Friction Ridge Examiner Training

Contents

1. Scope

The purpose of this document is to provide Canadian Law Enforcement Agencies recommendations for friction ridge examiner training. The recommendations will promote consistency, improved practices, and will offer guidance in developing training plans, policies and guidelines.

2. Definitions

Forensic Identification Course (FIC): This course is designed to provide the fundamental forensic science theories, concepts, and skills essential for crime scene related casework. Areas of study include friction ridge examination, physical comparison, forensic photography, digital image processing, and various crime scene examination techniques.

Forensic Identification Service (FIS): a forensic identification entity providing forensic identification services.

Friction Ridge Examiner: an individual who has successfully completed their basic training program and has demonstrated to a Forensic Identification Service (FIS) that they possess the requisite knowledge, skills and abilities to perform the tasks required of their current position. An individual authorized to conduct friction ridge examinations for the FIS by observing and interpreting data, making decisions, forming opinions, issuing reports and/or providing testimony.

Known Fingerprint: an impression of friction ridges left from a finger, recorded under controlled conditions, where the source of the impression is known.

Proficiency Testing: an evaluation of an examiner's performance against pre-established criteria.

Unknown Fingerprint: an impression of friction ridges left from a finger where the source of the impression is unknown.

3. Introduction

Quality and consistency in training will improve the overall performance of friction ridge examiners[1]. Canadian friction ridge examiners are trained to competency via the Forensic Identification Course. The course (FIC) is delivered at the Canadian Police College (CPC), the Ontario Police College (OPC), and more recently by some Canadian law enforcement agencies.

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[1] AAAS, Forensic Science Assessments: A Quality and Gap Analysis- Latent Fingerprint Examination, (Report prepared by William Thompson, John Black, Anil Jain, and Joseph Kadane), September 2017.
DOI: 10.1126/srhrl.aag2874- Performance improves with training-in these studies, trained examiners performed significantly better (lower error rates) than trainees; Tangen et al., 2011; Thompson et al., 2013, 2014.

This document is not intended as a training plan and is not meant as a substitute for existing agency training. The recommendations will allow for flexibility, as each law enforcement agency tailors their training for their individual needs.

This document outlines the recommended minimum training required for friction ridge examiners. Friction ridge examinations are highly specialized tasks that require a continued education approach. CanFRWG is developing a continued education framework document.

Recommendations for pre-course (FIC) training are outlined in Appendix A. At a minimum an examiner should be given the time and resources required to complete any pre-course modules and or assignments. Assigning examiners to the FIS section prior to the FIC for a period of time will help the examiner prepare for and maximize their learning experience. The length of the assignment to the section will be dependent on an agency's policies, protocols and resources. A period of a minimum of 3 months is recommended.

In this document, the following verbal forms are used: "shall" indicates a requirement, "should" indicates a recommendation; "may" indicates permission; and "can" indicates a possibility or capability. (OSAC Articulation Guideline)

4.   Friction ridge examiner training

Friction ridge examiner training has been separated into the following modules:

1. History of fingerprints
2. Friction Ridge Skin
3. Fingerprint Patterns
4. Analysis, Comparison, Evaluation and Verification (ACE-V)
5. Probabilities and statistics
6. Photography and digital image enhancement
7. Unknown fingerprint development and enhancement processes
8. Expert witness testimony

There are recommended reading reference lists for each module. The reading reference lists are to be considered as an introduction to the topic and additional reading is recommended.

4.1. **History**

Friction ridge examiners should have a basic understanding and knowledge of the history of fingerprint analysis and comparison. This includes early pioneers, the history of friction ridge skin scientific research and the evolution of the fingerprint discipline. An examiner should have knowledge of:

- Early use of friction ridges
    - Trademarks found in ancient pottery
    - Trademarks found in clay used on legal contracts
    - Finger seals used in China for the sealing of documents
- Early pioneers and researchers and their contributions

- o Nehemiah Grew
- o Marcello Malpighi
- o J.C.A. Mayer
- o Johannes E. Purkinje
- o Edmond Locard
- o Inez Whipple
- o Harris Hawthorne Wilder
- o William Herschel
- o Henry Faulds
- o Alphonse Bertillon
- o Francis Galton
- o Edward Richard Henry
- o Juan Vucetich
- o Harold Cummins
- o Alfred Hale
- o Michio Okajima
- o William Babler
- History of ACE-V
  - o Roy Huber
  - o Dave Ashbaugh

Recommended reading

Ashbaugh, David R. Quantitative-Qualitative Friction Ridge Analysis. Chapter II –History of Friction Ridge Identification. Boca Raton: CRC Press, 1999.

