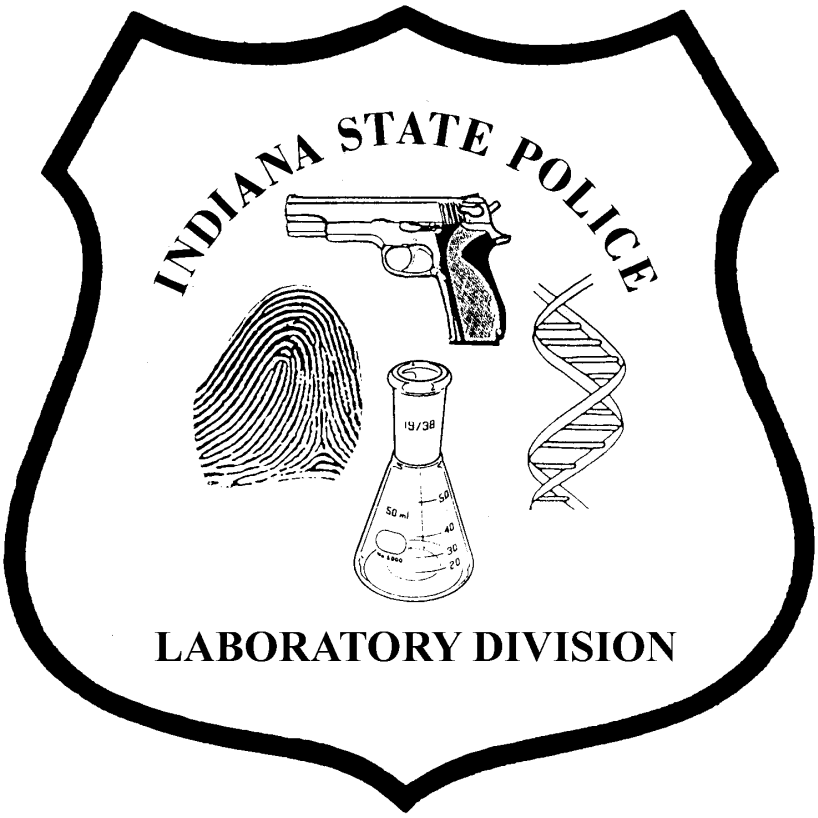
BLOODSTAIN PATTERN ANALYSIS



TEST METHODS

FORWARD

Bloodstain pattern analysis performed by the Indiana State Police (ISP) Laboratory Division attempts to identify any bloodstain pattern(s) present and classify the pattern(s) based on their physical characteristics. Once a classification has been made, the bloodstain pattern type is then evaluated for the presence of any additional information the pattern type may display. All observations are recorded in the case notes and summarized in a Certificate of Analysis or Crime Scene Investigator (CSI) Report.

Bloodstain pattern analysis is conducted by trained and skilled analysts who have completed the ISP bloodstain pattern training program. The analysts are both Civilian and sworn ISP employees. These analysts have participated in extensive formalized training programs under the direction of the (ISP) Laboratory Division. During the training program, the new analyst must successfully complete testing consisting of written tests, oral examinations, mock trial, and competency sample analyses. In order for the trainee to be declared competent in this discipline they shall successfully complete a 40 hour Bloodstain Pattern Interpretation course, approved by the Division Commander, provided by an entity other than the ISP and an internal training program. Examination of bloodstain pattern evidence will begin upon completion of the training programs and approval the Laboratory Division Commander.

The interpretation of blood spatter may not always be definitive. Each analyst is expected to use their training, experience and education to support conclusions, opinions and interpretations.

This test method is a general approach to the examination of bloodstain pattern analysis evidence and the conclusions, opinions and interpretations as they relate to these examinations. Minor deviations may be employed with the approval of a technical supervisor. The deviation, justification and supervisor's approval shall be documented in the case notes.

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1. Bloodstain Pattern Analysis:

1.1. Scope: This test method is designed as a procedure for Laboratory Division personnel to assist investigations where bloodstain patterns occur on physical evidence in a variety of alleged criminal activities. The scope of this type of evidence includes interpretation of the possible patterns that might be observed on an item of evidence.

The items of evidence will be examined for any areas of possible bloodstaining. Appropriate notes shall be taken on the evidence. Once appropriate notes and photographs have been taken of the item it is not required that the actual stained area be retained.

1.2. Precautions/Limitations:

1.2.1. All bloodstains do not exhibit discernable patterns, and do not lend themselves to evaluation.

1.2.2. Evidence shall be handled in a manner that will not alter the appearance of the stains.

1.3. Related Information:

1.3.1. Appendix 1: Worksheets
1.3.2. Appendix 4: Sketch Templates
1.3.3. Serology Test Method

1.4. Instruments:

1.4.1. A digital camera and associated equipment (tripods, lenses, flashes, etc.) shall be used to complete the photography needed to document the evidence and/or crime scene. The analyst shall have a basic knowledge of camera use and terminology. The photographs should be taken with the camera set in JPEG mode and with the resolution being set at medium or high. The digital files from the camera shall be stored on a secure electronic medium.

