

**Department of Forensic Science**

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**FORENSIC BIOLOGY  
PROCEDURES MANUAL  
OF  
FORENSIC SCIENCE  
SCREENING AND COLLECTION  
FOR DNA ANALYSIS**

TABLE OF CONTENTS

1 [Blood Analysis](#)

- 1.1 Whole Blood Specimens
- 1.2 Dried Stains/Swabs

2 [Semen Analysis](#)

- 2.1 Oral Rinses
- 2.2 Liquid Samples (Including Condoms Containing a Liquid Sample)
- 2.3 Dried Stains on Underpants/Swabs/Smears Inside PERKs
- 2.4 Dried Stains on Clothing/Bedding Items/Swabs

3 [Vaginal Fluid Analysis](#)

4 [Saliva Analysis](#)

5 [Analysis of Perspiration / Skin Cells](#)

6 [Urine Analysis](#)

- 6.1 Liquid Samples
- 6.2 Dried Stains/Swabs

7 [Feces Analysis](#)

- 7.1 Whole Fecal Samples
- 7.2 Dried Stains/Swabs

8 [Tissue Analysis](#)

9 [Bone Analysis](#)

10 [Tooth Analysis](#)

11 [Hair/Fiber Analysis](#)

12 [Single Perpetrator PERK Triaging](#)

Appendix A [Chemical Tests for Blood](#)

Appendix B [Screening Tests for Seminal Fluid / Semen](#)

Appendix C [References](#)

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# 1 BLOOD ANALYSIS

The portion size of a swab or stain collected for DNA extraction should be judged based on a number of criteria, such as whether the stain appears dilute (for bloodstains) or if the sample may be heavily soiled or possibly degraded. Examine the stain, swab or item and remove a reasonable portion for DNA extraction. An alternative to cutting the stain or item directly is to swab the stain or item, air dry the swab and cut an appropriate portion of the swab for DNA extraction.

## 1.1 Whole Blood Specimens

All whole blood specimens will be preserved on bloodstain cards as soon as possible after receipt.

The procedure to preserve whole blood specimens on bloodstain cards should be performed in a well-ventilated area, such as in a bio-safety cabinet (preferable) or fume hood avoiding areas subject to temperature and/or humidity extremes.

Safety glasses will be worn while preserving whole blood specimens on bloodstain cards. If the procedure is not conducted in a hood with a safety sash separating the person from the blood, a face shield will be worn. The use of double gloves is preferred.

### 1.1.1 Supplies

- Bloodstain cards – Whatman (DO NOT USE FTA CARDS)
- Disposable transfer pipets
- Tissues (Kimwipes, etc.)
- Permanent ink pen or other permanent marker
- Biohazard disposable receptacle

### 1.1.2 The following method describes the procedure to preserve whole blood specimens on stain cards.

1.1.2.1 Describe the blood sample in notes, including any identifying information on the blood tube, as appropriate.

1.1.2.2 At a minimum, label the bloodstain card with the following:

- Subject's name
- Case number
- Item number
- Date card is made
- Preserver's initials

1.1.2.3 Mix the blood in the tube by gently inverting the tube several times.

**CAUTION:** When mixing post-mortem samples, take care that the stopper does not become dislodged from the top of the tube.

1.1.2.4 Uncap the tube so as to prevent any contaminating spatter or aerosol that may occur as the suction is broken in the tube. A Kimwipe may be useful for covering the cap while it is being twisted off of the tube.

1.1.2.5 Using a fresh disposable pipet for each blood sample, transfer blood from the tube to the appropriately labeled bloodstain card. Alternatively, slowly decant the liquid blood from the tube to the bloodstain card. If clotting of the sample has occurred or a red top tube was submitted, gently break up the clot (using the pipet tip, applicator sticks, etc.) before transferring the blood onto the bloodstain card. Discard any excess blood from the tube in an appropriate biohazard container.

**CAUTION:** Do not over-saturate the card, as drips and spill-over can occur.

- 1.1.2.6 Allow the bloodstain card to **COMPLETELY AIR DRY** before packaging it in an appropriately sealed and identified container. Allow the residual blood in the corresponding tube and the cap to completely air dry before packaging in a separate container. The cards and tubes may be stored at room temperature or otherwise refrigerated or frozen.
- 1.1.2.7 If no analysis will be conducted on the sample, the case notes will indicate that sample has been preserved.
- 1.1.2.8 If DNA analysis will be conducted on the sample, cut an appropriately sized portion of the dried blood stain (approximately 1-3mm<sup>2</sup> for a typical bloodstain card) and place it in a microcentrifuge tube for DNA extraction.

## 1.2 Dried Stains/Swabs

- 1.2.1 Examine the item for visible red-brown staining. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In instances where no stains are visible, the use of an alternate light source (ALS), ultra-violet (UV) light, and/or luminol/BlueStar may be helpful in locating stains. In some instances, in the absence of any visible stains, random swabbing of the item may be appropriate, depending on the item, substrate, color, other examinations requested, etc.
- 1.2.2 Test stain(s)/stained area(s) for blood using the combined PTMB test and record results.
- 1.2.3 If appropriate, examine the stain for a possible mixture of physiological fluids (semen, urine and/or feces) and record results.
- 1.2.4 Assess and document the suitability of stain(s)/stained area(s) for DNA PCR-based typing.
- 1.2.5 Stains that test inconclusive for blood may be taken forward for DNA analysis.
- 1.2.6 As appropriate, cut an appropriate sized portion of the stain/stained area and place into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.
  - 12.6.1 If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

**2 SEMEN ANALYSIS****2.1 Oral Rinses**

- 2.1.1 Centrifuge and/or allow cellular debris to settle to the bottom of the container.
- 2.1.2 Discard the supernatant and preserve the sediment on multiple swabs, as appropriate, transferring a portion of the sediment to an appropriately labeled microscope slide. Allow the swabs to air dry and package in an appropriate number of labeled swab boxes.
- 2.1.3 Continue to 2.4.2

**2.2 Liquid Samples (Including Condoms Containing a Liquid Sample)**

- 2.2.1 Preserve the liquid sample on multiple swabs, as appropriate, transferring a portion of the sample to an appropriately labeled microscope slide. Allow the swabs to air dry and package in an appropriate number of labeled swab boxes.

**NOTE:** When a condom is submitted, and if applicable based upon case scenario, in addition to removing apparent liquid or dried semen from the inner surface, remove possible secretions present on the outer surface with a swab(s) moistened with distilled/Type I water and label appropriately. This sample may contain vaginal fluid and may be suitable for DNA PCR-based typing. Air dry and package samples obtained from the inner and outer surfaces separately.

- 2.2.2 Continue to 2.4.2

**2.3 Dried Stains on Underpants/Swabs/Smears Inside PERKs**

- 2.3.1 Examine the underpants/swabs for stains, if appropriate. In addition to locating stains visually, an alternate light source (ALS) may be useful. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item may be appropriate, depending on the item, substrate, color, other examinations requested, etc.
- 2.3.2 When selecting samples to extract for potential DNA STR analysis, a traditional approach including acid phosphatase (AP) testing, microscopic identification of spermatozoa, and/or p30 testing as described in 2.3.3-2.3.5 below may be used. Alternatively, an abbreviated screening approach may be used.
- 2.3.2.1 The abbreviated screening approach may include any one or a combination of any of the following, at the examiner's discretion:
- the use of acid phosphatase results to help identify which samples to extract and quantitate.
  - no acid phosphatase testing, relying upon information provided by the investigating agency/PERK information form, in determining which samples to extract and quantitate.
  - the use of a Casework Direct extraction and quantitation in determining which samples to fully extract and quantitate.
- 2.3.3 Test stains and/or swabs, as appropriate, for the possible presence of seminal fluid using the acid phosphatase test, and record results.

**NOTE:** Alternatively, smears correspondingly labeled to PERK swabs may be microscopically examined first. If no spermatozoa are observed on the smears, test the correspondingly labeled swabs for acid phosphatase activity. If spermatozoa are observed on the smears, acid phosphatase testing of the correspondingly labeled swabs is optional.

