Latent Print Development Technical Procedures Manual

Escondido Police Department
Forensic Services Unit

TABLE OF CONTENTS

Contents

1. INTRODUCTION: OVERVIEW, SCOPE, & PURPOSE

The services offered in latent print development include, but are not limited to, the development, collection, documentation, and preservation of latent print evidence. Expert testimony in court is provided in reference to development casework.

The methods outlined in this manual are guidelines for the development and examination of latent prints in this Forensic Services Unit. They are not comprehensive instructions for all types of examinations; situations may arise that are not covered in this manual. Unit personnel shall always use their best judgment in the development and preservation of latent print evidence.

BACK TO TABLE OF CONTENTS

2. GENERAL COMMENTS

Latent prints are treated physically or chemically to allow the print to be visible. There are many methods for developing latent prints and some of these methods are discussed below.

Acid Fuchsin (Hungarian Red)	LumiCyano
Acid Yellow	Mikrosil
Accutrans	MRM 10
Amido Black	Molybdenum Disulfide
Ardrox	5-MTN
Basic Red 28	Muriatic Acid (Hydrochloric Acid)
Basic Yellow	Nile Red
Blood Fixative	Ninhydrin
Blue Star	Oil Red O
Coomassie Brilliant Blue	Physical Developer
Gentian Violet (Crystal Violet)	Powder/Lifting
CyanoBlue	RAM
Cyanoacrylate (Superglue) Fuming	RAY
DFO (1,8-Diazafluoren-9-One)	Rhodamine 6G
Dye Staining	RTX Developer
Fluorescent Powders	Safranin O
fpNatural 1	Silver Nitrate
fpNatural 2	Small Particle Reagent
Gun Blueing (Perma Blue)	Sticky-Side Powders
Hydrochloric Acid (Muriatic Acid)	Sudan Black
Iodine	Thermanin
Indanedione (1,2-Indanedione)	Thenoyl Europium Chelate (TEC)
Leuco Crystal Violet	Wetwop
Liqui-Drox	Zinc Chloride

The formulas for mixing these processing solutions can be found in this (Latent Print Development Technical Procedures) Manual. If a hard copy of this manual is located, the Specialists shall verify that the hard copy is the most current revision. Specialist should use the most updated Manual and formulas.

Development and testing of new chemical techniques is encouraged. Specialists must first get Supervisor approval to test a new method or chemical. The testing and development will not be tried on evidence without a validation study or performance check.

The reliability of all chemical processing solutions shall be tested at the time of initial preparation and prior to application for casework. If a chemical processing solution does not have a positive reaction / pass the quality control, the Specialists preparing the solution shall notify the Technical

Manager. If the chemical solution is remade and still does not pass the quality control, the vendor that provided the chemical may be contacted. An evaluation of the vendor / chemical will be made if after reordering the chemical, the solution still does not pass the quality control.

Each time a new reagent with an extended use of life (batch use) is prepared, the reagent is labeled with the identity of the reagent, the date of preparation and expiration, and the initials of the individual who prepared and tested the reagent. The individual who prepares and tests extended use of life reagents completes the Reagent Log. In the case where reagents are prepared for single use situations, the results are recorded in the examiner's case notes or on the Quality Control form. Any excess reagent is disposed of according to the SDS.

All evidence shall be visually examined prior to any processing. Documentation of any unusual conditions and/or stains should be made. Possible bloodstain(s) should be documented by photography and collected. A sample outside of an area of ridge detail should be documented and collected prior to further processing. If the sample is large enough, presumptive testing is recommended. Photographs of the results of the presumptive test should be taken.

Each person performing latent print development is expected to select the sequence of physical and/or chemical development processes that is most likely to be effective for the surface/conditions being examined.

All processing techniques should be considered in major cases.

RETURN TO TABLE OF CONTENTS

3. DNA COLLECTION

Presumptive Blood

FSU personnel may need to perform a presumptive blood test on an evidence item. This test is to determine if there is a possibility the stain in question is blood. Personnel shall use a prepared presumptive blood reagent.

If the presumptive blood testing results are positive, the following technique shall be used for the collection of the stain(s):

1. Photograph the stain(s)
2. With gloved hands, moisten a sterile swab with water.
3. Swab the stained area(s).
4. Obtain as much of the stain as possible while trying to avoid any possible friction ridge detail.
5. Package the swab, inside of an envelope. A photograph of where the stain was collected may also be included within the Stain / Swab Collection Kit.

Contact DNA

There are a lot of variables with an item to dictate the area to swab for contact DNA. Specialists shall use their experience to determine the area to swab. If possible, swab an area prior to print processing that would not affect latent prints. An example would be the mouth area of a soda can or bottle.

If the item cannot lend itself to swabbing without destroying latent prints, latent prints shall be performed on the item first.

RETURN TO TABLE OF CONTENTS

4. REAGENT/SAMPLE PREPARATION AND PROCEDURES (QUALITY CONTROL)

To meet the desired level of quality assurance within the Forensic Services Unit, the reliability of all chemical processing methods is tested prior to application for casework. Testing includes both reagent preparation verifications and positive process controls. Reagent verifications are recorded in the "Batch Reagent Log," and process control results are recorded in each specialist's case notes.

The reagents are stored at room temperature in the Wet Print Room (241C).

Positive controls are performed prior to evidence processing as detailed in the Reagent/ Quality Assurance Sample Preparation and Procedures below. However, specialists using the Cyanoacrylate Fuming process will perform the positive control at the same time as the evidence processing. See appropriate methods for further details.

The following quality control methods are used to ensure that proper techniques are followed, instruments are operable, and that the quality of the reagents being used is adequate for the conditions encountered.

Note: To test the effectiveness of a reagent, a test print is used. The test print method is a competent method of testing a reagent and may be the procedure required when a specific technique has not been developed.

4.1. AMINO ACIDS/PROTEINS

Purpose:

To test reagents and methods that enhance impressions composed of amino acid and protein residues. Reagents including but not limited to: Ninhydrin, DFO, IND or other amino/protein reactive reagents

Use either A or B below for test print.

A. Finger Impressions from Individuals.

Equipment Needed to Perform Procedures:

1. Finger impressions containing amino acids or proteins obtained from individuals.
2. Porous item similar to evidence item.

Preparation of test impressions:

1. Apply perspiration, saliva, or other secretions to finger by rubbing finger across portions of nose, ears, face, neck, or hands.
2. Place the treated finger on the porous item.
3. To test the porous item, see "Steps for Using Test Impressions" below.
4. If results are negative (no prints developed or no color change), repeat the test impression process using a different subject or the source listed in Section B below.

B. Finger Impressions from Amino Acid Control Pad

Equipment Needed to Perform Procedure:

1. Forensic brand amino acid control pad.
2. Suitable substrate surface/item – similar to anticipated evidence sample.

Preparation of Test:

1. Press finger on control pad.
2. Place treated finger on substrate surface/item.
3. To test the item, see "Steps for Using Test Impressions" below.
4. If results are negative (no prints developed), repeat the test impression process or the source listed in Section A above.

Steps for Using Test Impressions:

1. Apply the chemical processing reagent to the impressions, from either process A or B above.
2. A positive result is indicated by the visualization of developed prints or color change.
3. Record the test results in the technician's case notes.
4. If results are negative (no prints developed), repeat the test. If the re-test is negative, the control pad is not acceptable for use on casework and is disposed of. A new control pad shall be used. If the test from the new control pad is negative, the reagent is not acceptable for use on casework. The reagent is disposed of according to laboratory safety policy, and a new reagent is prepared.

Safety Concerns:

Follow the safety procedures for handling the samples, chemicals, and reagents that are being used.

Storage and Location of Chemicals and Solutions:

The processing reagents are stored in the Latent Print Development Chemical Processing Room.

RETURN TO TABLE OF CONTENTS

4.2. BLOODY COMPONENTS (BLOOD PROTEINS/HEMOGLOBIN)

Purpose:

To validate the reagents and methods used to process blood-contaminated impressions. Reagents including but not limited to: Acid Yellow, Amido Black, Coomassie Blue, Leuco-Crystal Violet, and other blood-reactive reagents.

Equipment Needed to Perform Procedure:

1. Human or Mammalian blood
2. Suitable substrate item – similar to anticipated evidence sample.

Preparation of Test:

1. Place blood on gloved finger
2. Place treated finger on substrate surface/item.
3. To test the item, see "Steps for Using Test Impressions" below.

Steps for Using Test Impressions:

1. Apply the reagent to the surface/item with the treated finger.
2. A positive result is indicated by an appropriate color change on the item.
3. Evaluate and record the test results in technician's case notes.
4. If there is no color change in the stained areas, the reagent/method being evaluated is not acceptable for use on casework. The reagent is disposed of according to laboratory safety policy and a new reagent is prepared.

Safety Concerns:

Follow the safety requirements for the handling of blood and for the reagents that are being tested.

Storage and Location of Chemicals and Solutions:

Human or Mammalian blood is stored in a sealed container and refrigerated in the Forensic Biology Section or the Latent Print Development analytical area.

Shelf Life:

Human or Mammalian Blood—no expiration date.

Other Comments:

Prior to the reagent testing above, a presumptive blood test must be used.

RETURN TO TABLE OF CONTENTS

4.3. PRESUMPTIVE BLOOD TESTING - HEMASTIX TEST /KASTLE-MEYER (PHENOLPHTHALEIN)

Personnel may need to perform a presumptive blood test in the latent print development area. This test is to determine if there is a possibility that the stain in question is blood and to enhance the stain for possible latent prints.

Hemastix Presumptive Test for Blood

Materials and Supplies:

1. "Hemastix" is a product of Ames Division, Miles Laboratories. Each plastic reagent strip contains a reagent pad for each test. The active ingredients for blood are 3,3',5,5' – tetramethylbenzidine (TMB) and diisopropylbenzene dihydroperoxide.
2. Distilled Water
3. Clean Cotton Swab

Procedure:

1. Gently rub a swab, which has been slightly moistened with distilled water, to the area to be tested then touch the moistened swab to the reagent pad.
2. Positive and negative controls shall be tested to verify the reliability and purity of the reagents.

Positive control: Known blood on moistened swab touched to reagent pad.
Negative control: Distilled water added to the reagent pad.

Interpretation:

The appearance of a greenish color or green spots on the reagent pad within 60 seconds indicates the presence of heme, a component of blood.

Catalytic blood tests are very sensitive, but not specific. The positive color test alone should not be interpreted as a positive proof of the presence of blood. Potential sources of false positives are chemical oxidants and vegetable peroxidases. If a chemical oxidant is suspected, retest the sample with Phenolphthalein.

Kastle-Meyer (Phenolphthalein) Presumptive Test for Blood

Materials and Supplies:

1. Kastle-Meyer reagent working solution
2. 3% hydrogen peroxide

3. Distilled water
4. Clean cotton swabs

Procedures:

1. Moisten a cotton swab with distilled water
2. Rub a small portion of the suspected bloodstain
3. Add one drop of the Kastle-Meyer working solution to the swab
4. Add one drop of the hydrogen peroxide to the swab
5. Positive and negative controls shall be tested to verify the reactivity of the solution.

Positive control: Known blood on a moistened swab
Negative control: Distilled water added to a swab

Interpretation:

The rapid appearance of a bright pink color after the addition of hydrogen peroxide indicates the presence of heme, a component of blood. A negative result can be interpreted as the absence of detectable amounts of heme.

Catalytic blood tests are very sensitive, but not specific. The positive color test alone should not be interpreted as a positive proof of the presence of blood. Potential sources of false positives are chemical oxidants and vegetable peroxidases. These however, are usually visibly distinguished from blood. Color development which occurs before the addition of the hydrogen peroxide may be due to the presence of a chemical oxidant. This should not be considered a positive result.

Disposal

Due to the presence of a metal, this solution must be disposed of as hazardous waste.

RETURN TO TABLE OF CONTENTS

4.4. LIPIDS, FATS, OILS, GREASE

Purpose:

To test reagents and methods that enhance the lipids, fats, oils, and grease of sebaceous impressions. Reagents including but not limited to: Gentian (Crystal) Violet, Iodine, Physical Developer, Small Particle Reagent, Sticky Side Powder, Sudan Black, Wetwop, Perma Blue, RTX, HCL and other sebaceous material reactive reagents.

Use either A or B below for test print.

A. Finger Impressions from Individuals.

Equipment Needed to Perform Procedures:

1. Finger impressions containing components of sebaceous materials.
2. Suitable substrate surface/item—similar to anticipated evidence sample.

Preparation of Test:

1. Rub finger across portions of nose, ears, face, neck, or hands.
2. Place fingerprint impression containing sebaceous residues on the item(s).

Steps for Using Test:

1. Apply the reagent solution to the fingerprint impression on the item.
2. A positive result is indicated by the visualization of fingerprint impression on the item.
3. Evaluate and record the test results in the technician's case notes on the Quality Control form.
4. If results are negative (no prints developed), repeat the test by rubbing finger across portions of nose, ears, face, neck, or hands of a different subject. If the re-test is negative, the reagent is not acceptable for use on casework. The reagent is disposed of according to laboratory safety policy and a new reagent is prepared.

B. Finger Impressions from Sebaceous Oil Control Pad

Equipment Needed to Perform Procedure:

1. Forensic brand sebaceous oil control pad.
2. Suitable substrate surface/item – similar to anticipated evidence sample.

Preparation of Test:

1. Press finger on control pad.
2. Place treated finger on substrate surface/item.
3. To test the item, see "Steps for Using Test Impressions" below.
4. If results are negative (no prints developed), repeat the test impression process or the source listed in Section A above.

Steps for Using Test Impressions:

1. Apply the reagent to the impressions, from either process A or B above.
2. A positive result is indicated by the visualization of developed images.
3. Record the test results in the technician's case notes.
4. If results are negative (no prints developed), repeat the test. If the re-test is negative, the control pad is not acceptable for use on casework and is disposed of. A new control pad shall be used. If the test from the new control pad is negative, the reagent is not acceptable for use on casework. The reagent is disposed of according to laboratory safety policy, and a new reagent is prepared.

Safety Concerns:

Follow the safety procedures for handling the samples, chemicals, and regents that are being used.

Storage and Location of Chemicals and Solutions:

The reagents are stored in the Latent Print Development Chemical Processing Room.

RETURN TO TABLE OF CONTENTS

4.5. WATER, CHLORIDES AND SULFATES

Purpose:

To test reagents and methods that enhance impressions consisting of water with both inorganic and organic contaminants. Reagents including but not limited to: Cyanoacrylate Ester Fuming, Fluorescent Powders, Silver Nitrate, and other liquid and/or dissolved salts reactive reagents.

Use either A or B below for test print.

A. Finger Impressions from Individuals.

Equipment Needed to Perform Procedures:

1. Finger impressions containing components of sebaceous materials.
2. Suitable substrate surface/item—similar to anticipated evidence sample.

Preparation of Test:

1. Rub finger across portions of nose, ears, face, neck, or hands.
2. Place fingerprint impression containing sebaceous residues on the item(s).

Steps for Using Test:

1. Apply the reagent solution to the fingerprint impression on the item.
2. A positive result is indicated by the visualization of fingerprint impression on the item.
3. Evaluate and record the test results in the technician's case notes on the Quality Control form.
4. If results are negative (no prints developed), repeat the test by rubbing finger across portions of nose, ears, face, neck, or hands of a different subject. If the re-test is negative, the reagent is not acceptable for use on casework. The reagent is disposed of according to laboratory safety policy and a new reagent is prepared.

B. Finger Impressions from Sebaceous Oil Control Pad

Equipment Needed to Perform Procedure:

1. Forensic brand sebaceous oil control pad.
2. Suitable substrate surface/item – similar to anticipated evidence sample.

Preparation of Test:

1. Press finger on control pad.
2. Place treated finger on substrate surface/item.
3. To test the item, see "Steps for Using Test Impressions" below.
4. If results are negative (no prints developed), repeat the test impression
5. process or the source listed in Section A above.

Steps for Using Test Impressions:

1. Apply the reagent to the impressions, from either process A or B above.
2. A positive result is indicated by the visualization of developed images.
3. Record the test results in the technician's case notes.
4. If results are negative (no prints developed), repeat the test. If the re-test is negative, the control pad is not acceptable for use on casework and is disposed of. A new control pad shall be used. If the test from the new control pad is negative, the reagent is not acceptable for use on casework.
5. The reagent is disposed of according to laboratory safety policy, and a new reagent is prepared.

Safety Concerns:

Follow the safety procedures for handling the samples, chemicals, and regents that are being used.

Storage and Location of Chemicals and Solutions:

The reagents are stored in the Latent Print Development Chemical Processing Room.

RETURN TO TABLE OF CONTENTS

4.6. CYANOACRYLATE ESTER RESIDUES (DYE STAINS)

Purpose:

To validate the reagents, equipment operability, and methods used to dye-stain cyanoacrylate ester developed impressions. To satisfy this requirement, test squares containing previously superglue impressions are prepared and processed according to the method being evaluated. Reagents including but not limited to**:** Rhodamine 6G, Ardox, Basic Yellow, and other Cyanoacrylate Ester reactive reagents.

Equipment Required:

1. Pieces of plastic.
2. Superglue.
3. Superglue chamber.

Preparation of Test Squares:

1. Rub finger across portions of nose, ears, face, neck, or hands.
2. Place at least one finger impression on each plastic square.
3. Place pieces of plastic in superglue chamber, and process with cyanoacrylate fumes until prints are visible.
4. Remove from superglue chamber and evaluate the results.
5. Store these positive control cards/squares in a labeled package in the Chemical Processing Room.

Steps for Evaluating Prepared Test Squares:

1. Select the dye stain or method to be evaluated.
2. Apply the selected dye stain to the test square prints.
3. Observe test square with an alternate light source.
4. The test is considered positive with the observation of test print fluorescence.
5. If results are negative (no prints fluoresce), repeat the test on a different square. If the re-test is negative, the reagent is not acceptable for use on casework. The reagent is disposed of according laboratory safety policy, and a new reagent is prepared.

Safety Concerns:

Follow the safety requirements for handling the alternate light source and for the chemicals/reagents that are being used.

Storage and Location of Chemicals and Solutions:

The superglue and the superglue chamber are stored in the Fingerprint Processing Room. The prepared test squares are stored in the Latent Print Development Chemical Processing Room.

