

BLOODSTAIN PATTERN ANALYSIS



PROCEDURES MANUAL

INDIANA STATE POLICE BLOODSTAIN PATTERN ANALYSIS PROCEDURES MANUAL

FOREWORD

Bloodstain pattern analysis (BPA) 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 report (i.e. Certificate of Analysis, Forensic Scientist (FS) Field Service Report, or Crime Scene Investigator (CSI) Records Management System (RMS) Incident Report).

BPA is conducted by trained and skilled FSs and CSIs who have completed the Laboratory Division's bloodstain pattern training program. The FS are civilian and the CSIs are sworn ISP employees. These FSs/CSIs have participated in extensive formalized training programs under the direction of the Laboratory Division. During the training program, the new FS/CSI must successfully complete testing consisting of written tests, oral examinations/reviews, 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 BPA course, approved by the Laboratory 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 authorization by the Laboratory Division Commander.

The analysis of bloodstain patterns at scenes and on evidence may not always be definitive. Each FS/CSI is expected to use their training, experience, and education to support conclusions, opinions, and interpretations.

This procedures manual is a general approach to the examination of BPA evidence and the conclusions, opinions, and interpretations as they relate to these examinations. Deviations from procedure may be employed with the approval of a technical supervisor. The deviation, justification, and supervisor's approval shall be documented in the case notes.

The following procedures are to be used by authorized FSs/CSIs when examining scenes of bloodshed, evidentiary items, and photographs for the purpose of issuing a BPA report.

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1. Bloodstain Pattern Analysis:

- 1.1. Scope:** This procedures manual is designed for Laboratory Division personnel to assist investigations where bloodstain patterns occur at scenes of crime and/or on physical evidence in a variety of alleged criminal activities. The scope of this type of evidence includes analysis of the possible patterns that might be observed.

Crime scenes and/or items of evidence will be examined for potential areas of bloodstain pattern evidence. 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 informative conclusions, opinions, and interpretations.
- 1.2.2.** Evidence should be handled in a manner that will not alter the appearance of the stains.

1.3. Related Information:

- 1.3.1.** Appendix 1: [Technical Review Worksheets](#)
- 1.3.2.** [Crime Scene Investigation Procedures Manual](#)
- 1.3.3.** [Serology Test Method](#)
- 1.3.4.** [Field Support Policy 011 – Utilization of Forensic Scientists for Field Service](#)

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 FS/CSI shall have a basic knowledge of camera use and terminology. The photographs should be taken with the camera set in JPEG format and with the resolution being set at the highest available setting (e.g. “fine” for Nikon cameras). The digital files from the camera shall be stored on a secure electronic medium as per laboratory policy.

1.5. Reagents/Materials:

- 1.5.1.** Reagents required will vary depending upon specifics of the case.
- 1.5.2.** Materials:
- 1.5.2.1. Various size scales
 - 1.5.2.2. Magnifier Loop with scale
 - 1.5.2.3. Tape measure
 - 1.5.2.4. Level
 - 1.5.2.5. Colored string

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- 1.5.2.6. Tape
- 1.5.2.7. Markers
- 1.5.2.8. Protractor
- 1.5.2.9. Scientific calculator
- 1.5.2.10. Photography equipment (digital camera, tripods, lenses, flashes, etc.)

1.6. Hazards/Safety:

- 1.6.1.** When a FS is processing a crime scene for bloodstain patterns, all the requirements noted in Field Support Policy (FSUP) 011 (*Utilization of Forensic Scientists for Field Service*) shall be followed.
- 1.6.2.** Universal precautions shall always be used during the processing of biological evidence. FSs/CSIs 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 FS/CSI 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. If the FS/CSI is not performing their own serological examinations, they should wait to issue the BPA report until after the Certificate of Analysis for the associated serology testing has been issued.
- 1.8.3.** If the FS/CSI 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 FS/CSI shall be proficient in the tests performed.
- 1.8.4.** If serological testing will alter the stain or pattern rendering it unsuitable for further analysis, thorough documentation and pattern analysis shall be completed prior to serological testing. If it is necessary to remove an entire stain, it shall be documented in notes and photographed.
- 1.8.5.** 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

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blood: dry, color, etc.). Sketch templates are available on the network drive.

