

# Codes of Practice and Conduct

*Appendix: Bloodstain Pattern Analysis*

*FSR-C-102*

This is a consultation issued to allow comments from interested parties; all comments will be given consideration when finalising this appendix prior to publication. Comments should be sent to [FSRConsultation4@homeoffice.gsi.gov.uk](mailto:FSRConsultation4@homeoffice.gsi.gov.uk) and should be submitted by **27 February 2015**. This mailbox is not for general correspondence and is not routinely monitored so no acknowledgement will normally be sent.

**1. INTRODUCTION**

1.1.1 This Appendix provides further explanation of some of the requirements of the Forensic Science Regulators' Codes [A] specifically pertaining to bloodstain pattern analysis (BPA). It is complementary to the Codes. Numbering used in this Appendix is in alignment with ISO/IEC 17025 (2005) [B] and where applicable ISO/IEC 17020 (2012) [C].

**2. SCOPE**

2.1.1 This specifically relates to the classification, identification and/or interpretation and evaluation of bloodstain patterns. It excludes the activities of searching and screening for bloodstains, but includes bloodstain pattern analysis on items and clothing.

**3. IMPLEMENTATION**

3.1.1 This appendix is available for incorporation into a providers' quality management system from the date of publication.

3.1.2 The Forensic Science Regulator requires that the Codes and compliance to the requirements set out in this appendix against the specified ISO/IEC 17025 / ISO/IEC 17020 clauses are included in the providers' schedule of accreditation by October 2017 as detailed in the Codes..

**4. MODIFICATION**

4.1.1 This is a draft issue of this document for consultation

**5. TERMS AND DEFINITIONS**

5.1.1 The terms and definitions set out in the Codes apply to this Appendix. Terms and definitions employed in this Appendix are listed in the Glossary

5.1.2 The terminology is the language used in International Standards with regards to the use and meaning of the words 'must', 'shall', 'should' and 'recommend'. The word 'shall' has been used in this document where there is a corresponding requirement in ISO/IEC 17025 or the Forensic Science Regulator's Codes of Practice and Conduct; the word 'should' has been used to indicate generally accepted practice in fingerprint examinations.

## 6. PROVISIONS

### 6.1 Personnel (ISO 17025:2005 ref. 5.2; ISO 17020:2012 ref. 6.1.1)

#### Qualifications

6.1.1 Minimum qualifications and experience for bloodstain pattern practitioners must be sufficiently defined and documented by the organisation.

#### Competency levels

6.1.2 It is recommended that competency levels be defined that distinguish:

- a. **basic** – competency in the recognition, preservation and documentation of bloodstain pattern evidence; and
- b. **advanced** – competency in the analysis, evaluation, interpretation and reconstruction of bloodstain pattern evidence, including the reporting of evidence of opinion.

6.1.3 The organisation should formally document the authorisation process for BPA practitioners and this should specify the competency level that they are authorised to work at.

#### Training

6.1.4 The training<sup>1</sup> requirements for bloodstain pattern practitioners must be documented for both competency levels.

6.1.5 The training required to develop competency must include formal instruction in all facets of BPA (SWGSTAIN, 2008) relevant to the desired level of competency. Where formal training in a topic is not deemed to be necessary, an awareness of these areas is recommended. The recommended minimum topics of training are as follows.

- a. Health and safety issues associated with BPA.
- b. The history of BPA.
- c. Scientific principles as they relate to BPA:
  - i. the scientific method and its application to BPA experimentation;

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<sup>1</sup> The training course is required to meet the requirements of the International Association of Bloodstain Pattern Analysts (IABPA) if professional membership is sought or required by the practitioner.