Shelf Life:

Prepared cyanoacrylate ester processed latent impressions—no expiration date.

RETURN TO TABLE OF CONTENTS

4.7. DYE STAINING

General Comment:

Dye staining of cyanoacrylate ester fumed material is utilized on non-porous surfaces. The laser-activated dyes fluoresce when illuminated by laser or high-intensity light sources of the appropriate wavelength.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable.

Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Goggles (when viewing with laser)
4. Mask

Materials and Equipment:

1. Laser, forensic light source or UV light
2. Laser dye solution
3. Photographic equipment
4. Color filters

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solutions of the dye and rinse solvents as described in this Latent Print Development Technical Procedures Manual.

2. Apply an even coat of the dye solution to the evidence item(s) by immersion or with a rinse bottle.

3. Rinse off any excess dye with a rinse bottle containing the appropriate rinse solution.

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes.

5. While wearing the appropriate laser goggles, examine under laser or high intensity light source illumination.

6. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Notes:

1. The preparation and application of the dyes shall take place under a properly ventilated hood.

2. Any evidence treated with dye shall be thoroughly dried before moving to any other area of the laboratory

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. Most dye stains destroy DNA, so swabbing must be done prior to processing.

References:

1. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints.*

Ardrox	pp. 10-11
Basic Red 28	pp. 12-13
Basic Yellow 40	pp. 14-15
Rhodamine 6G	pp. 36-37
TapeGlo	pp. 44-45

2. Day, Kelley. Enhancement of Cyanoacrylate Developed Latent Prints Using Nile Red. *Journal of Forensic Identification*, Vol. 46, No. 2, Mar/Apr 1996, pp. 183-187.

3. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000.

RAM	pp. 19
Liqui-Drox	pp. 51
MBD	pp. 52-53
MRM 10	pp. 54-55
Rhodamine 6G	pp. 57-58
Safranin O	pp. 59
Thenoyl Europium Chelate	pp. 60-61

4. Law Crime Scene Products, Technical Notes.

RAY
RAM
RedStar

5. Escondido Police Department Latent Print Development Technical Procedures Manual.

RETURN TO TABLE OF CONTENTS

5. LATENT PRINT PROCESSING CHEMICALS

5.1. ACID FUCHSIN (HUNGARIAN RED)

General Comments:

Acid Fuchsin or Hungarian Red is used to enhance latent prints in blood on porous and non-porous surfaces. This method stains the protein components of blood. Enhanced impressions fluoresce with an alternate light source and impressions can be lifted with a white gelatin lifter.

Safety Concerns:

The toxic and carcinogenic properties of Acid Fuchsin/Hungarian Red have not been thoroughly investigated; however, Hungarian Red shall be handled with extreme care. The glacial acetic acid and sulfosalicylic acid solutions may be flammable and corrosive and shall be handled with extreme care. Mixture and application of the solutions shall be conducted in a fume hood. Safety glasses, gloves, and a lab coat shall be used.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection (optional)
4. Mask (optional)

Materials and Equipment:

1. Glass trays
2. Absorbent/filter paper
3. Glass beakers
4. Graduated cylinders
5. Magnetic stirrer and stirring rod
6. White gelatin lifters
7. ALS/Laser
8. Colored Filters (Red)
9. Photographic equipment

Chemicals:

2 g Hungarian Red Blood Stain (pre-mixed)
20 g Sulfosalicylic acid
10 mL Glacial acetic acid
Distilled water

5.1.1 Procedure: Option One (unmixed)

1. Mix **Sulfosalicylic acid solution.**
   - Place 20 grams of Sulfosalicylic acid in a large beaker and fill beaker with 1 L of Distilled water.
   - Used Magnetic stirrer to mix.
   - Place Solution in squirt bottle until needed.

2. Mix **Acetic Acid Solution** – Distilled water may be used in place of acetic acid solution
   - Place 10 mL of glacial acetic acid in large beaker
   - Fill beaker with 190 mL of distilled water
   - Place magnetic stir bar in the beaker.
   - Use magnetic stirrer to stir solution for five (5) minutes.
   - Place the solution in a squirt bottle until needed.

3. Mix **Working Solution**
   - Available in premixed solution and does not require prior mixing of solution
   - Place solution in squirt bottle to apply to an item of evidence

4. Prior to spraying or dipping item of evidence with any of the solutions, the bloody impression shall be dried or cured to prevent the print from dissolving when the solution is applied.

5. Cover the impression with filter or tissue paper.

6. Spray sulfosalicylic acid solution onto the tissue paper. Paper shall remain in contact with impression during this step. Allow tissue paper to remain on item for two minutes. Increase setting time for larger stains.

7. Rinse area with distilled water.

8. The Acid Fuchsin solution may be applied by dipping the item in a container filled with the solution or by using a squirt bottle filled with the solution to saturate the stained area

9. Rinse item with acetic acid solution or distilled water and allow to air dry. Immediately blot any excess solution with tissue paper.

10. When completely dry, place white gelatin lifter over the impression. Leave lifter on the impression for 15-30 minutes.

11. Remove the gelatin lifter and view the lift with laser or ALS. View at 515nm - 560nm range with green filter and 600 nm with a red filter and photograph immediately. The Acid Fuchsin will bleed into the gelatin lifter therefore photography is needed right after lifting off of surface.

5.1.2 Procedure: Option Two (premixed with fixative)

1. Prior to spraying or dipping item of evidence with any of the solutions, the bloody impression shall be dried or cured to prevent the print from dissolving when the solution is applied.

2. The Acid Fuchsin solution may be applied by dipping the item in a container filled with the solution or by using a squirt bottle filled with the solution to saturate the stained area.

3. Rinse item with acetic acid solution or distilled water and allow to air dry. Immediately blot any excess solution with tissue paper.

4. When completely dry, place white gelatin lifter over the impression. Leave lifter on the impression for 15-30 minutes.

5. Remove the gelatin lifter and view the lift with laser or ALS. View at 515nm - 560nm range with green filter and 600 nm with a red filter and photograph immediately. The Acid Fuchsin will bleed into the gelatin lifter therefore photography is needed right after lifting off of surface.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Acid Fuchsin – original container
Glacial acetic acid and sulfosalicyclic acid – squirt bottles or containers away from sunlight.

Shelf Life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Prior to application, a small area of the background of the object or surface being enhanced should be stained with the solution. If the background develops a significant color, the Acid Fuchsin solution may not be appropriate for enhancement of this item.

2. Successful staining of the impression will result in a deep magenta colored impression.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations

References

1. Guide for the Chemical Enhancement of Bloody Footwear and Tire Impression Evidence, SWGTHREAD. Accessed December 2018, http://www.crime-scene-investigator.net/guide-for-the-chemical-enhancement-of-bloody-footwear-and-tire-impression-evidence.html

2. MEDTECH Forensics, Acid Fuchsin with fixative, Accessed December 2018, http://store.medtechforensics.com/index.php/acid-fuchsin-hungarian-red-with-fixative-1-liter.html

3. North Carolina State Crime Laboratory, Technical Procedure for Hungarian Red, Version 2 Effective Date: 10/31/2013

RETURN TO TABLE OF CONTENTS

5.2. ACID YELLOW

General Comments:

Acid Yellow is a protein dye, sensitive to the proteins found in blood. This method is best used to develop or enhance prints containing blood on non-porous, dark surfaces. This technique is not suitable for use on porous surfaces because of the saturation of the dye into the background. Prints in blood fluoresce green-yellow after viewing under blue-green 385-509 nm light.

Safety Concerns:

Acid Yellow is not labeled as hazardous. Since the acetic acid smell might be irritating, masks may be worn. Acid Yellow will color the skin and clothing.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Materials and Equipment:

1. Glass trays
2. Absorbent/filter paper
3. Acid yellow working solution, fixing solution and rinse solution
4. Alternate Light Source
5. Color filters (orange)
6. Photographic equipment

Chemicals:

100 ml Acetic Acid
2 gm Acid Yellow or Pre-Mix Solution
1400 ml Distilled Water
500 ml Ethanol

Procedure:

1. Prepare pre-wash, working and rinse solutions:

Pre-Wash Solution
Mix 11 grams 5-sulfosalicylic acid in 500 ml distilled water

Working Solution

Option 1

Pre-mixed solution from forensic vendor (e.g. Arrowhead Forensics)

Option 2

- Mix 2 gm Acid Yellow in 100 ml Acetic Acid
- Add 500 ml Ethanol
- Add 1400 ml distilled water
- Mix with magnetic stirrer for at least 30 minutes

Rinse Solution

- Add 125ml Anhydrous Ethanol to 25ml Acetic Acid
- Add 350ml distilled water

2. The pre-wash solution is used to fix the print. Place an absorbent piece of paper the size of the print above the print. Place one edge of the paper on the object and spray the solution, or use a pipette to apply the solution, to fix the paper to the object. Wet the entire paper onto the object with the least amount of air bubbles as possible. Allow the solution to sit for 1-3 minutes.

3. The pre-mixed solution of Acid Yellow is applied the same way as the pre-wash with a new, dry piece of absorbent paper. The solution should be applied (leave in contact with the print) for 1-5 minutes.

4. The rinse solution can be sprayed or applied with a pipette and then patted dry; however, it is preferred to hang dry at room temperature. Use caution if you pat dry to not wipe the print away.

5. View under 450 nm light with orange goggles. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Mix as needed. Keep original container in a cool, dry environment away from dust.

Shelf Life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Acid Yellow does NOT develop latent prints. Consideration should be given to sequential processing techniques.

2. Prior to any processing, photograph all bloody prints with a scale. Photographs shall be taken after each processing technique.

3. Lifting prints is not suggested, but prints can be lifted with a white gel lifter if done carefully.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations

References:

1. Arrowhead Forensics-Acid Yellow 7, Accessed December 2018. https://www.arrowheadforensics.com/a-1521b-acid-yellow-7-25gm.html

2. BVDA – Staining blood traces. (n.d.). Retrieved from http://www.bvda.com/en/acid-yellow-7

3. *Chemical Formulas and Processing Guide for Developing Latent Prints (*2000). pp. 14-16, 43-44. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section

4. *Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009)*. Sandridge: Home Office, Police Scientific Development Branch.

5. Sirchie Technical Information- Acid Yellow 7 Aqueous Solution. TI11-684ENG-REV1.

6. Sears, V.G; Butcher, C.P.; Fitzgerald, L.A. (2005). Enhancement of fingerprints in Blood Part 3: Reactive Techniques, Acid Yellow 7, and Process Sequences. *Journal of Forensic Identification*, 55 (6), pp. 741-759

7. Smith, Erin; Validation Study. San Diego Sheriff's Crime Laboratory, *"Acid Yellow – A Fluorescing Blood Enhancer for Dark Surfaces"*

RETURN TO TABLE OF CONTENTS

5.3. ACCUTRANS

General Comments:

AccuTrans is a silicone impression compound used for taking impressions of friction ridge detail on various surfaces. Ideal for use on rough surfaces after developing with fingerprint powder.

Safety Concerns:

AccuTrans is not classified as hazardous or dangerous to human health or the environment.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask (if DNA a component of case)

Materials and Equipment:

1. AccuTrans dispenser
2. AccuTrans casting silicone

Procedure:

1. Insert AccuTrans casting silicone into dispenser.

2. Remove protective cap.

3. Place new tip in place of protective cap on dispenser.

4. Apply to surface of item containing ridge detail.

5. Allow to set. Setting time of regular AccuTrans is approximately 4 minutes at room temperature.

6. When AccuTrans is set, remove silicone to lift latent prints and photograph results.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Store only in original container in cool, dry area. Recommended storage temperature 15-30C, 50% humidity.

Shelf life:
Two years from date of manufacture. If the product is used after this date, a test must be performed to check its effectiveness.

Notes:

1. AccuTrans is ideal for rough surfaces such as brick, Styrofoam, textured computer housings and human skin.

2. Fingerprint Powder is used prior to AccuTrans to enhance prints on difficult surfaces.

3. The setting time depends on the ambient temperature. The lower the temperature, the slower the material sets, and the higher the temperature, the faster the setting time.

4. AccuTrans comes in various colors that are generally used for the following purposes:
   White – Reverse prints
   Brown – Tool marks and Casings
   Black – Firearms, tool marks
   Transparent – Direct fingerprint lifts, Self Pooling

Disposal:

Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Advanced Forensic Materials (n.d.), Accessed December 2018, https://www.accutransusa.com/

2. Coltene: AccuTrans (n.d.), Accessed December 2018, https://accutrans.coltene.com/

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch.

RETURN TO TABLE OF CONTENTS

5.4. AMIDO BLACK

General Comments:

Amido black is a protein dye, sensitive to the proteins found in blood. This method is best used to develop or enhance prints containing blood on non-porous surfaces (porous surfaces may produce a high background color). Amido black stains the protein residues in a blood-contaminated latent print by turning a blue-black color.

Safety Concerns:

Amido black is not a carcinogen, however, some of the solvents used to prepare it should be considered potentially hazardous and /or flammable.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Materials and Equipment:

1. Trays with cover
2. Magnetic stirring device
3. Amido black working solutions and rinse solutions
4. Photographic equipment

Methanol Based Solution

Caution must be exercised when applying the methanol-based solution to painted surfaces. The methanol may destroy the latent print(s) as well as the surface beneath the prints. All blood must be dried prior to application. Heavy cyanoacrylate fuming may be detrimental to this process.

Chemicals:

Developer Solution

2 g Napthol blue black (Amido Black)
100 mL Glacial acetic acid
900 mL Methanol

Rinse Solution

100 mL Glacial acetic acid
900 mL Methanol

Final Rinse
Distilled water

Soak Method Procedure:

1. Prepare developer solution of Amido Black by combining ingredients using magnetic stirring device until all the naphthol blue black is dissolved. This should take approximately 30 minutes.

2. Prepare rinse solution of Amido black by combining ingredients.

3. Pour a sufficient quantity of the Amido Black developer solution into a clean, dry, tray. If spraying or squirting, see below. Pour a similar amount of acetic acid/methanol rinse solution into a second tray, and a similar quantity of the acetic acid/distilled water rinse into a third tray.

4. Leave immersed for approximately 5 minutes, covering the tray to prevent evaporation of methanol. **If the item cannot be immersed, the area of the item to be treated should be heated with a lamp or fan heater for at least one hour. ** Optional **

5. Immerse the stained items in the rinse solution, and rock the dish gently, until the excess dye has been removed from the background.

6. Immerse the processed items in final rinse of distilled water. Rock the dish gently for about 30 seconds.

7. Allow evidence to dry at room temperature.

8. Photograph any developed prints.

Spray Method Procedure:

1. Prepare developer solution of Amido Black by combining ingredients using magnetic stirring device until all the naphthol blue black is dissolved. This should take approximately 30 minutes.

2. Prepare rinse solution of Amido black by combining ingredients.

3. Apply Amido Black to the evidence by spraying or squirting. Leave the developer on the evidence until the latent prints become a blue-black color.

4. **If the item cannot be immersed, the area of the item to be treated should be heated with a lamp or fan heater for at least one hour. ** Optional**

5. Spray the stained items with the rinse solution, until the excess dye has been removed from the background and the rinse is clear in color.

6. Spray the processed items with the final rinse of distilled water. Spray the items for about 30 seconds until the rinse is clear in color.

7. Allow evidence to dry at room temperature.

8. Photograph any developed prints.

Water Based Solution

The Amido Black water based solution is a one step process that includes a blood fixer. The sensitivity and color intensity of the process are similar to that of the Amido Black methanol based formula. This process used a tap water rinse.

Chemicals

Citric Acid Stock

38 g Citric acid
2 L Distilled water

Developer Solution

1 L Citric Acid Stock
2 g Napthol blue black (Amido Black)
2 ml Photo flo 600 solution

Rinse Solution 1

1 L Citric Acid Stock

Rinse Solution 2

Distilled Water

Procedure:

1. Fix the blood impression Immerse the item of evidence in methanol or 5-Sufosalicylic acid for one hour.

2. Prepare developer solution of Amido Black by combining ingredients using magnetic stirring device until all the naphthol blue black is dissolved. This should take approximately 30 minutes.

3. Prepare a Rinse Solution 1 of Amido black.

4. Pour a sufficient quantity of the Amido Black developer solution into a clean, dry, tray. If spraying or squirting, see below. Pour a similar amount of Rinse Solution 1 into a second tray, and a similar quantity of the Rinse Solution 2 into a third tray.

Spraying
Apply Amido Black to the evidence by spraying or squirting. Leave the developer on the evidence until the latent prints becomes a blue-black color.

5. Leave immersed in Developer Solution for approximately 2 minutes.

6. Immerse the stained items in Rinse Solution 1, and rock the dish gently, until the excess dye has been removed from the background.

7. Immerse the processed items in Rinse Solution 2 rinse of distilled water. Rock the dish gently for about 1 minute.

8. Allow evidence to dry at room temperature.

9. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark bottles

Shelf Life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Powders and Ninhydrin may be used prior to Amido black, and consideration should also be given to alternative enhancement techniques.

2. Prior to any processing, photograph all bloody prints with a scale. Do not lift prints. Photographs shall be taken after each processing technique.

3. Be aware of the potential for cross contamination if more than one article is processed in the same working solution or rinse.

4. A light application of cyanoacrylate fuming may be used prior to the Amido black with methanol solution.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations

References:

1. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/amidow.html

2. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000,pp. 14-16, and 43-44.

3. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques*.

4. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints,* pp. 4-5.

RETURN TO TABLE OF CONTENTS

5.5. ARDROX

General Comments:

Ardrox is a fluorescent dye used to enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety Goggles
4. Goggles (when viewing with laser)
5. Mask (optional)

Materials and Equipment:

1. Beakers
2. Graduated cylinder
3. Clear or dark storage bottles
4. Tray
5. Rinse bottle
6. Laser, forensic light source or UV light
7. Photographic equipment
8. Color filters (yellow)

Chemicals:

Ardrox dye
Methanol
Acetone
Isopropanol
Acetonitrile
Petroleum ether

5.5.1. Procedure: Option One

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solution of Ardrox dye as described.

Ardrox Working Solution
2 ml Ardrox
100 ml Methanol

Mix 2 ml Ardrox in 100 mL of Methanol.

This dilution can be adjusted to make it stronger (add another 1 to 2 ml of Ardrox) or make it weaker (add 1 ml Ardrox to 100 ml of Methanol) from the beginning.

