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# ~~Best Practice Recommendation for Articulating a Source Identification in~~Technical Report on the Articulation of the Reasoning and Foundational Principles Behind Friction Ridge Examinations

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# Foreword

The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2015 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 or 401 N 21st Street, Colorado Springs, CO 80904.

All hyperlinks and web addresses shown in this document are current as of the publication date of this standard.

ASB procedures are publicly available, free of cost, at www.aafs.org/academy-standards-board~~The "Articulation document", as it has come to be known by those drafting and debating it, originated in the Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) shortly after the release of the National Research Council's (NRC) 2009 report, Strengthening Forensic Science in the United States: A Path Forward.~~

~~The NRC report was critical of, among other things, the way friction ridge examiners expressed the results of their comparisons. The report particularly disapproved of examiners' tendency to present those results as facts, rather than expert opinions, and to describe them in absolute terms such as "individualization", "100% certain", "exclusion of all others", and "zero error rate" that the NRC and other critics noted overstated the strength of both the evidence and the foundational basis of the science to support it. Beyond these particular phrases, the entire practice of stating or implying, regardless of the wording used, that the potential donor pool could be reduced to a single source was strongly condemned.~~

~~Very shortly after the release of the NRC report, the discipline responded with strong recommendations that these terms not be used in expressing friction ridge conclusions and that absolute certainty in conclusions should be neither expressed nor implied; however, they offered no guidance on what should be communicated instead.~~

~~Some laboratories have adopted a weight-of-evidence approach to friction ridge reporting. As of this writing, such laboratories are a minority. The majority of laboratories continue to report "identifications." This document is intended as temporary measure while debates over proper reporting and presentation of associative conclusions are settled. It describes a way of articulating the reasoning and foundational principles behind an identification.~~

~~SWGFAST undertook the writing of the Articulation document in an effort to fill that void. Its goal was to offer guidance on how a friction ridge examiner could describe the examination process and~~

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~~report the findings without overstating them and while operating within a logically consistent framework. SWGFAST completed two drafts of the Articulation document, which were put out for public comment. Before the document was finalized, SWGFAST was dissolved in favor of the newly formed Organization of Scientific Area Committees (OSAC).~~

~~In 2015, the Friction Ridge Subcommittee (FRS) of the OSAC took up the legacy SWGFAST document and began the work of updating the references, clarifying some of the explanations, strengthening some of the recommendations and prohibitions, and putting the document through a full Standards Developing Organization (SDO) process, to result in a Best Practice Recommendations document that could be submitted to the OSAC Registry of Standards and Guidelines for adoption. The document you are reading is the result of that effort.~~

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**Keywords:** *TBD*

# Table of Contents *(to be updated when the document is finalized)*



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# ~~Best Practice Recommendation for Articulating a Source Identification in~~ Technical Report on the Articulation of the Reasoning and Foundational Principles Behind Friction Ridge Examinations

## 1 Scope

This document ~~offers guidance for~~provides reference information to aid in articulating the reasoning and foundational principles behind the ~~source identification conclusion resulting from the~~ examination of friction ridge evidence. ~~This document takes into consideration the current status of professional practices, legal decisions,~~It provides additional explanations and ~~scientific research.~~references in support of fundamental statements made within the friction ridge discipline. The ~~scope~~statements in the document include basic premises of ~~this document is limited to~~ friction ridge examination, the ~~source identification conclusion~~execution of the examination process, and the communication of the results of examinations. This document does not address ~~or consider inconclusive or exclusion~~the specific friction ridge examination conclusions or wording of those conclusions which are the subject of a separate document.

## 2 Normative References

There are no normative reference documents. Annex ~~B, Bibliography,~~A contains ~~informative~~bibliographical references.

## 3 Terms and Definitions

For purposes of this document, the following definitions apply.

~~**3.1**~~
~~**conclusions**~~
~~Findings or statements expressed as opinion and made by an examiner after completing the Evaluation phase~~**agreement (synonym of** ~~the friction ridge comparison process. They may offer support for one proposition over the other. Conclusions describe an examiner's knowledge, information, or belief about whether propositions are true or false.~~

~~**3.2**~~**3.1**
**correspondence**
**and corresponding friction ridge detail**
~~Observation of~~**)**
Observed similarities in pattern type, ridge flow, and friction ridge features in sequence, of the same or similar type, in the same relative position to each other, with associated intervening ridge counts. An accumulation of similarities between two impressions resulting in overall conformity that supports a conclusion of source identification.

**3.2**
**analysis (phase of the examination process)**
The interpretation of observed data in a friction ridge impression in order to categorize its suitability/utility.

