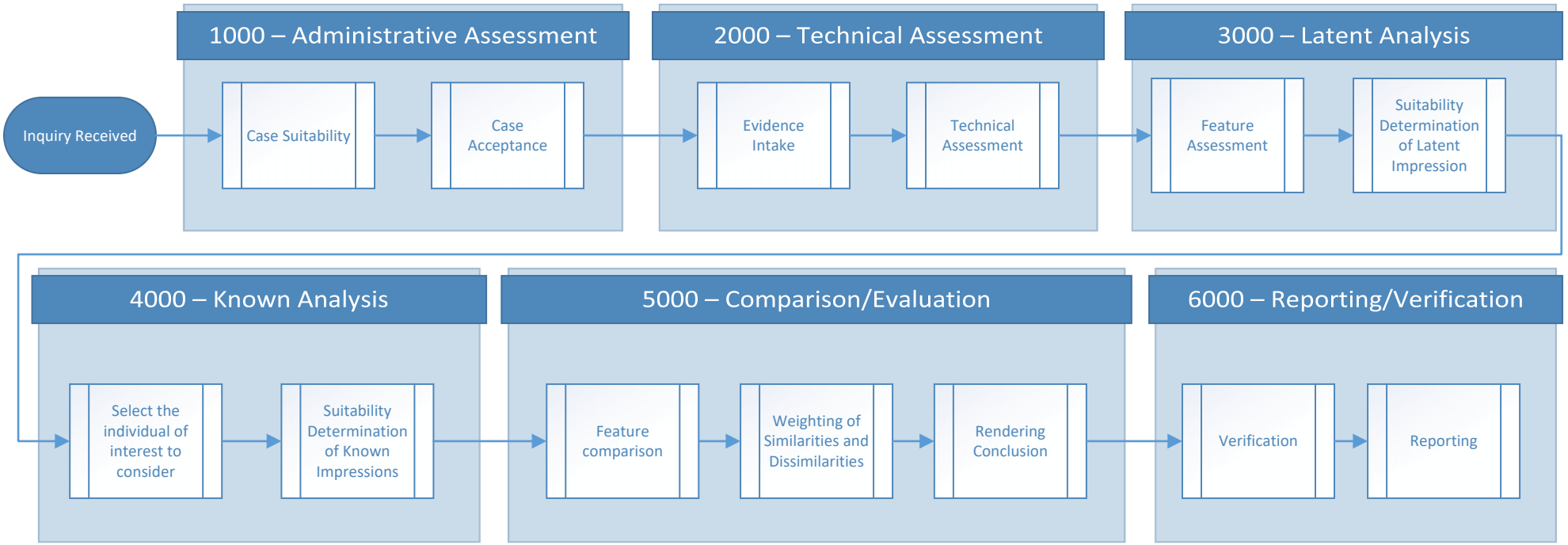
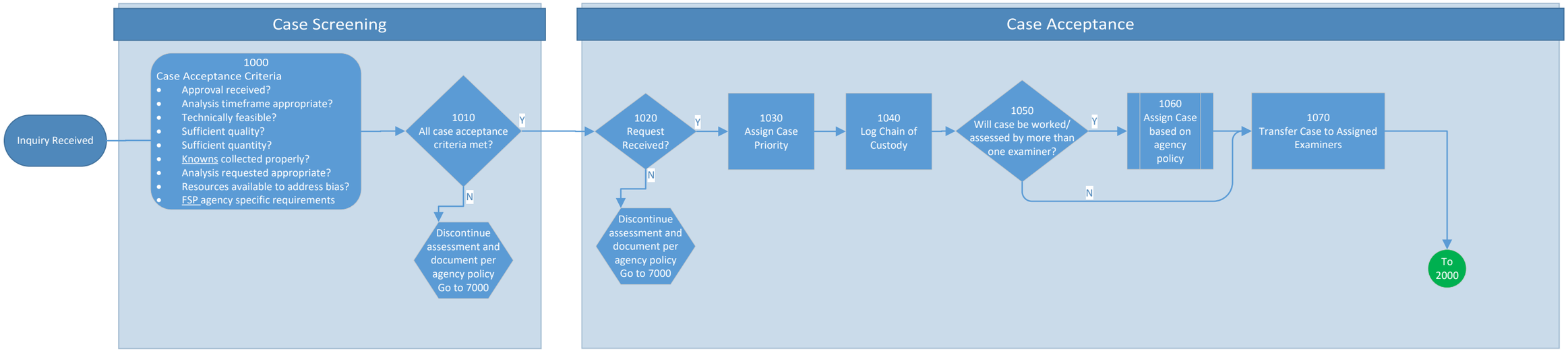


Introduction to the Friction Ridge Process Map

The friction ridge examination process map offers a visual description of the conventional process used for associating impressions of friction ridge skin by latent print examiners. The process is commonly referred to as ACE-V: Analysis, Comparison, Evaluation, and Verification. In broad strokes, a friction ridge examination following the ACE-V process proceeds as follows: Analysis refers to an initial information-gathering phase in which the examiner studies the unknown print to assess the quality and quantity of discriminating detail present. The examiner considers information such as substrate, development method, various levels of ridge detail, and pressure distortions. A separate analysis then occurs with the exemplar. Comparison is the side-by-side observation of the friction ridge detail in the two impressions to determine the agreement or disagreement in the details. In the Evaluation phase, the examiner assesses the agreement or disagreement of the information observed during Analysis and Comparison and forms a conclusion. Verification in some agencies is a review of an examiner's conclusions with knowledge of those conclusions; in other agencies, it is an independent re-examination by a second examiner who does not know the outcome of the first examination. This map does not cover latent processing techniques or how to use AFIS systems including unsolved latent searching.

