Crime Laboratory Division

Washington State Patrol

Materials Analysis
Impressions Training Manual

September 2023

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1 INTRODUCTION

1.1 PURPOSE AND SCOPE

This manual provides the outline for the Impressions training program. It is designed to provide the trainee with the scientific, technical and other specialized knowledge, skill, and experience required to perform independent casework under the Impressions discipline as laid out in the Materials Analysis Technical Procedures (MATP).

1.2 MANUAL ORGANIZATION

Each chapter covers core concepts essential for Impressions casework. These concepts include:

- Impression formation
- Evidentiary value of impressions evidence
- History of Impressions as a forensic discipline
- Terminology
- Manufacturing of footwear and tires
- Lifting and casting impressions
- Chemical enhancement of impressions
- Photography and scanning impressions
- Image processing and software
- ACE-V (assessment, comparison, evaluation, and verification)
- Test impressions and feature reproducibility
- Make/model searches for footwear and tires
- Human factors related to impressions casework
- Legal considerations related to impressions casework
- Mock Casework (following the MATP)

In general, each chapter should be covered in the order presented. Specific points related to tires and tire tracks are separated out within each chapter to allow for different training approaches (see section 1.4 Training Plan).

Each chapter is organized into the following five parts:

- Objectives – a list of the goals for each chapter.
- Topic Areas – a list of subjects and vocabulary that will be covered during training
- Readings – the list of minimum required readings to complete the training.
- Study Questions – a series of questions to ensure comprehension and encourage discussion
- Practical Exercises – a set of hand-on activities to develop first-hand experience

1.3 QUALIFICATIONS

The trainee shall have successfully completed the Foundation Training Manual and the following chapters from the Instrument and Techniques Training Manual: Evidence Recovery, Imaging and Visualization, and Microscopy (Basic). A refresher of instruments and techniques may be considered if the trainee does not routinely use these techniques in the current authorized casework subdisciplines.

The trainer must be a qualified analyst in the Impressions Discipline. The trainer should have sufficient experience to cover the variety of possible evidence submissions, scenarios that are encountered, and courtroom testimony in the discipline. The trainer must have a thorough understanding of, and follow, the applicable discipline/area procedures and the policies and procedures of the laboratory/division.

The trainer may delegate specific chapters or content to be taught by other instructors. Such instructors must have sufficient experience to cover the variety of possible evidence submissions and scenarios that are encountered in the area that they are going to instruct and a thorough understanding of the applicable procedures and policies of those topics. The trainer shall approve the qualifications of any instructors.

1.4 TRAINING PLAN

A training plan will be developed and approved as outlined in the QOM.

The training plan should include which of the following training approaches will be used. The choice of training approach shall be determined by the trainer in consultation with the technical lead and the trainee's supervisor. Possible approaches include performing footwear and tire training simultaneously, or performing footwear first with tire training after. Either method allows for modification as determined by the trainer and trainee in consultation with the technical lead and the trainee's supervisor during the course of the training period.

Trainees who demonstrate prior related training and experience may be able to progress through the training program at an accelerated pace or skip certain content based on the evaluation of the trainee. Adjustment of the training plan based upon the trainee's prior related training and/or experience will be left to the technical lead in consultation with the trainer and trainee's supervisor.

1.5 EXPECTATIONS

The trainee will maintain a notebook (and/or digital equivalent) throughout the duration of the training program and will record notes and observations for each study segment, including answers to study/discussion questions/exercises and documentation of completion of practical and competency exercises. The training notebook should be maintained in a neat, organized, and current fashion and should be available for review upon request.

The trainee is encouraged to take outside courses in Impression analysis and related techniques (e.g. photography, Photoshop, etc.) when possible. Notes from such external training events shall be kept as part of the training records.

The trainer should create a learning environment that serves to continuously improve the discipline. Such resources shall include the following:

- Knowledge of all applicable laboratory policies and procedures regarding this discipline
- Training and reference materials available internally and externally
- Organizations and courses that facilitate professional development
- Participation in research, local organization, give a poster presentation, etc.
- Participation in training events for other colleagues, law enforcement partners, etc.

The trainer will continuously evaluate the trainee throughout the training for the trainee's comprehension and competency in their knowledge, practical skills, and critical thinking skills. Training is progressive and continuously builds on and reinforces prior learning. Unacceptable training progress may occur during the course of the training. It is important that any such instances be openly and promptly addressed among the trainee, the trainer, the technical lead, and/or the trainee's supervisor, as appropriate. An appropriate course of action should be developed and implemented to move training progress back to acceptable status.

1.6 TRAINING COMPLETION

In order to successfully complete this training program the trainee must, after completion of all subject areas required based on the training plan, successfully complete a closed book written exam passed with 80%, a competency exam passed with a pass/fail, and an oral testimony exam with a pass/fail. The

content of these exams will be overseen by the technical lead in consultation with the trainer and the trainee's supervisor. The competency exam will take the form of a mock case, which will include a draft report. The oral testimony exam may be either a full moot court or an oral examination of testimony type questions.

The completion of these steps will be documented on a training checklist worksheet. An example of a training checklist worksheet is provided at the end of this manual. Other example checklists may be available in electronic format.

Upon satisfactory completion of the above exams, the trainee will be signed off to perform casework in accordance with the QOM. Supervised casework is optional and dependent on the trainee's repertoire of subdisciplines as well as performance on mock casework. The number of supervised case requests shall be determined by the technical lead in consultation with the trainer and the trainee's supervisor. Final approval for independent casework, technical review, and for conducting verifications will be determined by the technical lead in consultation with the trainer and the trainee's supervisor.

1.7 TRAINING RECORDS

Training records, including training IOCs and authorizations, will be maintained in accordance with the QOM. Individual scientists are strongly encouraged to maintain copies of their own training records and their training notebook(s).

1.8 QUALITY ASSURANCE

This training manual, including related umbrella documents where applicable, complies with the following external document:

- ANSI/ASB Standard 095 (First Edition – 2020): Standard for Minimum Qualifications and Training for a Footwear/Tire Forensic Science Service Provider (https://www.aafs.org/academy-standards-board).