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Rinse solvents with running water or methanol.

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

5. While using an orange or red filter, examine under laser or high intensity light source illumination at 415nm-520nm with yellow filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints.

5.5.2. Procedure: Option Two

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solutions of Ardrox dye as described.

Ardrox Working Solution
2 ml Ardrox P133D
10 ml Acetone
25 ml Methanol
10 ml Isopropanol
8 ml Acetonitrile
945 ml Petroleum ether

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

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Rinse solvents with running water or methanol.

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

5. While using an orange or red filter, examine under laser or high intensity light source illumination at 415nm-520nm with yellow filter.

6. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The preparation and application of Ardrox shall take place under a properly ventilated hood.

2. Any evidence treated with Ardrox shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. Ardrox should be used after DNA collected as dye stains destroy DNA.

Disposal:

The solution can be reused. If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Dalrymple, B. & Norman, J. (2012). Finding latent Evidence with Chemistry & Light. Ron Smith & Associates. pp. 23, 96

2. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 45. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section

3. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/ardrox.html

4. Technical notes, Lightning Powder Co. Inc., Salem, OR., 2001.

RETURN TO TABLE OF CONTENTS

5.6. BASIC RED 28

General Comments:

Basic Red 28 is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

5.6.1. Pre-mixed

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Photographic equipment
5. Color filters (red or orange)

Chemicals:

Basic Red 28 premix solution

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

3. Rinse solvents with distilled water.

4. Allow evidence item to dry

5. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 470nm-550 nm laser with red or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.6.2. Unmixed

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask (optional)

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Scale
4. Beakers
5. Graduated cylinders
6. Dark colored bottles
7. Laser, forensic light source or UV light
8. Photographic equipment
9. Color filters (red or orange)

Chemicals:

Basic Red 28 dye

Propanol
Acetonitrile
Petroleum ether

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Mix stock and working solutions:

Stock Solution
0.2 g Basic Red dye
60 ml Propanol
40 ml Acetonitrile

Dissolve Basic red dye into propanol and then add acetonitrile.

Working Solution
5 ml Stock Solution
95 ml Petroleum ether

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. Rinse solvents with distilled water.

5. Allow evidence item to dry

6. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 470nm-550 nm laser with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

7. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of Basic Red 28 shall take place under a properly ventilated hood.

2. Any evidence treated with Basic Red 28 shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. Basic Red 28 can be modified by the addition of Basic Yellow 40 dye to provide a wider range of fluorescence.

7. Basic Red 28 should be used after DNA collected as dye stains destroy DNA.

Disposal:

The solution can be reused. If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Basic Red 28-32 oz. set. (Dec. 2018.). Retrieved December 2018, https://www.shopevident.com/product/basic-red-28-dye-stain-32-oz-premix

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/br28.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.7. *BASIC YELLOW 40*

General Comments:

Basic Yellow 40 is a fluorescent dye used to enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety Goggles
4. Colored goggles (when viewing with laser)
5. Mask

5.5.1 Unmixed

Materials and Equipment:

1. Beakers
2. Graduated cylinder
3. Clear or dark storage bottles
4. Tray
5. Rinse bottle
6. Laser, forensic light source or UV light
7. Photographic equipment
8. Color filters (yellow or orange)

Chemicals:

Basic Yellow 40 Dye
Ethanol

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solutions of Basic Yellow 40 dye

Working Solution

0.5 g Basic Yellow dye

250 ml Ethanol

Mix 0.5 gm Basic Yellow 250 ml of ethanol. Most of the dye will not dissolve, major portion of clear solution should be poured into another container.

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Rinse solvents with distilled water or ethanol.

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

5. While using an orange or red filter, examine under laser or high intensity light source illumination at 450 nm-500 nm laser with yellow or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark colored bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.5.2 Premixed

Materials and Equipment:
1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Photographic equipment
5. Color filters (yellow or orange)

Chemicals:

Basic Yellow Dye (pre-mixed)

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Rinse solvents with distilled water or ethanol.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter, examine under laser or high intensity light source illumination at 450 nm-500 nm laser with yellow or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The preparation and application of Basic Yellow 40 shall take place under a properly ventilated hood.

2. Any evidence treated with Basic Yellow 40 shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. Basic Yellow 40 should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Dalrymple, B. & Norman, J. (2012). Finding latent Evidence with Chemistry & Light. Ron Smith & Associates. pp. 23, 103

2. Dalrymple, B. & Norman, J. (2015). Advanced Sequential Processing Workshop. Ron Smith & Associates. pp. 130

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

4. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/by40.html

RETURN TO TABLE OF CONTENTS

5.8. BLOOD FIXATIVE

General Comments:

Before enhancing blood prints using Amido Black or other common stains, the blood should be dry, and the blood should be fixed. The fixation of blood is done to prevent disruption or running of the blood during enhancement. Solution of 5-sulfosalicylic acid.

Safety Concerns:

Blood fixative is not a carcinogen, however, some of the solvents used to prepare it should be considered potentially hazardous and /or flammable.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection (optional)
4. Mask

Materials and Equipment:

1. Blood Fixative Solution (5-sulfosalicylic acid)

Procedure:

1. Spray or immerse evidence item in blood fixative solution

2. Allow to dry

3. Continue with sequential processing as described in the QAM.

Notes:

1. For use as a precursor to blood enhancers.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Store only in original container in cool, well ventilated place away from sources of ignition, direct sunlight, strong bases and strong acids.

Shelf life:

Not applicable

Notes:

None

References:

1. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

2. Tri-tech Forensics, Blood Fixative-5-Sulfosalicylic Acid (n.d.) Accessed December 2018, https://www.tritechforensics.com/che-1601-5-sulfosalicylic-acid-blood-fixative

3. Sirchie, Blood Fixative 8 oz (n.d.). Accessed December 2018, https://www.sirchie.com/forensics/blood-search-id-enhancement/blood-evidence-enhancement/blood-fixative-8-oz.html#.XBmUiMKWyUk

RETURN TO TABLE OF CONTENTS

5.9. BLUESTAR

General Comments:

Latent bloodstain reagent that reacts with the iron contained in the heme group in blood hemoglobin. Bluestar catalyzes and emits an intense blue chemiluminescence, visible in the dark.

Safety Concerns:

Precautions shall be taken to avoid inhalation of dust and/or mist from the solution while spraying. Keep away from heat and other ignition sources.

Safety Equipment:

1. Gloves (impervious to solution)
2. Lab Coat
3. Goggles
4. Mask or dust respirator

Materials and Equipment:

1. Distilled water
2. Spray bottle with adjustable spray nozzle
3. Photographic equipment

Chemicals:

BlueStar

Procedure:

Mixing Instructions

1. Mix BlueStar solution using tablets. Open spray bottle and add 125 ml (4fl oz) of distilled water

2. Take a white tablet out of the white-top tube and close the tube immediately. Take a Beige tablet out of the orange top tube and close the tube immediately. DO NOT switch caps. The white cap goes to whit-top tube and the orange cap on the orange-top tube.

3. Add the pair of tablets to the distilled water. If you need more working solution, use 125 ml (4 fl oz.) per pair of tablets.

4. Twist the head with its plunger onto the spray bottle firmly.

5. Allow about 1-2 minutes for complete dissolution and mixing of the chemicals, swirling gently with a circular motion. DO NOT shake the container upside down.

Application Instructions

Indoors

1. Close all windows, block all outside light sources, turn off all the lights.

2. Wait at least 5 minutes for eyes to adjust to darkness for best observation quality.

3. Spray lightly, horizontally ahead of you, at least 2 inches (50 cm) away from the target, in a side sweeping motion. Do not point to ground.

4. Do not saturate walls and vertical surfaces. This will create dripping.

5. Be aware of false reactions from certain household detergents, chlorine, some paints and varnishes, copper, certain iron metabolizing, plants such as lichens, thyme and some tree mosses, and certain soils containing iron.

6. Photograph

   Photography guidelines

   i. Set the camera on a tripod, perpendicularly to the area being photographed.

   ii. Disable the automatic flash and the autofocus mode if the camera has one.

   iii. Set the sensitivity level to ISO 400 to obtain acceptably short exposure times.

   iv. Use a large lens aperture, typically a f/2.8 "f/stop" value.

   v. Set the exposure time to "B".

   vi. Focus the lens manually over a spot of light provided by a flashlight over the blood area.

   vii. Turn off all lights. Darkness should not be complete. Pictures shot in dimmed light will allow you to view not only the bloodstains, but other details of the scene as well.

   viii. Re-spray the blood print to reactivate a bright reaction.

   ix. Shoot several pictures using different shutter speeds, typically 30 seconds.

Outdoors

1. Wait for night time, and turn off all area lights in an urban environment. If necessary, screen off distant light sources, or even a very bright moon, and work facing away from parasite lights.

2. Pay attention to wind direction, if any. Do not spray into the wind, but use it to carry a light cloud of product over the area being searched.

3. Wait at least 5 minutes for eyes to adjust to darkness for best observation quality.

4. Spray lightly, horizontally ahead of you, at least 2 inches (50 cm) away from the target, in a side sweeping motion. Do not point to ground.

5. Do not saturate walls and vertical surfaces. This will create dripping.

6. Be aware of false reactions from certain household detergents, chlorine, some paints and varnishes, copper, certain iron metabolizing, plants such as lichens, thyme and some tree mosses, and certain soils containing iron.

7. Photograph

   Photography guidelines

   i. Set the camera on a tripod, perpendicularly to the area being photographed.

   ii. Disable the automatic flash and the autofocus mode if the camera has one.

   iii. Set the sensitivity level to ISO 400 to obtain acceptably short exposure times.

   iv. Use a large lens aperture, typically a f/2.8 "f/stop" value.

   v. Set the exposure time to "B".

   vi. Focus the lens manually over a spot of light provided by a flashlight over the blood area.

   vii. Turn off all lights. Darkness should not be complete. Pictures shot in dimmed light will allow you to view not only the bloodstains, but other details of the scene as well.

   viii. Re-spray the blood print to reactivate a bright reaction.

   ix. Shoot several pictures using different shutter speeds, typically 30 seconds.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

DO NOT attempt to store the product AFTER MIXING the tablets with water. The mixed product is an active chemical compound that oxidizes. Inert gases are constantly released and will in time accumulate under pressure in a sealed container, causing swelling and leaking.

Storage:

Unmixed tablets - original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Best results are obtained when the product is used within 3 hours after mixing the tablets in water. There is therefore no requirement to rush the investigation due to immediate product deterioration.

2. Over-spraying Bluestar does NOT result in improved blood detection, and in case the DNA is only available in very low quantities, over spraying might dilute it too much for collecting usable samples.

3. Total darkness is not required. Natural low intensity diffused light is preferred. Artificial light (tungsten or fluorescent) produces yellowish or greenish pictures. A flash should be avoided.

4. When reacting to blood, the BLUESTAR® FORENSIC latent bloodstain reagent emits an intense light-blue chemiluminescence in the 420 to 440 nanometer range.

5. False reactions may occur due to the presence of certain household detergents, chlorine, some paints and varnishes, copper, certain iron metabolizing plants such as lichens, thyme and some tree mosses, and certain soils containing iron. Typically, “false” reactions are markedly dimmer and whiter.

6. Cyanoacrylate fuming may be detrimental to this process.

Disposal:

Dispose of unused mix in a sink under running water.
Dispose of cleaning residues according to local, state, and federal regulations applying to the biohazards of blood.

References:

1. Bluestar Forensic, Bluestar Forensic Tablets: User’s manual (Jan 2018), Accessed December 2018, https://www.bluestar-forensic.com/pdf/en/instructions_bluestar_tablets_8.pdf

2. Evident, Bluestar Blood Reagent. Accessed December 2018, https://www.shopevident.com/category/blood-trajectory/bluestar-blood-reagent

RETURN TO TABLE OF CONTENTS

5.10. COOMASSIE BRILLIANT BLUE

General Comments:

Coomassie Brilliant Blue is a protein stain, sensitive to the proteins found in blood. This method is best used to develop or enhance prints containing or deposited in blood on both porous and non-porous surfaces. Coomassie Brilliant Blue stains the protein residues in a blood contaminated latent print a blue color.

Safety Concerns:

Coomassie Brilliant Blue is not a carcinogen; however, some of the solvents used to prepare it should be considered potentially hazardous and/or flammable.

Safety Equipment:

1. Gloves (impervious to solutions)
2. Lab Coat
3. Eye protection
4. Mask

Materials and Equipment:

1. Trays
2. Beakers
3. Spray bottles
4. Magnetic stirring device
5. Photographic equipment

Chemicals:

Working Solution
0.96 g Coomassie brilliant blue
84 ml Glacial acetic acid
410 ml Methanol
410 ml Distilled water

Rinse Solution
100 ml Glacial acetic acid
450 ml Methanol
450 ml Distilled water

Final Rinse Solution

Distilled water

Procedure:

Coomassie Brilliant Blue consists of developer and rinse solutions with a final rinse of distilled water. Stain must be fixed to the surface before using this procedure.

1. Prepare working solution of Coomassie Brilliant Blue. Combine all ingredients using magnetic stirring device. Mix until Coomassie Brilliant Blue is dissolved. This should take approximately 30 minutes.

2. Prepare Rinse solution. Combine all ingredients using magnetic stirring device.

3. Apply the working solution to the samples to be processed by dipping or using a squirt bottle or sprayer.

4. Leave the working solution on for approximately 30 to 90 seconds then apply the acetic acid/methanol rinse solution. These two steps can be repeated until maximum contrast is achieved.

5. Once a maximum contrast is achieved; apply the final bath of distilled water.

6. Allow processed items to dry at room temperature.

7. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Stain must be fixed to surface prior to using this method of development.

2. The contrast achieved with Coomassie Brilliant Blue is not as strong as Amido Black due to the lighter color of the dye stain and the development of the surfaces' background.

3. Development time may be shortened if the surface strongly adsorbs the dye.

References:

1. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000,pp. 47-48.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/coom.html

RETURN TO TABLE OF CONTENTS

5.11. CYANOACRYLATE (SUPER GLUE) FUMING

General Comments:

Cyanoacrylate Ester fumes react (polymerize) with water and other latent print constituents to form a hard, whitish, plastic-like deposit. It is useful on most non-porous and some porous surfaces. Developed prints may be dusted with powders or treated with fluorescing dyes to enhance contrast.

Safety Concerns:

Cyanoacrylate fumes irritate the mucous membranes. In the glue form it bonds skin-to-skin, and skin to other objects. Extreme heating of glue could create cyanide gas.

When opening any of the cyanoacrylate fuming cabinets, be certain the exhaust hoods are turned on. Do not attempt to remove articles from the cabinets until all the fumes have been exhausted.

Safety Equipment:

1. Gloves
2. Lab coat
3. Eye protection
4. Mask

Procedure:

1. After visual examination and documentation in notes, secure the samples to be processed in a suitable cyanoacrylate fuming cabinet.

2. Turn on the fan (on side of chamber).

3. Place warm water in a smaller aluminum dish.

4. Pour cyanoacrylate ester (about size of dime) in the larger aluminum dish.

5. Place the smaller aluminum dish on top of the larger aluminum dish and place in the chamber on the hot plate. Or, place warm water in a beaker; pour cyanoacrylate ester (about size of dime) in the larger aluminum dish. Place the beaker in the chamber and the glue dish on the hot plate.

6. Add positive control card (see “Positive Control” below).

7. Close the cabinet door(s) and turn on hot plate(s) and fan.

8. Development time varies from 5-30 minutes and control card shall be frequently monitored.

9. When development is complete (control print develops or glue evaporates), switch off hot plates, and turn on exhaust hoods (switch on wall).

10. After a couple minutes, open doors to cabinet and let fumes exhaust (goggles and mask may be worn).

11. After fumes have cleared, turn off the fan and exhaust hoods.

Positive Control:

1. A positive control is run in the superglue chamber by preparation of a sebaceous test impression.

2. Preparation of the test impression:

3. Analyst applies perspiration to their finger by rubbing finger across face, hand, etc. or moistens finger on sebaceous oil control pad.

4. The treated finger is then touched to a piece of plastic to be placed in the chamber or the treated finger is touched to the inside glass door of the chamber.

5. The test impression and evidence are developed at the same time.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Although developed prints should stay on the processed samples for an extended period of time, they may be further preserved through photography and by powdering and lifting.

2. Cyanoacrylate glue fumes could affect firearms examination. Each chamber opening and barrel opening should be covered (e.g. with tape) before fuming with glue.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Mock, James P., *Basic Latent Print Development*, p. 46-47.

3. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 26-27.

4. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints*, 2000, pp.18-20.

RETURN TO TABLE OF CONTENTS

5.12. CYANOBLUE

General Comments:

CyanoBlue is a water based fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Colored goggles (when viewing with laser)
3. Lab coat
4. Mask
5. Safety goggles

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Photographic equipment
5. Colored filters (orange or red

Chemicals:

CyanoBlue premix dye

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Dye solution should come in contact with the processed area for about five seconds.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. Examine under laser or high intensity light source illumination at 415-480 nm laser with orange or red filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of CyanoBlue shall take place under a properly ventilated hood. However, CyanoBlue is water based, so fumes are minimal and non-toxic.

2. Any evidence treated with CyanoBlue shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. CyanoBlue should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 59. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

4. The Safariland Group, CyanoBlue 16 oz. (Dec. 2018.). Retrieved December 2018, http://www.safariland.com/products/forensics/latent-print-processing/latent-print-reagents-and-chemicals/cyanoblue-16-oz.-1003867.html#start=1

5. The Safariland Group-Lightning Powder, CyanoBlue: Technical notes (n.d.)

RETURN TO TABLE OF CONTENTS

5.13. DFO (1, 8-DIAZAFLUOREN-9-ONE)

General Comments:

DFO is a ninhydrin analogue that reacts with amino acids and proteins present in latent print residues. When the reaction is complete, DFO developed prints fluoresce with the use of a laser or alternate light source. Like ninhydrin, DFO is an effective reagent to develop latent prints on paper.

Safety Concerns:

DFO is not a carcinogen; however, some of the solvents used in its preparation should be considered potentially hazardous and/or flammable.