This process map was originally created by the NIST/NIJ Expert Working Group on Human Factors in Latent Print Analysis and published in 2012. The map was then updated by the OSAC Friction Ridge Subcommittee to describe the various steps of the ACE-V process and the several different ways they are currently practiced by the friction ridge examination community. The OSAC Friction Ridge Subcommittee does not support or endorse all the different ways the steps of the ACE-V process are currently practiced as depicted by the process map. As the OSAC Friction Ridge Subcommittee continues to develop standards and best practice recommendations related to the friction ridge examination process, this map will be updated to reflect a single standardized process that is recommended for the friction ridge community.

The intended uses of this process map are to facilitate discussions about key decision points in the ACE-V process, help the research and standard's development community be able to cite the specific latent print activity that their efforts address, and enable laboratory managers to better understand how their protocols compare with other laboratories.



This process map uses the following symbols:

Legend	
	Task or activity of the process
	Predefined process (Individual steps not detailed on map)
	Documentation
	Decision
	Inputs
	Output
	Connector
	Discontinuation of exam
	Start/End

Technology Assist
Describes how technology aids in the steps on this page

Underlined Word
Word that will be defined in the glossary

This process map provides a visual description of the various steps of the ACE-V process and the several different ways they are currently practiced by the friction ridge examination community. The OSAC Friction Ridge Subcommittee does not support or endorse all the different ways the steps of the ACE-V process are currently practiced as depicted by the process map.

Examiner Evidence Intake

2000
Item(s) forwarded to assigned examiner:

- Questioned Exemplars
- Known Exemplars
- Inked Impressions (exemplars)
- Lift card
- Digital images of friction ridge detail
- Photo of friction ridge detail
- Physical item
- Friction fridge skin (hand, foot, finger, etc.)

2010
Inventory
(mark and describe evidence per agency policy)

2020

Select single Item/latent to review using one or more of the following criteria:

- Quality/complexity
- Perceived probative value based on examiner's understanding of the case
- Administratively chosen
- Forensic objective (customer driven; investigative question)
- Random order
- Latent to latent
- Case type
- Priority
- By item number
- Surface/Substrate

