2 Fluorescence may occur due to a naturally occurring substance within the latent print residue itself (inherent luminescence), may be transferred to the friction ridge skin via contamination and re-deposited, or may be induced in latent print residue with certain chemicals and powders known to exhibit fluorescent properties.

2.3 Alternatively, fluorescence of the substrate may also occur.

## 3.0 Equipment/Reagents

Alternate light source

Filtered goggles

## 4.0 Procedure

4.1 Turn on ALS. Make sure the ALS comes to full operating power (fan reaches consistent speed).

4.2 Turn on the lamp and wait for bulb to reach a consistent brightness. The lamp function will vary slightly in different models. Some models have a variable power dial that may need to be adjusted.

4.3 Choose the band-width that corresponds to the color of goggle being utilized.

4.4 Observe evidence with the appropriate wavelength/goggle combination:

| WAVELENGTH | CORRESPONDING FILTER |
|---|---|
| < 400nm | yellow or clear UV safe |
| 400-450nm | yellow |
| 450-540nm | orange |
| >540-700nm | red |

4.5 Turn off the ALS lamp and allow to cool completely before powering off ALS.

4.6 The ALS used shall be recorded in ILIMS case notes.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 If an ALS malfunctions, it will be taken out of service until it can be repaired. The ALS shall be tagged indicating that it is out of service. Maintenance, service, etc. will be recorded in the maintenance log.

5.1.2 No calibration is required of these units.

5.1.3 The manufacturer's operator instructions shall be read prior to initial use of the equipment.

### 5.2 CONTROLS: Not applicable

### 5.3 SAFETY:

5.3.1 As with other electrical appliances, guard against electrical shock. This can be accomplished by ensuring that all connections are proper and that no loose, damaged, or frayed wires exist. Make sure the ALS is unplugged before attempting any maintenance and do not use outdoors if wet conditions exist.

5.3.2 The eyes are generally more vulnerable than the skin, and appropriate eye protection must be used. Permanent eye damage can occur from reflected, refracted, or direct illumination to the eye. Most of the light emitted by an ALS is not absorbed, but is reflected and scattered off the surface being examined. Extreme care should be taken around highly reflective surfaces. Never look directly into the light or allow beams to bounce off the surface into your eyes or the eyes of another person in the vicinity. Filtered goggles or shields shall be utilized when using this equipment as they provide protection from potentially harmful rays and provide additional enhancement for viewing latent prints.

5.3.3 The nature and extent of all potential hazards are not yet known because in-depth assessments have not been made on most of the high intensity light sources used in forensic identification work.

# Iodine Fuming #3

## 1.0 Background/References

1.1 Iodine fuming is one of the oldest latent print methods currently employed in the examination processes for the visualization of latent prints. Iodine vapors are physically absorbed by fats and oils of a latent print deposit and turn the latent print a yellow/brown color.

1.2 Friction Ridge Skin, James F. Cowger, (1983), pages 93-96.

1.3 Fingerprint Techniques, Andre A. Moenssens, (1971), pages 114-120.

1.4 Scott's Fingerprint Mechanics, Robert D. Olsen, (1978), pages 247-256.

1.5 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 Use when attempting to develop prints that are thought to be recently deposited and/or composed of fatty or oily residue. Iodine reacts better to recently deposited prints because the specified residues tend to become less receptive to this process with time.

2.2 Other latent print methods such as DFO or ninhydrin tend to dissolve the fats with which iodine reacts. Therefore, if iodine fuming is to be used, it must be used prior to other latent print development processes.

2.3 Iodine is not suitable for metals or dark surfaces.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS

Fume hood

Plastic chamber or a heavy-duty sealable plastic bag

3.2 REAGENTS

Iodine crystals

## 4.0 Procedure

4.1 In a fume hood, break open a glass ampoule of iodine crystals.

4.2 Place the crystals in an airtight chamber (ex. sealable heavy plastic bag, commercial fuming chamber, etc.).

4.3 Apply heat if necessary. The application of heat may be accomplished in various ways including transfer of body heat, contained hot water, or an electric warming plate. Iodine crystals will start to sublimate, go from a solid to a gas, resulting in purplish fumes with the application of heat (approximately 100° F/38° C).

4.4 Place the control test and the questioned surface in the chamber and proceed with fuming.

4.5 The control test and evidence are monitored by viewing through the chamber to determine when processing is complete.

4.5.1 Latent prints, if developed, will turn a yellow-brown color.

4.5.2 The process needs to be carefully monitored so that over-development does not occur.

4.6 Prints are evaluated to determine their suitability for comparison.

4.7 Prints deemed to be of value shall be marked and photographed as soon as possible.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 The resulting yellow-brown latent prints will fade quickly and must be preserved.

5.1.2 It is suggested that the camera be set up prior to iodine processing.

5.1.3 Iodine prints that have faded, or are completely gone, can sometimes be redeveloped by reprocessing. Iodine reprocessing cannot be done if other methods have been used or if too long of a time span has elapsed.

5.1.4 Shelf life of sealed iodine is indefinite.

5.1.5 Iodine crystals shall be disposed of in the hazardous waste containers located in the fume hoods.

### 5.2 CONTROLS:

5.2.1 Testing of iodine is performed simultaneously with the evidence processing.

5.2.2 This test involves the making of a quality latent print (oil based) on a test surface similar to the evidence being examined. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 The test print is exposed to the fumes in the same manner as the questioned surface would be. Positive results (development of a yellow-brown impression) and negative results (minimal development in negative control areas) are documented in the laboratory case notes.

### 5.3 SAFETY:

5.3.1 Safety is a serious concern when using the iodine fuming method. *Iodine is toxic in any form. ALWAYS AVOID INHALING IODINE FUMES.*

5.3.2 Iodine fumes may irritate the skin and damage the respiratory tract. Headaches that can last for several days may result from exposure to iodine. Long-term effects to the thyroid gland may result from exposure.

5.3.3 Adequate ventilation when using the method is mandatory as the fumes are corrosive to metals and may discolor other surfaces that they come in contact with.

5.3.4 Iodine shall be purchased in glass ampoules. The ampoules shall stay sealed until use.

# Lifting Methods #4

## 1.0 Background/References

1.1 Lifting methods are effective for the preservation of latent print impressions because the adhesive on the lifting medium is stickier than the surface on which the latent print deposit resides. It is a good idea to have a variety of lifting mediums as they vary in clarity, adhesion, and flexibility.

1.2 Scott's Fingerprint Mechanics, Robert D. Olsen, (1978). Pages 369-387.

1.3 Fingerprint Techniques, Andre, A. Moenssens, (1971). Pages 109-112.

1.4 Friction Ridge Skin, James F. Cowger, (1983). Pages 85-88.

1.5 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 Lifting methods are applicable to prints that have been developed utilizing methods such as powders, SPR, and occasionally prints deposited in dust.

2.2 Lifts are an inexpensive, easy, and quick method of preserving developed latent prints for future comparison.

2.3 Latent print lifting is one of the most common and effective methods of preserving latent prints at a crime scene.

2.4 Lifting may not be the most effective method of preserving a particular latent print.

## 3.0 Equipment/Reagents

Powder station exhaust vent or hood

Various sizes and types of standard lifting tapes

Various sizes of lift cards

Elastic tapes

Gel lifters

Casting compounds

## 4.0 Procedure

### 4.1 PROCEDURE 1 - TAPES AND GEL LIFTS:

4.1.1 Ensure that the surface has been prepared for lifting by removing excess powder.

4.1.2 Lifting mediums should be removed from their backing in a smooth, continuous motion without hesitation to avoid lines in the adhesive.

4.1.3 The lifting medium is then applied to the latent bearing surface in a smooth, continuous motion, taking care to avoid air pockets and creases. It may be necessary to firmly rub the lifting medium onto the surface using a fair amount of pressure.

4.1.4 Removal of the lifting tape or gel lift from the latent bearing surface should also be performed in a smooth continuous motion and applied to the glossy side of the latent lift card or plastic cover supplied with the gel lift.

4.1.5 Latent lift cards shall be filled out as completely as possible and shall include the following:

Unique case identifier;

Date and initials;

Item # and description of item;

Significant information about the orientation and/or position of the latent print on the object through description and/or diagram. One should be able to pinpoint the area and orientation of a latent print on the object.

4.1.6 Lifts from non-adjacent areas should be placed on different cards.

4.1.7 If latent prints appear to be simultaneous impressions or are in close proximity to one another, it is recommended that they be lifted together.

4.1.8 Multiple lifts of the same latent may be placed on the same card. A notation indicating the order in which they were lifted should be made on the card.

### 4.2 PROCEDURE 2 - CASTING COMPOUNDS:

4.2.1 Ensure that the surface has been prepared for lifting by removing excess powder.

4.2.2 Casting material is mixed either by hand or through the use of an extruder gun.

4.2.3 Casting material is applied to the latent bearing surface in a manner that precludes air pockets. It may be necessary to place the casting material to the side of the latent and then smooth it across the surface.

4.2.4 The casting material is left in place until solidified.

4.2.5 It then is removed from the surface and attached to a latent lift card. The appropriate documentation is noted as detailed in 4.1.5.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 Caution should be exercised in using general-purpose tapes (those not developed for lifting latent prints) as they may cause migration of some latent print ridge detail or may have striations or other imperfections making it hard to perform comparisons.

5.1.2 Lifting should be performed after any necessary photography. The analyst's training and experience will determine the use and/or sequence of the lifting and photographic processes.

5.1.3 Store lifting mediums and casting compounds in a cool dry place.

5.1.4 Dispose of lifting mediums and casting compounds in the trash.

### 5.2 CONTROLS:

5.2.1 Not applicable

### 5.3 SAFETY:

5.3.1 There are no known health hazards associated with the use of lifting mediums or casting compounds.

# Powder Detection Methods #5

## 1.0 Background/References

1.1 The use of powders is one of the oldest techniques for development of latent prints. Many commercially produced latent print powders are available and no powder is universally applicable to all types of non-porous and/or semi-porous surfaces. Most analysts stock a variety of different types and colors of powders as well as a variety of brushes for specialized applications. Powder particles physically adhere to latent print residue allowing the latent print to be visualized. This coloring of the friction ridge residue occurs because the residue has greater adhesion properties than the substrate.

1.2 Scott's Fingerprint Mechanics, Robert D. Olsen, (1978), pages 209-235.

1.3 Fingerprint Techniques, Andre A. Moenssens, (1971), pages 106-109 and 112-114.

1.4 Friction Ridge Skin, James F. Cowger, (1983), pages 85-88.

1.5 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 Latent print powders are used to develop invisible ridge detail, improve contrast of visible ridge detail, and to facilitate lifting and preservation of latent print evidence from non-porous and some semi-porous surfaces.

2.2 The type of powder that is selected is dependent upon:

2.2.1 Whether resulting latent prints will be photographed. If photography will occur, a powder color that contrasts with the surface is often desirable.

2.2.2 The nature of the surface to be processed. Traditional powders are often most effective on non-textured surfaces while magnetic powders are often most effective on plastics and textured surfaces. The use of magnetic powders and wands should generally be avoided on substrates that contain iron. Fluorescent powders tend to have limited use. They are useful on multicolored surfaces or surfaces with a light texture that doesn't accept magnetic powder well.

2.3 The type of applicator selected is dependent upon:

2.3.1 The size of application area. Larger brushes are ordinarily used for large areas and smaller brushes for concentrated work or individual latent prints. Fiberglass brushes are often used for both instances.

2.3.2 The type of powder to be used. Magnetic wands are used in conjunction with magnetic powders while traditional powders are used with a variety of brushes. Traditional, non-magnetic, fluorescent powders are applied with a feather brush. The application of fluorescent powders requires the use of an ALS.

2.4 The prior use of cyanoacrylate ester often increases the adhesion of powders to latent print residue.

2.5 Powder processing is not suitable for surfaces that are wet, tacky, or exceptionally rough. Powder processing is generally the last step in the latent print processing sequence.

2.6 Single-use powders and brushes should be employed in cases with known blood or other biological contaminants. In the event that single-use brushes/powders are employed, a notation to that effect should be made in the case notes. When evidentiary items known to originate from the suspect verses the victim, they should be processed separately, utilize single-use brushes/powders, and employ appropriate decontamination measures between samples (10%bleach or bleach substitute).

## 3.0 Equipment/Reagents

Hood/exhaust vents/particulate filters

Traditional, magnetic, and fluorescent powders

Magnetic wand, feather brush, fiberglass brush, animal hair, etc.

Alternate light source

Filtered goggles

## 4.0 Procedure

### 4.1 PROCEDURE 1 - TRADITIONAL POWDERS:

4.1.1 A variety of brushes or applicators may be utilized with the exception of magnetic wands.

4.1.2 Apply a small amount of powder to the brush and remove excess powder.

4.1.3 Powder should be applied to the surface in a smooth circular motion with only the tips of the brush touching the surface. Once the direction of ridge flow can be established, powdering should proceed by following the ridge flow until optimal development is achieved.

4.1.4 The adherence of powder to a latent print may be enhanced by utilizing the "huffing technique." Huffing is accomplished by gently breathing on the surface, which may add moisture to the latent print residue, enabling powder to adhere more effectively. All visible moisture should be evaporated prior to the application of additional powder.

4.1.5 If too much powder has been applied, it may be possible to remove excess powder by tapping the object, blowing air over the surface, or by brushing it out.

4.1.6 Prints are evaluated to determine their suitability for comparison.

4.1.7 Prints deemed to be of value shall be marked and photographed or lifted.

### 4.2 PROCEDURE 2 - MAGNETIC POWDERS:

4.2.1 Magnetic powders utilize a magnetic wand in their application.

4.2.2 The wand is dipped into the magnetic powder where the powder is picked up by the tip of the wand. The powder forms a bristle-less brush that is then applied directly to the surface. The actual wand should not come in contact with the surface.

4.2.3 The application of magnetic powders is similar to the powdering method described in 4.1.3 and 4.1.4 above.

4.2.4 The plunger located at the end of the brush is pulled to its fully extended position to release the powder from the tip of the brush.

4.2.5 Excess powder may be removed by passing a wand over the surface without making contact.

4.2.6 Prints are evaluated to determine their suitability for comparison.

4.2.7 Prints deemed to be of value shall be marked and photographed or lifted.

### 4.3 PROCEDURE 3 - FLUORESCENT POWDERS:

4.3.1 A variety of brushes or applicators may be utilized.

4.3.2 Lightly dip the brush into the powder. Remove excess powder. A very small amount of fluorescent powder goes a long way.

4.3.3 If possible, it is best to use an ALS while applying the powder. This will prevent over powdering and loss of ridge detail. The application of fluorescent powders is similar to the powdering methods described in 4.1.3 and 4.1.4 above.

4.3.4 Prints are evaluated to determine their suitability for comparison.

4.3.5 Prints deemed to be of value shall be marked and photographed or lifted. When photographing latent prints developed with fluorescent powders, it is necessary to use an ALS and a camera filter that corresponds to the color of viewing goggle utilized with the ALS.

4.3.6 It is necessary to use black latent lift cards with fluorescent powders.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 Latent print quality may be enhanced by repeated powdering and lifting of the same area.

5.1.2 An ample number of appropriate brushes will help preclude cross-contamination of powders and brushes.

5.1.3 When powder-processing evidence known to be biologically contaminated, every effort shall be made to avoid cross contamination by utilizing previously unused brushes and powder. Brushes and powder will be discarded after use on contaminated items. Magnetic wands will be disinfected.

5.1.4 Powders stored in a cool dry place have an indefinite shelf life.

5.1.5 Dispose of powders in the trash.

### 5.2 CONTROLS:

5.2.1 Test impressions are generally not applicable. However, when there is doubt as to the suitability of a powder for processing a particular surface a test impression should be made on a similar surface if available. If a similar surface is not available, then an area of the suspected surface may be explored “blindly.”

### 5.3 SAFETY:

5.3.1 Safety concerns when using commercial fingerprint powders are minimal.

5.3.2 Analysts are required to use the down draft hood or exhaust vents positioned at each workstation when performing powdering and lifting in the laboratory.

5.3.3 When fingerprint powders are to be used for an extended period of time, a dust mask or half face respirator with dust filters should be worn to minimize the inhalation of the powder particles.

5.3.4 Persons using fingerprint powders should monitor reactions (if any) to the fingerprint powders.

# Small Particle Reagent #6

## 1.0 Background/References

1.1 Two types of small particle reagents (SPR) are available for use, traditional SPR which consists of a suspension of fine molybdenum disulfide ($MoS_2$) particles in a detergent solution and commercially available white or dark SPR. These solutions work like a liquid fingerprint powder by adhering to the fatty portion of the latent print residue resulting in a gray or white colored latent print.