Safety Equipment:

1. Gloves resistant to solvents
2. Lab coat
3. Eye goggles when viewing with laser
4. Mask
5. Goggles

Materials and Equipment:

1. Laser or forensic light source
2. Laser goggles
3. Latex gloves
4. Magnetic stirring device
5. Dry heat source or development chamber
6. Color filter (orange)
7. Photographic equipment

Chemicals:

DFO Stock Solution

1 g DFO
200 ml Methanol
200 ml Ethyl Acetate
40 ml Glacial acetic acid

DFO Working Solution

Entire DFO Stock Solution
2L Petroleum ether

Procedure:

1. Prepare the DFO stock solution. Combine ingredients and place on magnetic stirring device for approximately 20 minutes until DFO is dissolved.

2. Prepare the DFO working solution. Dilute the stock solution to 2 L with petroleum ether. The working solution should be a clear gold color.

3. Dip the samples to be processed into the DFO solution for approximately five to ten seconds. It is only necessary to wet the surface with the solution. If dipping the samples is not feasible, the solution can be applied with a soft brush or by spraying.

4. Allow the evidence to air dry.

5. Place your sample in the DFO oven and turn on the oven. Leave the evidence in the oven for approximately 20 minutes (oven temperature should be at approximately 200 degrees). A dry iron may be used in place of an oven.

6. Examine the processed samples with the laser or Alternate Light Source at 495 nm - 550 nm with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

7. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. If the evidence is to be dipped a second time, it should air dry between applications, and any developed prints should be photographed first.

2. When DFO is used on some brown paper products such as cardboard boxes, the background may fluoresce and cause interference with the detection of latent prints. By utilizing the 570nm wavelength of the light source and a red filter, the background interference can be dropped-out with the print still being visible.

3. Drying the evidence vertically is not recommended, because it produces a fluorescent band along the bottom of the article, which could mask latent prints.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Technique.*

2. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 20-21.

3. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, pp. 24-25.

RETURN TO TABLE OF CONTENTS

5.14. FLUORESCENT POWDERS

General Comments:

Fluorescent powders react like other fingerprint powders by adhering to latent print moisture and sebaceous residues. They are applied as with conventional powders, and documented by standard lift techniques and photography. Fluorescent powders are most useful on irregular non-porous surfaces and some vinyl materials. An ultraviolet or forensic light source is required for visualization.

Safety Concerns:

The fluorescent powders are not considered to be dangerous in the quantities used. However, the examiner shall take precautions to prevent injury to the skin and eyes from laser light.

Safety Equipment:

1. Gloves
2. Lab coat or coveralls
3. Mask
4. Laser goggles

Materials and Equipment:

1. Laser or high intensity light source
2. Fluorescent fingerprint powder
3. Clean fiberglass filament or feather duster style fingerprint brush
4. Photographic equipment

Procedure:

1. Select the most appropriate powder for the material to be processed. Use a new or clean fiberglass filament or feather duster style fingerprint brush dedicated for this purpose.

2. Dip the brush into the fluorescent powder. Use this powder very sparingly since this powder tends to "paint" the background and a little of this powder goes a long way.

3. Lightly dust the area for latent prints.

4. Examine for possible latent prints using a laser or a light source.

5. Photograph any prints that develop.

Storage:

Store in cool, dry environment

Shelf life:

Indefinite

Notes:

The color of the powder selected should contrast with the color of the surface to which it is applied.

Disposal:

Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints,* pp. 24-25.

RETURN TO TABLE OF CONTENTS

5.15. fpNatural 1 Powder

General Comments:

fpNatural 1 is a plant based IR fluorescent powder ideal for developing latent prints on multi-colored and densely patterned backgrounds. fpNatural 1 contains phycocyanin and chlorophyll that illuminate in the IR spectrum.

Safety Concerns:

Use in well ventilated area and wear appropriate PPE.

Safety Equipment:

1. Gloves
2. Lab Coat
3. Mask
4. Goggles (optional)

Materials and Equipment:

1. fpNatural 1 powder
2. fiberglass fingerprint brush
3. Laser, forensic light source
4. Filters (blue or red)
5. Infrared sensitive camera with IR filter to block out other wavelengths

Procedure:

1. Pour needed amount of powder into a small pile.

2. Dip tips of bristles of brush in fpNatural 1 powder.

3. Apply a small amount of powder onto the surface and begin to brush.

4. Clean excess powder from evidence item using brush.

5. Illuminate fpNatural 1 with high intensity light source-blue or red.

6. Photograph prints using IR sensitive camera fitted with an IR Pass Filter.

Notes:

1. fpNatural 1 is best suited for polymer banknotes and glossy surfaces.

2. IR sensitive camera equipped with an IR pass filter to block out all other wavelengths is required to visualize prints.

5.16. fpNatural 2 Powder

General Comments:

fpNatural 2 is a mineral pigment based IR fluorescent powder ideal for developing latent prints on multi-colored and densely patterned backgrounds. fpNatural 2 contains Egyptian Blue (calcium copper silicate) that exhibits strong near infrared fluorescence when illuminated with either visible or near-infrared light.

Safety Concerns:

Use in well ventilated area and wear appropriate PPE.

Safety Equipment:

1. Gloves
2. Lab Coat
3. Mask

Materials and Equipment:

1. fpNatural 2 powder
2. fiberglass fingerprint brush
3. Laser, forensic light source (IR 780 nm light source)
4. Infrared sensitive camera with IR filter to block out other wavelengths

Procedure:

1. Pour needed amount of powder into a small pile.
2. Dip tips of bristles of brush in fpNatural 2 powder.
3. Apply a small amount of powder onto the surface and begin to brush.
4. Clean excess powder from evidence item using brush.
5. Illuminate fpNatural 2 with visible near IR or IR.
6. Photograph prints using IR sensitive camera fitted with an IR Pass Filter.

Storage:

Store in cool, dry environment.

Shelf life:

Indefinite

Notes:

1. fpNatural 2 is best suited for polymer banknotes and glossy surfaces.

2. IR sensitive camera equipped with an IR pass filter to block out all other wavelengths is required to visualize prints.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 26. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Foster + Freeman, (n.d.). Exploiting the IR fluorescent properties of plants and minerals. Retrieved December, 2018, from http://www.fosterfreeman.com/qdelist/fprints/627-infrared-fingerprint-powders.html

RETURN TO TABLE OF CONTENTS

5.17. GENTIAN VIOLET (CRYSTAL VIOLET)

General Comments

Gentian violet is a dye that stains the constituents of sebaceous sweat (lipids, fats, and oils) producing a purple color. Gentian violet is very effective for the development of latent prints on the adhesive side of tapes.

Safety Concerns:

This dye should be considered potentially toxic if swallowed or absorbed by the skin, and should not be used in large quantities, or for the treating of large surfaces.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye protection (optional)
4. Mask (optional)

Materials and Equipment:

1. Working solution
2. Tray (glass, plastic or metal)
3. Tongs
4. Magnetic stirring device
5. Photographic equipment

Chemicals:

Working Solution
1 g Gentian Violet
1000 ml Distilled water

Procedure:

1. Prepare the Crystal Violet (Gentian Violet) dye working solution. Combine the ingredients and place on magnetic stirring device for approximately 25 minutes or until fully mixed.

2. Pour sufficient stain to immerse the samples to be processed into a clean, dry, dish or tray (goggles may be worn).

3. Immerse and soak the samples for 1 to 2 minutes.

4. Rinse off the excess dye under a gentle stream of cold running water.

5. Let evidence dry at room temperature.

6. Examine and photograph all developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines

Notes:

1. If the developed prints are faint, soak the tape again in the stain solution for a few more minutes. Rinse again and examine the contrast of the prints. This can be repeated several times, but use caution not to overdevelop the latent prints.

2. If the contrast between the latent print and the background is not sufficient for adequate photography, a light source can be used to obtain improved contrast via fluorescence. If fluorescent examination is going to be done, it is recommended that the evidence dry for 24 hours first. If the concentration of the crystal violet is high, there may not be any visible fluorescence. Faintly developed latent prints tend to fluoresce better.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Mock, James P., *Basic Latent Print Development*, p. 48.

3. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 18-19.

4. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, p. 12.

RETURN TO TABLE OF CONTENTS

5.18. GUN BLUEING (PERMA BLUE)

General Comments:

Perma Blue is a stain used to develop latent prints on unfired and fired cartridge casings. The presence of any latent print residue on the metal surface of a cartridge casing inhibits the deposition of the stain. As a result, the latent print appears light in color against a blueish-black background of stained metal.

Safety Concerns:

No major safety issues are known to be associated with this technique at this time.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Mask

Materials and Equipment:

1. Trays
2. Rinse bottle
3. Distilled water
4. Photographic equipment

Chemicals:

Gun Blueing solution

Procedure:

5.18.1. Option 1

1. Lightly fume the cartridge with Cyanoacrylate Ester. Will obtain best results when not fumed in CAE chamber.

2. Immerse cartridges in the reagent. Gently stir and roll the cartridges in the solution.

3. Monitor closely for development

4. Halt development by immersing in distilled water for two minutes. Allow to air dry.

5. Photograph any prints.

5.18.2. Option 2

1. Immerse cartridges in the reagent. Gently stir and roll the cartridges in the solution. Optional: spray clear lacquer spray to cartridge case to stabilize the development process and to enhance the contrast of friction ridge detail.

2. Monitor closely for development

3. Halt development by immersing in distilled water for two minutes. Allow to air dry.

4. Photograph any prints

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of gun blueing solution shall take place under a properly ventilated hood.

2. Any evidence treated with gun blueing shall be thoroughly dried before moving to any other area of the laboratory.

3. Since the working solution is corrosive to cartridge casings, you shall consult with a Firearms Examiner prior to processing

4. Lacquered steel cartridges or those cartridges with a polymer jacket around the casing will resist the oxidation/reduction resulting in little or no development of latent prints

5. A number of gun blueing products sold under various trade names can be used in a diluted solution to reveal friction ridge detail. They all work essentially in a similar fashion, except that different chemical concentrations may be required:

    a. Perma Blue 0.5 ml in 10 ml water
    b. Kettner Gun Blue 0.5 ml in 80 ml water
    c. Outer's Gun Blue 0.5 ml in 20 ml water

6. Should over development occur, excess gun blueing may be removed from the metal cartridge cases using acidified hydrogen peroxide.

7. A clear lacquer spray can be applied to cartridge cases to stabilize the development process, and to enhance the contrast of the developed friction ridge detail.

8. The used working solution may be reused if no contamination is noted after processing.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Knaap, W., IAI International Educational Conference 2018, Chemical Formulae Reference Book (2018). pp. 18-19.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/bluing.html#ttops

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

4. Saunders, G.C., "Evaluation of Several Techniques for Developing Latent Fingerprints on Unfired and Fired Cartridge Cases," International Symposium on Fingerprint Detection and Identification, Ne'Urim, Israel, June 1995.

5. Vandiver, James, "Fingerprints on Cartridges," Identifications News, June 1976.

RETURN TO TABLE OF CONTENTS

5.19. HYDROCHLORIC (MURIATIC) ACID

General Comment:

Hydrochloric (muriatic) acid vapors are used to develop latent prints on the emulsion side/glossy side of thermal paper. The acid is reacting with the oils in latent prints.

Safety Concerns:

Hydrochloric Acid (Muriatic Acid) is extremely corrosive and shall be used in a fume hood. Caution shall be exercised to avoid the inhalation of vapors and contact with skin.

Safety Equipment:

1. Gloves (resistant to solvents)
2. Lab coat
3. Goggles
4. Mask

Materials and Equipment:

1. Beakers
2. Graduated Cylinders
3. Large container

Chemicals:

Hydrochloric Acid (Muriatic Acid)

Procedure:

Hydrochloric Acid (muriatic acid) is purchased from a swimming pool supply store. Commercially available muriatic acid is concentrated hydrochloric (HCL) acid.

1. Place your evidence to be processed in an enclosed clear container.

2. Pour a small quantity (approximately 25ml) of hydrochloric acid in a small beaker and place the beaker in the enclosed container.

3. Observe the development of latent prints. Processing time is between 30 minutes to an hour.

4. Any developed latent prints should be preserved through photography soon after fuming is complete.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Hydrochloric acid is used for the glossy side of thermal paper. Additional sequential processing shall be performed on the non-glossy side of the paper.

2. Hydrochloric acid prints will fade and should be photographed within a couple days of development.

3. Hydrochloric acid prints may be redeveloped using the same technique after they have faded.

Disposal:

The acid is poured back into the original container and is re-used. If contaminated, the chemical is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Journal of Forensic Identification, 52 (4), 2002, *Latent Fingerprint Development on Thermal Paper using Muriatic (Hydrochloric) Acid*, pp. 427 – 432.

2. Validation Study by Serena Martin, San Diego Sheriff's Crime Laboratory, 10/28/09, *"Hydrochloric Acid Developing Prints on Thermal Paper"*

RETURN TO TABLE OF CONTENTS

5.20. 1,2-INDANEDIONE (IND)

General Comments:

IND is a chemical process that reacts with amino acids present in latent print residues. When the reaction is complete, IND developed prints fluoresce with the use of an alternate light source. Like ninhydrin and DFO, IND is an effective reagent to develop latent prints on porous items.

Safety Concerns:

IND is not a carcinogen; however, some of the solvents used in its preparation are considered potentially hazardous and/or flammable.

Safety Equipment:

1. Gloves resistant to solvents
2. Lab coat
3. Eye goggles when viewing with laser
4. Mask
5. Goggles during solution preparation (optional)

Materials and Equipment:

1. Laser or forensic light source
2. Beakers
3. Graduated cylinders
4. Magnetic stirring device
5. DFO oven or dry iron
6. Forensic light source
7. Color filters (orange or red)
8. Photographic equipment

5.20.1. IND HFE 7100 Solution (IND-E)

Chemicals:

Working Solution

2g 1,2 – Indanedione
70 ml ethyl acetate
930 ml HFE 7100

Procedure:

1. Prepare the working IND solution by first dissolving IND crystals into ethyl acetate. Then, add HFE 7100 to solution.

2. Dip the samples to be processed into the IND solution. If dipping the samples is not feasible, the solution can be applied with a soft brush or by spraying.

3. Allow the evidence to air dry.

4. Place your sample in the "DFO" oven and turn on the oven. Leave the evidence in the oven for approximately 1 hour (oven temperature should be at approximately 200 degrees). A dry iron may be used in place of an oven.

5. Examine the processed samples with an alternate light source. For most papers, viewing between 450nm – 515nm (green light) with an orange filter. Some darker colored papers (cardboard box, paper bags), viewing between 515nm – 570nm with an orange or red filter may be needed. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any developed prints.

5.20.2.IND Petroleum Solution (IND-P)

Chemicals:

Working Solution

2g 1,2 – Indanedione
180 ml ethyl acetate
20 ml Glacial acetic acid
1800 ml Petroleum ether

Procedure:

1. Prepare the working IND- P solution by first mixing ethyl acetate and glacial acetic acid.

2. Dip the samples to be processed into the IND solution. If dipping the samples is not feasible, the solution can be applied with a soft brush or by spraying.

3. Allow the evidence to air dry.

4. Place your sample in the "DFO" oven and turn on the oven. Leave the evidence in the oven for approximately 1 hour (oven temperature should be at approximately 200 degrees). A dry iron may be used in place of an oven.

5. Examine the processed samples with an alternate light source. For most papers, viewing between 450nm – 515nm (green light) with an orange filter. Some darker colored papers (cardboard box, paper bags), viewing between 515nm – 570nm with an orange or red filter may be needed. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner

6. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.
Storage:

Storage:
Dark bottle

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Previous validations have shown that IND does not destroy DNA.

2. On regular paper, ballpoint pen and Sharpie® inks do not run.

3. On thermal paper/receipts, the ink and the printer ink runs. In addition to the inks running, the thermal paper/receipts turn dark. If necessary, treatment with "running" ninhydrin can clear the dark background.

4. Fading of developed prints can occur.

References:

1. Kasper, Stephen P.; Minnillo, Donna J.; Rockhold, Amy M., *"Validating IND (1, 2-Indanedione)",* October 2002- Vol 4 – No. 4

2. BVDA, 1,2-Indanedione (1,2-IND) product information. (n.d.), Accessed December 2018, http://www.bvda.com/en/ind

3. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/indane.html

RETURN TO TABLE OF CONTENTS

5.21. IODINE

General Comment:

Iodine fumes adhere to sebaceous lipid-like materials (fats/oils/greases), and are used to develop latent prints primarily on porous surfaces. Iodine stains latent materials to a yellow or coffee brown appearance. Due to diffusion of stain materials into the paper matrix it is generally difficult to obtain latent prints on paper after several weeks.

Safety Concerns:

Iodine fumes should be considered toxic, and used with caution. Improper usage or exposure may cause irritation to the eyes or skin, and may be harmful if inhaled or ingested.

Safety Equipment:

1. Gloves (resistant to solvents)
2. Lab coat
3. Goggles
4. Mask

Materials and Equipment:

1. Fuming chamber
2. Ceramic or glass dish
3. Heat source

Chemicals:

Iodine Crystals

There are two ways to apply iodine: fuming with heat and a cold technique.

Fuming Method – Heat Technique:

1. Place the material to be processed in an iodine-fuming chamber.

2. Place a small quantity of iodine crystals in the receptacle.

3. Apply gentle heat to crystals until fuming begins.

4. Observe the development of latent prints.

5. Any developed latent prints should be preserved through photography soon after fuming is complete.

Fuming Method - Cold Technique:

1. Place paper items to be processed into an unheated fuming cabinet or plastic bag, which can be sealed.

2. Place a small quantity of iodine crystals into the chamber or plastic bag.

3. At room temperature, development may take from thirty minutes to several hours.

4. When using the plastic bag technique, vaporization of the crystals may be hastened by holding the bottom of the bag with the crystals firmly in the palm of the hand so that body temperature can speed the vaporization of the crystals.

5. When using this technique, the examiner shall be careful to ensure that the crystals are at the bottom of the bag and not touching the material to be processed. Iodine crystals in direct contact with paper discolor the area touched and may obscure any ridge detail.

6. Any developed latent prints should be preserved through photography soon after fuming is complete.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Iodine developed prints will slowly fade. Photography should be performed immediately.

2. Iodine developed prints may often be redeveloped with iodine after they have faded.

3. Magnetic fingerprint powder has shown success in intensifying iodine-developed prints. Magnetic fingerprint powders of colors different from the background can be used after iodine development for contrast. Spraying a clear lacquer over the magnetic powder can permanently fix the iodine-developed prints.

