Ada County Sheriff's Office

Forensic Lab

Latent Fingerprint Analytical Method

Version 1.0

1.0 **Scope**

1.1 This analytical method specifies procedures to follow during laboratory development, collection, and preservation of latent fingerprints.

1.2 This analytical method specifies procedures to follow during analysis, comparison, evaluation, and verification of fingerprints.

1.3 This analytical method is intended to be followed to ensure the highest level of quality and safety for latent fingerprint processing and comparison.

2.0 References

ACSO Policy Manual located at https://aces.ada.net.gov/sites/ADAPortal/departments/sheriff/policy/Documents/ACSO%20Policy%20Manual%20112414.pdf

Ada County Forensic Crime Lab Quality Assurance Manual

Ada County Forensic Crime Lab Health and Safety Manual

SWGFAST

SWGIT Sections 6, 8, and 11

3.0 Terms and Definitions

3.1 **ACE-V** - The acronym for a scientific method; Analysis, Comparison, Evaluation, and Verification (see individual terms).

3.2 **AFIS** - The acronym for Automated Fingerprint Identification System, a generic term for a fingerprint matching, storage, and retrieval system.

3.3 **Analysis** -The first step of the ACE-V method. The assessment of an impression to determine suitability for comparison.

3.4 **APIS** - The acronym for Automated Palmprint Identification System, a generic term for a palmprint (or complete friction ridge exemplar) matching, storage, and retrieval system.

3.5 **Arch – plain** - A pattern type in which the friction ridges enter on one side of the impression and flow, or tend to flow, out the other side with a rise or wave in the center.

3.6 **Arch** - **tented** - A pattern type that possesses either an angle, an upthrust, or two of the three basic characteristics of a loop.

3.7 **Artifact** -

3.7.1 Any distortion or alteration not in the original friction ridge impression, produced by an external agent or action.

3.7.2 Any information not present in the original object or image, inadvertently introduced by image capture, processing, compressions, transmission, display, or printing.

3.8 **Bias** - See cognitive bias, confirmation bias, and contextual bias.

3.9 **Bifurcation** The point at which one friction ridge divides into two friction ridges.

3.10 **Blind verification** - The independent examination of one or more friction ridge impressions at any stage of the ACE process by another competent examiner who is provided with no, or limited, contextual information, and has no expectation or knowledge of the determinations or conclusions of the original examiner.

3.11 **Bridge** - A connecting friction ridge between, and generally at right angles to, parallel running friction ridges.

3.12 **Characteristics** - Distinctive details of the friction ridges, including Level 1, 2, and 3 details (also known as features).

3.13 **Cognitive bias** - The effect of perceptual or mental processes on the reliability and validity of one's observations and conclusions.

3.14 **Comparison** - The second step of the ACE-V method. The observation of two or more impressions to determine the existence of discrepancies, dissimilarities, or similarities.

3.15 **Competency** - Possessing and demonstrating the requisite knowledge, skills, and abilities to successfully perform a specific task.

3.16 **Complete friction ridge exemplars** - A systematic recording of all friction ridge detail appearing on the palmar sides of the hands. This includes the extreme sides of the palms, joints, tips, and sides of the fingers (also known as major case prints).

3.17 **Complex examinations** - The encountering of uncommon circumstances during an examination (e.g., the existence of high distortion, low quality or quantity, the possibility of simultaneity, or conflicts among examiners).

3.18 **Consensus determination or conclusion** - Agreement reflecting the collective judgment of a group of examiners trained to competency when making determinations or conclusions with respect to one or more impressions.

3.19 **Conclusion Determination** - made during the evaluation stage of ACE-V, including individualization, inconclusive, exclusion.

3.20 **Confirmation bias** - The tendency to search for data or interpret information in a manner that supports one's preconceptions.

3.21 **Conflict** - A difference of determinations or conclusions that becomes apparent during, or at the end of, an examination.

3.22 **Connective ambiguity** – When friction ridges are not clearly traceable, which makes minutia unclear as to the exact location. Minutia location can be shifted within a couple of ridges due to the clarity.

3.23 **Consultation** - A significant interaction between examiners regarding one or more impressions in question.

3.24 **Contextual bias** - The effect of information or outside influences on the evaluation and interpretation of data.

3.25 **Core** –

3.25.1 The approximate center of a fingerprint pattern.

3.25.2 A specific formation within a fingerprint pattern, defined by classification systems such as Henry.

3.26 **Delta** - The point on a friction ridge at or nearest to the point of divergence of two type lines, and located at or directly in front of the point of divergence. Also known as a tri-radius.

3.27 **Deviation-**

3.27.1 A change in friction ridge path.

3.27.2 An alteration or departure from a documented policy or standard procedure.

3.28 **Discrepancy** - The presence of friction ridge detail in one impression that does not exist in the corresponding area of another impression (compare with dissimilarity).

3.29 **Dissimilarity** - A difference in appearance between two friction ridge impressions (compare with discrepancy).

3.30 **Dissociated ridges** –

3.30.1 Disrupted, rather than continuous, friction ridges.

3.30.2 An area of friction ridge units that did not form into friction ridges, generally due to a genetic abnormality.

3.31 **Distortion-**Variances in the reproduction of friction skin caused by factors such as pressure, movement, force, and contact surface.

3.32 **Dot** - An isolated friction ridge unit whose length approximates its width in size.

3.33 **Edgeoscopy** –

3.33.1 Study of the morphological characteristics of friction ridges.

3.33.2 Contour or shape of the edges of friction ridges.

3.34 **Elimination prints** - Exemplars of friction ridge skin detail of persons known to have had legitimate access to an object or location.

3.35 **Enclosure** - A single friction ridge that bifurcates and rejoins after a short course and continues as a single friction ridge.

3.36 **Ending ridge** - A single friction ridge that terminates within the friction ridge structure.

3.37 **Erroneous exclusion** - The incorrect determination that two areas of friction ridge impressions did not originate from the same source.

3.38 **Erroneous individualization** - The incorrect determination that two areas of friction ridge impressions originated from the same source.

3.39 **Error** - A conclusion reached by an examiner that contradicts the mating status of two impressions, and therefore is probably wrong (compare with non-consensus decision.

3.40 **Evaluation** - The third step of the ACE-V method wherein an examiner assesses the value of the details observed during the analysis and the comparison steps and reaches a conclusion.

3.41 **Exclusion** - The determination by an examiner that there is sufficient quality and quantity of detail in disagreement to conclude that two areas of friction ridge impressions did not originate from the same source.

3.42 **Exemplars** - The prints of an individual, associated with a known or claimed identity, and deliberately recorded electronically, by ink, or by another medium (also known as known prints).

3.43 **False-negative rate (FNR)** - The proportion of the comparisons between mated prints that result in an erroneous exclusion conclusion.

3.44 **False-positive rate (FPR)** - The proportion of the comparisons between non-mated prints that result in an erroneous individualization conclusion.

3.45 **Features** - Distinctive details of the friction ridges, including Level 1, 2, and 3 details (also known as characteristics).

3.46 **Fingerprint** - An impression of the friction ridges of all or any part of the finger.

3.47 **Focal points** –

3.47.1 In classification, the core(s) and the delta(s) of a fingerprint.

3.47.2 Another term for target group.

3.48 **Friction ridge** - A raised portion of the epidermis on the palmar or plantar skin, consisting of one or more connected ridge units.

3.49 **Friction ridge detail (morphology)** - An area comprised of the combination of ridge flow, ridge characteristics, and ridge structure.

3.50 **Friction ridge examiner** - A person who analyzes, compares, evaluates, and verifies friction ridge impressions.

3.51 **Friction ridge unit** - A single section of ridge containing one pore.

3.52 **Furrows** - Valleys or depressions between friction ridges.

3.53 **Galton details** - Term referring to friction ridge characteristics (also known as minutiae) attributed to the research of English fingerprint pioneer, Sir Francis Galton.

3.54 **Ground truth** - Definitive knowledge of the actual source of an impression.