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- ii. the principles of physics and fluid mechanics as they relate to BPA.
- d. Bloodstain classification and terminology.
- e. Bloodstain pattern principles and their application to BPA:
  - i. blood composition and related human anatomy and physiology;
  - ii. injury and wounding, and their relationship to bloodstain pattern formation;
  - iii. the effects of surface characteristics on the resulting bloodstain patterns;
  - iv. the effect of environmental factors on the formation and/or drying time of bloodstain patterns;
  - v. the characteristics of blood dynamics, including drop formation, oscillation, droplet flight paths, accompanying drops and secondary spatter.
- f. Mathematical methods in BPA:
  - i. methods for the measurement of individual bloodstains;
  - ii. trigonometric methods for impact spatter origin determination.
- g. The relationship between the physical appearance of bloodstain patterns (size, shape, distribution, and location) and the mechanism by which they were created.
- h. Bloodletting injuries and their potential effects on the potential bloodstain patterns.
- i. Searching, chemical testing, and enhancement techniques for bloodstains and potential impact on BPA and other evidence types.
- j. Methods of documenting bloodstain pattern evidence, for example, video, photography, sketching and note taking.
- k. Methods for the preservation and collection of bloodstain pattern evidence.
- l. The application of BPA to the reconstruction of bloodletting events.
- m. The relationship between bloodstain pattern evidence and other types of forensic evidence.
- n. The reporting of BPA findings, conclusions, and opinions by written and/or verbal methods including the limitations of BPA and the application of experiments and reconstruction where necessary.

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- o. The legal obligations (FSR-I-402) [D] pertaining to BPA, including court rulings that are relevant to BPA evidence.
- p. Development of examination and search strategies.
- q. Hypothesis testing<sup>2</sup> and evaluation of hypotheses using reconstructive experiments.

6.1.6 Each area of instruction must have documented objectives and should have a formal assessment of the trainee's knowledge and/or competency (for example, written test, practical test and oral test).

6.1.7 During the course of training, a BPA trainee and trainer/mentor must document and participate in a mentorship programme or equivalent training programme. This training should include, but is not limited to, the evaluation of the required objectives, the review of completed casework, supervised BPA and the observation of court testimony.

6.1.8 A training record must be kept for each trainee.

6.1.9 The practitioner should be made aware of the relevant texts, journals and other professional literature in BPA.

### Requirements for a bloodstain pattern analysis mentor/trainer

6.1.10 A mentor/trainer must be an active practitioner in the field of BPA, with a minimum defined level of ongoing casework experience as a qualified bloodstain pattern practitioner for each role..

### Competency assessment

6.1.11 The organisation should determine and document the requirements for competency for each role, using guidance from the Special Working Group on Bloodstain Analysis (Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN), 2008)

6.1.12 A BPA trainee must participate in and successfully complete a test supported by a competency framework<sup>3</sup> prior to performing independent analysis and rendering expert opinion.

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<sup>2</sup> Hypothesis testing should be unbiased and attempt to test both prosecution and any reasonable defence hypothesis either known or unknown.

Continuing education requirements for a bloodstain pattern practitioner

- 6.1.13 BPA analysts must maintain their competency through regular casework according to the guidelines laid down by the organisation.
- 6.1.14 Ongoing competence should be supported by continual professional development (CPD) and knowledge transfer including, for example, review of case studies, scene debriefs, professional conferences, internal and external seminars and/or workshops.
- 6.1.15 It is recommended that personnel performing BPA belong to at least one professional organisation that covers BPA.

**6.2 Job descriptions (ISO 17025:2005 ref. 5.2.4; ISO 17020:2012 ref.5.2.7)**

Scope of work relating to bloodstain pattern analysis

- 6.2.1 The job description for a bloodstain pattern analyst must be specified. This could be covered in a wider job description.
- 6.2.2 Duties may include:
  - a. collection and preservation of bloodstain pattern evidence;
  - b. documentation of bloodstain patterns;
  - c. interpretation of bloodstain patterns;
  - d. case-specific experimentation;
  - e. reconstruction;
  - f. report writing; and
  - g. presentation of evidence in court.

