Forensic Science and Identification Services (FS&IS)
Canadian Criminal Real Time Identification Services (CCRTIS)
Biometric Business Solutions (BBS)

Scanner Block Certification Specification

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Royal Canadian Mounted Police Gendarmerie royale du Canada

Canada

DISCLAIMER

The purpose of the specifications contained in this document is to enable law enforcement and other agencies to electronically connect via a standard interface to the RCMP National Police Services (NPS). Agencies that fully implement this specification will be able to capture and transmit finger/palm print and demographic data in a format compatible with the RCMP Real Time Identification (RTID), Canadian Criminal Real Time Identification Services (CCRTIS). Authorized agencies will be able to submit criminal, refugee and civil fingerprints for search against and possible storage in the RCMP National Automated Fingerprint Identification System (AFIS) database. Authorized agencies will also be able to initiate image request transactions.

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1 Introduction

This section describes the background and purpose of the Royal Canadian Mounted Police (RCMP) fingerprint image quality certification process.

1.1 Background and Purpose

Potential vendors of the RCMP Real Time Identification (RTID) system are required to undergo a verification process that examines their software application's ability to successfully meet the compliancy requirements of the National Police Services National Institute of Standards &Technology Interface Control Document (NPS-NIST-ICD) specifications. Vendors must complete NPS-NIST-ICD certification and meet Scanner Block Certification Specification requirements described in this document in order to be certified.

The RCMP pre-requisite is the Federal Bureau of Investigation (FBI) Electronic Biometric Transmission Specification (EBTS) Appendix F[1] conformity requirements regarding fingerprint image quality as captured on a scanner block. Specifically, reference is made to Section 2.6 of the FBI EBTS Appendix F certification under the caption of "Requirement – Fingerprint Artifacts and Anomalies:

> *"Artifacts or anomalies detected on the fingerprint images that are due to the scanner or image processing shall not significantly adversely impact support to the functions of conclusive fingerprint comparisons (identification or non-identification decision), fingerprint classification, automatic feature detection, or overall Automated Fingerprint Identification System (AFIS) search reliability."*

The RCMP's scanner block certification specification's additional image integrity requirements from a forensic perspective compliments and improves upon the FBI EBTS Appendix F certification.

> ***To ensure that the integrity of the fingerprint images stored within the National Fingerprint Database is maintained, the accuracy of the Automated Fingerprint Identification System is not compromised, and ultimately that the friction ridge images are of sufficient evidentiary value for court purposes.***

Therefore, prior to enabling a client to interface with RTID, their application software and associated scanner block must have successfully met the requirements of the RCMP image quality certification process.

The Automated Fingerprint Identification System (AFIS) digitally searches and stores fingerprint data. The AFIS is comprised of two subsystems; the tenprint subsystem for criminal, civil and immigration purposes and the latent subsystem for investigative purposes.

A Scanner Block is a fingerprint capture device that uses electronic digitizing technology to capture fingerprints or palm prints directly from a subject's hands.

An Electronic Fingerprint Capture Device (EFCD) is a device that uses electronic digitizing technology to capture fingerprints or palm prints in a digital image format.

[1] https://www.fbibiospecs.cjis.gov/Document/Get?fileName=Master%20EBTS%20v10%20-%20FINAL%2020130702.pdf

1.2 RCMP Image Quality Certification Process

The RCMP requires that each scanner block that captures fingerprint images (ten print rolled/plain, palm print and ID Flat) must undergo an in-depth forensic examination of the images it captures and processes. This forensic examination is conducted at the individual image level as represented in an associated NIST packet the application software creates. The forensic examination is conducted independently by two (2) Senior Fingerprint Examiners in isolation and subsequent examination results are then compared, compiled and the final results are tabulated in a spreadsheet.