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**3.3**
**clarity**
The fidelity and coherence with which the anatomical details of friction ridge skin are reproduced in a friction ridge impression, and are able to be visualized.[1]

**3.4**
**comparison (phase of the examination process)**
The search for and detection of similarities and dissimilarities in observed data between friction ridge impressions.

**3.5**
**complexity (of a comparison)**
A characteristic of a comparison in which the attributes of one or both impressions may require additional consideration and quality assurance measures relating to the evaluation of a source conclusion. Usually refers to the quality and clarity of at least one of the impressions in the comparison set, affecting the difficulty of the comparison.

**3.6**
**complexity (of an impression)**
A characteristic of an impression whose attributes may require additional consideration and quality assurance measures. Usually refers to the quality and clarity of the impression being analyzed, having the potential to affect the difficulty of a subsequent comparison.

**3.7**
**conclusion (synonym of source conclusion)**
Opinion stated by an examiner after interpretation of observed data. The opinion is the professional judgment that the observed data can offer support for one proposition over another. A conclusion is distinct from a "*proposition.*"

**3.8**
**disagreement**
A dissimilarity, or an accumulation of dissimilarities, that is deemed to be outside of expected variations in the appearance of impressions from the same source, resulting in overall nonconformity.

**~~3.3~~3.9**
**discriminability**
The degree to which information in an impression can be used to distinguish ~~between~~it from impressions made by different sources. The discriminability of an impression ~~encompasses~~is a combination of the quantity, spatial arrangement, clarity, and rarity of features ~~found on the friction ridge skin.~~observed.

**3.10**
**dissimilarity**
An observation that two impressions have a general difference of appearance when comparing an individual feature or detail. Not to be confused with *"disagreement"*.

[1] Kalka, N.D., M. Beachler, R.A. Hicklin. "LQMetric: A Latent Fingerprint Quality Metric for Predicting AFIS Performance and Assessing the Value of Latent Fingerprints", *JFI* 70(4): 443-463. 2020.

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**3.11**
**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.

**3.12**
**exemplar impression (synonym of exemplar or known and exemplar prints)**
**exemplar or known (synonym of exemplar impression and exemplar prints)**
**exemplar prints (synonym of exemplar impression and exemplar or known)**
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/molded prints, or photographs of friction ridge skin.

**3.13**
**observed data**
Any information seen within an impression that an examiner may rely 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.

**3.14**
**pattern force area**
A region of friction ridge skin ~~in~~ which in theory, minutiae ~~of a specific type are~~were forced to form due to ~~the flow of the ridges.~~pattern type and existing ridge fields during friction ridge formation. As these minutiae form more predictably, their configurations are more common and less random.

NOTE For example, in the outflow of a loop, many ridges ~~are converging~~converged during formation, which ~~necessarily forces~~forced many ridge endings to form as space ~~runs~~ran out. ~~Because the pattern forces these minutiae to form predictably and their configurations are more common and less random, they are properly assigned less weight than more randomly distributed minutiae toward an association between two impressions.~~

~~3.4~~3.15
**probability**
~~Probability is an~~An expression of the chance that a particular event occurs. ~~Probability estimates can be calculated using an appropriate model or assigned by considering a subjective assessment that is based upon observations interpreted using the examiner's experience.~~

~~**3.5**~~
~~**proposition**~~
~~Propositions are statements~~
**propositions**
Statements about the actual state of nature. ~~They are either true or false and can be thought of as the ground truth.~~

~~3.6~~3.16 ~~Propositions are often made in pairs of "competing propositions." "Competing," means that one of the propositions must be true and the other must~~ or an event, which is unknown or unknowable. Not to be ~~false, but together they include all possibilities. For example, two~~

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~~competing propositions are:~~confused with "*conclusions*," nor "*source conclusions*" (refer to those definitions for further clarification).

~~Proposition #1. Person X is the source of the latent print.~~
~~Proposition #2. Person X is not the source of the latent print.~~

~~In forensic science, evidence is examined for purposes of accumulating data or information which may provide support for one proposition over the other. Despite the ability to accumulate data or information in support for one proposition over the other, it will never be known which proposition is in fact true or false (the ground truth).~~

**3.17**
**questioned impression (synonym of questioned image or questioned item)**
**questioned image (synonym of questioned impression and questioned image)**
**questioned item (synonym of questioned impression and questioned image)**
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.

NOT For example the questioned impression may be a "known impression" in tenprint to tenprint examinations.

~~**3.7**~~
**rarity (of a feature type)**
~~Rarity of features observed on friction ridge skin refers to its~~ The frequency ~~of appearance~~ or prevalence ~~in a group of people~~of a friction ridge feature, either in isolation or in conjunction with other information about its local context.

~~**3.8**~~**3.18**

NOTE For example, the prevalence of a type of feature could be affected by its proximity to a pattern force area, the finger number or palmar region on which it is located, or the pattern type in which it is located.