1.5. Reagents/Materials: N/A

1.6. Hazards/Safety:

1.6.1. If a laboratory analyst is processing a crime scene for bloodstain patterns, a sworn officer must be at the scene at all times.

1.6.2. Universal precautions should always be used during the processing of biological evidence. Analysts shall wear appropriate personal protective equipment.

1.7. Reference Materials/Controls/Calibration Checks: N/A

1.8. Procedures/Instructions:

1.8.1. All items of evidence shall be marked with the proper case number, item number, and other identifying marks when possible.

1.8.2. A visual exam shall be performed in which the analyst attempts to identify any bloodstain pattern(s) present and classify them based on physical characteristics. Once the pattern(s) are classified, a bloodstain pattern should be evaluated for the presence of any additional information the stain(s) may exhibit. All observations shall be recorded in the case notes.

1.8.3. If the analyst is performing their own serological examination of the evidence as well as the pattern analysis, the procedures and methods given in the Serology Test Method shall be followed and the analyst shall be proficient in the tests performed.

1.8.4. Notes and sketches shall document the item(s) of evidence and the observed bloodstains including the following: number, locations, sizes, shapes, directionality and any additional observations (condition of blood: dry, color, etc).

1.8.5. Photographs shall include at a minimum: overall, medium, close-up (macro), and technical (close-up with a metric scale and as near 90 degrees as possible).

1.8.6. To determine the angle of impact, make measurement(s) utilizing a viewing loop (or a metric ruler) with an embedded scale in 0.5 mm increments or smaller. Place a viewing loop over the stain(s) to measure the width and length of the individual stain(s) within a pattern. The analyst then uses a scientific calculator to complete the angle of impact calculations using the following:

Sin^{-1} (width ÷ length) = angle of impact

1.8.7. When determining the area of origin, the three dimensional aspect of trajectories shall be documented:

- Gamma (**γ**) is the angle of the bloodstain path measured from the true vertical (plumb) of the surface.
- Alpha (**α**) is the impact angle of the bloodstain path moving out from the surface.
- Beta (**β**) is the angle of the bloodstain path pivoting about the vertical (z) axis.

A representative sampling of stains within a pattern shall be utilized to ensure accurate determination of area of origin.

1.8.8. If the analysis is performed at the crime scene a CSI Report shall be completed. The crime scene shall be processed for bloodstain patterns in a systematic approach.

1.8.9. If a crime scene is processed the crime scene protocol shall be utilized.

1.9. Records:

1.9.1. All notes and photographs shall be stored in the case record.

1.9.2. A Certificate of Analysis or CSI Report shall be issued with the examination conclusions, opinions and interpretations.

1.10. Interpretations of Results:

1.10.1. Analysts shall base their conclusions, opinions and interpretations on their training and experience supported by documentation through notes, photos and other physical evidence. The documentation needs to be sufficient enough to allow another qualified analyst to review the notes and reach the same conclusion, opinions and interpretations. This is documented with a completed Technical Review Worksheet that is stored in the case record.

1.11. Report Writing:

1.11.1. Scene Specific Narrative: A CSI report regarding bloodstain pattern analysis shall refer to the stains as “reddish-brown” stains. The analyst shall determine that the stains are consistent with blood based on their education, training and experience. If presumptive testing for blood is conducted at the scene, the results should be included in the report. Origin determinations shall primarily appear in scene specific reports but shall not specify whose blood created the patterns. A scene based report shall concentrate on pattern analysis (size, shape, distribution, concentration, etc.) and documentation data. Only a limited amount of scene reconstruction shall be reported due to the lack of supporting laboratory reports such as pathological and serological findings.

1.11.2. Non-Scene Specific Narrative: Laboratory based reports typically deal with the evaluation of bloodstain patterns on specific items of evidence, but might also deal with the analysis of photographs taken from the crime scene. As with the previous report scenario these reports shall primarily concentrate on pattern analysis (size, shape, distribution, concentration, etc.) and documentation of the patterns with limited reconstruction conclusions.

1.11.3. Common Phrases to be used when writing reports are:

-Consistent with...
-Indicative of...
-Appeared to be...
-Apparent bloodstains...
-Based upon current information...
-In the condition received...
-At the time of examination...

1.11.4. Example of report wording:

- For a target (example T-shirt, wall…) with impact spatter:

  Item (*X)*
  The "*target*" was examined.

  Area (*A)* - (*describe location of area on target*)
  A pattern was observed with approximately (*X#)* of reddish brown stains with diameters of (*Y-Z*) mm which is consistent with being impact spatter.

- For type of pattern observed:

  Consistent with being: impact spatter (optionally defined as high, medium or low impact) /dripped blood stains/cast-off blood stains/an expirated bloodstain pattern/a blood trail, etc...

- For a void pattern:

  Examination of the (photographs, notes, sketches, etc.) revealed that the (*item X or crime scene location*) exhibited a void area. The void is consistent with the presence of an intermediate target being present during the time of bloodshed.