Each image is examined against the potential anomalies listed in Section 4 Image Quality Evaluation and the results are documented accordingly. Images are also compared to ink and paper images of the same donor which are used as a baseline for comparison to the electronic images. Scanner blocks that introduce extraneous information or do not reproduce the friction ridges accurately may not be certified.

In order to qualify for RCMP Image Quality Evaluation a vendor must demonstrate that the prerequisites and requirements have been successfully met. Image quality evaluation will always be conducted at the RCMP in Ottawa, Ontario, Canada.

Once the NPS-NIST-ICD compliancy and Image Quality Evaluation is successfully completed, a Certification Letter will be issued based on the findings of the testing.

2 Requirements

This section describes the prerequisites for RCMP image quality certification and the vendor's responsibilities concerning the process.

2.1 FBI Certification

The vendor must have successfully completed NPS-NIST-ICD Certification of the EFCD system with the specified scanner block device(s).

2.2 RCMP NPS-NIST-ICD Certification

The vendor must have successfully completed NPS-NIST-ICD Certification of the EFCD system with the specified scanner block device(s).

2.3 Hardware and Software

The Vendor must provide a pre-configured computer with the same demographic and fingerprint capture software application(s) used during the NPS-NIST-ICD Certification along with the specified scanner block device(s) to the RCMP Forensic Science and Identification Services (FS & IS) in Ottawa, Ontario, Canada where it will be set-up and configured based on the vendor's direction and specifications.

The cost of shipping all necessary computer hardware and the scanner block device(s) to the RCMP in Ottawa and subsequent return, will be the responsibility of the vendor.

For testing purposes only, the vendor's software must provide the following functionality:

- Display the calculated NFIQ (NIST Fingerprint Image Quality) scores for each captured fingerprint in correlation to capture type:
  - Type-4: each of rolled fingers 01-10; left and right hand four finger plain based on fingerprint quality score of segmented plains; left plain thumb and right plain thumb.
  - Type-14: left and right hand four finger plain based on fingerprint quality score of segmented plains; segmented fingers 01-10 from left and right hand four finger plains; and left and right plain thumbs taken together.

- A method of easily extracting or exporting a compiled NIST format data packet consisting of the demographic information and WSQ formatted captured fingerprint images.
- A method to access the un-compressed and un-altered captured fingerprint image produced by the scanner block device in a human readable format (i.e.: 8-bit colour depth, square pixel, Windows bitmap or TIFF image format). The un-compressed fingerprint images are used to compare and identify any anomalies between the post-processed WSQ compressed image in the NIST packet generated by the vendor's software and the un-compressed image from the scanner block device.

2.4 Configuration Settings Document

The vendor must submit a completed Vendor Certification Scanner Device Configuration form for each scanner block device to BBS Certification prior to commencement of any testing.

2.5 Best Practices

The vendor must provide the Best Practices and the Operating Manual for their scanner block and software prior to any enrolment being performed.

3 Fingerprint Image Capture Process

3.1 Workstation

Once the workstation has been fully staged, the workstation will be configured to create and store a CAR-N and/or MAP-N transaction.

3.2 Image Capture

Twenty-five (25) RCMP individuals with varying finger size and quality will be fingerprinted electronically to create 14 Type-4 records, 4 or 6 Type-15 and/or 3 Type-14 records. The same individuals will participate whenever possible. The images will be captured using the vendor's best practices for capturing images. The same twenty-five (25) individuals will also provide inked paper copies of their fingerprints to be used for comparison purposes.

RCMP staff familiar with Livescan devices will enroll all twenty-five individuals. To maintain consistency, a single experienced enroller is assigned to enroll each candidate. The enrolment process will document at the finger level any instances where the image quality did not achieve required quality threshold levels and whether overrides needed to be engaged.

During the enrolment process, the operator will record observations and issues encountered. For example, if moisture is required, platen temperature, roll time, etc. The NFIQ (NIST Fingerprint Image Quality) scores will also be recorded for each finger. These observations may be associated to the operation of the software, the scanner block, or the quality of the subject's prints and may be referenced during the analysis process.