~~**3.9**~~
~~**source identification**~~
~~Source identification is the conclusion that the observed corresponding friction ridge details offer substantially stronger support that the two impressions were made by the same source than by different sources.~~

**3.19**
**similarity**
An observation that two impressions share a general likeness when comparing an individual feature or detail. Not to be confused with "*agreement*."

**3.20**
**source**
An area of friction ridge skin of an individual from which an impression originated.[2]

[2] National Institute of Justice (U.S.). *The Fingerprint Sourcebook*. Washington DC: U.S. Dept. of Justice Office of Justice Programs National Institute of Justice; 2011. http://purl.fdlp.gov/GPO/gpo18039. Accessed November 11 2022.

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~~3.10~~3.21
**strength of the evidence**
~~A means of describing the weight of~~The relative support the evidence lends to one proposition over another. It may be described verbally or numerically.

## ~~4 Recommendations~~

3.22
**suitability (synonym of utility)**
The usefulness of an impression for a further step in the examination process, such as comparison or Automated Biometric Identification System (ABIS) entry.

## ~~5~~4 General

This document presents a series of statements, in sequence, that build upon one another. Together these provide a ~~recommended~~ roadmap for articulation of the foundational principles and reasoning for ~~the~~ current friction ridge ~~source identification practice~~examination practices. This document does not provide a script for examiners; rather, this series of statements taken together ~~provide~~provides a high-level overview of the main concepts behind the current practice of friction ridge ~~comparison~~examination. Each brief statement is followed by a more in-depth explanation of the theory behind the statement.

~~*Best Practice Recommendation: Examiners should be familiar with the concepts stated in Sections 4.2 through 4.9 along with their explanations and supporting references. Examiners should be able to put these concepts into their own words. Examiners should not overstate any of their conclusions (i.e. make a claim that cannot be substantiated with available facts or data).*~~

Supporting references are provided in each section ~~and practicing examiners should be aware of this material.~~ The references cited are meant to be representative, not all-inclusive. ~~An overview of these statements is included in Annex A.~~

## ~~6~~5 Discriminating and Persistent Nature of Friction Ridge Skin

### ~~6.1~~5.1 Statement

Friction ridge skin contains persistent morphological structures that can be highly discriminating.

### ~~6.2~~5.2 Further Explanation

~~6.2.1~~5.2.1 Research and practical application have shown that the combination of the features present in friction ridge skin ~~are~~can be highly variable between different sources. Research and practice have also shown that, barring injury ~~or~~, disease, or other conditions damaging to the skin the essential structure and ridge arrangements of these features remain unchanged (except for growth) over the life of an individual.

~~6.2.2~~5.2.2 An entire complement of a particular anatomical source of friction ridge skin is highly discriminating. However, it is less certain at what point a subset of the skin's features, imperfectly reproduced as an impression, are no longer discriminating enough to distinguish between similar sources. Furthermore, while research has demonstrated that some configurations of friction ridge features are highly discriminating, others, particularly in pattern force areas, are

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less so. Since impressions are often incomplete or indiscernible in part, their degree of discriminability is considered at all stages of the examination.

~~**6.2.2.1** While the highly discriminating nature of friction ridge skin is often expressed as "uniqueness", this claim has not been empirically proven. Additionally, it has been suggested that the concept of uniqueness is neither a guarantee of an examiner's ability to make an accurate source identification, nor a necessary precondition to reaching a reliable forensic conclusion.~~

~~**6.2.3 References Supporting Statement and Explanation**~~

## 5.3 ~~*Studies of discriminability*~~References Supporting Statement and Explanations

The following references support the statement and explanations for the discriminating and persistent nature of friction ridge skin.

a) *Discriminability, persistence, and morphology*. Wilder and Wentworth (1932), Cummins and Midlo (1943), Hale (1952), Babler (1979), Maceo (2011), Wertheim (2011), Kücken and Champod (2013), Yoon and Jain (2015)

b) *Historical use of friction ridge skin for personal identification*. Barnes (2011)

c) *Recent scientific studies of friction ridge discriminability*. Neumann et al. (2007), Neumann et al. (2012)

d) *Features in pattern force areas (e.g., deltas, outflows of a loop) tend to be more common*. Champod and Margot (1997)

~~**6.2.3.1** *Uniqueness is unproven and unnecessary*. Cole (2009), National Research Council (2009), Page et al. (2011)~~

# ~~7~~6 Transfer of Friction Ridge Features to Impressions

## ~~7.1~~6.1 Statement

An impression, or recording, of the features of friction ridge skin can result when contact is made with a receptive surface.

