LATENT PRINT

ANALYTICAL METHODS

Table of Contents

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.
12	Minor wording, grammatical changes and numbering adjustments throughout. Content changes to methods: #1, sections 1.10, 1.11, 2.1-2.2, 2.3.4.2-2.3.4.3, 4.3.1, 4.4, 5.1; #3, section 4.7, remove 5.1.1; #5, section 2.6; #10, section 4.1.5, 4.1.10.2; #11, section 2.2; #20 (new); #21, section 3.3; & #23, section 4.1.1.3, 5.1.2.2.

13	Minor wording, grammatical changes, and numbering adjustments throughout. Content changes to methods: #1, section 5.1; #2, section 2.2; #4, sections 4.1, 4.1.4; #5, section 2.3.2; #6, section 4.2.5; #7, section 2.2; #9 (new); #10, sections 2.3, 2.4; #11, sections 1.1, 3.2, 4.1.11, 4.1.12, 5.2.2; #12, sections 2.4, 4.10, 5.1.1; #16, sections 1.5, 2.4, 2.5, 3.3; #17, sections 1.6, 2.1, 4.1.4.1; #24, sections 4.1.1.3, 4.2.3; #25 (new); #26, sections 1.12, 2.1, 4.1.1.1, 4.1.2.1, 4.1.2.2, 4.1.6, 4.2.1; #27 (new); #28 (new); #29, sections 4.5.1, 4.6, 4.9.3, 5.1.2.
14	Minor wording, grammatical changes, and numbering adjustments throughout. Content changes to methods: #1, sections 1.2, 2.3.4.2, 4.2.1, 4.4, 4.4.2; #2, section 2.2; #5, section 5.3.3; #8, section 5.2.2; #9, sections 1.1, 1.3, 2.3, 4.1, 4.6, 4.9; #10; #11, sections 4.1.1, 4.1.7; #12, sections 4.6.2, 5.3.1; #13, section 5.3.3; #14, section 4.2; #16, section 1.1; #17, sections 1.6, 4.1.4; #18, section 3.1; #19, section 5.3; #20, section 3.2; #24, sections 1.4, 4.1.3-4.1.4, 4.2.3, 4.4.3, 4.4.4, 5.1.1.2; #26; #27, sections 1.3, 4.3.2.1-4.3.2.3; #29, sections 4.10.1, 4.10.3.
15	Content changes to methods #1, section 5.1 and #2, sections 1.5, 4.4-4.7.

General Latent #1

1.0 Background/References

1.1 The discipline of Latent Print Examination 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 features and details such as ridge flow, 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 (friction ridge arrangements stay 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.

1.10 OSAC Registry Proposed Standard – OSAC 2021-N-0020, Best Practice Recommendations for Limited Examinations, Version 2.0 April 2022.

1.11 OSAC Registry Proposed Standard – OSAC 2022-N-0033, Standard for Processing Evidence for the Detection of Friction Ridge Impressions, Version: 2.0 July 2022.

*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 every situation or type of evidence encountered and are designed to accommodate the majority of evidence encountered.

2.2 Examiners 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.

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 generally non-destructive and should be attempted prior to other processing methods.

2.3.2 PHYSICAL METHODS (Methods #3-9)

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 #10-23)

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 #24-29)

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

2.3.4.2 Latent prints are examined and compared using ACE-V methodology (Analysis, Comparison, Evaluation – Verification).

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

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 contaminants, 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. Recent studies have shown that while secretions within these glands are composed of ~98% water, the water content in freshly-deposited prints range from ~20-70% 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 destructive technique to the most destructive technique.

4.3.1 Selecting specific processing techniques with higher sensitivity in lieu of conducting full sequential processing may improve efficiency and throughput. When opting to use limited processing techniques, the examiner should consider both offense type and the potential of a given technique to negatively impact subsequent latent print processing.

4.4 Impressions developed in the lab and deemed suitable for further analysis shall be marked if possible and preserved prior to the continuation of processing.

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

4.4.2 Palm prints and impressions of indeterminate orientation and/or anatomical source 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 and require the application of processing techniques using sequences appropriate for the relevant areas in a manner that is least likely to negatively impact other areas of evidence. *If the base requirement is not performed or additional steps are added to the sequence, the examiner shall have adequate documentation in their notes to justify the necessity of the change. Justification shall be to the extent that another qualified examiner would come to*

the same conclusion (e.g. 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 examiner 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

SEMI-POROUS (ex. glossy cardboard with a paper backing):

1. **Visual**: White light
2. **ALS**
3. Iodine
4. **Cyanoacrylate Fuming**
5. **Visual:** White light
6. **Powders:** Luminescent or non-luminescent (glossy side)
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

BLOOD EVIDENCE:

POROUS:

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

COPPER-BASED/BRASS

1. **Visual**: White light
2. **ALS**
3. **RECOVER or NON-POROUS SEQUENCE**

THERMAL PAPER:

1. **Visual**: White light
2. **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

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

Non-adhesive side of semi-porous/porous tape:
See semi-porous/porous processing

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

1. **Visual:** White light
2. **ALS**
3. **Sticky-Side Powder (or equivalent)** or **Gentian Violet** or **Small Particle Reagent**
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-wavelength, 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 examiners 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 Advance Operation Manual (2012).

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 naturally occurring substances within the latent print residue (inherent luminescence) or contaminants with fluorescent properties may be transferred to the friction ridge skin and re-deposited onto a surface. Fluorescence may also be induced in latent print residue with the application of certain chemicals and powders known to exhibit fluorescence.

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 wavelength that corresponds to the color of goggles being utilized.

4.4 Observe evidence with the appropriate wavelength/goggle combination:

WAVELENGTH	CORRESPONDING FILTER
< 400nm	yellow or clear UV safe
400-450nm	yellow
450-535nm	orange
>535-700nm	red

4.5 The Polilight 400 requires that you turn off the ALS lamp and allow the instrument to cool completely before fully powering off. Avoid turning the instrument off and on in rapid succession.

4.6 The Mini-CrimeScope Advance can be directly powered down after use. For short breaks in instrument use, set the light intensity shutter to "minimum." Avoid turning the instrument off and on in rapid succession. Allow the instrument to cool for at least 15 minutes prior to turning it back on.

4.7 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 methods used for latent print processing. 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 suitable for comparison shall be marked and photographed as soon as possible, as they tend to fade quickly.

5.0 Comments

5.1 ADDITIONAL INFORMATION:

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

5.1.2 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.

5.1.3 Shelf life of sealed iodine is indefinite.

5.1.4 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 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. 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, ADHESIVE LIFTS, 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 adhesive lift or 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 difficult to perform comparisons.

5.1.2 Lifting should be performed after any necessary photography. The examiner'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 examiners 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. Standard 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 standard powders may be used with a variety of brushes (fiberglass, animal hair, feather). Non-magnetic, fluorescent powders may be 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 biologically contaminated evidentiary items are known to originate from the suspect versus 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

Standard, 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 – STANDARD 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 suitable for comparison 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 suitable for comparison 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 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 suitable for comparison 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 with blood, 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 Examiners 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 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/stir 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:

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

Place a magnetic stir bar in the beaker.

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

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 suitable for comparison 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 suitable for comparison shall be marked and photographed or lifted.

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 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 examiner 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-adhesive side, the non-adhesive 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 examiner 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 fingerprint powder

Liqui-Nox detergent or equivalent

Tap or deionized water

3.3 Sticky-Side Powder Working Solution:

Mix a solution of water and Photo-Flo in a glass beaker in a 1:1 ratio.

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 print shall serve as a negative control.

5.2.3 An examiner 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 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 comparison and/or classification.

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 examiners 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 examiner's discretion to determine the appropriate methods for the given circumstances.

3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Black printer's 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 examiner 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 middle and proximal phalanges 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 fingertips.

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, examiner'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 Examiners 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 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.

Swabbing for DNA Preservation #9

1.0 Background/References

1.1 Handler or Touch DNA refers to DNA that is recovered from skin cells transferred to an object that has been touched or casually handled. Firearms and other weapons often contain rough or textured areas that are not conducive to latent print processing but may accumulate skin cells that may be preserved.

1.2 Saliva and/or skin cells may be left behind on drinking vessels such as cans, bottles, drinking glasses, and straws. Swabbing relevant areas of these items may preserve DNA.

1.3 Swabbing for DNA may be done as part of the latent print processing sequence on items with no biology assignment. Swabbing for DNA may also be done on shared items at the request of the biology section on a case-by-case basis.

2.0 Scope

2.1 To provide a method for the preservation of possible handler DNA from firearms prior to latent print processing.

2.2 To provide a method for the preservation of possible saliva/DNA on drinking vessels prior to latent print processing.

2.3 To provide a method for the preservation of possible handler DNA from other items (e.g. gloves, shell casings, etc.) as requested by biology prior to latent print processing.

3.0 Equipment/Reagents

3.1 Swabs

3.2 Envelopes

3.3 Sterile water

4.0 Procedure

4.1 Use a freshly prepared 10% bleach solution, or equivalent disinfectant before and after examining biologically contaminated evidence. Prep work area with clean paper and appropriately disinfected supplies (pen, scale, etc.).

4.2 Moisten swabs using sterile water. Avoid oversaturation of swabs.

4.3 Concentrate collection on the tips of swabs (~60-90° angle) using a fair amount of pressure and rotating swabs as needed.

4.4 With regard to firearms, examiners should consider swabbing finely textured surfaces, rough surfaces, or surfaces with small ridges on their edges or surfaces (e.g. grips, hammers, slide, triggers/trigger guard, magazine lips/bases).

4.5 With regard to drinking vessels, examiners should consider swabbing mouth openings of bottles, ribbed areas inside and outside of bottle caps, and insides/outsides of drinking straw ends.

4.6 ILIMS notes packets should indicate the number of swabs taken and their origin. This may be accomplished through a combination of notes and photographs with annotations. For example:

Used 2 swabs to swab textured areas of grip (Item # 1.2/Agency Exhibit # 1.2 = two swabs from textured areas of grip, item 1)

Used 1 swab on ridged area of slide (Item # 2.1/ Agency Exhibit #2.1 = one swab from slide area of 9mm handgun, item 2, from x location)

Used 1 moistened swab to swab area at open mouth of can/rim (Item #3.1/Agency Exhibit #3.1 swab from mouth/rim area of Pepsi can, item 3)

4.7 Swabs from small areas may be combined (e.g. use same swab for trigger and edge of trigger guard).

4.8 Swabs from different areas should be packaged and sub-itemed separately.

4.9 Swabs from multiple items may be combined at the request of the biology section on a case-by-case basis.

5.0 Comments

5.1 Only one item should be open at a time to avoid cross-contamination.

5.2 Exercise caution and wear appropriate protective gear including a face mask when collecting swabs.

5.3 Change gloves between items and avoid touching items that could contaminate gloves.

5.4 Frequently disinfect items that occupy the examination area (scales, pens, keyboard, etc.).

Amido Black #10

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 Fingermark Visualisation Manual. Home Office; 2022 6.1.3-6.1.10

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 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 Two different formulations of Amido Black are available for use in the laboratory. One is an Amido Black methanol-based formulation that may be used in conjunction with cyanoacrylate ester fuming. The other is a water-based formulation that is not effective when used in conjunction with cyanoacrylate fuming.