- 2.3.4 Examine smears correspondingly labeled to PERK swabs. If appropriate, based on the acid phosphatase test results, extract stains/swabs for the presence of spermatozoa and transfer to an appropriately labeled microscope slide to be examined microscopically. The presence of spermatozoa is microscopically confirmed by the presence of identifiable heads and/or by the presence of intact spermatozoa.
- 2.3.4.1 If no spermatozoa are identified, record the results. If the acid phosphatase test exhibited a result indicative of the presence of seminal fluid, proceed to 2.3.5.
- 2.3.4.2 If no spermatozoa are identified and results obtained for the acid phosphatase test were not indicative of the presence of seminal fluid, no further testing need be conducted. Record the results.
- 2.3.4.3 If no spermatozoa are identified in an extract of a stain and the stain is/will be consumed during DNA analysis, the slide must be returned with the evidence.
- 2.3.4.4 If no spermatozoa are identified in an extract of a stain and a portion of the stain remains/will remain after DNA analysis, the microscope slide of the negative extract may be discarded.
- NOTE:** All microscope slides/smears submitted with evidence will be returned with the evidence, regardless of the screening result. PERK smears will be returned in the PERK.
- 2.3.4.5 If spermatozoa are identified, record the results and return the microscope slide with the evidence.
- 2.3.5 Test stains/swabs for the presence of human prostate-specific antigen (p30) as appropriate and record results.
- 2.3.6 If appropriate, examine stain(s)/swabs for possible mixtures of physiological fluids (blood, urine and/or feces) and record results.
- 2.3.7 Assess and document the suitability of stains/stained areas/swabs for DNA PCR-based typing.
- 2.3.8 Stains that test inconclusive for seminal fluid may be taken forward for DNA analysis.
- 2.3.9 As appropriate, cut an appropriate sized portion of the swab or stain and place it into a microcentrifuge tube for DNA extraction. The size of the cutting or stain collected may be proportional to the number of sperm identified or expected yield of sperm based upon information provided. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.
- 2.3.9.1 If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

## 2.4 Dried Stains on Clothing/Bedding Items/Swabs

- 2.4.1 Examine the item for stains. In addition to locating stains visually, an alternate light source (ALS) may be useful. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item may be appropriate, depending on the item, substrate, color, other examinations requested, etc.
- 2.4.2 Test stains and/or swabs, as appropriate, for the possible presence of seminal fluid using the acid phosphatase test, and record results.

- 2.4.3 For items on which a stain or stains exhibit a strong acid phosphatase reaction, the following abbreviated screening approach may be used in consideration of the alleged scenario at the examiner's discretion by following 2.4.3.1-2.4.3.3. Otherwise, proceed to 2.4.4.
- 2.4.3.1 The stain or stains exhibiting a strong acid phosphatase reaction may be differentially extracted and quantitated without conducting microscopic examinations for spermatozoa and/or p30 testing.
  - 2.4.3.2 Any additional stains not selected for extraction that produced an acid phosphatase reaction will be addressed in the Certificate of Analysis. Refer to the FB PM Report Writing.
  - 2.4.3.3 Proceed through 2.4.6 – 2.4.9, as applicable.
- 2.4.4 If appropriate, based on the acid phosphatase test results, extract stains/swabs for the presence of spermatozoa and transfer to an appropriately labeled microscope slide to be examined microscopically OR examine the slide previously made during the preservation of an oral rinse or liquid sample. The presence of spermatozoa is microscopically confirmed by the presence of identifiable heads and/or by the presence of intact spermatozoa.
- 2.4.4.1 If no spermatozoa are identified, record the results. If the acid phosphatase test exhibited a result indicative of the presence of seminal fluid, proceed to 2.4.5.
  - 2.4.4.2 If no spermatozoa are identified and results obtained for the acid phosphatase test were not indicative of the presence of seminal fluid, no further testing need be conducted. Record the results.
  - 2.4.4.3 If no spermatozoa are identified in an extract of a stain and the stain is/will be consumed during DNA analysis, the slide must be returned with the evidence.
  - 2.4.4.4 If no spermatozoa are identified in an extract of a stain and a portion of the stain remains/will remain after DNA analysis, the microscope slide of the negative extract may be discarded.  
  
**NOTE:** All microscope slides/smears submitted with evidence will be returned with the evidence, regardless of the screening result.
  - 2.4.4.5 If spermatozoa are identified, record the results and return the microscope slide with the evidence.
- 2.4.5 Test stains/swabs for the presence of human prostate-specific antigen (p30) as appropriate and record results.
- 2.4.6 If appropriate, examine stain(s)/swabs for possible mixtures of physiological fluids (blood, urine and/or feces) and record results.
- 2.4.7 Assess and document the suitability of stains/stained areas/swabs for DNA PCR-based typing.
- 2.4.8 Stains that test inconclusive for seminal fluid may be taken forward for DNA analysis.
- 2.4.9 As appropriate, cut an appropriate sized portion of the swab or stain and place it into a microcentrifuge tube for DNA extraction. The size of the cutting or stain collected may be proportional to the number of sperm identified or expected yield of sperm based upon information provided. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.
- 2.4.9.1 If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

### 3 VAGINAL FLUID ANALYSIS

The Department does not perform tests to indicate or identify the presence of vaginal fluid. However, its presence may be inferred if a reasonable person would infer its presence, e.g., on vaginal swabs, female victim's underpants, etc.

- 3.1** Examine the item for stains. In addition to locating stains visually, an alternate light source (ALS) may be useful in locating stains believed to contain vaginal fluid. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item or collection for DNA may be appropriate.

**EXAMPLE:** Pubic area swabs or underpants collected from a suspect in a sexual assault case may be sampled for DNA regardless of visual examination results.

- 3.2** If appropriate, examine stain(s) for possible mixtures of physiological fluids (blood, urine, semen and/or feces), and record and report results.

- 3.3** As appropriate, cut an appropriate sized portion of the stain/stained area and place the cutting into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.

- 3.3.1** If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

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## 4 SALIVA ANALYSIS

The Department does not perform tests to indicate or identify the presence of saliva. However, its presence may be inferred if a reasonable person would infer its presence, e.g., on postage stamps, envelope flaps, chewing gum, cigarette butts, mouth openings in masks, mouth openings of bottles, etc.

The Casework Direct extraction method may be employed as a means of determining which samples, if any, to process further for DNA analysis, as applicable. Refer to the appropriate FB Procedures Manuals.

- 4.1** Examine the item for stains. In addition to locating stains visually, an alternate light source (ALS) may be useful in locating stains believed to contain saliva. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item or collection for DNA extraction may be appropriate.

**EXAMPLE:** A thighs/external genitalia sample from the victim of alleged cunnilingus may be sampled for DNA extraction regardless of the results of other examinations/testing.

- 4.2** If appropriate, examine stain(s) for possible mixtures of physiological fluids (blood, urine, semen and/or feces), and record results.

- 4.3** As appropriate, cut an appropriate sized portion of the stain/stained area and place the cutting into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.

- 4.3.1** If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

## 5 ANALYSIS OF PERSPIRATION / SKIN CELLS

The Department does not perform tests to indicate or identify the presence of perspiration or skin cells. However, the presence of these may be inferred if a reasonable person would infer their presence, e.g., on hat bands, inside gloves, on cuffs and/or collars of shirts and jackets, etc. These samples may be referred to as touch or trace DNA sample or wearer DNA samples.

The Casework Direct extraction method may be employed as a means of determining which samples, if any, to process further for DNA analysis, as applicable. Refer to the appropriate FB Procedures Manuals.

- 5.1** Examine the item for stains. In addition to locating stains visually, an alternate light source (ALS) may be useful in locating stains believed to contain perspiration or skin cells. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item or collection for DNA extraction may be appropriate.

**EXAMPLE:** The interior sweatband/rim of a baseball cap may be sampled for DNA extraction regardless of visual examination results.

- 5.2** If appropriate, examine stain(s) for possible mixtures of physiological fluids (blood, urine, semen and/or feces), record and report results.

- 5.3** As appropriate, cut an appropriate sized portion of the stain/stained area and place the cutting into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.

- 5.3.1** If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

## 6 URINE ANALYSIS

The Department does not perform tests to indicate or identify the presence of urine. However, the detection of a characteristic urine odor may aid in identifying a stain in which urine may be present and may therefore be taken forward for DNA analysis.

The Casework Direct extraction method may be employed as a means of determining which samples, if any, to process further for DNA analysis, as applicable. Refer to the appropriate FB Procedures Manuals.