2 IMPRESSION FORMATION AND EVIDENTIARY VALUE

2.1 OBJECTIVES

- To have a historical perspective concerning footwear and tire track evidence
- To understand the value of footwear and tire track evidence in criminal investigations including how impression evidence has been used successfully in cases
- To understand how impressions are formed
- To understand the factors and variables that will affect impression formation appearance
- To have a general understanding how crime scene responders search and recover impression evidence, and how that impacts what is submitted to the lab for analysis.
- To successfully use basic lighting techniques to visualize impressions

TIRES

- Same as above

2.2 TOPIC AREAS

1. History
2. Value of footwear and tire evidence
   a. Case studies
3. Impression formation
   a. Positive / negative
   b. 2D / 3D
   c. Latent / visible
   d. Dry origin / wet origin
   e. Distortion / overlapping
4. Impression detail variation
   a. Matrix
   b. Substrate
   c. Impression dynamics
5. Impression age
6. General crime scene search and recovery of impression evidence
   a. Lighting techniques
   b. Search methods

2.3 READINGS

☐ ANSI/ASB Standard 095 **(current edition)** Standard for Minimum Qualifications and Training for a Footwear/Tire Forensic Science Service Provider.

☐ ASB Technical Report 051 **(current edition)** Scope of Work for a Footwear/Tire Examiner.

☐ Bodziak WJ **(2000)** *Footwear Impression Evidence: Detection, recovery, and Examination*, 2nd ed., CRC Press; Boca Raton [read chapters 14 and 15].

☐ Bodziak WJ **(2017)** *Forensic Footwear Evidence: Practical Aspects of Criminal and Forensic Investigations*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 1 and 19].

- ☐ Hilderbrand DS and D'Amour L **(2020)** *Footwear, The Missed Evidence: A Guide to the Documentation, Collection, and Preservation of Forensic Footwear Evidence*, 4rd Ed., Independently published [read chapters 2, 4, 5, and 6].
- ☐ Hilderbrand D **(1995)** "Footwear, The Missed Evidence," Minutiae, Nov-Dec 1995, pp. 2-5.
- ☐ Saferstein R **(2004)** *Criminalistics: An Introduction to Forensic Science*, 8th Ed., Pearson Education Inc. [read chapter 15 section "Other Impressions"].
- ☐ Snyder C **(2015)** "The ability of footwear to produce impressions of good detail in sandy soil substrates" *Journal of Forensic Identification* 65(3): 273-288.

TIRES

- ☐ Bodziak, WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 13 and 14].
- ☐ Hamm ED **(1975)** "Tire tracks and footwear identification" *Identification News* 25(1): 3-6.
- ☐ McDonald P **(1989)** *Tire Imprint Evidence*, CRC Press; Boca Raton [read chapters 15 and 16].
- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read chapter 1].

2.4 STUDY QUESTIONS

1. What can footwear and tire impressions provide to a criminal investigation? Give specific examples.

2. How long has footwear impression evidence been recognized as having value in an investigation? Describe how it was used in some specific examples.

3. The investigative value of footwear and tire evidence is greatest during the first _____ of the investigation.

   a. Hours
   b. Days
   c. Weeks

4. Is it possible for partial shoe impressions to have evidential value? Explain.

5. Explain several reasons why footwear and tire impression evidence is often neglected or overlooked.

6. Describe the different ways that impressions can be formed.

7. Describe a couple of examples when information about the age of a footwear impression can, and cannot, be inferred from the evidence. Explain why this information might be important.

8. What are two reasons for keeping a crime scene log documenting all people that enter a scene, from an impression analyst's perspective?

9. Describe some general crime scene search techniques to successfully locate impression evidence.

2.5 PRACTICAL EXERCISES

Note: Time practical exercises (marked with *) should not delay completion of this chapter.

1. Review the content of the following references. Then, discuss with your trainer the value of the following references that were important to the development of the Impression discipline:
   a. Cassidy MJ **(1980)** *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Canadian Government Publishing Centre.
   b. Abbott JR **(1964)** *Footwear Evidence*, Charles C Thomas, Springfield, Illinois, USA.

2. Obtain a pair of shoes. If there are not already small and medium sized randomly acquired characteristics on the outsoles, purposely place some with the help of your trainer. Wear the shoes regularly over the course of the training and repeat the following actions at approximately 1 month intervals*:
   a. Image the outsole
   b. Make a test impression of the outsole

3. Create different types of impressions on various substrates using a footwear outsole. With your trainer, observe the features of the outsole and impressions. Document how those features imprinted and varied in the formed impressions. Additional, different types of outsoles should also be used.

   Note: the formed impressions may be saved for future chapter practicals related to recovery, and imaging (Chapters 5 and 7).

   a. Two dimension impressions
      i. Transfer - wet origin impression with varying amounts of mud/soil
      ii. Transfer – dry origin impression with dust
      iii. Transfer – dry origin impression with dry soil
      iv. Transfer - wet origin impression using outdoor ground water on a relatively clean substrate (e.g. non-visible impression)
      v. Negative impression in dust or other dirty substrate
   b. Three dimensional impressions
      i. In various types of soil
      ii. In snow (when possible)
      iii. In a mud puddle
   c. Complex impressions
      i. Overlapping impressions
      ii. Smeared / distorted impression
      iii. Impression on substrate with interfering objects (e.g. large rocks in fine soil, small twig or scattered sand on floor, etc.)

   Recommended Substrates
   - Tile
   - Vinyl flooring
   - Cement / asphalt
   - Wood floor / wood door
   - Paper / cardboard
   - Glass piece / window
   - T-shirt / fabric
   - Vehicle exterior
   - Carpet
   - Soil

4. Make diminishing series of bloody impressions with the same outsoles on the following surfaces. With your trainer, observe the features of the outsole and document how those features imprinted and varied in the formed impressions.

   a. Flat (little to no texture)
   b. Low pile / loop carpet
   c. Concrete or asphalt

   Compare the marks in the series, in terms of visible characteristics and features, and describe the differences observed between the different surfaces. Save at least one series for chemical enhancement (Chapter 6).

5. Place several of the created impressions in different environments and allow them to be exposed to different conditions for different amounts of time*. Document those conditions and the resulting effects on the impressions.