Technical Assessment

2030
Is friction ridge detail present?

2080
Is the Quality and Quantity sufficient to proceed to analysis per agency policy?

2090
Preserve the friction ridge detail per agency policy

2100
Continue without assessing additional latents?

2110
If more than one latent was assessed, select single latent for analysis

2040
Would physical, chemical, optical, or digital enhancement processing be helpful?

2060
Is the enhancement technique available? (in house or outsource)

2070
Apply physical, chemical, optical, digital enhancement (off map conducted by examiner or someone else)

2020

2030

2050
Have all value determinations been made?

2020

2120
Are potential value determinations verified prior to discontinuation of case?

2140
Conduct blind verification?

2160
Conduct fully blinded?

2170
Share limited case data (per agency policy)

2180
Conduct independent analysis (examiner begins at 2030)

2150
Review initial examiner analysis and confirm that determinations are well supported

2190
Consensus determination reached?

2200
Resolve conflicts (Follow agency conflict resolution policy)

2210
Document per agency policy

2130
Impression(s) suitable for Analysis?

2220
Output:
Latent(s) of potential value

3000

Discontinue examination and document per agency policy
Go to 7000

Technology Assist

- Automated quality mapping tools
- Digital processing techniques
- Magnifier

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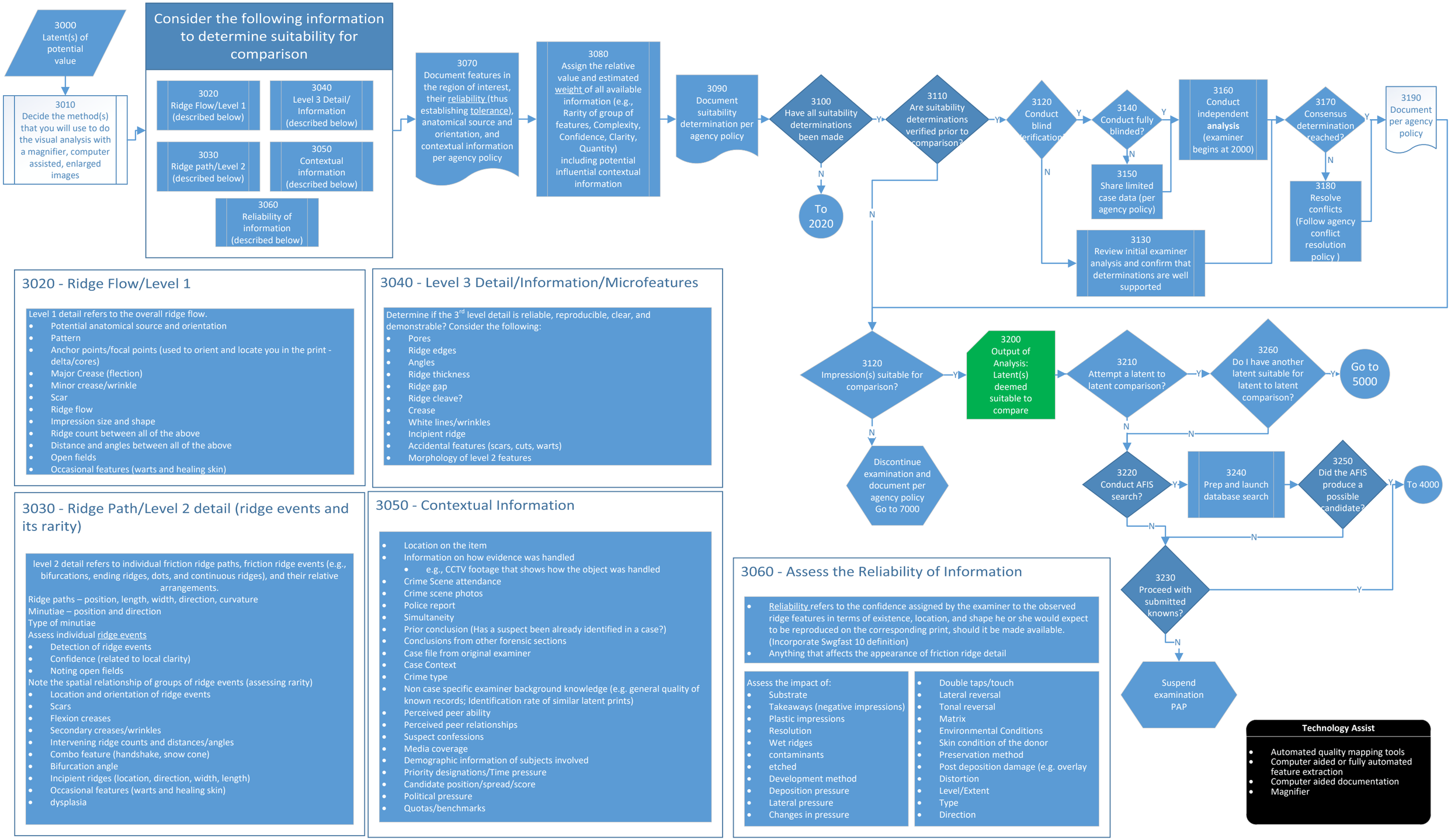
Latent Analysis - Feature Assessment and Suitability Determination of Latent Impression



3020 - Ridge Flow/Level 1

Level 1 detail refers to the overall ridge flow.

- Potential anatomical source and orientation
- Pattern
- Anchor points/focal points (used to orient and locate you in the print - delta/cores)
- Major Crease (flection)
- Minor crease/wrinkle
- Scar
- Ridge flow
- Impression size and shape
- Ridge count between all of the above
- Distance and angles between all of the above
- Open fields
- Occasional features (warts and healing skin)

3040 - Level 3 Detail/Information/Microfeatures

Determine if the 3rd level detail is reliable, reproducible, clear, and demonstrable? Consider the following:

- Pores
- Ridge edges
- Angles
- Ridge thickness
- Ridge gap
- Ridge cleave?
- Crease
- White lines/wrinkles
- Incipient ridge
- Accidental features (scars, cuts, warts)
- Morphology of level 2 features

3030 - Ridge Path/Level 2 detail (ridge events and its rarity)

level 2 detail refers to individual friction ridge paths, friction ridge events (e.g., bifurcations, ending ridges, dots, and continuous ridges), and their relative arrangements.

Ridge paths – position, length, width, direction, curvature

Minutiae – position and direction

Type of minutiae

Assess individual ridge events

- Detection of ridge events
- Confidence (related to local clarity)
- Noting open fields

Note the spatial relationship of groups of ridge events (assessing rarity)

- Location and orientation of ridge events
- Scars
- Flexion creases
- Secondary creases/wrinkles
- Intervening ridge counts and distances/angles
- Combo feature (handshake, snow cone)
- Bifurcation angle
- Incipient ridges (location, direction, width, length)
- Occasional features (warts and healing skin)
- dysplasia

3050 - Contextual Information

- Location on the item
- Information on how evidence was handled
  - e.g., CCTV footage that shows how the object was handled
- Crime Scene attendance
- Crime scene photos
- Police report
- Simultaneity
- Prior conclusion (Has a suspect been already identified in a case?)
- Conclusions from other forensic sections
- Case file from original examiner
- Case Context
- Crime type
- Non case specific examiner background knowledge (e.g. general quality of known records; Identification rate of similar latent prints)
- Perceived peer ability
- Perceived peer relationships
- Suspect confessions
- Media coverage
- Demographic information of subjects involved
- Priority designations/Time pressure
- Candidate position/spread/score
- Political pressure
- Quotas/benchmarks