Disposal:

The iodine crystals are re-used. If contaminated, the chemical is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Manual of Fingerprint Development Techniques.*

2. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, pp. 28-30.

3. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 28-29.

4. Olsen, Robert, Scott's Fingerprint Mechanics, pp. 243-256.

RETURN TO TABLE OF CONTENTS

5.22. LEUCO CRYSTAL VIOLET (LCV)

General Comments:

Leuco crystal violet (LCV) is a catalytic test for blood. LCV is the reduced or colorless form of crystal violet. When LCV and an oxidizer such as hydrogen peroxide come into contact with hemoglobin or its derivatives, a violet colored dye (crystal violet) is formed.

Safety Concerns:

Precautions shall be taken to avoid inhalation of crystals and/or mist from the solution while spraying.

Safety Equipment:

1. Gloves (impervious to solution)
2. Lab Coat
3. Goggles
4. Mask

Materials and Equipment:

1. Beakers
2. Scale
3. Magnetic stirring device
4. Paper towels

Chemicals:

Working Solution

1000 ml Hydrogen peroxide (3%)
20 g 5-Sulfosalicylic acid
7.4 g Sodium acetate
2 g LCV

Procedure:

1. Prepare working solution by combining ingredients in the order listed. Place on a magnetic stirring device for approximately 30 minutes.

2. Apply the working solution by spraying with an aerosol sprayer or cascading the liquid over the impression with a squirt bottle. Application may also be possible by immersion or towel.

3. Development will occur within 30 seconds.

4. Allow area to dry. *Optional*: Blot the area with tissue paper or paper towel.

5. Proceeding steps can be repeated to possibly improve contrast.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. LCV interferes with other scientific examinations like forensic biology. Collect blood samples PRIOR to LCV processing.

2. LCV is a colorless solution. This technique is particularly useful for spray applications on large floor surfaces.

3. LCV luminesces and can be photographed and viewed under various wavelengths of UV and infra-red light.

4. LCV treatment can be followed with Amido black (glacial acetic acid/methanol mixture) should additional contrast be needed.

5. If LCV crystals are yellow, instead of white, do not use. This means the crystals are old and the solution will not be effective.

6. Cyanoacrylate fuming may be detrimental to this process.

7. Surfaces like tile or wood floors, where the LCV has pooled or beaded, may be rinsed with water approximately 2 minutes after the reagent has been applied. Carpeted areas or areas that have absorbed the LCV, need not be rinsed. Should the enhancement occur outdoors (in intense light) the impression should be photographed as soon as possible since photo-ionization of the dye may occur creating a violet background.

References:

1. Bodziak, William, *Footwear Impression Evidence: Detection, Recovery and Examination (2nd edition),* PP. 160-163.

2. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, pp. 31-32.

3. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints,* pp. 8-9.

RETURN TO TABLE OF CONTENTS

5.23. LIQUI-DROX

General Comments:

Liqui-Drox is a fluorescent dye used enhance cyanoacrylate developed latent prints on adhesive and non-adhesive sides of dark-colored tape. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Graduated cylinders
4. beakers
5. Ardrox P133D
6. Liqui-Nox
7. Distilled Water
8. Laser, forensic light source or UV Light
9. Photographic equipment
10. Color filters (yellow)

Chemicals:

Liqui-Drox Working Solution

200 ml Ardrox P133D
400 ml Liqui-Nox
400 ml distilled water

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solution of Liqui-Drox. Mix Ardrox P133D, Liqui-Nox, and distilled water. Stir ingredients. The solution should be thick and have a milky yellow color.

   *The Liqui-Drox solution will become clear with time and should not be used in this condition. Stir to return the milky color to the solution and use as normal.

2. Apply solution with a small brush to both sides of the tape, provided the nonadhesive side of the tape has been cyanoacrylate fumed. Brush until a lather is produced. Allow the solution to sit on the tape for about 10 seconds.

3. Rinse the tape evidence under a stream of water until Liqui-Drox is no longer visible

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes.

5. While using a long wave ultra violet light. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints. Photograph promptly, because the ridge detail begins to fade within 12 hours. Do not leave the specimen under the UV light for extended periods of time because this will cause the latent print to fade.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of Liqui-Drox shall take place under a properly ventilated hood.

2. Any evidence treated with Liqui-Drox shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders on the non adhesive side of tape should

follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. Liqui-Drox should be used after DNA collected as dye stains and UV light destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 51. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Hollars, M., Trozzi, T., and Barron, B., (2000). "Development of Latent Fingerprints on Dark Colored Sticky Surfaces Using Liqui-Drox", Journal of Forensic Identification, 50(4), pp. 357-362

3. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/liqui.html

4. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.24. LUMICYANO

General Comments:

Lumicyano allows, with a one-step process, the revelation of fingerprints using standard fuming chambers. This process removes the stages of dyeing or dusting with powder. Fingerprints are fluorescent immediately. The Lumicyano process requires the combined use of Lumicyano Powder and Lumicyano Solution.

Safety Concerns:

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Avoid breathing dust.

Safety Equipment:

1. Eye protection
2. Gloves
3. Lab coat
4. Mask

Materials and Equipment:

1. Foil dish
2. Hot plate
3. Fuming chamber
4. Photography equipment
5. Forensic light source
6. Colored filters (orange)

Chemicals:

Lumicyano Solution
Lumicyano Powder

Procedure:

1. Place the proper amount of Lumicyano Powder into a new foil dish then disperse the powder evenly to avoid clustering. It is possible to get chunks of Lumicyano Powder in the vial. This arises from its crystalline structure and potential traces of moisture entering the vial while using it or even during the bottling. You may just break these chunks with a clean and dry metallic spatula by scratching the powder. This phenomenon does not affect the efficiency of the product. Close immediately the vial after use to avoid any potential humidity absorption.

2. Add directly Lumicyano Solution™ (see further for recommended dosage) into the foil dish. Lumicyano Powder is dissolved instantly with the Lumicyano Solution. Gently move the liquid around the foil dish until you homogenize the mixture and it becomes an evenly mixed fluid.

3. Place the prepared foil dish with its mixture onto the hotplate. Raise hygrometry until 70/80%. Higher hygrometry may lead to over glueing. Then raise gradually the hotplate temperature to reach 1200C/250°F. Fume completely the mixture until none remains left in the foil dish.

4. Photograph developed prints within 24 hours of development. For optimal results view under 480nm - 495nm wavelength with an orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Notes:

1. Lumicyano is fully compatible with DNA analysis as genetic material is not altered over a fuming cycle.

2. Fluorescence intensity may fade over time. It is recommended to photograph developed prints within the first few days of development.

3. It is possible to perform an additional fuming cycle using Lumicyano to recover the fluorescence without damaging the ridge details.

4. Photograph using orange filter especially on reflective surfaces.

Storage:

Original containers in cold, dry and dark environment.

Shelf life:

Refer to Chemical Shelf Life guidelines.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Anne Bisotti; Clémence Allain; Jean-Luc Georges; Florence Guichard; Pierre Audebert; Isabelle Barbosa; Laurent Galmiche (2016). New Lumicyano Kit: Comparison Studies with the First

Generation and Effectiveness on Nonporous Substrates. Journal of Forensic Identification, 66 (6), pp. 560-575.

2. https://www.shopevident.com/sites/default/files/msds/Lumicyano_User_Guide_V11.pdf

3. Crime Scene Technology-Lumicyano Frequently asked Questions V-12, 2016.

RETURN TO TABLE OF CONTENTS

5.25. MIKROSIL

General Comments:

Mikrosil is a silicone impression compound used for lifting impressions of friction ridge detail on various surfaces. Ideal for use on rough surfaces after developing with fingerprint powder. Mikrosil is available in white, black, brown and gray to increase detail on various surfaces.

Safety Concerns:

Mikrosil is not classified as hazardous or dangerous to human health or the environment.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Mask (if DNA a component of case)

Materials and Equipment:

1. Mikrosil Silicone
2. Mikrosil Hardener
3. Wooden mixing sticks
4. Lift cards

Procedure:

To be conducted after latent prints developed on surface of item

1. Squeeze out equal lengths about 1 ½" to 2" long from the two tubes onto the shiny side of one of the white cards. One line of paste will be thinner than the other due to the smaller nozzle on the tube. The tubes are designed this way to give proper portions of each paste.

2. With one of the wooden mixing sticks, mix the two components together thoroughly on the card. This should take 30-60 seconds.

3. Optional: Scrape Mikrosil off of mixing card with wooden stick and set off to side of card. Use this drying time to gauge drying time of Mikrosil on evidence.

4. Scrape Mikrosil off of mixing card with wooden and place it on latent print. Setting time will be between 5-8 minutes in 68°F(20°C) weather and 12-15 minutes in below-freezing temperatures. When the Mikrosil has set, gently peel it from the surface.

5. Photograph results.

Positive Control:

Positive controls are run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Store only in original container in dry area. Recommended storage temperature 15-30C, 50% humidity.

Shelf life:

Two years from date of manufacture. If product used after this date a test must be performed to check the product effectiveness.

Notes:

1. Mikrosil is ideal for rough, textured surfaces.

2. Fingerprint Powder is used prior to Mikrosil to enhance prints on difficult surfaces.

3. The setting time depends on the ambient temperature. The lower the temperature, the slower the material sets, and the higher the temperature, the faster the setting time.

4. Mikrosil comes in various colors that are generally used for the following purposes:

   White – Reverse prints
   Gray- Prints
   Brown – Toolmarks and Casings
   Black – Firearms, Toolmarks

Disposal:

Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Armor Forensics Technical Note (May 2006), Mikrosil Casting Putty

2. Evident, Mikrosil Silicone-White 200G Tube, Accessed December 2018, https://www.shopevident.com/product/mikrosil-silicone-white-200g-tube

3. The Safariland Group, Mikrosil White, 7 oz., Accessed December 2018, http://www.safariland.com/products/forensics/evidence-collection/tool-mark-casting/mikrosil-white-7-oz.-200g-F_155.html#q=mikrosil&start=1

4. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.26. 5-METHYLTHIONINHYDRIN (5-MTN)

General Comments:

5-Methylthioninhydrin (5-MTN) is a reagent for fingerprints that combines the favorable characteristics of ninhydrin (strong color) and those of DFO and 1,2-IND (strong fluorescence).5-MTN-developed fingerprints have a stronger color than those developed with regular ninhydrin. Therefore, the working solution can have a lower concentration (at 3 g per liter, the strength of the color is about the same). After treatment with zinc chloride, 5-MTN-developed prints become a more reddish colored purple.

Safety concerns:

Fume hood use is required for reagent preparation and application.

Safety Equipment:

1. Eye protection
2. Gloves
3. Lab coat
4. Mask

Materials and Equipment:

1. 3 g 5-MTN crystals
2. 1000 ml petroleum ether
3. Tray (glass, plastic or metal)
4. Tongs
5. Photographic equipment

Procedure:

1. Submerge item in reagent - 5 seconds. May also be applied by brushing solution onto item or spraying solution onto item until coated.
2. Heat up to 80 degrees C with humidity exposure at 60% - 70 % relative humidity. Monitor for development. May also use steam iron for development.
3. Photograph developed prints using a green filter.
4. View non-Zinc Chloride latent prints under a forensic light source at 530 nm using no barrier filter.
5. Item may be treated with Zinc Chloride. View under a forensic light source at 530 nm using orange barrier filter.

Storage:

Store in dark container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Disposal:

Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. "Latent Fingerprint Investigation, Amino acid reagents, 5-Methylthioninhydrin (5-MTN)", http://www.bvda.com.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/5mtn.html

RETURN TO TABLE OF CONTENTS

5.27. MOLYBDENUM DISULFIDE (MBD)

General Comments:

Molybdenum Disulfide (MBD) is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

5.27.1.Premix

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Photographic equipment
5. Color filters (red or orange)

Chemicals:

MBD premix solution

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Optional: Rinse solvents with running water.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 415nm-535 nm laser with red or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.27.2. Unmixed

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Magnetic stirring device
4. Laser, forensic light source or UV light
5. Photographic equipment
6. Color filters (red or orange)

Chemicals:

M.B.D. Stock Solution
1g M.B.D. powder
1 L Acetone

M.B.D. Working Solution
10 ml M.B.D. Stock Solution
30 ml Methanol
10 ml Isopropanol
950 ml Petroleum ether

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare M.B.D. Stock Solution. Use magnetic stirring device to combine ingredients.

2. Prepare M.B.D. Working solution. Use magnetic stirring device to combine ingredients in order listed

3. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

4. Optional: Rinse solvents with running water.

5. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

6. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 415nm-535 nm laser with red or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

7. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of MBD shall take place under a properly ventilated hood.

2. Any evidence treated with MBD shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. MBD should be used after DNA collected as dye stains destroy DNA.

Disposal:

The solution can be reused. If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 52-53. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/mbd.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.28. MRM 10

General Comments:

MRM 10 is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

1. Glass tray
2. Beakers
3. Magnetic stirring device
4. Rinse bottle
5. Dark storage bottles
6. Laser, forensic light source or UV light
7. Photographic equipment
8. Color filters (red or orange)

Chemicals:

Stock Solution A

1 g Rhodamine 6G
1 L Methanol

Stock Solution B

2 g Basic Yelllow 40
1 L Methanol

Stock Solution C

1 g MBD
1 L Acetone

MRM 10 working solution

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

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prior to mixing the MRM 10 cyanoacrylate dye solution, stock solutions A, B, and C must be prepared.

2. Mix Stock Solution A. Use magnetic stirring device to combine the ingredients for Stock Solution A. Stir until Rhodamine 6G is dissolved into methanol.

3. Mix Stock Solution B. Combine the ingredients and place on magnetic stirring device to dissolve the Basic Yellow 40 into methanol.

4. Mic Stock Solution C. Combine the ingredients and place on magnetic stirring device to dissolve MBD.

5. Mix MRM 10 working solution. Combine the ingredients in the order listed. **Do not place on a stirring device.**

6. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

7. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use air compressor or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

8. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 430 nm-530 nm laser with red or orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

9. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines

Notes:

1. The application of MRM 10 shall take place under a properly ventilated hood.

2. Any evidence treated with MRM 10 shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. MRM 10 should be used after DNA collected as dye stains destroy DNA.

Disposal:

The solution can be reused. If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 54-55. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/mrm.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.29. NILE RED

General Comments:

Nile Red is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

5.29.1. Premix

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Nile Red dye solution
4. Laser, forensic light source or UV light
5. Photographic equipment
6. Color filters (red or orange)

Chemicals:

Nile Red dye solution

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

3. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 450nm-560 nm laser with orange or red filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

4. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.29.2. Unmixed

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Magnetic stirring device
5. Photographic equipment
6. Color filters (red or orange filters recommended)

Chemicals:

Nile Red dye solution

100 mg Nile Red Dye
1L Ethanol

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare Nile Red dye solution and use magnetic stirring device to combine ingredients.

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 450nm-560 nm laser with orange or red filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of Nile Red shall take place under a properly ventilated hood.

2. Any evidence treated with Nile Red shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. Nile Red should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/nile.html

2. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.30. NINHYDRIN

General Comments:

Ninhydrin reacts with the amino acids and proteins in a latent print to produce a purple colored stain. Latent prints may develop within a few hours or over the course of several days. The application of heat and humidity can accelerate the reaction so that the majority of latent prints develop within minutes. Ninhydrin is useful for processing latent prints on porous surfaces – especially paper.

Ninhydrin can also be effective in enhancing partial and faint impressions in blood (see Notes in this section).

Safety Concerns:

Ninhydrin is not a carcinogen; however, some of the solvents used to prepare it should be considered potentially hazardous and/or flammable. Care should be taken not to allow the solvents to be ingested or absorbed by the skin.

Safety Equipment:

1. Gloves resistant to solvents
2. Lab coat
3. Eye protection (optional)
4. Mask (optional)

Materials and Equipment:

1. Trays
2. Tongs or tweezers
3. Ninhydrin solution
4. Drying racks
5. Steam iron (optional)
6. Photographic equipment

5.30.1. Ninhydrin- HFE-7100

Chemicals:

Ninhydrin-HFE 7100 Working Solution

5 g Ninhydrin Crystals
45 ml ethanol
2 ml ethyl acetate
5 ml acetic acid
1 L Engineered Fluid HFE-7100

Procedure:

1. Mix Ninhydrin working solution using magnetic stirring device. Dissolve 5g Ninhydrin Crystals into 45 ml ethanol. Add 2 ml ethyl acetate. Add 5 ml acetic acid. Mix until all Ninhydrin crystals are dissolved.

2. Stir in one liter of Engineered Fluid HFE-7100. Mix until a milky yellow solution is formed.

3. Cover and allow solution to settle for approximately 30 minutes. A thin oily film may form on top of the solution. This film consists of water, excess ethanol and ninhyrin and must be removed prior to use. The film can be removed using separatory funnel, filter paper, or pipette.

5.30.2. Ninhydrin – Petroleum Ether

Chemicals:

Ninhydrin – Petroleum Ether Working Solution

5 g Ninhydrin Crystals
30 ml ethanol
40 ml isopropanol
930 ml petroleum ether

Procedure:

1. Mix Ninhydrin working solution using magnetic stirring device. Dissolve the Ninhydrin crystals first into methanol before adding the chemicals in the above order.

Processing Procedure (Ninhydrin can be applied by dipping, brushing, or spraying):

1. Handwritten or typed evidence item(s) must be photocopied and/or photographed prior to processing (evidence may be damaged in development).

2. Prepare one of the working solutions of Ninhydrin as described in this Manual after due consideration of the substrate to be processed.

3. Select the appropriate application process (dipping, brushing, or spraying). Applications shall be done under a fume hood.

    A. Dipping Process:
        i. Pour a sufficient quantity of the Ninhydrin solution into a clean shallow dish or tray.
        ii. Immerse the material to be processed (handle with tweezers or tongs)
        iii. Remove and allow the processed material to thoroughly dry.
        iv. Photograph and/or photocopy any developed prints.