- For movement of victim:

  The blood evidence on (*item X*) is consistent with victim moving or being moved after blood flow was initiated.

- For point of origin/point of convergence:

  The blood source for the pattern appears to have originated from (*location X* example: near the floor/near the door knob/near light switch, etc.).

The bloodstain pattern on (*item X*) was examined. The point of convergence for this bloodstain pattern was determined to be approximately (*give two-dimensional measurements*). The origin for this pattern was determined to be approximately (*give three-dimensional "3D" measurements*).

- Wording for angle of impact:

  The angle of impact was determined to be approximately (*angle to the nearest whole degree*).

- Wording for Contact/Transfer Patterns:

  A contact/transfer pattern was observed on (*item X*) possibly from (straight edged instrument, a blunt object, etc.). The overall pattern measured approximately (*give measurements*).

  or

  A contact/transfer pattern was observed on (*item X*), however, the possible source of the contact/transfer pattern could not be determined.

- When overlapping/complex blood patterns are present:

  A combination of the report wordings should be used. The specific wording shall objectively represent the observed patterns.

- Wording when blood is present but of limited quantity:

  Due to the limited quantity of bloodstain evidence on (*item X*), no apparent bloodstain patterns could be determined.

- Wording when blood is present but no pattern:

  No discernable pattern was detected on (*item X*).

- Wording when no bloodstains are observed:

  No bloodstain patterns were observed on (*item X*).

1.11.5. Comment at conclusion of report:

> "The conclusions, opinions and interpretations in this report are based on the evidence, which was examined through (*date of report*)."
>
> **NOTE:** Exercise caution when using terms such as "blood" and "bloodstain" unless laboratory results confirm the presence of blood.

1.11.6. Report wording may be altered with permission of a qualified technical supervisor.

1.12. References:

1.12.1. Eckert, William G. and Stuart H. James. 1998. Interpretation of Bloodstain Evidence at Crime Scenes. pp. 1-17; 311-315. CRC Press, Boca Raton.

1.12.2. Bevel, Tom and Ross M. Gardner. 2002. Bloodstain Pattern Analysis. pp. 1-17;26;107-135;361-367. CRC Press, Boca Raton.

1.12.3. James, Stuart H. 1999. Scientific and Legal Applications of Bloodstain Pattern Interpretation. pp. 33-45; 157-173; 265. CRC Press, Boca Raton.

A.1. APPENDIX 1 WORKSHEETS

Bloodstain Pattern Interpretation Technical Review Worksheet

Analyst: _____ Case # _____

Reviewer: _____ Date: _____

Documentation:	**Yes**	**N/A**	**Comments**
1. Was the quantity/quality of notes taken appropriate?	☐	☐	_____
2. Are all notes legible and properly marked by the analyst?	☐	☐	_____
3. Were item descriptions, (or areas of examination), complete?	☐	☐	_____
4. Was a thorough examination performed to support the conclusion(s)?	☐	☐	_____
5. Is there sufficient documentation to support the conclusion(s)?	☐	☐	_____
6. Were appropriate photos taken (with and without scales)?	☐	☐	_____
7. Is there a key or legend for uncommon abbreviations?	☐	☐	_____

Report:

8. Are all areas of the report properly completed?	☐	☐	_____
9. Are all items (or areas) of examination properly described?	☐	☐	_____
10. Does the final report account for each examination?	☐	☐	_____
11. Was correct terminology used in the report?	☐	☐	_____
12. Were results correctly reported?	☐	☐	_____

Administrative review _____

A.2 APPENDIX 2
Crime Scene Protocol

1. *Establish the Dimensions and Identify Potential Safety and Health Hazards*

- Ensure that the perimeter of the crime scene(s) has been established.
- Evaluate the scene(s) for potential safety and health hazards and take appropriate action.

2. *Establish Security*

- Ensure that the scene(s) has been secured utilizing crime scene tape, rope, barriers, individuals, etc.
- Ensure that a crime scene sign-in/sign-out log is established maintaining one (1) point of entry and exit.

3. *Plan and Communicate*

- Communicate with investigators.
- Plan a strategy.
- Consider the need for a search warrant or a consent to search.
- Identify needs including additional personnel and equipment.
- Re-evaluate steps One (1) and Two (2).

4. *Evaluate the Probative Value of Potential Crime Scene Processing Activities (Primary Survey)*

- Conduct a walk-through to determine the crime scene elements: the approach, entry, exit, offense, etc.
- Locate obvious items of physical evidence.
- Form a hypothesis of the events based upon the physical evidence.
- Plan a crime scene(s) processing strategy.
- Re-evaluate step Three (3).

5. *Document and Process the Scene(s) and/or Item(s)*

- Document the overall scene(s) before processing using photography, notes, and sketching when necessary.
- Process the scene(s) and/or item(s) in an attempt to locate potential evidence.
- Re-evaluate step Four (4).

6. *Final Detailed Examination of the Scene (Secondary Survey)*

- Examine the scene(s) and/or items in detail for potential evidence.
- Protect potential evidence as necessary.
- Re-evaluate step Five (5).