3060 - Assess the Reliability of Information

- Reliability refers to the confidence assigned by the examiner to the observed ridge features in terms of existence, location, and shape he or she would expect to be reproduced on the corresponding print, should it be made available. (Incorporate Swgfast 10 definition)
- Anything that affects the appearance of friction ridge detail

Assess the impact of:

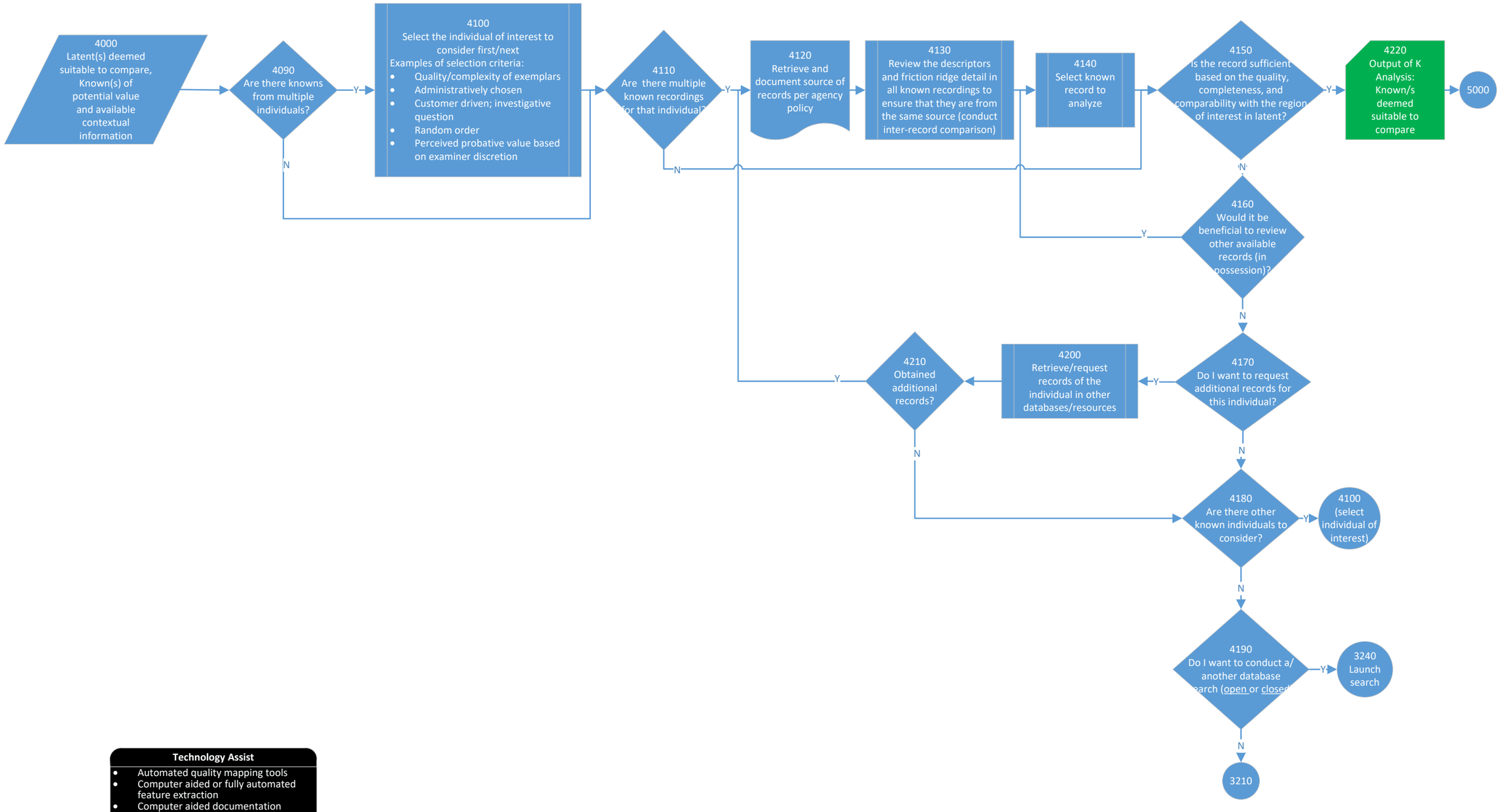
- Substrate
- Takeaways (negative impressions)
- Plastic impressions
- Resolution
- Wet ridges
- contaminants
- etched
- Development method
- Deposition pressure
- Lateral pressure
- Changes in pressure

- Double taps/touch
- Lateral reversal
- Tonal reversal
- Matrix
- Environmental Conditions
- Skin condition of the donor
- Preservation method
- Post deposition damage (e.g. overlay
- Distortion
- Level/Extent
- Type
- Direction

Technology Assist

- Automated quality mapping tools
- Computer aided or fully automated feature extraction
- Computer aided documentation
- Magnifier

Known Analysis



Technology Assist

- Automated quality mapping tools
- Computer aided or fully automated feature extraction
- Computer aided documentation
- AFIS searching
- Candidate list thresholds
- Magnifier

This process map provides a visual description of the various steps of the ACE-V process and the several different ways they are currently practiced by the friction ridge examination community. The OSAC Friction Ridge Subcommittee does not support or endorse all the different ways the steps of the ACE-V process are currently practiced as depicted by the process map.