## ~~7.2~~6.2 Further Explanation

Contact with a surface can result in an impression, or recording, of the friction ridge skin. The resulting impression is not a perfect recording of the skin, as it is subject to distortions, differences in composition and substrate, and environmental effects. Each impression from the same area of friction ridge skin will ~~reproduce~~record a subset of that skin's features that will vary in appearance from other impressions of the same source skin. This is true of both questioned and ~~known~~exemplar impressions.

## ~~7.3~~6.3 References Supporting Statement and Explanation

The following references support the statement and explanations for the transfer of friction ridge features to impressions.

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a) *Ridgeology*. Ashbaugh (1999)

b) *Distortions*. Maceo (2009)

c) *Reproducibility of friction ridge skin features in an impression.* Monson et al. (2019)

## ~~8~~7 Analysis of Impression to ~~Detect Discriminating Features~~Observe Data for ~~Comparison~~Suitability Assessment

### ~~8.1~~7.1 Statement

During analysis of a friction ridge skin impression, ~~an examiner detects features that would be expected to be~~the data present in ~~another~~the impression~~, generally a known~~ is observed and its discriminability is assessed in order to categorize its suitability for comparison. Analysis is applied both to questioned and exemplar~~, from the same area of friction ridge skin~~ impressions.

### ~~8.2~~7.2 Further Explanation

Examiners have demonstrated an ability to ~~accurately detect discriminating features~~observe data such as ridge events, creases, and scars in friction ridge impressions that surpasses that of untrained individuals. Examiners are capable of ~~accurately detecting discriminating features~~observing data even in highly distorted impressions. Examiner confidence in the ~~reliability~~existence and type of observed ~~features~~data increases with ~~their~~the clarity of the data observed in an impression. ~~Before comparing two impressions, an examiner decides that both contain sufficient clear, discriminating features.~~

### ~~8.3~~7.3 References Supporting Statement and Explanation

The following references support the statement and explanations for the analysis of impression to observe data for suitability assessment.

a) *Effects of expertise and human factors on analysis and comparison*. Busey and Parada (2010), Busey and Vanderkolk (2005)

b) *Expertise/novice ability.* Tangen, Thompson, and McCarthy (2011)

~~b)~~c) *Qualitative analysis and comparison*. Hicklin et al. (2013), Langenburg (2012), Maceo (2009)

d) ANSI/ASB Best Practice Recommendation 165, *Best Practice Recommendation for Analysis of Friction Ridge Impressions*, 1st Ed., 2024

## ~~9~~8 Comparison of ~~Features~~Observed Data to ~~Evaluate Correspondence~~Assess Similarity and Dissimilarity

### ~~9.1~~8.1 Statement

~~The~~During comparison, the observed ~~features are then compared between~~data in comparable areas of two friction ridge impressions~~. An examiner considers correspondences~~ are assessed for similarity and ~~differences between these features~~dissimilarity.

### ~~9.2~~8.2 Further Explanation

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A ridge-to-ridge comparison between two side-by-side impressions ~~determines~~assesses whether ~~or not~~ there ~~are corresponding features~~is similarity or dissimilarity in ~~agreement, or disagreement. Correspondence or~~ the ~~lack thereof is judged~~observed data in comparable areas of the two impressions. Similarity and dissimilarity are assessed with respect to both the ~~features~~observed data and ~~their~~its spatial relationships. ~~Because every~~Every recording of the same area of friction ridge skin is different~~, the ground truth of whether~~. As a ~~particular feature actually exists and its true appearance can only be known by examining the source skin.~~ result, the assessment of similarity and dissimilarity takes into account tolerances for distortion and other environmental effects.

### ~~9.3~~8.3 References Supporting Statement and Explanation

The following references support the statement and explanations for the comparison of observed data to assess similarity and dissimilarity.

a) *Quantitative comparison and evaluation*. Ashbaugh (1999), Fagert and Morris (2015), Ulery et al. (2014)

b) ANSI/ASB Best Practice Recommendation 166, *Best Practice Recommendation for Comparison and Evaluation of Friction Ridge Impressions*, 1st Ed., 2024

## ~~10~~9 Accumulated ~~Correspondence~~Similarity Decreases Probability of Repetition in a Different Source

### ~~10.1~~9.1 Statement

~~As an examiner finds more corresponding features between two impressions, it becomes less likely that the corresponding set of features would also be present in an impression from a different source.~~

#### ~~10.2~~1.1 Further Explanation

The larger the set of similarities observed between two impressions the greater the likelihood of those observations if the impressions originated from the same source versus if they originated from different sources. Furthermore, the greater the clarity and/or rarity of those similarities, the greater the likelihood of those observations if the impressions originated from the same source versus if they originated from different sources.