- 1.8.6. Photographs of patterns shall include overall, medium, close-up (macro), and technical (close-up with a metric scale and perpendicular to the target surface). Photos should be stored in a folder created per item photographed-Folder name "case_item#" ex. "1811234_item1". The individual photo file names are left to the FS's/CSI's discretion.
- 1.8.7. Select individual impact spatter stains in a representative distribution spanning the width of the pattern. Stains selected should have upward directionality and be well formed.
- 1.8.8. Label each selected spatter stain with a unique identifier. Place a metric scale adjacent to each stain and a horizontal level line under each stain. Take overall, medium, and macro photographs of each stain with markings in place.
- 1.8.9. 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. Utilize a scientific calculator to complete the angle of impact calculations using the following formula:

$$\sin^{-1}(\text{width} \div \text{length}) = \text{angle of impact}$$

- 1.8.10. To determine the area of origin in 3-dimensional space, there are the options of using the string method or mathematical trigonometry (tangent) method. Extend a "line" through the long axis of each selected stain to the area on the target surface plane where they all converge. Measure from the area of convergence to the leading edge of each selected spatter stain. Photograph the convergent lines and record the measurements.
 - 1.8.10.1. String method: Using a protractor, a string is pulled away from the leading edge of each selected stain at the angle of impact. Attach the string to a "yard stick or dowel" assembled perpendicular to the target surface at the area of convergence. (A tri-pod is suggested for attaching the yard stick and/or strings to). When completed, the strings will encompass the area of origin in 3-dimensional space. Record the range of distance, and photograph.
 - 1.8.10.2. Trigonometry (tangent) calculating formula for Area of Origin:
$$\text{TAN}(\theta) = H / D \text{ or } H = \text{TAN}(\theta) \cdot D$$

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θ = angle of impact

D = distance to area of convergence

H = height (distance) from target surface

1.8.10.3. The tangent will give the height (distance) from the area of convergence in 3-dimensional space. For example: To calculate the tangent on most scientific calculators, press “tan” and enter the angle of impact. Be sure to use closed parenthesis before and after this number before hitting “enter” or an error will appear. Then multiply by the distance to the selected stain from the area of convergence in centimeters (cm). The resulting number is the height of the origin of impact from the surface plane.

Example: $\tan(30^\circ) \times 90 \text{ cm} = 0.57735 \times 90 \text{ cm} = 51.961$

Rounded Answer: 52 cm (area of origin from surface)

Then $52 \text{ cm} \div 2.54 \text{ (cm per inch)} = 20.472 \text{ inches}$

1.8.11. When the analysis is performed at the crime scene a CSI RMS Incident Report or a FS Field Service Report shall be completed. The crime scene shall be evaluated for bloodstain patterns in a systematic approach.

1.8.12. When a crime scene is evaluated, the crime scene protocol described in [SOP-LAB-005](#) shall be utilized.

1.9. Records:

1.9.1. All notes and photographs shall be stored in electronic case records. For example:

1.9.1.1 Laboratory case and request folder – “case number_request number” – ex. “1011234_1” – the request number corresponds to the laboratory request number assigned in LIMS.

1.9.1.2 Photos: create a folder per item photographed – folder name “case_item#” ex. “1011234_item1”. The individual photo file names are left to the FS’s/CSI’s discretion.

1.9.2. A Certificate of Analysis, FS Field Service Report, or CSI RMS Incident Report shall be issued with the examination observations, conclusions, opinions, and interpretations.