3.55 **Henry Classification** - An alpha-numeric system of fingerprint classification named after Sir Edward Richard Henry used for filing, searching, and retrieving tenprint records.

3.56 **IAFIS** - The acronym for Integrated Automated Fingerprint Identification System, the FBI's national AFIS.

3.57 **Identification** – The determination by an examiner that there is sufficient quality and quantity of detail in agreement to conclude that two friction ridge impressions originated from the same source.

3.58 **Impression** - Friction ridge detail deposited on a surface.

3.59 **Incipient ridges** - Ridges that are not fully formed in development. (also known as nascent ridges).

3.60 **Inconclusive** - The determination by an examiner that there is neither sufficient agreement to individualize, nor sufficient disagreement to exclude.

3.61 **Joint (of the finger)** - The hinged area that separates segments of the finger.

3.62 **Known prints** (finger, palm, foot) The prints of an individual, associated with a known or claimed identity, and deliberately recorded electronically, by ink, or by another medium (also known as exemplars).

3.63 **Latent print** –

3.63.1 Transferred impression of friction ridge detail not readily visible.

3.63.2 Generic term used for unintentionally deposited friction ridge detail.

3.64 **Level 1 detail** - Friction ridge flow, pattern type, and general morphological information.

3.65 **Level 2 detail** - Individual friction ridge paths and associated events, including minutiae.

3.66 **Level 3 detail** - Friction ridge dimensional attributes, such as width, edge shapes, and pores.

3.67 **Lift** - An adhesive or other medium used to transfer a friction ridge impression from a substrate.

3.68 **Loop** - A pattern type in which one or more friction ridges enter upon one side, recurve, touch or pass an imaginary line between delta and core and flow out, or tend to flow out, on the same side the friction ridges entered. Types include left slant loops, in which the pattern flows to the left in the impression; right slant loops, in which the pattern flows to the right in the impression; radial loops, in which the pattern flows in the direction of the radius bone of the forearm (toward the thumb); and ulnar loops, in which the pattern flows in the direction of the ulna bone of the forearm (toward the little finger).

3.69 **Major case print** - A systematic recording of the friction ridge detail appearing on the palmar sides of the hands. This includes the extreme sides of the palms, joints, tips, and sides of the fingers (also known as complete friction ridge exemplars).

3.70 **Mark** - Term commonly used in the United Kingdom and some Commonwealth countries to designate a latent print.

3.71 **Mated impressions** - Impressions intentionally collected to originate from the same source, and used for the purpose of measuring error rates.

3.72 **Matrix** - The substance that is deposited or removed by the friction ridge skin when making an impression.

3.73 **Minutiae** - Events along a ridge path, including bifurcations, ending ridges, and dots (also known as Galton details).

3.74 **Missed exclusion** - The failure to make an exclusion when in fact the friction ridge impressions are non-mated (includes false positive, non-consensus inconclusive and non-consensus no value).

3.75 **Missed individualization** - The failure to make an individualization when in fact both friction ridge impressions are mated (includes false negative, non-consensus inconclusive and non-consensus no value).

3.76 **Negative predictive value (NPV)** - The proportion of exclusion determinations that are correct.

3.77 **NGI** - The acronym for Next Generation Identification, the updated version of IAFIS.

3.78 **Non-consensus determinations of no value** - Decisions of no value that conflict with the consensus.

3.79 **Non-consensus determination of suitability** - When an examiner's determination of suitability does not concur with consensus. Suitability determinations include non-consensus no value, and non-consensus value decisions.

3.80 **Non-consensus determination of value** - Decisions of value that conflict with the consensus.

3.81 **Non-consensus exclusion conclusion** - When an examiner reaches a decision of exclusion that conflicts with the consensus, exclusive of false negative errors.

3.82 **Non-consensus inconclusive** - When an examiner reaches a decision of inconclusive that conflicts with the consensus, exclusive of false positive and negative errors.

3.83 **Non-consensus individualization conclusion** - When an examiner reaches a decision of individualization that conflicts with the consensus, exclusive of false positive errors.

3.84 **Non-mated impressions** - Impressions intentionally collected to originate from different sources, and used for the purpose of measuring error rates.

3.85 **Original image** - An accurate replica (pixel for pixel) of the primary image.

3.86 **Palmprint** - An impression of the friction ridges of all or any part of the palmar surface of the hand.

3.87 **Pattern classification** - Sub-division of pattern type, defined by classification systems such as Henry or National Crime Information Center (NCIC) classifications.

3.88 **Pattern type** - Fundamental pattern of the ridge flow: arch, loop, whorl. Arches are subdivided into plain and tented arches; loops are subdivided into radial and ulnar loops; whorls are subdivided into plain whorls, double loops, pocket loops, and accidental whorls.

3.89 **Phalanx/Phalange** –

3.89.1 A bone of the finger or toe.

3.89.2 Sometimes used to refer to a segment of a finger.

3.90 **Poroscopy** - A study of the size, shape, and arrangement of pores.

3.91 **Positive predictive value (PPV)** - The proportion of individualization decisions that are correct.

3.92 **Primary image** - The first recording of an image onto media.

3.93 **Proficiency** - The ongoing demonstration of competency.

3.94 **Quality** - The clarity of information contained within a friction ridge impression.

3.95 **Quantity** - The amount of information contained within a friction ridge impression.

3.96 **Ridge flow** –

3.96.1 The direction of one or more friction ridges.

3.96.2 A component of Level 1 detail.

3.97 **Ridge path** –

3.97.1 The course of a single friction ridge.

3.97.2 A component of Level 2 detail.

3.98 **Ridge unit** See friction ridge unit.

3.99 **Segment (of the finger)** - The proximal, medial, or distal section of the finger.

3.100 **Short ridge** - A single friction ridge beginning, traveling a short distance, and then ending.

3.101 **Simultaneous impression** - Two or more friction ridge impressions from the same hand or foot deposited concurrently.

3.102 **Source** - An area of friction ridge skin from an individual from which an impression originated.

3.103 **Spur** - A bifurcation with one short friction ridge branching off a longer friction ridge.

3.104 **Stand-alone** - A segment of a simultaneous impression that has sufficient information to arrive at a conclusion of individualization independent of other impressions within the aggregate.

3.105 **Substrate** - The surface upon which a friction ridge impression is deposited.

3.106 **Sufficiency** The product of the quality and quantity of the objective data under observation (e.g., friction ridge, crease, and scar features).

3.107 **Sufficient** - The determination that there is sufficiency in a comparison to reach a conclusion at the evaluation stage.

3.108 **Suitable** - The determination that there is sufficiency in an impression to be of value for further analysis or comparison.

3.109 **Target group** - A distinctive group of ridge features (and their relationships) that can be recognized.

3.110 **Technical review** - Review of notes, documents, and other data that forms the basis for a scientific conclusion (see ASCLD-LAB 2008 Manual).

3.111 **Tenprint** –

3.111.1 A generic reference to examinations performed on intentionally recorded friction ridge impressions.

3.111.2 A controlled recording of an individual's available fingers using ink, electronic imaging, or other medium.

3.112 **Tolerance** - The amount of variation in appearance of friction ridge features to be allowed during a comparison, should a corresponding print be made available.

3.113 **Trifurcation** - The point at which one friction ridge divides into three friction ridges.

3.114 **Type lines** - The two innermost friction ridges associated with a delta that parallel, diverge, and surround or tend to surround the pattern area.

3.115 **Verification-** The independent application of the ACE process as utilized by a subsequent examiner to either support or refute the conclusions of the original examiner; this may be conducted as blind verification. Verification may be followed by some level of review as specified by agency policy.

3.116 **Whorl - accidental** – A pattern type consisting of the combination of two different types of patterns (excluding the plain arch) with two or more deltas, that possesses some of the requirements for two or more different types of patterns, or that conforms to none of the definitions of a pattern.

3.117 **Whorl - central pocket loop** - A pattern type that has two deltas and at least one friction ridge that makes, or tends to make, one complete circuit, which may be spiral, oval, circular, or any variant of a circle. An imaginary line drawn between the two deltas must not touch or cross any recurving friction ridges within the inner pattern area.