**6.3 Accommodation and environmental conditions (ISO 17025:2005 ref. 5.3; ISO 17020:2012 ref.6.2.1)**

- 6.3.1 The organisation must:
  - a. specify conditions required for safe handling of bloodstain evidence items;
  - b. specify procedural guidelines for best practice to preserve and avoid contamination of bloodstained evidence items; and

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<sup>3</sup> Competency demonstrated through peer reviews, regular competency and proficiency tests.

- c. have access to facilities to perform case-specific examination and experimentation.

**6.4 Selection of methods (ISO 17025:2005 ref 5.4.2 ISO 17020:2012 ref.7.1)**

End-user requirements for bloodstain pattern evidence must be described and appropriate methods and their limitations are specified and documented. These will include the following.

Techniques and strategies for examining bloodstain patterns

- 6.4.1 Devise and develop the examination strategy taking into account other evidence types.

- 6.4.2 Preservation of bloodstain evidence, for example, the management of fragile or vulnerable bloodstain patterns.

Documentation of bloodstain patterns

- 6.4.3 Methods for documenting bloodstain patterns include:

- a. photography;
- b. sketching;
- c. measurements;
- d. note-taking;
- e. image capture.

Bloodstain pattern identification and classification

- 6.4.4 Methods to identify individual patterns (refer to Table 1) that include:
  - a. the basis for classification;
  - b. the use of recommended terminology (SWGSTAIN, 2009);
  - c. the relationship between an individual bloodstain pattern with its causal mechanism;
  - d. recognition of physical, physiological, wetting and chemical altering effects;
  - e. the determination of directionality;
  - f. the interpretation of voids, shadowing and limiting angles;
  - g. how to draw valid conclusions from bloodstain pattern boundaries;
  - h. area of origin determination;

- i. calculating an area of origin of blood spatter:
  - i. string method;
  - ii. tangent method;
  - iii. directional analysis.
- j. limitations of attempting to determine the sequence, aging and drying times of bloodstains;
- k. using BPA as a basis for sample selection;
- l. use of microscopy to examine and evaluate bloodstains;
- m. securing wetted items to minimise alteration of bloodstain patterns;
- n. awareness of the difficulties commonly encountered in the examination of bloodstain patterns (for example, bloodstains on dark clothing, small bloodstains).

Table 1 – **Bloodstain pattern types**

Pattern formation mechanisms dominated by gravity	Drip pattern Drip stain Drip trail Flow pattern Pool Saturation
Pattern formation dominated by spatter mechanisms	Cast-off pattern 'Expiration'/exhaled pattern Projected (for example, arterial) Impact spatter Forward spatter Back spatter Splash pattern Mist pattern Satellite stain (secondary spatter)
Pattern formation dominated by contact mechanisms	Transfer stain Swipe pattern Wipe pattern



Altered bloodstains e.g. dilutions, physical and physiological issues	Insect stain Serum stain Void
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**6.5 Validation (ISO 17025:2005 ref. 5.4.5; Inspection methods and procedures (ISO 17020:2012 ref 7.1.1-7.1.4)**

6.5.1 The requirements for validation are set out in the validation guidance to the Codes [\[E\]](#). BPA is an interpretive method; however, it is based upon well-established scientific principles, supported by scientific literature extending back over 100 years. The main areas of published scientific study that form the foundation of BPA include the following:

- a. aging blood;
- b. biomechanics;
- c. clothing and fabric;
- d. environmental factors;
- e. expired (exhaled) blood;
- f. firearms;
- g. fluid dynamics;
- h. impact patterns;
- i. maths and physics;
- j. reconstruction;
- k. scientific theory;
- l. other patterns;
- m. searching and enhancement;
- n. sequencing;
- o. software;
- p. target surface;

q. transfer patterns.

6.5.2 Each of these areas is supported by numerous key scientific papers listed in SWGSTAIN (2012).

6.5.3 It is therefore considered that the principles underpinning BPA are validated and soundly based on well-established principles and scientific peer-reviewed methodology.

6.5.4 Any novel method used by the organisation that is not referenced in the peer-reviewed scientific literature (for example, a new software method) will require validation.