### 6.1 Liquid Samples

- 6.1.1 When a liquid sample believed to be urine is submitted, centrifuge the sample and/or allow cellular debris to settle to the bottom of the container.
- 6.1.2 Preserve a portion of the sediment on swabs.
- 6.1.3 Return liquid to an appropriate leak proof container.
- 6.1.4 As appropriate, cut an appropriate sized portion of the swab(s) and place the cutting into a labeled microcentrifuge tube for DNA extraction

### 6.2 Dried Stains/Swabs

- 6.2.1 Examine the item for stains. In addition to locating stains visually, an alternate light source (ALS) may be useful in locating stains believed to contain urine. The detection of a characteristic urine odor may also be helpful. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate. In some instances, in the absence of any visible stains, random swabbing of the item or collection for DNA extraction may be appropriate.
- 6.2.2 If appropriate, examine stain(s) for possible mixtures of physiological fluids (blood, semen or feces), and record results.
- 6.2.3 As appropriate, cut an appropriate sized portion of the stain/stained area and place the cutting into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.
  - 6.2.3.1 If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

## 7 FECES ANALYSIS

The Department does not perform tests to indicate or identify the presence of feces. However, the detection of a characteristic fecal odor may aid in identifying a stain in which feces may be present and may therefore be taken forward for DNA analysis.

The Casework Direct extraction method may be employed as a means of determining which samples, if any, to process further for DNA analysis, as applicable. Refer to the appropriate FB Procedures Manuals.

### 7.1 Whole Fecal Samples

**NOTE:** In general, the Department does not conduct DNA analysis on whole fecal samples or samples heavily contaminated with fecal material. If a specific exception is made, the following procedures may be used.

7.1.1 Preserve a portion of the fecal sample, as appropriate.

7.1.2 Place an appropriate amount of fecal sample into a microcentrifuge tube for extraction.

7.1.2.1 If the fecal material is moist and will not be extracted immediately, it should be frozen or air dried. If frozen, it will need to thaw prior to extraction.

7.1.3 Alternatively, the fecal sample may be collected onto a swab and air dried. An appropriate portion of the swab can then be cut and placed into a microcentrifuge tube for DNA extraction.

### 7.2 Dried Stains/Swabs

7.2.1 Examine the item for stains. In addition to locating stains visually, the detection of a characteristic fecal odor may be helpful. Describe the item and the appearance, size, and location of stains in notes, diagrams, and/or photographs, as appropriate.

7.2.2 If appropriate, examine stain(s) for possible mixtures of physiological fluids (blood, semen or urine), and record results.

7.2.3 As appropriate, cut an appropriate sized portion of the stain/stained area and place the cutting into a labeled microcentrifuge tube for DNA extraction. If a stain is smeared over a large area of fabric, more than one microcentrifuge tube may be needed to extract the stain.

7.2.3.1 If more than one microcentrifuge tube is used to extract a stain, the entire sample should be condensed into one sample tube during the manual purification step or after the robotic purification step.

**8 TISSUE ANALYSIS**

- 8.1** If appropriate, freeze the tissue until you are ready to proceed with the examination.
- 8.2** Describe the item appearance, size, etc., in notes, diagrams, and/or photographs, as appropriate.
- 8.3** If appropriate, test for blood, and record the results.
- 8.4** Cut a very thin slice of tissue (i.e., 1 mm thick slice of muscle) and place the sample into a labeled microcentrifuge tube for DNA extraction. If the tissue sample is degraded, a slightly larger portion of the sample may be used.
- 8.4.1 Alternatively, cellular material may be collected from the tissue by swabbing the sample and placing a portion of the swab into a labeled microcentrifuge tube for DNA extraction. The swab or portion of the swab placed into the microcentrifuge tube should be air dried or frozen if not proceeding directly to DNA extraction.

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**9 BONE ANALYSIS**

- 9.1 If appropriate, freeze the bone until you are ready to proceed with the examination.
- 9.2 Describe the item appearance, size, etc., in notes, diagrams, and/or photographs, as appropriate.
- 9.3 If appropriate, test for blood, and record results.
- 9.4 If appropriate, submit to the OCME for species, bone type, and/or sex determination.
- 9.5 Transfer to the Firearms Section for tool marks if required.
- 9.6 If appropriate, clean bone by soaking in water and washing with a strong jet of Type I water or an ultrasonic cleaner and air dry. If no analysis will be conducted on the sample, the case notes will indicate that sample has been preserved.
- 9.7 Using a Kimwipe and 95% ethanol vigorously clean the outer surface of the bone sample. Repeat this step 2-3 more times to remove any surface dirt or contaminants.
- 9.8 Place the bone into a weigh boat or lay it on a piece of clean disposable bench paper inside of a biological safety hood to dry.
- 9.9 The bone sample (i.e., small in size) may be pulverized using liquid nitrogen (9.9.1) or an electric drill and bit(s) (9.9.2) following the procedures listed below:
  - 9.9.1 Pulverizing the bone sample using liquid nitrogen:
    - 9.9.1.1 Place the bone fragment(s) into a clean mortar and pour a small volume of liquid nitrogen over the top. Ensure there is a sufficient volume of liquid nitrogen in the mortar to cover the bone fragment(s).
    - 9.9.1.2 Allow the bone to sit in the liquid nitrogen for 30 to 60 seconds and then pour off the excess liquid nitrogen into a separate container. Using a pestle, crush the bone fragment(s). Place a barrier such as a piece of parafilm over the top of the mortar and pestle to prevent the pulverized bone fragments from flying out of the mortar.
    - 9.9.1.3 Transfer a small portion of the pulverized bone to a 2.0 mL microcentrifuge tube for DNA extraction.
  - 9.9.2 Pulverizing the bone sample using a drill and bit(s):
    - 9.9.2.1 Clean an appropriately sized drill bit with 10% bleach followed by 95% ethanol and allow it to dry.
    - 9.9.2.2 Place the bone sample in a hood on a clean piece of disposable bench paper.
    - 9.9.2.3 While holding the bone sample firmly, use an electric drill and the cleaned drill bit to drill a hole approximately 1.0 mm deep.
    - 9.9.2.4 Tap the bone gently on the bench paper to dislodge the surface bone powder.
    - 9.9.2.5 Replace the bench paper with a clean sheet, discarding the original sheet along with the surface bone powder.
    - 9.9.2.6 Clean the drill bit again with 95% ethanol and a Kimwipe and allow it to dry.

- 9.9.2.7 Use the drill bit to drill approximately 3-5 mm further into the same hole in the bone.
- 9.9.2.8 Tap the bone gently on the bench paper to dislodge the bone powder onto the paper.
- 9.9.2.9 Transfer a sample of bone powder (approximately the size of a PEA or larger, depending on bone quality) to a 2.0 mL microcentrifuge tube for DNA extraction.

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**10 TOOTH ANALYSIS**

**NOTE:** Molars are the tooth of choice for DNA recovery.

- 10.1** If appropriate, freeze the tooth until you are ready to proceed with the examination.
- 10.2** Describe the tooth appearance, size, etc., in notes, diagrams, and/or photographs, as appropriate.
- 10.3** If appropriate, test for blood and record the results.
- 10.4** If appropriate, clean the outer surface of the tooth by soaking in water and washing with a strong jet of Type I water or an ultrasonic cleaner and air dry. If no analysis will be conducted on the sample, the case notes will indicate that sample has been preserved.
- 10.5** Clean the outer surface of the tooth with a 10% bleach, then sterile water and then 95% ethanol or isopropanol (avoiding introduction of the 10% bleach solution into any cracks in the tooth).
- 10.6** Working in a hood, using a sterile diamond saw blade and a rotary shaft tool cleaned with 10% bleach and 95% ethanol or isopropanol, cut/grind away the upper crown portion of the tooth until the pulp chamber becomes visible. In addition, make small nicks in the sides of the tooth to facilitate crushing the lower portion of the tooth.

**NOTE:** It should take approximately 5-10 minutes to remove the crown of the tooth.

- 10.7** To gain access to the pulp, place the tooth minus the crown into a small plastic zip closure bag. Insert the zip closure bag into a second zip closure bag. Ensure the bags are sealed.
- 10.8** Lay the zip closure bag on a hard surface. Using a hammer, pulverize the tooth sample inside the zip closure bag being careful not to puncture the zip closure bag.
- 10.9** Transfer the pulverized/crushed tooth sample to a microcentrifuge tube for DNA extraction.