7. *Recover and Preserve the Evidence*

- Recover potential evidence.
- Package the evidence.
- Establish a chain of custody for the recovered item(s).
- Re-evaluate step Six (6).

A.3. APPENDIX 3 DEFINITIONS

Bloodstain Pattern Analysis Terminology List

(Developed by the International Association of Bloodstain Pattern Analysts)

Angle of Impact – The acute angle formed between the direction of a blood drop and the plane of the surface it strikes.

Arterial Spurting (or gushing) Pattern – Bloodstain pattern(s) resulting from blood exiting the body under pressure from a breached artery.

Back Spatter – Blood directed back towards the source of energy or force that caused the spatter.

Bloodstain – Evidence that liquid blood has come into contact with a surface.

Bubble Rings – Rings in blood that result when blood containing air bubbles dries and retains the bubble's circular configuration as a dried outline.

Cast-Off Pattern – A bloodstain pattern created when blood is released or thrown from a blood-bearing object in motion.

Directionality – The directionality of a bloodstain or pattern which indicates the direction the blood was traveling when it impacted the target surface. Directionality of a blood drop's flight can usually be established from the geometric shape of its bloodstain.

Directionality Angle – The angle between the long axis of a bloodstain and a predetermined line on the plane of the target surface which represents 0 degrees.

Direction of Flight – The trajectory of a blood drop which can be established by its angle of impact and directionality angle.

Draw-Back Effect – Blood in the barrel of a firearm that has been drawn backward into the muzzle.

Drip Pattern – A bloodstain pattern which results from blood dripping into blood.

Expirated Blood – Blood that is blown out of the nose, mouth, or a wound as a result of air pressure and/or air flow which is the propelling force.

Flight Path – The path of the blood drop, as it moves through space, from the impact site to the target.

Flow Pattern – A change in the shape and direction of a bloodstain due to the influence of gravity or movement of the object.

Forward Spatter – Blood which travels in the same direction as the source of energy or force which caused the spatter.

High Velocity Impact Spatter (HVIS) – A bloodstain pattern caused by a high velocity impact /force to a blood source such as that produced by gunshot or high speed machinery. (Note – The Indiana State Police (ISP) Laboratory uses the term High Impact Spatter)

Impact Pattern – Bloodstain pattern created when blood receives a blow or force resulting in the random dispersion of smaller drops of blood.

Impact Site – That point where force encounters a source of blood.

Low Velocity Impact Spatter (LVIS) – A bloodstain pattern that is caused by a low velocity impact/force to a blood source. (Note: The ISP Laboratory uses the term Low Impact Spatter)

Medium Velocity Impact Spatter (MVIS) – A bloodstain pattern caused by a medium velocity impact/force to a blood source. A beating typically causes this type of spatter. (Note: The ISP Laboratory uses the term Medium Impact Spatter)

Misting – Blood which has been reduced to a fine spray, as a result of the energy or force applied to it.

Parent Drop – A drop of blood from which a wave, cast-off, or satellite spatter.

Passive Drop (Bleeding) – Bloodstain drop(s) created or formed by the force of gravity acting along.

Point (Area) of Convergence – The common point (area), on a two dimensional surface, over which the directionality of several blood drops can be retraced.

Point (Area) of Origin – The common point (area) in a three dimensional space to which the trajectories of several blood drops can be retraced.

Projected Blood Pattern – A bloodstain pattern that is produced by blood released under pressure as opposed to an impact, such as arterial spurting.

Ricochet – The deflection of blood after impact with a target surface that results in straining of a second target surface.

Satellite Spatter – Small droplets of blood that are distributed around a drop or pool of blood as a result of the blood impacting the target surface.

Perimeter Stain – A bloodstain that consists of only its outer periphery, the central area having been removed by wiping or flaking after liquid blood has partially or completely dried.

Spatter – That blood which has been dispersed as a result of force applied to a source of blood. Patterns produced are often characteristic of the nature of the forces which created them.

Spine – The pointed or elongated stains which radiate away from the central area of a bloodstain.