1.9.2.1. Notes and photographs shall be generated and a report shall be issued when analysis is performed at a crime scene, on an item of evidence, or on photographs of a crime scene or evidence item and any BPA observations, conclusions,

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opinions, and interpretations, including negative results (e.g. no bloodstain pattern present), are made.

- 1.9.2.2. BPA notes and report are not required for consultations discussing the merits of performing a BPA examination or for discussions with a DNA analyst that provides direction on the area(s) to sample for DNA analysis.

1.10. Interpretations of Results:

- 1.10.1. FSs/CSIs shall base their observations, conclusions, opinions, and interpretations on their training and experience supported by documentation through notes, photos and other physical evidence. The documentation shall be sufficient for another authorized BPA FS/CSI 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. Stains that have the obvious and reasonable appearance of being blood due to the physical characteristics present, scene context, and the FS's/CSI's knowledge, training, and experience may be referred to as being blood if combined with a preceding qualifier such as 'apparent,' 'appeared to be,' etc.
- 1.11.2. A single, general qualifying statement may replace overly repetitive usage of a preceding qualifier.
- 1.11.3. When obvious physical characteristics are insufficient and/or scene context is limited to reasonably refer to stains as 'apparent blood' etc., it is recommended that the FS/CSI conservatively refer to the stain(s) only by the physical characteristics present.
- 1.11.4. If presumptive testing for blood is conducted by the FS/CSI at the scene, the FS/CSI may refer to that stain and associated stains with similar physical characteristics and scene context as being 'presumptive blood' and/or 'apparent blood,' etc. Results of presumptive testing should be included in the report.
- 1.11.5. When laboratory results confirm the presence of blood, the FS/CSI may refer to that stain and associated stains with similar physical characteristics and scene context as being blood.
- 1.11.6. The report may document the physical characteristics of stains and/or stain patterns (e.g. size, shape, distribution, concentration, location, etc.) to support the appropriate stain classification.
- 1.11.7. When physical characteristics are insufficient and/or uncertainty is present to reasonably refer to stains as a specific stain classification, it is recommended that the FS/CSI conservatively refer to the stain(s) by a more general classification and/or the physical characteristics

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present (i.e. 'spatter' as opposed to 'impact spatter' or 'cast-off spatter.')

- 1.11.8. Origin determinations may appear in scene specific reports, but should refrain from specifying whose blood created the patterns until the completion of confirmatory laboratory testing (e.g., DNA, pathology, and latent prints).
- 1.11.9. The absence of bloodstains, when relevant to the conclusions, should be reported.

1.11.10. 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...

1.11.11. Examples 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/dripped blood stains/cast-off blood stains/an expired 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:

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

- For area of origin/area 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 area 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:

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

- Wording when positive results for presumptive testing for blood:

Blood was detected by presumptive chemical testing.

- When no bloodstains are observed:

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

1.11.12. Comment at conclusion of report:

The observations, conclusions, opinions, and interpretations in this report are based on the evidence, which was visually examined through (date of draft completed report OR last date physical evidence was examined).”

1.11.13. Comment if no presumptive and/or confirmatory testing of stains was performed:

The term blood in this report refers to possible or apparent blood stains based on physical appearance, no {presumptive chemical / immunological confirmatory} testing was performed on the stains.

NOTE: Exercise caution when using terms such as “blood” and “bloodstain” unless laboratory results confirm the presence of blood.

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.