## 11 HAIR/FIBER ANALYSIS

Typically screening of hairs for nuclear DNA suitability and/or DNA analysis of hairs will not be conducted, regardless of the results of DNA analysis on any/all appropriate non-hair evidence. Screening of hairs and DNA analysis on hairs will typically be limited to specific cases in which the only evidence in the case is hair evidence or the probative value is certain (i.e., a clump of hair is recovered from a decedent's clutched hand). If, upon receipt of a Certificate of Analysis detailing that no results were obtained through other testing in a case, a specific request is made for hair examinations, a discussion between the examiner or supervisor and the investigator will occur, during which the probative nature and the information that may be gleaned from this hair examination will be considered. The determination of whether to proceed will be based on the numbers of hairs that will need to be screened and whether the information gained will reasonably be expected to provide probative information for the case when no other evidence has yielded a probative DNA profile.

If a case consists only of hairs submitted for DNA testing ("Hair Only Case"), it may, after discussion with a Trace Evidence supervisor, go to the Trace Evidence (TE) Section first, where the evidence will be examined for nuclear DNA suitable hairs and the appropriate hairs forwarded to the Forensic Biology Section (SX) examiner for DNA testing.

In the rare case that hair examinations are to be conducted, and there are a small number of hairs on an item of evidence, the SX examiner will recover the hairs from the item and subsequently screen them for suitability for nuclear DNA analysis.

In the rare case that hair examinations are to be conducted, and a large number of hairs are present on an item of evidence or a large case has many items requiring hair recovery and/or examination, the item(s) may be forwarded to the TE Section on a case by case basis for collection of the hairs and a determination of the suitability of the hairs for nuclear DNA analysis. These cases are discussed between the Forensic Biology examiner or supervisor and a Trace Evidence supervisor prior to submission. In some cases where large numbers of hairs are recovered, examination by DFS may not be possible or testing on a representative number of hairs will be attempted and the remaining hairs not examined. This case approach shall be documented in the case file.

For cases in which the evidence is examined and hairs are screened for nuclear suitability by a TE examiner, the Nuclear DNA Hair Referral form (Document 210-F206) should be used. This form can then be used by the SX examiner to supplement the notes.

Hairs previously mounted on microscope slides, typically re-submitted in cold cases, may be forwarded to the TE Section for de-mounting and assessment of the hair(s) for nuclear DNA analysis.

### 11.1 Hair/Fiber Recovery and Preservation

- 11.1.1 When evidence is examined for biological substances, hairs/fibers may be collected from the item and/or left on the item for possible future recovery and examination.
- 11.1.2 With the aid of oblique lighting, if applicable, recover hairs/fibers and/or other trace evidence from items being examined for biological fluids using one or more of the following methods: forceps, post-it notes, gentle scraping and/or careful shaking over clean paper.
- 11.1.3 Package and appropriately label recovered hairs/fibers. When screening/examinations are complete, place the hair/fiber package in the item packaging.
- 11.1.4 If hairs/fibers are to remain on the item for possible future recovery, the trace evidence should be protected from loss or other deleterious effects by wrapping the item in the same clean examination paper on which it was examined and placing it in the original packaging (when possible).
- 11.1.5 If there is a possibility that loose hairs/fibers may be lost during the examination for biological substances (for example, while examining a broken windshield for blood, one or two hairs/fibers are noted on the glass), recover, package, and appropriately label these hairs/fibers. Place the package in the item packaging.

- 11.1.6 Document findings (i.e., hairs/fibers recovered, hairs/fibers observed/not recovered, hairs/fibers recovered and more remain, etc.) along with an estimate of the numbers of hairs observed and/or recovered (small number or large number).

## 11.2 Procedure for Screening Hairs for Suitability for Nuclear DNA Analysis

**NOTE:** The SX examiner does not differentiate between hair fragments (shafts with no root) and fibers.

- 11.2.1 To determine suitability for nuclear DNA testing, hairs/fibers may be examined with the aid of a stereo microscope and/or by placing a cover slip over the hairs mounted in water or xylene substitute on a glass microscope slide, followed by examination with a compound microscope using bright field illumination. When using the stereo microscope, paper/post-it notes or other such material providing varying contrasts with the hairs/fibers being examined may be helpful. If there is any question about the suitability, DNA analysis should be attempted.
- 11.2.2 When hairs suitable for nuclear DNA analysis are found, the documentation should allow for tracking from the microscopic examination through the DNA interpretive stages. When no hairs suitable for nuclear DNA analysis are found, the documentation should reflect why the hair(s) are not suitable.
- 11.2.3 While examining hairs/fibers for nuclear DNA suitability, the presence of any apparently extraneous body fluids should be noted.
- 11.2.4 The documentation of the microscopic examination of hairs/fibers recovered should reflect the following information:
- Method or type of scope used, i.e., stereo and/or compound microscope/wet mount
  - The approximate number of hairs/fibers recovered
  - The presence or absence of a root and if the sample is suitable for nuclear DNA analysis
  - The exact number of hairs from each item on which nuclear DNA analysis will be conducted
  - The growth stage of the hair, if known
    - ?? may be used if growth stage is unknown - Forensic Biology examiners are only expected to be able to recognize that there is material (i.e., tissue) on a hair root that may be suitable for nuclear DNA testing and are not expected to know the exact growth stage of the hair with certainty.
    - Roots of hairs in the anagen or anagen/catagen growth stage may not appear to have tissue surrounding them, but rather appear like a crook with a natural end rather than a cut end, as a fragment or fiber would have. Although Forensic Biology examiners are not expected to be able to identify with certainty an anagen or anagen/catagen phase hair, if there is any question as to whether or not a hair examined is in the anagen or anagen/catagen phase rather than a fragment or fiber, DNA analysis should be attempted.
- 11.2.5 Additional specific observations such as approximate length, color, etc., of a hair may be documented.

## 11.3 Preparation of Hairs Deemed Suitable for Nuclear DNA Analysis

- 11.3.1 Wash the hair to reduce surface dirt and contaminants by immersing the hair in sterile Type I Water in a clean 50 mL beaker or other suitable container. If the hair contains a biological fluid that is important to the investigation DO NOT wash the hair.
- 11.3.2 Use a clean scalpel blade to cut a 0.5 to 1 cm portion from the root end of the hair and then place the hair root into a microcentrifuge tube for DNA extraction.
- 11.3.3 The remainder of the hair, if not consumed, should be packaged, labeled appropriately and returned to the item packaging.

## 12 SINGLE PERPETRATOR PERK TRIAGING

This triaging approach applies to cases with a single alleged perpetrator, no previous consensual intercourse within 120 hours of the alleged assault, no reason to expect >1 male's DNA detected, and an adult female victim who was fully cognizant and aware during the alleged assault.

After the STR testing conducted based upon this triaging approach is complete, a Certificate of Analysis will be written and the evidence returned to the submitting agency, regardless of what other samples remain untested in the PERK.

**NOTE:** Exceptions to conduct further screening may be made for cases with impending court dates. Otherwise, further screening beyond this approach requires a request from the investigating agency after receipt of the Certificate of Analysis.

Report wording that makes clear that further testing can be conducted upon request will be included in the Certificate of Analysis.

For the purposes of this approach, positive screening results are those that indicate or identify seminal fluid.

It is preferable that a single sample go forward for DNA STR analysis with the least amount of screening time possible. If an internal or external body sample is positive and will *likely* give a useable result, only that sample need go forward for DNA STR analysis. All other screening will cease with the exception of the other applicable samples of the same level.

**EXAMPLES:** If vaginal, anal, and oral assaults are alleged, all three internal samples will be screened. The one most likely to give a result will be chosen for STR analysis. If, in this scenario, the anorectal sample is negative, the perianal/buttocks sample will not be screened.

If vaginal and oral assaults are alleged, only the VC and oral samples will be screened. If both are negative, both the TEG and LLA samples will be screened. If either or both are positive, the one likely to give a usable male result will be chosen for STR analysis. No other samples in the PERK will be screened.

If a single sample that will *likely* give a useable result is not identified, up to **FOUR** samples may be taken forward to quantitation in deciding which sample(s) to take forward for DNA STR analysis.

Up to **TWO** samples total may be taken for DNA STR analysis if a single sample likely to give a useable result has not been identified.