The NIST packet for each test case will be extracted from the workstation and labelled accordingly to align with the test case. Once the twenty-five test cases have been captured as NIST packets they will be delivered to RCMP Fingerprint Services for examination and analysis.

3.2.1 Rolled & Plain Images

Submissions with rolled and plain images can contain up to a total of fourteen (14) images; ten (10) rolled impressions of each individual finger (code 01 to 10), two (2) plain impressions of each individual thumb (code 11 & 12) and two (2) plain impressions of the four (4) fingers from each hand captured simultaneously (code 13 & 14). Rolled & Plain images are included as Type-4 records.

3.2.2 ID Flats

ID Flat submissions contain a total of three (3) images; two (2) plain impressions of the four (4) fingers from each hand captured simultaneously (code 13 & 14) and one (1) plain impression of both thumbs also captured simultaneously (code 15). This ICD requires that ID Flat images are included as Type-14 records. Coordinates for each individual finger segment position are required for each Type-14 record.

3.3 Additional Image Capture

During the analysis process, if any anomalies are identified that may have been introduced during enrolment, the Senior Fingerprint Examiners will request that those subject(s) have their fingerprints retaken by a different enrolment operator.

The operator will retake a total of five (5) sets of fingerprints from within the same twenty-five (25) test subjects.

4 Image Quality Evaluation

This section describes the image quality evaluation criteria, definitions, assessment measurement and findings.

4.1 Image Examination

Prior to any formal assessment of a set of electronic images, the fingerprint examiners will examine the ink and paper fingerprints of the donor and use those images as a baseline. This comparison will allow the examiners to determine whether the electronic image quality is consistent with the ridge detail on the inked prints. Finally, a report in the form of a spreadsheet will be sent back to Biometric Business Solutions with a final recommendation.

Due to the file format of the saved fingerprint impressions from scanner blocks, the examiners use the AWARE program for viewing the NIST impressions and the MS Windows Photo Viewer program for viewing the impressions produced on ink and paper. The ink and paper impressions are scanned at 1200dpi and saved in TIFF format.

Two (2) Senior Fingerprint Examiners will independently make observations during the analysis of the fingerprint images. These observations will be recorded for each fingerprint image using the criteria outlined below and compiled in a spreadsheet format. In order to ensure the evidentiary value for court purposes, the images are examined using the Friction Ridge Identification methodology - ACE-V (Analysis, Comparison, Evaluation, and Verification). This approach provides the examiner with a controlled and consistent guideline for the examination of fingerprints.

4.1.1 Analysis

Analysis of the ridge detail will allow the examiner to determine if anomalies are present in the fingerprint impression and if the anomalies are produced through user practices (e.g. roll method) or if the anomalies may have been produced by the scanner block solution itself.

4.1.2 Comparison

Comparison will allow the examiner to determine how accurately the scanner block solution reproduces the ridge detail from the subject to the substrate. The examiner will compare by following friction ridges in sequence from the scanner block produced impression to an impression produced using ink on paper from the same subject. The ink and paper impressions will be the examiner's baseline for comparison.

The comparison protocol addresses the three levels of detail described below;

- First level - overall pattern; presence of a ridge system
- Second level – major ridge path deviation; presence of bifurcations and ridge endings

- Third level – shapes of the ridge structures; edges and textures of the ridge detail; position/presence of pores on the ridge detail[2]

4.1.3 Evaluation

Evaluation of the physical measurements during comparison will allow the examiner to determine whether or not any of the anomalies found could pose a potential risk to the:

- integrity of the National Database
- accuracy and reliability of a search against the National Database and/or;
- reliability of the true likeness of the reproduced ridge detail to the actual ridge detail of a subject

4.1.4 Verification

The Verification stage will allow a second examiner to apply the same method or approach in order to support or refute the first examiner's findings. These two examiners will not consult prior to completing the image examination process in order to maintain an unbiased conclusion.