### 9.2 Further Explanation

**9.2.1** ~~The quantity of corresponding features is important; however, so are their clarity and rarity.~~ In general, the variability in appearance of observed data is greater for impressions that originated from different sources than for multiple impressions that originated from the same source.

**~~10.2.1~~9.2.2** Not all ~~features~~observed data carry the same weight. ~~Features~~Observed data with higher clarity generally indicate more accurate representations of the source friction ridge skin. ~~Features~~Observed data that are rarer allow the examiner to better discriminate between two sources.

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~~10.2.2~~9.2.3 Quantity, spatial arrangement, clarity, and rarity combined make up the discriminability of the impression. A more discriminating impression is less likely to have ~~its features repeated~~similar observed data in impressions ~~made by~~originating from different sources.

~~10.2.3~~9.2.4 Conversely, the ~~accumulation~~larger the set of ~~apparent differences in the impression make it more likely that the~~ dissimilarities observed between two impressions ~~were made by~~the greater the likelihood of those observations if the impressions originated from different sources~~.~~ versus if they originated from the same source.

## ~~10.3~~9.3 References Supporting Statement and ~~Explanation~~Explanations

The following reference supports the statement and explanations for the accumulated similarity decreases probability of repetition in a different source.

a) *Quantifying variability and weight of evidence*. Egli et al. (2007), ~~Gutièrrez~~Gutiérrez et al. (2007), Neumann et al. (2007), Neumann et al. (2012), Stoney and Thornton (1986)

# ~~11~~10 Evaluation of the ~~Observations~~Observed Data Under Two Competing Propositions

## 10.1 Statement

### ~~11.1~~1 ~~Statement~~

~~Once an~~ During evaluation, the examiner assesses observed similarities and dissimilarities to determine whether there is agreement or disagreement in the observed data. Within this assessment, two competing propositions are considered: 1) that the two impressions originated from the same source, and 2) that the two impressions originated from different sources.

## 10.2 Further Explanation

**10.2.1** ~~observes correspondence they must then consider~~The examiner considers the support for each proposition and if the support for one proposition outweighs the other.

**10.2.2** The relative weighing of propositions determines the direction, if any, the examiner moves from the neutral position (i.e., Inconclusive).

~~11.1.1~~10.2.3 To determine the strength of the evidence, the examiner weighs the probability of observing the ~~corresponding features~~similarities and dissimilarities in two impressions assuming they were made by the same source against the probability of observing the ~~same correspondence in two impressions~~ similarities and dissimilarities assuming they were made by different sources. The strength of the evidence is the degree to which the probability of one proposition outweighs the probability of the other proposition.

### ~~11.2~~1.1 ~~Further Explanation~~

~~**11.2.1.1** A formal way to consider these two possibilities is by framing them as two competing propositions. One proposition is: the unknown impression came from the same source as the known impression; the other proposition is: the unknown impression came from a different source than the known impression.~~

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~~11.2.1.2~~ The ~~same source proposition considers the degree~~combination of ~~correspondence (including both agreement~~the direction and ~~possible disagreement) of the observed features. The different source proposition considers the discriminability of the observed features.~~

~~11.2.2~~10.2.4 ~~The degree to which support for a proposition of same source outweighs support for a proposition of different source is~~ the strength of ~~the~~ evidence ~~(also referred to as a likelihood ratio or Bayes' Factor).~~ is recorded as one of the conclusions documented in ASB Standard 013, Standard for Friction Ridge Examination Conclusions *(Draft published)*.

### ~~11.3~~10.3 References Supporting Statement and ~~Explanation~~Explanations

The following references support the statement and explanations for the evaluation of the observed data under two competing propositions.

a) *Two competing propositions are considered.* ~~Finkelstein and Fairley (1970),~~ *Aitken et al (2010), Neumann et al. (2012), Robertson et al. (2016)*

b) *Using ~~Strength of Evidence~~likelihoods to ~~Support Conclusions~~indicate support for propositions. Champod (2015), Cole (2009), Cole (2014), Swofford (2015)*

c) *Probability can be an expression of your degree of belief in the truth of an event. Lindley (2014)*

d) *ASB Standard 013 – Standard for Friction Ridge Examination Conclusions (Draft published)*

## 11 Communication of Results of Examinations

### 11.1 Statements

~~**11.4 Source Identification Conclusion**~~

~~**11.4.1 Statement**~~

~~The examiner reaches a conclusion of source identification.~~

Because target audiences for the results of friction ridge examinations vary, the specific wording used to convey the reasoning and foundational principles behind friction ridge examinations can vary.

Some statements made by examiners, while wholly understandable to a subject matter expert, can be prone to misinterpretation by the layperson.

Statements which lack foundation or support, overstate the strength of evidence, or are factually inaccurate are to be avoided.