Barnes, J. Chapter 1-History, in The Fingerprint Sourcebook. Ed. Himpton, E.H., Robinson, L.O., Laub, J.H. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

Cole, Simon, Suspect Identities. A History of Fingerprinting and Criminal Identification. Harvard University Press.

4.2 Friction Ridge Skin

Examiners need to understand the premises of discriminability and persistence of friction ridge skin that allow for the use of friction ridge impressions as a means of identification. Examiners should develop an:

- Understanding of the anatomy, physiology and the embryological development of friction ridge skin. Such as:
  - o Embryological development
  - o Physiology of friction ridge skin
  - o Primary ridges
  - o Secondary ridges
  - o Papillary pegs
  - o Pores and pore ducts
  - o Cellular mitosis
  - o Anatomical structures supporting persistence of friction ridge skin features

- ▪ Desmosomes
- ▪ Hemidesmosomes
- ▪ Basement membrane
- ▪ Dermal papillae
  - o Changes due to damage
    - ▪ Permanent scars
    - ▪ Transient features (e.g. warts wrinkles)
    - ▪ Effects of aging

<u>Recommended reading</u>

Babler, W. Embryonic Development of Epidermal Ridges and Their Configurations. Birth Defects: Original Article Series. 1991, 27(2), 95-112.

Maceo, A., Casey, W. Chapter 2- Anatomy and Physiology of Adult Friction Ridge Skin and Chapter 3- Embryology and Morphology of Friction Ridge Skin, in The Fingerprint Sourcebook. Ed. Himpton, E.H., Robinson, L.O., Laub, J.H. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

Maceo A.V. Qualitative Assessment of Skin Deformation: A Pilot Study. Journal of Forensic Identification, 390 / 59 (4), 2009

4.3 Fingerprint Patterns

- • Friction ridge examiners should be able to classify fingerprints based on the accepted North American definitions.

<u>Recommended reading</u>

CanFRWG Definitions for Friction Ridge Comparison. 2022-12.

SWGFAST Document #19 Standard Terminology of Friction Ridge Examination (Latent/Tenprint). Ver. 4.1, 03/14/13.

4.4 ACE-V

Examiners should have a comprehensive understanding of the ACE-V process and be able to demonstrate the proper application of ACE-V.

4.4.1 Analysis (A)

- • Understand and demonstrate the ability to analyze an unknown friction ridge impression, based on, but not limited to the following factors:
  - o The proper orientation of fingerprints, palm prints, and plantar impressions.
  - o The three main areas of the palm.
  - o Suitability assessments to determine if a friction ridge impression is suitable to continue to the comparison phase.
  - o Prior to the comparison, assess the following factors and any effects they may have on the unknown fingerprint.
    - ▪ Anatomical factors

- Substrate
- Matrix
- Development method
- Deposition pressure
- Lateral distortion
- Clarity and tolerance

- Understand the importance of documenting the analysis. CanFRWG recommends the use of the ACE-V electronic form
- Understand the importance of documenting the features observed at the analysis phase. CanFRWG recommends the GYRO method of annotating friction ridge impression features.
- Feature recognition and selection

4.4.2 Comparison (C)

- Understand and demonstrate the ability to perform a comparison of an unknown to a known fingerprint, using proper practices:
  - Target group
  - Selecting a starting point
  - Ridge to ridge in sequence
  - Use of tolerance to assess similarities and dissimilarities
  - Annotating the features in agreement during the comparison

4.4.3 Evaluation (E)

- Understand and demonstrate the ability to reach correct conclusions at the evaluation phase, taking into account the following factors:
  - Weighting the value of friction ridge features and feature configurations
  - Pattern force
  - Conclusion scale

4.4.4 Verification (V)

- Understand the importance of having ACE opinions verified
  - Open verification
  - blind verification

<u>Recommended reading</u>

Ashbaugh, David R. Quantitative-Qualitative Friction Ridge Analysis. Chapter II –History of Friction Ridge Identification. Boca Raton: CRC Press, 1999.