3.118 **Whorl - double loop** - A pattern type that consists of two separate loop formations with two separate and distinct sets of shoulders and two deltas.

3.119 **Whorl - plain** - A fingerprint pattern type that consists of one or more friction ridges that make, or tends to make, a complete circuit, with two deltas, between which, when an imaginary line is drawn, at least one recurving friction ridge within the inner pattern area is cut or touched.

4.0 Management Requirements

4.1 to 4.12 **See Ada County Sheriff's Office Forensic Crime Lab Quality Assurance Manual**

4.13 **Technical Records**: Latent fingerprint documentation is extremely important to provide a detailed record of tests performed, conclusions, and allow for independent review by other experts.

4.13.1 **General**

4.13.1.1 Latent fingerprint documentation includes a combination of notetaking, photographing, and diagramming.

4.13.1.2 If multiple forensic scientists conduct casework, each analyst shall document the tests they performed, reagent lot numbers used, controls, specific areas or items tested, and the equipment they utilized. Each analyst shall produce a separate report for the work that they performed.

4.13.1.3 Photographs of examination quality shall be maintained as a digital record. Digital records shall be contained within the Laboratory Management System (LIMS).

4.13.2 **Technical records**

4.13.2.1 All original documentation shall be retained. Original documentation can be retained through scanning in a digital file and maintaining this file in the LIMS.

4.13.2.2 Latent processing documentation shall include:

the test performed
the outcome of any control performed
the conclusion of each test.
the location of a developed impression that is suitable for analysis
the identifier of a developed impression that is suitable for analysis

4.13.2.3 Latent print examination documentation shall include if known:

the latent identifier
the date of analysis
the method of preservation
the development medium
the substrate
the deposition pressure

the anatomical aspect
the pattern type
the clarity of detail
the quantity of detail present
the date of comparison
the comparison conclusion

4.13.2.4 Verifications of latent examinations shall be documented in the technical records to allow determination of the print verified, the verifier, and the date verified.

4.13.3 **Photography and Imaging**

4.13.3.1 General Photography

4.13.3.1.1 Impressions developed in the lab can be captured by photographing or scanning.

4.13.3.1.2 Examination quality impressions shall be captured in a loss less digital format at a resolution of at least 1000 ppi.

4.13.3.1.3 All impressions of examination quality that are not developed in the lab shall be saved in a loss less format as soon as practicable.

4.13.3.1.4 A scale shall appear in the photograph or scan and an attempt to fill the frame should be made.

4.13.3.2 Digital image enhancement

4.13.3.2.1 Image processing shall only be conducted on a working copy of the original image.

4.13.3.2.2 A history of the image processing shall be maintained.

4.13.3.2.3 Images, both processed and original, shall be stored in a secure format. This is usually done through the LIMS.

5 Technical Requirements

5.1 General:

Latent print processing and comparison are a combination of both laboratory procedures and analytical examination. Processing may require a sequencing of techniques to develop impressions that are then analyzed for value to compare.

5.2 Personnel

5.2.1 A forensic scientist may perform latent print processing and a separate forensic scientist may perform analytical examination.

5.3 Accommodation and Environmental Conditions

5.3.1 Safety

Refer to the Health and Safety Manual.

5.4 Testing Methods

5.4.1 Friction Ridge Detection and Preservation

5.4.1.1 General

Latent fingerprints can be developed and preserved through a variety of methods depending on the matrix of the fingerprint residue and the substrate. The following lists provide guidelines on the sequencing of methods based on the matrix and substrate: If a step is in bold it shall be used unless a reason is documented in the notes.

General Evidence:

Porous

1. **Visual**
2. **Alternate light source (ALS)**
3. Iodine Fuming
4. **DFO (may choose just one of DFO, Ninhydrin, or Indanedione)**
5. **Ninhydrin**
6. **1, 2 Indanedione**
7. Physical Developer or Silver Nitrate

Non-Porous

1. **Visual**
2. **ALS**
3. **Cyanoacrylate Fuming (CAE)**
4. **Dye Stain**

5. **Powder**

Blood Evidence:

Porous

1. **Visual**
2. **ALS**
3. **Ninhydrin, LCV, or Amido Black**

Non Porous

1. **Visual**
2. **ALS**
3. **CAE**
4. **Amido Black or LCV**
5. **Dye Stain**
6. **Powder**

Glossy Paper/Cardboard/Photo paper

Glossy side

1. **Visual**
2. **ALS**
3. Iodine (non glossy side)
4. **CAE**
5. **Powder**
6. **DFO, Ninhydrin, or Indandione (non glossy side)**
7. Physical Developer (non glossy side)

Leather

1. **Visual**
1. **ALS**
2. **Cyanoacrylate Fuming**
3. **Powder**

Painted Surfaces

Latex Paint: process as for porous evidence

Semi-gloss/enamel paint: process as for non-porous evidence

Semi Porous (e.g. Rubber/Synthetic gloves):

1. **Visual**
2. **ALS**
3. Iodine
4. **Cyanoacrylate fuming**
5. **Ninhydrin**
6. **Dye Stain**
7. **Powder**
8. Physical Developer

Tape

Non-adhesive side of non-porous tape:

1. **Visual:**

2. **ALS**
3. **Cyanoacrylate Fuming**
4. **Dye Stain/ALS**
5. **Powder**

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

1. **Visual:**
2. **ALS**
3. **Gentian Violet, Small Particle Reagent, Sticky Side Powder, or Wetwop**
4. Cyanoacrylate Fuming
5. Dye Stain/ALS

Varnished Wood

1. **Visual**
2. **ALS**
3. **Cyanoacrylate fuming**
4. **Dye Stain (water based reagent if appropriate)/ALS**
5. **Powder**

Wet Surfaces Porous

1. **Visual**
2. **ALS**
3. **Dry to room temperature**
4. **Physical developer or Oil Red O**

Non-Porous

1. **Visual**
2. **ALS**
3. **Small Particle Reagent (SPR)**

Exemplars from Human Skin

1. Decomposing and/or Macerated Friction Ridge Skin (water soaked)
2. Ink and/or powder lift method (if possible)
3. 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

5.4.1.1.1 **Acid Yellow**

Acid yellow is used on bloody impressions. It reacts with the proteins present in blood, staining blood a yellow color which fluoresces when visualized with an alternate light source in the 400-490 nm range. The background reagent can be rinsed away which may increase the contrast of the impression on the substrate.

Reagents

Prewash

5-sulfosaliycyclic acid	11 grams
Distilled water	500 mL

Dissolve the 5-sulfosalicyclic acid in distilled water.

Working Solution

Acid yellow	0.5 gram
Acetic acid	25 mL
Ethanol	125 mL
Distilled water	350 mL

Mix acid yellow in acetic acid. Add ethanol then distilled water. Mix with magnetic stirrer for at least 30 minutes.

Rinse Solution

Ethanol	125 mL
Acetic acid	25 mL
Distilled water	350 mL

Add ethanol to acetic acid then add distilled water.

Method

- Place a piece of paper towel on the area of the impression.
- Lightly pour the prewash onto the surface through the towel and allow to sit for 1 minute. Ensure the solution is in complete contact with the impression.
- Place another piece of paper towel on the impression and, in similar fashion, apply the working solution onto the surface. To ensure complete staining, the solution should

remain in contact with the impression for at least 1-2 minutes to obtain maximum development.

- Apply the Rinse solution to remove Reagent stain from background areas. An optional water rinse may follow.
- Allow the impression to air dry.
- Visualize impression with an alternate light source in the 450 nm range.

Interpretation

Positive: A yellow staining will appear within 1-2 minutes.

Negative: No change or less intense yellow staining results.

Cautions/Safety

- Use in a very well-ventilated area. Ethanol and acetic acid in the quantity and concentration of this formulation are inhalation hazards.
- Wear eye protection and masks when spraying any reagent.
- Acid yellow works only with bloody or other protein-based impressions. Consider a presumptive test for blood prior to application, when possible.
- This chemical enhancement does not include a chemical fixative. Fresh blood impressions may be damaged or destroyed if not fixed prior to treating.