1.2 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.3 Advances in Fingerprint Technology, First Edition, Henry C. Lee and R.E. Gaensslen, (1991), pages 82-83.

1.4 Technical Notes #1-2757, Lightning Powder Co.

## 2.0 Scope

2.1 Small particle reagent is used to develop latent prints from a variety of surfaces including adhesives and non-porous items that are or have been wet.

2.2 The color of SPR should be chosen to contrast with the background.

2.3 SPR may be used by dipping or spraying. Dipping is the preferred method as spraying is less sensitive. It is, however, difficult to prevent damage to fingerprints located on the lower side of an article in a dish and spraying is a valid alternative when processing large items, vehicles, or responding to crime scenes.

2.4 Surfaces that need other forensic examinations such as biology, questioned document, or trace examinations should be carefully evaluated prior to processing to determine if the SPR procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

### 3.1 EQUIPMENT AND MATERIALS:

Beaker

Balance

Magnetic stirrer/stirring bar

Spray bottles

Processing tray

### 3.2 REAGENTS

Commercially available dark SPR or white SPR

Molybdenum Disulfide ($MoS_2$)

Photo-Flo

Deionized water

### 3.3 Small Particle Reagent Working Solution:

1. Place a 1500 ml beaker on magnetic stirrer base.
2. Add 1000 ml of deionized water to the beaker.

3. Place a magnetic stirring bar in the beaker.

4. Dissolve 30g of $MoS_2$ in the water ($MoS_2$ may be purchased in 30g bottles).

5. Add three to four drops of Photo-Flo to the solution.

# 4.0 Procedure

## 4.1 PROCEDURE 1 - DIPPING METHOD:

4.1.1 Shake or stir the SPR thoroughly and pour the solution into a tray.

4.1.2 Add the item to be processed to the solution. The item should be submerged.

4.1.3 Agitate the solution in the tray for 2-3 minutes, remove the item from the SPR and gently rinse with tap water.

4.1.4 Allow the surface to dry (if feasible).

4.1.5 Prints are evaluated to determine their suitability for comparison.

4.1.6 Prints deemed to be of value shall be marked and photographed or lifted. Depending on the circumstances, the item may or may not be dried prior to lifting.

## 4.2 PROCEDURE 2 - SPRAY METHOD:

4.2.1 Place the SPR into a spray bottle and shake thoroughly. The bottle should be shaken often to keep the SPR in suspension.

4.2.2 Spray the SPR onto the item being examined. If the location of the latent print is known, spray the area above the prints and allow the SPR to flow over the print. Otherwise, spray the area to be examined starting at the top and working downwards.

4.2.3 Gently rinse the processed area with tap water and allow it to dry (if feasible).

4.2.4 Prints are evaluated to determine their suitability for comparison.

4.2.5 Prints deemed to be of value shall be marked and photographed or lifted. Depending on the circumstances, the item may or may not be dried prior to lifting.

# 5.0 Comments

## 5.1 ADDITIONAL INFORMATION:

5.1.1 Powdered molybdenum disulfide has an indefinite shelf life. The shelf life of the SPR working solutions is at least six months, but shall be tested prior to each use.

5.1.2 When working in the laboratory, excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

## 5.2 CONTROLS:

5.2.2 This test involves the making of a quality latent print on a test surface similar to the one being examined. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 The test print is exposed to the SPR in the same manner as the questioned surface.

5.2.4 An analyst shall not proceed with the processing of the evidence until a control test bearing positive results (development of a gray colored latent with traditional SPR or a white colored latent with white SPR) and a negative control test (minimal background development) has been carried out and documented in the laboratory case notes.

## 5.3 SAFETY:

5.3.1 There does not appear to be any health hazards associated with small particle reagent, but the process should be monitored to see if there are any allergies. Lab coats, gloves, and safety glasses should be worn. When using the powder in the dry form, precautions should be taken to prevent the powder from becoming airborne and possibly inhaled.

# Sticky-Side Powder #7

## 1.0 Background/References

1.1 Adhesives on the sticky sides of tape and other items, such as labels, present problems in processing. Traditional powdering methods will not work (unless modified) because the adhesive properties cause the powder to obscure latent print deposits. Sticky-side powder is a liquid fingerprint detection method that develops latent prints on adhesive surfaces. Sticky-side powder adheres to the fatty/oily components and/or epithelial cells present in latent print residue on these surfaces.

1.2 Journal of Forensic Identification, Vol. 44, No. 2. March/April, 1994. "Sticky-Side Powder: The Japanese Solution," pages 133-138, Darren S. Burns.

1.3 "Sticky-Side Powder", Technical Note, Lightning Powder Co., (April, 1994).

## 2.0 Scope

2.1 Sticky-side powder is used to process adhesives. Due to the color of the resulting latent print, sticky-side powder may be more appropriate for certain types of tapes than for others (e.g. masking tape vs. electrical tape).

2.2 When the item to be processed contains both an adhesive side and a non-porous side, the non-porous side should be processed prior to the application of sticky-side powder.

2.3 Sticky-side powder can be used in two ways, the powder solution can be painted on, or the surface can be immersed in an aqueous solution containing the powder solution.

2.4 Surfaces that require other forensic examinations, such as trace or biology, should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

2.5 The following procedure provides two formulations for sticky-side powder; "Sticky-Side Powder Working Solution" & "Sticky-Side Powder Equivalent Working Solution." Either may be used dependent upon analyst preference. The chosen formulation should be reflected in the case notes.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance
Small glass beaker
Stir rod
Soft brush (animal hair, paint brush, etc.)
Glass tray

3.2 REAGENTS:

Sticky-Side powder

Photo-Flo

Non-magnetic Black Powder

Liqui-Nox detergent or equivalent

Tap or deionized water

3.3 Sticky-Side Powder Working Solution:

1. Mix a solution of water and Photo-Flo in a glass beaker in a 1:1 ratio.
2. Mix approximately equal amounts of sticky-side powder into the Photo-Flo solution to make a liquid that has the consistency of paint. Mix a volume suitable for the application at hand.

3.4 Sticky-Side Powder Equivalent Working Solution:

1. Measure out 0.5g of non-magnetic black fingerprint powder and place in a glass beaker.
2. Add 1 ml of water.
3. Add 1 ml of Liqui-Nox or other equivalent detergent.
4. Thoroughly mix the liquid and fingerprint powder.

## 4.0 Procedure

4.1 The reagent is painted onto the adhesive surface with soft brush or the item may be submersed in the solution. When using the submersion method, ensure that the adhesive side is up, as some agitation may be necessary.

4.2 Allow the reagent to remain on the surface for approximately 10 to 20 seconds.

4.3 Rinse with tap water.

4.4 Examine the adhesive surface for latent prints. The surface may be reprocessed to improve contrast and/or make the latent print(s) darker.

4.5 Allow the surface to dry thoroughly.

4.6 Any suitable latent prints shall be marked and photographed. Prints may be covered with a protective cover such as lifting tape or clear plastic.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 The powder component of sticky-side powder has an indefinite shelf life. The working solution shall be mixed prior to each use.

5.1.2 Working solution may be rinsed down the drain or disposed of in the trash.

5.2 CONTROLS:

5.2.1 Testing of sticky-side powder and sticky-side powder equivalent is performed on each batch of working solution prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 An analyst cannot proceed with the processing of the evidence until a control test bearing positive results (development of a print) and a negative control (minimal background development) has been carried out and documented in the laboratory case notes.

5.3 SAFETY:

5.3.1 When using sticky-side powder in the previously described manner, there does not appear to be a significant health hazard. When using the powder in the dry form, precautions should be taken to prevent the powder from becoming airborne and possibly inhaled. Small amounts of sticky-side powder can be safely washed down the drain, while larger amounts should be collected in a suitable container for disposal.

# Taking Known Exemplars (Reference Standards) #8

## 1.0 Background/References

1.1 Known exemplars (reference standards) is a term used to describe the intentional recording of an individual's friction ridge impressions that are made for documentation purposes. These impressions may be made using a number of techniques, including, but not limited to, traditional ink, live scan, and powder/adhesive lift methods. The goal of the process is to produce legible impressions that are suitable for classification and/or comparison.

1.2 Friction Ridge Skin, Comparison and Identification of Fingerprints, James F. Cowger, (1993) Chapter 2 *Taking Inked Prints*, pages 9-33.

1.3 The Science of Fingerprints, U.S. Department of Justice, F.B.I. Laboratory Division, (1984), pages 111-128.

1.4 Scotts Fingerprint Mechanics, Robert D. Olsen, SR (1977), pages 55-92. The

1.5 The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011, Chapter 4.

## 2.0 Scope

2.1 The following techniques are used when analysts are called upon to take fingerprint cards for state and/or federal background checks or to take comparison quality exemplars that may be utilized in forensic casework.

2.2 It is up to the analyst's discretion to determine the appropriate methods for the given circumstances.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Black printers ink
Brayer & inking plate
Porelon pad
Black fingerprint powder
Fiberglass brush
Fingerprint cards/paper
Fingerprint stand
Adhesive lifts/covers
Fingerprinting spoon
Protective apparel (lab coat, safety glasses, face shield etc.)

## 4.0 Procedure

4.1 PROCEDURE 1 - KNOWN EXEMPLARS:

4.1.1 Ensure that the area to be printed is dry and free of debris.

4.1.2 Inked Fingerprints

4.1.2.1 Place the fingerprint card in the cardholder.

4.1.2.2 Beginning with the right thumb, roll the thumb from nail-bed to nail-bed on an inking plate or Porelon pad. Roll the thumb in the same manner on the fingerprint card in the space marked "R. THUMB." Roll the thumb with even pressure to avoid smearing.

4.1.2.3 Continue this procedure for each finger ensuring the prints are placed in the corresponding box on the fingerprint card.

4.1.2.4 If a mistake is made, the analyst may affix an adhesive tab over the error and roll a new print or start over with a new fingerprint card.

4.1.2.5 Ink the right and left thumbs and place a plain impression in the corresponding box at the bottom of the fingerprint card. Repeat the procedure with the right and left four fingers simultaneously placing plain impressions in the corresponding boxes at the bottom of the fingerprint card.

4.1.2.6 If an amputation, deformity, or injury makes it impossible to print a finger, a notation shall be made to that effect in the individual finger block.

4.1.3 Inked Palm Prints

4.1.3.1 Place a piece of white paper or palm print card around a cylindrical object (piece of pipe, cardboard tube etc.).

4.1.3.2 Using a brayer, apply a thin coat of ink to the palmar friction ridges from the wrist to the tips of the fingers.

4.1.3.3 Place the wrist of the inked palm on the paper and roll the cylinder back toward the subject while applying pressure to the palm. This method will produce quality ridge detail for the entire palmar surface, including hard to capture areas such as the medial and proximal joints and center of the palm.

4.1.3.4 Individually ink and roll the thenar and hypothenar portions of the palm using the inking plate. The sides of the hand are placed on the inking plate at an approximate 45° angle and partially rolled to ink the correct portion of the palm. The same motion is then repeated to transfer the ink to the palm print sheet. These impressions may be placed on the same sheet if there is adequate space.

4.1.3.5 Repeat the above procedure for the other hand.

4.1.4 Complete Friction Ridge Exemplars.

4.1.4.1 Complete friction ridge exemplars are often referred to as major case prints. They consist of recordings of all friction ridge skin on the palmar surface of the hands and on occasion, the plantar portion of the feet. A complete set of palmar major case prints includes a set of rolled fingerprints, palm prints, sides of palms, sides of fingers (full length), and finger tips.

4.1.4.2 These prints may be obtained through traditional inking methods or by using the black powder/adhesive lift method.

4.1.5 Black Powder/Adhesive Lift Method

4.1.5.1 Lightly powder the portion of friction ridge skin to be printed using a fiberglass brush and black powder.

4.1.5.2 Choose an adhesive lift of appropriate size and remove the backing.

4.1.5.3 Place the powder-processed skin onto the adhesive lift and ensure that it makes good contact.

4.1.5.4 Carefully remove the adhesive from the skin and smooth an acetate cover over the lift avoiding creases and air pockets.

4.1.6 All exemplars should be marked with the date, analyst's name, case number (if known) and subject's name (if known).

## 5.0 Comments

### 5.1 CONTROLS:

Not applicable

### 5.2 SAFETY:

5.2.1 Analysts should be cognizant of potential risks from subjects being printed.

5.2.2 When fingerprint powders are to be used for an extended period of time, a dust mask or half face respirator with dust filters should be worn to minimize the inhalation of the powder particles.

5.2.3 Persons should monitor reactions (if any) to the fingerprint inks and/or powders.

# Amido Black #9

## 1.0 Background/References

1.1 Amido Black is also known as Amido Black 10B, Amido Black 12B, Napthol Blue Black, Napthalene Black or Acid Black 1. Amido Black is a dye that stains the protein portion of blood a blue-black color.

1.2 Fingerprint Source Book v2.0 (second edition), Home Office, 2017

1.3 Journal of Forensic Identification, Vol. 45, No. 5 Sept/Oct 1995. "A New Use for an Old Friend," pages 498-503.

1.4 Proceedings of the International Forensic Symposium on Latent Prints, "Enhance Latent Prints in Blood with New Staining Techniques," page 147, Paul Norkus and Kevin Noppinger.

## 2.0 Scope

2.1 Blood contaminated prints may be processed with Amido Black to detect faint deposits of friction ridge skin impressions. It is generally used on dried blood stains on non-porous surfaces, but has been successful in developing prints on some semi-porous and porous surfaces as well. When used on porous or semi-porous surfaces, consideration should be given to the potential for excessive background staining.

2.2 Amido Black will not detect the normal constituents of latent prints and therefore must be used in the proper sequence with other latent print processing methods.

2.3 The Amido Black process utilizes a working solution, a rinse solution, and an optional wash solution (deionized water). Blood must be fixed prior to the application of Amido Black to prevent the liquid solutions used in the process from washing away some or all of the blood deposits.

2.4 Bloodstains must be carefully examined and evaluated to preclude destruction of potentially valuable evidence. Any samples to be used for the biological examination of blood deposits or trace analysis should be collected prior to enhancement. It is often necessary to coordinate with investigators and/or other laboratory sections (e.g. biology) to determine which procedures may provide the most valuable findings.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance

Magnetic stirrer/stirring bar

Pipettes

Beakers

Graduated cylinder

Appropriately sized storage bottles

Spray or rinse bottles

3.2 REAGENTS:

Amido Black

Glacial acetic acid

Methanol

Deionized water

3.3 Amido Black Working Solution:

1. Weigh out 3-5 grams of Amido Black and place in a clean, dry beaker.
2. Measure out 100 ml of acetic acid and add to the Amido Black.
3. Measure out 900 ml of methanol and add to the beaker containing the Amido Black and acetic acid.
4. Stir the solution with a magnetic stirrer for thirty minutes and transfer the solution to a clean storage bottle.

3.4 Amido Black Rinse Solution (de-stain):

1. Measure out 100 ml of acetic acid and pour into a clean, dry glass beaker.
2. Measure the 900 ml of methanol and add it to the beaker.
3. Stir the solution for two to three minutes and transfer the solution to a clean, dry storage bottle.

## 4.0 Procedure

4.1 Determine if samples for biology should be taken prior to processing.

4.2 Conduct control tests using prepared blood slides stored in the laboratory refrigerator.

4.3 Fix impressions using heat, methanol, or cyanoacrylate. Blood can be fixed to an object by heating at a 100° centigrade in a fingerprint development chamber for thirty minutes (restricted to non-heat sensitive objects). Methanol may be sprayed or pipetted over the item. The Amido Black working solution contains methanol, and as such will suffice for this fixing rinse. Cyanoacrylate is an effective method for non-porous evidence as it will fix all possible latent prints, not just those contaminated with blood.

4.4 Immerse the item in the Amido Black working solution for two to three minutes. Alternatively, the item may be sprayed or irrigated with the Amido Black working solution.

4.5 Immerse, irrigate, or spray the item with the de-stain rinse solution to remove the excess dye.

4.6 Resulting latent prints are a dark blue-black. The above process may be repeated to improve contrast.

4.7 Immerse or irrigate the surface with deionized water wash (optional).

4.8 Allow the item to dry thoroughly.

4.9 Prints are evaluated to determine their suitability for comparison.

4.10 Prints deemed to be of value shall be marked and photographed.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of the pre-mixed Amido Black, working solution, and de-stain is indefinite.

5.1.2 Excess reagent shall be collected, when possible, and placed in the hazardous waste container located in the fume hood.

### 5.2 CONTROLS:

5.2.1 Testing of Amido Black is performed each day prior to use.

5.2.2 Control tests are performed by the application of the reagent to a slide prepared with a smear of known blood. The area surrounding the blood smear shall serve as a negative control.