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. 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 be most probative.

3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance

Magnetic stirrer/stir bar

Pipettes

Beakers

Graduated cylinder

Storage bottles

Spray or rinse bottles

3.2 REAGENTS:

Amido Black

Glacial acetic acid

Methanol

5-Sulfosalicylic acid dihydrate

Deionized water

3.3 Methanol-Based Amido Black:

MeOH Amido Black Working Solution

Add 4 g of Amido Black to a beaker;

Add 100 mL of acetic acid;

Add 900 mL of methanol;

Stir for 30 minutes with a magnetic stirrer

MeOH Amido Black Rinse Solution (de-stain):

Add 100 mL of acetic acid to a beaker;

Add 900 mL of methanol;

Stir for 2-3 minutes and transfer the solution to a storage bottle.

3.4 Water-Based Amido Black

H_2O Amido Black Fixing Solution

Add 1 L of DI water to a beaker;

Add 23 g of 5-Sulfosalicylic acid;

Stir until dissolved (magnetic stirrer recommended).

H_2O Amido Black Rinse Solution (de-stain)

Add 950 mL of DI water to a beaker;

Add 50 mL glacial acetic acid;

Stir for 2-3 minutes.

H_2O Amido Black Working Solution:

Add 1 L of water-based rinse solution to a beaker;

Add 2 g of Amido Black;

Stir for 30 minutes with magnetic stirrer.

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 Methanol-Based Amido Black:

4.3.1 Fix impressions using heat, methanol, or cyanoacrylate. Blood can be fixed to an object by heating at a 100°C in a fingerprint development chamber for thirty minutes (restricted to non-heat sensitive objects). Methanol may be sprayed or pipetted over the item. The Methanol-Based 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.

4.3.2 Immerse the item in the MeOH Amido Black working solution for ~3 minutes and allow to sit for an additional 2 minutes. Alternatively, the item may be sprayed or irrigated with the MeOH Amido Black working solution.

4.3.3 Rinse the item with the de-stain rinse solution to remove the excess dye.

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

4.3.5 Allow the item to dry thoroughly.

4.4 Water-Based Amido Black

4.4.1 Fix impressions by irrigating or submerging the item in the Water-Based Fixing Solution for ~5 minutes and allow item to dry. Blood can also be fixed to an object by heating at 100°C in a fingerprint development chamber for thirty minutes (restricted to non-heat sensitive objects). Cyanoacrylate is NOT an effective method for fixing blood in conjunction with the Water-Based Amido Black formulation.

4.4.2 Immerse the item in the H_2O Amido Black working solution for ~3 minutes and allow to sit for an additional 2 minutes. Alternatively, the item may be sprayed or irrigated with the H_2O Amido Black working solution.

4.4.3 Rinse the item with the de-stain rinse solution to remove the excess dye.

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

4.4.5 Allow the item to dry thoroughly.

4.5 Prints are evaluated to determine their suitability for comparison.

4.6 Prints deemed to be suitable for comparison shall be marked and photographed.

5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Shelf life of the pre-mixed Amido Black, methanol-based working solution, and de-stain is indefinite. Shelf life of water-based working solution is approximately 12 months.

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 For the methanol-based formulation, 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 For the water-based formulation, control tests are performed by the application of the fixing solution followed by the reagent to a slide prepared with a smear of known blood. The area surrounding the blood smear shall serve as a negative control.

5.2.4 An examiner 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, and goggles are worn when mixing or using Amido Black. Amido Black should be mixed and used in a fume-hood or outside in an area with adequate ventilation.

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. If it comes into contact with the eyes, skin or mouth, the area should be flushed with generous amounts of water and a doctor or poison center may be consulted. Similarly, if inhaled, remove a person from the contaminated area and consult a doctor or poison center.

5.3.3 5-Sulfosalicylic acid is a corrosive solid capable of causing severe skin burns and eye damage. Avoid breathing in dust and ensure that it does not come into contact with the skin, eyes, or mouth. If it comes into contact with the eyes, skin or mouth, the area should be flushed with generous amounts of water and a doctor or poison center may be consulted. Similarly, if inhaled, remove a person from the contaminated area and consult a doctor or poison center.

5.3.4 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.

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

Cyanoacrylate Ester #11

1.0 Background/References

1.1 Cyanoacrylate ester (CAE), also referred to as "superglue," is available from various suppliers and may vary in viscosity. 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.

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

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

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

1.9 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 liquid

Cyanoacrylate gel packs

CAE cartridges

Water

4.0 Procedure

4.1 PROCEDURE 1 – CYANOACRYLATE FUMING CHAMBER:

4.1.1 Select the appropriately sized fuming chamber.

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 total amount of liquid CAE amount for the Air Science CA60T is ~3.0 g.

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.

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 CA 60T – 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.

4.1.11 Once fuming cycle has finished, examine item for comparable ridge detail.

4.1.12 Prints may be marked and photographed at this point but are commonly further enhanced with dye stains or powders prior to preservation.

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 commonly further enhanced with dyes or powders 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 when using the vacuum chamber.

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 commonly further enhanced with dyes or powders 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 latent test print is applied to a non-porous surface and put into the tank in an easily monitored position with the questioned surface. The area surrounding the intentionally deposited 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) #12

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.

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

2.4 Latent prints composed of blood on dark or multi-colored surfaces may be successfully enhanced with the application of DFO.

2.5 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/stir 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:

Dissolve 0.5 g of DFO powder in 100 mL of methanol (magnetic stirrer recommended);

Add 100 mL of ethyl acetate and mix thoroughly;

Add 20 mL of acetic acid;

Store stock solution in a dark brown glass or polypropylene bottle.

3.4 DFO Working Solution:

Add 220 mL of stock solution to 780 mL of petroleum ether and 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). Spraying 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 10 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 with iron set to high (cotton/linen) 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 450nm to 570nm range.

4.8 Prints are evaluated to determine their suitability for comparison.

4.9 Prints deemed to be suitable for comparison 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 subsequent applications of DFO.

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 approximately 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 print shall serve as a negative control. Examiners 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 examiner 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 or well-ventilated area.

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 #13

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/stir 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:

Add 1000 mL of deionized water to glass beaker;

Add 1 g of Gentian Violet to a beaker;

Stir for approximately 25 minutes or until completely dissolved (magnetic stirrer recommended).

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 suitable for comparison 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 print shall serve as a negative control.

5.2.3 An examiner 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 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 examiner should wear a lab coat, double-glove or wear heavy-duty (non-disposable) gloves, and safety glasses.

1, 2 Indanedione #14

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 bottles

3.2 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:

Dissolve 1 g of 1,2 Indanedione into 30 mL of Methylene Chloride;

Add 60 mL of Ethyl Acetate and stir;

Add 10 mL of Glacial Acetic Acid followed by 900 mL of Petroleum Ether and stir.

3.4 1,2 Indanedione Stock Solution 2:

Dissolve 0.4 g of Zinc Chloride into 10 mL of Absolute Ethanol;

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:

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). Spraying 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 15 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 with iron set to high (cotton/linen) 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 Indanedione 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 450nm to 570nm range using an orange or red barrier filter.

4.4 Prints deemed to be suitable for comparison 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 print shall serve as a negative control. Examiners should use caution when using a commercially available control pad as they may exhibit inherent luminescence.

5.2.3 An examiner 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) #15

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 Indanedione," 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/stir 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:

Dissolve 0.2 g 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 Indanedione 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 450nm to 570nm range using an orange or red barrier filter.

4.4 Prints deemed to be suitable for comparison 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) may 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 print shall serve as a negative control. Examiners should use caution when using a commercially available control pad as they may exhibit inherent luminescence.

5.2.3 An examiner 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 examiner 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) #16

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. While LCV is more specific for blood than protein stains, it may still 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.

1.5 Canadian Society of Forensic Science Journal, Vol.34, Issue 3, Sept. 2001. "Interference of Ninhydrin Pretreatment on Leuco Crystal Violet Visualization of Bloodstains," G.M. Miskekky & M.R. Kelderman.

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. 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 be most probative.

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 (Note: consider use of Formula B if LCV is to be used after ninhydrin).

3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

Balance
Magnetic stirrer/stir 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" Working Solution

Dissolve 10g of 5-sulfosalicylic acid in 100 mL deionized water;
Add 400 mL 3% hydrogen peroxide;
Add 0.75g Leucocrystal Violet;
Mix vigorously.

3.4 Formula "B" Working Solution

Dissolve 10g 5-sulfosalicylic acid in 500 mL 3% hydrogen peroxide;
Add 3.7g sodium acetate and 1.0g Leucocrystal Violet;
Mix 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 suitable for comparison 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 examiner 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 examiner should wear a lab coat, gloves, and safety glasses.

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

Ninhydrin #17

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.

1.6 Fingermark Visualisation Manual (second edition), Home Office, 2022.

2.0 Scope

2.1 Ninhydrin is one of the most commonly used methods 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/stir 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:

Add 300 mL of 2-propanol to a beaker on the magnetic stirrer;

Add 100 mL of acetic acid;

Place the stir bar in the beaker and turn stirrer to low;

Add 50g of ninhydrin crystals.

It may take up to two hours for the ninhydrin to dissolve. Cover the beaker to avoid excess evaporation.

3.4 Ninhydrin Working Solution:

Add 30 mL of the ninhydrin stock solution to a 1 L beaker;

Fill the beaker to the 1-liter mark with N-Hexane and stir.

If the working solution appears cloudy, clarify by adding a small amount of 2-propanol.

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 handheld steam iron. When using the fingerprint development chamber, it is recommended that items be placed on a sheet of cardboard or paper to avoid contact with condensation formed on the shelves. The steam iron should be set to high (cotton/linen) with a full water reservoir. The steam iron should hover ~1-2 inches above the surface, never touching the surface, 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.

4.1.4.1 Items with a high thermal mass (wood, plasterboard, etc.) should be heated to 80°C prior to introducing humidity into the oven.