[2] www.ncjrs.gov/pdffiles1/nij/225320.pdf

4.2 Anomalies

An anomaly is defined as 'something that deviated from what is standard, normal or expected'; they are not a feature of the friction skin. With respect to fingerprint images, anomalies can negatively affect clarity, continuous agreement of ridges, and minutiae placement. Poor minutiae placement can negatively affect the AFIS Search for both Tenprint and Latent searches and can affect the forensic examiners ability to compare and identify fingerprint images.

Anomalies can be identified in both a pass and fail situation.

4.2.1 Ridge Stretching or Smearing

This anomaly occurs when there is stretching or smearing of the friction ridge detail. See Figure 1.

4.2.2 Unnatural Ridge Flow

This anomaly occurs when the friction ridge or ridges exhibit curvatures similar to waves which often involve a large area of the print. See Figure 2.

4.2.3 Ridge Misalignment

This anomaly occurs when the friction ridge path is offset or disconnected. This anomaly negates the continuous agreement of friction ridge characteristics in sequence. See Figure 3.

4.2.4 Ridge Count

This anomaly occurs when there is a disagreement in the number of friction ridge formations in sequence between two comparators. See Figure 4.

4.2.5 Image Centering

This anomaly occurs when any of the four sides are abruptly cut in a straight line. The images should be centered within the box. See Figure 5.

4.2.6 Pixelation

This anomaly occurs when the number of pixels per inch of the image are low and the individual pixels are apparent to the viewer. The entire image can be pixelated or only portions of the image. See Figure 6.

4.2.7 Grey Shading in Background Image

This anomaly occurs when an image displays a shadow of light grey behind the image itself or at the outer edges of the captured image. See Figure 7.

4.2.8 Blur Mask

This anomaly occurs when a firmware introduced overlay is applied to a region of the fingerprint image where potential distortion may exist within the friction ridges. See Figure 8.

4.2.9 Ridge Superimposition

This anomaly occurs when a fingerprint image displays duplicated, merging or overlapped friction ridges within the current image being analyzed which are not present in the plain impression or baseline inked impression. See Figure 9.

4.2.10 Dirty Platen

This anomaly appears when there are residual images or artifacts in the background of a captured fingerprint or outside of the captured image. See Figure 10.

4.2.11 Feathering

This anomaly appears as striations across ridges (similar to passing a dry brush over a wet canvas). See Figure 11.

4.3 Levels of Detail

Levels of detail in a fingerprint image are graded according to an internationally recognized scale (Organization of Scientific Area Committees (OSAC), Friction Ridge Subcommittee (FRS) formerly the (Scientific Working Group on Friction Ridge Analysis, Study, and Technology (SWGFAST), International Fingerprint Research Group (IFRG), and RCMP).

OSAC:

https://www.nist.gov/topics/forensic-science/organization-scientific-area-committees-osac

FRS:

https://www.nist.gov/topics/forensic-science/friction-ridge-subcommittee

Clarity of the impressions will dictate the levels of detail available for comparison as well as dictate the examiner's tolerance for discrepancies.

4.3.1 Level One

Refers to the overall pattern and shape of a print. Level One detail, on its own, is not used for identification purposes, but can assist in pattern classification, or narrowing down a search.

4.3.2 Level Two

Includes minutiae, such as ridge endings, bifurcations, enclosures that present themselves in the friction skin. Level two, in conjunction with Level One detail, can provide basic information for identifications.

4.3.3 Level Three

The shapes of the ridge structures. This level of detail encompasses the morphology (edges, textures, and pore positions) of the ridge. The features of third level details are unique in their shapes, sequences, and configurations.

