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## Best Practice Recommendation for Analysis of Friction Ridge Impressions



**ASB**  
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## Best Practice Recommendation for Analysis of Friction Ridge Impressions

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## Foreword

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

The examination of friction ridge impressions is conducted in accordance with a process 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.

The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2016 with a vision of safeguarding Justice, Integrity and Fairness through Consensus Based American National Standards. To that end, the ASB develops consensus based forensic standards within a framework accredited by the American National Standards Institute (ANSI), and provides training to support those standards. ASB values integrity, scientific rigor, openness, due process, collaboration, excellence, diversity and inclusion. ASB is dedicated to developing and making freely accessible the highest quality documentary forensic science consensus Standards, Guidelines, Best Practices, and Technical Reports in a wide range of forensic science disciplines as a service to forensic practitioners and the legal system.

This document was revised, prepared, and finalized as a standard by the Friction Ridge Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Friction Ridge subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

Questions, comments, and suggestions for the improvement of this document can be sent to AAFS-ASB Secretariat, [asb@aafs.org](mailto:asb@aafs.org) or 401 N 21st Street, Colorado Springs, CO 80904.

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**Keywords:** *analysis, complexity, friction ridge, quality*

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# Best Practice Recommendation for Analysis of Friction Ridge Impressions

## 1 Scope

This document provides best practice recommendations for the Analysis of friction ridge impressions as part of the Analysis, Comparison, and Evaluation examination process. These recommendations include how to assess, document the quality of friction ridge detail, and categorize impressions on the basis of their complexity, and document the utility of impressions for further examination.

This document does not address the Comparison or Evaluation stages of the friction ridge examination process.

## 2 Normative References

There are no normative references.

## 3 Terms and Definitions

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

### 3.1

#### **analysis (phase of the examination process)**

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 any other examiner's decisions, conclusions or observed data used to support the conclusion.

### 3.3

#### **comparison (phase of the examination process)**

The search for and detection of similarities and dissimilarities in observed data between friction ridge impressions.

### 3.4

#### **complexity (of an impression)**

A characteristic of an impression whose attributes may require additional consideration and quality assurance measures.

### 3.5

#### **consultation**

A discussion or interaction initiated by an examiner seeking guidance for the purpose of interpreting an image or comparison.

**3.6  
evaluation**

**(phase of the examination process)**

The weighting of the aggregate strength of the evidence (observed similarities and dissimilarities when considering two competing propositions) between the observed data in the friction ridge impressions being compared in order to formulate a source conclusion.

**3.7  
exemplar impression  
exemplar or known  
exemplar prints**

The deliberately recorded images or impressions from the friction ridge skin of an individual.

NOTE Examples may include, but are not limited to, inked tenprints, inked palm prints, Livescan prints, powder and lift prints, casted/moulded prints, or photographs of friction ridge skin.

**3.8  
Forensic Service Provider  
FSP**

Organization or individual that conducts and/or supplies forensic services.

**3.9  
friction ridge detail  
friction ridge features**

The combination of ridge flow, ridge characteristics, and ridge structure of friction ridge skin, as reproduced and observed in an impression. The observed data used to compare and interpret similarity or dissimilarity between impressions.

**3.10  
interpretation**

Explanations for the observations, data, and calculations.

**3.11  
minutia**

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

**3.12  
observed data**

Any information seen within an impression that an examiner relies upon to reach a decision, conclusion, or opinion. This not only includes minutiae, but attributes such as clarity, scars, creases, edge shapes, pore structure, and other friction ridge features.

**3.13  
questioned impression (also questioned image or questioned item)**

An impression or image of friction ridge skin whose source or identity is unknown; it can include latent impressions, impressions from an unknown source or a known source.

**3.14**  
**suitability**  
**utility**

The usefulness of an impression for a further step in the examination process, such as comparison or Automated Biometric Identification System (ABIS) entry.

**3.15**  
**suitability decisions**  
**utility decisions**

A decision made by an examiner in accordance with FSP policy and/or procedure as to whether or not an impression will proceed to the next step in the examination process.

**3.16**  
**suitability for Automated Biometric Identification System (ABIS) searches**  
**utility for Automated Biometric Identification System (ABIS) searches**

A decision made by an examiner in accordance with FSP policy and/or procedure as to whether or not an impression will proceed to an ABIS database search.