Although this approach, as written, relies upon the indication or identification of seminal fluid using traditional AP testing, microscopic techniques and p30 testing, an abbreviated screening approach, as detailed in Section 2.2 of this manual, may be incorporated such that no AP testing, microscopic identification of spermatozoa and/or p30 testing is required. If this abbreviated screening approach is chosen, a maximum of **FOUR** samples may still be taken forward to quantitation and a maximum of **TWO** samples may still be taken for DNA STR analysis. It is still preferable that a single sample go forward for DNA STR analysis, if possible.

### 12.1 Alleged Digital Penetration Only or Cunnilingus Only cases

12.1.1 Choose up to two samples to take to quantitation and/or DNA STR Analysis.

12.1.1.1 If the male quantitation result for a sample is N/A, the sample will be discontinued.

12.1.1.2 If both samples are discontinued due to N/A male quant, the Certificate of Analysis will be written.

12.1.1.2.9 Other remaining samples in the PERK will remain untested unless a request is received from the agency after receipt of the Certificate.

**EXAMPLE:** Alleged digital penetration and PERK includes a neck swab for saliva, a breast swab for saliva, a vaginal/cervical sample and a thighs/external genitalia sample. An examiner may choose either the V/C or TEG and either the neck or breast samples for quantitation and possible DNA STR analysis. The other unchosen samples will remain untested, regardless of the result obtained from the chosen samples. If the scenario is such that the V/C and TEG would be more informative, those two may be the samples chosen and the neck and breast swabs left untested.

## 12.2 Alleged Assaults with Possible Seminal Fluid

**NOTES:** Screening and DNA STR analysis for vaginal assaults are limited to the V/C and TEG samples (i.e., The PAB sample will not be screened or taken forward for an alleged vaginal assault.)

Screening and DNA STR analysis for anal assaults are limited to the ANO and PAB samples (i.e., The TEG sample will not be screened or taken forward for an alleged anal assault.)

12.2.1 Screen all internal sample(s) associated with the alleged assault(s).

**NOTE:** If an external ejaculation is alleged and an associated sample is included in the PERK (e.g., swab from stomach where ejaculation occurred, condom, etc.) this sample may be screened along with the internal samples associated with the alleged assault and one of each may be taken forward for DNA STR analysis. In this instance, one sample associated with the assault and one sample associated with the external ejaculation may be taken forward, resulting in the maximum TWO samples for DNA STR analysis.

12.2.1.1 If one is positive, DNA STR analysis will be conducted on that sample. No screening of the external samples associated with the other assault(s) for which the internal samples are negative will occur.

12.2.1.1.9 If the positive screening result is questionable (i.e., not many sperm are identified OR no sperm are identified but a positive p30 result is obtained), the associated external sample may be taken forward to quantitation along with the positive internal sample and the best of the two chosen for STR DNA analysis.

12.2.1.2 If multiple samples are positive, choose ONE with the best screening result (i.e., most sperm identified) for DNA STR analysis.

12.2.1.2.9 If multiple samples all have questionable positive results, the positive samples may be taken to quantitation at which point the best one (or possibly two) chosen for DNA STR analysis.

12.2.2 If no internal samples are positive, screen all external sample(s) associated with the alleged assault(s).

12.2.2.1 If one is positive, DNA STR analysis will be conducted on that sample.

12.2.2.2 If multiple samples are positive, choose ONE with the best screening result (i.e., most sperm identified) for DNA STR analysis.

12.2.2.2.9 If multiple samples all have questionable positive results, the positive samples may be taken to quantitation at which point the best one (or possibly two) chosen for DNA STR analysis.

12.2.3 If no internal or external samples are positive, the remaining samples in the PERK will be assessed, with the use of the Sexual Assault Information Form or other information provided by the investigating agency, to determine which, if any, should be screened or taken forward for quantitation (e.g., neck swab for saliva straight to quantitation, screen UPS for semen, swab UPS and take directly to quantitation due to alleged cunnilingus, or take TEG sample forward to quantitation for alleged cunnilingus, etc.).

12.2.3.1 If no cunnilingus is alleged, no samples collected specifically for possible saliva are present, and no seminal fluid is indicated with p30 or identified through sperm search, no samples will be taken for quantitation or DNA STR analysis.

### 12.3 Suspect PERKs Submitted in Cases to Which This Triaging Chapter Applies

12.3.1 If a sample or samples from the victim PERK are likely to produce a useable male result, the non-reference samples in the suspect PERK(s) will not be examined.

12.3.2 If there is question as to whether or not a useable profile will be obtained from the victim PERK, ONE non-reference sample from the suspect PERK may be tested.

12.3.2.1 If both the pubic area swab(s) and UPS are submitted in the suspect PERK, the pubic area swab(s) will be tested.

12.3.2.2 If UPS, but no pubic area swab(s), are submitted, the UPS may be tested.

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**APPENDIX A – CHEMICAL TESTS FOR BLOOD****1 Combined Phenolphthalein-Tetramethylbenzidine (PTMB) Test**

## 1.1 Safety Considerations

- Phenolphthalin - Caution! Avoid contact and inhalation!
- Potassium hydroxide - Caution! Corrosive! Poisonous!
- Tetramethylbenzidine - Caution! Harmful if swallowed, inhaled or absorbed through skin! Emits toxic fumes under fire conditions!
- Glacial acetic acid - Caution! Corrosive! Flammable!
- Ethanol - Caution! Flammable! Poisonous!
- Oxidized zinc - Caution! Danger of spontaneous combustion if allowed to dry!

## 1.2 Materials and Equipment

- Dropper bottles
- Cotton swabs
- Test tubes, microtiter plates, or filter paper
- 100 ml graduated cylinder
- Weigh boats or weigh paper
- Balance
- Spatula
- Scissors
- Tweezers
- Magnetic stir plate

## 1.3 Stock Solutions

## 1.3.1 Phenolphthalin Stock Solution

## 1.3.1.1 Mix the following thoroughly until dissolved:

- 1 g Phenolphthalin
- 25 g Potassium Hydroxide (KOH)
- 100 mL Type I water

## 1.3.1.2 Labeling

Label the bottle as Phenolphthalin Stock Solution with a lot number (date of preparation followed by the initials of the person preparing the stock solution) and “No Expiration” as there is no expiration date for this solution.

## 1.3.1.3 Storage

This colorless solution is stored under refrigeration over fresh granular zinc to keep it in the reduced form. The oxidized zinc in the bottle should not be allowed to dry.

## 1.3.1.4 Disposal

When the reduced Phenolphthalin Stock Solution is depleted, cover the zinc in the bottom of the bottle completely with a solution of potassium hydroxide in distilled or Type I water (25g KOH/100mL water).

Label the bottle “For Disposal” and refrigerate. Notify the Safety Officer that the zinc is ready to be disposed of in accordance with Department procedures.

### 1.3.2 Tetramethylbenzidine (TMB) Stock Solution

1.3.2.1 Mix the following thoroughly until dissolved:

- 10 mg Tetramethylbenzidine (TMB)
- 30 mL Glacial Acetic Acid

1.3.2.2 Labeling

Label the bottle as TMB Stock Solution with a lot number (date of preparation followed by initials of person preparing the stock solution) and “No expiration”, as there is no expiration date for this solution.

1.3.2.3 Storage

The TMB Stock Solution should be stored at room temperature.

1.3.2.4 Disposal

Dispose of the TMB Stock Solution and other materials contaminated with this solution as hazardous waste in accordance with Department procedures.

## 1.4 Working Solutions

- Type I water
- Ethanol
- 3% Hydrogen Peroxide
- 1:5 dilution of Phenolphthalin Stock Solution in Type I water (1 part Stock Solution plus 4 parts Type I water)
- TMB Stock Solution

1.4.1 Labeling

1.4.1.1 Each bottle containing a working solution will be labeled with the identity of the contents.

1.4.1.2 Each bottle containing a working solution with a lot number will be also be labeled with that lot number (all but the Type I water).

1.4.1.2.1 The bottle containing the 1:5 dilution of phenolphthalin Stock Solution must be labeled appropriately. If the lot number of the diluted stock solution is recorded in the reagent log book, then the bottle must be labeled with this lot number. If only the neat stock solution is recorded in the reagent log book, then the bottle must be labeled with the lot number of the neat stock solution, the date of the dilution, and the initials of the person making the dilution.

1.4.1.3 Each bottle containing a working solution that is used solely for PTMB testing will also be labeled to indicate that no expiration date applies.