5.2.3 An analyst shall not proceed with the processing of the evidence until a control test bearing positive results (known blood staining a blue-black color) and a negative control (minimal background staining) has been carried out and documented in the laboratory case notes.

### 5.3 SAFETY:

5.3.1 Gloves, lab coats, goggles, and respirators, (if there is a chance of the reagents becoming airborne) are worn when mixing or using Amido Black.

5.3.2 Glacial acetic acid is corrosive and extremely irritating to the eyes and respiratory system. Avoid breathing the vapors and use in a fume hood, with a respirator, or with adequate ventilation. Glacial Acetic Acid will cause burns if it comes in contact with skin.

5.3.3 Methanol is *flammable*. It needs to be handled carefully with gloves during the mixing and use of Amido Black. Methanol is toxic in quantities as small as 30 ml and should not be allowed to come in contact with the skin, eyes, or mouth. It is possible for methanol to be absorbed through the skin. If methanol comes into contact with the eyes or mouth, the area should be flushed with generous amounts of water and a doctor may be consulted. Inhalation of methanol vapors should be kept at a minimum and the solution should be used in a hood or well-ventilated area.

5.3.4 In addition, analysts must be aware of the biological hazards associated with blood and other body fluids and take extra precautions to protect themselves.

# Cyanoacrylate Ester #10

## 1.0 Background/References

1.1 Cyanoacrylate ester (CAE), also referred to as "superglue," is sold as a number of brands and in a number of viscosities. Items that are to be processed with CAE are exposed to an atmosphere rich in CAE fumes. This may be accomplished through the use of a fuming chamber, CAE fuming wand, or vacuum chamber.

1.2 Proceedings of the International Symposium on Latent Prints, 1987, "Methods of Latent Print Development," pages 15-23, Henry C. Lee and R. E. Gaensslen.

1.3 Advances in Fingerprint Technology, Henry C. Lee and R. E. Gaensslen, (1991).

1.4 Journal of Forensic Identification, Vol.46, No. 4 July/August, 1996. "Cyanocarylate Fuming Precautions," Michael W. Goetzs.

1.5 Journal of Forensic Identification, Vol. 46, No. 1 January/February, 1996. "The Super Glue Fuming Wand: A Preliminary Evaluation," J. Froude, Jr.

1.5 Coleman Vacu-Print Instructions and Notes, Lightning Powder, (1995).

1.6 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.7 Air Science, Operating Manual: SAFEFUME Cyanoacrylate Fuming Chamber, Rev 2 July-11-2008.

1.8 Attestor Forensics. MEGAfume User Manual. Version 040521_07_EN 2021.

## 2.0 Scope

2.1 Fuming with cyanoacrylate ester (CAE) is a process that is used to visualize latent print deposits on non-porous and some semi-porous objects. CAE processing also prepares the surface for the acceptance of powders and dye-stains that may enable further visualization of the latent prints.

2.2 When CAE vapors contact moisture and other components of friction ridge residue, the cyanoacrylate ester polymerizes, fixing the latent prints to the surface. This makes them more stable and less susceptible to damage.

2.3 The process is temperature, humidity, and pressure sensitive.

2.4 Objects that need additional forensic examinations such as trace or questioned document examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Fuming chamber

Vacuum chamber

CAE fuming wand

Disposable aluminum dishes

3.2 REAGENTS:

Cyanoacrylate gel or liquid

CAE cartridges

# 4.0 Procedure

## 4.1 PROCEDURE 1 – CYANOACRYLATE FUMING CHAMBER:

4.1.1 Select the appropriately sized fuming chamber. (NOTE: remove any shelf and bracket components that will not be used to avoid unnecessary cleaning and decontamination).

4.1.2 Place the item to be processed in the chamber (suspend if possible).

4.1.3 Add control test (control test may be monitored during fuming and should be checked at conclusion of fuming).

4.1.4 Ensure the water level in the humidifier reservoir is appropriate. Water should be changed with each use on the MEGAfume. (NOTE: outlets inside the Air Science Chamber are specifically designed to operate either the humidifier or the hotplate – ensure appropriate appliances are plugged into appropriate outlets.)

4.1.5 Add liquid CAE to a disposable aluminum dish and place on the hot plate. The recommended amount of liquid CAE for the MEGAfume is ~0.4 g. The recommended amount of liquid CAE amount for the Air Science CA30 is ~1.5 g (2-3 cm pool) and twice that for the CA60T.

4.1.6 Turn on power.

4.1 7 The touch panel on the front of the unit is used to control the chamber. Menu screens are designed to prompt the use of action to be taken to complete a full cycle. Screen is touch operated. Do not tap on screen with any object that could damage it.

4.1.8 Upon start-up the unit will load software and self-calibrate.

4.1.9 Once running, the unit will prompt the user for each activity.

4.1.10 Set the desired humidity level and fuming time.

4.1.10.1 The MEGAfume CYAN I setting is the "standard program for cyanoacrylate, suitable for standard cyanoacrylate development with relatively fresh prints on non-porous surfaces, e.g. plastic bags, hard plastic, glass etc." The CYAN I defaults are: 80% relative humidity (RH); 0 minute humidity saturation time; 12 minute cycle; and 120°C hot plate temperature.

The MEGAfume CYAN II setting is a "modified program for cyanoacrylate, suitable for cyanoacrylate development with fingerprints that may be older and/or prints on compound material (consisting of non-porous and semi-porous material)." "This program has a longer saturation time to reduce the risk of inadequate humidity during the fuming process." The CYAN II defaults are: 80% relative humidity (RH); 10 minute humidity saturation time; 15 minute cycle; and 120°C hot plate temperature.

4.1.10.2 The Air Science chamber defaults are 80% relative humidity with a 15 minute cycle. These settings are baselines. When utilizing the large chamber – time and/or amount of glue/# of hot plates may need to be adjusted based on the surface being processed.

4.1.10.3 The use of operating parameters that differ from the default settings noted above shall be recorded in the ILIMS case notes.

## 4.2 PROCEDURE 2 –CAE FUMING WAND METHOD

4.2.1 In a fume hood or other well-ventilated area, place a CAE cartridge onto the end of the fuming wand. Select cartridge size dependent upon amount and size of evidence.

4.2.2 Follow manufacture instructions to ignite the fuming wand. Fumes should be visible once the wand is hot.

4.2.3 Raise or lower the heat level if desired.

4.2.4 Conduct a control test.

4.2.5 Fume the item by holding the fuming wand at least 3-4 inches away moving the wand in small circles. Fumes will rise so it is best to direct the fumes below the item if possible or deflect the fumes toward the item. Do not hold the wand too close to the item or in the same area too long, as damage and/or over development may occur.

4.2.6 Turn the fuming wand off and allow the unit to cool completely prior to removing cartridges or repackaging.

4.2.7 Examine item for comparable ridge detail.

4.2.8 Prints may be marked and photographed at this point, but are more commonly further enhanced with powders or dyes prior to preservation.

## 4.3 PROCEDURE 3 - VACUUM CHAMBER METHOD

4.3.1 Place items of evidence and controls into the vacuum chamber. It is not necessary to unfold items or leave large amounts of space between the items. *Do not place pressurized items such as sealed cans, bottles etc. in the chamber as they may explode.*

4.3.2 Add the CAE source. Foil CAE gel packs are recommended (number is dependent on chamber size and space), but a small dish with liquid CAE may also be used.

4.3.3 Place the lid on the vacuum chamber and close the release valve.

4.3.4 Turn on the vacuum pump.

4.3.5 Open the Gas Ballast Valve about one half turn.

4.3.6 Open the Isolation Valve (silver lever) to up position. If necessary, press on the lid until the chamber begins to evacuate.

4.3.7 Close the Gas Ballast Valve.

4.3.8 Evacuate the chamber to approximately 25 inches of mercury as shown on the chamber gauge.

4.3.9 Close the Isolation Valve.

4.3.10 Open the Gas Ballast Valve, wait 2-3 seconds and turn off the pump.

4.3.11 Close the Gas Ballast Valve.

4.3.12 Leave the items under vacuum for at least 20 minutes. There is no danger of over fuming.

4.3.13 Evacuate the chamber by slowly opening the release valve.

4.3.14 Remove glue and evidence. Check control test and examine item for comparable ridge detail.

4.3.15 Prints may be marked and photographed at this point, but are more commonly further enhanced with powders or dyes prior to preservation.

# 5.0 Comments

## 5.1 ADDITIONAL INFORMATION:

5.1.1 In the event of over-fuming, it may be possible to use an adhesive lifting technique (tape, gel lifter etc.) to lift away heavy upper deposits, revealing underlying ridge detail.

5.1.2 The “foil packets" may be stored at room temperature and have a shelf life of six months to a year. The shelf life of the “foil packets" can be greatly extended by refrigeration. CAE should be in a gel form, ensure CAE has not dried out/crystalized prior to use. Liquid CAE and cartridges may be stored at room temperature with an indefinite shelf life.

5.1.3 CAE may be disposed of in the trash.

5.1.4 The manufacturer's operator instructions shall be read prior to initial use of the CAE fuming chambers, fuming wands, and vacuum chambers.

## 5.2 CONTROLS:

5.2.1 Testing of CAE and processing are performed at the same time.

5.2.2 A quality test print is applied to a non-porous surface and put into the tank in an easily-monitored position with the questioned surface. Placing one’s own fingerprints on a black latent lift card works well for this purpose. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 When the development of the positive control test is complete, the questioned surface is also finished. Positive results (indicated by development of a white print) and negative results (a lack of background development) shall be documented in the laboratory case notes.

## 5.3 SAFETY:

5.3.1 CAE fuming should only be conducted in a filtered chamber or well-ventilated area. Precautions should be taken to avoid inhaling or allowing the vapors to contact the eyes, as the vapors can be irritating to the eyes, nose, and throat. Persons wearing contact lenses should wear non-vented goggles when instrument filtration is not available.

5.3.2 Precautions include using sealed CAE chambers and evacuating the fumes from the chambers prior to removal of the questioned and test surfaces.

5.3.3 If liquid glue is allowed to contact the skin, adhesion may result. If the skin sticks together, immerse affected areas in warm water. This will loosen the skin so that it can be gently pulled apart.

# 1, 8 DIAZAFLUOREN-9-ONE (DFO) #11

## 1.0 Background/References

1.1 1, 8 Diazafluoren-9-one is an analogue of the ninhydrin molecule. DFO develops latent prints containing amino acids. Developed prints may be visible to the unaided eye but should be viewed with an alternate light source.

1.2 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.3 Technical Notes #1-0038, Lightning Powder Co., 1, 8-Diazafluoren-9-One (DFO).

1.4 The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

## 2.0 Scope

2.1 DFO is used to develop prints on porous surfaces such as paper and cardboard.

2.2 DFO may detect latent prints on porous surfaces that ninhydrin will not and the reverse is also true. It does not replace ninhydrin but is used in addition to it.

2.3 DFO should be used after iodine and prior to ninhydrin or physical developer.

2.4 Surfaces that need other forensic examinations such as trace or questioned document examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

### 3.1 EQUIPMENT AND MATERIALS:

Fume hood

Balance

Magnetic stirrer/stirring bar

Alternate light source/filtered goggles

Fingerprint development chamber or iron

Beaker

Graduated cylinder

Pipettes or trays

Storage Bottles

### 3.2 REAGENTS:

DFO powder

Methanol

Ethyl Acetate

Acetic Acid

Petroleum Ether

### 3.3 DFO Stock Solution:

1. In a fume hood, dissolve 0.5 gram of DFO powder in 100 ml of methanol. This may be facilitated by use of a magnetic stirrer.

2. Add 100 ml of ethyl acetate and mix thoroughly.
3. Add 20 ml of acetic acid.
4. Store stock solution in a dark brown glass or polypropylene bottle.

3.4 DFO Working Solution:

1. Add 220 ml of stock solution to 780 ml of petroleum ether.
2. Mix thoroughly.

If less working solution is desired, halve or quarter the stock solution and petroleum ether accordingly.

## 4.0 Procedure

4.1 Conduct control tests.

4.2 Pour a sufficient amount of the working solution into a glass tray.

4.3 Dip or irrigate the evidence with the solution for approximately ten seconds (DFO may also be painted on). Although it is possible to spray this solution, it is *not recommended* due to the health hazards involved and its inability to soak the specimen adequately.

4.4 Dry for approximately three minutes.

4.5 Repeat 4.3 and 4.4.

4.6 Apply dry heat.

4.6.1 When using the fingerprint development chamber, the specimen should be heated for ten minutes at 100° C with a dry heat. The use of operating parameters that differ from the default setting shall be recorded in ILIMS case notes.

4.6.2 A dry iron will work as an alternative to a fingerprint development chamber. Sandwich the evidence between a thick layer of paper towels or other protective material on the counter. Apply dry heat to the surface for several minutes. A dry iron can be placed directly on top of the paper towels and used in the same manner as when ironing clothes. One advantage to this method is that it is possible to stop heating and check the progress with an alternate light source. If the latent prints are not very bright, continue to heat. Added heating time may improve resulting print development.

4.7 DFO-developed latent prints may or may not be visible to the unaided eye and should be viewed with an alternate light source. DFO fluoresces when illuminated with monochromatic light in the 450 nm to 570 nm range.

4.8 Prints are evaluated to determine their suitability for comparison.

4.9 Prints deemed to be of value shall be marked and photographed using the ALS and appropriate barrier filter (orange or red) on the camera.

4.10 Faint latent prints may be made to fluoresce brighter with a second or third application of DFO. The second and third applications of DFO (if necessary) are performed in the same manner as the first.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of pre-mixed DFO is indefinite. The shelf life of the DFO stock solution and working solution is six months.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROLS:

5.2.1 Testing of DFO is performed each day prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control. Analysts should use caution when using a commercially available control pad as they may exhibit inherent luminescence.

5.2.3 The test is illuminated with an alternate light source as outlined in 4.7.

5.2.4 An analyst shall not proceed with the processing of the evidence until control tests bearing positive results (fluorescing print) and negative results (a lack of background development) have been carried out and documented in the laboratory case notes and on the control tests work sheet.

5.3 SAFETY:

5.3.1 DFO has not been fully investigated for potential health hazards but is thought to be similar to ninhydrin, which may act as an irritant. Gloves, lab coats, and safety glasses should be worn when mixing and using DFO. The application of the DFO working solution should be performed in a fume hood, well-ventilated area, or while wearing an air-purifying respirator equipped with an organic vapor cartridge.

5.3.2 Glacial acetic acid is *corrosive* and extremely irritating to the eyes and respiratory system. Avoid breathing the vapors and use in a fume hood or with adequate ventilation. Glacial acetic acid will cause burns if it comes in contact with skin.

5.3.3 Methanol needs to be handled carefully with gloves during mixing and use. Methanol is toxic in quantities as small as 30 ml and should not be allowed to come in contact with the skin, eyes, or mouth. It is possible for methanol to be absorbed through the skin. If methanol comes into contact with the eyes or mouth, the area should be flushed with generous amounts of water and a doctor may be consulted. Inhalation of methanol vapors should be kept at a minimum.

# Gentian Violet #12

## 1.0 Background/References

1.1 Gentian Violet or Crystal Violet, is a biological stain used to dye epithelial cells and fatty components of latent print residues an intense purple color. Due to the toxic nature of this reagent, it should only be used in small quantities with the appropriate safety precautions observed.

1.2 Chemical Formulas and Processing Guide for Developing Latent Prints, FBI, (1994).

1.3 Lightning Powder Technical Notes, "Crystal Violet," (2000).

1.4 Processing Guide for Developing Latent Prints, "Gentian Violet," USDJ/FBI, (2000).

1.5 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 Gentian Violet is a dye stain used in the laboratory to visualize latent print deposits on many types of adhesive surfaces.

2.2 Gentian Violet may also be used on small non-porous surfaces contaminated with grease and oils. It is not suitable for water-soluble adhesives or porous surfaces.

2.3 Surfaces that need other forensic examinations such as biology or trace should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance
Magnetic stirrer/stirring bar
Graduated cylinder
Glass beaker
Glass tray
Storage bottles

3.2 REAGENTS:

Gentian Violet or Crystal Violet powder
Deionized water

3.3 Gentian Violet Working Solution:

1. Weigh out 1 gram Gentian Violet.
2. Measure 1000 ml of deionized water and pour into glass beaker.
3. Slowly add the Gentian Violet.
4. Stir for approximately twenty-five minutes or until completely dissolved.