6. Experiment with and demonstrate how lighting techniques can be used to visualize impressions using the created impressions.

TIRES

7. Select a vehicle tire and drive over wet soil, then over a piece of posterboard or similar material. With your trainer, observe the features of the tire impression and document how the tire tread features imprinted. Repeat at approximately 1 month intervals.

8. Using the same vehicle tire, drive over wet soil and create a 3D impression. Observe the features of the tire impression with your trainer and document how the tire tread features imprinted. How do they vary from the 2D impression?

9. If possible, observe the above tire impressions (created in exercises #7 and/or #8) over time and document how they change and under what conditions*.

3 TERMINOLOGY

3.1 OBJECTIVES

- Understand the terms associated with footwear and tire impression evidence
- To appropriately use terminology related to some aspects related to the Impressions discipline (see 3.2 Topic Areas)
- To understand the synonymous terms and terminology differences related to the Impressions discipline

TIRES

- Same as above

3.2 TOPIC AREAS

1. Terminology related to:
    a. Footwear outsole features
    b. Examination and conclusion terms
    c. Professional organizational terms
    d. Tire tread features
        i. Rib, groove, etc.
    e. Tire features
        i. Wheel, tire, lug, etc.
    f. Types of tire tread design
        i. All Season, All-Terrain, etc.
2. Synonyms
3. Terminology differences

3.3 READINGS

☐ ASB Technical Report 097 **(current edition)** Terminology Used for Forensic Footwear and Tire Evidence.

☐ Bodziak WJ **(2017)** *Forensic Footwear Evidence: Practical Aspects of Criminal and Forensic Investigations*, CRC Press (Taylor & Francis Group); Boca Raton [read "Glossary"].

☐ Hilderbrand DS and D'Amour L **(2020)** *Footwear, The Missed Evidence: A Guide to the Documentation, Collection, and Preservation of Forensic Footwear Evidence*, 4rd Ed., Independently published [read "Glossary of Terms"].

☐ NIST OSAC Lexicon website **(current edition)** "OSAC Preferred Terms" (https://www.nist.gov/organization-scientific-area-committees-forensic-science/osac-lexicon).

TIRES

☐ Bodziak WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 1, 7 (pages 157-172), and Glossary].

☐ McDonald P **(1989)** *Tire Imprint Evidence*, CRC Press; Boca Raton [read chapters 1, 2, 5, and Glossary].

- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read chapters 7, 8, and 9].
- ☐ Nause LA **(1982)** "Tire impressions as evidence" *R.C.M.P. Gazette* 44(12): 11-27 (Reprinted in *Identification Canada*, July/October 1985, Vol 8(3/4): 8-15).

3.4 STUDY QUESTIONS

1. Define numerous terms related to the Impression discipline provided by your trainer; examples are provided below. If significant conflicting definitions are found for any of the terms, cite the sources and describe the differences. Discuss your results with your trainer.

   Footwear Outsole Features

   a. Class characteristic
   b. Randomly acquired characteristic
   c. Outsole design
   d. Specific outsole design
   e. Wear
   f. Specific (location of) wear
   g. Degree of Wear
   h. Texture
   i. Schallamach pattern

   Examination and Conclusion

   j. Correspond
   k. Similar
   l. Observation
   m. Interpretation
   n. Superimposition
   o. Side-by-side
   p. Identification
   q. Exclusion

   Professional Organizational Terms

   r. ASB
   s. SWGTREAD
   t. OSAC

   Tire Tread Features

   u. Tread design
   v. Ribs
   w. Sipe
   x. Groove
   y. Lateral Groove
   z. Notch
   aa. Non-Directional Symmetrical tread design
   bb. Directional tread design
   cc. Asymmetrical tread design
   dd. Aspect ratio

2. Explain the difference between a footwear outsole design, specific outsole design, and outsole design element? Provide illustrative or photographic examples.

3. What is the difference between a randomly acquired characteristic, individual characteristic, identifying characteristic, and accidental characteristic?

4. Explain the difference between the terms dimension, physical size, and shoe size, as they are used in the impression discipline.

5. Give at least two synonyms for the term “test impression”.

6. What is the term used to describe documentation of the footwear or tire treads from sources such as first responders, victim(s), and other individuals who may have legitimately left impressions at the scene, so that they may be excluded and allow for the focus to be on impressions likely to be from the perpetrator?

7. Are the terms “tread design”, “tread pattern”, “outsole pattern”, and “outsole design” synonyms of each other? Explain.

8. What is the difference between distortion and variation in the impression making process, according to their definitions? Find or create examples.

9. What is the term used for the surface or object on which an impression is deposited?

TIRES

10. What is the difference between a “tire” and a “wheel”? What is a lug or nut?

11. The flattened area of a tire that makes contact with the road is known as _____.

12. What is a circumferential groove on a tire? Show an example.

13. What are sipes on a tire tread?

3.5 PRACTICAL EXERCISES

1. Have your trainer provide you image Practical Exercise A, which are images of the same impression with different locations indicated. Associate the best correct term(s) with the different numbers on the footwear impression images.

    a. Lateral side
    b. Medial side
    c. Heel
    d. Arch or instep area
    e. Toe
    f. Ball
    g. Edge

2. Have your trainer explain under what circumstances shoe size (not physical size) might be determined when no suspect shoes are submitted.

3. Have your trainer provide you image Practical Exercise B, which is an image of a pair of shoes. Associate the best correct term(s) with the different locations indicated on the footwear image.

    a. Toe box
    b. Toe cap
    c. Tongue
    d. Upper
    e. Midsole
    f. Outsole
    g. Eyelet
    h. Collar or cuff

TIRES

4. Find and photograph two examples of wheel/tires having the following features:

    a. lower aspect ratio vs. higher aspect ratio
    b. symmetrical tire tread design vs. asymmetrical tire tread design
    c. directional tire tread design vs. non-directional tire tread design

5. Have your trainer provide you Practical Exercise C, which is an image of a tire tread. Use the best terms to describe the colored portions of the tire tread indicated.