1.4.2 Storage

All working solutions may be stored at room temperature.

## 1.5 Minimum Standards and Controls

- 1.5.1 On the day of use, a positive reagent control (known bloodstain) and a negative reagent control (Type I water or same substrate type as used for positive control with no stain) must be tested to ensure the reagents are working properly. The results of this testing must be documented in the case file.
- 1.5.2 If either control does not give the expected result, testing of evidence samples will not proceed until the problem has been resolved and a new set of positive and negative controls gives the expected result.

**NOTE:** Substrates such as leather or suede may cause the results to be more difficult to interpret.

## 1.6 Combined Phenolphthalein-Tetramethylbenzidine (PTMB) Test Procedure

**NOTE:** If it is possible that a stain will be consumed, do not perform the PTMB testing and proceed directly to collection of the stain for DNA analysis.

- 1.6.1 Gently rub a suspected stain with a cotton swab which has been moistened with Type I water or place a small cutting of the stain in a small test tube or microtiter plate, or on filter paper and moisten with Type I water if desired.
- 1.6.2 Add a drop of ethanol.
- 1.6.3 Add a drop of the working solution of phenolphthalein.
- 1.6.4 Add a drop of 3% hydrogen peroxide.
- 1.6.5 Note any color change. An immediate pink color is expected if blood is present.
- 1.6.6 Add a drop of tetramethylbenzidine stock solution.
- 1.6.7 Note any color change. An immediate blue-green color is expected if blood is present.
- 1.6.8 Interpretation

Positive reaction = immediate pink color at 1.6.5 followed by immediate blue-green color at 1.6.7

Negative reaction = no color change at 1.6.5 followed by no color change at 1.6.7

Inconclusive reaction = development of color combinations other than those specified for a positive reaction, including one test positive and the other test negative

## 2 Luminol Test

### 2.1 Safety Considerations

- Sodium perborate - Caution! Harmful if swallowed, inhaled or absorbed through skin!
- Aminophthalhydrazide (luminol) - Caution! Irritant! Emits toxic fumes under fire conditions!

### 2.2 Materials and Equipment

- Spray bottle (must contain no metal parts as the luminol will react with some metals)
- 50 mL graduated cylinder
- Balance
- Weigh boats or weigh paper



- Spatula
- Zip-closure bags, conical tubes or other appropriate containers (optional)
- Magnetic stir plate

## 2.3 Stock Solutions

### 2.3.1 Solution A

2.3.1.1 Mix the following ingredients (proportionally) until thoroughly dissolved.

- 0.7 g sodium perborate
- 50.0 mL Type I water

2.3.1.2 Solution A should be stored in the dark at room temperature for up to 6 months.

### 2.3.2 Solution B

2.3.2.1 Mix the following ingredients (proportionally) until thoroughly dissolved.

- 0.1 g Aminophthalhydrazide (luminol)
- 5.0 g sodium carbonate
- 50 mL Type I water

2.3.2.2 Solution B should be stored in the dark at room temperature for up to 6 months.

**NOTE:** The dry chemicals in Solutions A and B may be weighed out and placed in appropriately labeled containers and stored in the dark at room temperature. Each container must be labeled with the date prepared, the initials of the preparer and the amount of Type I water to be added. The Type I water can be added when needed.

## 2.4 Minimum Standards and Controls

2.4.1 Immediately prior to use as outlined in 2.5.2, a positive reagent control (known dilute bloodstain) and a negative reagent control (Type I water or same substrate type as used for positive control with no stain ) must be tested to ensure the reagents are working properly. The results of this testing must be documented in the case file.

2.4.2 If either control does not give the expected result, testing of evidence samples will not proceed until the problem has been resolved and a new set of positive and negative controls gives the expected result.

## 2.5 Luminol Procedure

2.5.1 Immediately prior to conducting the tests, mix equal parts of solutions A and B and place in a spray bottle.

2.5.2 Under darkened conditions (total darkness is best), spray the positive and negative controls and document results in the case file.

2.5.3 Spray any areas of interest on the evidence being tested.

2.5.3.1 Areas containing blood will luminesce immediately.

2.5.4 Mark areas of luminescence for subsequent testing with the PTMB test.

## 2.5.5 Interpretation

Positive reaction = immediate luminescence

Negative reaction = no luminescence

Inconclusive reaction = Slow and/or weak luminescence

### 3 BLUESTAR® Forensic Test for blood

**NOTE:** BLUESTAR® Forensic Test Kit information is available at <http://www.bluestar-forensic.com>

#### 3.1 Safety Considerations

- Beige Tablet - Ca Beige Tablet - Caution! Avoid contact with skin and eyes, gloves must be worn.
- White Tablet - Caution! Avoid contact with skin and eyes, gloves must be worn.

#### 3.2 Materials and Equipment

- Spray bottle (must contain no metal parts as chemicals may react with some metals)
- 100 mL graduated cylinder

#### 3.3 BLUESTAR® Working Solution

3.3.1 Dissolve the white and beige tablets in 125 mL Type I water.

**USE IMMEDIATELY! DO NOT STORE!**

#### 3.4 Minimum Standards and Controls

3.4.1 Immediately prior to use as outlined in 3.5.2, a positive reagent control (known dilute bloodstain) and a negative reagent control (Type I water or same substrate type as used for positive control with no stain ) must be tested to ensure the reagents are working properly. The results of this testing must be documented in the case file.

3.4.2 If either control does not give the expected result, testing of evidence samples will not proceed until the problem has been resolved and a new set of positive and negative controls gives the expected result.

#### 3.5 BLUESTAR® Forensic Test Kit for blood Procedure

3.5.1 Immediately prior to conducting the tests, dissolve the tablets in Type I water, as described in 3.3.1 in a spray bottle.

3.5.2 Under darkened conditions (total darkness is best), spray the positive and negative controls and document results in the case file.

3.5.3 Spray any areas of interest on the evidence being tested.

**NOTE:** Areas containing blood will luminesce immediately.

3.5.4 Mark areas of luminescence for subsequent testing with the PTMB test.

#### 3.5.5 Interpretation

Positive reaction = immediate luminescence

Negative reaction = no luminescence

Inconclusive reaction = Slow and/or weak luminescence

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**APPENDIX B – SCREENING TESTS FOR SEMINAL FLUID / SEMEN****1 Acid Phosphatase Test**

## 1.1 Safety Considerations

- Glacial acetic acid - Caution! Corrosive! Flammable!
- Sodium acetate - Caution! Irritant!
- Sodium  $\alpha$ -naphthyl acid phosphate - Caution! Irritant! Emits toxic fumes under fire conditions!
- o-Dianisidine (Naphthanil diazo blue B) - Caution! Highly toxic! Emits toxic fumes under fire conditions!
- Naphthanil diazo red - Caution! Avoid contact and inhalation! Emits toxic fumes under fire conditions!

## 1.2 Materials and Equipment

- 5 ml and 500 ml Graduated cylinders
- Balance
- Spatula
- Scissors
- Tweezers
- Filter paper or microtiter plate (optional)
- Weigh boats or weigh paper
- Cotton swabs
- Test tubes or bottles
- Disposable transfer pipets or droppers

## 1.3 Stock Solutions

## 1.3.1 Acid Phosphatase (AP) buffer

## 1.3.1.1 Mix the following thoroughly until dissolved:

- 2.5 ml Glacial acetic acid
- 10.0 g Sodium acetate (anhydrous)
- 450.0 ml Distilled water

## 1.3.1.2 Labeling

Label the bottle as AP buffer with a lot number (date of preparation followed by the initials of the person preparing the stock solution) and “No Expiration” as there is no expiration date for this solution.

## 1.3.1.3 Storage

AP buffer may be stored at room temperature.

## 1.4 Working Solutions

- Type I water
- Sodium  $\alpha$ -Naphthyl Acid Phosphate Solution (see 1.4.1)
- Dye Solution (see 1.4.2)

1.4.1 Sodium  $\alpha$ -Naphthyl Acid Phosphate Solution1.4.1.1 Add a small amount (approximately 4 mg) of sodium  $\alpha$ -naphthyl acid phosphate to

approximately 3 mL of AP buffer (proportionally) in an appropriately labeled container and mix well.

1.4.1.1.1 Discard by the end of the day.

1.4.2 Dye Solution

1.4.2.1 Add a small amount (approximately 4 mg) of o-dianisidine or naphthyl diazo red to approximately 3 mL of AP buffer (proportionally) in an appropriately labeled container and mix well.