## 4.0 Procedure

4.1 Pour a sufficient quantity of working solution into a glass tray.

4.2 Conduct control tests.

4.3 Immerse the substrate into the working solution for 1-2 minutes.

4.4 Rinse with cool tap water. Developed latent prints will appear purple in color.

4.5 The above process may be repeated until optimal development of latent prints is achieved.

4.6 Prints are evaluated to determine their suitability for comparison.

4.7 Prints deemed to be of value shall be marked and photographed. Depending on the item, it may be possible to lift prints after photographing.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of pre-mixed Gentian Violet and working solution are indefinite.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

### 5.2 CONTROLS:

5.2.1 Testing of Gentian Violet is performed each day prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (development of a purple print) and negative results (a lack of background development) have been carried out and documented in the laboratory case notes.

### 5.3 SAFETY:

5.3.1 Gentian Violet/Crystal Violet is a suspected human *carcinogen*. It is known to affect the kidney, ureter, bladder, and thyroid of animals. It can be harmful if inhaled, and is irritating to the eyes and skin.

5.3.2 Gentian Violet should not be used in large amounts.

5.3.3 A dust mask or respirator with dust filter should be used when working with the dry form. Gentian Violet should be prepared and used in a fume hood or well-ventilated area. The analyst should wear a lab coat, double glove or wear heavy-duty (non-disposable) gloves, and safety glasses.

# 1, 2 Indanedione #13

## 1.0 Background/References

1.1 1,2 Indanedione, an analogue of ninhydrin, is an amino acid reagent used to develop and visualize latent prints on porous surfaces. It produces pale pink colored prints upon exposure to ambient light. 1,2 Indanedione prints fluoresce strongly when examined using a forensic alternate light source (ALS) with wavelengths between 450nm and 570nm using an orange or red filter. The addition of a Zinc Chloride solution was found to enhance the fluorescence results obtained with the 1,2 Indanedione reagent.

1.2 The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

1.3 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 1,2 Indanedione is used to develop prints on porous surfaces such as paper and cardboard.

2.2 When using sequential processing, 1,2 Indanedione should be used after Iodine, DFO, and ninhydrin processing and prior to processing with Physical Developer. 1,2 Indanedione may enhance ninhydrin developed prints.

2.3 Surfaces that need other forensic examinations such as handwriting analysis, body fluid examinations, or trace examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Graduated cylinders

Balance

Magnetic stir bar

Spatula

Beaker

Alternate Light Source (ALS)

Fingerprint development chamber or iron

Pipettes or trays

Storage bottles3.2 REAGENTS:

1,2 Indanedione powder

Zinc Chloride

Methylene Chloride (Dichloromethane)

Ethyl Acetate

Glacial Acetic Acid

Absolute Ethanol

Petroleum Ether

3.3 1,2 Indanedione Stock Solution 1:

| | |
|---|---|
| 1, 2 Indanedione | 1 gram |
| Methylene Chloride | 30 mL |
| Ethyl Acetate | 60 mL |
| Glacial Acetic Acid | 10 mL |
| Petroleum Ether | 900 mL |

Dissolve 1 gram of 1,2 Indanedione into 30 mL of Methylene Chloride. Next add 60 mL of Ethyl Acetate and stir. Next, add 10 mL of Glacial Acetic Acid followed by 900 mL of Petroleum Ether and stir.

3.4 1,2 Indanedione Stock Solution 2:

| | |
|---|---|
| Zinc Chloride | 0.4 grams |
| Absolute Ethanol | 10 mL |
| Ethyl Acetate | 1 mL |
| Petroleum Ether | 190 mL |

Dissolve 0.4 grams of Zinc Chloride into 10 mL of Absolute Ethanol. Next add 1 mL of Ethyl Acetate followed by 190 mL of Petroleum Ether and stir.

3.5 1,2 Indanedione and Zinc Chloride Working Solution:

100 mL of Stock Solution I

8 mL of Stock Solution 2

Add 8 mL of Stock Solution 2 to 100 mL of Stock Solution 1 and stir. Stock solutions should be stored in dark brown glass bottles in a darkened area. Shelf life of the working solution is approximately 3 months.

## 4.0 Procedure

4.1 Dip the evidence into or irrigate it with the solution for approximately five seconds (the solution may also be painted on). Although it is possible to spray this solution, it is *not recommended* due to the health hazards involved and its inability to soak the specimen adequately.

4.2 Allow the item to dry and then apply dry heat. When using a fingerprint development chamber, the specimen should be heated for fifteen minutes at 100° C with a dry heat. The use of operating parameters that differ from this setting shall be recorded in ILIMS case notes. A dry iron will work as an alternative to a fingerprint development chamber. Place a thick towel or other protective material on the counter, followed by the evidence, and then a few paper towels. Apply dry heat to the surface for several minutes. A dry iron can be placed directly on top of the paper towels and used in the same manner as when ironing clothes. One advantage to this method is that it is possible to stop heating and check the progress with an alternate light source.

4.3 If the latent prints are not very bright, continue to heat. Added heating time may improve resulting print development. 1,2 lndanedione developed latent prints may or may not be visible to the unaided eye and should be viewed under an alternate light source. 1,2 Indanedione fluoresces when illuminated with monochromatic light in the 450 nm to 570 nm range using an orange or red barrier filter.

4.4 Prints deemed to be of value shall be marked and photographed. Prints developed with 1,2 Indanedione tend to fade over time if exposed to bright light. Therefore, the prints should be kept in a darkened environment and photographed as soon as possible after development.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION

5.1.1 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

### 5.2 CONTROLS:

5.2.1 Testing of the 1,2 Indanedione working solution is performed each day prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control. Analysts should use caution when using a commercially available control pad as they may exhibit inherent luminescence.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (fluorescence) and negative results (a lack of background development) have been carried out and documented in the laboratory case notes.

5.2.4 The test is illuminated with an alternate light source as outlined in 4.3.

### 5.3 SAFETY:

5.3.1 Eye protection, a lab coat, and gloves should be worn. All mixing and application of chemicals should be done inside a ventilated laboratory fume hood.

5.3.2 1,2 Indanedione may be harmful by: inhalation, ingestion, and skin absorption. May cause skin and eye irritation.

5.3.3 Zinc Chloride is hazardous, avoid contact with skin and eyes; is harmful if swallowed, causes severe skin burns and eye damage, and may cause respiratory irritation.

5.3.4 Dichloromethane (Methylene Chloride) is hazardous, avoid contact with skin and eyes; causes skin irritation, serious eye irritation, and may cause drowsiness or dizziness. Classified as a possible human *carcinogen.*

5.3.5 Ethyl Acetate is hazardous by ingestion or inhalation and slightly hazardous in case of contact with skin or eyes. The substance is toxic to mucous membranes and the upper respiratory tract. Repeated or prolonged exposure to the substance can produce blood, kidneys, liver, or the central nervous system (CNS) damage.

5.3.6 Glacial Acetic Acid is *corrosive* and extremely irritating to the eyes and respiratory system. Avoid breathing the vapors and use in a fume hood or with adequate ventilation. Glacial acetic acid will cause burns if it comes in contact with skin.

5.3.7 Absolute Ethanol causes severe eye irritation. Flammable liquid and vapor. Causes respiratory tract irritation. This substance has caused adverse reproductive and fetal effects in humans. May cause central nervous system depression. May cause liver, kidney and heart damage. Causes moderate skin irritation.

5.3.8 Petroleum Ether is hazardous; may be fatal if swallowed and enters airways. May cause genetic defects and cancer. Highly flammable liquid and vapor.

# 1, 2 Indanedione Thermal Paper (TP) #14

## 1.0 Background/References

1.1 1, 2 Indanedione TP is an amino acid reagent that is used to develop and visualize latent prints on thermal paper. Prints fluoresce strongly when examined using an alternate light source (ALS) with wavelengths between 450nm and 570nm with corresponding filters.

1.2 Thermal paper presents a challenge when processing for latent prints. It darkens or turns black when heat is applied due to its thermosensitive properties and when polar carriers are used as in conventional methods. 1, 2 Indanedione TP overcomes these limitations by not utilizing heat and polar carriers.

1.3 Journal of Forensic Identification, Vol. 66, No. 3, 2016. "A Limited Validation and Comparison of 1, 2 Indanedione TP and ThermaNin for Latent Print Development on Thermal Paper," pages 245-256, 2016. Ponschke, Michelle and Hornickle, Mandi.

1.4 Journal of Forensic Identification, Vol.53, No. 3, 2003. "Thermal Paper: Latent Friction Ridge Development via 1, 2 Indandedione," pages 265-271, 2003. John T. Stimac.

## 2.0 Scope

2.1 1, 2 Indanedione TP is used to develop prints on thermal papers such as receipts and prescription bottle labels.

2.2 Surfaces that need other forensic examinations such as handwriting analysis, body fluid examinations, or trace examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Graduated cylinders
Balance
Magnetic stirrer/stirring bar
Spatula
Beaker
Alternate Light Source (ALS) with red and orange filters
Pipettes or trays

3.2 REAGENTS:

1,2 Indanedione powder
Ethyl Acetate
HFE 7100

3.3 1, 2 Indanedione Working Solution:

| | |
|---|---|
| 1, 2 Indanedione | 0.2 gram |
| Ethyl Acetate | 7 mL |
| HFE-7100 | 93mL |

Dissolve 0.2 gram of 1, 2 Indanedione into 7 mL of Ethyl Acetate. Add 93 mL of HFE-7100. Store in dark brown glass bottle in a darkened area.

## 4.0 Procedure

4.1 Irrigate the thermal paper with an even coat of the reagent.

4.2 Do not apply heat. Allow the item to air-dry for approximately 24 hours in a darkened environment.

4.3 1, 2 lndanedione TP developed latent prints may or may not be visible to the unaided eye and should be viewed under an alternate light source. 1, 2 Indanedione TP fluoresces when illuminated with monochromatic light in the 450 nm to 570 nm range using an orange or red barrier filter.

4.4 Prints deemed to be of value shall be marked and photographed. Prints developed with 1, 2 Indanedione TP tend to fade over time if exposed to bright light. Therefore, the prints should be kept in a darkened environment and photographed as soon as possible after development.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of the working solution is approximately seven days.

5.1.2. Slight warming of the solution (30-40° C) will aid in the dissolution of the Indanedione.

5.1.3 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROLS:

5.2.1 Testing of the 1, 2 Indanedione TP working solution is performed each day prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control. Analysts should use caution when using a commercially available control pad as they may exhibit inherent luminescence.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (fluorescence) and negative results (a lack of background development) have been carried out and documented in the laboratory case notes. The analyst may need to wait 2-3 hours after application to the control test to ensure that the controls perform as expected.

5.2.4 The test is illuminated with an alternate light source as outlined in 4.3.

5.3 SAFETY:

5.3.1 Eye protection, a lab coat, and gloves should be worn. All mixing and application of chemicals should be done inside a ventilated laboratory fume hood.

5.3.2 1, 2 Indanedione may be harmful by; inhalation, ingestion, and skin absorption. May cause skin and eye irritation.

5.3.3 Ethyl Acetate is hazardous by ingestion or inhalation and slightly hazardous in case of contact with skin or eyes. The substance is toxic to mucous membranes and the upper respiratory tract. Repeated or prolonged exposure to the substance can produce blood, kidneys, liver, or the central nervous system (CNS) damage.

5.3.4 HFE-7100 may be harmful if inhaled, swallowed or absorbed through skin. May cause skin, eye, and respiratory tract irritation. HFE-7100 is not considered a Hazardous chemical as defined by the OSHA Hazard Communication Standard, 29 CFR1910.1200.

# Leucocrystal Violet (LCV) #15

## 1.0 Background/References

1.1 Leucocrystal Violet (LCV) is a biological stain that reacts with the hemoglobin components of blood to create an intense purple color. It is the completely reduced form of crystal violet and is colorless until it comes into contact with the heme. LCV is not specific for blood and may react with a variety of non-blood matrices.

1.2 Forensic Science International, Vol. 82, No. 1, September 1996. "Use of Leucocrystal Violet to Enhance Shoe Prints in Blood," William J. Bodziak.

1.3 Chemical Formulas and Processing Guide for Developing Latent Prints, US Department of Justice, 1994, pp 47-48.

1.4 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 Leucocrystal Violet is a dye stain used to visualize impression deposits in blood on many types of non-porous and porous surfaces such as some papers, metal and plastic as well as adhesive surfaces.

2.2 LCV may be considered when there is an expectation that excessive background staining may occur with protein stains. LCV is more specific to blood but may be less effective than protein stains.

2.3 The LCV reagent contains a fixative (5-sulfosalicylic acid) negating the need to fix blood prints prior to processing.

2.4 Surfaces that need other forensic examinations such as biology or trace should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

2.5 The following procedure gives two working formulations for Leucocrystal Violet. Either “Formula A” or “Formula B” may be used for blood enhancement. The chosen formulation should be reflected in the case notes.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance

Magnetic stirrer/stirring bar

Graduated cylinder

Glass beaker

Glass tray

Storage bottles

3.2 REAGENTS:

Leucocrystal Violet powder

Sodium acetate

5-sulfosalicylic acid

3% hydrogen peroxide

Deionized water

3.3 Formula "A"

1. Dissolve 10g of 5-sulfosalicylic acid in 100ml deionized water.
2. Add 400ml 3% hydrogen peroxide to sulfosalicylic acid solution.
3. Immediately prior to use, add 0.75g Leucocrystal Violet to above. Stir the mixture vigorously.
4. For ease of use at crime scenes, premix the 5-sulfosalicylic acid and 3% hydrogen peroxide then add premeasured LCV onsite and mix.

3.4 Formula "B"

1. 10g 5-sulfosalicylic acid dissolved in 500ml 3% hydrogen peroxide.
2. Add 3.7g sodium acetate and 1.0g Leucocrystal Violet. Stir the mixture vigorously.

## 4.0 Procedure

4.1 Determine if samples for biology should be taken prior to processing.

4.2 Conduct control tests using prepared blood slides/paper controls stored in the laboratory refrigerator.

4.3 Spray the impression using a fine mist sprayer. Items may also be soaked or the surface flooded with the solution.

4.4 Development of dark purple impressions should occur in approximately 30 seconds.

4.5 Prints are evaluated to determine their suitability for comparison.

4.6 Prints deemed to be of value shall be marked and photographed. Depending on the item, it may be possible to lift prints after photographing.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of the working solution is approximately three months.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROLS:

5.2.1 Testing of Leucocrystal Violet is performed each day prior to use.

5.2.2 This test involves the making of a mark in blood on a slide or paper control and following the processing procedure. The area surrounding the intentionally deposited mark shall serve as a negative control.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (development of a purple mark) and negative results (lack of background development) have been carried out and documented in the case notes.

5.3 SAFETY:

5.3.1 The reacted form of Leucocrystal Violet (purple colored form), i.e. Crystal Violet is a suspected human *carcinogen*. It is known to affect the kidney, ureter, bladder, and thyroid of animals. It can be harmful if inhaled, and is irritating to the eyes and skin.

5.3.2 Leucocrystal Violet may be harmful by inhalation, ingestion, or skin absorption; may cause skin and eye irritation; may cause irritation to mucous membranes and upper respiratory tract.

5.3.3 A dust mask should be used when working with the dry form. Leucocrystal Violet should be prepared and used in a fume hood or well-ventilated area. The analyst should wear a lab coat, gloves, and safety glasses.

5.3.4 In addition, analysts must be aware of the biological hazards associated with blood and other body fluids and take extra precautions to protect themselves.

# Ninhydrin #16

## 1.0 Background/References

1.1 Ninhydrin (triketohydrindene hydrate) reacts with the amino acids and proteins present in the latent print deposit to produce a characteristic purple color (Ruhemann's Purple). The combination of heat and humidity accelerates the reaction of the amino acids and ninhydrin.

1.2 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.3 Friction Ridge Skin, James F. Cowger, (1983), pages 96-98.

1.4 Processing Guide for Developing Latent Prints, FBI (2001).

1.5 The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

## 2.0 Scope

2.1 Ninhydrin is the most commonly used method for porous and semi-porous substrates. Excessive background discoloration may occur in substrates composed of a high plant or animal protein content (ex. leather and currency). It is not effective on items that have been wet.

2.2 Ninhydrin processing should be performed after iodine and DFO processing and prior to 1, 2 Indanedione and physical developer. Ninhydrin may develop additional prints if used after DFO.

2.3 Latent prints composed of blood can often be successfully darkened with the application of ninhydrin. This may be used on porous items as well as non-porous surfaces. To allow for further processing, non-porous surfaces should be processed with cyanoacrylate ester prior to the application of the ninhydrin reagent.