### ~~11.5~~11.2 Further Explanation

~~Source identification is~~When articulating the ~~conclusion that the observed corresponding~~ results of friction ridge ~~details offer substantially stronger support that the two impressions were made by the same source than by different sources.~~

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~~**11.6 Communication of Findings**~~

~~**11.7~~1.1 ~~Statement**~~

~~The examiner shall communicate the findings. The target audiences for these communications vary by agency or situation.~~

~~**11.7.1 Further Explanation**~~

~~**11.7.1.1** Reported conclusions shall be expressed as the informed opinion of the examiner.~~

~~**11.7.1.2** Reported conclusions may be expressed in one of the three following ways to ensure proper interpretation.~~

~~**11.7.1.2.1** The latent impression on Exhibit 1 was identified (see note) to the standards bearing the name XXXX.~~

~~NOTE If using this format, the definition of "source identification" in section 4.8.2 shall be included in the report and testimony.~~

~~**11.7.1.2.2** The latent impression on Exhibit 1 and the standards bearing the name XXXX have corresponding friction ridge detail. The observed correspondence offers substantially stronger support that the two impressions were made by the same source than by different sources.~~

~~**11.7.1.2.3** The latent impression on Exhibit 1 and the standards bearing the name XXXX have corresponding friction ridge detail. The observed correspondence is believed to be rare among impressions that came from different sources.~~

~~**11.7.2**11.2.1 ~~Specific~~examinations, the use of specific words and phrases ~~conveying absolute certainty~~ are inappropriate or misleading ~~and shall not be used, or implied, to express conclusions in an open population. Specific~~. Such problematic phrases include the following~~.~~

a) *Individualization, Made by, Originated from the same source, Exclusion of all others.*

Use of the term "individualization" or phrases such as "originated from the same source~~",~~" (outside of the presentation of propositions), "made by", "matched to", and "exclusion of all others~~", etc. implies~~" imply the reduction of an open population (i.e., the ~~pool of potential sources~~world's population) to a single source. ~~This determination~~These terms and phrases de facto ~~excludes~~exclude all other possibilities. Unless case related contextual information is considered when making this determination, such as a closed-set population, this claim is not supportable by the current research and empirical testing.

b) *Zero error rate, Infallible.*
A claim of a zero error rate for the examination of friction ridge impressions is demonstrably false; errors have occurred in practice, proficiency testing, and performance studies. Furthermore, the concept of a zero error rate is incompatible with the practice of science.

c) *Citing a personal degree of confidence as a measure of accuracy*
While an examiner may express confidence in their conclusion, there is no established metric by which to measure a degree of confidence in a specific conclusion (e.g., 100% confident,

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extremely confident, etc.). Even a documented personal error rate does not account for the variability in the chance of error due to the specific circumstances of the comparison at hand.

It is inappropriate to conflate confidence with accuracy by asserting or implying that because an examiner has confidence in the conclusion it is therefore accurate. Examiners can be both confident and inaccurate in their conclusions as is evidenced by documented errors both in practice and performance studies.

~~b)~~d) *Certainty, Practical impossibility, Reasonable degree of scientific* ***certainty*** ~~.~~ *, and equivalents.*

The concept of ~~100%~~ certainty is incompatible with the practice of science. Science is inherently an endeavor to generate the best possible answers to questions that are never knowable with certainty. Arguments such as "I would not have signed the report unless I was ~~100%~~ certain" are not sufficient support for a claim of ~~100%~~ certainty. ~~Numerical certainties~~Furthermore, statements that include a measure of ~~any degree should not be reported without an empirical basis.~~certainty are similarly inappropriate because certainty is generally perceived as a categorical statement as opposed to a scalable measure.

In practice, the concept of certaintly is often inappropriately conflated with confidence. Whereas certainty is associated with the accuracy of a result, confidence is associated with a person's conviction in that result.

e) *Citing a number of friction ridge comparisons as a measure of accuracy*

Performance studies have demonstrated that an examiner's years of experience is not correlated with reduced error rates. Given this lack of correlation, it is inappropriate to assert that any number of comparisons performed is a reliable measure of the accuracy of the proffered conclusion. Research has shown that the chance of error in a given comparison is most heavily influenced by the attributes of the impressions examined as opposed to the examiner performing the comparison.

f) *The concept of the uniqueness of friction ridge skin alone is sufficient to justify a conclusion*

While the friction ridge skin can be considered highly discriminable, and is essential for the reliable practice of friction ridge examination, the examination of friction ridge impressions does not involve the direct comparison of the friction ridge skin. Instead, friction ridge examiners perform comparisons on reproductions of that skin.