Langenburg, Glenn (2017) Addressing potential observer effects in forensic science: a perspective from a forensic scientist who uses linear sequential unmasking techniques, Australian Journal of Forensic Sciences, 49:5, 548-563, DOI: 10.1080/00450618.2016.1259433

4.5 Probabilities and statistics

Fingerprint examiners analyzing and comparing unknown fingerprints to known fingerprints report opinions based on the balance of probabilities between two competing propositions. Proposition 1, the

impressions were made by the same source versus proposition 2, the impressions were made by different sources. An identification is an examiner's opinion that there is sufficient agreement between the two impressions to conclude that they were made by the same source.

As such, the reported conclusions are not statements of fact, but rather an examiner's opinion based on their knowledge, training, and experience. That opinion carries a degree of uncertainty and examiners need to understand and explain the probability of error and some of the following concepts.

- Probability basics
  - Definition
  - How to calculate probabilities
  - Conditional probabilities
    - Sensitivity
    - Specificity
    - False Positive Rate
    - False Negative Rate
    -
- Error rates
- Basic understanding of statistical models
  - AFIS based likelihood ratio
  - Feature based likelihood ratio
  - FRstat

Recommended reading

Hockey, D.; An Introduction to Error rates

Ulery, B. T.; Hicklin, R. A.; Buscaglia, J.; Roberts, M. A. Accuracy and Reliability of Forensic Latent Fingerprint Decisions. PNAS 2011, 108 (19), 7733–7738.

Pacheco, I.; Cerchiai, B.; Stoiloff, S. Miami-Dade Research Study for the Reliability of the ACE-V Process: Accuracy and Precision in Latent Fingerprint Examinations; NCJRS Doc. No. 248534, Dec, 2014.

4.6 Photography and digital image enhancement

Canadian friction ridge examiners are often expected to photograph friction ridge impressions, using photographic theory and forensic protocols. At a minimum, examiners photographing friction ridge detail should have a basic understanding of;

- How digital images are captured
- Shooting modes (i.e. aperture priority)
- Metering modes
- Factors that affect exposure
  - ISO
  - Aperture
  - Shutter speed
- Depth of field
  - Increasing depth of field

- Macro photography
- Photographing with a forensic light source
    - Visible light spectrum
    - Excitation filters
    - Barrier/viewing filters
- Demonstrate the ability to photograph friction ridge detail
    - Using overall, midrange, close-up, and as close as possible (ACAP)
    - Include appropriate scales/rulers in the photos

Unknown fingerprints, captured via a digital camera and/or scanner, may require some digital processing to improve contrast and or convert the ridge detail to "black" on a "white" background. Although there are a number of software programs available, Examiners should have an understanding of;

- Raster images
- Pixel properties
- Resolution
- Resizing
- Resampling
- Colour modes (RGB, CMYK, Grayscale)
- Image compression
    - Lossy
    - Lossless
- File formats
    - Jpeg
    - Tiff
    - raw

Demonstrate the ability to;

- Calibrate images 1/1
- Use different color modes to select the color channel that provides the best contrast
    - RGB
    - CMYK
- Convert white or colored ridges to black
- Use levels, or a similar tool, to help increase contrast by adjusting the shadows, midtones, and highlights,
- Sharpen images as needed.
- Create demonstrative exhibits that includes, but is not limited to, a fingerprint chart

Recommended reading

CPC Basic Digital Manual 2022 Part 2 Chapters 1 and 2.

Dalrymple, Brian. Smith, Jill. Forensic Digital Image Processing Optimization of Impression Evidence. CRC Press Taylor & Francis Group. First Edition 2018

Duncan, Christopher. Advanced Crime Scene Photography Second Edition. CRC Press Taylor & Francis Group.

4.7 Unknown fingerprint development and enhancement processes

Not all friction ridge examiners are expected or required to process and develop friction ridge impressions, however, all examiners need to understand the effects of the development process on the friction ridge detail. This is essential to the examiner's ability to analyze friction ridge detail. Be familiar with processing, development and preservation methods:

- o   How the methods are applied.
- o   The sequential order of the methods.
- o   The properties of the latent print residue, substrate, and or method that facilitate the development of the friction ridge impression
- o   The impact of method(s) on the appearance of the friction ridge impression.
- Examiners who are expected to process and develop friction ridge impressions need to demonstrate through practical exercises;
  - o   An ability to recognize the impact on the appearance of the friction ridge detail due to the various development processes.
  - o   An ability to properly apply the methods
  - o   How to use controls (positive and negative) to test the efficacy of chemicals or chemical solutions.
  - o   How to properly prepare chemicals and solutions.
  - o   Ability to follow relevant health and safety considerations;
    - ▪   Handling and storage of chemicals
    - ▪   Proper interpretation of Safety Data Sheets (SDS)
    - ▪   Proper use of ventilation (fume hoods)
    - ▪   Proper use and maintenance of eye wash stations and personal safety showers
    - ▪   Proper use and maintenance of personal protective equipment (PPE).