4.1.5 Prints are evaluated to determine their suitability for comparison.

4.1.6 Prints deemed to be suitable for comparison 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 suitable for comparison 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 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 examiner cannot proceed with the processing of the evidence until control tests bearing positive results (development of a purple print) and negative results (minimal background 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 #18

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/stir bar
Beaker (20mL & 250mL)
Graduated cylinder
Pipettes or trays
Spatula

3.2 REAGENTS:

ThermaNin
Isopropyl Alcohol
Ethyl Acetate
HFE-7100

3.3 ThermaNin Working Solution:

Dissolve 0.4 grams of ThermaNin powder into 1.5 mL of Ethyl Acetate in a covered 20 mL beaker on the magnetic stirrer for 5-10 minutes;

Add 0.5 mL of isopropyl alcohol;

Measure 98 mL of HFE-7100 into a 250 mL beaker and add the ThermaNin solution;

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 suitable for comparison 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 print shall serve as a negative control.

5.2.3 An examiner 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 examiner 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) #19

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 latent prints on items immersed in water for long periods of time and on decades 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 stir 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 1000 mL 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 stir 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 suitable for comparison shall be marked and photographed.

5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 Cleanliness is important with 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 print shall serve as a negative control.

5.2.3 An examiner 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 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 #20

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 examiner 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
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)

1 g Rhodamine 6G powder;

1000 mL Methanol;

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

3.4 Stock Solution 2 (MBD)

1 g MBD;

1000 mL Acetone;

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

3 mL Stock Solution 1

7 mL Stock Solution 2

2 mL Ardrox P133D

20 mL Methanol

10 mL Isopropanol

8 mL Acetonitrile

950 mL Petroleum Ether

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 380-530nm 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 suitable for comparison 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 examiner 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.

RECOVER LFT #21

1.0 Background/References

1.1 While studying the properties of polythiazyl (a polymeric metal consisting of sulfur and nitrogen), or $(SN)_x$, researchers noticed the development of friction ridge detail on sample vials. The synthesis of (SN)x is produced by converting tetrasulfur tetranitride (S_4N_4) to disulfur dinitride (S_2N_2) crystals by thermal cracking. The S_2N_2 crystals are then polymerized to form a solid state $(SN)_x$. Fingerprint residue on the sample vials reacted with the nitride during polymerization of S_2N_2. Following the "discovery" of this processing technique, items of varying surface types and porosities were subjected to this technique where latent prints, blue/black in color, were developed. How quickly latent prints were visualized depended on the exposure time to a S_2N_2 atmosphere with porous items requiring longer exposure times. Despite this technique's apparent use on a multitude of surface types, much of its most current research has focused on metallic surfaces. Firearm cartridges and cartridge cases are particularly problematic substrates for latent print recovery, with reported success rates being very low. S_2N_2 has shown solid sensitivity and specificity, and an ability to develop latent prints on metallic surfaces aged up to one year. While the interaction between S_2N_2 and the latent print matrix has yet to be fully explained, disulfur dinitride is an effective treatment on metal surfaces including those exposed to adverse environments including items that have been washed with water and detergents, bleach, or acetone. Through internal validation, the RECOVER LFT system has been deemed fit for use in the latent print processing of copper-based/brass items.

1.2 Foster+Freeman, "RECOVER Latent Fingerprint Technology User Manual," 2019.

1.3 Foster+Freeman, "DEVELOP Safety Data Sheet," 2019.

1.4 P. F. Kelly, R. S. P. King and R. Mortimer, "Fingerprint and Inkjet-Imaging using Disulfur Dinitride," Chemical Communications, vol. 46, pp. 6111-6113, 2008.

1.5 R. S. P. King, Novel Chemistry and Applications of Polythiazyl, Doctoral Dissertation. Loughborough University, 2009.

1.6 R. Lam, D. Hockey, J. Williamson and N. G. R. Hearns, "Latent Fingermark Development on Fired and Unfired Brass Ammunition Under Controlled and Blind Conditions," Forensic Science International, vol. 337, pp. 1-7, 2022.

1.7 Idaho State Police Forensic Services, Latent Print Section, Foster+Freeman RECOVER LFT Validation, 2022.

2.0 Scope

2.1 RECOVER LFT is a technique used to aid in the visualization of latent prints on copper-based metallic items including brass and copper-colored cartridge casings and cartridges. It may be used in lieu of the traditional non-porous processing sequence for these items.

2.2 RECOVER LFT has the potential to be effective on copper-based metallic items that may have been wet or subjected to other harsh cleaning techniques.

2.3 RECOVER LFT may be used in conjunction with other forensic examinations such as DNA and Firearms analysis. Preference would be for latent print processing to occur prior to Firearms analysis and collection for DNA prior to RECOVER in instances where both are to be attempted on the same item.

2.4 RECOVER LFT may be used on copper-based items that were previously processed for latent prints prior to the introduction of this technique.

3.0 Equipment/Reagents

3.1 EQUIPMENT AND MATERIALS:

RECOVER instrument

Fume hood

French chalk

3.2 REAGENTS:

RECOVER DEVELOP precursor (S_2N_2)

Isopropyl alcohol (for cleaning)

4.0 Procedure

4.1 Place the RECOVER main unit on a stable, flat, and level surface within an active fume hood.

4.2 Choose an appropriately sized glass chamber based on size/quantity of items being processed. Apply French chalk to both the upper and lower edges of the glass chamber to prevent sticking to the rubber seals on the base and lid.

4.3 Place the glass chamber onto the base of the main unit, lining up with the lower seal and slide the lid onto its mounting holes on the back column.

4.4 Connect the main power adaptor to a main power supply and connect the DC power to the RECOVER main unit.

4.5 Touch the screen of the RECOVER main unit to activate the system. (There is NO on/off power button). Select the “Play” symbol and raise the chamber lid, using the touchscreen scroll bar.

4.6 Select “Copper Based” metal type (copper, brass, bronze, etc.), then select Chamber size Small/Large (small chamber height: 200mm/large chamber height: 400 mm).

4.7 The reference number of the required DEVELOP precursor is displayed: DEVELOP R1/2/3/4. R1 for small chamber/R3 for large chamber (Note: R2 may be utilized in lieu of R3 with the large chamber for copper-based materials).

4.7.1 Remove the cap from the required DEVELOP vial and insert the glass vial directly into the recess in the center of the base of the RECOVER main unit.

4.8 Load the evidence rack with the items of evidence and a prepared control and lower the rack into the chamber. System mounting pegs/clips can be utilized as needed.

4.9 Lower the chamber lid with the touchscreen scroll bar, ensuring a proper upper seal.

4.10 Select "Play" for the system to start initializing checks (chamber conditioning – check for air leaks/initiate vacuum).

4.10.1 The chamber will pump down for approximately 20 minutes.

4.10.2 Monitor the system for warning errors (leak failures may occur if the chamber is not properly seated on the seals).

4.10.3 The system may also fail to pump down when overly porous items are placed inside (e.g. cardboard elements or wooden handles).

4.11 Once the system displays "Ready to Fume" select "Play" to start the fuming process. A warning is displayed to make the user aware that the fume hood must be active.

4.11.1 Sebaceous based prints tend to develop more quickly than eccrine based prints and may result in ridges that are darker in color while eccrine based prints may appear light in color with darkened background discoloration.

4.11.2 Due to the unknown composition of latent evidence prints, copper-based (brass) items should be fumed for approximately one hour. Although some latent print matrices may appear to darken quickly (within minutes), the risk of over development is low.

4.12 Select "End Fuming" to display a confirmation box. Select "Yes" to confirm termination.

4.12.1 The examiner will need to manually track the fuming time (the system has no timer or programmable end time and will continue to fume if not manually stopped).

4.12.2 The use of operating parameters that differ from those listed above shall be recorded in the ILIMS case notes.

4.13 Wait for the chamber to be completely purged and fumes vented. When venting is complete, the lid will be fully raised, and the message "Remove Evidence" will be displayed. Evidence may now be removed and examined.

4.14 Prints are evaluated to determine their suitability for comparison.

4.15 Prints deemed to be suitable for comparison shall be marked and photographed. Depending on the surface, examiners may want to consider advanced lighting techniques such as coaxial or diffused lighting.

5.0 Comments

5.1 ADDITIONAL INFORMATION:

5.1.1 It is important to protect the headstamp of a cartridge case while processing with RECOVER. Placing a protective covering (adhesive label, electrical tape, DIFF-Lift, or COVER tabs (Foster+Freeman) over the headstamp prior to fuming limits the darkening effect on the headstamp that could hinder subsequent firearms analysis.

5.1.2 A fine film of non-toxic residue accumulates on the internal surfaces of the chamber during each cycle. Internal surfaces, evidence rack, and component parts should be cleaned with alcohol moistened wipes after each use. Continue cleaning until no residue collects on the wipes. Remove the lid and glass chamber and clean with alcohol wipes.

5.1.3 Shelf life for the DEVELOP precursor is approximately 18 months. The reagent may be used beyond its expiration date providing appropriate positive and negative control results are obtained.

5.1.4 The used DEVELOP glass vials can be discarded with solid waste/glassware.

5.2 CONTROL TESTS:

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

5.2.2 Make a quality latent print on a copper-based metal blank. The area surrounding the intentionally deposited latent print serves as a negative control.

5.2.3 Positive results and negative results shall be documented in the laboratory case notes. Depending on the composition of the matrix, controls may present as blue/black print (positive) on lighter background (negative) or light-colored print (positive) with blue/black darkened background discoloration (negative).

5.3 SAFETY:

5.3.1 RECOVER DEVELOP precursor contains copper bromide tetrathiatetrazocine. Heating (in air) may cause a fire. Keep RECOVER DEVELOP precursor out of extreme heat. The precursor may be harmful if contact with skin, eyes, or swallowing occurs.

5.3.2 Respiratory hazards may occur with inadequate or obstructed ventilation. The RECOVER instrument must be operated within an active fume hood. Caution should be taken to avoid breathing fumes.

5.3.3 Thermal hazards may occur with inadequate or obstructed ventilation. Caution should be taken to avoid contact with hot surfaces.

Rhodamine 6G #22

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:

Add 0.1 g Rhodamine 6G to the storage bottle or beaker;
Add 1L of methanol OR deionized water;

Agitate gently to mix;

Label the bottle with the carrier used (H_2O or MeOH).

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 450nm- 540nm 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 suitable for comparison 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 examiner 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 #23

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
Stir rod
Storage bottle

3.2 REAGENTS:

Sudan Black B powder
Methanol
Deionized water

3.3 Sudan Black B Working Solution:

Add 15 g of Sudan Black powder to a 2 L beaker;

Add 1L of methanol and stir with a plastic stir rod;

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 runoff 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 suitable for comparison 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 examiner 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 #24

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 Advanced Digital Imaging Training Program 2024.

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 Software

3.3 Adobe Photoshop

4.0 Procedure

4.1 DIGITAL IMAGE PRESERVATION & STORAGE

4.1.1 Examiners 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/File Storage (e.g. SD card, USB drive, server file manager)

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 *Category 1 Images* are captured for documentation purposes only. They may be captured at a lower resolution and/or alternate file type (e.g. JPG) to achieve a smaller file size. All images acquired via tablet fall into this category.