6. Have your trainer provide you Practical Exercise D, which is an image of a tire sidewall, and/or at least one other example of a tire sidewall (e.g., illustration, photograph, or actual tire). Identify the following features of the tire, if visible:

    a. Manufacturer
    b. Model name
    c. Tire size
    d. Date of Manufacture
    e. Mold Number

7. Have your trainer provide you Practical Exercise E, which is an image of a tire impression in snow. What terms would you use to best describe this tire impression?

8. A tire sidewall reads in part “P225/50 R17 98H”.

    a. Describe what all the letters/numbers mean.
    b. What is this tire’s load index and how many pounds is it designed to approximately carry?

9. Have your trainer provide you Practical Exercise F, which are multiple images of different tire treads. Categorize as either All-Terrain / Off-Road type tire treads or All-Season tire treads, based on their tread design features.

10. Review a recent Tire Tread Guide for awareness of the different tire manufacturers, tire categories, and general terminology used to describe tires.

4 MANUFACTURING

4.1 OBJECTIVES

- To become familiar with the footwear outsole manufacturing methods
- To understand how footwear outsoles are manufactured
- To understand the significance of certain footwear outsole manufacturing processes to the examination process
- To be knowledgeable of the terminology used relating to footwear outsole manufacturing processes and their products
- To understand the different shoe sizing systems and the limitations of estimating shoe size from questioned impressions

TIRES

- To become familiar with and understand the different types of tire and tire tread manufacturing methods
- To understand the significance certain tire manufacturing processes to the examination process
- To be knowledgeable on the terminology related to tire manufacturing

4.2 TOPIC AREAS

1. Footwear outsole manufacture
    a. Mold manufacturing
        i. Hand milling
        ii. Computer-aided design-Computer-aided manufacture (CAD-CAM)
        iii. Electrical discharge machines (EDM)
        iv. Cast molds
    b. Outsole molding processes
        i. Compression-molding
            1. Mold warp
            2. Solid compression-molded outsoles
            3. Microcellular outsoles
        ii. Injection molding
        iii. Open pour molding
    c. Outsole modifications
        i. Siping
        ii. Stitching
    d. Cutting processes
        i. Die cutting
        ii. Calendaring
        iii. Wellman outsole cutting process
    e. Texture
        i. Hand stippling
        ii. Acid etching

f. Forensic significance of:
   i. Texture
   ii. Mold defects
   iii. Air bubbles
   iv. Siping and stitching
   v. Cut outsoles
g. Shoe sizing systems
   i. Determination of shoe size from impressions

2. Tire manufacture
   a. Tire Types
      i. Bias
      ii. Bias-belted
      iii. Radial
         1. Radial Tire Construction
   b. Tire tread molds
      i. Shell or two-piece
      ii. Segmented
   c. Mold making processes
      i. Cast
      ii. Engraved
      iii. Ventless Molds
   d. Retreaded tires
      i. Commonality
      ii. Recognition
   e. Aftermarket siping

4.3 READINGS

- ☐ Bodziak WJ **(1986)** "Manufacturing processes for athletic shoe outsoles and their significance in the examination of footwear impression evidence" Journal of Forensic Sciences 31(1): 153-176.
- ☐ Bodziak WJ **(2017)** *Forensic Footwear Evidence: Practical Aspects of Criminal and Forensic Investigations*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 8, 9, 10, and 11].
- ☐ Champod C, Voisard R, and Girod A **(2000)** "A statistical study of air bubbles on athletic shoe soles" *Forensic Science International* 109(2): 105-123.
- ☐ Hilderbrand DS and D'Amour L **(2020)** *Footwear, The Missed Evidence: A Guide to the Documentation, Collection, and Preservation of Forensic Footwear Evidence*, 4rd Ed., Independently published [read chapter 3].
- ☐ Jay CB and Grub MJ **(1985)** "Defects in polyurethane-soled athletic shoes – Their importance to the shoeprint examiner" *Journal of the Forensic Science Society* 25(3): 233-238.
- ☐ Kainuma A **(2005)** "Manufacturing variations in a die-cut footwear model" *Journal of Forensic Identification* 55(4): 503-513.
- ☐ Music DK and Bodziak WJ **(1988)** "Evaluation of the air bubbles present in polyurethane shoe outsoles as applicable in footwear impression comparisons" *Journal of Forensic Sciences* 33(5): 1185-1197.

TIRES

- ☐ Bodziak WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 5 and 6].
- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read chapters 11 and 12].

4.4 STUDY QUESTIONS

1. Describe the ways that footwear outsole molds are made and which are the most common in current use.
2. What are the different techniques to apply texture to a mold?
3. Explain whether the texture is expected to appear the same in all molds of the same design/size or not.
4. By examining an outsole, how can one determine whether the texture was likely acid etched vs. hand stippled?
5. How might mold defects occur?
6. How would each mold defect type described above affect the appearance of the resulting outsole?
7. Describe the different ways footwear outsoles can be molded.
8. What are some artifacts of the outsole molding process that may be detected during examination and comparison? What is the significance of those features?
9. Describe the different ways footwear outsoles can be manufactured using cutting methods.
10. What are some artifacts of the manufacturing process using cutting methods that may be detected during examination and comparison? What is the significance of those features?
11. Why is fabric placed on outsoles and what information may be obtained if observed in an impression?
12. You receive a partial, questioned impression consisting of a herringbone (zig zag) pattern at the edge of the outsole. The specific outsole design is consistent with the known footwear. Discuss how you might determine whether the specific outsole design in that location is the same or different in the half size larger or smaller, and whether that is necessary to the comparison.
13. Describe how air bubbles are most likely to form during outsole manufacturing and what is the significance of air bubbles in the impression examination process?
14. True or False? Many athletic shoes use microcellular molded outsoles that do not expand so there is no cutting, grinding, or variation between multiple soles from the same mold.
15. Discuss the various shoe sizing systems used. Determine and note several reasons why shoe sizes may vary between manufacturers, shoe styles, and shoe types.

16. Explain whether an individual's shoe size can be accurately determined based upon the dimensions from a footwear impression.

TIRES

17. Discuss the three basic methods of tire construction (Bias, Bias-belted, and Radial). What is the most common type of tire encountered on vehicles currently?