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**APPENDIX 1
TECHNICAL REVIEW WORKSHEET**

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Bloodstain Pattern Analysis Technical Review Worksheet

FS/CSI: _____

Case # _____

Technical Reviewer: _____

Date: _____

Documentation:

	Yes	N/A	Comments
1. Was the quantity/quality of notes taken appropriate?	<input type="checkbox"/>	<input type="checkbox"/>	_____
2. Are all notes legible and properly marked by the FS/CSI?	<input type="checkbox"/>	<input type="checkbox"/>	_____
3. Were item descriptions (or areas of examination) complete?	<input type="checkbox"/>	<input type="checkbox"/>	_____
4. Was a thorough examination performed to support the conclusions?	<input type="checkbox"/>	<input type="checkbox"/>	_____
5. Is there sufficient documentation to support the conclusion(s)?	<input type="checkbox"/>	<input type="checkbox"/>	_____
6. Were appropriate photos taken (with and without scales)?	<input type="checkbox"/>	<input type="checkbox"/>	_____
7. Is there a key or legend for uncommon abbreviations?	<input type="checkbox"/>	<input type="checkbox"/>	_____

Report:

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

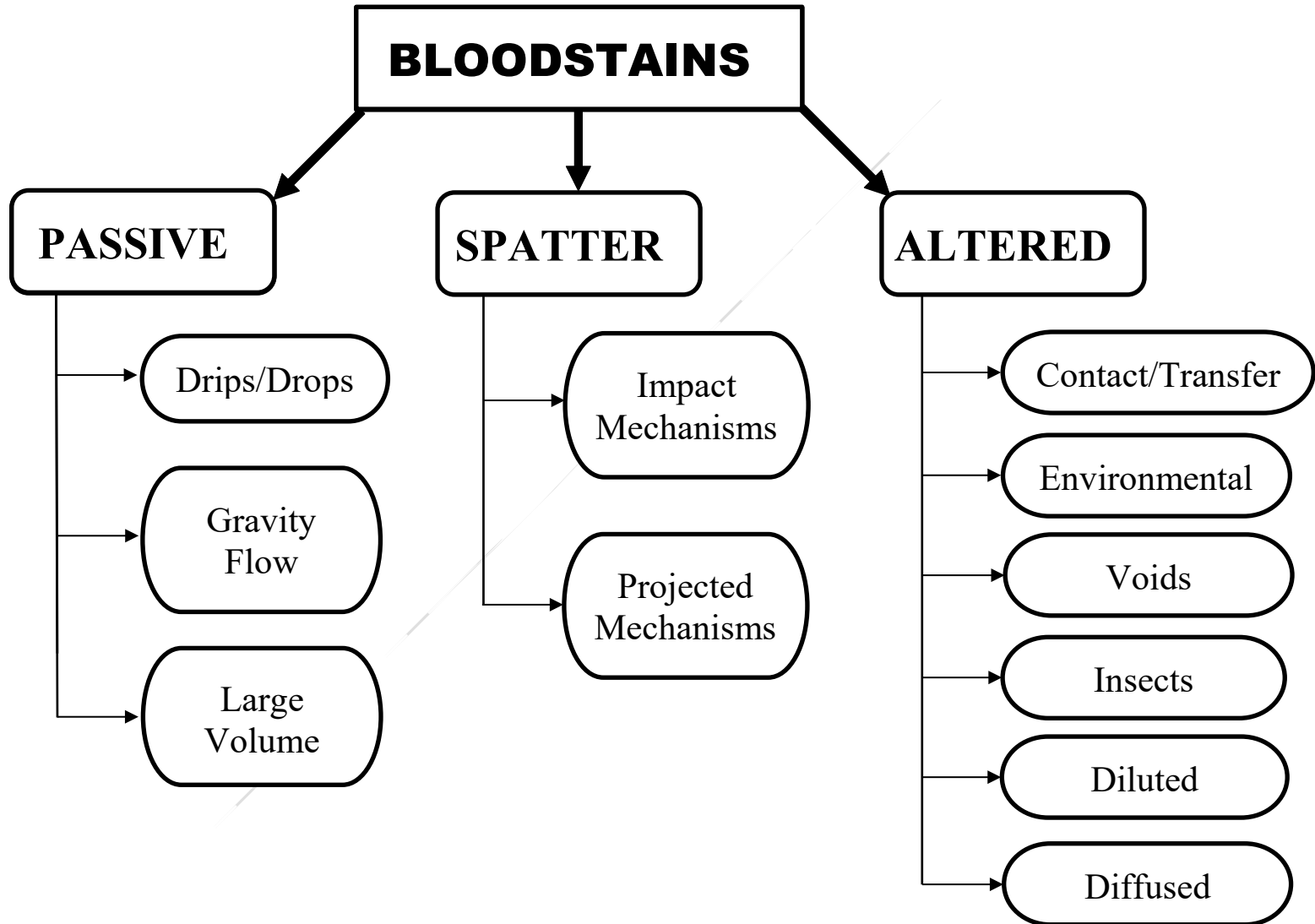
Administrative review _____

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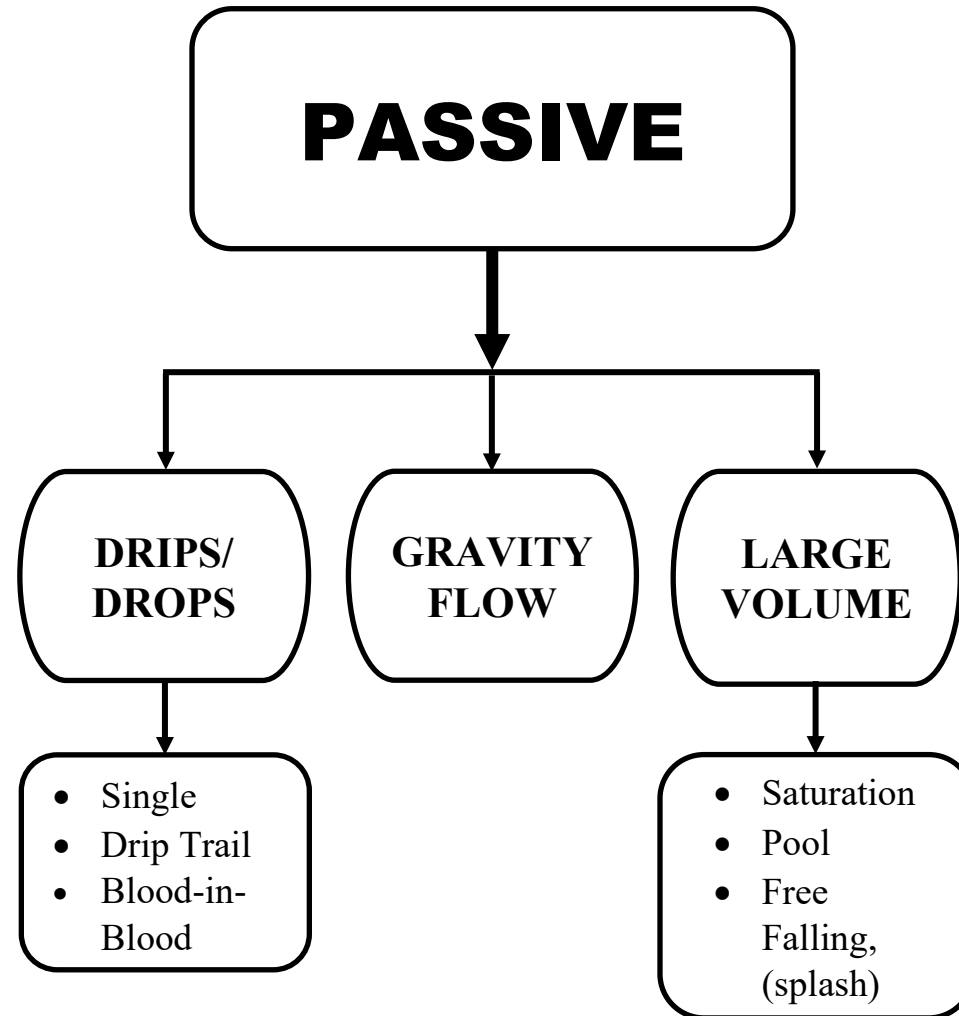
APPENDIX 2