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

4.1.4 *Category 2 Images* are used for scientific analysis/comparison and shall be stored and transmitted without compression or with lossless compression (i.e. capture in a TIF or RAW file format).

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

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

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

4.1.4.4 Digital camera images captured by latent section examiners 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.

4.1.4.5 Friction ridge impressions captured on a flatbed scanner shall be captured in color, at a minimum resolution of 1200 ppi and contain a scale in centimeters

4.1.4.6 Comparison quality images intended for MBIS or printing shall be calibrated when possible. Images captured on a flatbed scanner are at 1:1 and no calibration is needed.

4.1.4.7 Outside agencies may submit digital images of latent prints or processed film. Images of latent prints should contain a scale. It is preferred that existing images be submitted in a lossless format such as TIF or RAW and at as high a resolution as possible. Upon receipt of a lossy file type (ex. JPG), the image shall be uploaded to Adams Web. The examiner should magnify the image to look for "blocking" that may indicate loss of detail due to compression and take it into consideration during their analysis. Enhancement of images uploaded as JPG should be processed in Photoshop as TIF.

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 generally accepted processing commands and is in no way all inclusive. All processing commands employed are left to the discretion of the examiner. Suggested settings/guidelines/notes appear after the command in parenthesis.

Foray Technologies preloaded "Latent Print Actions"

Image – Adjustments – **Black & White** (use to increase or decrease one or more color values as well as adjust saturation for one or more color values; image does not retain color values)

Image – Adjustments – **Brightness/Contrast** (use to adjust shadows/highlights/midtones; more control if used inside other tools like black and white, hue and saturation, or shadows and highlights)

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 – **Exposure** (use sparingly)

Image – Adjustments – **Hue/Saturation** (use to increase or decrease one or more color values as well as adjust saturation for one or more color values; image retains color information; may be used in conjunction with calculations to eliminate background noise)

Image – Adjustments – **Invert**

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** (must convert to grayscale prior. The preferred method for balancing tonal range and contrast by adjusting Shadows (amount, tone, radius 25-35), Highlights (amount, tone, radius 25-35), and Adjustments (brightness, midtone); can use in selected areas)

Image – **Apply Image** – (use to adjust tonal range and contrast. May be used with all color channels, select color channels, or grayscale images where images retain their original color or grayscale mode; can use in selected areas. Consider change in opacity and scroll through Blending options using ⟵ ⟶)

Image – **Calculations** (commonly used to eliminate backgrounds in chemically processed prints such as ninhydrin. May be used with two color channels or two grayscale channels where the result is an Alpha channel (must convert Alpha channel to Grayscale before proceeding). Scroll through blending options and consider a change in 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 – Image Rotation – **Flip Canvas Horizontal**

Image – Mode – **RGB, CMYK or Lab Color Channels** (use to remove one color/suppress background colors; have single channel visible and convert to gray scale. When using Lab color you typically adjust the contrast in channel a or b to visualize the detail in that channel)

Image – Mode – **Grayscale** (covert image to black and white)

Filter – **Camera Raw** (apply when inside photoshop (best) so it can be undone; only adjust White Balance, Temperature, Tint, Exposure, Contrast, Highlights, Shadows, Whites, Blacks, Texture, Clarity, Dehaze, Vibrance, and Saturation.)

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

Filter – Noise – **Dust & Scratches** (is a controlled smoothing process that eliminates dissimilar pixel values (i.e. hot spots are replaced by mean value of surrounding pixels).; consider radius of 1-5 pixels and threshold value between 0-50 levels; 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 – use round feathered brush, hardness set to 0, diameter of 8-10 ridges, & exposure between 15-50%; place cross hair over ridge and use single clicks (best) or drag across ridges)

Crop Tool – (use to remove a portion of the image that is outside the area of interest)

Dodge Tool – (dodge highlights – use round feathered brush, hardness set to 0, diameter of 8-10 ridges, & exposure between 15-50%; place cross hair over furrow and use single clicks (best) or drag across ridges)

Marquee, Lasso and Selection Tools (set feather to 75; use shift + tool to add area, use alt + tool to remove area; set feather to 0 for inversions, areas of high contrast, and straight edges; magic wand tolerance max value is 50)

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

4.4.4 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 in the latent section. This includes documenting competency testing.

5.1.1.3 The Latent Section Discipline Lead shall ensure system 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 other system users.

5.1.3 Examiners

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

5.1.3.2 Examiners 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 offline 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 Examiners 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 software are made (e.g. manufacturer/vendor changes).

Feature Selection in Friction Ridge Examination #25

1.0 Background/References

1.1 The palms of the hands and soles of the feet display a variety of macroscopic features that are typically developmentally stable and may be used to determine the anatomical location an impression originated from.

1.2 The palms of the hands and soles of the feet also display a great variety of microscopic features formed during embryological development or acquired after birth. Variation in these microscopic features/feature sets allow for and lend support for source conclusions.

1.3 White, A. Features of the Friction Ridge Skin: Attributes, Diagnosticity, and Limitations. Journal of Forensic Identification 2022 72(1) 33-127.

1.4 OSAC Registry Proposed Standard – OSAC 2022-S-0038, Standard for Feature Selection in Friction Ridge Examination, Version 2.0 August 2023.

2.0 Scope

2.1 This method specifies the features that can be utilized during friction ridge examinations and provides guidance regarding factors affecting the distortion and diagnosticity of those features.

3.0 Equipment/Reagents

Magnifiers/Pointers

Computers/Digital imaging system

4.0 Procedure

4.1 Examiners shall use only those features and their associated attributes included on the following list during friction ridge examinations to support suitability determinations and source conclusions. Other aspects of impressions of friction ridge skin may be used to aid in the interpretation of the features and their attributes (e.g., shape and smearing of the impression can indicate the impact of torque during contact, causing differences in the curvature of the ridges).

4.1.1 **Ridges:** The ridges are the primary feature type in the friction ridge skin. The ridges are the fully formed elevated papillary rows of skin on the volar surfaces of normal human hands and feet. Fully formed ridges can be distinguished from incipient ridges by the existence of sweat pores spaced somewhat evenly along the path of the ridge. Attributes include:

4.1.1.1 Number – count of ridges within a region of skin or within an impression of the skin.

4.1.1.2 Ridge Width – distance between the edges of a ridge at a given location on the ridge.

4.1.1.3 Furrow Width – distance between the edges of adjacent ridges at a given location on the ridges.

4.1.1.4 Length – distance between two locations along the path of a ridge.

4.1.1.5 Spacing – distance between the midpoints of two adjacent ridges.

4.1.1.6 Direction – angle of the path of a ridge in relation to a fixed point in the skin or impression (e.g., a ridge that is perpendicular to an irregular crease).

4.1.1.7 Curvature – change in angles along the path of a ridge for a given segment of the ridge.

4.1.1.8 Edge Shape – contour of the edge of a ridge (straight, protrusion, and intrusion).

4.1.1.9 Pore Position – location of a pore with respect to the edge of the ridge or another pore.

4.1.1.10 Open Field – four or more adjacent and continuous ridges with a visible length of at least 3mm where no minutiae are present within an area of skin.

4.1.2 **Minutiae:** A minutia defines the end of a ridge and is the primary landmark within the ridged skin used by examiners and biometric systems. A ridge can end in three different manners: 1) no connection to the adjacent ridge above the level of the furrow (i.e., ending ridge), 2) completely connected to the adjacent ridge from the bottom of the furrow to the top of the ridge (i.e., bifurcation) or 3) partially connected to the adjacent ridge (i.e., ambiguous minutiae). The manner in which a ridge ends can change during adolescent growth as the cells of the skin rapidly multiply to keep pace with the growing hand or foot. Additionally, the connectors between two ridges can change as a result of the aging process. Attributes include:

4.1.2.1 Number – count of minutiae within a region of skin or within an impression of the skin.

4.1.2.2 Density – number of minutiae within a specified surface area (e.g., per mm2).

4.1.2.3 Orientation – direction of the path(s) of the ridge(s) emanating from a minutia in relation to a fixed point in the skin or impression.

4.1.2.4 Connectedness – extent to which the end point of one ridge segment is joined or linked to a neighboring ridge.

4.1.2.5 Compound Minutiae – the combination of multiple minutiae within a close proximity or that manifest as a single structure. Compound minutiae might include the following: short ridge, dot, break, enclosure, overlap, spur, crossbar, bridge, opposing bifurcations, dock, ending ridge plus bifurcation combination, trifurcation/double bifurcation, return, and merge point.

4.1.2.6 Pattern Force Minutiae – Minutiae that form in a pattern force area bearing a direction consistent with the majority of minutiae in that area.

4.1.2.7 Counter Pattern Force Minutiae – Minutiae that form in a pattern force area bearing a direction not consistent with the majority of minutiae in that area.

4.1.3 **Incipient Ridges:** Incipient ridges are raised papillary ridges that are typically lower in elevation than the mature ridges. Incipient ridges occupy space in the furrows, between the mature ridges. Unlike the mature ridges, incipient ridges do not have sweat pores. Incipient ridges are typically less than one half the average width of the surrounding mature ridges and often display numerous breaks. Incipient ridges often continue to manifest as people age. Incipient ridges can fuse to each other or to the ends of mature ridges and can approach the height and width of the mature ridges.

4.1.3.1 Number – count of incipient ridges within a region of skin or within an impression of the skin.

4.1.3.2 Density – number of incipient ridges within a specified surface area (e.g., per mm^2).

4.1.3.3 Width - distance between the edges of an incipient ridge at a given location on the incipient ridge.

4.1.3.4 Length – distance between two locations along the path of an incipient ridge.

4.1.3.5 Direction – angle of the path of an incipient ridge in relation to a fixed point in the skin or impression (e.g., an incipient ridge that is perpendicular to an irregular crease).

4.1.3.6 Inter-Incipient Gap – distance between the ends of two incipient ridges (i.e., the separation between incipient ridges within a row of incipient ridges).

4.1.3.7 Edge Shapes – contours along the edges of an incipient ridge (straight, protrusion, and intrusion).

4.1.4 **Dissociated Ridges:** Dissociated ridges are raised portions of the friction ridge skin that are broken into short, wavy or dotlike segments that may be completely disorganized or somewhat follow the ridge flow in a given region of skin. Dissociated ridges are typically at the same elevation as any surrounding normal ridges and might or might not contain sweat pores. Dissociated ridges are also known as dysplasia. Attributes include:

4.1.4.1 Number – count of ridge segments within a region of skin or within an impression of the skin.

4.1.4.2 Density – number of ridge segments within a specified surface area (e.g., per mm^2).

4.1.4.3 Ridge Width – distance between the edges of a ridge segment at a given location on the segment.

4.1.4.4 Furrow Width – distance between the edges of adjacent ridges at a given location on the ridges.

4.1.4.5 Length – distance between two locations along the path of a ridge segment.

4.1.4.6 Spacing – distance between the midpoints of two adjacent ridges.

4.1.4.7 Direction – angle of the segment of a ridge in relation to a fixed point in the skin or impression (e.g., a segment that is perpendicular to the core of a loop).