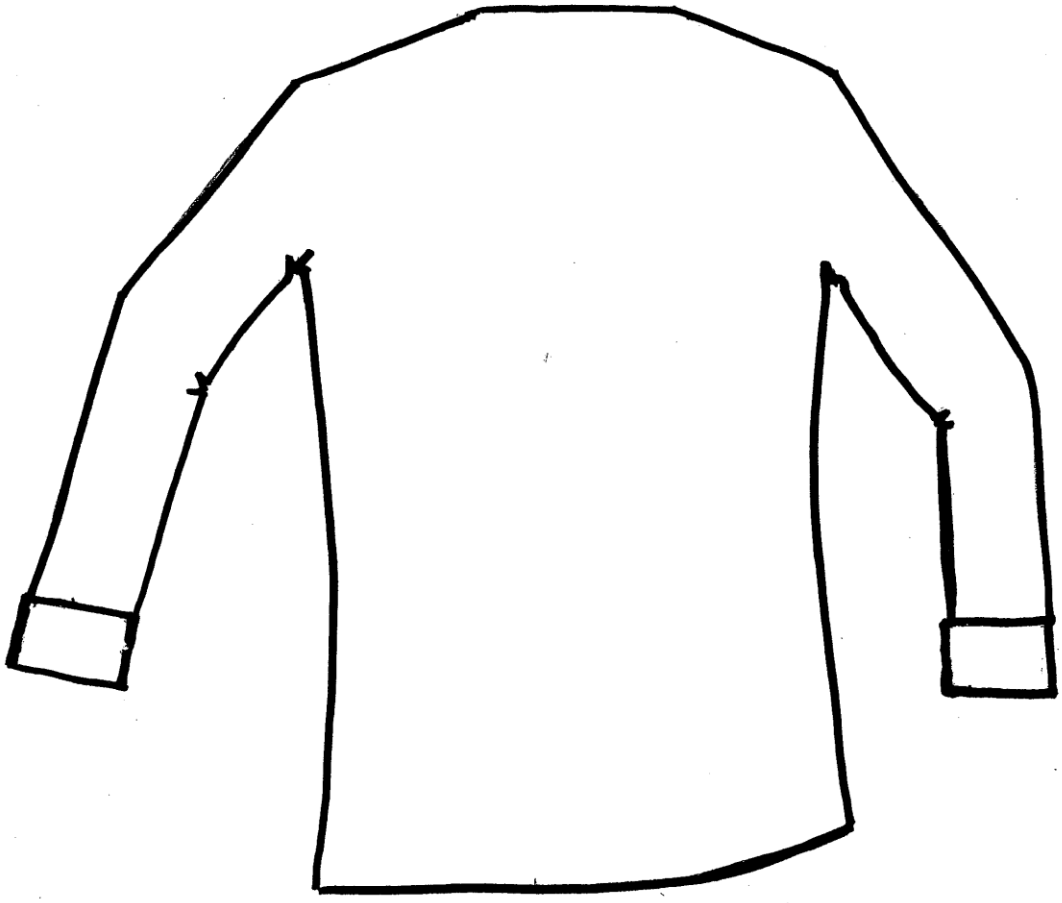
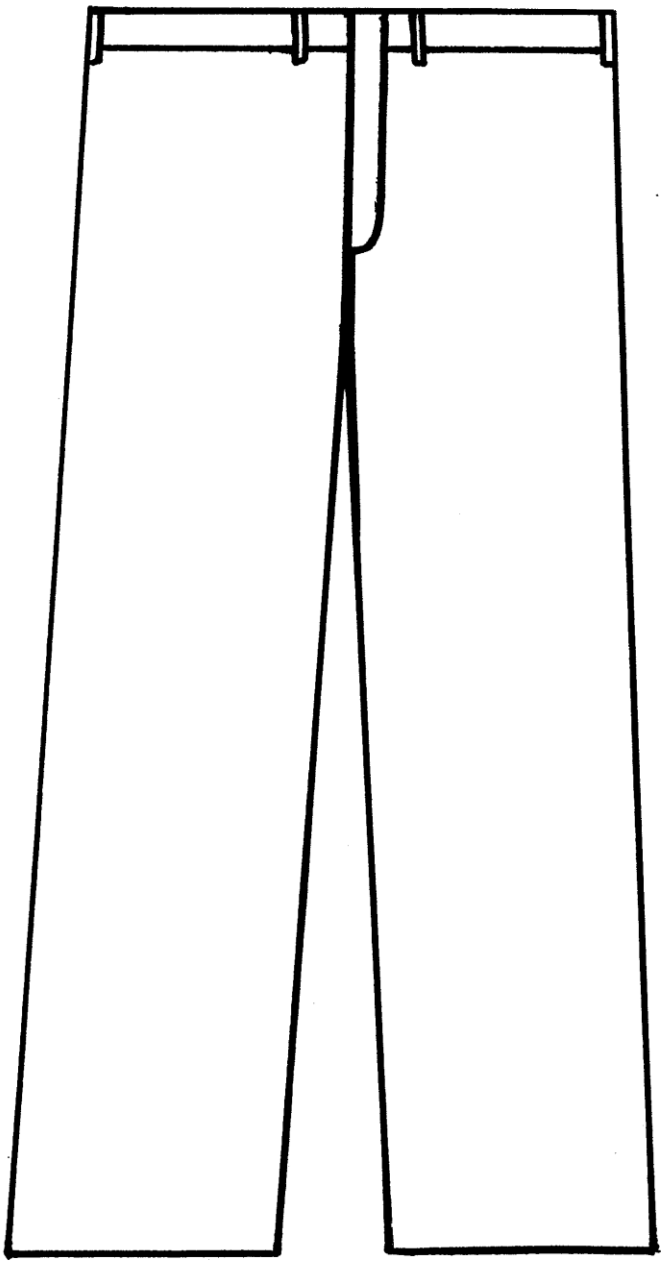
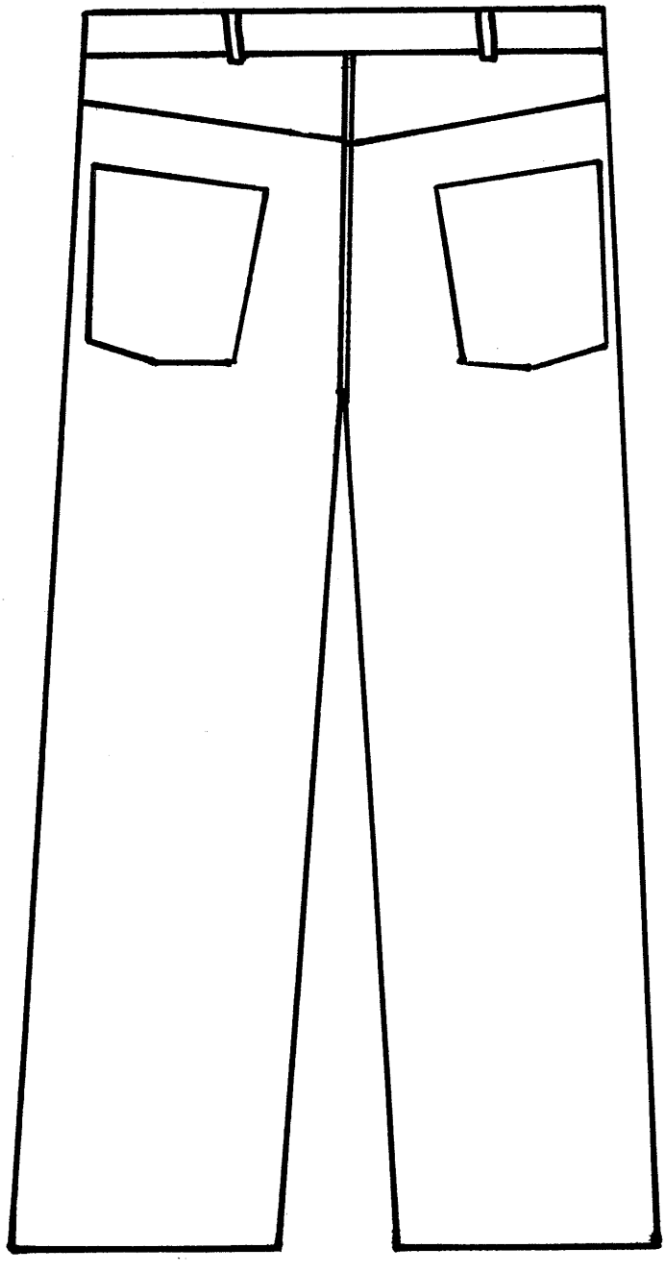
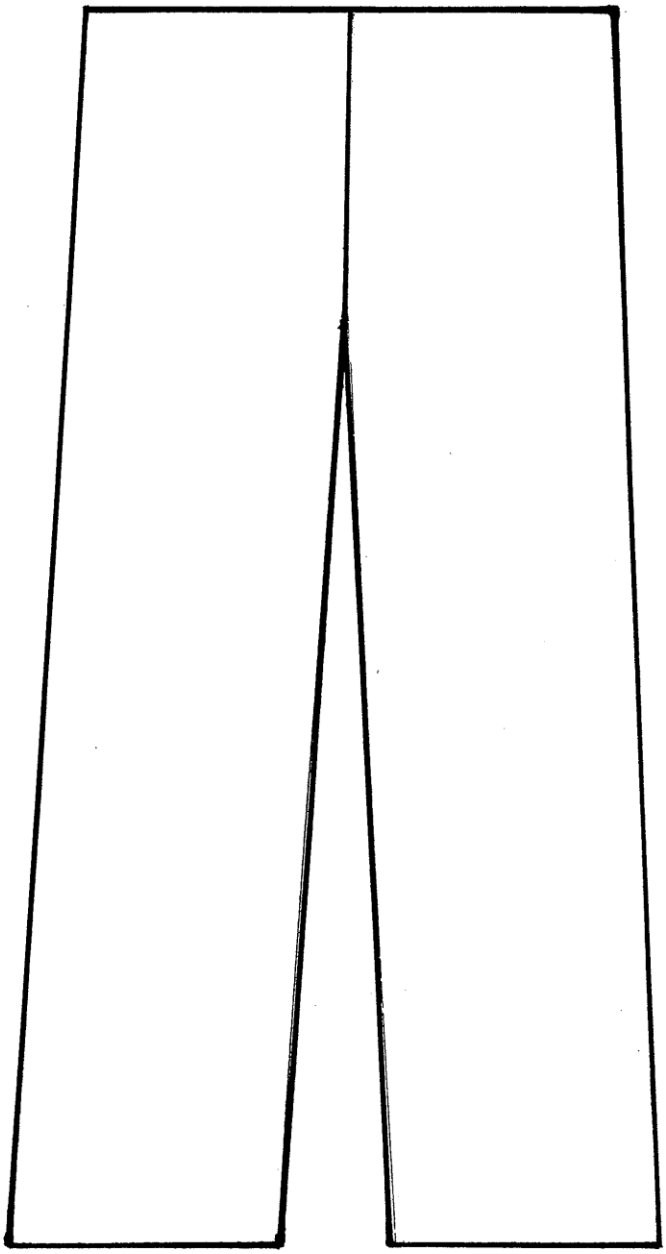
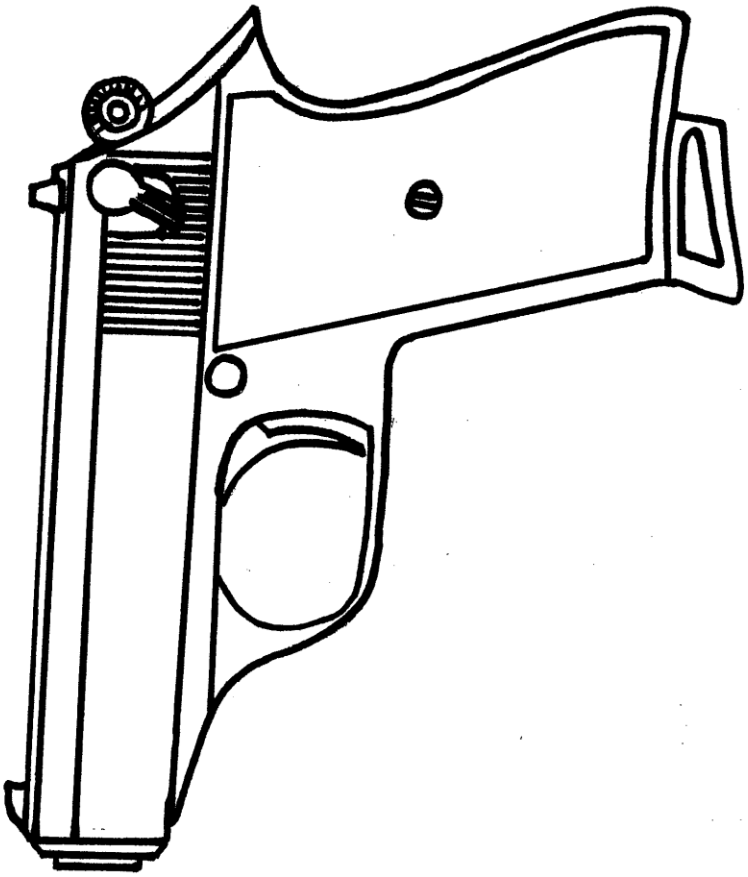
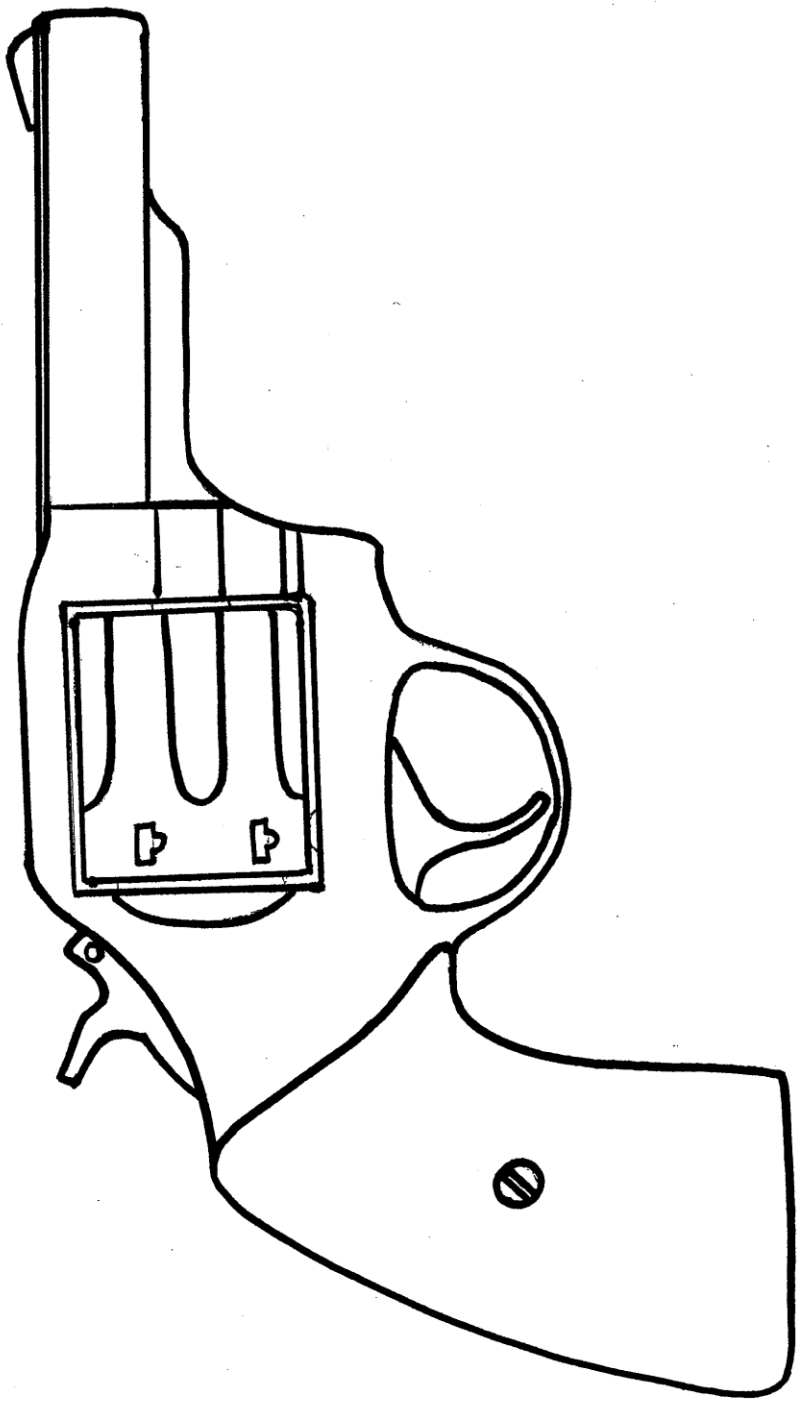
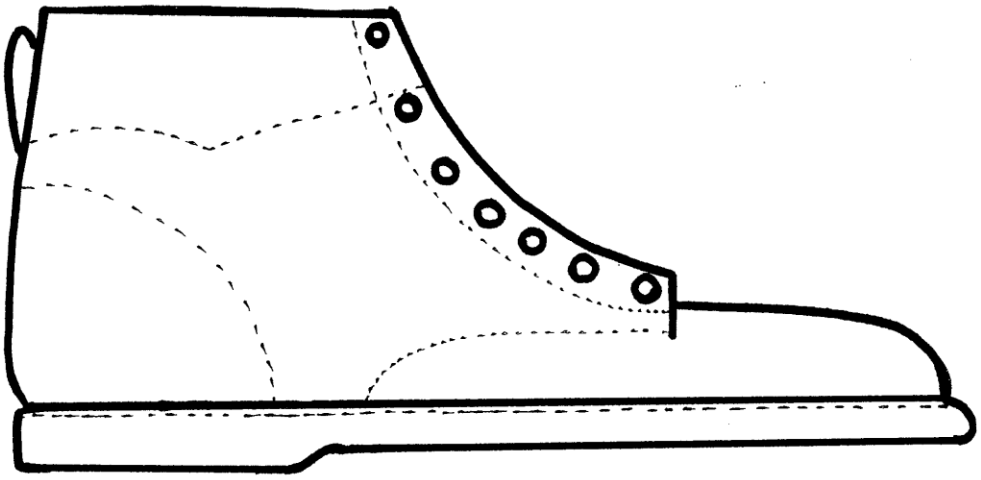