NOTE This designation is often referred to as “suitable for ABIS/AFIS” or “of value for ABIS/AFIS.”

**3.17**  
**verification (phase of examination process)**

Independent examination by one or more examiners to ascertain if a decision, conclusion, or opinion is reproduced or is in conflict with the decision, conclusion, or opinion of another examiner.

NOTE 1 Verification may be implemented in multiple ways including blind, open, and consensus. The general term verification is inclusive of these various types.

NOTE 2 Verification is a quality assurance measure for friction ridge examination.

NOTE 3 The use of the term “independent” indicates an autonomous examination but not necessarily one without knowledge of a prior decision, conclusion, or opinion.

## **4 Analysis of Friction Ridge Impressions**

**4.1** The examiner selects a questioned impression which has been assessed as having observable data and potential utility.

**4.2** The observable data in the questioned friction ridge impression is analyzed and should be documented by the examiner prior to comparison with an exemplar friction ridge impression.

At a minimum, sufficient minutiae should be documented to support the examiner’s utility decision (i.e., ridge endings, bifurcations, and dots).

**4.3** 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.

**4.4** The quality of the features and related observable data should be analyzed and documented by the examiner.

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

**4.4.2** Documentation should conform to the NIST Markup Instructions for Extended Friction Ridge Features <sup>1</sup>, as provided by the criteria in 4.4.2.1 through 4.4.2.6 (see Annex 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 friction ridge impression. For example, Category 3 (green) quality regions indicate areas within a friction ridge impression where the examiner has no doubt as to the presence of minutiae; whereas Category 2 (yellow) quality regions indicate areas in which the presence of minutiae is debatable.

**4.4.2.1** Category 5 quality: all observed data are definitive. Marked as **aqua**.

**4.4.2.2** Category 4 quality: definitive ridge edges, debatable pores. Marked as **blue**.

**4.4.2.3** Category 3 quality: definitive minutiae, debatable ridge edges. Marked as **green**.

**4.4.2.4** Category 2 quality: definitive ridge flow, debatable minutiae. Marked as **yellow**.

**4.4.2.5** Category 1 quality: debatable ridge flow. Marked as **red**.

**4.4.2.6** Category 0 quality: Background can be marked as **black**.

**4.4.3** Documentation of the quality of the features and related observable data should include an explanation of the marking system if different than described in 4.4.2.

**4.5** The complexity of the impression should be analyzed and should conform to the criteria<sup>2</sup> in 4.5.1 through 4.5.3.

**4.5.1** *Non-complex Impression*: all of the following conditions are met:

- a) greater than 15 minutiae designated as Category 3 (green) quality or higher; or greater than 12 minutiae designated as Category 4 (blue) quality or higher;
- b) the observed data provides strong indication of the anatomical region and orientation.

NOTE An FSP may require less documentation for friction ridge impressions at this complexity level, such as only documenting 16 or 13 minutiae, respectively.

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<sup>1</sup> 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>

<sup>2</sup> 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.



**4.5.2** *Low complexity Impression:* one or both of the following conditions are met:

- a) 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;
- b) the observed data provides a weak indication of the anatomical region or orientation.

**4.5.3** *High complexity Impression:* one or both of the following conditions are met:

- a) 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;
- b) the observed data provides no indication of the anatomical region or orientation.

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

**4.7** The friction ridge impression is 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.

**4.7.1** 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 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.

**4.7.2** The utility designation for each friction ridge impression should be documented to indicate which friction ridge impression(s), if any, will proceed to further examination steps. Documentation should conform to the following criteria.