Controls

Positive: A known blood stain on a substrate.

Negative: An unstained area of the substrate.

Controls are checked at the time of use.

5.4.1.1.2 **Alternate Light Source (ALS)**

See section 5.5.1

5.4.1.1.3 **Amido Black (methanol based)**

Amido black is used on bloody impressions and is a dark blue-black colored reagent. It reacts with the proteins present in blood, staining blood a blue-black color. The background reagent can be rinsed away which may increase the contrast of the impression on the substrate.

Amido black is especially useful for bloody or protein-based impressions deposited on lighter colored, non-porous surfaces such as glass, plastic, vinyl, etc. but may work on concrete or some papers. Results may be best on faint impressions.

Reagents

Developer Solution

Naphthol blue black	2 g
Glacial acetic acid	100 mL
Methanol	900 mL

Dissolve the naphtol blue black in the above ingredients.

Rinse Solution

Glacial acetic acid	100 mL
Methanol	900 mL

Final Rinse – Rinse with distilled water.

The Reagent and Rinse solutions are stored in bottles at room temperature or refrigeration.

The Reagent and Rinse solutions do not expire and may be used until the entire volume is consumed.

Method

- Stain and rinse a small area of substrate that is not part of the impression, to check for background staining. Do not use this reagent if significant background staining occurs.

- Apply the Reagent to the impression via spraying, pouring, or submersion. To ensure complete staining, the solution should remain in contact with the impression for at least 1-2 minutes to obtain maximum development.
- Apply the Rinse solution to remove Reagent stain from background areas. An optional water rinse may follow.
- Allow the impression to air dry.
- The impression may be re-stained to make darker, if desired.

Interpretation

Positive: A blue-black staining will appear within 1-2 minutes.

Negative: No change or less intense blue-black staining results.

Cautions/Safety

- Use in a very well-ventilated area. Methanol and glacial acetic acid in the quantity and concentration of this formulation are inhalation hazards.
- Wear eye protection and masks when spraying any reagent.
- Amido black works only with bloody or other protein-based impressions. Consider a presumptive test for blood prior to application, when possible.
- Porous substrates may absorb the blue-black reagent causing background staining that cannot be rinsed away. This might result in little contrast with the treated bloody impression.
- This chemical enhancement does not include a chemical fixative. Fresh blood impressions may be damaged or destroyed if not fixed prior to treating.

Controls

Positive: A known blood stain on a substrate.

Negative: An unstained area of the substrate.

Controls are checked at the time of use.

5.4.1.1.4 **Amido Black (water based)**

Amido black is used on bloody impressions and is a dark blue-black colored reagent. It reacts with the proteins present in blood, staining blood a blue-black color. The background reagent is rinsed away which may increase the contrast of the impression on the substrate.

Amido black is especially useful for bloody or protein-based impressions deposited on lighter colored, non-porous surfaces such as glass, plastic, vinyl, etc. but may work on concrete or some papers. Results may be best on faint impressions.

The water based formula may be considered for use when the substrate is sensitive to methanol or in any situation where a less vaporous solution is desired.

Reagent

Deionized water	500 mL
5-sulfosalicylic acid dihydrate, ≥99.0	20g
Naphthol blue black	3g
Sodium carbonate	3g
Formic acid	50 mL
Glacial acetic acid	50 mL
Kodak Photo Flo solution	37.5 mL

Combine all reagent components in a ≥1L capacity bottle. Dilute mixture to 1L with deionized water. Although the mixture will be ready to use immediately, allow the mixture to stand for several days prior to use for best results.

The solution is stored in a bottle at room temperature or refrigeration. This reagent does not expire and may be used until the entire volume is consumed.

Rinse – water

Method

- Stain and rinse a small area of substrate that is not part of the impression, to check for background staining. Do not use this reagent if significant background staining occurs.

- Apply the Reagent to the impression via spraying, pouring, or submersion. To ensure complete staining, the solution should remain in contact with the impression for at least 3-5 minutes to obtain maximum development.
- Rinse with water to remove Reagent stain from background areas.
- Allow the impression to air dry.
- The impression may be re-stained to make darker, if desired.

Interpretation

Positive: A blue-black staining will appear within 3-5 minutes.

Negative: No change or less intense blue-black staining results

Cautions/Safety

- Amido black works only with bloody or other protein-based impressions. Consider a presumptive test for blood prior to application, when possible.
- Porous substrates may absorb the blue-black reagent causing background staining that cannot be rinsed away. This might result in little contrast with the treated bloody impression.
- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A known blood stain on a substrate.

Negative: An unstained area of the substrate.

Controls are checked at the time of use.

5.4.1.1.5 **Ardrox**

Ardrox is a dye-stain used to aid in the visualization of cyanoacrylate fuming developed latent fingerprints on non-porous substrates.

Ardrox should be used after cyanoacrylate fuming and prior to powdering. Surfaces that require 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.

Reagent

Ardrox P133D	2 mL
Acetone	10 mL
Methnaol	25 mL
Isopropanol	10 mL
Acetonitrile	9 mL
Petroleum Ether	945 mL

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

Method

- Apply the Reagent to the impression via spraying or dipping.
- Allow to air dry.
- View the item through an orange filter using an alternate light source set in the 450-525 nm range. Visualization of developed ridge detail is dependent upon the condition of the item and background interface.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a non-porous substrate.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.6 **Basic Yellow**

Basic yellow is a dye-stain used to aid in the visualization of cyanoacrylate fuming developed latent fingerprints on non-porous substrates.

Basic yellow should be used after cyanoacrylate fuming and prior to powdering. Surfaces that require 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.

Reagent

Basic yellow	2 grams
Methanol	1000 mL

Dissolve basic yellow in methanol. Combine all reagent components in a ≥1L capacity bottle.
The solution is stored in a bottle at room temperature. This reagent does not expire and may be used as long as passes control test prior to use.

Method

- Apply the Reagent to the impression via spraying, pouring, or submersion.
- Allow to air dry.
- View the item through an orange filter using an alternate light source set in the 450nm range. Visualization of developed ridge detail is dependent upon the condition of the item and background interface.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a non-porous substrate.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.7 **Cyanoacrylate ester (CAE, superglue)**

Cyanoacrylate (CA, i.e., superglue) fuming has been shown to be an effective means of latent print development on non-porous and some semi-porous surfaces (e.g., plastic, carbon paper, metals, glass, tapes, wood, rubber and rock). Cyanoacrylate ester fumes are monomers that polymerize on latent print residue and create a more stable impression.

Method

Liquid CA with heat source

Liquid glue is placed in a disposable container (aluminum foil works well), which is then placed over a heat source in the vehicle, processing area, or fuming chamber resulting in the production of fumes. Heating may be accomplished with a coffee cup warmer or a light fixture assembly (60 watt bulb). DO NOT USE A HOT PLATE OR DIRECT FLAME. Once the test print shows sufficient development, ventilate area to evacuate all fumes.

Cautions/Safety

- Cyanoacrylate ester fumes are strongly irritating to the eyes and respiratory system. Fuming should only be conducted in a well-ventilated area and non-porous gloves should be worn to prevent skin contact.
- It should be noted, that the cyanoacrylate esters can cause a glaze-like coating to cover the entire evidentiary surface resulting in considerable loss of contrast when over-fuming occurs.
- Do not store cyanoacrylate in areas that can become hot (e.g., the trunk of a car); the cartridges may start to fume and the pads/packs or liquid may dry out.
- Cyanoacrylate should be allowed to come to room temperature prior to use.