2.4 Surfaces that need other forensic examinations such as questioned document examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance

Magnetic stirrer/stirring bar

Beaker

Graduated cylinder

Pipettes or trays

Brushes or tongs

Fingerprint development chamber or steam iron

3.2 REAGENTS:

N-Hexane

Acetic acid

2-propanol (isopropyl alcohol)

Ninhydrin crystals

### 3.3 Ninhydrin Stock Solution:

1. Place a one-liter beaker on the magnetic stirrer.
2. Add 300 ml of 2-propanol to the beaker.
3. Add 100 ml of acetic acid.
4. Place the stirring bar in the beaker and turn the stirrer onto a low level.
5. Add 50g of ninhydrin crystals to the solution. It may take up to two hours for the ninhydrin to dissolve. Cover the beaker to avoid excess evaporation.

### 3.4 Ninhydrin Working Solution:

1. Add 30ml of the ninhydrin stock solution to a one-liter beaker.
2. Fill the beaker to the 1-liter mark with N-Hexane.
3. Stir. If the working solution appears cloudy, clarify by adding a small amount of 2-propanol.
4. Upon standing in its storage container, some of the ninhydrin may fall out of solution causing a visible oily yellow layer at the bottom. Do not dip, brush, or spray items with this yellow layer.

## 4.0 Procedure

### 4.1 PROCEDURE 1 - POROUS SUBSTRATES:

4.1.1 Conduct control tests.

4.1.2 Saturate the item with the ninhydrin working solution in a fume hood. Dipping or irrigating are the preferred methods, though brushing the solution on works well with large items. Spraying is the least desirable of the application options as this allows the solution to become airborne.

4.1.3 Allow the item to dry.

4.1.4 Expose the item to a warm (approximately 80°C) and humid atmosphere (approximately 65%). This can be accomplished in the fingerprint development chamber or with a hand held steam iron. When using the fingerprint development chamber, it is recommended that items be placed on a sheet of card board or paper to avoid contact with condensation formed on the shelves. When using the steam iron, it should move and hover above the surface, never being allowed to touch, as accidental contact will result in excessive discoloration. Monitor the item closely and remove the heat/humidity source when sufficient ridge detail develops or when no additional color change takes place.

4.1.5 Prints are evaluated to determine their suitability for comparison.

4.1.6 Prints deemed to be of value shall be marked and digitally preserved as they may fade with time and may not be retrievable with reprocessing.

4.1.7 It is recommended that the item be re-examined after approximately 24 hours to ensure that no additional latent prints have developed.

### 4.2 PROCEDURE 2 - BLOOD ENHANCEMENT:

4.2.1 Determine if samples for biology should be taken prior to processing.

4.2.2 Conduct control tests using prepared blood slides/paper controls stored in the laboratory refrigerator.

4.2.3 Impressions on porous items may be fixed using heat or methanol. Cyanoacrylate ester may be considered as a fixing option for semi-porous and non-porous items.

4.2.3.1 Blood can be fixed to the object by heating at 100°C in the fingerprint development chamber for one hour (restricted to non-heat sensitive objects). Heat fixing may damage latent prints that are composed of normal latent print constituents.

4.2.3.2 Methanol may be pipetted over the item and limited to the stain so that the remainder of the surface is unaffected. Three or four applications of methanol are needed to fix the stain.

4.2.3.3 Cyanoacrylate fuming may be an effective method for semi-porous items as it may fix all possible latent prints, not just those contaminated with blood.

4.2.4 Failure to fix the stain does not always render a lower quality latent print.

4.2.5 Apply the working solution to the stain and allow the item to remain at room temperature for approximately 48 hours. The ninhydrin will turn the protein component of the bloodstain a dark purple and may develop portions of the latent not previously seen.

4.2.6 Prints are evaluated to determine their suitability for comparison.

4.2.7 Prints deemed to be of value shall be marked and digitally preserved as they may fade with time and may not be retrievable with reprocessing.

## 5.0 Comments

### 5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of pre-mixed ninhydrin is indefinite. The shelf life of the ninhydrin stock solution and working solution is up to one year.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

### 5.3 CONTROLS:

5.3.1 Testing of the ninhydrin working solution is performed each day prior to use.

5.3.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control. When using ninhydrin as a blood reagent, control tests are performed by the application of the reagent to a slide or paper prepared with a smear of known blood. The area surrounding the intentionally deposited blood smear shall serve as a negative control.

5.3.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (development of a purple print) and negative results (minimal back ground development) have been carried out and documented in the laboratory case notes.

### 5.4 SAFETY:

5.4.1 Gloves, lab coat, and eye protection shall be worn when using or mixing ninhydrin. Precautions should also be taken to avoid inhalation of the fumes.

5.4.2 The solvent used in the ninhydrin working solution, Hexane, is *extremely flammable* and the solution is to be used or mixed in a fume hood or in another well-ventilated area. Ensure that ninhydrin treated items are completely dry prior to exposing to the heat source.

5.4.3 Glacial acetic acid is *corrosive* and extremely irritating to the eyes and respiratory system. Avoid breathing the vapors and use in a fume hood or with adequate ventilation. Glacial acetic acid will cause burns if it comes in contact with skin.

5.4.4 2-propanol, also known as Isopropyl Alcohol, is *flammable*. It is an irritant, and can be harmful if inhaled. Avoid breathing the vapors and use in a fume hood or with adequate ventilation.

# ThermaNin #17

## 1.0 Background/References

1.1 ThermaNin (2-isononylninhydrin) is a ninhydrin hemiketal used for developing fingerprints on thermal paper. It reacts with water in the paper or atmosphere to convert the compound back to ninhydrin which can react with the amino acids found in fingerprints to produce coloration.

1.2 Thermal paper presents a challenge when processing for latent prints. It darkens or turns black when heat is applied due to its thermosensitive properties and when polar carriers are used as in conventional methods. ThermaNin overcomes these limitations by not utilizing heat and polar carriers.

1.3 Journal of Forensic Identification, Vol. 66, No. 3, 2016. "A Limited Validation and Comparison of 1,2 Indanedione and ThermaNin for Latent Print Development on Thermal Paper," pages 245-256, Ponschke, Michelle and Hornickle, Mandi,

1.4 BVDA. "ThermaNin," http://www.bvda.com/en/thermanin#tab20.

1.5 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 ThermaNin is used to develop prints on thermal papers such as receipts and prescription bottle labels.

2.2 Thermal papers treated with ThermaNin allow for the retention of printed text.

2.3 Surfaces that need other forensic examinations such as handwriting analysis, body fluid examinations, or trace examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance
Magnetic stirrer/stirring bar
Beaker
Graduated cylinder
Pipettes or trays
Spatula

3.2 REAGENTS:

ThermaNin
Isopropyl Alcohol
Ethyl Acetate
HFE-7100

3.3 ThermaNin Working Solution:

| | |
|---|---|
| ThermaNin | 0.4 grams |
| Isopropyl Alcohol | 0.5mL |
| Ethyl Acetate | 1.5 mL |
| HFE-7100 | 98mL |

Dissolve 0.4 grams of ThermaNin powder into 1.5 mL of Ethyl Acetate on the magnetic stirrer for 5-10 minutes. Add 0.5mL of isopropyl alcohol. Dilute with 98 mL of HFE-7100 and stir. Store in dark brown glass bottle in a darkened area.

## 4.0 Procedure

4.1 Irrigate the thermal paper with an even coat of the reagent.

4.2 Do not apply heat. Allow the item to air-dry for approximately 24 hours.

4.3 Prints deemed to be of value shall be marked and digitally preserved. Prints may fade with time and may not be retrievable with reprocessing.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of the working solution is approximately seven days.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.1.3 Slight warming of the solution (30-40° C) will aid in the dissolution of the ThermaNin powder.

5.2 CONTROLS:

5.2.1 Testing of the ThermaNin working solution is performed each day prior to use.

5.2.2 This test involves the making of a quality latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (purple/pink-colored print) and negative results (a lack of development surrounding the deposited latent print) have been carried out and documented in laboratory case notes. The analyst may need to wait 2-3 hours after application to the control test to ensure that the controls perform as expected.

5.3 SAFETY:

5.3.1 Eye protection, a lab coat, and gloves should be worn. All mixing and application of chemicals shall be done inside a ventilated laboratory fume hood.

5.3.2 ThermaNin is combustible. It forms explosive mixtures with air on intense heating in dry form. In event of a fire, ThermaNin will develop hazardous combustion gases or vapors.

5.3.3 Ethyl Acetate is hazardous if ingested or inhaled and slightly hazardous in case of contact with skin or eyes. The substance is toxic to mucous membranes and the upper respiratory tract. Repeated or prolonged exposure to the substance can damage the blood, kidneys, liver, or central nervous system (CNS).

5.3.4 Isopropyl Alcohol is flammable. It is an irritant, and can be harmful if inhaled. Avoid breathing the vapors and use in a fume hood or with adequate ventilation.

5.3.5 HFE-7100 may be harmful if inhaled, swallowed or absorbed through skin. May cause skin, eye, and respiratory tract irritation. HFE-7100 is not considered a Hazardous chemical as defined by the OSHA Hazard Communication Standard, 29 CFR1910.1200.

# Physical Developer (PD) #18

## 1.0 Background/References

1.1 Physical Developer is a silver-based aqueous reagent that is believed to react with a mixture of amino acids in combination with lipids (fats, oils, and waxes) present in the fingerprint residue. The reaction results in the formation of a silver-gray deposit. In some cases, light to dark graying of the overall surface may occur with use of physical developer which may obscure prints. This can be mitigated by neutralizing the alkaline nature of some paper/cardboard through the use of an acid pre-wash.

1.2 Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

1.3 Advances in Fingerprint Technology, Henry C. Lee, R.E. Gaensslen, (1994), pages 79, 80, 81, 95, 112.

1.4 Technical Note #1-2730, Lightning Powder Co., (113133).

1.5 Technical Information #TI02-46ENG-REV6 Physical Developer.

## 2.0 Scope

2.1 Physical Developer is a method used for the development of latent prints on porous substrates. It is not suitable for non-porous surfaces.

2.2 This method is the final step in the sequential processing of porous items.

2.3 Physical Developer is the only method to show adequate results on paper that has been wet, and has shown good results on paper currency. It has also been shown to develop marks on items immersed in water for long periods of time and on decade's old paper.

2.4 Surfaces that need other forensic examinations such as body fluid, trace, or questioned document examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Beaker
Graduated cylinder
Glass trays
Plastic tongs
Glass or plastic stirring rod
Mechanical laboratory rocker
Nanopure water

3.2 REAGENTS:

Maleic Acid

Physical Developer Kit (parts A & B)

1. Any contamination may ruin the Physical Developer working solution. To avoid contamination use clean glassware rinsed with tap water, then with nanopure water prior to beginning.
2. Fill a beaker with 1000ml of nanopure water, add 25 g maleic acid. Stir until dissolved. Store unused maleic acid solution in glass bottle for future use.
3. In a separate beaker, add 5 ml of the Physical Developer solution A (20% silver nitrate solution) to 90 ml of the Physical Developer solution B (reductant solution). Stir the working solution for approximately one minute with a clean glass/plastic stirring rod.
4. The Physical Developer working solution has a short shelf life. Mix immediately prior to use.

## 4.0 Procedure

4.1 Arrange the glass trays in a stainless steel sink (rocking by hand) or in a fume hood (mechanical rocker), so that the evidence can be moved easily from one tray to another in the proper sequence.

4.2 Fill a clean glass tray with a volume of the maleic acid solution adequate to submerge the items being processed in a single layer.

4.3 Add the Physical Developer working solution to its dedicated glass tray.

4.4 Conduct control tests.

4.5 Submerge the items in a single layer in the maleic acid solution for 5-10 minutes (all bubbling action should stop).

4.6 Use non serrated plastic tongs to transfer items to the Physical Developer solution. Do not use metal tools.

4.7 Gently rock the Physical Developer solution tray for approximately 5-15 minutes, monitoring visually, until friction ridge development is complete or adequate time has elapsed. Rocking may be done manually or with a mechanical laboratory rocker.

4.8 Remove the item from the Physical Developer working solution and place into a tray with running tap water. Rinse until the water runs clear.

4.9 Dry completely.

4.10 Prints are evaluated to determine their suitability for comparison.

4.11 Prints deemed to be of value shall be marked and photographed.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Cleanliness is important in the Physical Developer method. A good deal of the instability in the earlier solutions was a result of laboratory equipment that was not spotless. Some contaminants, especially salts, will cause the silver nitrate in the solution to come out of suspension, thus spoiling the Physical Developer solution and perhaps ruining the item being examined. It is important to keep the glassware spotless and rinsed with nanopure water prior to use. When washing glassware, use detergent, not abrasive cleaners.

5.1.2 Physical Developer will cause dark stains on many surfaces. Care must be taken to avoid spills in the laboratory. Full strength chlorine bleach will usually remove any stains from counter tops and floors, but the bleach may cause damage to fabrics stained with Physical Developer.

5.1.3 Shelf life for ready to use kit (un-mixed) is reportedly six months from date of purchase. The reagent shall be mixed upon each use and may be used beyond its expiration date providing appropriate positive and negative control results are obtained. Unmixed Physical Developer kits are stored in the laboratory refrigerator in an effort to prolong shelf life.

5.1.4 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROLS:

5.2.1 Testing of Physical Developer is performed prior to each use.

5.2.2 This test involves the making of a quality (oil based) latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited latent print shall serve as a negative control.

5.2.3 An analyst shall not proceed with the processing of the evidence until control tests bearing positive results (development of a silver-gray print) and negative results (minimal background development) have been carried out and documented in the laboratory case notes.

5.3 SAFETY:

5.3.1 Maleic acid is corrosive and extremely irritating to the eyes and respiratory system. Maleic acid may cause an allergic skin reaction and will cause burns if it comes in contact with eyes or skin. Avoid breathing the dust/vapors/spray. Use in a fume hood, with a respirator, or with adequate ventilation.

5.3.2 Physical Developer should only be used in a fume hood or well-ventilated area, as it is irritating to the respiratory tract. Standard laboratory protocol is followed for chemical handling.

# RAM #19

## 1.0 Background/References

1.1 RAM (Rhodamine, Ardrox, and MBD (7-(P-Methoxybenzylamino)-4Nitrobenz-2-Oxa-1, 3-Diazole) is a combination stain used to dye previously developed CAE prints. The ability to use RAM at various wavelengths, may enable the analyst to maximize fingerprint fluorescence and suppress background fluorescence.

1.2 **The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.**

1.3 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

## 2.0 Scope

2.1 RAM is a dye-stain used to aid in the visualization of CAE developed latent prints on non-porous substrates.

2.2 RAM should be used after CAE and prior to powdering.

2.3 Surfaces that need other forensic examinations such as body fluid or trace examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Graduated Cylinders
Balance
Spatula
Beaker
Spray or rinse bottles
Glass tray
Storage bottles
Alternate light source/filtered goggles

3.2 REAGENTS

Rhodamine 6G powder
Methanol
MBD
Acetone
Ardrox P133D
Isopropanol
Acetonitrile
Petroleum Ether
Acetone

Mixing Procedure: The two stock solutions must be mixed prior to formulating the RAM dye.

3.3 Stock Solution 1 (Rhodamine 6G)

Rhodamine 6G powder -1 g

Methanol - 1000 mL

Combine the ingredients and place on a stirring device until all the Rhodamine 6G is thoroughly dissolved.

3.4 Stock Solution 2 (MBD)

MBD- 1 g

Acetone- 1000 mL

Combine the ingredients and place on a stirring device until all the MBD is thoroughly dissolved.

3.5 Ardrox P133D

Ardrox is used undiluted directly from the container.

3.6 RAM Working Solution

Stock Solution 1- 3 mL

Ardrox P133D- 2 mL

Stock Solution 2- 7 mL

Methanol - 20 mL

Isopropanol - 10 mL

Acetonitrile - 8 mL

Petroleum Ether - 950 mL

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

## 4.0 Procedure

4.1 Suspend the item to be processed over a glass collection tray.

4.2 Irrigate the working solution over the item. Allow the item to dry completely.

4.3 View the item through the appropriate filters (yellow/orange) using an alternate light source set in the 380-530 nm range. Visualization of developed ridge detail is dependent upon the condition of the item and background interference. Precise adherence to excitation wavelengths is not always possible depending on the available light source and/or background interference.

4.4 Prints are evaluated to determine their suitability for comparison.

4.5 Prints deemed to be of value shall be marked and photographed. Photography will require the aid of an appropriate (yellow/orange) barrier filter on the camera and the use of an alternate light source.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Stock solutions should be stored in dark bottles- shelf life is indefinite. The RAM working solution is stable for approximately 30 days. After 30 days it should be checked for separation. If the solution has separated, shake the container vigorously and the solution will usually return to suspension. If this does not occur, discard the solution.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROL TESTS:

5.2.1 Testing of RAM is performed each day prior to use.

5.2.2 This test involves placing a drop of the RAM working solution onto a surface. The area surrounding the intentionally deposited working solution shall serve as a negative control.