4.1.4.8 Curvature – change in angles along the path of a ridge segment.

4.1.4.9 Edge Shape – contour of the edge of a ridge segment (straight, protrusion, indentation, and discontinuity).

4.1.4.10 Pore Position – location of a pore with respect to the edge of the ridge segment or another pore.

4.1.4.11 Connectedness – extent to which the end point of one ridge segment is joined or linked to a neighboring ridge.

4.1.5 **Ridge flow:** Ridge flows are general paths of ridges commonly found in specific regions of the hands and feet that reflect the stresses on the surface of the skin caused by the growth of the hands and feet and the presence of the regular flexion creases at the time the ridges are forming. These ridge flows are not defined "pattern elements," but useful during the examination process because they are predictive for each region of the hand and foot. Attributes include:

4.1.5.1 Curvature – change in angles along a series of parallel ridges at a given location along a ridge flow.

4.1.5.2 Convergence – loss of ridges along a ridge flow, causing an overall decrease in the width of the ridge flow.

4.1.5.3 Divergence – gain of ridges along a ridge flow, causing an overall increase in the width of the ridge flow.

4.1.6 **Pattern Elements – Recurves and Triradii (Deltas):** Pattern elements, and the relationships between pattern elements, are most often associated with the development of classification schemes for the digits, palms, and feet. In the examination of partial impressions, the presence of one or more pattern elements can provide anatomical reference points and can be used to reduce the number of potential donors of an impression. Pattern elements include triradii (singular "triradius") and recurves. A triradius is a convergence of three ridge fields, which creates three distinct rays from the center of the convergence. A recurve is the portion of a ridge path where the ridge turns with an acute inner angle, reversing the direction of the ridge path and resulting in an approximately 120^{o} - 180^{o} change. Attributes include:

4.1.6.1 Number – count of recurves and triradii within a region of the friction ridge skin or in an impression.

4.1.6.2 Triradius Angle – angle formed by two rays of a triradius.

4.1.6.3 Recurve Ridge Count – number of ridges enclosed by a recurving ridge.

4.1.6.4 Pattern Element Relationships – ridge counts, distance, or angles between recurves or triradius centers of two or more pattern elements.

4.1.6.5 Recurve Direction – Angle of the bisector of the recurve in relation to a fixed point in the skin or impression.

4.1.7 **Regular Creases:** Regular creases are those flexion creases which form prior to the friction ridges and prior to flexion of the hand or foot during embryological formation. Regular creases are tightly bound to the underlying palmar connective tissue and ridges tend not to traverse through these creases. Regular creases are also referred to as primary creases or major creases. Attributes include:

4.1.7.1 Number – count of regular creases within a region of skin or within an impression of a skin.

4.1.7.2 Configuration – organization of the regular crease as a single structure or a compound structure (e.g., the palmar digital crease of the middle finger is typically a double crease while the palmar digital crease of the index finger is typically a single crease).

4.1.7.3 Spacing – distance between the midpoints of two regular creases.

4.1.7.4 Position – location of a regular crease within the structure of the hand or foot.

4.1.7.5 Width – distance between the edges of a regular crease at a given location on the regular crease.

4.1.7.6 Length – distance between two locations along the path of a regular crease.

4.1.7.7 Curvature – change in angles along the path of a regular crease for a given segment of the crease.

4.1.7.8 Direction – angle of the path of a regular crease in relation to a fixed point in the skin or impression (e.g., a crease that is parallel to the direction of the surrounding ridges).

4.1.7.9 Edge shapes – contours of the skin contained within a regular crease.

4.1.7.10 Branching – diverging pattern of smaller creases along a regular crease.

4.1.8 **Irregular Creases:** Irregular creases are those flexion creases which form during or after ridge formation (ridges typically traverse through these creases). Although not as deep as the regular creases, the irregular creases also have attachments to the underlying structure of the hand or foot. Biologically, irregular creases are distinct from wrinkles; however, in impressions of friction ridge skin, irregular creases and wrinkles both tend to record as a linear void dissecting the ridges. Irregular creases are also referred to as secondary creases or minor creases. Irregular creases show greater variability than regular creases within the human population. Attributes include:

4.1.8.1 Number – count of irregular creases within a region of skin or within an impression of a skin.

4.1.8.2 Density – number of irregular creases within a specified surface area (e.g., per mm^2).

4.1.8.3 Width – distance between the edges of an irregular crease at a given location on the irregular crease.

4.1.8.4 Length – distance between two locations along the path of an irregular crease.

4.1.8.5 Curvature – change in angles along the path of an irregular crease for a given segment of the crease.

4.1.8.6 Direction – angle of the path of an irregular crease in relation to a fixed point in the skin or impression (e.g., a crease that is parallel to the direction of the surrounding ridges).

4.1.8.7 Branching – diverging pattern of smaller creases along an irregular crease.

4.1.8.8 Angle of intersection – angle(s) created by the intersection of two or more irregular creases.

4.1.8.9 Spacing – distance between the midpoints of two irregular creases.

4.1.9 **Wrinkles:** Wrinkles are a result of a breakdown in the skin over time. The disorganization of the various fibers and large proteins in the dermis causes the dermis to fold inward, causing a crimp in the epidermis. Unlike regular and irregular creases, wrinkles do not have dedicated attachments to the underlying structure of the hand or foot. In impressions of friction ridge skin, wrinkles and irregular creases both tend to record as a linear void dissecting the ridges.

4.1.9.1 Number – count of wrinkles within a region of skin or within an impression of a skin.

4.1.9.2 Density – number of wrinkles within a specified surface area (e.g., per mm^2).

4.1.9.3 Width – distance between the edges of a wrinkle at a given location on the wrinkle.

4.1.9.4 Length – distance between two locations along the path of a wrinkle.

4.1.9.5 Curvature – change in angles along the path of a wrinkle for a given segment of the wrinkle.

4.1.9.6 Direction – angle of the path of a wrinkle in relation to a fixed point in the skin or impression (e.g., a wrinkle that is parallel to the direction of the surrounding ridges).

4.1.9.7 Branching – diverging pattern of smaller wrinkles along a wrinkle.

4.1.9.8 Angles of intersection – angle(s) created by the intersection of two or more wrinkles.

4.1.9.9 Spacing – distance between the midpoints of two wrinkles.

4.1.10 **Scars:** A scar is a disfiguration of the skin as a result of wound healing. The disfiguration can occur in varying degrees dependent on the amount of skin contraction experienced at the site of the injury and medical intervention (e.g., stitches). Some scars are imperceptible, while others are dramatic. Additionally, scars initiated by temperature and chemical burns tend to disfigure the skin differently than cuts or punctures. Simple, linear scars tend to exist at a lower elevation than the tops of the ridges. Complex scars and scars that contain epithelial islands can exist at the same or higher elevation than the normal ridges. Attributes include:

4.1.10.1. Number – count of scars within a region of skin or within an impression of a skin.

4.1.10.2 Width – distance between the edges of a scar at a given location on the scar.

4.1.10.3 Length – distance between two locations along the path of a scar.

4.1.10.4 Surface Area – measure of the total area of the surface the scar occupies.

4.1.10.5 Curvature – change in angle along the path of a scar for a given segment of a scar.

4.1.10.6 Direction – angle of the path of a scar in relation to a fixed point in the skin or impression (e.g., a scar that is perpendicular to the direction of the surrounding ridges).

4.1.10.7 Created Minutiae – new minutiae created at the border of a scar due to the misalignment of the original ridges during the healing process.

4.1.10.8 Edge Shapes – contours defined by the border of a scar and any epithelial islands created as a result of the injury.

4.1.11 **Unstable features:** Unstable features are those features temporarily present in the skin as the result of wound healing or disease. Unstable features include, but are not limited to, warts, eczema/psoriasis, actively healing injuries, calluses, and blisters. Depending on the nature of the unstable feature, it may exist lower, equal, or higher elevations than the tops of the main ridges. Attributes include:

4.1.11.1 Number – count of unstable features within a region in the skin or impression.

4.1.11.2 Width – distance between the edges of an unstable feature at a given location on the unstable feature.

4.1.11.3 Length – distance between two locations along the path of an unstable feature.

4.1.11.4 Surface Area – measure of the total area of the surface the unstable feature occupies.

4.1.11.5 Curvature – change in angle along the path of an unstable feature for a given segment of the feature.

4.1.11.6 Direction – angle of the path of an unstable feature in relation to a fixed point (e.g., scrape that is parallel to the direction of the surrounding ridges).

4.1.11.7 Edge Shapes – contours of an unstable feature.

4.1.12 **Shape of the Impression:** The shape of an impression is generally dictated by the contact points between a hand or foot and a surface. The shape of an impression is often a combination of outer borders and inner borders. The outer perimeter delineates the maximum surface area of contact between the hand/foot and the surface. Within the outer contact perimeter, inner borders can be created by the topology of the hand/foot (e.g., the mid-palm), the topology of the skin (e.g., regular creases), or movement on the surface (e.g., smears leading to the final stop position of a palm). The surface area and borders of an impression can help discriminate between potential donor regions of an impressions (e.g., a latent print that only needs to be compared to the interdigital region of the palms), isolate individual latent prints on a lift card or image, or assess the completeness of exemplar prints (e.g., visible non-ridge skin border in an exemplar palm print ensure complete recording of the ridged skin). Attributes include:

4.1.12.1 Surface Area – measure of the total area of the surface the impression occupies.

4.1.12.2 Outline – the contours along the border of the impression.

4.1.12.3 Non-Ridged Skin Border – the junction or transition between the ridged skin and the non-ridged skin.

4.2 The diagnosticity of features should be considered when conducting friction ridge examinations and forming suitability determinations and source conclusions.

4.2.1 Diagnosticity, generally, refers to the usefulness of information to assist in a choice or decision. Diagnosticity of friction ridge features refers to the usefulness of the feature, or attribute of a feature, for establishing search parameters (Search Diagnosticity) or the usefulness of the feature for determining source (Source Diagnosticity).

4.2.2 Features that exhibit low levels of variation in the population can be used for establishing search parameters. Features with generally low variation include the following: shape of the impression, creases, pattern elements, and ridge flows. Conversely, those features that exhibit higher levels of variation in the human population are useful for distinguishing one finger, palm, toe, or foot from another.

4.2.3 Pattern elements, ridge flows, and creases can be useful for excluding a given donor, however these features do not typically provide strong support for same source opinions.