Controls

Positive: A deposited print on a non-porous substrate. The test card is placed within the confines of the area to be fumed (for example, a vehicle interior). The test card must be visible so that latent print development may be monitored to avoid over-fuming.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.8 **DFO (1,8 Diazafluoren-9-one)**

DFO is used to develop latent prints on porous surfaces such as paper and cardboard. DFO reacts with the amino acids in perspiration. DFO will detect latent prints that ninhydrin will not and the reverse is also true. To does not replace ninhydrin but is used in addition to it. It should be used prior to ninhydrin or physical developer. When this reaction is complete, the developed latent prints will fluoresce with the use of an alternate light source.

Reagent

Stock Solution

DFO	0.5 grams
Methanol	100 mL
Ethyl Acetate	100 mL
Glacial acetic acid	20 mL

Combine the ingredients and place on a magnetic stirring device for approximately 20 minutes or until the DFO is dissolved.

Working Solution

Dilute the stock solution by adding 780 mL of petroleum ether. The working solution should be a clear gold color.

Method

- Apply the Reagent to the impression via spraying or dipping.
- Allow to air dry then place in oven at 100º C for 20 minutes.
- If an oven is not available, a dry iron may be used.
- View the item through an orange filter using an alternate light source set in the 485-510 nm range. Visualization of developed ridge detail is dependent upon the condition of the item and background interface.
- Apply DFO a 2nd or 3rd time in developed prints are faint.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.

- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.9 **Gentian Violet**

Gentian violet is a stain used to dye epithelial cells and fatty components of latent print residues an intense purple color. Gentian violet is used to visualize latent prints on many types of adhesive surfaces. Gentian violet may also be used on small non-porous surfaces contaminated with grease and oils. Water-soluble, adhesive type tapes should not be processed by this method.

Reagent

Gentian Violet	1 gram
Distilled water	1000 mL

Combine ingredients and stir for approximately 25 minutes.

Method

- Apply the Reagent by dipping in solution for approximately 1-2 minutes.
- Rinse with cold water.
- The process may be repeated until optimal development of latents is achieved.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- 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.
- Use in a ventilated area when possible.
- It should not be used in large amounts.
- Wear eye protection and mask when using reagent.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.10 **1,2 Indanedione**

Indanedione is used to develop latent prints on porous surfaces. Indanedione reacts with the amino acids present in perspiration. It flouresces when examined using an alternate light source with wavelengths between 450 and 570 nm using an orange or red filter.

Indanedione should be used after processing with ninhydrin and prior to processing with physical developer.

Reagent

Stock solution

1,2-Indanedioine	1 gram
Methylene chloride	30 mL
Ethyl acetate	60 mL
Glacial acetic acid	10 mL
Petroleum Ether	900 mL

Dissolve Indanedione in methylene chloride. Add ethyl acetate and stir. Add glacial acetic acid followed by petroleum ether.

ZnCl Solution

Zinc chloride	0.4 grams
Ethanol	10 mL
Ethyl acetate	1 mL
Petroleum ether	190 mL

Dissolve ZnCl in ethanol. Add ethyl acetate followed by petroleum ether.

Working Solution
Mix 900mL of stock solution with 72mL of ZnCl solution.

Method

- Apply indanedioine via dipping or painting.
- Allow to dry and then reapply a second time.
- Once dry, apply dry heat. The item should be heated for twenty minutes at 100° C.
- A hair dryer or dry iron will work as an alternative to an oven. Place a thick towel or other protective material on the counter, followed by the evidence, and then a few paper towels. Apply dry heat to the surface for several minutes. A dry iron can be placed directly on top of the paper towels and used the same as when ironing clothes.
- lndanedione developed latent prints may or may not be visible to the naked eye and should be viewed under an alternate lightsource. Indanedione fluoresces when illuminated with monochromatic light in the 450 nm to 570 nm range using an orange or red filter.
- Prints deemed to be of value should be marked and photographed. Prints developed with lndanedione tend to fade over time if exposed to bright light. Therefore, the prints should be photographed as soon as possible after development.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear appropriate eye protection when using.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.11 **Iodine**

Iodine fuming is one of the oldest latent print methods currently employed in the examination processes for the visualization of latent prints. Iodine fumes adhere to grease of oils on porous surfaces and appear as a yellow stain. Iodine reacts to recently deposited prints because specified residue tends to become less receptive to this process with time. Iodine is not suitable for metals or dark surfaces.

Reagent

Iodine crystals

Method

- Place iodine crystals in an airtight fuming chamber.
- Apply heat to the crystals and observe development.
- Remove the object from the chamber when sufficient development has occurred.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area. Iodine is toxic in any form. Always avoid inhaling iodine fumes.
- Iodine fumes may irritate the skin and damage the respiratory tract.
- Developed prints can vanish and must be persevered immediately.
- Prints that have faded or are completely gone, can sometimes be redeveloped by reprocessing. Reprocessing cannot be done if other methods have been used or if too long of a time span has elapsed.

Controls

Positive: A deposited print on a similar substrate being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.12 **Leucocrystal violet (LCV)**

LCV is for use on bloody impressions. LCV is the reduced form of crystal violet and is a clear, colorless reagent. When LCV and hydrogen peroxide come into contact with the hemoglobin in blood, an oxidation reaction catalyzed by the peroxidase-like activity of the hemoglobin will occur. The result is a dark violet dye which has an affinity for proteinaceous substrates. The resulting violet color may increase the contrast of an impression on a substrate.

LCV is especially useful for bloody impressions deposited on lighter colored, porous and non-porous surfaces such as vinyl flooring, carpeting, fabric, etc. Results may be best on faint impressions.

Reagent

5-sulfosalicylic acid dihydrate, ≥99.0	10g
Hydrogen peroxide (%3 Concentration)	500 mL
Sodium acetate anhydrous	3.7g
Leucocrsytal violet	1g

Combine the 5-sulfosalicylic acid, sodium acetate, and leucocrystal violet with the 500mL 3% hydrogen peroxide in a dark bottle. A 473mL volume of 3% hydrogen peroxide (the volume commonly sold at pharmacies) is an acceptable substitute for the 500mL 3% hydrogen peroxide volume.

The solution should be stored in a dark bottle and refrigerated. It expires 30 days after mixing.

Optional rinse – water

Method

- Apply LCV to the impression via spraying, pouring, or submersion and allow it to remain in contact with the impression for at least 30 seconds.
- Rinse non-porous substrates with water to remove excess LCV when necessary.
- Allow the impression to air dry.

- Enhanced impressions that aren't rinsed should be photographed as soon as possible. This is to document the impression prior to any background color development that may occur.

  An indirect sampling method may be used prior to LCV application, if desired. Define the area to be sampled and tested. Moisten filter paper with deionized water and press it onto the defined area. Mark the filter paper before removing it so the orientation is documented. Remove the filter paper and spray with LCV then proceed with the method described above. This technique may be less sensitive than directly spraying, pouring, or submersion because it relies on the efficacy of the stain to transfer to the filter paper.

  Interpretation

  Positive: A violet color within 30 seconds to 3 minutes.
  Negative: No color change. Unreacted areas will also turn violet over time if not rinsed. See Cautions.

  Because impressions that are not visible may be enhanced or detected with the application of LCV, a violet color reaction may be interpreted and reported as a positive result with a presumptive test for blood.

  Cautions/Safety

- LCV crystals that have turned yellow should not be used.
- The LCV reagent is light sensitive and may discolor over time due to exposure. LCV reagent should be colorless or near colorless. Should it appear blue or violet, consider making up fresh reagent. Store in dark bottles.
- Treated areas will change from colorless to violet over time, unless rinsed. The timing varies with environmental conditions and may occur within hours to several days after application.
- Use in a ventilated area when possible.
- Wear appropriate eye protection when using.

  Controls

  Positive: A known blood stain on a substrate.

  Negative: An unstained area of the substrate.

  Controls are checked at the time of use.

5.4.1.1.13 **Ninhydrin**

Ninhydrin is used to develop latent prints on porous surfaces. Ninhydrin reacts with the amino acids and proteins present in perspiration to produce a characteristic purple color. The combination of heat and humidity accelerates the reaction of the amino acids and ninhydrin.