5.2.3 The test is illuminated with an alternate light source as outlined in 4.3.

5.2.4 An analyst shall not proceed with the processing of evidence until control tests bearing positive results (fluorescence) and negative results (lack of fluorescence) have been carried out and documented in the laboratory case notes and on the control tests work sheet.

5.3 SAFETY:

5.3.1 Eye protection, a lab coat and gloves should be worn. All mixing and application of chemicals should be done inside a ventilated laboratory fume hood.

5.3.2 Rhodamine 6G, Ardrox P133D, and MBD are classified as suspected animal *carcinogens*, but sufficient evidence of human carcinogenicity has not been established. RAM is thought to be relatively safe when exposure is at low levels. It should never be inhaled or allowed to get into the eyes or mouth, as it is an irritant. If this should occur, the eyes or mouth should be flushed with a generous amount of water.

5.3.3 Methanol, isopropanol, and petroleum ether are highly *flammable*. All three chemicals should be handled carefully with gloves during mixing and use of the stain. Methanol and isopropanol are toxic in quantities as small as 30 ml and should not be allowed to come in contact with the skin, eyes, or mouth. It is possible for methanol and isopropanol to be absorbed through the skin. If methanol, isopropanol, or petroleum ether comes into contact with the eyes or mouth, the area should be flushed with generous amounts of water. Inhalation of chemical vapors should be kept at a minimum and the stain should be used in a fume hood or well-ventilated area.

5.3.4 Acetonitrile may be fatal if swallowed, inhaled or absorbed through skin; affects cardiovascular system, central nervous system, liver and kidneys; may cause irritation to skin, eyes, and respiratory tract; flammable liquid and vapor.

# Rhodamine 6G #20

## 1.0 Background/References

1.1 Rhodamine 6G has been used to visualize CAE developed prints since the early 1980's. While a number of alternatives have been proposed, it is still one of the most widely used dyes for this purpose.

1.2 The Fingerprint Sourcebook. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

1.3 An Introduction to Lasers, Forensic Lights and Fluorescent Fingerprint Detection Techniques, E. Roland Menzel, (1991), pages 42-44.

1.4 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.5 Chemical Formulas and Processing Guide for Developing Latent Prints, U.S. Department of Justice, F.B.I. Laboratory Division, (1994), pages 55-56.

1.6 Technical Notes #1-0041, Lightning Powder Co. Inc., pages 1-4.

## 2.0 Scope

2.1 Rhodamine 6G is a dye-stain used to aid in the visualization of CAE developed latent prints on non-porous substrates.

2.2 Rhodamine 6G should be used after CAE and prior to powdering.

2.3 Surfaces that need other forensic examinations such as body fluid or trace examinations should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance

Spatula

Beaker

Spray or rinse bottles

Glass tray

Storage bottles

Alternate light source/filtered goggles

3.2 REAGENTS:

Rhodamine 6G powder

Methanol or deionized water

3.3 Rhodamine 6G working solution:

1. Measure out approximately 0.1 gram Rhodamine 6G (about the size of a BB) and add to the storage bottle.
2. Add approximately one liter of methanol or deionized water depending on the carrier the analyst wishes to use.

3. Seal the bottle and agitate gently to mix.
4. Label the bottle with the type of carrier used (water or methanol).

## 4.0 Procedure

4.1 Suspend the item to be processed over a glass collection tray.

4.2 Irrigate the working solution over the item.

4.3 Rinse with an appropriate solution (methanol or water, dependent on the working solution).

4.4 Allow the item to dry completely.

4.5 View the item through an orange filter using an alternate light source set in the 450 nm- 540 nm range. Visualization of developed ridge detail is dependent upon the condition of the item and background interference. Precise adherence to excitation wavelengths is not always possible depending on the available light source and/or background interference.

4.6 Prints are evaluated to determine their suitability for comparison.

4.7 Prints deemed to be of value shall be marked and photographed. Photography will require an orange barrier filter on the camera and the use of an ALS.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 The use of water in lieu of methanol is useful when methanol may damage the item being processed, as may be the case with some lacquers, plastics, or tapes. The methanol formulation should be utilized in a fume hood or well ventilated area. The chosen formulation should be reflected in the case notes.

5.1.2 If there is concern over background staining, test a small area prior to processing the entire item.

5.1.3 The pre-mixed Rhodamine 6G and the working solution have an indefinite shelf life when stored at room temperature.

5.1.4 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROL TESTS:

5.2.1 Testing of Rhodamine 6G is performed each day prior to use.

5.2.2 This test involves placing a drop of the Rhodamine 6G working solution onto a surface. The area surrounding the intentionally deposited working solution shall serve as a negative control.

5.2.3 The test is illuminated with an alternate light source as outlined in 4.5.

5.2.4 An analyst shall not proceed with the processing of the evidence until control tests bearing positive results (fluorescence) and negative results (lack of fluorescence) have been carried out and documented in the laboratory case notes and on the control tests work sheet.

5.3 SAFETY:

5.3.1 Rhodamine 6G is classified as a suspected animal *carcinogen*, but sufficient evidence of human carcinogenicity has not been established. Rhodamine 6G is thought to be relatively safe when exposure is at low levels. It should never be inhaled or allowed to get into the eyes or mouth, as it is an irritant. If this should occur, the eyes or mouth should be flushed with a generous amount of water and a doctor may be consulted.

5.3.2 Methanol is highly *flammable*. It should be handled carefully with gloves during mixing and use of the stain. Methanol is toxic in quantities as small as 30 ml and should not be allowed to come in contact with the skin, eyes, or mouth. It is possible for methanol to be absorbed through the skin. If methanol comes into contact with the eyes or mouth, the area should be flushed with generous amounts of water and a doctor may be consulted. Inhalation of methanol vapors should be kept at a minimum and the stain should be used in a well-ventilated area.

# Sudan Black #21

## 1.0 Background/References

1.1 Sudan Black B, Solvent Black 3, is a dye that stains fatty components to produce a blue-black image. Sudan Black B is a lysochrome dye or fat stain. This type of dye essentially colors fats by dissolving into them. It is considered to be a low-sensitivity method and contaminants such as grease are required as a target to which the reagent can bind.

1.2 Fingerprint Source Book v2.0 (second edition), Home Office, 2017.

1.3 Lightning Powder Technical Note No. 1-0034, "Sudan Black", (May, 1995).

## 2.0 Scope

2.1 Sudan Black is a dye-stain method used to develop friction ridge detail on non-porous waxy substrates and surfaces contaminated with grease, dried beverages, and foodstuffs. Sudan Black may also be considered for use on semi-porous contaminated surfaces with the understanding that background staining may occur and could obscure developed prints. Sudan Black will also enhance CAE developed fingerprints.

2.2 Sudan Black is not suitable for use on porous surfaces or dark colored items. While there is preferential solubility into fats, some background staining may occur.

2.3 Surfaces that need other forensic examinations such as biology or trace should be carefully evaluated prior to processing to determine if this procedure will have an impact on subsequent examinations.

## 3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Beaker
Glass tray
Graduated cylinder
Balance
Spatula
Stirring rod
Storage bottle

3.2 REAGENTS:

Sudan Black B powder
Methanol
Deionized water

3.3 Sudan Black B Working Solution:

1. Place 15 g of Sudan Black powder into a 2-liter glass beaker.
2. Add 1-liter of methanol and stir with a plastic stirring rod.

3. Add 500 ml of deionized water to the beaker and stir. Sudan black B is insoluble in water, and the addition of water reduces the solubility to the point where precipitation begins to occur. Pour the solution, including any solid matter, into a clean glass bottle with a tight-fitting screw top.

## 4.0 Procedure

4.1 Shake the container of Sudan Black working solution and pour a sufficient amount into a tray large enough to hold the item of evidence.

4.2 Soak the item for 2-3 minutes. For large items, irrigate the solution over the surface, catching the run off in a tray for reuse on the item.

4.3 Rinse the article in cool running tap water.

4.4 Allow the item to dry at room temperature.

4.5 Prints are evaluated to determine their suitability for comparison.

4.6 Reprocessing can sometimes enhance faintly developed latent prints.

4.7 Prints deemed to be of value shall be marked and photographed. While it is possible to lift the prints with tape, the tape frequently does not lift the print sufficiently and prints that have been lifted have been known to migrate causing the image to blur. Therefore, it is strongly recommended that prints be photographed prior to and after lifting.

## 5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 The pre-mixed Sudan Black and the working solution have an indefinite shelf life at room temperature.

5.1.2 Excess reagent shall be collected and placed in the hazardous waste container located in the fume hood.

5.2 CONTROL TESTS:

5.2.1 Testing of Sudan Black is performed each day prior to use.

5.2.2 This test involves the making of a quality (fat/oil based) latent print on a test surface similar to the evidence being examined and following the processing procedure. The area surrounding the intentionally deposited print shall serve as a negative control.

5.2.3 An analyst cannot proceed with the processing of the evidence until control tests bearing positive results (development of a blue-black print) and negative results (minimal background development) have been carried out and documented in the laboratory case notes.

5.3 SAFETY:

5.3.1 The Sudan Black working solution contains methanol. Methanol is toxic in quantities as small as 30 ml and should not be allowed to come in contact with the skin, eyes, or mouth. It is possible for methanol to be absorbed through the skin. If methanol comes into contact with the eyes or mouth, the area should be flushed with generous amounts of water and a doctor may be consulted. Inhalation of methanol vapors should be kept at a minimum and the Sudan Black should be used in a fume hood or well-ventilated area.

# Digital Imaging Procedure #22

## 1.0 Background/References

1.1 Latent print images are frequently captured, processed, and stored using digital devices. The intent of image processing is to allow for higher image clarity and contrast. Image processing may be used to increase the contrast between the print and the substrate, reverse the color of the ridges, etc.

1.2 SWGIT Guidelines Section 8 "General Guidelines for Capturing Latent Impressions Using a Digital Camera", Version 1.3.

1.3 International Association for Identification "Resolution 97-9."

1.4 Foray Technologies' ADAMS Web "Help" function.

1.5 Scientific Working Group on Imaging Technologies (SWGIT), "Guidelines for the Use of Digital Image Processing," Version 2.1.

1.6 SWGIT Guidelines, Section 11, "Best Practices for Documenting Image Enhancement," Version 1.3.

1.7 Scientific Working Group on Imaging Technologies (SWGIT), Section 6 "Guidelines and Recommendations for Training in Imaging Technologies in the Criminal Justice System," Version 1.3.

1.8 ASTM International. E2916-19e1 Standard Terminology for Digital and Multimedia Evidence Examination. West Conshohocken, PA; ASTM International, 2019.

## 2.0 Scope

2.1 This sets forth the Latent Print Section's procedures for the capture, storage, processing, and output of latent print digital images.

## 3.0 Equipment/Reagents

3.1 Computer

3.2 Adams Web/Digital Workplace Software

3.3 Adobe Photoshop

## 4.0 Procedure

4.1 DIGITAL IMAGE PRESERVATION & STORAGE

4.1.1 Analysts shall use one of the following digital image capture devices to acquire images.

4.1.1.1 Flatbed Scanner

4.1.1.2 Digital Camera

4.1.1.3 Digital Media (e.g. Thumb Drive, CD/DVD, etc.)

4.1.1.4 Tablet

4.1.1.5 Scanner (e.g. copy machine or standalone).

4.1.2 A primary image is the result of the first recording of an image onto media. An original image is an accurate replica (bit-for-bit value) of the primary image.

4.1.3 Digital images to be used for comparison purposes (category 2 images) shall be stored and transmitted without compression or with lossless compression (i.e. capture in a TIF or RAW file format is recommended).

4.1.3.1 Original close up images captured by latent section analysts should fill the frame as much as possible and contain a scale in centimeters. The scale should be on the same plane and as close as possible to the impression without obscuring detail.

4.1.3.2 Comparison quality images intended for MBIS or printing shall be calibrated (note exemption in 4.1.4.1).

4.1.4 Friction ridge impressions captured on a flatbed scanner (image sized 1:1) with the intention of being used for comparison purposes shall be captured in color, at a minimum resolution of 1200 ppi. Interpolation from a lower resolution up to 1200 ppi is not permitted.

4.1.4.1 Images captured on a flatbed scanner are at 1:1; therefore, no calibration of these images is needed.

4.1.4.2 Comparison quality images should include a scale in centimeters.

4.1.5 Images captured for documentation purposes only (category 1 images) may be captured at a lower resolution and/or alternate file type (e.g. JPG) to achieve a smaller file size.

4.1.5.1 All images acquired via tablet fall into this category.

4.1.6 Outside agencies may submit processed film for digital capture or digitally submit latent print images.

4.1.6.1 Images of latent prints should contain a scale.

4.1.6.2 It is preferred that existing images (those submitted by outside agencies) be submitted in a lossless format such as TIF or RAW and at as high a resolution as possible.

4.1.6.3 Upon receipt of a lossy file type (ex. JPG), the image shall immediately be converted to TIF and saved (upload to Adams Web/Digital Workplace meets this requirement). The analyst should also magnify the image to look for "blocking" that may indicate loss of detail due to compression, and take it into consideration during their analysis.

4.1.7 Category 2 images shall be acquired through the digital imaging system or directly uploaded from temporary storage into the system.

4.1.8 Digital imaging system software establishes a chain of custody from the time of acquisition into the program.

4.1.9 Images shall be designated using a file name structure generated by the digital imaging system software.

4.1.10 Category 1 images may be attached to the case record in ILIMS or uploaded to the digital imaging system.

## 4.2 DIGITAL IMAGE PROCESSING/ENHANCEMENT

4.2.1 Image processing shall only be conducted on working copies of the original image. Working copies used in forensic case examination shall be saved as a separate copy and shall not replace the original image.

4.2.1.1 The only exception to this rule is when adjusting white balance in the camera raw converter.

4.2.2 Evidentiary images requiring processing shall be processed using Adobe Photoshop or proprietary digital imaging system software using a copy of the original image.

4.2.3 The following is a list of commonly used, generally accepted processing commands and is in no way all inclusive. All processing commands employed are left to the discretion of the analyst. Suggested settings/guidelines/notes appear after the command in parenthesis.

Foray Technologies preloaded "Latent Print Actions"

Image – Adjustments – **Black & White** (use to remove two or more color values and/or adjust the color values so that a color channel may be used to suppress the background)

Image – Adjustments – **Brightness/Contrast**

Image – Adjustments – **Color Balance** (use to remove two or more color values and/or adjust the color values so that a color channel may be used to suppress the background)

Image – Adjustments – **Curves** (extraordinary contrast; convert to gray scale prior to; sample lightest possible ridge where ridge and furrows are very similar in tone; avoid flat line of "S" curve)

Image – Adjustments – **Exposure** (balance tonal range)

Image – Adjustments – **Hue/Saturation** (eliminates two or more color values; used in conjunction with Calculations to eliminate background noise)

Image – Adjustments – **Invert**

Image – Adjustments – **Levels** (use to redistribute/balance tonal range; use in conjunction with the Alt key to avoid clipping or adjust mid-tone value only; useful for one sided histograms)

Image – Adjustments – **Photo Filter** (use to remove two or more color values and/or adjust the color values so that a color channel may be used to suppress the background)

Image – Adjustments – **Shadows & Highlight** (balance tonal range and contrast; radius of <50; optimal is 30-50 pixels)

Image – **Apply Image** – (can change opacity and scroll through blending options using ← → )

Image – **Calculations** (useful for background suppression; set blending value to Color Dodge or Linear Dodge, consider a change opacity)

Image – **Rotate Canvas** (90 degree rotation is acceptable at any stage; increments other than 90 degrees should be the last processing step; suggest utilizing the Rotate View tool in lieu of other increment rotations).