4.2.4 Features that exhibit higher levels of variation in the population can be used to support same source opinions. The most variable features in the population typically include the following: ridges, minutiae, incipient ridges, dissociated ridges, and certain attributes of creases. Acquired features (wrinkles, scars, unstable features) exhibit more complex diagnosticity, depending on the feature.

4.2.5 The overall search diagnosticity and source diagnosticity for a given impression is impacted by the totality of a specific combination of features and available feature attributes. Generally, as the number and diversity of features increase, the search and source diagnosticities also increase.

4.2.6 The diagnosticity for each of the features include the following:

4.2.6.1 **Ridges:**

4.2.6.1.1 Search Diagnosticity:

Search diagnosticity for the ridges is generally low because all regions of the friction ridge skin are expected to have ridges.

4.2.6.1.2 Source Diagnosticity:

In general, as the surface area of an impression increases (ergo an increase in the number of ridges and the visible lengths of the ridges), the source diagnosticity of the impression also increases.

In general, as an open field increases in size (more ridges or longer visible lengths of the ridges), the source diagnosticity of the open field also increases.

4.2.6.2 **Minutiae:**

4.2.6.2.1 Search Diagnosticity:

In regions where growth stresses “force” minutiae to form, there tends to be a high density of minutiae that share direction (the transition zone from the hypothenar into the mid-palm region is one such zone). This concept is called “pattern force”. Pattern force areas can be used to narrow search parameters, which increase search diagnosticity of these minutiae.

4.2.6.2.2 Source Diagnosticity:

Minutiae type(s) and configurations can increase or decrease the source diagnosticity of the cluster of minutiae (e.g., in the distal portion of the fingers, bifurcations tend to occur less frequently and therefore have higher source diagnosticity compared to ridge endings).

Typically, as the surface area of skin represented in an impression increases, so too does the number of minutiae present within the impression. While the source diagnosticity of a cluster of minutiae typically increases as the number of minutiae increases, the source diagnosticity ranges at a given number of minutiae until a theoretical maximum threshold is achieved (e.g., a rolled fingerprint). Below this theoretical maximum threshold, source diagnosticity for a given cluster depends on anatomical region, the density of the minutiae, the influence of pattern force, the orientation of the minutiae, the distance between the minutiae, and the population of donors under consideration.

4.2.6.3 **Incipient Ridges:**

4.2.6.3.1 Search Diagnosticity:

The search diagnosticity for incipient ridges is generally low because incipient ridges can appear throughout the friction ridge skin and, unlike the ridges and minutiae, are not generally subject to pattern force.

4.2.6.3.2 Source Diagnosticity:

In general, as the number of incipient ridges within an impression increases, the source diagnosticity of the impression also increases.

4.2.6.4 **Dissociated Ridges:**

4.2.6.4.1 Search Diagnosticity:

The search diagnosticity for dissociated ridges is generally low because dissociated ridges can appear anywhere in the friction ridge skin.

4.2.6.4.2 Source Diagnosticity:

In general, as the number of dissociated ridges within an impression increases, the source diagnosticity of the impression also increases.

4.2.6.5 **Ridge flow:**

4.2.6.5.1 Search Diagnosticity:

The search diagnosticity of ridge flows is generally high because the ridge flows follow a predictable distribution in the human population for each region of the friction ridge skin.

4.2.6.5.2 Source Diagnosticity:

Generally, the source diagnosticity of ridge flows is low. Ridge flows tend to show significant left/right symmetry within a person. This symmetry is more pronounced within the corresponding hands of monozygotic twins.

4.2.6.6 **Pattern Elements – Recurves and Triradii:**

4.2.6.6.1 Search Diagnosticity:

The search diagnosticity of pattern elements is generally high because patterns follow a predictable distribution within human populations for each region of the friction ridge skin.

4.2.6.6.2 Source Diagnosticity:

The source diagnosticity of pattern elements is generally low. Patterns tend to show significant left/right symmetry within a person. This symmetry is more pronounced within the corresponding hands of monozygotic twins.

The source diagnosticity of a pattern element or group of pattern elements depends on the population under consideration and the region of skin within which it resides. For instance, whorls are less common in the interdigital regions of palms than the interdigital regions of feet based on population frequencies in the United States.

4.2.6.7 **Regular Creases:**

4.2.6.7.1 Search Diagnosticity:

The search diagnosticity of the regular creases is generally high because the regular creases follow predictable distributions within human populations for each region of the friction ridge skin.

4.2.6.7.2 Source Diagnosticity:

The source diagnosticity of the number, configuration, and position of the regular creases is generally low. These attributes tend to show significant left/right symmetry within a person. This symmetry is more pronounced within the corresponding hands of monozygotic twins.

The source diagnosticity of the width, length, curvature, and direction of the regular creases is low to moderate. These attributes often show significant left/right symmetry within a person and similarity within the corresponding hands of monozygotic twins.

The source diagnosticity of the edge shapes and branching of a crease is expected to range from moderate to high. These attributes can show significant left/right symmetry within a person and similarity within the corresponding hands of monozygotic twins.

4.2.6.8 **Irregular Creases:**

4.2.6.8.1 Search Diagnosticity:

The search diagnosticity of the number, density, width, length, curvature, and direction of irregular creases depends on the region of skin under consideration. The search diagnosticity of these attributes is higher for thenars of palms, proximal and middle phalanges of the fingers, and the arches of the feet because a high density of creases is expected in these regions. Elsewhere in the friction ridge skin the irregular creases are more variable, and consequently less useful for search diagnosticity.

4.2.6.8.2 Source Diagnosticity:

The source diagnosticity of the number, density, width, length, curvature, and direction of irregular creases depends on the region of skin considered. The source diagnosticity is lower for palm thenars, proximal and middle phalanges of the fingers, and the arches of the feet because a high density of creases is expected in these regions. Elsewhere in the friction ridge skin the irregular creases are more variable, and consequently display higher source diagnosticity.

The source diagnosticity of the branching and angles of intersection of irregular creases is expected to range from moderate to high. These attributes can show significant left/right symmetry within a person and similarity within the corresponding hands of monozygotic twins.

4.2.6.9 **Wrinkles:**

4.2.6.9.1 Search Diagnosticity:

The search diagnosticity for wrinkles is generally low because wrinkles can appear anywhere in the friction ridge skin.

4.2.6.9.2 Source Diagnosticity:

In general, as the number of wrinkles within an impression increases, the source diagnosticity of the impression also increases.

4.2.6.10 **Scars:**

4.2.6.10.1 Search Diagnosticity:

The search diagnosticity for scars is generally low because scars can appear anywhere in the friction ridge skin.

4.2.6.10.2 Source Diagnosticity:

In general, as the number of scars or the complexity of a scar within an impression increases, the source diagnosticity of the impression also increases.

4.2.6.11 **Unstable features:**

4.2.6.11.1 Search Diagnosticity:

The search diagnosticity for unstable features is generally low because unstable features can appear anywhere in the friction ridge skin.

4.2.6.11.2 Source Diagnosticity:

In general, as the number or complexity of an unstable feature within an impression increases, the source diagnosticity of the impression also increases.

4.2.6.12 **Shape of the Impression:**

4.2.6.12.1 Search Diagnosticity:

The search diagnosticity of size, outline, and non-ridged skin border of an impression is generally high because the size, contours, and skin type transitions of human hands and feet are generally shared in the population.

4.2.6.12.2 Source Diagnosticity:

The source diagnosticity of the shape of an impression is low. Hands and feet tend to show significant left/right symmetry within a person and similarity within the corresponding hands of monozygotic twins.

4.3 Factors affecting the appearance of features should be considered when conducting friction ridge examinations and interpreting the features and their attributes.

4.3.1 Variation in the appearance of the features can originate from biological causes or the result of physical contact. Biological factors are those factors affecting the stability of the feature over time in the friction ridge skin (e.g., aging) or the typical development of the feature (e.g., syndactyly). Contact factors are those factors that can affect the appearance of the features when they are recorded in an impression.

4.3.2 The following factors are common causes for features to vary in appearance over time or due to circumstances of touch. These factors are not meant to be exhaustive of all possibilities.

4.3.2.1 Adolescent growth – growth of the hand or foot from the time the ridges form until adult size is attained (typically late teens).

4.3.2.2 Aging – changes in the friction ridge skin that take place because of the natural aging process; typically, these changes begin after the age of forty.

4.3.2.3 Injury – physical damage to the hand, foot, or friction ridge skin that elicits a wound healing response (e.g., cut or burn); certain injuries can result in the formation of a scar.

4.3.2.4 Disease – disorder in the structure or function of the skin that produces specific signs or symptoms and is not related to a physical injury (e.g., wart, psoriasis, or acquired ridge aplasia).

4.3.2.5 Hand flexion – the degrees to which the digits can be flexed at the joints or the rotation of the thumb.

4.3.2.6 Abduction of digits – the degrees to which the digits can be spread apart from one another.

4.3.2.7 Angle of contact – the position of the hand or foot with respect to the surface during contact.

4.3.2.8 Compressive stress – the squeeze of the skin between the bone structure of the hand or foot and a surface (also referred to as “deposition pressure”).

4.3.2.9 Shearing stress – tangential force applied to the skin (also referred to as “lateral pressure”).

4.3.2.10 Torque – rotational force applied to the skin.

4.3.2.11 Residue factors – any factors related to the residue on the skin that can affect the recording of the skin (e.g., initial composition of the residue, distribution of residue on the skin, or redistribution of residue in an impression due to skin moving on a surface).

4.3.2.12 Surface conditions – any factors related to the surface that affect the recording of the skin (e.g., texture, curvature, pliability, or contaminants).

4.3.2.13 Environmental factors – any factors related to the environment (e.g., temperature, humidity, UV exposure, or time) that affect the appearance of the features after the impression is recorded on a surface.

4.3.2.14 Post-deposition factors – any non-environmental factors that affect an impression (e.g., overlays with other impressions or smearing caused by an object touching an impression).

4.3.2.15 Processing technique – method used to develop the features of a latent impression; each method has a signature appearance that can vary, typically because of residue issues or surface conditions.

4.3.2.16 Recovery method – manner in which an impression is preserved (e.g., lift or photograph) that causes distortion (e.g., crease in tape, lens distortion, poor lighting, poor focus, low resolution).

4.3.2.17 Electronic capture error – inaccurate recording of a feature by an automated device (e.g., livescan stitching error, image acquisition or processing fidelity).

4.3.2.18. Atypical anatomy – any deviation from the typical range of shape, size, or proportions of the human hand or foot or any disruption in the formation of the skin driven by genetic or epigenetic factors (e.g., syndactyly or congenital ridge aplasia). Atypical anatomy does not cause issues related to biological stability or recordability of the features; however, if it is not recognized during analysis, it can cause an examiner to underestimate or overestimate the source diagnosticity or search diagnosticity of a given feature set.