1.4.2.2 The solution may be protected from light by covering the container with foil or using a brown bottle.

1.4.2.2.1 Discard by the end of the day.

1.5 Minimum Standards and Controls

1.5.1 On the day of use, a positive reagent control (known seminal fluid stain) and a negative reagent control (Type I water or same substrate type as used for positive control with no stain) must be tested to ensure the reagents are working properly. The results of this testing must be documented in the case file.

1.5.2 If either control does not give the expected result, testing of evidence samples will not proceed until the problem has been resolved and a new set of positive and negative controls gives the expected result.

1.6 Acid Phosphatase (AP) Test procedure

**NOTE:** If it is possible that a stain will be consumed, do not perform the AP testing and proceed directly to collection of the stain for DNA analysis.

1.6.1 Moisten filter paper/swab with distilled water. (Do not use buffer solution, as this will contaminate the stained area.) Press the filter paper against the suspected stain or gently rub the stained area with the moistened swab. Alternatively, a small piece of the stain/swab can be placed on filter paper, in a small test tube, or in a microtiter plate.

1.6.1.1 If filter paper is used for AP mapping, the appropriate sized piece of filter paper should be moistened with Type I water, taking care not to soak the paper as this can dilute the stain and/or transfer the stain to another layer or portion of the item.

1.6.1.2 Apply the filter paper to the questionable stain or stained area by pressing the filter paper down onto the item carefully with moderate pressure long enough to transfer just a small amount of stain for testing (typically ~15 to 30 seconds).

1.6.1.3 Remember the orientation of the filter paper or mark a corner.

1.6.1.4 Apply the solutions in the order described below (see 1.6.2); however, in order to ensure each solution covers the entire piece of filter paper, disposable pipettes can be used to apply each solution over the paper while holding at an angle; place the paper down on bench paper or paper towel and read the reaction after 10-15 seconds as described below.

1.6.1.5 Mark the item or document in a diagram using the filter paper as reference where any positive areas were detected and note strength of reaction.

1.6.1.6 Be sure to change gloves between each application of filter paper to additional stains/stained areas for testing.

1.6.1.7 If necessary air dry the evidence item before repackaging.

1.6.2 Add 1-2 drops of sodium  $\alpha$ -naphthyl acid phosphate solution.

1.6.3 Add 1-2 drops of dye solution.

1.6.4 Note any color change. The development of a blue/purple color with o-dianisidine or an orange/red color with naphthanal diazo red within 10 to 15 seconds is indicative of acid phosphatase levels in seminal fluid/semen.

**NOTE:** Slow color development or development of a color not defined above may be attributed to increased acid phosphatase levels from non-seminal fluid sources (e.g., increased acid phosphatase levels in vaginal fluid due to the victim's age, bacteria and/or white blood cells).

1.6.5 The presence of semen in all samples exhibiting an inconclusive result (not attributable to an increase in phosphatase levels from non-seminal fluid sources) or a positive result must be either confirmed by identifying spermatozoa or, in the absence of spermatozoa indicated with p30.

1.6.6 Interpretation

Positive reaction = Blue/purple color with o-dianisidine within 10 to 15 seconds OR Orange/red color with naphthanal diazo red within 10 to 15 seconds

Negative reaction = No color development, slight/slow color development

Inconclusive reaction = Slow moderate to strong color development

## 2 Extraction of Spermatozoa from a Substrate

### 2.1 Materials and Equipment and Reagents

- Rotator, vortex, sonicator, or centrifuge (depending on extraction method used)
- Scissors
- Tweezers
- Dissecting needle
- Microscope slides
- Test tubes
- Type I water

### 2.2 Extraction Methods

**NOTE:** Any of the following methods are acceptable. Once complete, a 3.0  $\mu$ L spotting of the sediment created should be placed on a microscope slide (if the method does not already involve placement of the extract on a microscope slide). If the extraction is performed in a microcentrifuge tube, the tube can be centrifuged to collect the sediment at the bottom, the supernatant drawn off and discarded and the sediment at the bottom used for the spotting.

- If the slide will be stained for examination, it should be allowed to air dry.
- If the slide will be unstained for examination, it should be examined while wet.

2.2.1 Cut a small portion of a stain and soak in a test tube in Type I water.

OR

Soak a small portion of a stain in Type I water and rotate.

OR

Soak a small portion of a stain in Type I water and sonicate on low for 10 seconds, followed by a second 30 second sonication on low.

OR

Tease fibers apart and soak in a small amount of Type I water.

OR

Soak a small portion of a stain in Type I water and vortex.

OR

Soak a small portion of a stain in Type I water on a microscope slide, stain side down (may be followed by maceration).

OR

In some instances, a small portion of the stain can be cut for the p30 procedure and a sperm search can be conducted on a 3.0  $\mu$ L spot from the p30 extract.

OR

If the stain is small enough that consuming any portion of it for a sperm search may negatively impact the ability to obtain DNA analysis results, cut an appropriate amount of the stain (consuming it if necessary) for DNA extraction.

**NOTE:** 3.0  $\mu$ L of the sperm fraction produced during the differential extraction procedure should be spotted on a microscope slide for a sperm search if no sperm search is conducted prior to extraction.

### 3 Staining Slides/Smears to Aid in the Visualization of Spermatozoa (Optional)

#### 3.1 Kernechtrot-Picroindigocarmine Stain

##### 3.1.1 Safety Considerations

- Aluminum sulfate - Caution! Harmful if inhaled, in contact with skin, and if swallowed! Emits toxic fumes under fire conditions!
- Nuclear fast red - Caution! Irritant! Emits toxic fumes under fire conditions!
- Saturated picric acid solution - Caution! Toxic! Explosive when dry! Emits toxic fumes under fire conditions!
- Indigocarmine dye - Caution! Harmful if swallowed! Emits toxic fumes under fire conditions

##### 3.1.2 Materials and Equipment

- Filtration apparatus
- 500 ml glass beakers
- Balance
- Spatula
- Plastic bottles

- Glass rod
- Filter paper
- Weigh boats or weigh paper

3.1.3 Reagents

- Aluminum sulfate
- Nuclear Fast Red
- Type I water
- Picroindigocarmine dye
- Saturated picric acid solution - **Purchase saturated solution. DO NOT PURCHASE DRY PRODUCT!**

3.1.4 Kernechtrot Solution (KS)

3.1.4.1 Dissolve 5 g aluminum sulfate in 100 mL of hot Type I water in a beaker.

3.1.4.2 Immediately add 0.1 g Nuclear Fast Red and stir with a glass rod.

3.1.4.3 Allow to cool and filter through filter paper.

3.1.4.4 Labeling

Label the bottle as KS with the lot number (date of preparation followed by initials of preparer) and the expiration date.

3.1.4.5 Storage

The KS can be stored at room temperature for up to 6 months, but may need to be re-filtered after standing.

3.1.5 Picroindigocarmine Solution (PICS)

3.1.5.1 Dissolve 1 g Indigocarmine dye in 300 mL of a commercially purchased saturated solution of picric acid.

3.1.5.2 Filter through filter paper.

3.1.5.3 Labeling

Label the bottle as PICS with the lot number (date of preparation followed by initials of preparer) and the expiration date.

3.1.5.4 Storage

The PICS can be stored at room temperature for up to 6 months, but may need to be re-filtered after standing.

3.2 SERI Christmas Tree Stain (R540) Kit

3.2.1 Contents

- Solution A (Kernechtrot Solution – KS) – 30 mL
- Solution B (Picroindigocarmine Solution – PICS) – 30 mL
- Directions for use



3.2.2 Store and discard according to manufacturer's recommendation and expiration date.

3.3 KPICS/Christmas Tree Staining procedure

3.3.1 If not already prepared and dried, prepare a thin smear of an extract of a suspected semen stain on a microscope slide and allow to air dry or use a smear provided in a Physical Evidence Recovery Kit (PERK).

3.3.2 Fix the sample to the slide/smear with a quick flame heating, with a spray fixative or by placing it on a heat block overnight.