B. Brushing Process:
   i. Pour a quantity of the Ninhydrin solution into a clean dish or tray.
   ii. Dip the brush into the solution then "paint" the surface of the material to be processed.
   iii. Allow the processed material to thoroughly dry.
   iv. Photograph and/or photocopy any developed prints

C. Spraying Processing:
   i. Spray the Ninhydrin solution evenly over the surfaces to be processed until they are wet.
   ii. Allow the processed material to thoroughly dry.
   iii. Photograph and/or photocopy any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Latent prints may take days to develop so a minimum of 7 days is recommended prior to documenting any developed prints.

2. Item(s) should also be evaluated and/or examined by the Questioned Documents Section prior to latent print processing if indentation or apparent erasures are noted.

3. Latent prints processed with Ninhydrin will fade and eventually disappear. This fading process can start as soon as a few months after processing; therefore, photographing, photocopying or scanning useable prints is essential for preservation and documentation.

4. D.F.O. should not be used after Ninhydrin.

5. If paper items have been subjected to moisture, Physical Developer is the best method after processing with Ninhydrin. All prints developed with Ninhydrin shall first be photographed, as subsequent use of physical developer will destroy latent prints processed with Ninhydrin.

6. To enhance partial bloody impressions, the best results are usually obtained by lightly misting the areas with Ninhydrin then allowing the area to develop for a couple of days. It may be necessary to repeat this procedure several times before the prints develop to their optimum. Any prints processed in this manner should be photographed prior to processing and at each

stage of development. Prior consideration should also be given to alternative blood enhancement techniques, such as leuco crystal violet.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Mock, James P., *Basic Latent Print Development*, p. 44.

3. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 32-33.

4. Federal Bureau of Investigations*, Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, pp. 33-34, and p.56.

RETURN TO TABLE OF CONTENTS

5.31. OIL RED O

General Comments:

Oil Red O is stain that adheres to lipids (fats). This method is best used to develop or enhance prints on porous items which have been previously wet or damp. Oil Red O stains the lipid residues in a latent print by turning a red color on a pink background.

Safety Concerns:

Oil Red O is not a carcinogen, however, some of the solvents used to prepare it should be considered potentially hazardous and /or flammable.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection (optional)
4. Mask

5.31.1. Premix

Materials and Equipment:

1. Trays
2. Tongs or tweezers
3. Photographic equipment

Chemicals:

Oil Red O working solutions and buffer solutions

Procedure:

1. Handwritten or typed evidence item(s) must be photocopied and/or photographed prior to processing (evidence may be damaged in development).

2. Use a clean tray and immerse the item in the stain solution. Make sure that the item is thoroughly covered. Application shall be performed in a fume hood. Optional: place tray on oscillator.

3. Moderate to strong fingerprints should begin to appear in approximately five minutes. Weaker impressions may take longer.

4. Remove the item. Use a clean tray to immerse the item in buffer solution.

5. Remove item and rinse in distilled water.

6. Allow item to air dry at room temperature in fume hood.

7. Photograph any developed prints.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.31.2. Unmixed, at your own risk version (must have written last will and testament before mixing)

Materials and Equipment:

1. Trays
2. Tongs or tweezers
3. Scale
4. Beakers
5. Graduated cylinder
6. Magnetic stirring device
7. Dark storage bottle
8. Distilled water
9. Photographic equipment

Chemicals:
Oil Red O Stain Solution
1.54 g Oil Red O Powder
770 ml methanol
1.2 g Sodium Hydroxide
230 ml distilled water

Buffer Solution (pH 7)
26.5 g Sodium carbonate
2L distilled water
18.3 ml nitric acid

Procedure:

1. Handwritten or typed evidence item(s) must be photocopied and/or photographed prior to processing (evidence may be damaged in development).

2. Prepare Oil Red O Stain Solution. Dissolve 1.54g Oil Red O Powder into 770 ml methanol. Dissolve 9.2g sodium hydroxide in 230 ml of distilled water and add it to the Oil Red O solution.

3. Prepare Oil Red O Buffer Solution.Dissolve 26.5g of sodium carbonate into 2L of distilled water. Slowly add 18.3 ml of 70% concentrated nitric acid while stirring. Add distilled water to make 2.5 L.

4. Use a clean tray and immerse the item in the stain solution. Make sure that the item is thoroughly covered. Application shall be performed in a fume hood. Optional: place tray on oscillator.

5. Moderate to strong fingerprints should begin to appear in approximately five minutes. Weaker impressions may take longer.

6. Remove item use a clean to immerse the item in buffer solution.

7. Remove item and rinse in distilled water.

8. Allow item to air dry at room temperature in fume hood.

9. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Consideration should be given to possible indentation or apparent erasures. If necessary, item(s) may need to be examined by the Questioned Documents Section at San Diego County Sheriff's Department prior to latent print processing.

2. Prior to any processing, photograph or photocopy. Do not lift prints. Photographs shall be taken after each processing technique.

3. Ninhydrin, DFO and Indanedione can be used prior to Oil Red O and consideration should also be given to alternative enhancement techniques.

4. Be aware of the potential for cross contamination if more than one article is processed in the same working solution or rinse.

5. Oil Red O can be used after other porous development methods prior to physical developer.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Beaudoin, A. & Guigui, K. (2007). The Use of Oil Red O in Sequence with Other Methods of Fingerprint Development. Journal of Forensic Identification, 57 (4), pp. 550-581

2. Dalrymple, B. & Norman, J. (2012). Finding latent Evidence with Chemistry & Light. Ron Smith & Associates. pp. 46, 99

3. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/oilredo.html

4. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

5. Oil Red O - 16 oz. set. (n.d.). Retrieved December 2018, https://www.shopevident.com/product/oil-red-o-16-oz-set

RETURN TO TABLE OF CONTENTS

5.32. PHYSICAL DEVELOPER (Pre-mixed)

General Comments:

Physical developer is a silver-based liquid reagent, which reacts with the sebaceous materials (lipids, fats, oils, and waxes) present in latent print residues. Physical developer is a productive means of developing latent prints on porous objects; however, it should be considered the last of the processes in the chemical sequence.

Physical Developer has been found to work well on numerous items including wooden knife handles, clay fire-bricks, both sides of adhesive tape, concrete, unfinished wood, and paper items. This process has also been successful for developing latent prints on paper that has been wet.

Safety Concerns:

Physical Developer is not a carcinogen; however, some of the chemicals used should be considered potentially hazardous. Physical Developer is considered safe to use as long as due care and appropriate safety precautions are observed.

Safety Equipment:

1. Non-porous gloves
2. Lab coat
3. Eye protection
4. Mask

Materials and Equipment:

1. Clean glassware
2. Tongs (plastic)
3. Agitator

Chemicals:

Solution 1

Maleic Acid Solution

Solution 2

Redox Working solution
Detergent
Silver Nitrate

Rinse Solutioin

Tap water

Procedure:

To be used after processing with ninhydrin and photographing any already developed prints:

1. Pour appropriate quantities of the prepared solutions into separate, clean glass dishes or trays. Trays shall be extremely clean.

2. Submerge articles to be processed in Physical Developer solution #1 for 5 minutes or until any bubbling action ceases.

3. Remove the items being processed from solution #1, and submerge them in solution #2 for 5 to 15 minutes. Development times vary so this process requires monitoring.

4. Remove article and carefully rinse with cool tap water.

5. If your evidence has a dark or patterned background, follow this process with the bleaching solution (see "Notes #5" below).

6. Hang evidence in vent hood to dry.

7. Photograph any prints that develop.

8. Repeat procedure if necessary.

9. Rinse evidence with tap water.

10. Rinse evidence with tap water and allow to dry.

11. Photograph the developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Notes:

1. The shelf life of prepared Physical Developer working solution is only about 1-2 days. Mix only sufficient working solution to process the materials you currently have.

2. Faint prints may be improved by additional processing cycles.

3. A thorough rinsing process is necessary to remove excess chemicals and limit background development.

4. Prints develop at different speeds, so after the first print develops continue the immersion process in the physical developer solution as long as additional prints continue to develop or until the background begins to darken.

5. This process may darken the background. If the background is too dark, a sodium hypochlorite (bleach) solution as described in the FBI *Processing Guide for Developing Latent Prints, p.34,* can be used for lightening the background.

6. The distilled water and all solutions used in the Physical Developer process must be between 17° C and 23° C (62.5°F and 73.4° F).

7. All glassware and magnetic stirrers used in the process must be cleaned thoroughly. Wipe all internal surfaces of beakers with paper towels under cold tap water and rinse with distilled water before use.

8. All visible impressions must be photographed immediately. Diffused illumination is usually satisfactory, but in some cases oblique lighting may be useful.

9. Fluorescent examination may also prove useful, particularly if a confused background is present

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 34-35.

3. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints*, 2000, pp. 34-37.

4. Technical Information, Physical Developer. Sirchie 2015.

RETURN TO TABLE OF CONTENTS

5.33. POWDER/LIFTING

General Comments:

Fingerprint powders adhere to both sebaceous and eccrine materials such as the lipids, fats, oils and aqueous materials found in latent print residues. Powders, available in a variety of colors, are useful on dry, relatively smooth, non-porous surfaces.

Safety Concerns:

This procedure is considered relatively safe but precautions should be taken to prevent inhalation of the fingerprint powder. Powders, other than magnetic powders, should be applied at a workbench where vent hoods can exhaust any excess powder.

Safety Equipment:

1. Lab coat
2. Gloves
3. Eye protection (optional)
4. Mask (optional)

Materials and Equipment:

1. Fingerprint powder
2. Latent print brush
3. Latent lifting tape or other lifting devices
4. Latent lift cards
5. Scissors
6. Marking device

Procedure:

1. Pour a small amount of fingerprint powder into a small pile on a piece of paper or tray.

2. Dip the brush into the powder. Additional powder can be applied later if necessary.

3. Carefully dust the area to be processed for latent prints with gentle, light strokes.

4. Brush in the direction of any ridges that begin to appear, building powder onto the ridges to a point of clarity.

5. Clean excess powder from between ridges, and when the print(s) are no longer being enhanced, stop dusting.

6. Anchor the lifting tape beside the print(s) then overlay the tape onto the print. Smooth the tape as much as possible to remove air pockets.

7. Gently lift the tape from the processed item.

8. Place the tape on a contrasting color lift card and smooth the tape.

9. Detach the completed lift from the lifting tape.

10. Fill out the lift card with appropriate information such as case number, victim, date lifted, location and crime. A sketch should also be drawn on the lift-card that includes the position and direction of the latent print(s) that were lifted.

Notes:

1. If swabbing for DNA, the examiner shall use a disposable fingerprint brush.

2. Mikrosil casting, gel lifters, and/or the clear glue method may be used as an alternative to using lifting tape.

3. Additional lifts can occasionally be made from powdered prints and often the later lifts are of better quality than the first lift. If during the dusting process a print develops and then starts to fade, do not dust further. Print(s) can be destroyed.

4. As a general rule, the powder selected should contrast with the color of the evidence item.

5. Powdering may enhance faint bloody prints on non-porous surfaces like glass. These prints shall be photographed prior to dusting. Bloody prints shall not be lifted until they are completely dry and have been photographed.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Mock, James P., *Basic Latent Print Development*, p. 18

3. Federal Bureau of Investigations, *The Science of Fingerprints*

4. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 30-31

5. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints*, 2000, pp. 26-27.

RETURN TO TABLE OF CONTENTS

5.34. RAM

General Comments:

RAM is a fluorescent dye mixture of Rhodamine 6G, Ardrox, and MBD used to enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

5.34.1. Premix

Materials and Equipment:

1. Tray
2. Rinse bottle
3. RAM premix solution
4. Laser, forensic light source or UV light
5. Photographic equipment
6. Color filters (orange)

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Optional: Rinse solvents with running water or Petroleum ether.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 415 nm-530 nm laser with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.34.2. Unmixed

Materials and Equipment:

1. Tray
2. Beakers
3. Graduated Cylinders
4. Dark colored bottles
5. Rinse bottle
6. Laser, forensic light source or UV light
7. Photographic equipment
8. Color filters (orange)

Chemicals:

Rhodamine 6G Stock Solution
1 g Rhodamine 6G
1 L Methanol

M.B.D. Stock Solution
1 g M.B.D.
1 L Acetone

R.A.M. Working Solution
3 ml Rhodamine Stock Solution
2 ml Ardrox P133D
7 ml M.B.D. Stock Solution
20 ml Methanol

10 ml Isopropanol
8 ml Acetonitrile
950 ml Petroleum ether

Combine in order listed

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare Rhodamine 6G Stock Solution by dissolving R6G into methanol.

2. Prepare M.B.D. Stock Solution by dissolving M.B.D into Acetone.

3. Prepare R.A.M. Working Solution by combining ingredients in order listed.

4. Apply even coat of R.A.M working solution to evidence item(s) by immersion or with a rinse bottle.

5. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

6. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 415 nm-530 nm laser with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

7. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark colored bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of RAM shall take place under a properly ventilated hood.

2. Any evidence treated with RAM shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. RAM should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 45. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

3. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/ram.html#ttops

4. Evident R.A.M. Dye Stain – 32oz. Premix (n.d.). Retrieved December 2018, https://www.shopevident.com/category/chemical-processing/ram-dye-stain-rhodamine-ardox-and-mbd

RETURN TO TABLE OF CONTENTS

5.35. RAY

General Comments:

RAY is a fluorescent dye mixture of Rhodamine 6G, Ardrox, and Yellow 40 used to enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

5.35.1. Premixed

Materials and Equipment:

1. Tray
2. Rinse bottle
3. RAY premix solution
4. Laser, forensic light source or UV light
5. Photographic equipment
6. Color Filters (orange and red recommended)

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Optional: Rinse solvents with running water or Petroleum ether.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 450nm-550nm with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottle

Shelf life:

Refer to Chemical Shelf Life guidelines.

5.35.2. Unmixed

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light
4. Photographic equipment
5. Color Filters (orange and red)

Chemicals:

R.A.Y. Working Solution

0.5 g Basic Yellow 40 Dye
10 ml Glacial Acetic Acid
0.05 g Rhodamine 6 dye
4 ml Ardrox P133D
450 ml Isopropanol or denatured Ethanol
40 ml Acetonitrile

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare R.A.Y Working Solution by combining ingredients in the order listed.

2. Apply even coat of R.A.Y, Working Solution to evidence item(s) by immersion or with a rinse bottle.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 450nm-550nm with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottle

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of RAY shall take place under a properly ventilated hood.

2. Any evidence treated with RAY shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. RAY should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Evident-R.A.Y. Dye Stain- 32 oz. Premix. (n.d.) Retrieved December 2018, https://www.shopevident.com/product/ray-dye-stain-32-oz-premix

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/ray.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

4. Wilson, H. (2010). Ray Dye Stain Versus Gentian Violet and Alternate Powder for Development of Latent Prints on the Adhesive Side of Tape. Journal of Forensic Identification, 60 (5), pp. 510-523

RETURN TO TABLE OF CONTENTS

5.36. RHODAMINE 6G (R6G)

General Comments:

Rhodamine 6G is a fluorescent dye used to enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

5.36.1. Unmixed Solution

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety Goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

1. Beakers
2. Graduated cylinder
3. Clear or dark storage bottles
4. Tray
5. Rinse bottle
6. Rhodamine 6G dye
7. Laser, forensic light source or UV light
8. Photographic equipment
9. Color filters (orange or red)

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

5.36.1.1. Methanol Based Solution

Chemicals:
Methanol Based Solution

0.15 g Rhodamine 6G

250 ml Methanol

Procedure:

1. Prepare working solution of Rhodamine 6G dye by adding Rhodamine 6G to methanol.

2. Apply even coat Rhodamine 6G working solution to the evidence item(s) by immersion or with a rinse bottle.

3. Rinse vigorously in tap water or methanol before dye dries.

4. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

5. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 475nm-532 nm laser with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints.

5.36.1.2. Water Based Solution –shiny coated papers/magazines

Chemicals:

Water Based Solution

Rhodamine 6G dye
1 L Distilled water

Procedure:

1. Prepare working solution of Rhodamine 6G dye. Carefully add Rhodamine 6G to 1 liter of water until color is cherry red. Avoid adding too much Rhodamine 6G. It is not as soluble in water as it is in methanol.

2. Apply even coat of dye solution to the evidence item(s) by immersion or with a rinse bottle.

3. Immediately rinse evidence item(s) in water.

4. Remove water spots with compressed air or paper towel. Allow evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes

5. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 475nm-532 nm laser with orange filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

6. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The preparation and application of Rhodamine 6G shall take place under a properly ventilated hood.

2. Any evidence treated with Rhodamine 6G shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. Rhodamine 6G should be used after DNA collected as dye stains destroy DNA.

5.36.2. Premix Solution

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety Goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

1. Tray
2. Rinse bottle
3. Laser, forensic light source or UV light

4. Photographic equipment
5. Color filters (orange or red)

Chemicals:

Rhodamine 6G Premix solution

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

2. Optional: Rinse solvents with running water or methanol.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 475nm-532 nm laser with orange or red filter.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original packaging

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The preparation and application of Rhodamine 6G shall take place under a properly ventilated hood.

2. Any evidence treated with Rhodamine 6G shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and

fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. Rhodamine 6G should be used only after DNA has been collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 57-58. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Dalrymple, B. & Norman, J. (2012). Finding latent Evidence with Chemistry & Light. Ron Smith & Associates. pp. 22-23, 95

3. Dalrymple, B. & Norman, J. (2015). Advanced Sequential Processing Workshop. Ron Smith & Associates. pp. 75, 130

4. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

5. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/rhod.html

RETURN TO TABLE OF CONTENTS

5.37. RTX DEVELOPER

General Comments:

The RTX (Ruthenium Tetroxide) Developer is used for the development of latent prints that are deposited on all varieties of substrates. An exception, because of the reaction color, is those substrates having black porous surfaces.

Safety Concerns:

Caution should be used when using the RTX Developer. Fumes can irritate the eyes and respiratory tract. All applications shall be carried out in a fume hood.

Safety Equipment:

1. Gloves
2. Lab coat or coveralls
3. Mask (optional)
4. Eye protection (optional)

This method should be used prior to any other methods that require the application of aluminum powder, ninhydrin or cyanoacrylate esters, because those chemicals interfere with the effectiveness of the RTX Developer or the fumes from it. This method has not been found to interfere with the effectiveness of the other methods.

Procedure:

The RTX Developer can be applied two ways: by a Fuming method or by a Dip method.