4.4 Contrast

Contrast is measured in the ability of the device to capture friction skin and record pixel density levels with clarity. Clear contrast is when the ridges appear dark, and the furrows (spaces between the ridges) are much lighter or white. Poor contrast is identified when there is little differentiation between ridges and furrows. The higher the clarity, the easier it is for an AFIS system and examiner to differentiate ridges and the details within them. See Figure 12.

5 Compilation of Results

The following sections describe the ratings associated to the image analysis.

5.1 Frequency and Severity of Anomalies

Table 1 will be used to document the number of instances an anomaly has been observed within a subject's set of images. The severity of the anomaly will be documented as either "High", "Medium" or "Low".

Table 1 Anomalies

Criteria	Instances	Low	Medium	High
Ridge stretching or smearing				
Unnatural Ridge Flow (Wave)				
Ridge Misalignment				
Ridge Count				
Image Centering				
Pixelation				
Grey Shading				
Blur Mask				
Ridge Superimposition				
Dirty platen				
Feathering				

5.2 Levels of Detail Scoring

The overall 3rd level detail score is calculated by adding the individual scores for all fingers evaluated then dividing by the actual number of fingers scored. For example, the sums of all scores equals 36 and 14 images were evaluated for 3rd level detail then 36/14= 2.6. The minimum acceptable assessment score for 3rd level detail is 2.0.

This level of detail of the friction skin captured by the scanner block can be examined and compared to Ink fingerprints obtained from the donor.

Table 2 3rd Level Detail

Score	Description
3	3rd level detail fully visible and recorded
2	Moderate (2/3) of 3rd level detail visible
1	Poor (1/3) of print has 3rd level detail
0	No 3rd level detail visible

5.3 Contrast Score

The average contrast score is calculated by adding the individual scores for all images evaluated then dividing by the actual number of images scored. For example, if the sum of all scores equals 47 and 14 images were evaluated for contrast then 47/14= 3.4. The minimum acceptable assessment score for contrast is 2.0.

Table 3 Contrast

Score	Description
4	Clear contrast between ridges throughout print
3	Mostly clear (2/3) print contrast
2	Moderate clarity between ridges
1	Poor contrast between ridges
0	No contrast
N/A	Not applicable (Finger Number)

5.4 Assessment Results

The following table identifies the description of the assessment, the required minimum score and the score achieved.

Table 4 Average Achieved Scores

Description	Required Score	Achieved
3rd Level Detail	≥ 2.0	
Contrast	≥ 2.0	

6 Findings and Report

The findings of the overall evaluation will be compiled into a single report. The report will consist of the results of the analysis of the images captured.

Should the evaluation demonstrate that the scanner block does not meet acceptable image integrity, the vendor or integrator will be formally advised in writing and provided the opportunity to validate and rectify any concerns(s).

If the vendor or integrator addresses the anomalies identified in the report, subsequent testing and image evaluation will be conducted.

Appendix A Acronyms and Abbreviations

Table 5 Acronyms and Abbreviations

Acronym	Description
AFIS	Automated Fingerprint Identification System
BBS	Biometric Business Solutions
CCRTIS	Canadian Criminal Real Time Identification Services
CAR-N	Criminal (Tenprint submission) Retention No
EBTS	Electronic Biometric Transmission Specification
EFCD	Electronic Fingerprint Capture Device
FBI	Federal Bureau of Investigation (United States)
FRS	Friction Ridge Subcommittee
FS&IS	Forensic Science and Identification Services
IAFIS	Integrated Automated Fingerprint Identification System
ICD	Interface Control Document
MAP	Miscellaneous Applicant
NIST	National Institute of Standards and Technology (US)
NNS	National Police Services – National Institute of Standards and Technology (NPS-NIST) Server (RCMP – Transaction and workflow manager for RTID)
NPS	National Police Services
OSAC	Organization of Scientific Area Committees
RCMP	Royal Canadian Mounted Police
RTID	Real Time Identification System
TOT	Type of Transaction