Image – Rotate Canvas – **Flip Canvas Horizontal**

**Color Channels** (RGB, CMYK, or LAB Color; used to remove one color; follow with conversion to gray scale)

Filter – **Camera Raw** (useful for correcting white balance)

Filter – Foray – **Fast Fourier Transform (FFT)** (removes/reduces repeating patterns)

Filter – Noise – **Dust & Scratches** (removes artifacts, i.e. excess powder etc.; radius of 1 pixel per 1000 ppi +1; threshold value between 0-50; useful prior to printing and/or MBIS submission)

Filter - Noise - **Reduce Noise** (removes random artifacts)

Filter - Sharpen - **Sharpen Edges** (sharpens areas where significant color changes occur; less control than Unsharp Mask or Smart Sharpen)

Filter - Sharpen - **Smart Sharpen** (Similar to Unsharp Mask with more control)

Filter – Sharpen – **Unsharp Mask** (sharpens by increasing contrast –lighter pixels get lighter and the darker pixels get darker; amount should not exceed 100%; radius of 1 pixel per 1000 ppi +1 with threshold value set between 0-50; useful prior to printing)

**Burn Tool** – (burn shadows - feathered brush; diameter of 8-10 ridges; exposure between 15-50%; use single clicks)

**Crop Tool** – used to remove a portion of the image that is outside the area of interest.

**Dodge Tool** – (dodge highlights; feathered brush; diameter of 8-10 ridges; exposure between 15-50%; use single clicks)

**Marquee & Lasso Tools** (images with ppi >1000 determine feather by dividing resolution by 100 and multiplying by 5 – this is a recommendation only and may need to be modified based on size of area selected or as dictated by the program; avoid feathering for inversions, areas of high contrast, and straight edges)

**Type Tool** (set anti-aliasing to smooth)

4.2.4 Processed images will be designated using a file name structure generated by the digital imaging system software.

4.2.5 Processing history is recorded via the digital imaging system software.

4.2.6 Images stored in a secured digital imaging system maintained by ISP Forensic Services shall be referenced in the case record.

4.3 DIGITAL IMAGE PRINTING

4.3.1 Images shall be calibrated prior to printing.

4.3.2 Image calibration may be checked as needed by comparing the scale in the printed image with a standard metric scale.

4.4 DIGITAL IMAGE STORAGE, DELETION, AND RETRIEVAL

4.4.1 Images, both original and processed, shall be stored on the ISP digital imaging system server.

4.4.2 If an image is acquired into a case unintentionally, the image and associated case information is documented in the "Adams Web -Digital Image Deletion Log" and may be moved to the trash by the image owner or the Digital Imaging System Administrator. NOTE: moving the image to the trash does not delete the image from the system it only removes it from the case. Images can be restored until final deletion by the Digital Imaging System Administrator is complete. The "Adams Web -Digital Image Deletion Log" is located on the I: drive in the Latent Section folder.

4.4.3 A backup shall be completed by the ISPIT staff on a routine server backup schedule.

4.4.4 Cases may be deleted from the server once the statute of limitations has been exceeded.

4.4.5 Cases with no statute of limitation shall be stored on the ISP server indefinitely.

## 5.0 Comments

5.1 RESPONSIBILITIES:

5.1.1 Latent Section Discipline Lead

5.1.1.1 The Latent Section Discipline Lead shall act as the Digital Imaging System Administrator and/or appoint a Digital Imaging System Administrator.

5.1.1.2 The Latent Section Discipline Lead shall oversee and document the training of each new digital imaging system operator. This includes documenting competency testing.

5.1.1.3 The Latent Section Discipline Lead shall ensure access is limited to authorized users.

5.1.1.4 The Latent Section Discipline Lead or designee shall act as a liaison with ISPIT and digital imaging system technical staff on system maintenance, upgrades, and when technical difficulties arise.

5.1.1.5 The Latent Section Discipline Lead or designee shall be the only personnel authorized to delete images or cases entered into the digital imaging system.

5.1.2 Digital Imaging System Administrator

5.1.2.1 The Digital Imaging System Administrator shall be responsible for system maintenance to include: deletion of images/cases, archiving, etc.

5.1.2.2 The Digital Imaging System Administrator shall communicate system status to the supervisor and other system users.

5.1.3 Analysts

5.1.3.1 Analysts shall only use processing techniques that are supported by their training and/or experience.

5.1.3.2 Analysts shall maintain system security. Network and/or program passwords are not to be distributed to unauthorized users. Operators may change their passwords as needed.

## 5.2 QUALITY CONTROL:

5.2.1 Performance checks shall be conducted on equipment as needed.

5.2.2 When a problem is noted with a particular piece of equipment, software program, etc., the Digital Imaging System Administrator and/or the Latent Section Discipline Lead shall be notified.

5.2.3 If it is determined that the situation is persistent or cannot be easily rectified, an entry shall be made on the "Instrument Maintenance Log". The log shall detail the date, the person making the entry, the piece of equipment/software involved, and relevant details of the situation.

5.2.4 Affected equipment/software shall be taken off line and all users notified.

5.2.5 If necessary, technical support shall be sought and/or the equipment repaired before being put back into operation.

5.2.6 Actions taken to repair or correct the problem shall be documented on the "Instrument Maintenance Log."

## 5.3 TRAINING

5.3.1 Analysts utilizing imaging technologies shall be trained and tested for competency in the standard operating procedures and the operation of the relevant imaging technologies.

5.3.2 Formal training may be modified at the discretion of the Latent Section Discipline Lead dependent upon previous training and/or experience.

5.3.3 Continuing education may be provided as courses become available.

5.3.4 Competency testing shall be repeated when significant changes in hardware or software are made (e.g. manufacturer/vendor changes).

# Friction Ridge Examination Methodology #23

## 1.0 Background/References

1.1 Friction ridges are formed on the palmar portion of the hands and the plantar portion of the feet during fetal development.

1.2 Friction ridge arrangements are relatively persistent throughout the life of the individual, barring trauma or disease.

1.3 Friction ridge skin is often credited as being highly discriminating in nature. No two fingerprints, palm prints, or foot prints have ever been found to be fully duplicated between two individuals or within the same person.

1.4 An impression representative of the discriminating details of friction ridge skin may be transferred upon contact with a surface.

1.5 An impression containing a sufficient quantity and quality of detail may be identified to or excluded from a particular source.

1.6 No scientific basis exists for requiring a pre-determined minimum number of friction ridge characteristics to be present in two impressions in order to establish a positive identification.

1.7 Friction Ridge Examination is also supported by probability modeling and empirical data gained through more than one hundred years of operational experience.

1.8 The Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) - *SWGFAST documents are officially published in the Journal of Forensic Identification.*

1.9 Fingerprint Whorld, Vol. 26, No. 101, July 2000. "Scientific Comparison and Identification of Fingerprint Evidence," pages 95-106, *Pat A. Wertheim.*

1.10 Journal of Forensic Identification, Vol. 41, No. 1, January/February, 1991. "Ridgeology," pages 16-64, *David R. Ashbaugh.*

1.11 The United States Department of Justice - Uniform Language for Testimony and Reports for the Forensic Latent Print Discipline – Effective 8.15.20. ULTRs are published at https://www.justice.gov/olp/uniform-language-testimony-and-reports

## 2.0 Scope

2.1 Analysts shall apply the concepts of Analysis, Comparison, Evaluation, and Verification, herein referred to as ACE-V methodology, to friction ridge impressions preserved by the Latent Section or submitted by our customer agencies. The ACE-V methodology utilizes a qualitative and quantitative assessment of Level 1, Level 2, and Level 3 details.

## 3.0 Equipment/Reagents

3.1 EQUIMPENT AND MATERIALS

Magnifiers/Pointers

Computers/Digital imaging system

## 4.0 Procedure

4.1 ANALYSIS is the assessment of a friction ridge impression to determine suitability for comparison.

4.1.1 The value of friction ridge impressions is assessed according to the quality, quantity, the specificity of features, and the relationships they possess. Quality and quantity of detail may be influenced by the anatomical source (finger, palm, etc.), condition of the friction ridge skin, type of matrix, deposition factors, substrate considerations, environmental factors, development mediums, and preservation methods.

4.1.1.1 Level One Detail consists of overall ridge flow and pattern configuration. Level one detail may include information enabling orientation and can be used to determine anatomical source (i.e., finger, palm, foot, etc.). Anatomical information may be used to prioritize the potential corresponding areas and limit unnecessary comparisons. Certain orientation indicators such as recurves, deltas, creases, and scars may provide specific guidance on where to begin the comparison. Level one detail also includes general morphology (e.g., presence of incipient ridges, overall size).

4.1.1.2 Level Two Detail consists of the individual ridge paths, presence or absence of ridge path deviations (ending ridge, bifurcation, and dot or continuous ridge), and their relative arrangement.

4.1.1.3 Level Three Detail is confined to small shapes on individual ridges, relative pore positions, and other specific skin morphology (e.g., secondary creases, ridge breaks, etc.).

4.1.1.4 Other features associated with friction ridge skin (e.g., creases, scars, warts, paper cuts, blisters) may also be considered. These features may be permanent or temporary and exist as level one, two, or three detail.

4.1.2 Minimum quality assurance measures are associated with each level of complexity according to the following:

4.1.2.1 Non-Complex Prints - Limited documentation of the relevant features used as a basis for a conclusion; standard verification will be completed.

4.1.2.2 Complex Prints - Extensive documentation of the relevant features (i.e. charts or diagrams) used as a basis for a conclusion; original and verifying analysts should consider the possibility of an enhanced verification and review procedure (e.g., a blind verification, consensus opinion).

4.1.2.2.1 An impression may be classified as complex if modifying factors are present such as low specificity of features, significant distortion (e.g., multiple tap, superimposed impression, pressure changes, tonal reversal, and slippage), high tolerances, or the original conclusion is contested during verification.

4.1.2.3 An impression categorized initially as complex may be classified as non-complex if modifying factors are present such as high specificity of features, presence of creases, scars, and open fields.

4.1.2.4 Justification for reassignment of complexity shall be documented.

4.1.3 Impressions deemed "of value" are impressions that in the opinion of the examiner, contain sufficient quantity, quality, and specificity of ridge detail to warrant a comparison. The determination of sufficiency is based on the assessment of the discriminating strengths of the features and their arrangements. Impressions deemed "of value" proceed to the comparison step if there are known exemplars with which to compare. If no known exemplars can be located, or if a source identification is not effected, impressions shall be considered for MBIS inquiry. Note: not all latent prints deemed suitable for comparison are suitable for MBIS entry.

4.1.4 Impressions that do not contain sufficient detail to warrant a comparison in the opinion of the analyst are deemed to have "insufficient ridge detail" (IRD). This conclusion is noted as such in the case documentation.

4.1.5 Analysis of the impression also includes the selection of a suitable target area (core, delta, specific arrangement of features, etc.) for use during comparison.

4.1.6 Analysis occurs independently of the Comparison, Evaluation and Verification steps of ACE-V.

4.1.7 An arc over the top of a print represents the anatomical source as a finger and anatomical orientation, unless otherwise noted.

4.1.8 A bracket symbol documents the anatomical source as a palm print, footprint, or unknown anatomical source. If the orientation is known the print may be rotated appropriately in the digital imaging system or directionality indicated with an arrow.

4.1.9 The presence of friction ridge impressions that are assessed but not designated for comparison shall be documented. Documentation shall be accomplished by indicating that “no value” impressions were either “present” or “not present” in the Latent Analysis Matrix of ILIMS for all instances where latent prints have been marked and given a unique identifier. This is not required when the entire image or lift is IRD.

4.1.10 Impressions deemed “of value for exclusion only” consist of impressions that contain a portion of a print that is distinguishable (e.g. sizeable area with known location and orientation) and contains a locatable anchor point (core, delta, prominent crease, scar, vestige, etc.); but does not display sufficient characteristics to effect a source identification.

4.1.11 The receipt of latent lift cards or photos said to contain latent prints, which upon analysis show “no ridge detail present” shall be noted as “NDP.”

4.2 COMPARISON is the side-by-side, back and forth, observation of friction ridge detail to determine whether the detail in two impressions is in agreement or disagreement based upon features, sequences, and spatial relationships within the tolerance of clarity and distortion. Comparison begins with the determination of dissimilarity or similarity between two impressions at Level one. If the analysis phase provides indicators as to the probable anatomical area, a side by side comparison with the appropriate area of the known print(s) is conducted. In the absence of indicators, all areas of available known impressions must be compared.

4.2.1 If similarity is determined within tolerance at Level one a target group is selected from the features observed during the analysis phase and is then searched within the corresponding area of the other impression. Additional arrangements of features are compared between impressions in a cyclical process to evaluate disagreement or agreement between the impressions. If the initial target group is not found, alternative target groups shall be selected and compared.

4.2.2 Comparison is based on similarity, sequence, and spatial relationship.

4.2.3 Comparison is carried out in an objective manner beginning with the questioned print (or impression of poorest quality) and comparing to the known (or impression of better quality).

4.2.4 Fingerprint and palm print records may be downloaded or printed from the MBIS system. Original fingerprint cards held by the Idaho State Police Bureau of Criminal Identification (BCI) and/or ISPFS shall be checked out and tracked as appropriate. Fingerprint cards may also be downloaded from the FBI database via WIN or requested from individual state record bureaus.

4.2.4.1 When multiple exemplars are available for a given individual, it is incumbent upon the analyst to select the most complete, highest quality, exemplars that include all relevant comparable anatomical areas based on the latent prints.

4.2.4.2 The analyst shall scan/upload the exemplars into the digital imaging system. These copies/digital images shall be used for comparison purposes and the original cards returned to the BCI archive or the submitting agency.

4.2.5 The current national resolution standard for the transmission of 10-print images is approximately 500 ppi.

4.2.5.1 The following exemplars shall be considered to meet or exceed this standard and may be used for comparison purposes: original card, high quality photocopies and/or MBIS archive printouts traceable to a single source, copies obtained from the FBI, and digital images of original exemplars.

4.2.5.2 Examples of images not meeting these standards are 1:1 faxed images, low quality PDF's or low quality photocopies. These lower resolution images may at times be used for exclusion based on Level one detail depending on the clarity of the image.

4.3 EVALUATION is the formulation of a conclusion based upon analysis and comparison of friction ridge impressions. Conclusions that may be reached are source identification, source exclusion, or inconclusive.

4.3.1 'Source identification' is an analyst's conclusion that two friction ridge skin impressions originated from the same source. This conclusion is an analyst's opinion that the observed friction ridge skin features are in sufficient correspondence such that the analyst would not expect to see the same arrangement of features repeated in an impression that came from a different source and has found insufficient friction ridge skin features in disagreement to conclude that the impressions came from different sources.

4.3.1.1 The basis for a 'source identification' conclusion is an analyst's opinion that the observed corresponding friction ridge skin features provide extremely strong support for the proposition that the two impressions came from the same source and extremely weak support for the proposition that the two impressions came from different sources.

4.3.1.2 A 'source identification' is the statement of an analyst's opinion that the probability that the two impressions were made by different sources is so small that it is negligible.

4.3.1.3 A 'source identification' is not based upon a statistically-derived or verified measurement or actual comparison of all friction ridge skin impression features in the world's population.

4.3.1.4 No two prints will ever be exactly the same in *all* respects. Explainable differences are features that differ between a known and questioned print but can be explained as a result of distortion, slippage, twisting, printing defects, overlapping prints, etc.

4.3.2 'Source exclusion' is an analyst's conclusion that two friction ridge skin impressions did not originate from the same source.

4.3.2.1 The basis for a 'source exclusion' is an analyst's opinion that the observed friction ridge skin features are in sufficient disagreement and provide extremely strong support for the proposition that the two impressions came from different sources and extremely weak or no support for the proposition that the two impressions came from the same source.

4.3.2.2 Exclusion of a subject can only be reached if all relevant comparable anatomical areas are represented and legible in the known exemplars. Source exclusion should employ the use of an anchor point and second level detail.

4.3.2.2.1 An anchor point is an area of ridge flow, first level detail, present in the latent print that allows an analyst to reliably determine the anatomical location of the unknown impression. An anchor point may be a core, delta, characteristic shape (egg, L-shape, etc.) or a large field of ridge detail with characteristic crease and ridge flow patterning.

4.3.2.2.2 Second level details, i.e. target groups, used for source exclusion must be associated with the first level anchor point. Two or more target areas should be utilized prior to excluding.

4.3.2.2.3 Exclusions shall refer to the exemplars used.

4.3.3 'Inconclusive' is an analyst's conclusion that there is insufficient quantity and/or clarity of corresponding friction ridge skin features between two impressions such that the analyst is unable to identify or exclude the two impressions as originating from the same source.

4.3.3.1 The basis for an 'inconclusive' conclusion is an analyst's opinion that a 'source identification' or 'source exclusion' cannot be made due to insufficient information in either of the two impressions examined (i.e. lack of quantity, quality, or specificity in the questioned print, lack of a locatable anchor, or poor quality exemplars/lack of comparable areas).

4.3.3.2 Inconclusive conclusions shall not be construed as a statement of possible or probable identification.

4.4 VERIFICATION is the independent examination by another qualified analyst using the ACE methodology to either support or refute the conclusions of the original analyst.

4.4.1 A qualified analyst shall verify all latent print value decisions (NDP, IRD, and Of Value) and comparison conclusions.

4.4.2 Analysts shall not verify any conclusions with which they are not comfortable. Comfort level is a function of training and experience.