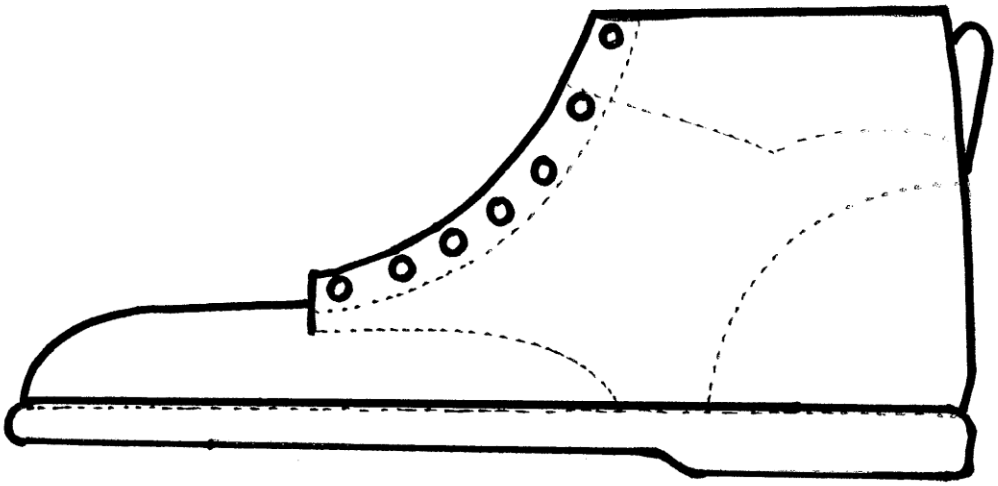
Swipe Pattern – The transfer of blood from a moving source onto an unstained surface. Direction of travel may be determined by the feathered edge.

Target – A surface upon which blood has been deposited.

Transfer/Contact Pattern – A bloodstain pattern created when a wet, bloody surface comes in contact with a second surface. A recognizable image of all or portion of the original surface may be observed in the pattern.

Void – An absence of strains in an otherwise continuous bloodstain pattern.

Wave Cast-Off – A small blood drop that originates from a parent drop of blood due to the wave-like action of the liquid in conjunction with striking a surface.

Wipe Pattern – A bloodstain pattern created when an object moves through an existing stain, removing and/or altering its appearance.

A.4. APPENDIX 4 SKETCH TEMPLATES