Excessive background discoloration may occur in substrates composed of a high plant or animal protein content. It is not effective on items that have been wet. Ninhydrin processing should be performed after DFO processing and prior to 1,2-indanedione and physical developer.

Reagent

Ninhydrin	5 grams
Methanol	30 mL
Isopropanol	40 mL
Petroluem Ether	930 mL

Dissolve ninhydrin crystals in methanol. Then add the isopropanol followed by the petroleum ether. The solution should be stored in a dark bottle.

Method

- Apply ninhydrin via spraying, dipping or painting.
- Allow to dry.
- Accelerate development by using a humidified environment (humidified chamber or steam iron).
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed. Developed print may fade with time and may not be retrievable with reprocessing.
- It is recommended that the item be re-examined after approximately 24 hours to ensure no additional latent prints have developed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear appropriate eye protection when using.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.14 **Oil Red O**

Oil Red O is a reagent used on porous surfaces that have been wet. It can also be used on porous surfaces that have not been exposed to water. Oil Red O reacts with the lipid portion of latent print residue, which is insoluble in water and will not be dissolved away during immersion.

Reagent

Stain Solution

Oil Red O	1.54 grams
Methanol	770 mL
Sodium hydroxide	9.2 grams
Distilled water	230 mL

Dissolve Oil Red O in methanol. Dissolve sodium hydroxide in distilled water. Add the sodium hydroxide solution to Oil Red O solution.

Buffer Solution

Sodium phosphate monobasic monohydrate	25.3 grams
Distilled water	250 mL
Sodium phosphate dibasic heptahydrate	84.7 grams
Distilled water	250 mL

Dissolve sodium phosphate monobasic monohydrate in distilled water. Dissolve sodium phosphate dibasic heptahydrate in distilled water. Shake both solutions until dissolved, then combine. Add distilled water to increase the combined buffer solution to 1L.

Method

- Apply the Reagent to the impression via submerison.
- Allow the impression to air dry.
- It is also acceptable to use deionized water in lieu of the buffer solution.
- Evaluate latent prints for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.

- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a porous substrate.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.15 **PDMAC**

PDMAC is used to develop latent prints on thermal paper. It is the preferred method for processing thermal paper and items sensitive to heat. It may be used on any porous item needing latent development. It has been found to be effective on thermal papers, currency and semi-glossy paper items. PDMAC can be used on colorful backgrounds as there is high flouresence when viewed with an alternate light source in the 475-515 nm range.

Reagent

Commerically available PDMAC packet (Pioneer Forensics)

Method

- Compress substrates between the two treated (dried) pages in the PDMAC packet for at least 30 minutes.
- Longer applications up to 24 hours have been used for items that have been exposed to dry air or long time intervals.
- PDMAC developed prints will fluoresce when illuminated with monochromatic light in the 475-515 nm range using an orange filter.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed. Developed print may fade with time and may not be retrievable with reprocessing.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear appropriate eye protection when using.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.16 **Physical Developer**

Physical developer is a silver-based aqueous reagent that reacts with lipids, fats, oils, and waxes present in the fingerprint residue to form a silver-gray deposit. Physical Developer is used to develop latent prints on porous surfaces and on certain nonporous surfaces. PD has also been found to be highly effective in developing latent prints on paper currency. Physical Developer is normally applied after DFO and/or ninhydrin.

This process cannot be used in conjunction with the silver nitrate method. If the PD process is used, it will negate the silver nitrate process.

Reagent

Physical Developer Kit (parts A & B)

Add 5 ml of solution A (20% silver nitrate solution) to 90 ml of solution B (reductant solution) in a beaker. Stir the working solution for approximately one minute with a clean glass/plastic stirring
rod. Do not mix the working solution until you are ready to use it as it does not have a very long
shelf life once mixed. Any contamination may ruin the physical developer working solution. To avoid contamination use clean glassware rinsed with tap water, then with distilled water prior to beginning.

Method

- Apply reagent via dipping. Allow to sit for 5-15 minutes until latent print development is complete of adequate time has elapsed.
- Rinse with water until the water runs clear
- Allow to dry completely.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed. Developed print may fade with time and may not be retrievable with reprocessing.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear appropriate eye protection when using.
- Cleanliness is important in the physical developer method. 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 distilled water prior to use. When washing glassware, use detergent, not abrasive cleaners.
- 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.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.17 **Powder**

Powders come in a variety of colors and combinations that can be used based on the substrate. This includes fluorescent and magnetic powders. The powder and tool for applying powder should be chosen based on the substrate and/or matrix of fingerprint residue.

Equipment

Fingerprint powder

Fingerprint brush

Fingerprint tape

Fingerprint cards

Method

- Use brush to lightly apply fingerprint powder
- Photograph or tape lift any prints that appear to be comparison quality

5.4.1.1.18 **RAM** (Rhodamine, Ardrox, and MBD (7-(P-Methoxybenzlamino-4Notrobenz-2-Oxa-1, 3-Diazile)

RAM is a dye-stain used to aid in the visualization of cyanoacrylate fuming developed latent fingerprints on non-porous substrates. RAM should be used after cyanoacrylate fuming and prior to powdering. Surfaces that require 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.

Reagent

Stock Solution 1 (Rhodamine 6G)

Rhodamine 6G	1 gram
Methanol	1000 mL

Combine and stir until all of the rhodamine 6G has dissolved.

Stock Solution 2 (MBD)

MBD	1 gram
Acetone	1000 mL

Combine and stir until all of the MBD has dissolved.

Working Solution

Stock Solution 1	3 mL
Ardrox P133D	2 mL
Stock Solution 2	7 mL
Methanol	20 mL
Isopropanol	10 mL
Acetonitrile	8 mL
Petroleum Ether	950 mL

Combine Ingredients in order listed. Do not place on magnetic stirrer.

Method

- Apply the Reagent to the impression via spraying, pouring, or submersion.
- Allow the impression to air dry.

- View the item through an orange filter using an alternate light source set in the 450-525 range. Visualization of developed ridge detail is dependent upon the condition of the item and background interface.
- Evaluate latent prints for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a non-porous substrate.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.19 **Rhodamine 6G**

Rhodamine-6G is a dye-stain used to aid in the visualization of cyanoacrylate fuming developed latent fingerprints on non-porous substrates.

Rhodamine-6G should be used after cyanoacrylate fuming and prior to powdering. Surfaces that require 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.

Reagent

Rhodamine 6G	0.1 gram (about the size of a BB)
Methanol	1000 mL

Measure out approximately Rhodamine 6G and add to the storage bottle. Add methanol then seal bottle and agitate gently to mix.

Method

- Apply the Reagent to the impression via spraying, pouring, or submersion.
- Allow the impression to air dry.
- View the item through an orange filter using an alternate light source set in the 450-525 range. Visualization of developed ridge detail is dependent upon the condition of the item and background interface.
- Evaluate latent prints for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a non-porous substrate.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.20 **Silver Nitrate**

Silver nitrate is used to develop latent prints on porous objects. It reacts with the salt content in perspiration. Silver nitrate can be prepared with two different carriers-water or alcohol. An alcohol-based solution can be prepared for processing objects (waxed paper, cardboard with a wax finish, Styrofoam) that may repel a water-based mixture

Stains caused by silver nitrate can't be removed with defacing the object. Latent prints developed by silver nitrate on certain types of glossy paper will often disappear within hours. These prints should be photographed as soon as possible.

Reagent

Water base

Silver nitrate	30 grams
Distilled water	1000 mL

Combine and stir for approximately 10 minutes or until all the crystals are dissolved.

Alcohol base

Silver nitrate	30 grams
Distilled water	100 mL
Ethanol	1000 mL

Combine the silver nitrate and distilled water and stir until all the crystals are dissolved. Add ethanol. The solution should be stored in a dark bottle.

Method

- Apply the Reagent to the impression via dipping or painting.
- Allow the impression to air dry.
- Subject to high-intensity light or sunlight to develop prints.
- Evaluate latent prints for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.21 **Small Particle Reagent**

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

Reagent

Commercially available SPR

Or

Working Solution

Molybdenum Disulfide (MoS_2)	30 grams
Photo Flo	3-4 drops
Distilled water	1000 mL

Dissolve 30 grams of MoS_2 in 1000 mL of distilled water and place on magnetic stirrer. Add Photo Flo to the solution.