Friction Ridge Examination Methodology ACE #26

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 footprints 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 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 available for reference at https://www.nist.gov/osac/subcommittees/friction-ridge*

1.9 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

1.10 ANSI/ASB Standard 015. Standard For Examining Friction Ridge Impressions. First Edition, 2024.

1.11 ANSI/ASB Best Practice Recommendation 142. Best Practice Recommendations for the Resolution of Conflicts in Friction Ridge Examination. First Edition, 2022.

1.12 ANSI/ASB Best Practice Recommendation 165. Best Practice Recommendation for Analysis of Friction Ridge Impressions.

1.13 First Edition, 2024. ANSI/ASB Best Practice Recommendation 166 Best Practice Recommendation for Comparison and Evaluation of Friction Ridge Impressions. First Edition, 2024.

2.0 Scope

2.1 Examiners shall apply the concepts of Analysis, Comparison, and Evaluation, herein referred to as ACE methodology, to friction ridge impressions preserved by the Latent Section or submitted by our customer agencies. The ACE methodology utilizes a qualitative and quantitative assessment of data.

3.0 Equipment/Reagents

3.1 EQUIMPENT AND MATERIALS

Magnifiers/Pointers

Computers/Digital imaging system

4.0 Procedure

4.1 ANALYSIS is the interpretation of observed data in a friction ridge impression in order to categorize its suitability/utility.

4.1.1 Observable data in the questioned friction ridge impression is analyzed and documented *prior to comparison* through notes and image annotation. Sufficient minutiae should be documented to support the examiner's utility decision.

4.1.2 The examiner selects a questioned impression that has been assessed as having observable data and potential utility.

4.1.2.1 If not already marked, the examiner marks the impression and gives it a unique identifier consisting of the item/sub-item number followed by the latent number (1.1, 1.1.1, etc.).

4.1.2.2 An arc over the top of a print generally represents the anatomical source as a finger and indicates anatomical orientation. A bracket symbol documents the anatomical source as a palm print, footprint, or unknown source.

4.1.3 The examiner shall consider the following observed data if present:

a) size and shape of the impression: the surface area and the outline of the impression border;

b) classification patterns: the presence, size, and shape of defined classifiable patterns present in the friction ridge skin (e.g., arch, loop, whorl);

c) cores and deltas: the existence, number, position, and shape of the cores and deltas;

d) ridge flows: the overall ridge flow that may lack a classifiable pattern but facilitate the search;

e) flexion creases: the existence, position, and path of flexion creases;

f) scars: the existence, position, and path of scars;

g) ridge paths: the location, direction, length, width, and curvature of the path of a ridge;

h) minutiae: the location, type, and direction of minutiae;

i) spatial relationships: the ridge counts, distances, directions, and angles between features.

4.1.4 In addition, the examiner should consider the following observed data if present:

a) secondary creases or wrinkles: the existence, position, path, and density of secondary creases or wrinkles;

b) incipient ridges: the location, direction, length, width, morphology, and density of incipient ridges;

c) pores: presence, location, and shape of pores;

d) occasional features: the existence, position, and path of occasional features (e.g., warts or healing skin);

e) ridge morphology: the edge shapes or texture of a ridge;

f) flexion crease morphology: the edge shapes or texture of a flexion crease;

g) scar morphology: the edge shapes or texture of a scar;

h) unstable or occasional feature morphology: the edge shapes or texture of an unstable or occasional feature.

4.1.5 Minutia markup (annotations) should be completed digitally on a new layer (analysis layer). Minutia markup should incorporate information regarding the quality of the features observed and should be documented as follows:

GREEN - examiner marks observed minutia green when there is high confidence in the existence of the feature and high confidence it will be present in a corresponding exemplar (e.g. presence and location of minutiae is not debatable). Green features are highly weighted during comparison. The examiner's tolerance for differences in green features is low.

YELLOW - examiner marks observed minutia yellow when there is medium confidence in the existence of the feature and medium confidence it will be present in a corresponding exemplar (e.g. location of the minutiae are debatable). Yellow features are weighted medium during comparison and examiner's tolerance for differences is medium.

RED - examiner marks observed minutia red when there is a low confidence in the existence of the feature and low confidence it will be present in a corresponding exemplar (e.g. location and/or presence of the minutiae are debatable). Red features are weighted low during comparison and examiner's tolerance for differences is high.

4.1.6 The complexity of an impression should be assessed and recorded during analysis.

4.1.6.1 *NON-COMPLEX* impressions contain > 12 minutiae designated as green quality and the observed data provides a strong indication of the anatomical region and orientation.

4.1.6.2 *LOW COMPLEXITY* impressions contain between 8-12 minutia designated as green quality and the observed data provides limited indication of the anatomical region or orientation.

4.1.6.3 *HIGH COMPLEXITY* impressions contain < 8 minutia designated as green quality or the observed data provides no indication of the anatomical region or orientation.

4.1.7 Suitability decisions resulting from the examination of observed data are based on the application of an examiner's knowledge, training, and experience. There is no scientific basis for selecting a particular threshold to establish the suitability of an impression. In theory, any friction ridge impression could be compared, but many are so fragmentary that a meaningful conclusion could not be reached or supported, thus it would be inefficient and ineffective to do so. Similarly, an examiner may make an operational decision not to proceed with a comparison or MBIS search of some impressions because of a higher perceived risk of error. Suitability decisions that may be assessed and recorded in casework include:

4.1.7.1 *SUITABILITY FOR COMPARISON* – is a decision that in the opinion of the examiner, an impression contains 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.

4.1.7.1.1 Impressions deemed "suitable 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.

4.1.7.2 *IRD* (Insufficient Ridge Detail) – is a decision that in the opinion of the examiner, an impression, lift, or photo does not contain sufficient data to warrant additional analysis and/or comparison.

4.1.7.3 *NDP* (No Ridge Detail Present) is a notation that lifts or photos do not contain observable friction ridge detail.

4.1.7.4 SUITABILITY FOR MBIS – is a decision made by an examiner in accordance with the Technical Case Requirements as defined in the MBIS analytical method as to whether or not an impression will proceed to an MBIS database search. Note: not all latent prints deemed suitable for comparison are suitable for MBIS entry.

4.1.8 The presence of unlabeled impressions that are assessed but not designated for analysis should be documented. Documentation will be accomplished by indicating that "no value" (NV) 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 designated IRD.

4.1.9 Impressions deemed "suitable for comparison" proceed to the comparison step if there are known exemplars with which to compare. If no known exemplars can be located, an identification is not effected, or other circumstances dictate, an impression deemed suitable for MBIS shall proceed to MBIS inquiry. Lifts or impressions deemed IRD or NDP do not proceed to comparison.

4.2 COMPARISON is the search for and detection of similarities and dissimilarities in observed data between friction ridge impressions.

4.2.1 A questioned impression, which has previously been deemed "suitable for comparison" is selected. Selection should take into consideration the quality of the observed data in the impression and the complexity of the impression. Selection may be sequential or arbitrary.

4.2.2 An exemplar impression is selected to compare against the questioned impression. Selection of an exemplar impression should take into consideration apparent similarity of the exemplar impression to the questioned impression and completeness of the recording of the impression. Selection may be sequential or arbitrary.

4.2.2.1 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 submitted to ISPFS as evidence 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.

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

4.2.2.2.1 The current national minimum resolution standard for the transmission of 10-print images is 500 ppi. 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, records obtained from the FBI, and digital images of original exemplars.

4.2.2.2.2 Examples of images not meeting these standards are faxed images, low quality PDF's or low-quality photocopies. These lower resolution images may be used at the discretion of the examiner with additional documentation and extra caution.

4.2.3 The examiner shall scan/upload the exemplars into the digital imaging system.

4.2.4 Exemplar impressions are analyzed as a whole for their utility for comparison. Documentation of the analysis is recorded in ILIMS with notation of type (finger, palm, foot, major case prints etc.) and overall complexity as follows:

NON-COMPLEX - high confidence (green quality) in the existence of features and high confidence they will be present in a corresponding unknown impression.

LOW-COMPLEXITY - medium confidence (yellow quality) in the existence of features and medium confidence they will be present in a corresponding unknown impression.

HIGH COMPLEXITY - low confidence (red quality) in the existence of features and low confidence they will be present in a corresponding unknown impression.

4.2.4.1 If the portion of the exemplars being utilized has the potential for high complexity, a more thorough analysis (color mapping i.e. red, yellow, green) may need to be done, or additional exemplars obtained.

4.2.5 Comparison of features should proceed from the lower quality impression to the higher quality impression. The lower quality impression is generally the unknown or latent but may also be a low-quality exemplar.

4.2.6 A target group identified during the analysis of the lower quality impression should be selected for comparison with the higher quality impression.

4.2.7 Features of the two impressions are assessed for agreement or disagreement in a side-by-side comparison. Features are assessed on similarity, sequence, and spatial relationship with regard to quality and distortion tolerance.

4.2.8 Documentation of features assessed as corresponding should occur contemporaneously during the side-by-side comparison.

4.2.8.1 Documentation should be done in a non-destructive manner on a digital image copy of each impression.

4.2.8.2 Features assessed as corresponding should be documented on an additional layer (comparison layer) for both the known and unknown impressions. Features assessed as disagreement are generally not documented.

4.2.8.3 The use of multiple layers (analysis and comparison) on the same image supports the ability to distinguish between features initially interpreted during analysis (prior to side-by-side comparison) and features interpreted during comparison.

4.2.9 Comparison and/or documentation should continue until an accumulation of features supports a source conclusion.

4.2.10 Once the features have been documented to support a source conclusion, the complexity of the comparison should be assessed.

4.2.10.1 *NON-COMPLEX COMPARISON*:

Both impressions have been determined to be non-complex during analysis AND

Fewer than three green quality features interpreted during comparison were altered from how they were documented during analysis.

4.2.10.2 *LOW COMPLEXITY COMPARISON*:

At least one impression had been determined to be low complexity during analysis and fewer than three green quality features interpreted during comparison were altered from how they were documented during analysis.

OR

Both impressions had been determined to be non-complex during analysis and three or more green quality features interpreted during comparison were altered from how they were documented during analysis.

4.2.10.3 *HIGH COMPLEXITY COMPARISON*:

At least one impression has been determined to be of high complexity during analysis.

OR

At least one impression has been determined to be of low complexity during analysis and three or more green quality features interpreted during comparison were altered from how they were documented during analysis.

4.3 EVALUATION is the weighting of the aggregate strength of the evidence (observed similarities and dissimilarities when considering two propositions) between the observed data in the friction ridge impressions being compared in order to formulate a source conclusion.

4.3.1 *SOURCE EXCLUSION* is an examiner's conclusion that the observed data provide substantially stronger support for the proposition that the questioned impression originated from a different source than the exemplar impressions compared.

4.3.1.1 The following conditions are met:

The observed data in the relevant areas of both impressions used to support the source conclusion are present and designated as yellow quality or higher during analysis.

