Best Practice Recommendation for Analysis of Friction Ridge Impressions

Friction Ridge Subcommittee
Physics/Pattern Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science

OSAC Proposed BPR

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Prepared by
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Disclaimer:

This document has been developed by the Friction Ridge Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science through a consensus process and *proposed* for further development through a Standard Developing Organization (SDO). This document is being made available so that the forensic science community and interested parties can consider the recommendations of the OSAC pertaining to applicable forensic science practices. The document was developed with input from experts in a broad array of forensic science disciplines as well as scientific research, measurement science, statistics, law, and policy.

This document has not been published by a SDO. Its contents are subject to change during the standards development process. All stakeholder groups or individuals are strongly encouraged to submit comments on this proposed document during the open comment period administered by the Academy Standards Board (ASB).

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1. Introduction

1.1. This document has been developed to improve the quality and consistency of friction ridge examination practices.

1.2. The examination of friction ridge impressions is conducted in accordance with a methodology consisting of Analysis, Comparison, and Evaluation. Analysis is the interpretation of observed data in a friction ridge impression in order to categorize its utility. Comparison is the search for and detection of similarities and differences in the observed data between two friction ridge impressions. Evaluation is the weighting of the aggregate strength of the observed similarities and differences between the observed data in the two friction ridge impressions in order to formulate a source conclusion.

1.3. In this document, the following verbal forms are used: "*shall*" indicates a requirement, "*should*" indicates a recommendation; "*may*" indicates permission; and "*can*" indicates a possibility or capability.

2. Scope

2.1. This document provides the best practice recommendations for the analysis of friction ridge impressions.

2.2. This document does not address the comparison or evaluation stages of the friction ridge examination methodology.

3. Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1. Analysis (phase of the Examination methodology): The interpretation of observed data in a friction ridge impression in order to categorize its utility.

3.2. Blind verification: A type of verification in which the subsequent examiner(s) has no knowledge of the original examiner's decisions, conclusions or observed data used to support the conclusion.

3.3. Comparison (phase of the Examination methodology): The search for and detection of similarities and differences in the observed data between two potentially corresponding friction ridge impressions.

3.4. Complexity (of an Impression): A characteristic of an impression whose attributes may require additional consideration and quality control measures. Impressions can be designated as high complexity, low complexity, or non-complex.

3.5. Evaluation (phase of the Examination methodology): The weighting of the aggregate strength of the observed similarities and differences between the observed data in the two friction ridge impressions in order to formulate a source conclusion.

3.6. Examination: The act or process of observing, searching, detecting, recording, prioritizing, collecting, analyzing, measuring, comparing, and/or interpreting.

3.7. Exemplar Impression: An impression to which a questioned impression is compared; it can include impressions from an unknown source or a known source.

3.8. Forensic Service Provider (FSP): A forensic science entity or forensic science practitioner providing forensic science services.

3.9. Friction Ridge Detail/Features: The combination of ridge flow, ridge characteristics, and ridge structure of friction ridge skin, as observed and reproduced in an impression. A large subset of the observed data used to compare and interpret similarity or dissimilarity between two impressions.

3.10. Interpretation: Explanations for the observations, data, and calculations.

3.11. Minutia: The point where a friction ridge begins, terminates, or splits into two or more ridges. A subset of the friction ridge detail/features traditionally consisting of ridge endings, bifurcations, and dots/short ridges used to compare and interpret similarity and dissimilarity between two impressions.

3.12. Observed Data: Any demonstrable information observed within an impression that an examiner relies upon to reach a decision, conclusion or opinion. This has historically been expressed as “features” or “minutiae,” but the use of the broader term “observed data” is inclusive of other types of data may be considered beyond minutiae, such as quality, scars, creases, edge shapes, pore structure, and or other friction ridge features.

3.13. Open (non-blind) verification: A type of verification in which the subsequent examiner has access to the original examiner’s decisions, conclusions or observed data used to support the conclusion.

3.14. Questioned Impression: An impression used for comparison against an exemplar impression; it can include impressions from an unknown source or a known source.