Method

- Apply the Reagent by dipping or spraying.
- Allow to set for 2-3 minutes.
- Gently rinse with water.
- Allow to air dry.
- Repeat procedure if necessary.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- There does not appear to be any health hazards associated with small particle reagent.
- Gloves and safety glasses should be worn.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding intentionally deposited print.

Controls are checked at the time of use.

5.4.1.1.22 **Sticky Side Powder**

Sticky side powder is used to develop latent fingerprints on the adhesive side of tape and labels. Sticky side powder detects the fat/oily cells left when handling adhesive surfaces. Due to the color of the resulting latent print, sticky side powder may be more appropriate for certain types of tapes than for others.

Reagent

Sticky side powder or titanium dioxide
Photo Flo
Distilled water

Mix a solution of water and Photo Flo in a beaker in a 1:1 ratio. Mix approximately equal amounts of sticky-side powder in the solution to make a liquid that has the consistency of paint.

Method

- Apply the Reagent by painting solution on item or by dipping in an aqueous solution containing the powder.
- Allow to set anywhere from 20 seconds to 5 minutes.
- Rinse with cold stream of water.
- Allow to air dry.
- Repeat procedure if necessary to improve contrast and/or make the latent print(s) darker.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- There does not appear to be any health hazards associated with sticky side powder.
- Gloves and safety glasses should be worn.

Controls

Positive: A deposited print on the sticky side of a piece of tape.

Negative: Area surrounding intentionally deposited print on the sticky side of tape.

Controls are checked at the time of use.

5.4.1.1.23 **Sudan Black**

Sudan black B is a dye that stains fatty components to produce a blue-black image. 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. It is used to develop friction ridge detail on nonporous waxy substrates and surfaces contaminated with grease, dried beverages,and foodstuff. Sudan black is not suitable for use on porous surfaces or dark colored items.

Reagent

Sudan Black	15 grams
Ethanol or methanol	1000 mL
Distilled water	500 mL

Combine the sudan black and ethanol and stir. Then add the distilled water and stir to obtain the working solution. Some of the sudan black will not be dissolved.

Method

- Apply the Reagent to the impression via dipping for approximately 2 minutes.
- Rinse with water and allow to air dry.
- Reprocessing can enhance faintly developed latent prints.
- Evaluate latent prints for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- Use in a ventilated area when possible.
- Wear eye protection and masks when spraying any reagent.

Controls

Positive: A deposited print on a substrate similar to the evidence being examined.

Negative: Area surrounding the intentionally deposited latent print.

Controls are checked at the time of use.

5.4.1.1.24 **Tape Glo**

TapeGlo is a fluorescent dye used to develop latent prints on the sticky side of tape. Developed prints can be visualized with an alternate light source at 450 nm.

Reagent

Commercially available TapeGlo.

No mixing is required when using TapeGlo.

Method

- Apply the Reagent by dipping.
- Allow to set for 30-60 seconds.
- Rinse with water and allow to air dry.
- Visualize with alternate light source at 450 nm.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- There does not appear to be any health hazards associated with TapeGlo.
- Gloves and safety glasses should be worn.

Controls

Positive: A deposited print on the sticky side of a piece of tape.

Negative: Area surrounding intentionally deposited print on the sticky side of tape.

Controls are checked at the time of use.

5.4.1.1.25 **Wetwop**

Wetwop is a pre-mixed liquid that is applied to the adhesive side of tape with a camelhair brush. It can be used to develop prints on any adhesive surface, such as masking, duct, clear, cellophane, brown packaging and nylon reinforced strapping tapes.

Reagent
Commercially available Wet Wop.

No mixing is required when using Wetwop.

Method

- Apply the Reagent by painting solution on item.
- Allow to set for 30-60 seconds.
- Rinse with cold stream of water.
- Allow to air dry.
- Repeat procedure if necessary.
- Evaluate item for comparable ridge detail.
- Prints deemed to be of value are marked and photographed.

Cautions/Safety

- There does not appear to be any health hazards associated with wetwop.
- Gloves and safety glasses should be worn.

Controls

Positive: A deposited print on the sticky side of a piece of tape.

Negative: Area surrounding intentionally deposited print on the sticky side of tape.

Controls are checked at the time of use.

5.4.2 Friction Ridge Examination – ACE-V

5.4.2.1 **General**

Friction ridge examination follows application and documentation of Analysis, Comparison, Evaluation, and Verification (ACE-V).

5.4.2.2 **Analysis**

Analysis is the methodical examination of a friction ridge impression to determine suitability for comparison. Analysis occurs independently of and prior to the Comparison, Evaluation and Verification steps of ACE-V. The goal of friction ridge analysis is to determine suitability for comparison. Factors considered to determine suitability include the following:

A. Clarity of detail

- High – impression that exhibits an overall clear flow of ridge path to include level 3 detail.
- Medium/High – impression that exhibits an overall of clear flow of ridge path, but may not exhibit level 3 detail
- Medium – impression that exhibits fairly clear flow of ridge path with little to no distortion or connective ambiguity
- Medium/Low – impression that exhibits fairly clear flow of ridge path with distortion or other factors present
- Low – impression that exhibits ridge path that is not clear that may also have high distortion

B. Quantity of detail:

Level 1 detail

- Overall ridge flow and pattern configuration
- Can be used for pattern interpretation
- Detail may include information enabling orientation, core, delta location and can be used to determine anatomical source (e.g., finger, palm, foot, toe)
- General morphology (e.g., presence of incipient ridges, overall size)
- Cannot be used alone to individualize
- Can be used to exclude under certain circumstances

Level 2 detail

- Examination of individual ridge path
- Presence of ridge path deviation (e.g., ridge ending, bifurcation and dot)
- Absence of ridge path deviation (e.g., continuous ridge)
- Ridge path morphology (e.g., size and shape)
- Used in conjunction with Level 1 detail to individualize
- Used in conjunction with Level 1 detail to exclude

Level 3 detail

- Structure of individual ridges
- Shape of the ridges
- Relative pore position
- Other specific friction skin morphology (e.g., secondary creases, ridge breaks, etc.)
- Used in conjunction with Level 1 and Level 2 detail to individualize
- Used in conjunction with Level 1 and Level 2 detail to exclude

Determination of Quantity by number of features (level 2 and/or level 3)

Fingerprint or toe print

- High > 14
- Medium 13 – 8
- Low < 8

Palmprint or area of Convergence

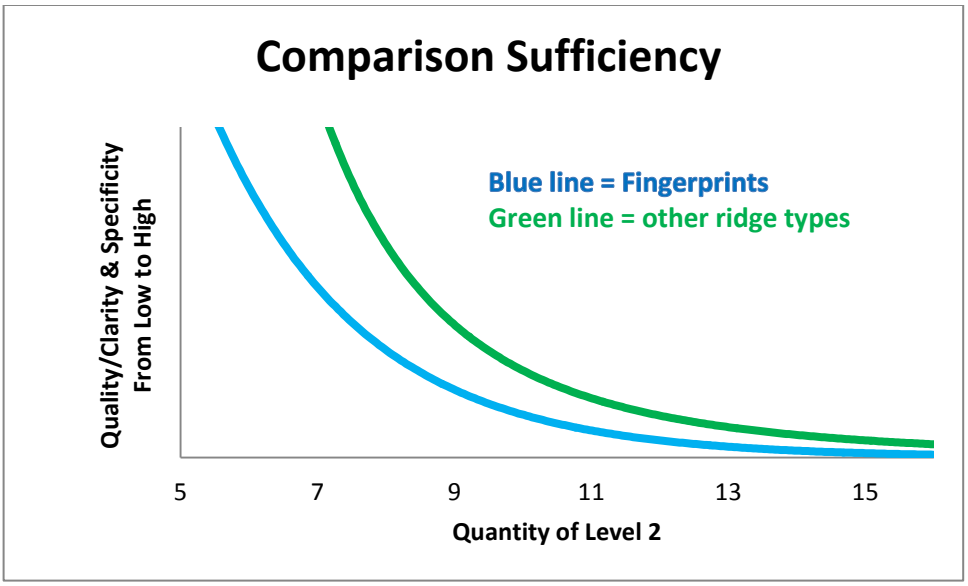
- High > 19
- Medium 9-18
- Low < 9

C. Anatomical source (e.g., finger, palm, joint, sole, toe) and orientation
D. Substrate if known
E. Development medium if known
F. Preservation method
G. Matrix
H. Deposition Pressure
I. Distortion or movement present in the impression