Recommended reading

Yamashita, Brian; French, Mike. Friction Ridge Sourcebook. Chapter 7 - in The Fingerprint Sourcebook. Ed. Himpton, E.H., Robinson, L.O., Laub, J.H. Washington, DC: U.S. Dept. of Justice, Office of Justice Programs, National Institute of Justice, 2011.

Home Office Centre for Applied Science and Technology (CAST). Fingerprint Visualization Manual. Centre for Applied Science and Technology (CAST), London, 2014

Champod, Christophe et al. Fingerprints and Other Ridge Skin Impressions (2nd Edition). Chapter 4. CRC Press, Boca Raton, 2016.

4.8 Legal issues

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Examiners are often called to testify as subject matter experts in the analysis and comparison of friction ridge impressions. As such, examiners need to have an understating of courtroom etiquette, qualification and admissibility, and any other areas of knowledge that have reasonable potential to be referenced during expert testimony. At a minimum, examiners should be able to demonstrate a general understanding of the following topics:

- How to construct a curriculum Vitae (CV)
- The meaning of voir dire and how to properly respond to qualifying questions
- Demonstrate how to prepare for and request pre-trial interviews
- Legal admissibility standards
    - Sec 657.3 CCC
    - R v Mohan
    - R v Abbey 2009
    - White burgess
- Notable Errors in Fingerprint-Related Cases
    - SCRO erroneous identification to Shirley McKie (1999)
    - FBI erroneous identification to Brandon Mayfield (2004)
- Expert testimony. Articulating the following subjects as they pertain to friction ridge examinations
    - Describe the ACE-V process
        - The analysis
        - How to conduct a comparison
        - The evaluation phase and the conclusion scale
        - Verification
            - Open verification
            - Blind verification
    - Describe the types of errors
        - Erroneous identification
        - False negative Erroneous exclusion
    - Describe the limitations of friction ridge examinations
    - Describe the types of bias that can impact judgement during friction ridge examinations
    - Describe strategies implemented to reduce the potential impact of bias
    - Describe the influence of quantity, quality, and rarity of features during friction ridge examinations

Recommended reading

National Academy of Sciences. Strengthening Forensic Science in the United States: A Path Forward. Pages 1-53, 136-145. National Research Council. 2009

Steele, Lisa J. The Defense Challenge to Fingerprints. Criminal Law Bulletin 40(3), 213- 240. 2004

Edmond, Gary, et al. A guide to interpreting forensic testimony: Scientific approaches to fingerprint evidence. Law, Probability & Risk. 13(1): 1-25. Oxford Academic. 2013

Executive Office of the President, President's Council of Advisors on Science and Technology (PCAST), Panel on Forensic Science, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, September 2016.

Executive Office of the President, President's Council of Advisors on Science and Technology (PCAST), Panel on Forensic Science, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods; Addendum to 1st edition September 2016, January 2017.

Richard, David. Expert Witness Testimony– A Guide for the Canadian. Identification Canada, Volume 41 No. 3 2018

Appendix A Pre-Forensic Identification Course training recommendations

Candidates registered for a FIC would benefit from some familiarity with:

- Health and safety recommendations and appropriate legislation
- Operating in a windows environment, including copying and pasting folders and documents
- General file management
- Introduction and some familiarity with the software programs used on the Forensic Identification Course, including, but not limited to;
  - Adobe® Photoshop® (30-day free trial is available)
  - CSIpix® forensic comparison software (30-day free trial is available)
  - Microsoft word®
  - Adobe Acrobat®
- Familiarity with the basic functions of digital cameras.
  - Exposure modes
  - Metering modes
  - Focus modes
  - Changing lenses
  - Downloading images and basic file management of images
- Familiarity with basic photography theory and skills
  - Depth of field
  - ISO
  - Shutter speed
  - Aperture
- Fingerprint pattern definitions
- Early discovery and uses of friction ridges
- Early pioneers, researchers and their contributions
- History of ACE-V
- Application of fingerprint powders
- Any other training recommended by the FIS