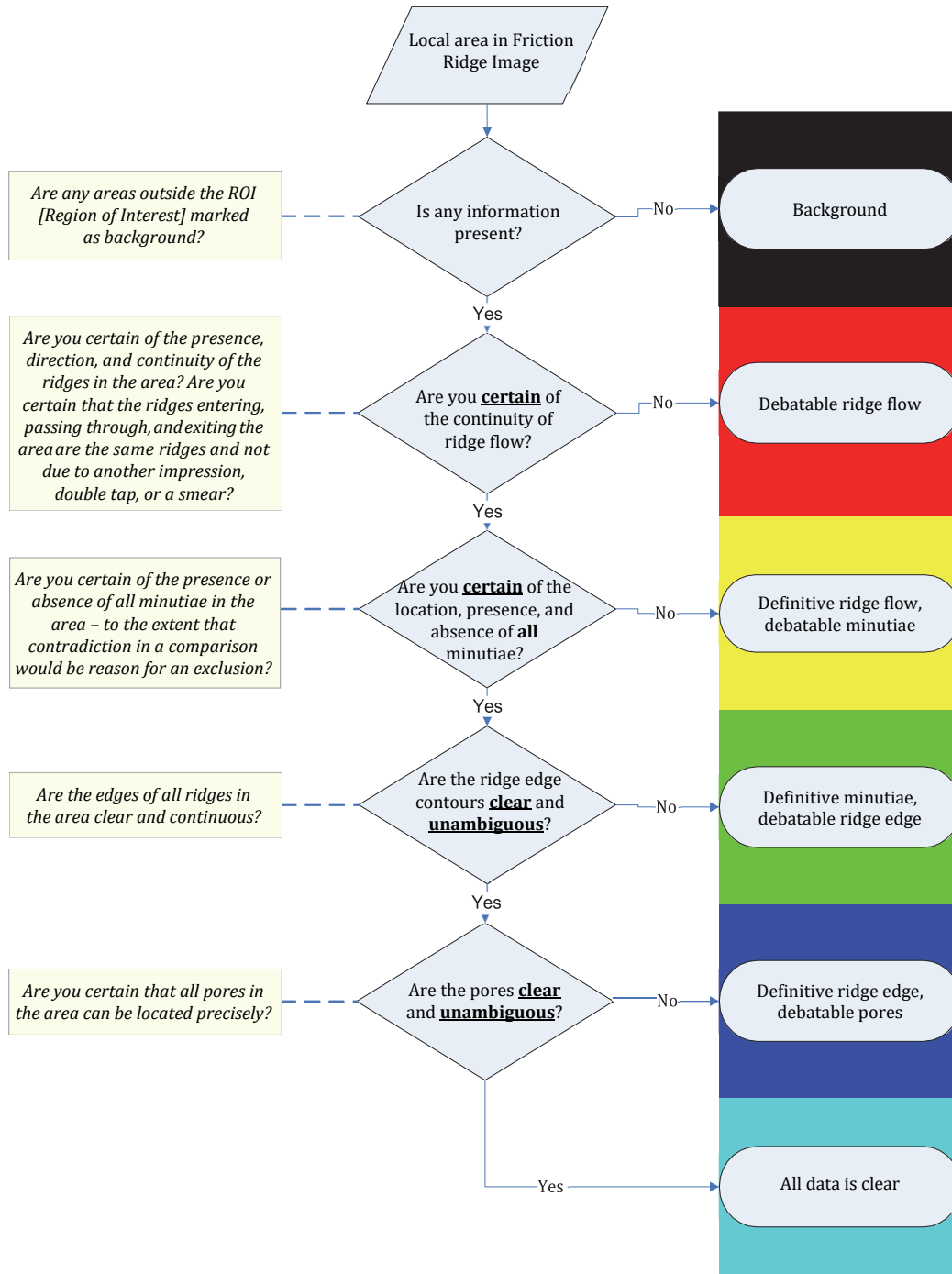
- a) Documentation should be done in a non-destructive manner on a digital image copy of the friction ridge impression. Some information, such as the utility decision, search identifier, and complexity designation may be documented in the case file.

**4.8** If an impression is determined to have utility, at a minimum the observed data supporting the utility decision should be documented including the presence, location, and quality of features. Each friction ridge impression should have the following information documented on the image or in the case file:

- a) a unique identifier;
- b) search identifier(s), such as the unique identifier generated by the database search, if applicable;
- c) designation of utility (suitable for comparison or suitable for ABIS searches);
- d) designation of complexity of the impression (non-complex, low complexity, or high complexity);
- e) designation of anatomical region and orientation, if known.

## Annex A (informative)

### Markup Instruction for Friction Ridge Quality



**Figure 1—Decision Process for Local Friction Ridge Quality**

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			Ridge flow	Minutiae	Dots	Incipients	Ridge edge features	Pores
Black	0	Background			X			
Red	1	Debatable ridge flow	?			X		
Yellow	2	Definitive ridge flow, debatable minutiae	✓	?			X	
Green	3	Definitive minutiae, debatable ridge edges		✓		?		X
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.
X	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**  
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