5.4.2.2.1 **Determination of sufficiency**

Sufficiency is based on the combination of clarity and quantity of detail present in the impression. If the combination of clarity and quantity of detail

falls below a certain level the impression is unsuitable for comparison and is concluded as no value. If this is not the case, the impression shall be compared with available exemplars. See the following chart:



5.4.2.3 **Comparison**

A comparison is performed after analysis of an impression. This is done by following ridges in sequence to determine if two impressions came from the same source. Documentation of the two impressions shall be as follows:

- The unique impression identifier(s)
- Known exemplar information:
    1) Unique known identifier (evidence #, name, date of birth, TCN, ….)
    2) Anatomical sources
    3) Medium (ink, livescan)
    4) Origin (evidence, state database)
    5) Quality of exemplars

- High – All areas properly collected and clarity of exemplars is clear in all fingers or areas of palms
- Medium – Most areas collected and clarity of exemplars is clear in the majority of all fingers or palms
- Low – May be missing areas and/or clarity of exemplars is lacking in fingers or areas of palms.

5.4.2.4 **Evaluation**

5.4.2.4.1 **Identification**

Identification is the result of the comparison of two friction ridge impressions containing sufficient quality (clarity) and quantity of friction ridge detail in agreement. Identification occurs when a Latent Print Examiner determines that the friction ridge impressions originated from the same source.

Basic principles:

- *"No scientific basis exists for requiring that a pre-determined minimum number of friction ridge features must be present in two impressions in order to establish a positive identification."* –Ne'urim Declaration, June 29, 1995. Thus, an impression that contains sufficient quality and quantity of friction ridge detail can be compared and either individualized to or excluded from a source.
- Identification is supported by friction ridge biological uniqueness and permanence, probability modeling, and empirical data gained through more than one hundred years of observation and experience.

Conditions that shall be satisfied are:

- Determined by a competent Latent Print Examiner, and
- Applied to a common friction ridge area in both impressions, and
- Sufficient quantity and clarity of the friction ridge details in common, and
- Absent any unexplainable friction ridge detail discrepancies and
- Reproducible conclusion that is verified by a competent Latent Print Examiner

5.4.2.4.2 **Exclusion**

Exclusion is the result of the comparison of two friction ridge impressions containing sufficient quality (clarity) and quantity of friction ridge detail which are not in agreement.

Exclusion occurs when a Latent Print Examiner determines that two friction ridge impressions originated from different sources.

Standard for Exclusion:

The standard for exclusion is disagreement of friction ridge details.

Basic principles:

- Based on sufficient quality and quantity of Level 1, 2 and/or 3 friction ridge details in disagreement.
- Exclusion is supported by the theories of biological uniqueness and permanence, probability modeling, and empirical data gained through more than one hundred years of operational experience.

Conditions that shall be satisfied:

- Determined by a Latent Print Examiner, and
- Applied to all available/appropriate comparable anatomical area standards, and
- Meet the following standards established to minimize errors in performing exclusions:
    - The print must have a strong focal point approximated to remove ambiguity as to the correct areas to compare, and
        - Focal points are defined here as:
            - A delta
            - A core location
            - A major crease, defined as those that have a dermal attachment (i.e. the finger joint creases, distal transverse crease, proximal transverse crease, radial longitudinal crease, thumb bracelet or wrist bracelet).
            - Major palm formations, defined here as a vestige or a loop/whorl formation in the thenar, hypothenar or interdigital region.

- Orientation must be conclusively determined.
- The print must have two target groups with visible separation.
  - A target group is at least three minutia adjacent to each other.

- Level 1 detail (i.e. ridge flow including pattern type and core to delta ridge count) is sufficient for exclusions in the absence of heavy distortion.
- Reproducible conclusion that is verified by a competency Latent Print Examiner or by two separate Latent Print Examiner Trainees

These criteria are required to support the conclusion of Exclusion; however, the presence of all of these criteria does not mean Exclusion is possible in all circumstances.

The possibility of a potential horizontal reversal should be considered in those circumstances where these are known to occur (e.g. paper to paper, tape to tape and tape to paper).

5.4.2.4.3 **Inconclusive**

An inconclusive result shall be accompanied by a reason the result was inconclusive (e.g., quality of exemplars, unable to exclude, area of exemplars needed).

5.4.2.4.4 **No value**

A determination of no value is given after analysis. This determination means that the impression is not suitable for comparison.

5.4.2.5 **Verification**

5.4.2.5.1 **Standard verification** – if an impression is analyzed and concluded to be medium or above clarity and medium or above quantity of level 2 detail, a verification is performed by a competent latent examiner checking the analysis, comparison, and evaluation of the reporting latent examiner's results. The verifying examiner does not need to reanalyze the impression.

5.4.2.5.2 **Secondary analysis verification –** if an impression is analyzed and concluded to be below medium clarity or below medium quantity of level 2 detail, a verification is performed by a competent latent examiner by reanalyzing the impression to come to the same conclusion as the reporting latent examiner. The verifying latent examiner does not have to keep

documentation of reanalysis if the results are the same. The verifying examiner shall chart the print and keep this as documentation in the case record.

5.4.2.5.3 **Blind verification –** at the discretion of the reporting latent examiner, the lab manager, or the technical leader a blind verification can be performed. A blind verification is the creation of a new duplicate case number with the impression. The duplicated case number is then given to a competent latent examiner to perform a repeat of the ACE process with no prior information.

5.4.3 Automated Database Searched

It is the discretion of the latent examiner as to whether a print is suitable to search through an automated database. If a print is deemed to be of value for comparison it is acceptable to be searched through a database, but other factors may inhibit the search.

5.5 Equipment

5.5.1 Alternate Light Source (ALS)

The ALS can be used to detect a wide variety of forensic evidence using the principles of fluorescence, reflection, and absorption.

5.5.1.1 **Method**

Various items of forensic interest (i.e. trace evidence, biological stains, etc…) can be enhanced with the use of ALS with appropriate filters. Refer to the operations manual of the ALS model prior to use.

5.5.1.1.1 High intensity white light with blue filter and no goggles may be used to visualize blood.

5.5.1.1.2 Violet (400-430nm) and blue (430-470nm) colors with yellow/orange goggles are used to visualize biological substances.

5.5.1.1.3 The blue, blue-green (460-510nm) and green (500-550nm) colors with orange and red goggles are used to visualize fiber and general trace evidence or fluorescent latent print powders and dyes.

5.5.1.2 **Safety**

Precautions should be used when operating any ALS. Proper eye protection shall be worn by anyone operating an intense light source. Permanent eye damage can occur from direct illumination to the eye or reflected or refractive light hitting the eye. Exposing the skin to the beam of light can cause burns and other skin damage. All persons in proximity of usage shall adhere to the above safety guidelines.

5.6 Traceability

There are no measurements taken in latent print processing or comparison that require tracebility.

5.7 Sampling

Sampling is not used for latent print processing or comparison.

5.8 Handling of test items

See Ada County Sheriff's Office Forensic Crime Lab Quality Assurance Manual

5.9 Assuring the quality

See Ada County Sheriff's Office Forensic Crime Lab Quality Assurance Manual

5.10 Reporting

See Ada County Sheriff's Office Forensic Crime Lab Quality Assurance Manual