AND

The observed data between the impressions are in disagreement.

4.3.1.2 Source exclusion should employ the use of an anchor point and target groups

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

4.3.1.2.2 Target groups used for source exclusion should be associated with the anchor point. Two or more target areas should be utilized prior to excluding.

4.3.2 *INCONCLUSIVE WITH DISSIMILARITIES* is an examiner's conclusion that the observed data provides more support for the proposition that the impressions originated from different sources rather than the same source; however, there is insufficient support for a Source Exclusion.

4.3.2.1 The following condition is met:

The observed data between the impressions needed to support the source conclusion display dissimilarities, but a more definitive determination of disagreement cannot be made due to limiting factors; the limiting factor(s) affecting a more definitive determination should be documented.

4.3.3 *INCONCLUSIVE* is an examiner's conclusion that the observed data does not provide more support for one proposition over the other.

4.3.3.1 At least one of the following conditions are met:

The observed data in the relevant area of at least one of the impressions needed to support a source conclusion are not present or were designated as red quality during analysis thus preventing a determination of agreement or disagreement, the limiting factor(s) affecting a more definitive determination should be documented.

OR

The similarities and dissimilarities of the observed data are insufficient to support either agreement or disagreement, the limiting factor(s) affecting a more definitive determination should be documented.

4.3.4 *INCONCLUSIVE WITH SIMILARITIES* is an examiner's conclusion that the observed data provides more support for the proposition that the impressions originated from the same source rather than different sources; however, there is insufficient support for a Source Identification.

4.3.4.1 The following condition is met:

The observed data between the impressions needed to support the source conclusion display similarities, but a more definitive determination of agreement cannot be made due to limiting factors, the limiting factor(s) affecting a more definitive determination should be documented.

4.3.4.2 Documentation shall include the observed agreement used to support an Inconclusive with Similarities conclusion.

4.3.5 *SOURCE IDENTIFICATION* is an examiner's conclusion that the observed data provides substantially stronger support for the proposition that the two impressions originated from the same source rather than from a different source.

4.3.5.1 The following conditions are met:

The observed data in the relevant areas of both impressions used to support the source conclusion are present and designated as yellow quality or higher during analysis;

AND

The observed data between the impressions are in agreement resulting in overall conformity;

AND

The observed data in agreement include at least 8 minutiae designated as green quality and were documented during analysis. NOTE The 8 minutiae threshold is not scientifically derived but was implemented as a best practice recommendation to ensure that lower quantity comparisons be given additional consideration.

4.3.5.2 A Source Identification is an examiner's opinion that the observed friction ridge skin features are in sufficient correspondence such that the examiner 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.

4.3.5.3 A Source Identification is not based upon a statistically-derived measurement or actual comparison of all friction ridge skin impression features in the world's population.

4.3.5.4 Documentation shall include the observed agreement used to support a Source Identification conclusion.

4.4 Source conclusions that are NOT supported by criteria outlined in 4.3.1-4.3.5 should be brought to the attention of the Discipline Lead and may be subject to additional quality assurance measures such as blind verification, verification by multiple examiners, or consensus review.

Verification #27

1.0 Background/References

1.1 VERIFICATION is the independent examination by one or more examiners to ascertain if a decision, conclusion, or opinion is reproduced or is in conflict with the conclusion or opinion of the original examiner.

1.2 ANSI/ASB Best Practice Recommendation 144. Best Practice Recommendations for Verification Component in Friction Ridge Examination, First Edition 2022.

1.3 ANSI/ASB Best Practice Recommendation 144. Best Practice Recommendations for Verification Component in Friction Ridge Examination, First Edition 2022; Addendum 1, 2024.

2.0 Scope

2.1 To provide guidance on the different types of verification and their applicability to casework.

3.0 Equipment

Magnifiers/Pointers

Computers/Digital imaging system

4.0 Procedure

4.1 A qualified examiner shall verify all latent print suitability decisions (NDP, IRD, and suitable for comparison) and comparison conclusions.

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

4.3 Verification is a quality assurance measure and as such different types of verification may be employed.

4.3.1 OPEN VERIFICATION (non-blind) is a type of verification in which the verifying examiner knows the identity of the other examiner(s) and has access to their decisions, conclusions or observed data used to support their conclusion.

4.3.1.1 Open verification is utilized in routine casework unless the criteria for blind verification has been met.

4.3.1.2 Examiners conducting open verification independently apply the ACE methodology (annotating images and making additional notes in ILIMS) prior to reviewing any data (annotated images) originally used to support the reported conclusions and opinions.

4.3.2 BLIND VERIFICATION is an independent examination of one or more friction ridge impressions at any stage of the ACE process by another competent examiner who has no knowledge of any other examiner's decisions, conclusions, or observed data used to support the original examiner's conclusion.

4.3.2.1 Blind verification shall be used when a single source identification or inconclusive with similarities results from an MBIS Hit.

4.3.2.1.1 The discipline lead shall be notified in all instances of an inconclusive with similarities resulting from an MBIS hit prior to the report being released.

4.3.2.2 Blind verification shall be used when there is a high complexity comparison resulting in a single source identification, single inconclusive with similarities, or single exclusion to a named victim, suspect, or subject.

4.3.2.3 Blind verification may also be used in high profile cases or other scenarios at the discretion of the examiner.

4.3.2.3 BLIND VERIFICATION PROCEDURE

4.3.2.3.1 The assigned case examiner or designee will open the images needed for analysis in Photoshop and "save as" to a file of their choosing (e.g. latent 1.1). Latent numbers may be retained in the images as they are commonly repeated from case to case (1.1, 1.2, etc.). If any case numbers are present in the images these shall be removed/cropped out.

4.3.2.3.2 The examiner or designee will then upload the "saved as" image(s) to a new case in Adams Web. The new case number will be in the format of the letter B followed by the four-digit year, followed by the next available Blind Verification case number (e.g. B2024-0001, B2024-0002, etc.) Blind verification will be selected as the crime field. The examiner will then notify the blind verifier that that there is a case for them to work.

4.3.2.3.3 The blind verifier should complete minutia markup as outlined in Latent Print Examination Methodology ACE #26 and shall document their analysis conclusions on a copy of the "Latent Analysis" panel.

4.3.2.3.4 If the blind verifier deems the impression suitable for comparison, copies of the exemplar(s) with all identifying information (name, SID#, etc.) removed/cropped out of the image will be added to the blind case folder in Adams Web. Exemplars should be renamed Subject A, Subject B Palm 1, Subject B Palm 2 etc.

4.3.2.3.5 Comparison by the Blind Verifier shall proceed as outlined in Latent Print Examination Methodology ACE #26. The blind verifier shall document their comparison conclusions on a copy of the "Latent Analysis" panel. All value/source conclusions shall be documented prior to any interaction between the original examiner or the verifier. This blind verifier's examination documentation will be uploaded to ILIMS as part of the notes packet and their analysis and/or comparison charts will be moved to appropriate case folder in Adams Web (i.e. ILIMS case #) using the "change folder" function at the conclusion of the blind verification.

4.4 Verification is not conducted on non-hit latent prints candidates generated by the MBIS system.

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

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

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

Consultation #28

1.0 Background/References

1.1 Consultation consists of varying levels of discussion between examiners. Not all discussions rise to the level of a consultation that requires documentation.

1.2 ANSI/ASB Standard 145. Standard for Consultation during Friction Ridge Examination. First Edition, 2023.

2.0 Scope

2.1 To provide guidance on documentation, quality, and consultant requirements.

3.0 Equipment

Magnifiers/Pointers

Computers/Digital imaging system

4.0 Procedure

4.1 A consultation shall occur only after an examiner has recorded their preliminary observations (notes and/or mark-up of observed data) in the case record.

4.2 Preliminary observations shall not be provided to the consultant until after the consultant has completed their observations.

4.3 A consultant who has viewed both known and unknown friction ridge impressions shall not be used as the verifier for that examination.

4.4 Consultations shall be documented when the interaction concerns one or more of the following:

4.4.1 Assessment of the utility of the friction ridge impression for comparison value;

4.4.2 Assessment of the utility of a friction ridge impression for an automated search;

4.4.3 Presence or absence of specific observed data during the analysis or comparison;

4.4.4 Simultaneity of impressions;

4.4.5 When there is high complexity (low quality, high ambiguity, high distortion, etc.) in an examination;

4.4.5.1 The consultant shall generate an additional set of notes, annotations, and/or images when there is high complexity.

4.4.6 Specific observed data used for comparison and/or searching efficiency such as target groups, anchor points or others; and

4.4.7 Comparison conclusion(s).

4.5 Documentation of in-depth interactions involving the following should be considered:

4.5.1 Assessment of orientation or anatomical position (region of interest);

4.5.2 Friction ridge distortion resulting from deposition pressure, substrate, and matrix;

4.5.3 Automated search parameter selection such as search orientation, pattern type, and demographic filtering;

4.5.4 Limitations in image quality such as contrast, focus, camera angle/position, noise, image artifacts; and

4.5.5 Latent print detection and development technique(s) utilized.

4.6 Documentation of the consultations shall be maintained per ISPFS Latent Print Quality Manual Section 9.0 “Documentation and Report Writing.”

MBIS #29

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. Idaho State Police is a member of the Western Identification Network (WIN). WIN is a consortium of 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 examiners 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 https://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 phalange 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 areas of the palm, as well as proximal and middle phalanges of the fingers.

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 finger 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 may be adjusted when orientation is not known.

4.1.8 An examiner 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: Examiners may search the databases of WIN and NGI. Examiners 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 examiner 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 Examiners 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, examiners 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 examiner. 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. Examiners 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 examiner may opt for a higher LOC/NOCI from ID, WIN, or NGI.

4.4.4.2 If the examiner 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 examiners. If this occurs, the appropriate ILIMS fields will be filled out indicating the identity of the examiner that performed the searches. The assigned case examiner 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 examiner 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 or palm, it is only necessary to search one latent impression unless substantially different areas 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. LCMG must be performed prior to transactions being accepted.

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 examiners 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 that were likely made by the same subject 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).

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 Examiners may, at their discretion, include other case documentation such as screenshots of the edited latent or demographic information pertaining to a HIT.

4.10.4 The MBIS matrix in ILIMS will be completed for each latent searched.

4.10.5 When results from a search are rejected (e.g., examiner realizes they searched the wrong database or anatomical area) the examiner 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 Examiners are responsible for periodically reviewing their TLI lists for possible candidates.

4.12.2 If the TLI candidate list produces a possible candidate, the examiner will research the statute of limitations for the case. If the statute of limitations has not expired, the examiner 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 examiner 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 WIN 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.

5.1.2 The NGI system operates on a first in/first out system once the FBI determined maximum number of "tagged" latent prints is reached.

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 examiners 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 Examiners 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 examiner 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.