6.5.5 Any reference material comprising bloodstain patterns that are created by the organisation and used to aid bloodstain identification should be validated. This process should ensure that the creation of the stain patterns are witnessed and catalogued by competent practitioners.

#### Verification

6.5.6 Verification (process validation) in this instance is based on the demonstration that practitioners can provide consistent reproducible and valid results that are compatible with the results of other competent practitioners. For organisations with multiple sites carrying out bloodstain pattern analysis, this verification should be carried out on each site.

6.5.7 As part of verification the organisation should identify the methods to be used in BPA by the organisation and confirm that they are within the scope of the published scientific literature, and therefore require no further validation. In these instances the process should be verified for use at the site.

#### Verification exercise

6.5.8 The organisation should undertake an exercise to demonstrate that the procedures used generate consistent and valid results. This should reflect the various aspects of BPA undertaken at the laboratory and at crime scenes. In general this should comprise:

- a. identification of assorted bloodstains on a target surface – drips, wipe, etc.;

- b. identification of assorted blood patterns on a target surface – impact spatter, cast-off, etc.;
- c. identification of angle of impact of assorted blood spots on a target surface;
- d. identification of area of convergence of an impact pattern;
- e. stringing/tangent method identification of area of origin (if method is used);
- f. interpretation exercise based on a case scenario and blood patterns on an item(s) of clothing.

6.5.9 This exercise should use known simulated samples, and should be sent to practitioners across the complete range of competence and experience at the site to demonstrate consistency and validity. The acceptance criteria for the exercise should be clearly defined in advance of the exercise.

Training and experience of practitioners

6.5.10 The organisation should outline the training provided to practitioners, and their range of experience in terms of case numbers/types involving blood pattern analysis. This could include a record of participation by practitioners in conferences, CPD, membership of the International Association of Bloodstain Pattern Analysts (IABPA), etc.

Casework experience

6.5.11 The organisation should outline the numbers of BPA cases dealt with historically at the site and identify any issues that may have arisen in terms of quality management system non-conformances, etc. over the previous five years.

6.5.12 The validation document is a living document and should be reviewed annually and updated with the results of collaborative exercises, proficiency tests, audits and non-conformances, etc.

**6.6 Uncertainty of measurement (ISO 17025:2005 ref. 5.4.6 ; ISO 17020:2012 ref. 6.2.7)**

6.6.1 Those methods that require an estimation of uncertainty of measurement should be listed. These may include area of origin calculations, size, shape and distribution measurements of individual bloodstains, and directionality measurements.

**6.7 Equipment (ISO 17025:2005 ref 5.5; ISO 17020:2012 ref.6.2.1/6.2.13)**

Types of equipment used for BPA should be specified. These may include equipment for distance measuring, angle measuring, and magnification.

6.7.1 Specify any requirements around the use and validation of software programs for BPA. These may include:

- a. directional analysis software; and
- b. image analysis software.

**6.8 Measurement traceability (ISO 17025:2005 ref. 5.6 ; ISO 17020:2012 ref. 6.2.7) Use of reference materials (ISO 17025:2005 ref 5.6.3.2; ISO 17020:2012 ref. 6.2.8)**

6.8.1 Specify any requirements for the use of pattern exemplars for interpretation (see 6.5.5).

**6.9 Assuring the quality of test and calibration results (ISO 17025:2005 ref. 5.9); Inspection methods and procedures (SO 17020:2012 ref. 7.1.5)**

6.9.1 A procedure for an independent verification of any bloodstain pattern interpretation by a qualified practitioner must be specified. This should include the review of the:

- a. results of any quantitative or semi-quantitative methods; and
- b. interpretation/evaluation of bloodstain pattern evidence.

6.9.2 A procedure for addressing any disagreements between the practitioner and the independent reviewer must also be specified.

6.9.3 The organisation shall undertake one BPA proficiency test per year.

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6.9.4 The organisation shall establish and document a competency test schedule to ensure the regular testing of all practitioners.