18. What are the two types of tire molds? What visible evidence on a tire might be present to determine which type was used?

19. What are the two primary methods of creating the tread portion of tire molds?

20. Generally describe the various components of a tire.

21. Describe the various features of a tire tread and what their purpose is. What is a retreaded tire and what types of vehicles typically use retreaded tires?

22. What are some visual indicators that a tire you are examining is a retreaded tire?

23. What would be a visual indicator in a questioned impression that the source tire was a retreaded tire?

24. How might an offset center mold seam assist in the comparison process if visible in both the questioned impression and the known tire?

4.5 PRACTICAL EXERCISES

1. Measure the outsole length of multiple pieces of footwear of the same shoe size. Ensure that the types of footwear are varied (e.g., flip flops, loafers, athletic shoes, boots, etc.). Repeat using a similar type of footwear. Compare and discuss the results with your trainer.

2. Find and examine examples of different texture (e.g., hand stippling, acid etching) and image them.

3. Find, examine, and document examples of the following outsole features, if possible:

   a. mold defects
   b. air bubbles
   c. flashing
   d. mold warp
   e. visible mold seam
   f. stitching and/or nail placement variations

4. Complete Footwear Exercises CE-1, CE-4, CE-5, CE-6, CE-7, and CE-8.

5. Tour a footwear manufacturing, footwear outsole manufacturing, or outsole mold manufacturing facility if possible.

6. Go through your closet and document the shoe sizes for the shoes you own. Repeat this process or obtain this information from one other person. Document what you observe about the consistency of shoe sizing in an individual's footwear collection.

TIRES

7. Find and examine examples of both shell and segmented mold tires. Photograph the seams, if possible.

8. Visit a tire store and examine the new tires. Look for examples of the following:

   a. Vent hole rubber
   b. Ventless seams

9. Tour a tire retreading factory to watch the retreading process, if possible. Examine or image a retreaded tire vs. an original manufactured tire, if possible. Describe the features that indicate it is a retreaded tire.

10. Search the internet for information regarding aftermarket siping of tires. Describe the intended purpose of this action, its pros, cons, and how impressions created from tires that were siped might look. Provide examples if possible.

5 LIFTING AND CASTING

5.1 OBJECTIVES

- To understand the different physical recovery methods for impression evidence and when they are used
- To understand when and how to use the electrostatic dust print lifter (ESDL), adhesive lifts, and gelatin lifts to preserve and/or enhance impressions
- To understand the documentation and imaging requirements for the different recovery methods
- To know how to prepare and cast footwear impressions, and how to instruct casting to crime scene responders
- To know how to clean and preserve dried casts

TIRES

- Same as above
- To know how to prepare and cast tire impressions, and how to instruct tire impression casting to crime scene responders

5.2 TOPIC AREAS

1. Evidence Assessment
   a. Substrate
   b. Matrices
      i. Blood
      ii. Environmental (e.g., soil, water)
2. Lifting
   a. Use of lifting – when, pros, cons
   b. Electrostatic dust lifting
   c. Gelatin lifts
   d. Adhesive lifts
      i. Black and magnetic powder processing
   e. Imaging and documentation
3. Casting impressions
   a. Use of casting – when, pros, cons
   b. Soil impressions
   c. Underwater impressions
   d. Snow impressions
   e. Imaging and documentation
   f. Cleaning casts
   g. Retention of associated evidence

5.3 READINGS

☐ Adair TW and Shaw RL **(2007)** "The dry-casting method: A reintroduction to a simple method for casting snow impressions" *Journal of Forensic Identification* 57(6): 823-831.

- ☐ ANSI/ASB Best Practice Recommendation 049 **(current edition)** Best Practice Recommendation for Lifting of Footwear and Tire Impressions.
- ☐ ANSI/ASB Best Practice Recommendation 126 **(current edition)** Best Practice Recommendation for Casting Footwear and Tire Impression Evidence at the Crime Scene.
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- ☐ WSP CLD CSRT Technical Procedures Manual **(current edition)** [read chapter(s) on Impressions]

TIRES

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- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read pp 27-29 and 46-55].

5.4 STUDY QUESTIONS

1. Describe some advantages of casting impressions over photography.
2. Casting is used to recover what types of footwear impressions?
3. Describe how dental stone is mixed. How would you determine the proper powder to water ratio for a dental stone product you just purchased?
4. Describe how dental stone should be poured to minimize damage to an impression.
5. Why is dental stone a superior casting material than plaster of Paris for forensic purposes?
6. What is the proper way to clean a dental stone cast?
    a. When should a cast be cleaned?
7. True/False. You are required to collect and retain as much of the soil as possible adhering to a collected cast, regardless of the quantity present.
8. Describe some ways a poured cast can be marked or labeled, and what it should include.
9. What method can be used to recover dried wet-origin impressions (e.g. light mud) in both their original state and after the application of powders?
10. True/False. A footwear impression can only be lifted once using the electrostatic lifting method.
11. Is it acceptable to throw away a lift that did not work (i.e. did not show any discernible detail of the impression and the impression is still present on the object)? Does this have to be documented?
12. Describe ways to ground the ESDL when performing electrostatic lifting.
13. True/False. It is recommended to observe electrostatic lifts and gelatin lifts (with the cover off) in a dark room with oblique light prior to determining if the lift is of value.
14. Describe some ways electrostatic lifts can be packaged after collection. Explain the pros and cons of the different methods.
15. Describe some ways gel lifts be packaged after collection and stored? Explain the pros and cons of the different methods.
16. Describe the pros and cons of gelatin lifts (including the different colors – black, white, translucent) adhesive lifting tapes, and ESDL lifts.
17. If you had a dusty impression on a metal object, would you lift it using the ESDL or a gelatin lifter? Explain why.
18. What color gelatin lift are commonly selected when lifting light soil impressions?

19. Explain whether or not fingerprint powder should be used to enhance the following types of footwear impressions?
    a. Dry origin transfer (dust) impressions
    b. Wet origin (dried light soil) impressions
    c. Three dimensional impressions
20. You have a visible two-dimensional, dry origin dust impression on a curved surface showing low contrast with the substrate. Describe the benefits of attempting it lift it with a gelatin or electrostatic dust print lifter.
21. Describe some substrates from which lifts should not be attempted and explain why.
22. Describe the imaging and documentation requirements when lifting or casting impressions.