3.3.3 Add a sufficient volume of KS (red stain) to cover the stained portion of the slide/smear.

3.3.4 Allow the KS stand on the slide/smear for at least 15 minutes.

3.3.5 Wash the KS off the slide/smear with a gentle stream of water.

3.3.6 Add a sufficient amount of PICS (green stain) to cover the stained portion of the slide/smear.

3.3.7 Allow the PICS to stand on the slide/smear for ~5-15 seconds.

3.3.8 Wash the PICS off the slide/smear with methanol, 95% Ethanol or a gentle stream of water.

3.3.9 Dry the slide/smear at room temperature.

**4 Microscopic Examination of Stained Slides/Smears for Spermatozoa**

4.1 Materials, Reagents and Equipment

- Type I water, xylene substitute or another appropriate mounting medium
- Coverslips
- Microscope (with approximately 200X-400X total magnification, with or without phase contrast capability)

4.2 Procedure

4.2.1 If necessary, follow the procedure for Köehler Illumination (section 7 of this appendix) on the microscope.

4.2.1.1 This should not often be necessary. The microscopes should maintain Köehler Illumination through several to many uses.

4.2.2 Scan the slide/smear at either ~200X or ~400X total magnification. Confirm at ~400X total magnification.

4.2.2.1 With phase microscopy: Spermatozoa heads are neon-like pink/red with darker pink/purple acrosomal caps and green tails. Epithelial cells and most bacteria stain green with some of the nuclei pink/red; however, these are shaped differently than spermatozoa. Yeast cells take on the same color as spermatozoa, but are shaped differently.

4.2.2.2 Without phase microscopy (bright field): Spermatozoa heads are neon-like pink/red with pale pink (almost colorless) acrosomal caps, blue-green necks/midpieces, and green tails. Epithelial cells appear bright blue with red to purple nuclei. Yeast cells take on the same color as spermatozoa, but are shaped differently.

- 4.2.3 Document the approximate number of spermatozoa/spermatozoa heads on the slide/smear per hpf (~400X), per lpf (~200X), per length of slide/smear (low or high power sweep), or per slide/smear as appropriate. Documentation of intact vs. heads only can be helpful in some cases.
- 4.2.4 If only one spermatozoon or spermatozoon head is observed, a second qualified examiner *must* confirm its presence and document that confirmation in the notes.

**5 Microscopic Examination of Unstained Slides/Smears for Spermatozoa**

5.1 Materials, Reagents and Equipment

- Type I water
- Applicator sticks
- Coverslips
- Microscope (with approximately 200X-400X total magnification, with or without phase contrast capability)

5.2 Procedure

- 5.2.1 If necessary, follow the procedure for Köehler Illumination (section 7 of this appendix) on the microscope.
  - 5.2.1.1 This should not often be necessary. The microscopes should maintain Köehler Illumination through several to many uses.
- 5.2.2 If not already prepared, place a small amount of an extract of a suspected semen stain on a microscope slide and cover with a coverslip, or add a drop of Type I water to a smear provided in a Physical Evidence Recovery Kit (PERK), agitate with an applicator stick and cover with a coverslip.
- 5.2.3 Scan the slide/smear at either ~200X or ~400X total magnification. Confirm at ~400X total magnification.
  - 5.2.3.1 When the coverslip is touched gently, the spermatozoa/heads will roll, exhibiting their characteristic 3-dimensional shape. Use the distinctive size and morphology to identify the spermatozoa/heads.
- 5.2.4 Document the approximate number of spermatozoa and spermatozoa heads on the slide/smear per hpf (~400X), per lpf (~200X), per length of slide/smear (low or high power sweep), or per slide/smear as appropriate. Documentation of intact vs. heads only can be helpful in some cases.
- 5.2.5 If only one spermatozoon or spermatozoon head is observed, a second qualified examiner *must* confirm its presence and document that confirmation in the notes.

**6 p30 ABACARD® Procedure**

**NOTE:** The “High Dose Hook Effect” is a false negative result that is obtained in the presence of high concentrations of p30 (usually undiluted semen). This effect results from large amounts of human p30 binding to the antibody to form an antigen-antibody complex and free p30 migrating toward the test area “T”. The antibody in the test area “T” is blocked by this free p30. Therefore, the mobile antigen-antibody complex cannot bind to the antibody. As a result no pink line will form in the test area “T”. To confirm the presence of “High Dose Hook Effect”, repeat the test using a 10-10,000 fold dilution of the sample.

6.1 Materials, Reagents and Equipment

- ABACard® p30 Test cards (test devices) – one per sample tested, including positive and negative controls
- Dropper (included in each test device pouch)

- Buffer (included in kit)
- Microcentrifuge
- Microcentrifuge tubes with lids and/or lids
- Spin-Ease baskets
- Timer
- Scissors
- Tweezers
- Microcentrifuge tube rack
- Pipettes (1000 µl and/or 200 µl)
- Pipette tips
- Dissecting needle
- Known semen or seminal fluid sample

6.2 Minimum Standards and Controls

- 6.2.1 On the day of use a positive reagent control (known seminal fluid/semen) and a negative reagent control (buffer) must be tested to ensure that the reagents and test device are working properly. The results of this testing must be documented in the case file.
- 6.2.2 If either control does not give the expected result, do not proceed with testing evidence samples until the problem has been resolved as demonstrated by testing another set of positive and negative reagent controls and achieving the expected results with both controls

6.3 Procedure

- 6.3.1 Cut a portion of the dried stain into small piece(s) (size based upon the substrate and the intensity of the acid phosphatase test) and place into a labeled microcentrifuge tube.
- 6.3.2 Add 350 µl of the buffer provided within the kit and cap the tube.
- 6.3.3 Allow the sample to extract at room temperature for a minimum of 2 hours to overnight.
- 6.3.4 Briefly spin the tube to force liquid to the bottom.
- 6.3.5 Remove the cutting(s) and place them into a Spin-Ease basket.
- 6.3.6 Centrifuge for 5 minutes at ~10,000 rpm to recover the liquid and pellet the sediment.
- 6.3.7 Remove approximately 320 µl of the extract and place into a new labeled microcentrifuge tube (if storing for later use) or remove approximately 200 µl of the extract and add directly into the sample well “S” on a labeled test device.
- 6.3.7.1 If conducting a microscopic sperm search, spot 3 µl of the remaining liquid with sediment onto a microscope slide. Refer to 3.3.1 or 5.2.1 for further direction. Refer to 2.2.3.3-2.2.3.5 for direction regarding the disposition of the laboratory created slide.
- 6.3.7.2 The aliquot in the new microcentrifuge tube may be stored between 2-8°C or frozen if not used immediately. The sample must then be allowed to warm to room temperature prior to conducting the test.
- 6.3.7.2.1 Once warmed to room temperature, add approximately 200 µl of the aliquot into the sample well “S” on a labeled device.
- 6.3.8 Record the result for each test device at 10 minutes.

- 6.3.8.1 A positive result can be seen as early as 1 minute.
- 6.3.8.2 For negative results, one must wait for the full 10 minutes.
- 6.3.8.3 Do not record the results after 10 minutes.
- 6.3.8.4 All control samples must give the expected results before the result on an unknown sample can be used.

6.4 Interpretation

- 6.4.1 Positive Result = 2 pink lines, one in the test area “T” and one in the control area “C”. Regardless of how faint a line may be in the T area, the result is positive if a line can be seen.
- 6.4.2 Negative Result = 1 pink line in the control area “C”.
  - 6.4.2.1 Consider the High Dose Hook Effect described above and dilute the remaining sample and perform the test again, if indicated.
- 6.4.3 Invalid Result = No pink line in the control area “C” or incomplete line in the test “T” area. The test is inconclusive. Repeat if sufficient sample remains.

7 Procedure for Köehler Illumination

- 7.1 Determine that the lamp is centered according to the instructions for the microscope in use.
- 7.2 Using a medium to low power objective (approximately 10X), place a specimen in position and focus.
- 7.3 Close the field diaphragm.
- 7.4 Focus the image of the field diaphragm by adjusting the sub-stage condenser.
- 7.5 Center the field diaphragm using the centering screws on the condenser.
- 7.6 Open the field diaphragm so that the rim just disappears beyond the field of view.
- 7.7 Adjust the condenser diaphragm (aperture diaphragm) to about ½ of the full aperture.

**NOTE:** Resolution, contrast, and depth of field can be regulated with the condenser diaphragm. It should not be used to regulate the brightness. For this purpose, either the regulating transformer or neutral density filters should be used.

**APPENDIX C – REFERENCES**

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