Appendix B Examples of Artifacts and Anomalies

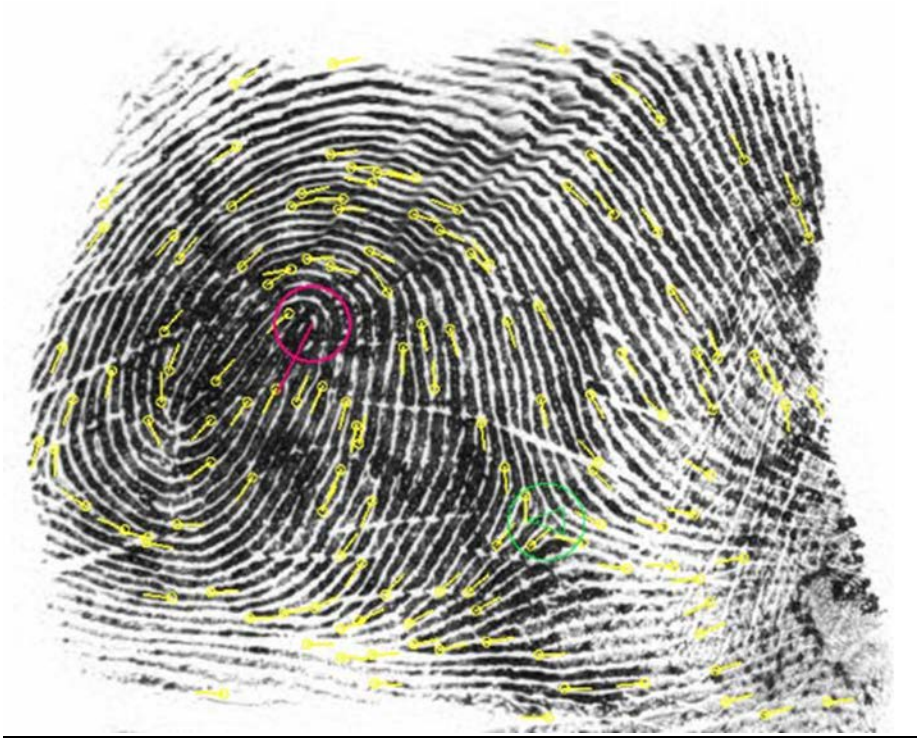

Figure 1 Friction Ridge Stretching or Smearing

Figure 2 Unnatural Friction Ridge Flow (Wave)