5000
Inputs:
Latent(s) and/or Known impressions deemed suitable for comparison and available contextual information

5010
Select a single latent to compare with another latent, one known, or a set of knowns from a single individual (see known selection criteria box below)

Known Selection Criteria
How do I select which latent/latent or latent/known to compare first/next? Select the applicable criteria:

- Quality/complexity of impressions
- Administratively chosen
- Customer driven; investigative question
- Random order
- Perceived probative value based on examiner discretion
- Sequential order
- Process based on grouping latents based on scene
- Based on scene examination

5020
Begin side by side comparison

5030
Select target group in latent and attempt to locate it in the compared impression(s)

5040
Was the target group found in the compared impression within your established tolerance?
Y
N

5320
Search for additional similarities as well as dissimilarities b//n latent and compared impression within established tolerance

5330
Note similarities and dissimilarities in level 2 detail and document per agency policy

5340
Assign the relative value of the similarities and dissimilarities in friction ridge detail given the estimated weight of all available information including potential influential contextual information

5050
Note similarities and dissimilarities in level 1 detail and document per agency policy

5060
Is there sufficient level 1 disagreement to potentially reach a conclusion?
Y
N

5290
Consider whether distortion, scarring, or clarity could be impacting the interpretation of level 1 information

5300
Can I exclude based on level 1 detail?
Y
N

5310
Are the data sufficient to exclude based on agency policy?
Y
N

Exclude

Support for exclusion/ different source

6000

5070
Would searching a new target group be beneficial, necessary, available or required?
Y
N

5090
Am I certain of the Q anatomical source?
Y
N

5150
Document the anatomical source

5100
Is there additional information that would influence my evaluation?
Y
N

5110
Have I searched all relevant areas?
N
Y

5120
Complete search of all available areas

5130
Document additional information used (e.g. cctv footage showing how the weapon was handled)

5140
Was it helpful?
Y
N

5160
Am I certain of the Q orientation?
Y
N

5210
Document contextual information used (e.g. cctv footage showing how the weapon was handled)

5170
Is there additional information that would help me determine orientation?
Y
N

5180
Have I conducted a 360 search for the target group?
Y
N

5190
Complete a 360 search

Conclusions

- Individualize
- Identification
- Support for identification/ same source
- NOT ID'd
- Inconclusive 1
- Inconclusive 2
- Support for exclusion/ different source
- Exclude

Technology Assist

- Computer aided statistical modeling of weight of evidence
- Computer aided minutiae locating (e.g. ULW ghost cursor)
- Computer aided feature extraction
- Computer aided comparison (360 degree searching)
- Computer aided documentation
- Computer aided selection of the known to compare (AFIS or CAFIS)
- Magnifier