Within the process of reproduction (e.g., deposition), discriminating information is lost. The amount of loss is variable, but loss always occurs. Furthermore, examiners must consider the influence of distortions, composition, substrate, and environmental effects on the appearance of the resulting subset of information recorded in an impression in order to determine its suitability to support any proffered conclusion. (see Section 5.2.2)

Examiners and lay audiences alike are vulnerable to reasoning incorrectly that the discriminability of friction ridge skin vouches for the accuracy of friction ridge conclusions. When discussing the friction ridge skin, it is improper for an examiner to invoke the skin's discriminability as the guarantor of the accuracy of the conclusion.

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### 11.3 References Supporting Statement and Explanations

The following references support the statement and explanations for the communication of results of examinations.

a) *Use of these phrases is inappropriate and unsupported*. Campbell (2011), Champod (2013), Cole (2014), Garrett (2009), National Research Council (2009), NIST (2012)

b) *Studies on the accuracy of experienced friction ridge examiners*. Langenburg (2009), Ulery, Hicklin et al. (2011), Tangen, Thompson et al. (2011)

c) *Forensic statistics*. Robertston et al. (2016), Aitken and Taroni (2004)

d) *Decision-making in forensic identification*. Biedermann et al. (2008)

## 12 Limitations

### 12.1 Statement

~~*c) Zero error rate / infallible method.*~~

~~A claim of a zero error rate for the method is demonstrably false; errors have occurred. Because the friction ridge comparison process takes place within the mind of the examiner, there is no way to separate a method error rate from a practitioner error rate. Furthermore, as with 100% certainty, the concept of a zero error rate is incompatible with the practice of science.~~

~~*d) It's my opinion (as a rationale for an unsubstantiated conclusion).*~~

~~Expert witness testimony allows the statement of an expert opinion. An expert opinion should be based on objective and observable data and should result in conclusions that can be substantiated by others.~~

~~**11.7.2.1** In addition to articulating the reasoning and fundamental principles used to reach a conclusion of Source Identification and the strength of the support for that conclusion, examiners should be aware of and prepared to articulate the limitations of the testimony they offer.~~

Friction ridge examinations and conclusions are subject to limitations both fundamental and practical

### 12.2 Futher Explanation

**12.2.1** Friction ridge examination is subjective in nature.

While performance studies have demonstrated that friction ridge examiners in the aggregate can reach accurate conclusions (under specific test conditions), friction ridge examination is fundamentally an exercise in personal (professional) judgment. Decisions are made based on human observations. Examiners also apply personally-derived thresholds to effect examination decisions. While these personal observations and thresholds are not arbitrarily derived or applied they can vary from examiner to examiner.

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Studies have demonstrated that individuals can develop expertise in friction ridge examination by acquisition of relevant knowledge, experience, and training. Furthermore, studies have shown that examiners often reach consensus and that variability amongst examiners was most strongly associated with high complexity impressions and with decisions at or near sufficiency thresholds.

The subjective nature of friction ridge examination means that examiners will not always agree with each other, necessitating the application of strong and transparent quality assurance practices.

**12.2.2** The age of a friction ridge impression cannot be determined from the appearance of the impression.

Absent exceptional circumstances, friction ridge impressions do not provide information indicative of when the deposition of a print took place. Numerous factors affect the appearance of an impression both at the time of deposition and over time. The influence of these factors is variable and not an indicator of age.

**12.2.3** The presence of a friction ridge impression generally indicates contact was made but not the specific activity resulting in the deposition.

In general, the presence of a friction ridge impression on an item of evidence indicates that a contact was made between a source and an item. The anatomical source of an impression along with its orientation and location on an item may also reveal information about how that item was handled. Absent exceptional circumstances, an impression cannot be directly associated with a specific event or activity. For example, the presence of a friction ridge impression on a firearm does not necessarily indicate that the impression was deposited during the firing of that firearm.

Under specific circumstances, an impression may not directly originate from a source contact but instead be a result of a transfer from one item to another (e.g., lifted by an adhesive surface).

**12.2.4** The absence of, or failure to detect, a friction ridge impression does not indicate that contact did not occur.

The deposition of a friction ridge impression is a chance event. A variety of factors may impede the deposition of an impression (e.g., absence of a matrix to deposit, non-receptive surfaces, etc.) or the longevity of a deposited print (e.g., wiping a surface, exposure to the elements), and the detection of friction ridge impressions on items of evidence is not always successful. As such, a lack of friction ridge impressions on an item of evidence does not indicate that the item was not contacted. Furthermore, the exclusion of a source to a detected impression does not indicate that that source did not contact the item.

Conversely, the absence of, or failure to detect, a friction ridge impression can also result from an item not being handled. As such, this observation provides no evidentiary support for either proposition (i.e., that the item was handled but no impression was deposited or detected or that the item was not handled).