5.5 PRACTICAL EXERCISES

1. Using dental stone, cast footwear impressions in the following materials. Attempt to use a shoe with numerous fine features or randomly acquired characteristics present and make the impressions have some visible detail so the success of the cast can be assessed. Document how well the various substrates captured detail.
    a. Soil with gravel and/or vegetation
    b. Sandy soil
    c. Fine, clay soil lightly damp (that retains good detail)
    d. Snow (if possible)
    e. Sloping soil (e.g. an impression with all or part on an incline)
    f. A puddle
2. Clean the casts from the footwear impressions made in the previous practical exercise and collect the resulting debris from at least one of them. Document how well the cleaned casts captured detail.
3. Using a shoe with numerous fine features or randomly acquired characteristics present, make a footwear impression in soil and have your trainer assist in taking an exam quality photograph of it. Cast that impression, and have your trainer assist in taking an exam quality photo of the cast. Discuss and compare with your trainer the visible detail observed in the original impression image, on the cast, and in the cast image to the known outsole of the source shoe. Document which option retained the most detail useful for comparison.
4. Discuss with your trainer or other Impressions analysts their case experience that included both casts and images from the same impression(s). Have them describe which proved to be more useful in comparison and under what circumstances.
5. Using an electrostatic lifting device, practice lifting impressions of dry origin from a variety of porous and non-porous surfaces. Note: The saved impressions created in Chapter 2 may be used in this practical exercise.
6. Retain three of the collected ESDL lifts from the previous exercise.
    a. Roll one of the ESDL lifts up, then unroll it, and evaluate the quality of the impression that remains.
    b. Place one of the lifts flat in a clean manila folder. Document how stable the ESDL lifted impression was after approximately an hour.
    c. Leave one of the lifts impression side up on the lab bench, photo stand, or comparable area for approximately 30 minutes and evaluated the amount of dust that collected.

7. Make dry residue impressions (positive and negative) and wet residue impressions on a variety of porous and non-porous surfaces. Note: The saved impressions created in Chapter 2 may be used in this practical exercise. Lift using white gelatin lifts, black gel lifters, and overlapping lengths of latent lift tape secured to contrasting lift cards. Document what methods worked the best with what impression types and surfaces.
8. Retain one of the gel lifts that shows good impression detail. Have your trainer assist you in taking an image of it with the lift cover on, and then off. Replace the cover and store the lift at room temperature for approximately 3-4 months. Re-image the lift with the cover off. Document any observed differences in impression detail between the two images taken several months apart. (The completion of the longevity portion of this practical exercise will not prevent successful completion of Chapter 5 or the training program as a whole.)
9. Create several damp water impressions on various surfaces, including one that is relatively flat and non-porous, and allow them to dry. Note: The saved impressions created in Chapter 2 may be used in this practical exercise. Enhance these marks using fingerprint powder (using both black and magnetic powders). Document the results. Lift the enhanced impression prints using gel lifters (of the appropriate contrasting color), overlapping lengths of latent lift tape, and large sized commercial clear adhesive impression lifters.
    a. Attempt to powder a dry-origin (dust) impression on a non-porous substrate. Document the results.

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10. Create a long tire impression in soil (~15 inches or longer). Perform at a minimum practicals 1a and 2. Save the cast for the Imaging chapter.

6 CHEMICAL ENHANCEMENTS

6.1 OBJECTIVES

- Become knowledgeable and experienced with different methods for the chemical stabilization and enhancement of impression evidence
- Understand the importance of sequential processing when using enhancement techniques and the photographic requirements related to chemically enhancing impression evidence
- To learn how to make, apply, and successfully use common chemical enhancements for different impression deposits and substrates
- To be familiar with and understand the potential use of uncommon chemical enhancements for different impression deposits and substrates

6.2 TOPIC AREAS

1. Evidence Assessment
   a. Substrate
   b. Matrices
      i. Blood
      ii. Environmental (e.g. soil, water)
      iii. Other (e.g. organic contaminants)
2. Fixative and common chemical enhancements
   a. 2% Sulfosalicylic Acid (2% SSA)
   b. Amido black (water based)
   c. Amido black (methanol based)
   d. Leucocrystal violet (LCV)
   e. Potassium thiocyanate
3. Uncommon chemical enhancements
   a. Luminol
   b. Powder
   c. Acid yellow 7
   d. Bromophenol blue
   e. 1,9-Diazafluoren-9-one (DFO)
   f. Hungarian Red
   g. Ninhydrin
4. Application Methods
5. Quality Control
6. Safety

6.3 READINGS

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- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapter on Impressions and related Appendices]

6.4 STUDY QUESTIONS

1. What are the documentation requirements when making up reagents?
2. What are the quality control and documentation requirements when using a reagent on evidence?
3. Discuss with your instructor where to find the chemicals, equipment, and supplies needed to perform enhancements.

4. When performing chemical enhancements of impressions, what information should be included in the report? What information should be included in your notes?
5. Under what circumstances might Amido Black and LCV be used? What are the limitations of these enhancements? What other substances might Amido Black and LCV react with other than blood? What is the reaction mechanism for these enhancement reagents?
6. When would LCV be a better choice than Amido Black to enhance a bloody impression?
7. When would one select the water based Amido Black reagent vs. the methanol based reagent?
8. Under what circumstances might luminol be used? What are the limitations of this enhancement? What other substances might luminol react with other than blood? What is the reaction mechanism for this enhancement reagent?
9. True or False. You should always take an exam quality image of the impression prior to processing or enhancing it, and between each chemical processing step.
10. What is the purpose of applying or including 5-sulfosalicylic acid in chemical enhancement preparations?
11. What would be a chemical enhancement reagent to use with an impression created in the following matrix?
    a. Blood on white fabric
    b. Blood on glossy finish wood floor plank
    c. Soil on cardboard
    d. Milk on vinyl flooring
    e. Calcium carbonate standard
    f. Ferric chloride standard
12. What considerations would there be before using an uncommon chemical reagent on an evidence sample?
13. Describe the quality control and safety measures required for use of the common chemical reagents.