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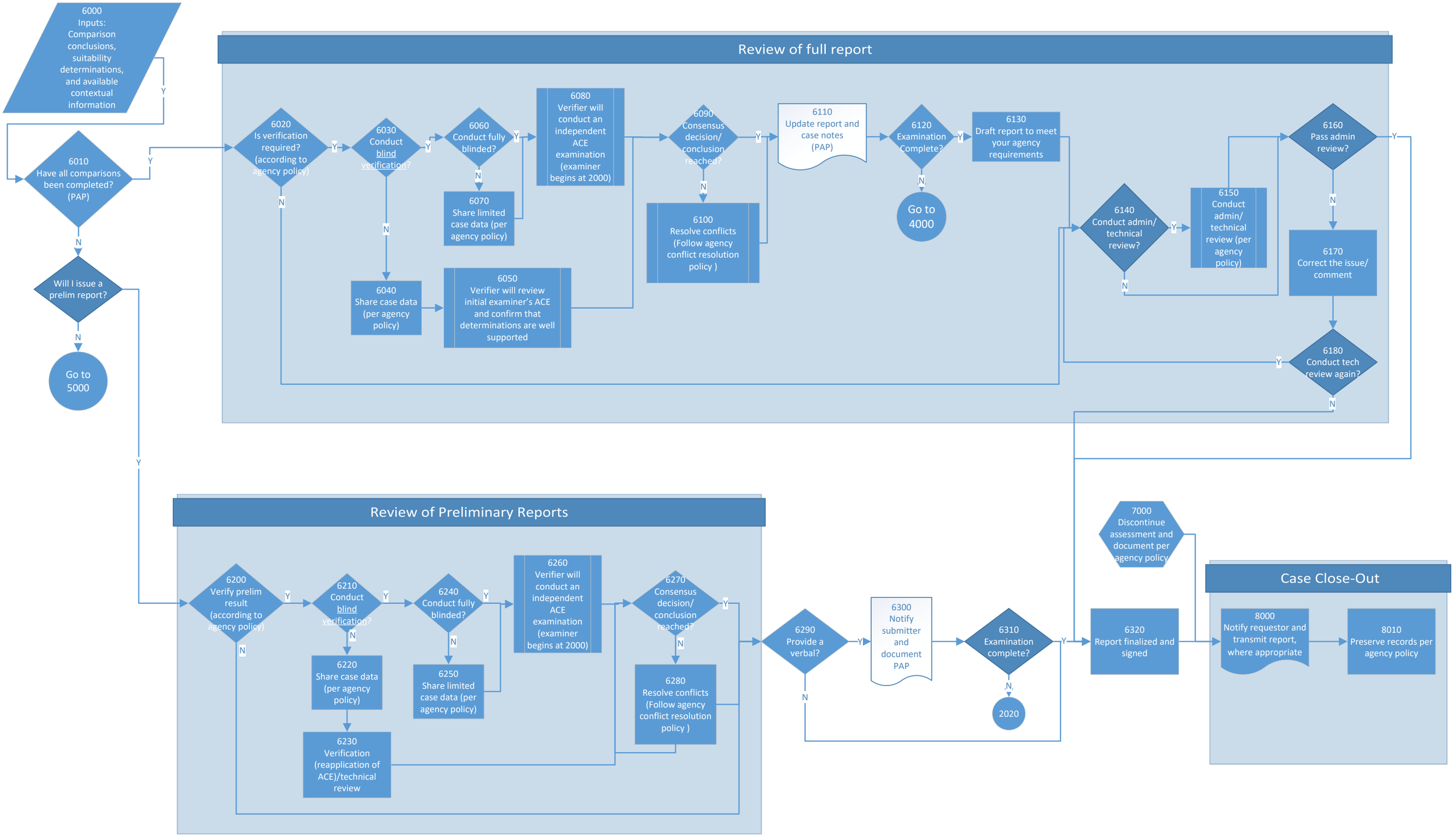
5350
Will
level 3 detail be
beneficial to your
evaluation?
Y
5410
Is the
reproducibility of
level 3 sufficient to
support
comparison?
5420
Note similarities and
dissimilarities in level 3 detail
and document per agency
policy
5430
Assign the relative value of the
similarities and dissimilarities in friction
ridge level 3 detail given the
estimated
weight
of all available information
including potential influential contextual
information
N
N
5360
Does data support
same source more
than different
source?
Y
5370
Was the
candidate
retrieved from
AFIS searc
Y
5380
Consider the
possibility of
incidental similarity
5390
Are the data
sufficient to the
exclusion of all
others?
Y
Individualize
N
N
N
5080
Will I attempt to
exclude?
Y
5400
Is the data in correspondence
sufficient that you would not
expect to see it in a different
source?
Y
Identification
N
N
NOT ID'd
6000
Support for identification/
same source
6000
5220
Assign the relative value of the
similarities and dissimilarities in
friction ridge detail given the
estimated
weight
of all available
information including potential
influential contextual information
5230
Note similarities
and
dissimilarities per
agency policy
5240
Am I restricted to only
comparing impressions
that are of value for id?
Y
5270
Would
additional
known records
help?
Y
5280
Obtain additional
knowns from
individual?
Y
5010
N
N
N
Exclude
Inconclusive 1
5250
Does the data
support different
source more than
same source?
Y
5260
Are the data sufficient
to exclude based on
agency policy?
Y
Exclude
N
N
Inconclusive 2
Support for exclusion/
different source
6000
5200
Was the
target group
found
in the compared impression
within your established
tolerance?
Y
5320
N



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Terms and Definitions

b//n - Between

PAP - Per Agency Policy

Administrative Review - An administrative review is conducted in order to determine the clerical accuracy of reports and case documentation and to ensure the examiner has followed agency policy and procedure. Administrative review shall be conducted on all cases. Administrative reviewers do not have to be trained to competency in friction ridge examination (*SWGFAST Doc# 16)*

Database Search (Closed) – This is sometimes used when a database search is conducted with an unknown impression against a closed database with a limited number of candidates e.g. in Case AFIS systems, as opposed to an open search where a database search is conducted with an unknown impression against a global database.

Changes in pressure - Contact pressure is the amount of force applied per unit area by the finger on the surface. This can affect both the extent of the final contact area as well as the degree of compression of the ridges and possibly of the substrate. The contact pressure and any movement encountered when the finger makes contact with the substrate can also cause the ridges to distort i.e. move closer together or further apart. This can then affect the distribution of particular features in the resultant fingermark and may affect the ability to compare the mark to a reference print.

Complexity - The interplay between quality and quantity of minutiae and its relation to the decision thresholds. It broadly represents how the amount of available information in an impression directly impacts the decision-making process (*SWGFAST Doc# 10*) Note 1: An Impression is considered complex if the following modifying factors are present: low specificity of features, significant distortion (e.g., multiple tap, superimposed impression, extreme pressure leading to tonal reversal, and slippage), high tolerances, or the original conclusion is contested during verification. Note 2: An Impression is considered as non-complex if modifying factors are present such as high specificity of features, presence of creases, scars, and open fields.