Fuming Method:

Fumes are blown out of the commercially obtained solution with the fumer directly onto the item to be processed. Latent prints develop in a black or brownish black color. Photograph any developed latent prints. To further develop a latent print, additional fumes can be blown over the item.

Dip Method:

Pour the commercially obtained working solution into a clean, dry, glass dish. Dip the item(s) to be processed into the solution. The developed prints will appear immediately, particularly on sticky surfaces. Photograph any developed latent prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Disposal:

The chemical is poured back into the original container and is re-used. If contaminated, the chemical is disposed of as hazardous waste.

References:

1. MASHIKO, Kenzo, Operation Manual for RTX

RETURN TO TABLE OF CONTENTS

5.38. SAFRANIN O

General Comments:

Safranin O is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. A laser or alternate light source is used in conjunction with this process. This dye is very effective at the low 500 nm region.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles
4. Colored goggles (when viewing with laser)
5. Mask

Materials and Equipment:

2. Tray
3. Rinse bottle
4. Scale
5. Magnetic stirrer & magnetic stirring rod
6. Laser, forensic light source or UV light
7. Photographic equipment
8. Color filters (orange or red)

Chemicals:

Safranin O Working Solution
1 gm Safranin O
1L Methanol

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare working solution of Safranin O dye**.** Combine Safranin O and Methanol. Place on stirring device for approximately 15 minutes.

2. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

3. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use air compressor or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

4. While using an orange or red filter/goggles, examine under laser or high intensity light source illumination at 470-560nm laser with orange or red filter. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

5. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of Safranin O shall take place under a properly ventilated hood.

2. Any evidence treated with Safranin O shall be thoroughly dried before moving to any other area of the laboratory.

3. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

4. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

5. The excitation wavelength may be varied to determine which produces the best fluorescence.

6. Safranin O should be used after DNA collected as dye stains destroy DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 59. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/safarin.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.39. SILVER NITRATE

General Comments:

Silver nitrate reacts with the sodium chloride or salt content in the eccrine materials of perspiration, and is useful in developing latent prints on porous items. When exposed to strong light such as sunlight or ultraviolet (UV), developed prints appear dark in color.

Safety Concerns:

Silver Nitrate solutions or crystals may cause burns or blisters if in prolonged contact with the skin. Silver Nitrate solutions and sprays should be considered caustic. Inhalation of Silver Nitrate spray may damage the lungs and could result in poisoning.

Safety Equipment:

1. Gloves resistant to solvents
2. Lab coat
3. Goggles (optional)
4. Mask (optional)

Materials and Equipment:

1. Tray
2. Tongs
3. Magnetic stirring device
4. Photographic equipment

5.41.1 Water Based Solution

Chemicals:

Working Solution – water based

30 g Silver nitrate
1 L Distilled water

Procedure:

1. Prepare the working solution of silver nitrate. Combine silver nitrate and distilled water and place on magnetic stirring device for approximately 10 minutes or until the crystals are dissolved.

Immersion Method:

1. Place a sufficient quantity of the silver nitrate working solution into a clean, dry, dish or tray to completely cover the item(s) to be processed. Immerse for approximately two minutes.

2. Remove the stained item(s) from the solution and allow to completely air dry away from direct sunlight.

3. Once completely dry, expose the item to high-intensity light to develop impressions.

4. Photograph any developed latent prints.

Brush Method

1. Brush the item(s) to be processed with a sufficient amount of silver nitrate working solution to completely wet the article.

2. Allow the item to air dry away from direct sunlight.

3. Once completely dry, expose the item to high-intensity light to develop impressions.

4. Photograph any developed latent prints.

5.41.2 Alcohol Based Solution

Chemicals:

Working Solution – alcohol based

30 g Silver nitrate
100 mL Distilled water
1 L Ethanol

Procedure:

1. Prepare the working solution of silver nitrate. Combine the silver nitrate and distilled water and place on magnetic stirring device until all the crystals are dissolved.

2. Add solution of silver nitrate and distilled water to ethanol.

Immersion Method:

1. Place a sufficient quantity of the silver nitrate working solution into a clean, dry, dish or tray to completely cover the item(s) to be processed. Immerse for approximately two minutes.

2. Remove the stained item(s) from the solution and allow to completely air dry away from direct sunlight.

3. Once completely dry, expose the item to high-intensity light to develop impressions.

4. Photograph any developed latent prints.

Brush Method

1. Brush the item(s) to be processed with a sufficient amount of silver nitrate working solution to completely wet the article.

2. Allow the item to air dry away from direct sunlight.

3. Once completely dry, expose the item to high-intensity light to develop impressions.

4. Photograph any developed latent prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark glass bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Use water based solution on general applications and alcohol based solution for processing samples that may repel water-based mixtures (waxed paper, Styrofoam, etc.).

2. Stains on blueprints, photographs or photostats caused by the Silver Nitrate process cannot be removed without damaging the article.

3. Latent prints developed by the Silver Nitrate process on certain types of glossy paper often disappear in hours. These prints should be photographed as quickly as possible.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints*, 2000, pp. 38-39.

RETURN TO TABLE OF CONTENTS

5.40. SMALL PARTICLE REAGENT (SPR)

General Comments:

Small Particle Reagent (SPR) is a physical development technique where small black metallic particles (MoS_2) adhere to the sebaceous materials (lipids, fats, oils) of latent print residues. SPR is known for its ability to develop latent prints on wet surfaces, like wet soda or beer cans, firearms found submerged in water, or vehicles in the rain where attempting to apply regular powder could damage the brush and/or ruin the latent print. SPR has also been used successfully on paper, cardboard, metal, bricks, concrete, plastic, vinyl, wood, and glass.

Safety Concerns:

Small Particle Reagent is not a carcinogen, nor is it believed to present any health hazards.

Safety Equipment:

1. Gloves impervious to solution
2. Lab coat
3. Goggles
4. Mask

Materials and Equipment:

1. Spray bottle of Small Particle Reagent
2. Lifting tape
3. Lift tape
4. Scissors
5. Photographic equipment

5.42.1 SPR - Premixed

Chemicals:

Small Particle Reagent premix bottle

Procedure:

There are two ways to apply SPR: It can be sprayed onto surfaces, or smaller articles can be dip processed.

5.42.2 SPR - Unmixed

Chemicals:

SPR Working Solution
30 g Molybdenum disulfide

2 Drops Pho Flo 200
1 L Water (distilled or tap)

Procedure:

1. Prepare working solution. Dissolve molybdenum disulfide into one liter of water in a spray bottle. Add two drops of Photo Flow 200.

2. Shake solution continually as molybdenum disulfide continually separates from water.

3. There are two ways to apply SPR: It can be sprayed onto surfaces, or smaller articles can be dip processed.

Spray Method:

1. Shake working solution, and agitate frequently to keep particles suspended (goggles may be worn)

2. Spray area to be examined starting at the top and working downwards. If signs of latent print development appear, continue spraying just above the area until there is no more buildup of the gray deposit.

3. Remove excess powder from developed latent prints by spraying or pouring water gently above the developed prints with another spray unit of clean water.

4. Allow surface to air dry.

5. Photograph developed prints prior to attempting to lift with tape.

Dip/Dish Method:

1. Agitate SPR working solution container (goggles may be worn).

2. Pour enough SPR into a dish or tray to cover the item(s) to be processed.

3. Prepare a second dish or tray with clear rinse water.

4. Immerse articles in the SPR solution immediately. Keep stationary at the bottom of the dish for two to three minutes. DO NOT AGITATE THE SOLUTION WHILE THE EVIDENCE IS IMMERSED.

5. Remove processed articles and rinse GENTLY with clear water or float the evidence face down in the tray of clear rinse water.

6. Let processed items air-dry. Heating is not recommended.

7. Photograph any developed prints prior to attempting to lift with tape.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container or spray bottle

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. If after an initial application of SPR, developed latent prints are faint, the item(s) can be treated a second time.

2. The SPR developed prints are fragile and can easily be destroyed. They should be photographed, and once dry, protected by covering with good quality, clear, latent print lifting tape where possible.

3. Experiments have shown that SPR developed prints can be lifted using clear latent print lift tape while the surface is still wet. However, this process is difficult, and may destroy the latent print by having water spots under the tape.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 38-39.

3. Mock, J., Small Particle Reagent for the Development of Latent Prints. Torrance Police Department (n.d).

RETURN TO TABLE OF CONTENTS

5.41. STICKY-SIDE POWDERS

General Comments:

Sticky-side powders are believed to adhere to the sebaceous and/or eccrine materials (lipids, fats, or salts and/or skin cells), and much like Crystal/Gentian Violet stain, Sticky-side powders can be used to process the adhesive side of tapes, contact papers and labels for latent prints.

Excellent results have been achieved on:

Duct tape	Adhesive bandages	Paper-backed label
Masking tape	Plastic surgical tape	Clear plastic tape
Double-sided foam tape	Reinforced packing tape	Packaging labels
Black electrical tape		

Good to fair results have been achieved on:

Cloth surgical tape	Adhesive edge of 3M™ Post-it® notes
Frosted plastic tape	

Poor results have been reported on:

Some paper labels, and tapes and labels with dried-out adhesives
Some contact papers or shelf papers

Safety Concerns:

This method is relatively safe but precautions must be taken against the inhalation of the sticky-side powder.

Safety Equipment:

1. Gloves
2. Lab coat
3. Eye protection
4. Mask

There are two procedures for this processing technique. One is the Sticky-Side Powder process and the other is an Alternative Black Powder process.

5.43.1 Sticky-Side Powder Solution:

Materials and Equipment:

1. Sticky-Side Powder
2. Photo-Flo
3. Small soft-bristled brush or camel hair fingerprint brush

4. Mixing jar or dish
5. Tongs
6. Photographic equipment

Place approximately 1 tsp. of sticky-side powder in a dish. Add Photo-Flo to the powder and stir until the mixture is the consistency of thin paint.

5.43.2 Alternative Black Powder Procedure:

Materials and Equipment:

1. Black fingerprint powder NOT magnetic powder
2. Ivory dish soap
3. Water
4. Small soft-bristled brush or camel hair fingerprint brush
5. Mixing dish
6. Tongs
7. Photographic equipment

Mix equal parts of fingerprint powder and Ivory soap in a dish (e.g. 3 tbsp. powder and 3 tbsp. soap). Slowly add water so the working solution has the consistency of thin paint.

Application Method:

1. Using a small brush or camel hair fingerprint brush, "paint" the solution onto the adhesive side of the item(s) to be processed.

2. Leave the powder on for 10 to 15 seconds and then rinse it off with water. The tape can be rinsed under running water.

3. When the solution is rinsed off, examine it. Photograph any developed prints.

4. The solution adheres too strongly to some tapes and labels. The solution may be applied, but it must be rinsed immediately.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Prepare as needed

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The non-adhesive side of the tape should be processed prior to sticky-side powder.

2. The use of cyanoacrylate fuming prior to using sticky-side powder does not prevent the sticky-side powder solution from working.

3. Sticky-side powder may be used after crystal violet (gentian violet).

4. Sticky-side powder may be applied several times to enhance the contrast of the print.

5. Over-development can sometimes be removed from tapes by rinsing off with a strong stream of water.

6. When photographing the sticky-side powder developed prints, the use of an alternate light source or laser often enhances the prints. Since the sticky-side powder absorbs light, causing the background to fluoresce might enhance the print, creating more contrast between the print and the background.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints*, pp. 40-41.

2. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for* Developing Latent Prints, 2000, pp. 10-13.

3. Marks, M.; Wright, L.; Latent Print Development for Adhesive and Non-Adhesive Sides of Tapes, July 2004.

4. Rauch, V., Alternative Sticky-Side Powder Validation Study, July 2004.

5.43.3 Sticky side powder - liqui-nox formula

General Comments:

Sticky side powder is used for the development of latent prints deposited on adhesive surfaces.

Liqui-Nox Formula
Liqui-Nox is a laboratory glassware soap used to create a soap/powder foam that is pained onto the surface of adhesive tapes.

Materials and Equipment:

1. Black fingerprint powder
2. Liqui-Nox
3. Tap water
4. Small soft-bristled brush or camel hair fingerprint brush
5. Mixing jar or dish
6. Tongs
7. Photographic equipment

Procedure:
1. Prepare Liqui-Nox solution:

Liqui-Nox solution
20 drops tap water
20 drops Liqui-Nox
0.5 g Black fingerprint powder

Mix the ingredients in a shallow bowl to create a foam with bubbles.

2. Use a camel hair brush to create paint the tape surface with the mixture.

3. Wait 15-30 seconds.

4. Rinse tape under a gentle stream of tap water.

5. Allow item to air dry at room temperature in fume hood.

6. Photograph any developed prints

Sticky Side Powder Formula

Sticky side powder is a suspension of black powder in a detergent solution. Development of latent prints on adhesive surfaces.

Materials and Equipment:

1. Black fingerprint powder

2. Liqui-Nox
3. Tap water
4. Small soft-bristled brush or camel hair fingerprint brush
5. Mixing jar or dish
6. Tongs
7. Photographic equipment

Procedure:

1. Prepare Sticky Side Powder solution
   1 tsp powder
   Photo Flow

Mix the ingredients in a shallow bowl to create a thin paste/paint.

2. Use a camel hair brush to create paint the tape surface with the mixture.

3. Wait 10-15 seconds.

4. Rinse tape under a gentle stream of tap water.

5. Allow item to air dry at room temperature in fume hood.

6. Photograph any developed prints

Storage:

Prepare as needed

Shelf life:

Refer to Chemical Shelf Life guidelines.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved December 2018, http://www.cbdiai.org/Reagents/liquinox.html
2. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch

RETURN TO TABLE OF CONTENTS

5.42. SUDAN BLACK

General Comments:

Sudan black is a chemical dye that stains the lipid, fat, and oil components of sebaceous secretions. Sudan black can be used for developing latent prints on smooth or rough, non-porous surfaces contaminated with foodstuff, oils and other greasy or sticky substances. Although Sudan black works best on glass, metal or plastics, it can also be used on waxy surfaces, such as candles or wax paper milk cartons.

Safety Concerns:

Sudan black is not believed to present any health hazards; however, the solvent used to prepare it should be considered potentially hazardous or flammable.

Safety Equipment:

1. Gloves
2. Lab coat
3. Eye protection
4. Mask

Materials and Equipment:

1. Working solution
2. Tray (glass, plastic or metal)
3. Tongs
4. Photographic equipment

Chemicals:

Working Solution

15 g Sudan black
1 L Ethanol
500 ml Distilled water

Procedure:

1. Prepare the working solution of Sudan black. Combine the Sudan black and the ethanol and stir. Add distilled water and stir. Some of the Sudan black will not be dissolved.

2. Pour enough of the dye solution into a clean, dry, glass tray to cover the samples to be processed (goggles may be worn). For large items, pour the solution over the surface, catching the runoff in a second tray for re-use.

3. Soak the evidence for 2 to 3 minutes.

4. Rinse the evidence stained items in cool, running tap water.

5. Allow the evidence to air dry.

6. Examine and photograph developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Clear or dark bottles

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The unused solution in the tray can be poured back into the bottle to be reused.

2. Faintly developed latent prints can occasionally be enhanced by reprocessing.

3. Enhances superglue developed latent prints.

References:

1. Home Office Scientific Research and Development Branch, *Fingerprint Development Techniques.*

2. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints,* pp. 42-43.

3. Federal Bureau of Investigations, *Chemical Formulas and Processing Guide for Developing Latent Prints,* 2000, p.40.

RETURN TO TABLE OF CONTENTS

5.43. THENOYL EUROPIUM CHELATE (TEC)

General Comments:

Thenoyl Europium Chelate is a fluorescent dye used enhance cyanoacrylate developed latent prints on various colored surfaces. This dye can be viewed only under ultraviolet light.

Safety Concerns:

Some laser dyes may be considered potential carcinogens and should be used with extreme care. Additionally, some of the solvents used in preparing these dyes should also be considered potentially hazardous and/or flammable. Direct exposure to laser light is potentially hazardous to skin and the eyes.

Safety Equipment:

1. Chemical and solvent resistant gloves
2. Lab coat
3. Safety goggles (when mixing chemicals and viewing with UV light)
4. Mask (optional)

Materials and Equipment:

1. Tray
2. Container with lid
3. Rinse bottle
4. Graduated cylinders
5. Beakers
6. Scale
7. Methanol
8. Magnetic stirrer & magnetic stirring rod
9. Scale
10. UV light source
11. Dark storage bottles
12. Photographic equipment

Chemicals:

Stock Solution – Part A

1 g Thenoyltrifluoroacetone (purity ≥ 97%)
200 ml Methylethyl ketone (HPLC grade)

Stock Solution – Part B

0.5 g Europium chloride hexahydrate (purity ≥ 99%)
800 ml Distilled water

Working Solution

100 ml Stock solution
180 ml Methyl ethyl ketone (HPLC grade)
720 ml Distilled water

Rinse Solution (if necessary)

Methanol

Procedure:

After the evidence has been fumed with cyanoacrylate ester (super glue):

1. Prepare Stock Solutions Part A and B separately. Combine Solutions A and B on a magnetic stirrer in a sealed container for 15-30 minutes. The sealed container is necessary due to evaporation of the methyl ethyl ketone.

2. Prepare Working Solution from Stock Solutions in previous step. Combine the ingredients for the Working Solution and place on a stirring device in a sealed container for 15 minutes.

3. Apply even coat of dye solution to evidence item(s) by immersion or with a rinse bottle.

4. Optional: Rinse solvents with a 800ml methanol and 200 ml distilled water solution.

5. Allow the evidence to dry thoroughly. Most dyes and rinse solutions dry completely in 15-30 minutes. If water droplets, use compressed air or pat evidence item gently with paper towel to remove them. If not removed, they may interfere with or obscure ridge detail.

6. While using an orange or red filter/goggles, examine under UV light. The wavelength at which fluorescence is optimized is adjusted in accordance to the personal preference of the examiner.

7. Photograph any prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Dark bottles with tight lids

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. The application of TEC shall take place under a properly ventilated hood.

2. Any evidence treated with TEC shall be thoroughly dried before moving to any other area of the laboratory.

3. If the working solution adheres to the background, a rinse consisting of 800 ml methanol and 200 ml distilled water can be applied. The rinse does not have to be mixed on a magnetic stirring device. The rinse ca be applied by either submerging the item or using a squirt bottle.