4.4.3 Analysts are encouraged to work out differing conclusions through collaboration. If the differing conclusions cannot be resolved, the ISPFS Latent Print Quality Manual Section 10.0 "Conflict Resolution" will be followed.

4.4.4 Analysts do not need to conduct verifications on non-hit latent prints candidates generated by the MBIS system. If a potential hit is generated, the ACE-V methodology shall be followed.

4.5 BLIND VERIFICATION is an independent examination of one or more friction ridge impressions *at any stage of the ACE process* by another competent analyst who is provided with no or limited contextual information, and has no expectation or knowledge of the determinations or conclusions of the original analyst(s).

4.5.1 Blind verification shall be used when a single source identification results from an MBIS Hit. It may also be used in situations where a single identification and/or single exclusions of a named subject exists in casework.

4.5.2 Blind verification may be used in casework with complex identifications or exclusions (e.g. high distortion, background interference, etc.).

4.5.3 Blind verification may also be used as part of the conflict resolution process.

4.6 OUTSIDE AGENCY VERIFICATION is the examination of friction ridge detail previously examined by an analyst not associated with Idaho State Police Forensic Services.

4.6.1 ISP Latent Section will conduct outside agency verifications as if they are a new case submitted for examination.

4.6.2 All procedures and guidelines shall be followed when conducting outside agency verifications.

# MBIS #24

## 1.0 Background/References

1.1 MBIS (Multi-Modal Biometric Identification System) is the general term referring to any system that includes a database of ten-print fingerprint cards, latent prints, and palm prints. MBIS also includes software that is utilized to search the database. The Idaho State Police is a member of the Western Identification Network (WIN). WIN is a consortium of several western states, referred to as central sites that share their databases. ISP contracts with WIN to maintain our database and IBW (Integrated Biometric Workstation) software. WIN provides all necessary computers, scanners, printers, and software needed to conduct searches. WIN also provides ISP access to the databases of central site members, other partner agencies, and the FBI. The intention of these procedures is to provide analysts with searching parameters for latent inquiries of the databases. Previous iterations of this system were referred to as ABIS (Automated Biometric Identification System) and AFIS (Automated Fingerprint Identification System). Manuals for the MBIS system are located on the local terminal desktop or online at www.winid.org under Training/WIN Biometric System.

1.2 Integra-ID Integrated Biometric Workstation Latent User Guide, V. 1.2, 02/03/2021

1.3 IBW Application Keyboard Shortcuts

1.4 NEC IBW Latent Quick Reference Rev.01.26.2021

1.5 NEC Archive Quick Reference Rev. 09.29.2020

1.6 NEC WIN Best Practices for Latent Examiners V 1.0, 11/6/2020

1.7 WIN-OPS Manual Revision 2008, September 2008

1.8 WIN-OPS QA Procedure Outline, April 2004

1.9 Universal Latent Workstation User Manual, May 2016

1.10 Universal Latent Workstation (ULW) Version 6.6.7 Supplemental Instructions April 2017

## 2.0 Scope

2.1 To provide guidelines on the suitability of latent prints for MBIS searching.

2.2 To provide a method for searching unidentified prints against the available databases.

## 3.0 Equipment/Reagents

3.1 MBIS terminal

## 4.0 Procedure

4.1 TECHNICAL CASE REQUIREMENTS: Not all latent prints are suitable for MBIS searching. In order to be considered for searching, latent impressions must meet a combination of the following technical requirements.

4.1.1 Searches are generally undertaken after latent prints have been compared to and excluded from the available known exemplars for possible victims, suspects, and/or named subjects.

4.1.2 Finger: Latent print impressions from the distal joint of the finger can be considered for searching fingerprint databases.

4.1.3 Palm: Latent print impressions from the palmar area of the hand can be considered for searching palm databases. This includes the writer's palm, thenar, hypothenar, and interdigital, as well as proximal and medial finger joint areas of the palm.

4.1.4 Minutiae Number: Routinely, only latent prints containing at least 10 (ten) minutiae located in the above described areas should be considered for MBIS searching.

4.1.4.1 Selection of minutia is limited by a one inch bounding box for finger searches and a three inch bounding box for palm searches.

4.1.4.2 Additional consideration should be given when a low minutia count is observed in a forced pattern area (delta, loop outflow, etc.).

4.1.5 Clarity of the overall print/minutia is also taken into consideration when determining suitability.

4.1.6 Core: It is not necessary to have the core area visible in the latent impression. During manual coding of latent impressions, the core should be marked if known or placed in the most likely position if unknown. Cores are not utilized when searching palms.

4.1.7 Search Rotation: Latent prints should be captured tip up/top of palm up. Default search rotation for the WIN system is 60 degrees for finger searches and 90 degrees for palm searches and is based off of orientation at capture. Search rotation should only be adjusted when orientation is not known.

4.1.8 An analyst may use his/her discretion when evaluating the overall suitability of the latent print for searching.

4.1.9 Latent prints are acquired into the MBIS system by means of electronic image file transfer.

4.2 DATABASES: Analysts may search the databases of WIN and NGI. Analysts should be guided by their experience, knowledge of the system's capabilities, workload, and common sense when choosing which databases to search.

4.3 DATABASE SELECTION: The following criteria categorize search parameters by crime type and severity. If the analyst cannot determine the severity either by the crime associated with the case, the investigative report, or by timely conversation with the investigator, then the lowest search parameters should be used.

4.3.1 Analysts may limit or expand any of the searches based on the circumstances of the case.

4.3.2 The Latent Section Discipline Lead may, as the circumstances of a case dictate, modify these search criteria.

4.3.3 Cases with latent prints meeting the Technical Case Requirements should be searched through WIN- Auto LI/LIP, Idaho, WIN - Exclude Idaho, and FBI's NGI databases.

4.3.3.1 NGI SEARCHES: NGI searches both the criminal and civil files in the same search. Candidates may return with either an FBI# or UCN (Universal Control number).

4.3.3.2 Examiners may consider opting out of Auto LI/LIP or NGI searches when the combination of database size, latent quality (low minutia count/high distortion), and location of latent minutia (forced pattern areas) dictate.

## 4.4 MBIS SEARCHING PROCEDURE:

4.4.1 Case Entry begins with case information being entered into IBW as follows:

4.4.1.1 The case number shall be as follows: IDFS followed by a CL, ML, or PL to denote regional lab, the last two digits of the case year, followed by the last four digits of the laboratory case number, i.e. IDFSML151500 translates to laboratory case number M2015-1500.

4.4.1.1.1 Historical numbering for ISP Forensics was as follows: ID 04 followed by the case number, followed by a C, M, or P to denote regional lab, and then the latent number (e.g.ID0420101500M1).

4.4.1.1.2 Historical numbering for BCI entry was as follows: ID 01 followed by the four digit year followed by the four digit BCI case number, followed by the latent number. A dash may or may not proceed the latent number. (e.g.ID01201015001).

4.4.1.2 Date of crime.

4.4.1.3 Crime code (Crime Type).

4.4.2 The entry of case information is followed by the acquisition of "New Evidence" items from which a "New Latent" may be acquired. Alternatively analysts may acquire individual latent prints directly into the Latent Screen.

4.4.2.1 Copies of latent prints prepped for database searches are often cropped or have resolution changes necessitated by the searching software. These copies are not considered evidence and need not be retained outside the MBIS system.

4.4.3 After acquisition, latent prints may be searched using the MBIS system auto encoding or may be manually processed and edited by the analyst. It is suggested that searches proceed as follows:

4.4.3.1 AUTO LI or AUTO LIP (Lights Out Latent Inquiry) is designed to be used with a ROI (Region of Interest). Pattern selection is not utilized for finger searches. For palms, database penetration can be adjusted by specifying right or left and palm area. Analysts have the option to specify search rotation for auto LI/LIP searches.

4.4.3.2 LI (Latent Inquiry) or LIP (Latent Inquiry Palm) search regions set to "Include Idaho." LI/LIP searches may utilize manual processing, editing, and/or user rotation/penetration parameters if applicable.

4.4.3.3 LATENT_COMBO or LATENT_PALM_COMBO search regions set to "Exclude Idaho" to search the remaining WIN database and register the print should no HIT be obtained. Combo searches may utilize manual processing, editing, and/or user specified rotation/penetration parameters.

4.4.3.4 LR (Latent Registration) is routinely performed after a print is searched through ID and WIN as a LI/LIP when no HIT is obtained.

4.4.3.5 REMOTE_LI for NGI search, if applicable. Prints submitted to NGI may be "tagged" and will result in temporary retention if searched as part of the LATENT_COMBO or LATENT_PALM_COMBO.

4.4.3.6 At times it may be beneficial to conduct additional database searches using modified search parameters (e.g. include incipient ridges, large ridges, wide ridges, search multiple cores and/or orientations).

4.4.4 For routine casework, the Limitation of Candidates (LOC)/Number of Candidate Images (NOCI) is set to 15 for both Idaho and WIN searches. The number of candidate images returned for NGI is 10 for fingers and 20 for palms (10 from upper palms and 10 from lower palms).

4.4.4.1 Depending on the circumstances of the case, an analyst may opt for a higher LOC/NOCI from ID, WIN, or NGI.

4.4.4.2 If the analyst intends to perform a Latent Candidate Merge (see 4.6) then the candidate list may contain a maximum of 255 candidates.

4.4.5 Qualified MBIS trained Forensic Scientists may search latent prints generated by/for other analysts. If this occurs, the appropriate ILIMS fields will be filled out indicating the identity of the analyst that performed the searches. The assigned case analyst will review the MBIS documentation and note the review in the appropriate ILIMS field. Forensic Scientists shall not perform the technical review of an MBIS search they performed.

4.5 SEARCHING MULTIPLE LATENT PRINTS FROM A CASE: For simultaneous impressions, the analyst will search all suitable impressions unless a search of the first simultaneous impression results in an identification.

4.5.1 If a case consists of multiple latent prints made by the same finger, it is only necessary to search one latent impression unless different areas of that finger are present in different impressions.

4.6 LATENT CANDIDATE MERGE (LCMG): MBIS searches of two or more latent prints from the same or differing cases may have the LCMG function performed. LCMG combines candidate lists from multiple inquiries into a single candidate list that places common candidates at the top of the merged list.

4.7 LATENT PRINT TO LATENT PRINT SEARCHES - (LLI). These are the searches of latent prints against the previously searched latent prints registered in the unsolved latent print database. LLI inquiries are not performed on a routine basis.

4.8 PRIORITY SEARCHES: different databases require different searching priorities.

4.8.1 ID/WIN searches utilizing the standard algorithms will be conducted at a priority 6 (normal) search.

4.8.1.1 Priority 1 searches may be performed for rush homicide cases and cases where/there is an urgent need to notify the submitting agency of the results of the search. Each WIN-OPS representative may elect to modify a search to a Priority 1 for high profile crimes within their state without prior notification to WIN. In cases where the WIN-OPS representative carries out the priority change, the following information is to be forwarded to the WIN office:

Date of priority change

Brief narrative of the offense

Hit/No hit

If hit, where the hit was effected

Other interesting facts

Submit to WIN

4.9 MBIS ONLY CASES

4.9.1 External agencies that employ their own latent print analysts may request and submit latent prints for MBIS only. The request shall be documented in the case record.

4.9.2 In these instances, ISP Forensics will only analyze/consider for MBIS search those latent prints designated by the agency. Latent prints not designated by the agency need not be analyzed or searched.

4.9.3 In the event of a HIT, only the latent that HIT will be fully analyzed, compared, evaluated, verified, and reported. Remaining latent prints will be returned to the submitting agency to complete the comparisons.

4.9.4 The latent section will provide these agencies with known exemplars of the identified individual(s) to facilitate the remaining comparisons.

4.10 CASE DOCUMENTATION: Documentation of MBIS searches and results shall be maintained in ILIMS as administrative documentation attached to the "CASE INFO" tab and shall consist of the following:

4.10.1 Candidate List – Each search will generate a "Latent Verification Report" containing a list of candidates ranked on matching score. System generated Latent Verification Reports generally show the Minutiae, Zoning, and Core placement (if applicable) on the left side image.

4.10.2 In the event of an MBIS HIT, the HIT chart or a split screen image of the search print and candidate print will be preserved as administrative documentation.

4.10.2.1 Split screen images, and any other MBIS generated fingerprint or tracing images, will not be utilized to make a source identification. Source identifications can only be made as a result of comparing the actual latent prints (or high resolution copies thereof) and actual known print cards (or high resolution copies thereof).

4.10.3 HITS will be recorded on the HIT LOG located near the MBIS terminal.

4.10.4 Analysts may, at their discretion, include other case documentation such as screenshots of the edited latent or demographic information pertaining to a HIT.

4.10.5 The MBIS matrix in ILIMS will be completed for each latent searched.

4.10.6 When results from a search are rejected (ex. analyst realizes they searched the wrong database or anatomical area) the analyst shall document in the notes what occurred and why the results were rejected. A record of the rejected candidate list does not need to be retained as the results are not valid.

4.11 REGISTERED LATENT PRINTS: Latent prints that remain unidentified at the conclusion of the MBIS search should be registered in the WIN unidentified latent database. If a registered latent is later identified, it may be deleted from the case or removed from the matcher. Prints stored in the database are not considered to be evidence.

4.12 TENPRINT TO LATENT INQUIRY CANDIDATE LISTS (TLI):

4.12.1 Analysts are responsible for periodically reviewing their TLI lists for possible candidates.

4.12.2 If the TLI candidate list produces a possible candidate, the analyst will research the statute of limitations for the case. If the statute of limitations has not expired, the analyst will request that the agency submit the original latent print(s) for comparison or rely on high quality digital images retained by ISPFS to complete the examination. If the statute has expired, the analyst may delete the print from the database or remove it from the matcher.

4.12.3 TLI HITS and their resulting actions will be documented on the "TLI HIT Log" located on the I: drive in the ABIS-DO NOT DELETE folder.

## 5.0 Comments

5.1 DATABASE MAINTENANCE: WIN periodically publishes lists of latent prints currently registered in the MBIS Unsolved Latent Database. The ISP Forensic Services Latent Section is responsible for maintaining latent prints that remain in the unsolved latent prints database.

5.1.1 The MBIS system is programmed to purge cases based on the crime date, type of crime, and associated statute of limitations. Cases that are no longer needed per the submitting agency may be manually deleted from the system or removed from the matcher prior to their auto deletion date.

5.2 QUALITY CHECK POLICY: MBIS system quality control checks will be conducted monthly. Controls will be run for Auto_LI, Auto_LIP, LI, and LIP. WIN supplied bitmap images are used for checking Auto LI/LIP and LFF pre-extracted/edited files are used for checking LI/LIPs.

5.2.1 Quality check procedure:

1. From the LCMS screen enter the QC case number;
2. Import bitmap and LFF files. (LFFs must be imported through the "Batch Import" screen. Adjust file type in file explorer screen to see LFF option.);

3. Enter an evidence number and the latent number;
4. Launch Auto LI/LIP utilizing the bitmap (BMP) images and a ROI.
5. Launch LI/LIP search with no human intervention on the pre-extracted latent file (LFF);
6. Compare the resulting candidate list to ensure results are consistent with the expected results;
7. The position on the candidate list may change over time;
8. Document the results of the Monthly QC check form;
9. The job may then be killed and purged from the IBW job queue.

5.3 TRAINING: All analysts utilizing MBIS shall be trained and tested for competency in the standard operating procedures and the operation of the system.

5.4 RESPONSIBILITIES:

5.4.1 Analysts shall maintain system security.

5.4.2 Network and/or program passwords are not to be distributed to unauthorized users. Operators may change their passwords as needed.

5.5 LIMITATIONS

5.5.1 Matching accuracy is highly dependent on the quality of fingerprints located in the search database as well as the quality of the latent prints chosen for submission. It is also dependent on the skill of the analyst in marking minutiae, search rotation, core placement, proper zoning, and pattern selection (if applicable).

5.5.2 Searches are limited to NEC/WIN participants and the NGI database. All other databases/vendors cannot be accessed by this system.

5.5.3 When multiple ten-print cards are entered for an individual, MBIS or 10-print MBIS users evaluate the prints and use the best available print(s) to construct the composite card (e.g. the right index and right middle finger may come from different cards). WIN MBIS stores up to three 10-print records in the matcher for each SID#. This may be the three most recent events, or the two most recent events and a best quality composite of older events. WIN MBIS continually updates as new records are added and a new (better) print may be available after the initial search. Only one palm event is stored for matching.

5.5.4 The MBIS terminal generates a candidate list and while the program tries to rank candidates, a potential match may be generated from any candidate on the list.

5.5.5 The MBIS system may create a different candidate list each time a query is performed.