**BLOODSTAIN PATTERN ANALYSIS
CLASSIFICATION CHARTS**

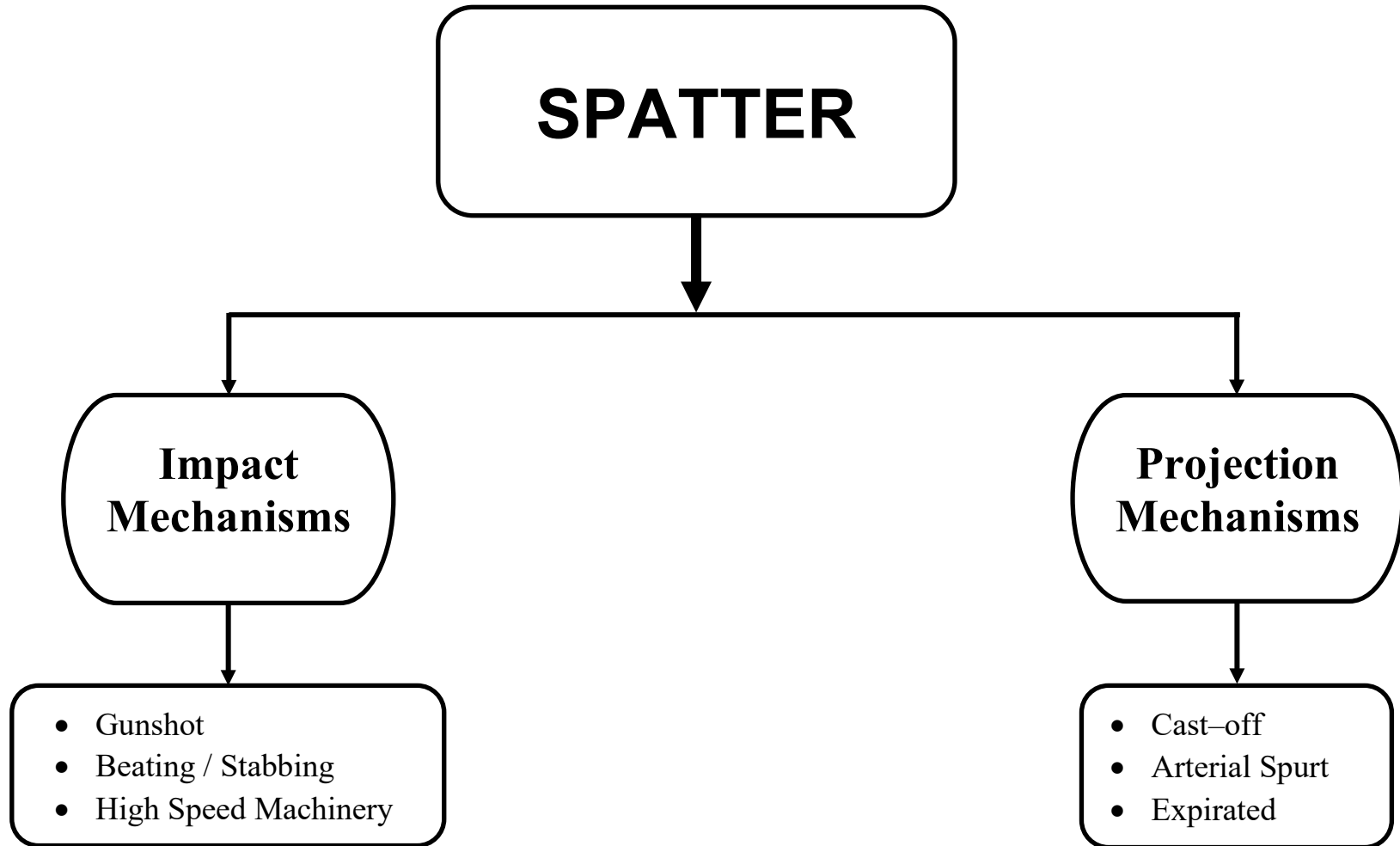
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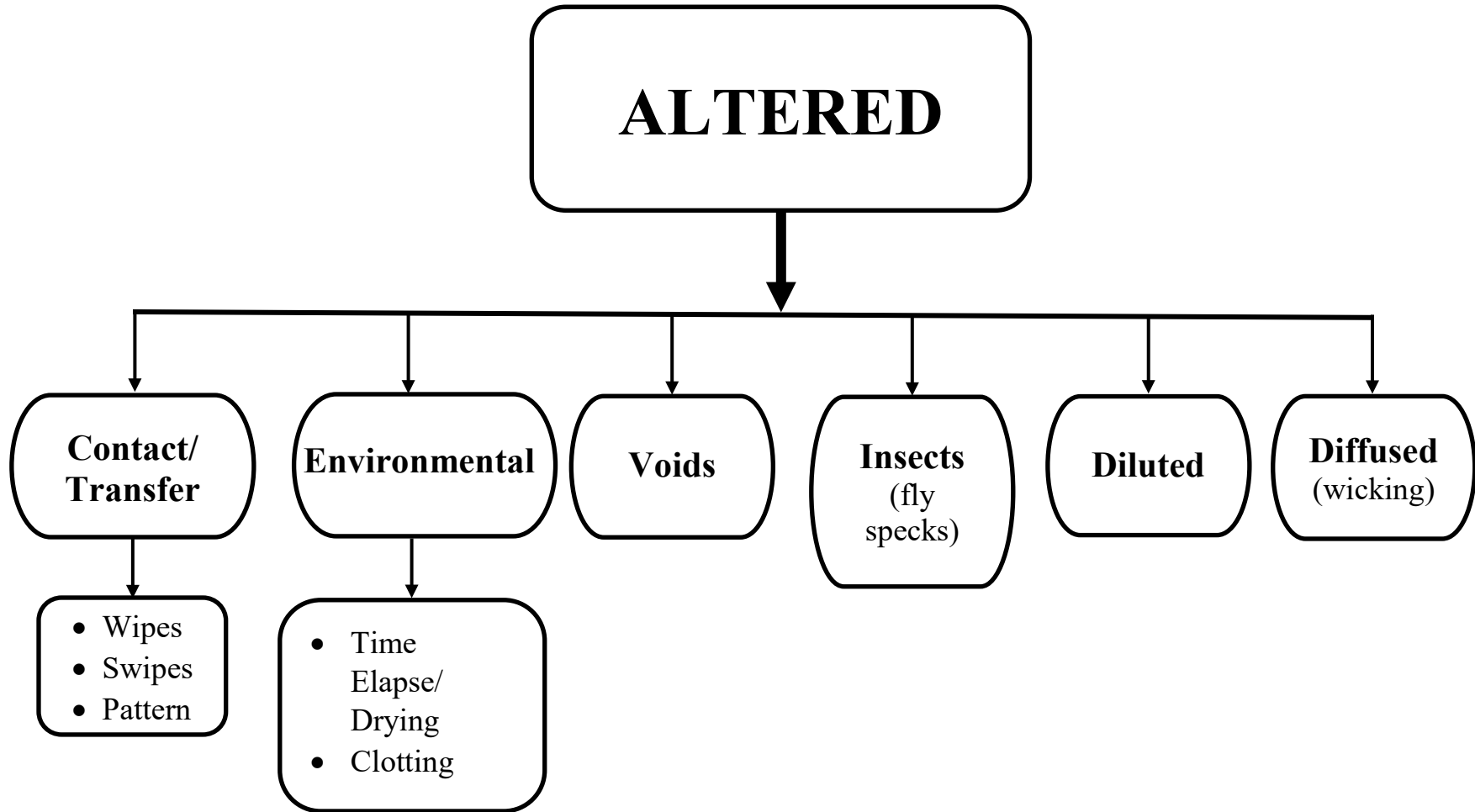
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APPENDIX 3

**Bloodstain Pattern Analysis
Terminology List**

(Published in ASB Technical Report 033, First Edition 2017 – Terms and Definitions in Bloodstain Pattern Analysis: AAFS Standards Board is the copyright holder and publisher. Full version can be located at <http://asb.aafs.org>)

Accompanying Drop – A small blood drop produced as a by-product of drop formation.