3.15. Suitability for Automated Biometric Identification System (ABIS) searches: The utility decision that an impression contains sufficient observed data to be utilized for an ABIS database search. The designation is often referred to as “suitable for ABIS” or “suitable for automated searching”.

3.16. Suitability for Comparison Decision (Suitability for Source Conclusions): A decision made by an examiner in accordance with FSP policy and/or procedure, that a friction ridge impression contains sufficient observed data to be utilized for comparison and a

Source Conclusion can potentially be reached. This designation is often referred to as "suitable for comparison" or "of value for comparison".

3.17. Utility: The usefulness of an impression for a further step in the examination process, such as comparison or ABIS entry.

3.18. Verification: Confirmation, through either re-examination or review of documented data by another examiner, that a conclusion or opinion conforms to specified requirements and is reproducible. NOTE: "Specified requirements" are the FSP's policies and procedures relating to Analysis, Comparison and Evaluation of friction ridge impressions.

4. General Recommendations

4.1. Analysis

4.1.1. A questioned impression, which has been assessed as having observable data and potential utility, shall be selected.

4.1.2. The observable data in the questioned friction ridge impression shall be analyzed and documented prior to comparison with an exemplar friction ridge impression.

4.1.3. The features and related observable data that should be considered during the analysis include classification pattern, ridge flow, minutiae, creases or wrinkles, and scars, as well as their individual attributes, such as type, location, orientation, shape, texture, and morphology.

4.1.3.1. At a minimum, minutiae shall be included to support the examiner's utility decision (i.e. ridge endings, bifurcations, and dots).

4.1.4. The quality of the features and related observable data should be analyzed and documented.

4.1.4.1. Documentation should be preserved digitally. The annotations may be done manually by the examiner or with automated image quality software.

4.1.4.2. Documentation should conform to the NIST Markup Instructions for Extended Friction Ridge Features[1], as provided by the following criteria (see Appendix A for further detail):

NOTE: The designation of quality is based on a standardized color-coding scheme, with each level defined in terms of the reliability of reproduction of different types of minutiae and other features at each location in the

[1] NIST (National Institute of Standards and Technology) 2013. Markup Instructions for Extended Friction Ridge Features, NIST Special Publication (SP) 1511, DOI https://doi.org/10.6028/NIST.SP.1151 or NIST Publication Link: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1151.pdf

friction ridge impression. For example, Category 3 (green) quality regions indicate areas within a friction ridge impression where the examiner has no doubt the presence of minutiae; whereas, Category 2 (yellow) quality regions indicate areas in which the presence of minutiae is debatable.

4.1.4.2.1. Category 5 quality: All observed data are definitive.

4.1.4.2.1.1. Marked as aqua.

4.1.4.2.2. Category 4 quality: Definitive ridge edges, debatable pores.

4.1.4.2.2.1. Marked as blue.

4.1.4.2.3. Category 3 quality: Definitive minutiae, debatable ridge edges.

4.1.4.2.3.1. Marked as green.

4.1.4.2.4. Category 2 quality: Definitive ridge flow, debatable minutiae.

4.1.4.2.4.1. Marked as yellow.

4.1.4.2.5. Category 1 quality: Debatable ridge flow.

4.1.4.2.5.1. Marked as red.

4.1.4.2.6. Category 0 quality: Background can be marked as black.

4.1.4.3. Documentation of the quality of the features and related observable data shall include an explanation of the marking system if different than described in the preceding section.

4.1.5. The complexity *of the impression* should be analyzed and should conform to the following criteria[2]:

4.1.5.1. Non-complex Impression: All of the following conditions are met:

4.1.5.1.1. Greater than 15 minutiae designated as Category 3 (green) quality or higher; or at least 12 minutiae designated as Category 4 (blue) quality or higher.

4.1.5.1.2. The observed data provides strong indication of the anatomical region and orientation.

[2] The criteria provided in this document are recommended for quality assurance purposes and based on consensus opinion of the OSAC Friction Ridge Subcommittee where supporting evidence in the scientific literature is limited. Adherence to these criteria will provide a common foundation for categorizing impressions as complex in a structured and consistent manner.