4. The application of the laser dye solution may enhance the powdering process by creating prints that lift more easily; therefore, the use of powders should follow the dye staining and fluorescence examination. No differences have been found when fingerprint powder is used prior to the dye staining process.

5. When the dye is still wet, the brightness of the luminescence can obscure the latent prints.

6. TEC should be used after DNA collected as dye stains and UV light can compromise DNA.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Chemical Formulas and Processing Guide for Developing Latent Prints (2000). pp. 60-61. United States: Federal Bureau of Investigations Laboratory Division Latent Fingerprint Section.

2. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.).Retrieved December 2018, http://www.cbdiai.org/Reagents/thenoyl.html

3. Manual of fingerprint development techniques: A guide to the selection and use of processes for the development of latent fingerprints. (2009). Sandridge: Home Office, Police Scientific Development Branch.

RETURN TO TABLE OF CONTENTS

5.44. ThermaNin

General Comments:

ThermaNin will not develop any fingerprints by itself. The process relies on the fact that after application of its solution to paper, ThermaNin will readily convert to Ninhydrin and the alcohol upon contact with water present in the paper or in the atmosphere. This conversion can be detected from the weak odor of the alcohol that will be given off by the paper afterwards. The Ninhydrin will then be available to react with any fingerprint residue in the paper.

Safety Concerns:

Ninhydrin is considered harmful if swallowed and irritating to eyes, skin and respiratory system; the alcohol as a skin and eye irritant.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye protection
4. Mask

Materials and Equipment:

1. Scale
2. Graduated Cylinder
3. Beakers
4. Magnetic stirring device
5. Tray (glass, plastic or metal)
6. Tongs
7. Photographic equipment

Chemicals:

Working Solution

4-5 g ThermaNin crystals
5 mL Isopropanol
15 mL Ethyl acetate (optional for petroleum ether/heptane based solutions)
980 mL Petroleum ether (60-80 degrees), heptane, or HFE-7100

Procedure:

1. Before beginning the procedure, make sure to photograph any visible fingerprints on the object or objects being studied.

2. Prepare working solution. Dissolve ThermaNin crystals into Petroleum ether/pentae or heptane by shaking for 5-10 minutes. Slight warminig of the soluiton (until approximately 30-40 °C) will aid in the dissolution of the crystals. Adding 0.5 ml of isopropanol (or 1.5 ml of ethyl acetate) per 100 ml of solution will help dissolve crystals as well.

3. Immerse item into the working solution to wet the latent fingerprints.

4. Pour the solution into a shallow pan to a depth of about 20 mm. Use forceps to immerse the item into the solution until the it is saturated with the solution.

5. Lay item on a flat surface at room temperature, in the dark and elevated humidity (around 80% is preferred).

6. DO NOT use heat as an accelerant; this will only turn the paper black, covering any latent finger prints.

7. Because of the sensitivity of the paper for polar solvents, treatment of the thermal paper with zinc chloride is not an option either.

8. Photograph all latent prints to make a permanent record.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Store in dark plastic or aluminum container. If stored in glass bottles, the shelf life of the working solution is drastically shortened.

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. ThermaNin will not develop any fingerprints by itself. The process relies on the fact that after application of its solution to paper, ThermaNin will readily convert to Ninhydrin and the alcohol upon contact with water present in the paper or in the atmosphere. This conversion can be detected by a weak odor of alcohol.

2. The porous item can be dipped/immersed more than once (with a certain waiting time in between, to allow for the conversion for the ninhydrin hemiketal to ninhydrin and alcohol) to increase the Ninhydrin concentration in the paper.

3. The prints developed will be purple in color as they are processed with ninhydrin.

Disposal:

Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. "Arrowhead Forensics, ThermaNin Tech Info. Accessed December, 2018, https://www.arrowheadforensics.com/thermanin.html

2. Ponschke, M. & Hornickel, M. (2016). A Limited Validation and Comparison of 1,2-Indanedione and ThermaNin for Latent Print Development on Thermal Paper. Journal of Forensic Identification, 66 (3), pp. 245-258.

RETURN TO TABLE OF CONTENTS

5.45. WETWOP or Other Pre-Mixed Brands

General Comments

Wetwop™ is used to process the adhesive side of tapes and labels for latent prints. Wetwop™ is available in black or white for contrast purposes. Other pre-mixed commercial brand products such as Wet Powder™, may be used and follow the same procedure as below.

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye protection
4. Mask

Safety Concerns:

No major safety issues are known to be associated with this technique at this time.
This product is not a dangerous substance and is not hazardous.

Materials and Equipment:

1. Working solution
2. Tray (glass, plastic or metal)
3. Tongs
4. Photographic equipment
5. Camelhair brush

Chemicals:

Wetwop™

Procedure:

1. Shake the bottle of Wetwop™ thoroughly.

2. Pour a small amount in a clean tray.

3. Using a camelhair brush, apply the Wetwop™ to the adhesive side of the tape (using a painting action).

4. Let the solution sit on the tape for approximately 15-30 seconds.

5. Rinse the solution with tap water.

6. Photograph any developed prints.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Original container. Prepare as needed.

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. If the developed prints are faint, the application process can be repeated several times, but use caution not to overdevelop the latent prints.

2. Swabbing for DNA must be completed on the non-adhesive side of the tape prior to processing the adhesive side.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations.

References:

1. Lightning Powder Company, *Technical Notes, Chemical Processing for Latent Prints.*

RETURN TO TABLE OF CONTENTS

5.46. Zinc Chloride

General Comments:

This procedure applies to porous items of evidence that are to be examined for the presence of latent prints. Zinc chloride is applied after processing an item with Ninhydrin or a Ninhydrin analog. Zinc chloride causes the latent prints to fluoresce under an alternate light source. It also has the ability to increase the strength of fluorescence of ridge detail for viewing and photography.

Safety Concerns:

Zinc chloride is considered toxic and corrosive. Prepare and apply in a fume hood.

Safety Equipment:

1. Eye protection
2. Gloves
3. Lab coat
4. Mask

Materials and Equipment:

1. Zinc Chloride
2. Camera/scanner
3. Dark, shatter-proof container
4. Dust or mist respirator (for application outside of fume hood)
5. Face shield visor and/or safety goggles
6. Forceps
7. Fume hood
8. Glass beakers
9. Glass tray, paint brush, or aerosol sprayer (for application)
10. Graduated cylinders
11. Laboratory coat and gloves
12. Laser and/or alternate light source
13. Color filers (orange or red)
14. Magnetic stirring device

5.46.1.Formula 1:

Chemicals:

Formula 1 Working Solution

30 g Zinc chloride dissolved in
500 ml methyl-tert-butylether (MTBE)
20 ml anhydrous Ethanol.

Procedure:

1. Prepare Formula 1 Zinc Chloride Working Solution. Use magnetic stirrer until zinc chloride is completely dissolved into MTBE and anhydrous ethanol. Dissolution may be slow.

2. Add 10 ml Glacial acetic acid and then dilute with 500 ml Petroleum ether.

3. Apply working solution by lightly spraying item.

4. Let item air dry. The air compressor may also be used.

5. Process and dry a second time.

6. Oven bake at 80 - 100 degrees C at 65% humidity for 40 minutes.

5.46.2.Formula 2:

Chemicals:

ZINC CHLORIDE STOCK SOLUTION

8 grams Zinc chloride crystals
180 ml Ethanol
Add 20 ml Glacial Acetic acid

ZINC CHLORIDE WORKING SOLUTION

6 ml Zinc chloride stock solution
100 ml Petroleum ether or Pentane or Heptane

Procedure:

1. Prepare Formula 2 Zinc Chloride Stock Solution. Use magnetic stirrer until all listed ingredients are dissolved.

2. Prepare Formula 2 Zinc Chloride Working Solution using the zinc chloride stock solution made in the previous step.

3. Apply working solution by lightly spraying item.

4. Let item air dry. The air compressor may also be used.

5. Process and dry a second time.

6. Oven bake at 80 - 100 degrees C at 65% humidity for 40 minutes

NINHYDRIN & 5-MTN TREATED ITEMS:

View under a forensic light source around 490nm to 505nm. Use dark orange filter or a 550nm to 590nm bandpass filters. Photograph results using an orange colored or 550nm (BP 35) bandpass filter.

1,2-INDANEDIONE TREATED ITEMS:

For most papers, view at 515 nm with orange filter.
For manila, brown paper bags, cardboard items & craft paper, view at 515 - 570 nm with orange or red 600(BP 35) filters.

Positive Control:

A positive control is run according to the appropriate procedures as detailed in the Quality Assurance Section of this manual.

Storage:

Store in dark container

Shelf life:

Refer to Chemical Shelf Life guidelines.

Notes:

1. Suggested viewing wavelength for item may be adjusted in accordance to the personal preference of the examiner.

2. The treated exhibit may be place in an insulated container (polystyrene foam tray) and covered with a layer of liquid nitrogen for enhanced luminescence of the ridge detail.

3. Other hydrocarbon solvents such as Pentane and Heptane may be substituted for Petroleum ether.

Disposal:

If contaminated or expired, the solution is disposed of as hazardous waste. Observe all federal, state and local environmental disposal regulations. State and local disposal regulations may differ from federal disposal regulations

References:

1. Latent Fingerprint Processing Techniques – Selection and Sequencing Guide, Chesapeake Bay Division of the International Association for Identification, (n.d.). Retrieved from http://www.cbdiai.org/Reagents/zncl.html#ttops

2. http://www.ncids.com/forensic/labs/Latent/Technical/Zinc-Chloride.pdf

RETURN TO TABLE OF CONTENTS

6. ENHANCEMENT TECHNIQUES FOR DECEASED INDIVIDUALS

There may be times when the Specialist needs to obtain the finger(s) or hand(s) of a deceased individual at the Medical Examiner's Office for the purpose of enhancing the friction ridge skin at the Forensic Services Unit.

Use of the following techniques is for the enhancement of friction ridge skin on both the palmar and plantar areas. These techniques are suitable for deceased individuals only. The Specialist should determine the best and most appropriate technique to use on the human remains.

All chemicals are stored at room temperature. These chemicals are not considered hazardous chemical waste.

The human remains shall be stored in a leak proof primary/secondary container and a biohazard label is placed on the container.

The remains shall be stored in the designated refrigerator in the Wet Room until enhancement techniques are used. Upon completion of these techniques the human remains shall be returned to the Medical Examiner's Office.

6.1. BOILING TECHNIQUE

The boiling technique is used for the enhancement of friction ridge skin on deceased individuals that are putrefied (have advanced decomposition) and macerated (friction ridge skin that has been immersed in water for an extended period of time).

Safety Concerns

None

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Supplies:

1. Electric hot pot (or equivalent)
2. Isopropyl Alcohol
3. Soap (liquid)
4. Sponge
5. Tap water
6. Towels

Procedure:

1. Remove any loose contaminants that may be present from the hand(s) using a sponge and warm soapy water.

2. Fill an electric pot approximately half full with tap water or enough to completely submerge the hand(s) in the pot.

3. Bring the pot of water to a boil.

4. Once the water has boiled, unplug the pot

5. Submerge the hand(s) into the water for five to ten seconds.

6. Remove the hand(s) from the water and examine for friction ridge detail.

7. Repeat steps 5 and 6 up to three times at a maximum.

8. Pour isopropyl alcohol onto the hand(s) and blot dry with a towel (cloth or paper).

9. Using one of the recording methods, record the friction ridge skin.

Notes:

When there are deep cuts on the skin, an alternative form of the procedure should be used in which the hand(s) is/are not submerged in the water from the pot. Suggested use for this method is a sponge.

6.2. TISSUE BUILDER INJECTION TECHNIQUE

The tissue builder injection technique is a rehydration method used to enhance the friction ridge skin of deceased individuals who are macerated or have friction ridge skin that is wrinkled.

Safety Concerns:

None

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Supplies:

1. Hypodermic syringe
2. Tissue builder solution
3. Hypodermic needle
4. Finger tissue cleaner
5. Tissue builder solvent
6. Isopropyl alcohol (optional)
7. Towels (optional)

Procedure:

1. Thoroughly cleanse the finger to be printed with the finger cleaning solvent or with isopropyl alcohol and towels.

2. Load the hypodermic syringe with the tissue builder solution.

3. Insert the needle into a finger right below the first joint or in the tip.

4. Inject the tissue builder using the needle to fill the entire collapsed area.

5. Using one of the preservation methods, record the friction ridge skin.

Notes:

1. Cleaning the finger prior to injection helps remove surface film and dirt and promotes better reproduction.

2. Best results are obtained by inserting the needle beyond the core of the finger ball and injecting the solution slowly while removing the needle from the finger.

3. When necessary, a string can be placed around the first and second joints and tied with a knot to prevent leakage of the solution.

6.3. I.D. ENHANCER™ SOLUTION TECHNIQUE

The I.D. Enhancer™ Solution technique is a rehydration method used to enhance the friction ridge skin of deceased individuals who are macerated or friction ridge skin that is wrinkled. The I.D. Enhancer™ Solution also works with mummified deceased individuals.

Safety Concerns:

None

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Supplies:

1. Hypodermic needle
2. Hypodermic syringe
3. Plastic container with lid (also known as specimen containers)
4. I.D. Enhancer™ Solution
5. Alcohol prep pads
6. Heating plate (optional)
7. Glass beaker
8. Isopropyl alcohol (optional)
9. Towels (optional)

Procedure (Soaking):

1. Thoroughly cleanse the finger to be printed with the alcohol prep pads or isopropyl alcohol and towels.

2. Place the finger into the room temperature solution and soak for approximately 15-30 minutes.

3. Remove the finger from the solution and air dry or blot friction ridge skin with a towel.

4. Using one of the recording methods, record the friction ridge skin.

Procedure (Injection):

1. Thoroughly cleanse the finger to be printed with the alcohol prep pads or isopropyl alcohol and towels.

2. Pour approximately 25 ml of I.D. Enhancer™ Solution into a glass beaker.

3. Load approximately 10cc of the room temperature I.D. Enhancer™ Solution into the hypodermic syringe.

4. Insert the needle into the finger right below the first joint or in the tip.

5. Inject the solution using the needle to fill the entire collapsed area.

6. Using one of the recording methods, record the friction ridge skin.

Optional: Place the beaker with the I.D. Enhancer Solution on a heating plate and gently heat the solution until it is warmed to 108º-113º Fahrenheit. Then follow Steps 3-6.

Notes:

1. Best results for the injection technique are obtained by inserting the needle beyond the core of the finger ball and injecting the solution slowly while removing the needle from the finger.

2. When necessary a string can be placed around the first and second joints and tied with a knot to prevent leakage of the solution when performing the injection technique.

3. The same solution used to soak the finger may be used for injection.

4. The I.D. Enhancer™ Solution may also be used on living individuals because it acts as a cleanser and moisturizer. The solution is applied directly to the friction ridge skin or can be used for submersion.

6.4. METAFLOW TECHNIQUE

The MetaFlow technique is a rehydration method used to enhance the friction ridge skin of deceased individuals who are mummified or hardened. Metaflow can be used as a solution to inject into the skin in place of the Tissue Builder Injection technique or the I.D. Enhancer Solution technique.

Safety Concerns:

None

Safety Equipment:

1. Gloves impervious to solvents
2. Lab coat
3. Eye Protection
4. Mask

Supplies:

1. Softener (Restorative or equivalent)
2. Preservative (Metaflow or equivalent)
3. Scalpel (optional)
4. Plastic container with lid (also known as specimen containers)
5. Paper towel(s) (optional)
6. Hypodermic needle (optional)
7. Hypodermic syringe (optional)

Procedure (Soaking):

1. Pour equal parts softener with equal parts preservative into a plastic container.

2. Immerse the friction ridge skin in the solution for approximately 24-72 hours.

3. Check the friction ridge skin periodically within the 24-72 hour submersion period.

4. Once the friction ridge skin is pliable and/or develops a white film it can be removed from the solution.

5. Optional step – if friction ridge skin is flakey it can be scraped away with a scalpel.

6. Air dry or blot friction ridge skin with a paper towel.

7. Using one of the recording methods, record the friction ridge skin.

Procedure (Injection):

1. Optional step – Steps number 1-4 from the soaking procedure may be used prior to injection if the friction ridge skin is not pliable enough to inject a needle.

2. Load the hypodermic syringe with equal parts softener and preservative.

3. Insert the needle in a finger right below the first joint or in the tip.

4. Inject the solution using the needle to fill the entire collapsed area.

5. Using one of the recording methods, record the friction ridge skin.

Notes:

1. Make sure friction ridge skin is completely submerged in the solution.

2. The tips of the fingers shall be placed in an upright position to prevent deforming of the friction ridge skin after it begins to soften.

3. The friction ridge skin shall not be submerged longer than a 72 hour period to prevent over swelling of the friction ridge skin.

4. Submerging the friction ridge skin longer than necessary may cause disfigurement of the friction ridges.

5. Use extreme caution when scraping the flakey skin as it is delicate and can be damaged easily.

6. Best results are obtained by inserting the needle beyond the core of the finger ball and injecting the solution slowly while removing the needle from the finger.

7. When necessary a string can be placed around the first and second joints and tied with a knot to prevent leakage of the solution.

RETURN TO TABLE OF CONTENTS

7. DIGITAL IMAGING

Photography is one method for documentation of developed latent prints. Those digital images shall be uploaded into QueTel for preservation. Latent print photographs may also be uploaded to Mideo for further analysis and comparison purposes. Notation of print images uploaded in to QueTel shall be made on the processing note forms and also in the Forensic Services Unit Development Report for further analysis.

Images that are taken on the DCS (Digital Capture System) are backed up / saved to an external drive. The DCS Images shall also be uploaded to QueTel. Any images taken using Mideo must also be uploaded to QueTel. Any history of enhancements to images shall be in the specialist's case notes.

RETURN TO TABLE OF CONTENTS

8. EQUIPMENT

For a list of equipment, refer to the Quality Assurance Manual. For operating procedures or further specifications, refer to the user's guide for each specific piece of equipment.

RETURN TO TABLE OF CONTENTS

9. REFERENCES

Refer to the Quality Assurance Manual for additional references.

RETURN TO TABLE OF CONTENTS

10. MANUAL REVISIONS

See Document Control for revision information.

RETURN TO TABLE OF CONTENTS