Contaminant - A substance other than a naturally occurring constituent of sweat secretions from the skin that may be found in fingermarks or be the major constituent of them (e.g. grease, blood)

Contextual Bias - A cognitive bias caused by contextual factors; an unwarranted or unintended influence of task-irrelevant contextual information on human judgment (*OSAC Lexicon*)

Crease (Major) - Major creases, or permanent flexion creases: the named creases that separate the joints of the fingers and divide the palm (NIST Special Publication 1151)

Crease (Minor) - Cracks, cuts, and thin or nonpermanent scars: collectively called linear discontinuities (*NIST Special Publication 1151)*

Database search (open or closed) – The term "Closed Search" is sometimes used when a database search is conducted with an unknown impression against a closed database with a limited number of candidates e.g. in Case AFIS systems, as opposed to an "Open Search" where a database search is conducted with an unknown impression against a global database

Deposition pressure - Pressure applied during the process of contact between the source and the substrate

Development method - A subset of visualization where a process applied to the fingermark results in it becoming visible in a

progressive way, producing a gradual change from invisible to clearly visible. Most chemical and physical processes can be considered to 'develop' impressions.

Direction – This is usually in refence to the orientation of the ridge flow (directional arrangement of friction ridges), and arrangement of friction ridge features as it relates to the distal direction, towards the tips of the fingers.

Distortion - Variances in the reproduction of friction skin caused by factors such as pressure, movement, force, and contact.

Double taps/touch – This may be caused by movement of the friction ridge skin or surface at the time of deposition. Occurs when the contact between a source and a substrate is partially broken and then the same source contacts the same area of substrate again

Environmental Conditions - The nature of the environment to which both the mark and substrate are exposed is critical in determining the changes that may occur over the time of exposure, e.g. temperature, humidity, airflow, optical radiation and atmospheric pollutants or contaminants.

Etched Impression – E.g. impressions on metal substrates that become etched into the metal through oxidation

Exclusion - The determination by an examiner that there is sufficient quality and quantity of detail in disagreement to conclude that two areas of friction ridge impressions did not originate from the same source (*SWGFAST Doc# 19*)

FSP - Forensic science service provider, forensic science practitioner

Identification (Also see Individualize) - The determination by an examiner that there is sufficient quality and quantity of detail in agreement to conclude that two friction ridge impressions originated from the same source (*SWGFAST Doc# 19*)

Inconclusive - The determination by an examiner that there is neither sufficient agreement to individualize, nor sufficient disagreement to exclude (*SWGFAST Doc# 19*)

Incipient ridges - A friction ridge not fully developed that may appear shorter and thinner than fully developed friction ridges (*SWGFAST Doc# 19*)

Inconclusive 1 - This inconclusive conclusion results from a lack of complete and legible known prints. This means comparisons were made to the extent possible, however additional clear and completely recorded exemplars, to include the required anatomical areas, are needed for re-examination (*SWGFAST Doc# 10 (Draft))*

Inconclusive 2 – This inconclusive decision is used when on balance, the data supports neither same source nor different source (LR1)

Individual - Subject of Interest, Suspect, Subject for Elimination

Individualize (Also see "Identification") - The determination by an examiner that there is sufficient quality and quantity of detail in agreement to conclude that two friction ridge impressions originated from the same source (*SWGFAST Doc# 19*)

Note: "…It is the position of SWGFAST that "individualization" is synonymous with the term "identification" as used in friction ridge examination. Both are defined as: "the decision by an examiner that there are sufficient discrimination friction ridge features in agreement to conclude that two areas of friction ridge impressions originated from the same source. The term individualization was originally introduced in latent print

examinations to provide a more specific term than identification. In the friction ridge community, identification has historically meant association with a specific individual, while in some forensic disciplines it is used to denote the correspondence of class characteristics. SWGFAST recognizes that individualization has been used within the latent print community to mean "to the exclusion of all others." The ability of a latent print examiner to individualize a single latent impression, with the implication that they have definitely excluded all other humans in the world, is not supported by research and was removed from SWGFAST's definition of individualization (SWGFAST Doc# 103

Knowns (Known Exemplars) - The prints of an individual, associated with a known or claimed identity, and deliberately recorded electronically, by ink, or by another medium (also known as known prints) (*SWGFAST Doc# 19*)

Lateral pressure – Pressure applied in a sideways manner as opposed to directly downward, during transfer of the impression onto the substrate. This can result in slippage or twisting and distortion of the impression

Lateral reversal - Impression may be flipped left-for-right, e.g. such as in some impressions on transparent tape *(NIST Special Publication 1151)*

Matrix - The substance that is deposited or removed by the friction ridge skin when making an impression (*SWGFAST Doc# 19*)

Open fields - Areas of continuous ridge flow where no individual ridge events are occurring

Plastic impressions - Created when the substrate is pliable enough at the time of contact to record the three-dimensional aspects of the friction skin. These impressions are formed when the raised friction ridges are physically pushed into the substrate, creating a mold of the friction skin ridge structure (*The Fingerprint Sourcebook. Chapter 7.1.1*)

Post deposition damage – Refers to damage occurring to the impression after deposition e.g. overlaying additional impressions onto the original impression, areas of the impression being removed through friction with other objects or environmental conditions having deleterious effects on the impression

Potential Value - A technical assessment that an impression has sufficient quantity and quality of friction ridge detail to proceed on to the ACE-V methodology. This decision is a utility decision and will be impacted PAP (Task Group Discussion)

Preservation method - Recording techniques, such as photography, lifting, live-scan, and ink.