NOTE: An FSP may require less documentation for friction ridge impressions at this complexity level, such as only documenting 15 or 12 minutiae, respectively.

4.1.5.2. Low complexity Impression: One or both of the following conditions are met:

4.1.5.2.1. Between 8 and 15 minutiae designated as Category 3 (green) quality or higher; or between 5 and 12 minutiae designated as Category 4 (blue) quality or higher.

4.1.5.2.2. The observed data does not provide a strong indication of the anatomical region or orientation.

4.1.5.3. High complexity Impression: The following condition is met:

4.1.5.3.1. Fewer than 8 minutiae designated as Category 3 (green) quality or higher; or fewer than 5 minutiae designated as Category 4 (blue) quality or higher.

4.1.6. The FSP should require additional quality control measures for friction ridge impressions designated as high complexity, such as additional documentation of observed data, mandatory consultation, blind verification, or multiple verifications.

4.1.7. The friction ridge impression shall be analyzed for its overall utility. The utility of an impression is an operational decision, not a scientific one, and may include suitability for comparison or suitability for database search.

NOTE 1: Minimum criteria for determinations of suitability for comparison should be defined by the FSP and should be consistent with, or more stringent than, the minimum criteria necessary to support a specific source conclusion.

NOTE 2: Although the scientific literature does not support numerical thresholds based solely on minutiae quantity, the FSP may decide to implement a threshold to help define the utility decision.

4.1.7.1. The utility designation for each friction ridge impression shall be documented to indicate which friction ridge impressions will proceed to further examination steps. Documentation should conform to the following criteria:

4.1.7.1.1. Documentation should be done in a non-destructive manner on a digital image copy of the friction ridge impression. Some information, such as the utility decision, search identifier, and complexity designation may be documented in the case file.

4.1.7.1.2. The observed data supporting the utility decision shall be documented including, at a minimum, the presence, location, and quality of features. At a minimum, the observed data supporting the examiner's utility decision shall be documented.

4.1.8. Each friction ridge impression shall have the following information documented on the image or in the case file:

4.1.8.1. A unique identifier (e.g. LP1, LP2, etc.).

4.1.8.2. Search identifier(s), such as the unique identifier generated by the database search, if applicable.

4.1.8.3. Designation of utility (e.g. suitable for comparison or suitable for ABIS searches).

4.1.8.4. Designation of complexity *of the impression* (non-complex, low complexity, or high complexity).

4.1.8.5. Designation of anatomical region and orientation, if known.

4.1.9. Routine monitoring of examiners' performance should be completed as part of verification or technical review of the case file. The monitoring should address all of the following:

4.1.9.1. Detection and documentation of presence of observed data on the image of the impression.

4.1.9.2. Determination and documentation of the quality of observed data on the image of the impression.

4.1.9.3. Determination and documentation of the complexity *of the impression*.

4.1.9.4. Determination and documentation of utility.

5. Appendix A: Markup Instruction for Friction Ridge Quality

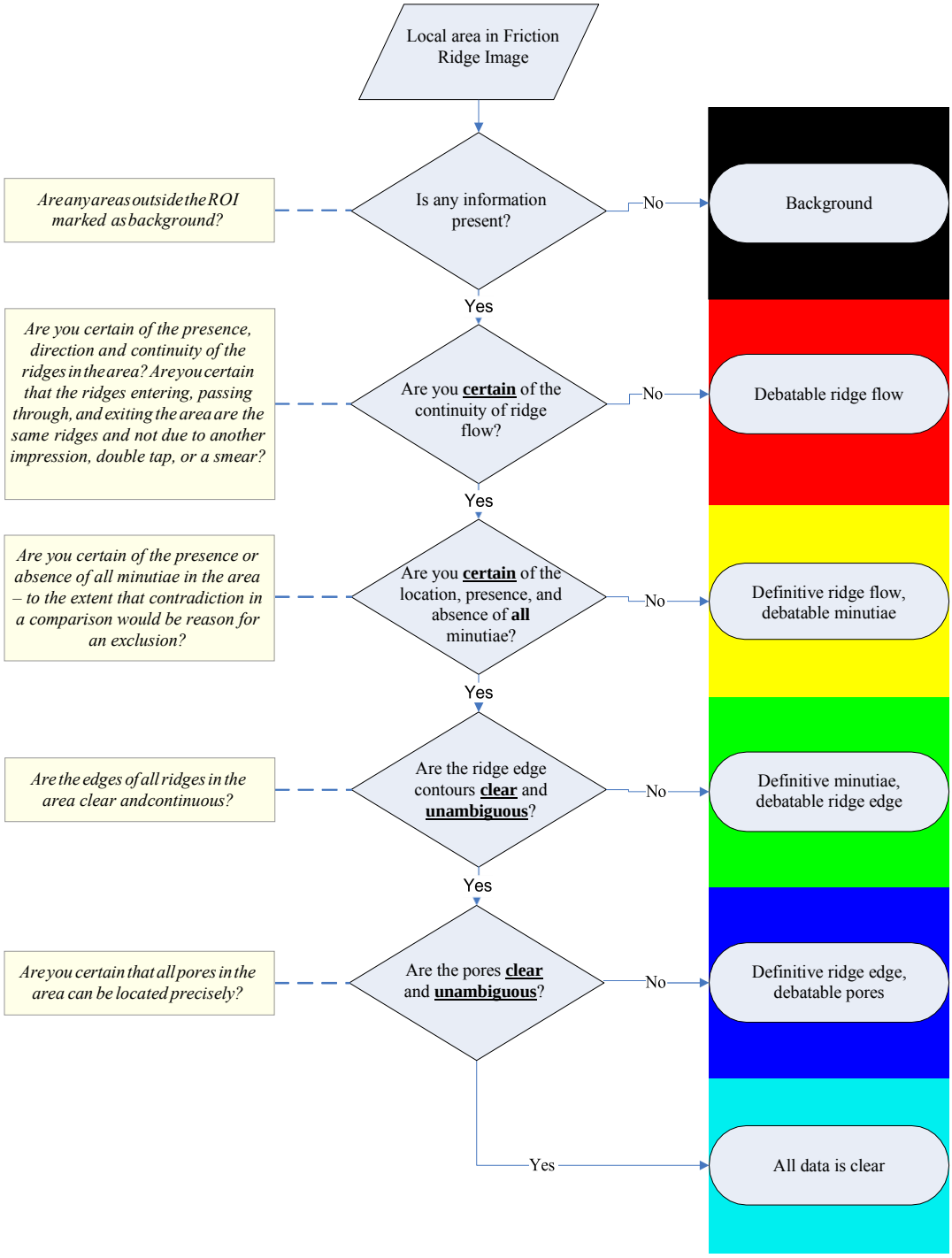

Figure 1: Decision process for local friction ridge quality. Reprinted courtesy of the National Institute of Standards and Technology, U.S. Department of Commerce. Not copyrightable in the United States.

			Ridge flow	Minutiae	Dots	Incipients	Ridge edge features	Pores
Black	0	Background			✗			
Red	1	Debatable ridge flow	?			✗		
Yellow	2	Definitive ridge flow, debatable minutiae	✓	?		✗		
Green	3	Definitive minutiae, debatable ridge edges		✓		?		✗
Blue	4	Definitive ridge edges, debatable pores			✓			?
Aqua	5	All features definitive			✓			

✓	Definitive and unambiguous	Presence, absence, and location are definitive. Contradictory presence or absence of definitive features in a comparison is cause for exclusion.
?	Debatable or ambiguous	Features may be marked, but presence, absence, and location are debatable. Corresponding/contradictory features in a comparison are supporting evidence for individualization/exclusion.
✗	Not discernible or unreliable	Features should not be marked and are ignored if present. No evidence for individualization or exclusion in a comparison exists.

Figure 2: Friction ridge quality designations and their relation to feature confidence. Reprinted courtesy of the National Institute of Standards and Technology, U.S. Department of Commerce. Not copyrightable in the United States.

6. Appendix B: Change Log

Version	Date	Change
1.0	09/30/2020	Original Issue