Figure 3 Friction Ridge Misalignment

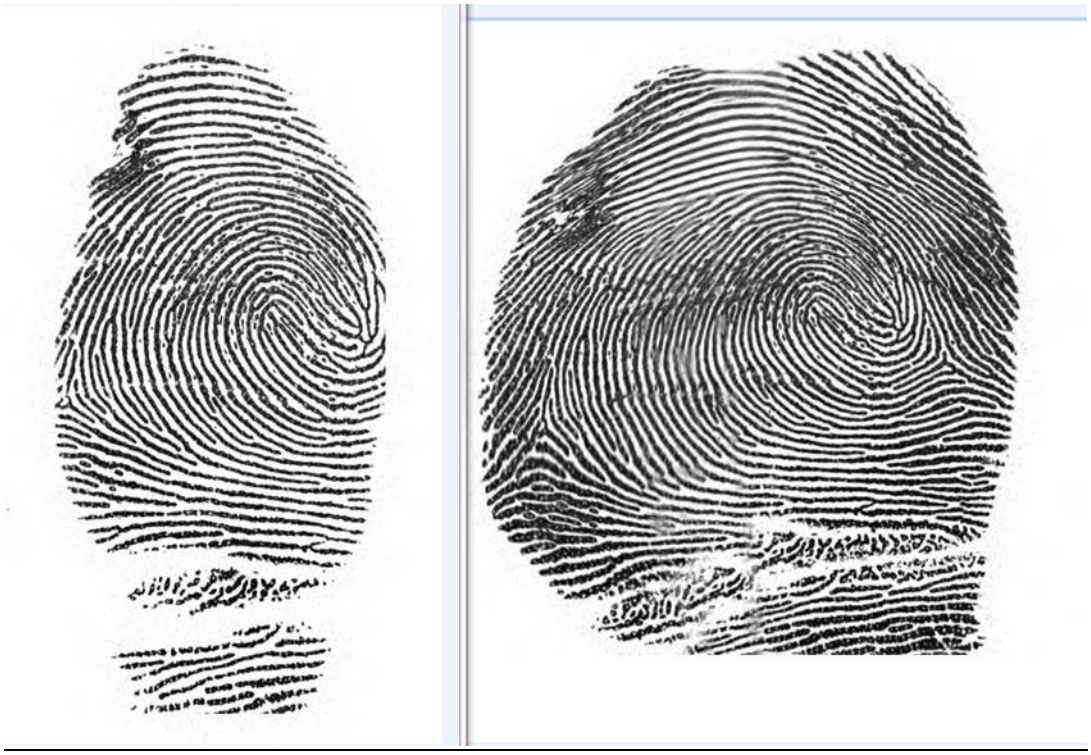

Figure 4 Ridge Count

Figure 5 Image Centering

Figure 6 Pixelation

Figure 7 Grey Background Shading

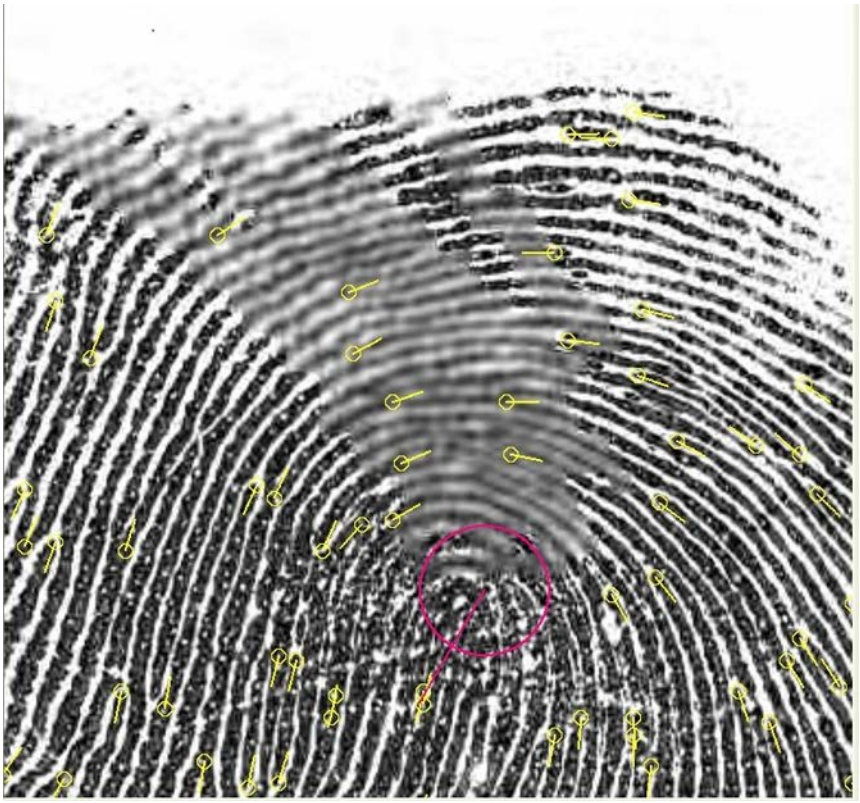