Reliability (Reproducibility) - Refers to the confidence assigned by the examiner to the observed ridge features in terms of existence, location, and shape he or she would expect to be reproduced on the corresponding print, should it be made available. (SWGFAST Doc# 10)

Region of interest (ROI) - A single continuous friction ridge impression (*NIST Special Publication 1151)*

Resolution - Is measured in pixels and megapixels. The number of pixels that a camera catches in a single photograph is known and quantified as the resolution

Simultaneous impression - Two or more friction ridge impressions from the same hand or foot deposited concurrently (*SWGFAST Doc# 19*)

Skin condition of the donor - E.g., damage due to scars, warts, dryness, certain occupations involving physical labor, or illness.

Substrate - The surface upon which a friction ridge impression is deposited (*SWGFAST Doc# 19*)

Surface – See Substrate.

Specificity – As opposed to sensitivity, assessing the impressions intrinsic value, i.e. its capacity to discriminate against impressions from different individuals. Specificity is related to the between source variability, how features in impressions will vary when they are left by different sources (adapted from Champod). Also - Weighted Values and rarity (*SWGFAST Doc# 10*).

Sufficiency - The product of the quality and quantity of the objective data under observation (e.g., friction ridge, crease, and scar features) (*SWGFAST Doc# 19*)

Sufficient - The determination that there is sufficiency in a comparison to reach a conclusion at the evaluation stage (*SWGFAST Doc# 19*)

Suitable - The determination that there is sufficiency in an impression to be of value for further analysis or comparison (*SWGFAST Doc# 19*)

Support for exclusion/different source - The conclusion that the observations provide more support for the proposition that the impressions originated from different sources rather than the same source; however, there is insufficient support for a Source Exclusion. The degree of support may range from limited to strong or similar descriptors of the degree of support. Any use of this conclusion shall include a statement of the degree of support and the factor(s) limiting a stronger conclusion (*OSAC Standard for Friction Ridge Examination Conclusions, Draft*)

Support for identification/same source - The conclusion that the observations provide more support for the proposition that the impressions originated from the same source rather than different sources; however, there is insufficient support for a Source Identification. The degree of support may range from limited to strong or similar descriptors of the degree of support. Any use of this conclusion shall include a statement of the degree of support and the factor(s) limiting a stronger conclusion (*OSAC Standard for Friction Ridge Examination Conclusions, Draft*)

Takeaways (negative impressions) - The outcome of a contact between a finger and a substrate where material has been transferred from the surface to the finger, i.e. material has been selectively removed from the surface at the points of contact.

Target Group - A distinctive group of ridge features (and their relationships) that can be recognized (*SWGFAST Doc# 19*)

Technical Review - Review of notes, documents, and other data that forms the basis for a scientific conclusion (*SWGFAST Doc# 19*)

Type of features - Level 1 detail refers to the overall ridge flow. Level 2 detail refers to individual friction ridge paths, friction ridge events (e.g., bifurcations, ending ridges, dots, and continuous ridges), and their relative arrangements. Level 3 detail refers to ridge structures (edge shapes and pores), and their relative arrangements. Creases, scars, warts, incipient ridges, and other features may be reflected in all three levels of details.

Tolerance - The allowance of variation in appearance of friction ridge features (*due to the factors listed in reliability of Information*), that will be accepted during comparison, should the corresponding print be available (for example, High tolerances: generous allowances for variations) (*SWGFAST Doc #10*)

Tonal reversal - Indicates if all or part of the image is reversed tonally (black for white), (*NIST Special Publication 1151)*

Verification - Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (*ISO 9000: 2015)*

Verification (Blind) - The independent examination of one or more friction ridge impressions at any stage of the ACE process by another competent examiner who is provided with no, or limited, contextual information, and has no expectation or knowledge of the determinations or conclusions of the original examiner. (*SWGFAST Doc# 19*)

Wet ridges – When friction ridge skin is wet with perspiration or contaminants like blood, it is possible during the deposition onto the substrate, that the moisture is forced into the furrows, leaving the areas where the ridges make contact, with less matrix. This may result in a negative (Take away) impression.

Resources

Champod, C. Lennard, C., Margot, P., Stoilovic, M (2016). Fingerprints and Other Ridge Skin Impressions, Second Edition. Boca Raton, FL: CRC Press, Taylor & Francis Group

ISO 9000: 2015, Quality management systems — Fundamentals and vocabulary

NIST Special Publication 1151, Markup Instructions for Extended Friction Ridge Features, 2013: http://dx.doi.org/10.6028/NIST.SP.1151

SWGFAST Doc# 10, Scientific Working Group for Friction Ridge Analysis, Study, and Technology (SWGFAST). (03/13/2013). Document #10 Standards for Examining Friction Ridge Impressions and Resulting Conclusions

SWGFAST Doc# 10 (Draft), Standards for Examining Friction Ridge Impressions and Resulting Conclusions (Draft for Comment Only Section 5.3.2.3 (PAGE 4))

SWGFAST Document 19 (2012), Standard Terminology of Friction Ridge Examination (Latent/Tenprint), Ver. 4.0

SWGFAST Document #103, Individualization/Identification Position Statement

The Fingerprint Sourcebook. Chapter 7.1.1