**12.2.5** Ground truth is unknown—.

In case work, the examiner cannot truly know whether any particular person is the source of an unknown impression since they did not observe the deposition of the impression. It is for this reason that ~~examiners should limit themselves to expressing their opinion~~the expression of professional judgement of the source of the unknown impression, along with a description of the

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strength of the evidence supporting that ~~opinion. Examiners should not~~professional judgement, be limited. It is inappropriate to give ~~an~~the impression that ~~their~~any conclusion is a known fact.

**12.2.6** The strength of the ~~support for~~evidence supporting the examiner's ~~opinion~~professional judgement is ~~dependent upon~~variable.

~~**11.7.2.1.1** All conclusions are not equal in strength. When presenting a conclusion, it is important to be transparent about the quality and, quantity of the data available, and the complexity of the comparison, which is variable.~~

~~The examiner should be transparent when presenting a conclusion of Source Identification about the quality and quantity of the~~ data that were used to reach the conclusion and how that quality ~~and,~~ quantity, and complexity affect the strength of the ~~support for~~evidence supporting the conclusion. ~~All Source Identifications should not be presented as equal in strength, either by direct phrasing or by implication.~~

~~**11.7.3**~~**12.2.7** ~~Repeatability by others~~Reproducibility is not ~~an indication~~a guarantee of accuracy.

~~Examiners should not imply~~It is inappropriate to assert that because ~~their~~a conclusion has been ~~repeated~~reproduced by others (through verification or other means~~), this somehow increases the accuracy of the conclusion. They should be willing to acknowledge that~~) it is therefore accurate. In both practice and performance studies, errors have occurred ~~in the discipline~~ that have been ~~repeated~~reproduced by ~~multiple~~other examiners. The only way to be certain of accuracy is to know ground truth. ~~The best~~In the absence of ground truth, the most appropriate way to support the accuracy of a conclusion is by clearly demonstrating the support the data provide for the conclusion.

~~**11.7.4**~~**12.2.8** Case type ~~may~~can be relevant to whether a comparison is performed, but is not relevant as support for a conclusion.

Agencies have different policies regarding the prioritization of cases based upon crime type. However, crime type ~~shall~~is not ~~be a~~an appropriate basis for adjusting the threshold for a ~~Source Identification~~ conclusion. For example, it is not appropriate to reach a ~~Source Identification~~ conclusion using less supporting data for a homicide than one would consider sufficient for a burglary.

## ~~**11.8**~~**12.3** References Supporting Statement and ~~**Explanation**~~**Explanations**

~~a) *Use of these phrases is inappropriate and unsupported.* Campbell (2011), Champod (2013), Cole (2014), Garrett (2009), National Research Council (2009), NIST (2012)~~

~~b)~~a) ~~*Forensic statistics.* Robertston et al. (2016), Aitken and Taroni (2004)~~

~~c)~~a) ~~*Decision-making in forensic identification.* Biedermann et al. (2008)~~

The following references support

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# ~~Annex A~~
~~(informative)~~

## ~~Overview of~~ the statement and explanations for limitations.

a) *Examiner variability.* Ulery, Hicklin et al. (2015, 2016)

~~a)~~b) *Examiner expertise.* Busey and Vanderkolk (2005), Busey and Parada (2010), Tangen, Thompson, and McCarthy (2011)

~~b)~~c) *Age determination of friction ridge impressions.* Girod, Ramatowski et al. (2016)

d) *Reproducibility of friction ridge conclusions.* Ulery, Hicklin et al. (2012), Tangen, Kent, and Searston (2020)

### ~~11.9~~1.1 ~~Statements~~

~~To provide a summary of the structure of the document, and to serve as a quick reference to its sections, each of the progression of statements that are explained within the document are presented here, using the same numbering system under which they appear in the document body.~~

~~**4.2.1** Friction ridge skin contains persistent morphological structures that can be highly discriminating.~~

~~**4.3.1** An impression, or recording, of the features~~ ~~skin can result when contact is made with a receptive surface.~~

~~**4.4.1** During analysis of a friction ridge skin impression, an examiner detects features that would be expected to be present in another impression, generally a known exemplar, from the same area of friction ridge skin.~~

~~c)~~e) ~~**4.5.1** The observed features are then compared between two *impressions.* An examiner considers correspondences and differences between these features.~~

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# Annex A
(informative)

## Bibliography

The following bibliography is not intended to be an all-inclusive list, review, or endorsement of literature on this topic. The goal of the bibliography is to provide examples of publications addressed in the standard.


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4] ANSI/ASB Best Practice Recommendation 166, *Best Practice Recommendation for Comparison and Evaluation of Friction Ridge Impressions*, 1st Ed., 2024[c].

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