Figure 8 Blur Mask

Figure 9 Friction Ridge Superimposition

Figure 10 Dirty Platen

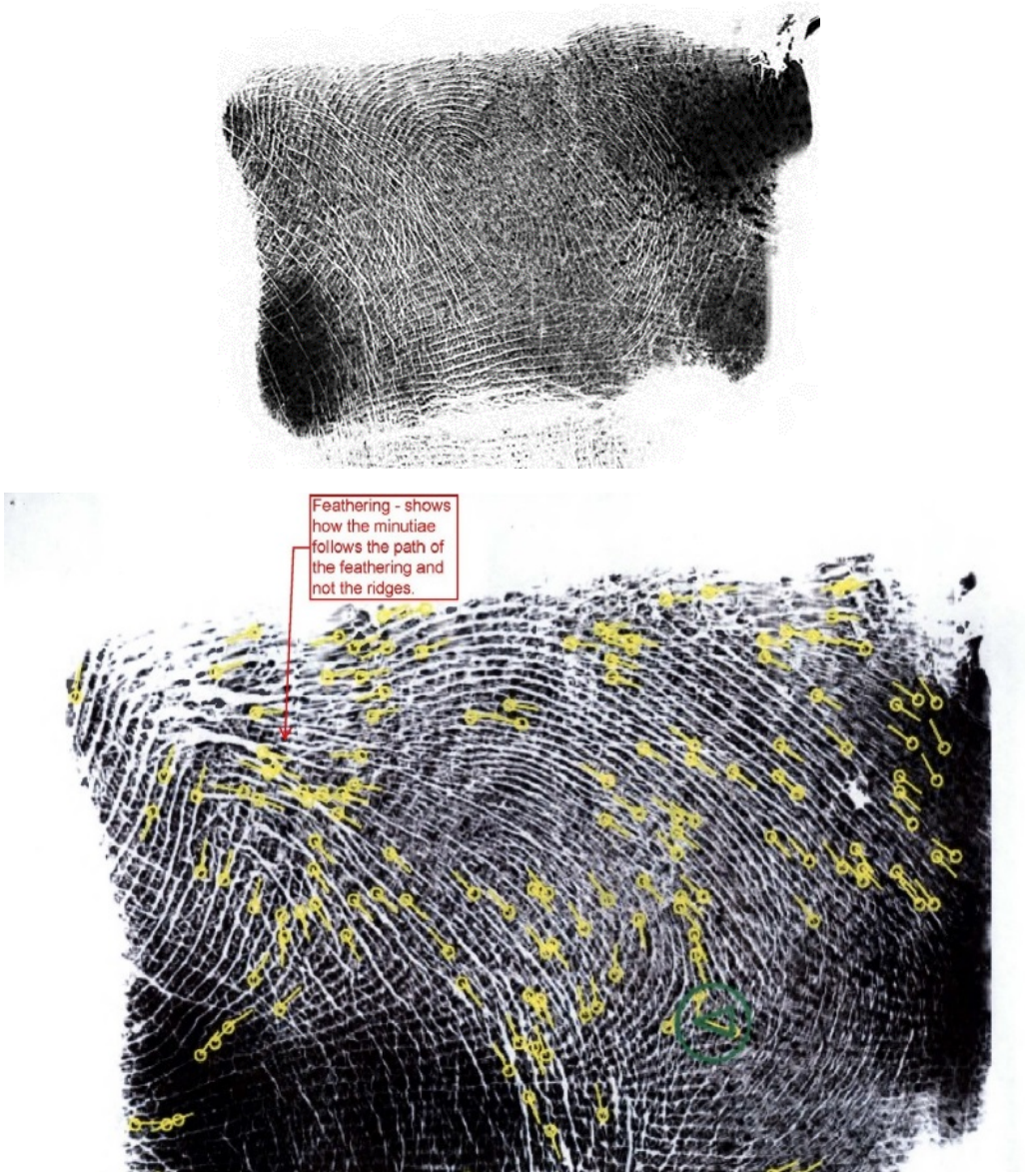

Figure 11 Feathering in Plain Impression

Figure 12 Poor Contrast