6.5 PRACTICAL EXERCISES

It is recommended that the trainee prepare the reagents themselves, or observe the preparation of the reagents to include knowledge of where the various components are stored in the lab and how they are made.

1. Discuss with your trainer the types of blood, environmental (e.g. soil, water) and organic impression types received in casework. What were the scenarios encountered with these deposits and how were they processed?
2. Obtain from your trainer blood impressions on both light and dark porous substrates. Apply Amido Black (water based) and Amido Black (methanol based) and document the results. Also, obtain a blood impression on a non-porous substrates and apply the reagents. Document the results.
3. Prepare with your trainer diminishing blood tracks on porous and non-porous surfaces, and enhance them by using either Amido Black water or methanol based reagent, and Leucocrystal Violet (LCV). Take exam quality images of the impressions before and after enhancement. Using Photoshop, enhance the post-chemical enhancement impression images.

4. Retain an Amido black processed impression on a non-porous object and an LCV processed impression on a porous object from the previous practicals for approximately 4-6 months. Evaluate at that time how the appearance of the samples have changed, if at all. (The completion of this particular practical exercise will not prevent successful completion of this chapter.)
5. Prepare a faint blood impression on an article of clothing and treat it with LCV. Successfully photograph it before and after enhancement.
6. With your trainer, prepare a faint blood impression on a dark, porous substrate and treat it with luminol. Successfully photograph it before and after enhancement.
7. Prepare several impressions created by different soils on the following substrates: paper, tile, and an item of clothing. Enhance them with potassium thiocyanate. Document the results.

7 IMAGING – PHOTOGRAPHY AND SCANNING

7.1 OBJECTIVES

- Understand the basic principles of photography and scanning
- To be able to successfully image impression evidence and understand the principles of forensic imaging and examination quality imaging
- To be able to implement and understand all requirements of digital image handling
- Successfully image a variety of footwear impressions on different substrates for both preservation and comparison purposes
- To successfully use the various tools and equipment needed for proper imaging such as scales, levels, flash, remote shutter release, tripod, etc.

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- Same as above
- Successfully image tire impressions both preservation and comparison purposes

7.2 TOPIC AREAS

1. Basic photographic principles
   a. Exposure – f-stop, shutter speed, ISO
   b. Exposure mode – aperture priority, program mode, shutter priority, etc.
   c. Focus – manual, auto
   d. File formats
      i. Compressed – JPG
      ii. Uncompressed – RAW, TIF, PSD
   e. Lens distortions
   f. Image distortions
2. Photographic Equipment
   a. Cameras
   b. Tripods and copy stands
   c. Flash units, flashlights
   d. Scales
   e. Bubble levels, angle finders
3. Scanning equipment
   a. Photocopiers
   b. Scanner
4. Documentary images
5. Examination quality images
6. Lighting Techniques
   a. Oblique light
   b. Painting with Light

7.3 READINGS

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- ☐ Rimmasch P **(2017)** "Lens testing: Reassessing the 50 mm rule" *Journal of Forensic Identification* 67(3): 323-340.
- ☐ WSP CLD CSRT Technical Procedures Manual **(current edition)** [read chapter(s) on Impressions].
- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapters on Impressions and Imaging & Visualization].

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- ☐ Bodziak WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read chapter 3 pp 52-67].
- ☐ McDonald P **(1989)** *Tire Imprint Evidence*, CRC Press; Boca Raton [read chapter 7].
- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read Chapter 2 pp 23-27 and 30-36, Chapter 3 pp 37-45].

7.4 STUDY QUESTIONS

1. Define the following terms and describe how each is an important factor or adjustment in impression photography.

    a. F-stop or aperture
    b. Shutter speed
    c. ISO
    d. Exposure mode (e.g. aperture priority, program mode, shutter priority)
    e. File format (e.g. RAW vs. JPG)

2. What is depth of field? Under what impression circumstances would this be an imaging consideration and what would the photographic set-up be if depth of field needed to be increased? Answer in terms of exposure mode selected, lighting considerations, and focusing considerations.

3. What does the term “bracketing” mean in photography? How would one bracket exposure and f/stop?

4. At what shutter speed does hand holding a camera generally become difficult to hold still and avoid camera shake/blur?

    a. Assume you are taking an overall image of the outsoles of a pair of black shoes with your point-and-shoot camera. The image is blurry and you notice that the shutter speed is slow. What are some options to correct this when re-taking the image?

5. Describe the difference between examination quality and documentary images.

6. List the critical components of an exam quality photograph and why are they important?

7. What are the consequences of the scale not being positioned properly in an image? Explain if:

    a. The scale is flat but placed above the surface of the impression (e.g., scale on the top surface of a 3D, sunken impression)
    b. One end of the scale is raised up while the other end is in contact with the substrate, placed adjacent to a flat impression.

8. What is the purpose of taking several photographs of impressions with varying lighting directions and heights?

    a. Where should your eye be to best evaluate the efficacy of the different lighting conditions?
    b. What is oblique light and how is it used to enhance footwear or tire impressions?

9. True or False. The deeper the 3D impression, the more oblique the lighting should be.

10. Name some techniques for increasing contrast of an imaged impression during the photography process (e.g. not Photoshop or digital processing efforts afterwards).

11. Describe common lens distortions that may occur in photographs and how this distortion might affect comparisons of that image.

12. Describe why the maximum resolution of a DSLR camera is important for exam quality impression images and how this relates to sensor size?

13. Describe when scanning might be a beneficial imaging capture method.

    a. Does the scanner capture in RAW format?

    b. Does the scanner have the ability to capture in a size other than 100% or natural size?

14. What are the submission requirements of images for impressions comparisons? For make/model requests?

15. What are the tracking and disposition/storage requirements for images submitted in casework? What about for images generated in casework?

16. Discuss documentation requirements related to imaging. What is required in the case notes/record and how are the steps of an image digital enhancement documented?