### **6.10 Reporting the results (ISO 17025:2005 ref. 5.10); Inspection Reports (ISO 17020:2012 ref. 7.4.2)**

6.10.1 Any organisation-specific requirements for using standardised terminology for reporting bloodstain pattern evidence should be defined. It is recommended these include the use of current best practice defined by SWGSTAIN (2009).

6.10.2 It is recommended that a BPA report includes any information that is relevant to BPA such as the following.

- a. Case information including the background information as supplied during the course of the investigation and analysis, such as medical/DNA reports, environmental conditions, description of evidence and/or materials received.
- b. The limitations of BPA from photographs.
- c. Data collated in the course of the examination that provide the basis for subsequent conclusions. These could include:
  - i. the location where observations are recorded; and
  - ii. measurements, such as areas of origin, room size, heights of bloodstains and distribution of a bloodstain pattern.
- d. Sketches, scene diagrams and plans.
- e. Descriptors of the reported stains and stain patterns.
- f. The results of testing conducted to identify blood.
- g. The results of any chemical enhancement of bloodstains.
- h. The location of collected stain samples relevant to the bloodstain pattern analysis.
- i. Conclusions and interpretations. When an opinion is reported, it must be clearly marked as such.
- j. The basis upon which the opinion has been made, along with any relevant reference(s).

## 7. REVIEW

7.1.1 This document is subject to review in accordance with the Codes [A] and other appendices.

7.1.2 If you have any comments please send them to the address as set out on the Internet site at [www.gov.uk/government/organisations/forensic-science-regulator](http://www.gov.uk/government/organisations/forensic-science-regulator) or email: [FSREnquiries@homeoffice.gsi.gov.uk](mailto:FSREnquiries@homeoffice.gsi.gov.uk)

## 8. GLOSSARY

Active practitioner	An individual who is an analyst actively involved in bloodstain pattern training and/or BPA casework and/or performing technical reviews of BPA casework.
Bloodstain pattern analysis trainer/mentor	An individual who is an active practitioner in the field of BPA with appropriate casework experience as a qualified bloodstain pattern analyst and having fulfilled all previously stated requirements for a bloodstain pattern analyst.
Bloodstain pattern analysis trainee	An individual who has met the pre-training minimum and is actively working towards meeting the requirements as described in SWGSTAIN (2008).
Bloodstain pattern analyst	An individual who has successfully completed the prescribed course of study.
Competency test	A method used to demonstrate the successful completion of a BPA trainee's course of study and for checking ongoing competence as a BPA practitioner. The competency test(s) may be administered incrementally and/or cumulatively.
Mentorship	A programme administered under the direction of a qualified bloodstain pattern analyst during the course of a BPA trainee's training. This training should include, but is not limited to, the evaluation of the required objectives, the review of completed casework files, supervised BPA scene and laboratory work, and the observation of expert

testimony.

Professional organisations	Organisations recognised by the general scientific community that devote a portion of their subject matter to the science of BPA, for example, the American Academy of Forensic Sciences (AAFS), the Canadian Society of Forensic Science (CSFS), the International Association of Bloodstain Pattern Analysts (IABPA), the International Association for Identification (IAI) and the Chartered Society of Forensic Science (CSFS).
SWGSTAIN	The Scientific Working Group on Bloodstain Pattern Analysis comprising BPA experts from North America, Europe, New Zealand, and Australia. SWGSTAIN serves as a professional forum in which practitioners in BPA and related fields can discuss and evaluate methods, techniques, protocols, quality assurance, education, and research. SWGSTAIN's ultimate goal is to use these professional exchanges to address substantive and operational issues within the field of BPA and to work to build consensus-based, or 'best practice', guidelines for the enhancement of the discipline of BPA.

## 9. REFERENCES

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## 10. FURTHER READING

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**James, S.H., Kish, P. E., Sutton, T. P.,** (2005) *Principles of Bloodstain Pattern Analysis: Theory and Practice*. Boca Raton, CRC Press.

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