Altered Stain – A bloodstain with characteristics that indicate a physical change has occurred.

Angle of Impact – The angle (alpha), relative to the plane of a target, at which a blood drop strikes the target.

Area of Convergence – The space in two dimensions to which the directionalities of spatter stains can be retraced to determine the location of the spatter producing event.

Area of Origin – The space in three dimensions to which the trajectories of spatter can be utilized to determine the location of the spatter producing event.

Backspatter Pattern – A bloodstain pattern resulting from blood drops which can be produced when a projectile creates an entrance wound.

Blood Clot – A gelatinous mass formed by a complex mechanism involving red blood cells, fibrinogen, platelets, and other clotting factors.

Bloodstain – A deposit of blood on a surface.

Bloodstain Pattern – A grouping or distribution of bloodstains that indicates through regular or repetitive form, order, or arrangement the manner in which the pattern was deposited.

Bubble Ring – An outline within a bloodstain resulting from air in the blood.

Cast-off Pattern – A bloodstain pattern resulting from blood drops released from an object due to its motion.

Cessation Pattern – A bloodstain pattern resulting from blood drops released from an object due to its abrupt deceleration.

Directionality – The characteristic of a bloodstain that indicates the direction blood was moving at the time of deposition.

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Directional Angle – The angle (gamma) between the long axis of a spatter stain and a defined reference line on the target.

Drip Pattern – A bloodstain pattern resulting from a liquid that dripped into another liquid, at least one of which was blood.

Drip stain – A bloodstain resulting from a falling drop that formed due to gravity.

Drip Trail – A bloodstain pattern resulting from the movement of a source of drip stains between two points.

Edge Characteristic – A physical feature of the periphery of a bloodstain.

Expiration Pattern – A bloodstain pattern resulting from blood forced by airflow out of the nose, mouth, or a wound.

Flow – A bloodstain resulting from the movement of a volume of blood on a surface due to gravity or movement of the target.

Forward Spatter Pattern – A bloodstain pattern resulting from blood drops which can be produced when a projectile creates an exit wound.

Impact Pattern – A bloodstain pattern resulting from an object striking liquid blood.

Insect Stain – A bloodstain resulting from insect activity.

Parent Stain – A bloodstain from which a satellite stain(s) originated.

Perimeter Stain – An altered stain consisting of its edge characteristics, the central area having been partially or entirely removed.

Pool – A bloodstain resulting from an accumulation of liquid blood on a surface.

Projected Pattern – A bloodstain pattern resulting from the ejection of blood under hydraulic pressure, typically from a breach in the circulatory system.

Satellite Stain – A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface.

Saturation Stain – A bloodstain resulting from the accumulation of liquid blood in an absorbent material.

Serum Stain – The stain resulting from the liquid portion of blood (serum) that separates during coagulation.

Spatter Stain – A bloodstain resulting from an airborne blood drop created when external force is applied to liquid blood.

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Splash Pattern – A bloodstain pattern created from a large volume of liquid blood falling onto a surface.

Swipe – A bloodstain resulting from the transfer of blood from a blood-bearing surface onto another surface, with characteristics that indicate relative motion between the two surfaces.

Target – A surface onto which blood has been deposited.

Transfer Stain – A bloodstain resulting from contact between a blood-bearing surface and another surface.

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

Wipe – An altered stain resulting from an object moving through a preexisting wet bloodstain.