17. What information can be obtained from image metadata and where can it be viewed?

18. As a lab analyst, should you take exam quality images in JPG format?

19. Assume you have a large item (e.g. piece of drywall) with multiple footwear impressions of a similar type on it. Describe how you would mark/label the impressions and then photograph them, to ensure you could keep all impressions sorted throughout the imaging, documentary, and comparison process.

20. Occasionally, when viewing a photograph of a 3D impression, the indented areas of the impression will appear raised. This phenomenon is known as the _____ effect, and though it does not interfere with the examination process, rotating the image 180□ may fix it.

    a. Inversion

    b. Reverse

    c. Optical

    d. Inverted

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21. Describe how the scale(s) should be placed in/along a long tire impression to successfully image overlapping sections of it.

22. How many images should be taken of each overlapping tire section (of a long tire impression) and what differs between each of those images?

7.5 PRACTICAL EXERCISES

Completion of the Imaging practical exercises must produce a sufficient number of examination quality photographs of footwear and tire impressions and enhancements of images, such that the trainee demonstrates their competence and efficiency under a variety of circumstances and with a variety of photographic set-ups. This includes capturing images with a camera mounted on tripod/quadrapod.

1. Go over the camera and scanner equipment with the User's Manuals currently used for capturing examination quality images in the laboratory. Identify all features of the device for routine and expected operation with your trainer.

2. Discuss with your trainer the benefits of evaluating image quality on a computer monitor vs. on the camera LCD screen.

    a. Demonstrate what types of image problems are typically visible on the camera LCD screens during capture and which are not.

    b. Discuss and practice ways to prevent and correct common image problems that might arise during image capture (e.g. focus problems, exposure problems, lighting problems, etc.).

3. Obtain a relatively flat impression having multiple, small randomly acquired characteristics from your trainer. Photograph it exam quality at the lowest resolution possible and in RAW format. Enlarge the resulting images and compare the detail, clarity, and visibility of the RACs. Repeat the exercise using the scanner at (approximately) 100 dpi and 1000 dpi.

4. Obtain an impression having multiple, small randomly acquired characteristics from your trainer. Photograph it using a range of different ISO settings (lowest to highest) and document the changes in noise or other observations in the enlarged images based on ISO settings.

5. Obtain a curved, relatively deep outsole design from your trainer. Take an exam quality image of it on aperture priority mode, at a range of f/stops from low to high, focusing on the top surface of the outsole. Compare the resulting images in terms of depth of field. Document the results.

6. Obtain a low contrast impression or nearly blank substrate (e.g. piece of exam paper) that is difficult to autofocus on and using a tripod or copy stand, successfully manually focus on it. Take an image (include a scale to the side) and document how you ensured focus was obtained.

7. Experiment capturing properly focused and exposed images with various lighting directions, angles, and heights using the following lighting sources, lighting techniques, and types of impressions. Some of the impression types may have been saved from Chapters 2 and 6.

    The list is not all inclusive and other light sources, lighting techniques, and impression types may be added. All images must be examination quality and saved until otherwise instructed. Document and discuss with your trainer which combinations worked well and which were less successful.

    a. Light Sources

        i. Ambient Light
        ii. Flashlights
        iii. External Off-Camera Flash Unit

    b. Lighting Techniques

        i. Oblique Light
        ii. Painting with Light

    c. Impression Types

        i. Two dimensional impressions

            1. Transfer – wet origin impression with varying amounts of mud/soil
            2. Transfer – dry origin impression with dust
            3. Transfer – dry origin impression with dry soil
            4. Transfer – wet origin impression using outdoor ground water on a relatively clean substrate (e.g. non visible impression)
            5. Negative impression in dust or other dirty substrate

6. Black gel lift (cover removed)
7. Electrostatic dust print lift
8. Black powdered, tape lifted impression on a card/paper
9. Bloody impression (unprocessed)
10. Amido black processed bloody impression
11. LCV processed bloody impression (still wet or re-wetted)

ii. Three dimensional impressions

1. Cleaned impression cast

iii. Complex Impressions

1. Overlapping impressions
2. Smeared / distorted impression
3. Impression on a curved surface
4. Impression on clear, colorless flat piece of glass

8. Obtain from your trainer a large object on which there are multiple impressions of different outsole designs. Discuss a potential analytical approach with your trainer, and then take documentary and exam quality images supporting the approach.

9. Take an examination quality photograph of an impression that is on the floor with the camera on a tripod/quadrapod. The goal is to practice and demonstrate successful use of the tripod. This exercise may be combined with one of the other practical exercises.

10. Scan different types of impressions on various surfaces, and then photograph those same impressions (e.g. low contrast impression, textured substrate, crinkled paper, shiny substrate, fabric substrate, etc.). All images must be examination quality.
    a. Compare the resulting images from the different capture methods.
    b. Determine the best settings for the scanner and camera for each impression/surface combination.
    c. Describe how the various substrates worked on the scanner vs the camera.

11. Take documentary images of a pair of footwear uppers and outsoles. Ensure they are properly exposed and in focus.
    a. Take examination quality images of a footwear outsole using oblique lighting from various directions, angles, and heights such that the fine detail on all portions of the outsole is visible in the resulting image.
    b. Document what limitations there were to this process.
    c. Document what photographic set up worked to achieve the best images.

12. Obtain some test impressions from your trainer. Scan and save them, or photocopy them, according to procedures.

TIRES

13. Successfully photograph a long section of 3D tire impression in soil using a tripod/quadrapod, with documentary and examination quality photos. Use shading techniques for oblique lighting control, if necessary.

8 IMAGE PROCESSING / PS / ADAMS

8.1 OBJECTIVES

- To use the Photoshop and file management software programs (e.g., Bridge, Lightroom) interfaces efficiently
- To understand how to successfully use the ADAMS interface for image storage
- To successfully resize images
- To successfully and properly use Photoshop to process impression digital images
- To successfully print images using optimal settings and media (e.g. paper, transparency) for a given task using the available equipment
- To successfully prepare questioned impressions and known test impressions for digital overlay comparisons in Photoshop

8.2 TOPIC AREAS

1. Foray ADAMS browser-based application
    a. Use and procedures
2. Adobe file management (Bridge, Lightroom) software
    a. General use
    b. Output for contact sheets
3. Adobe Photoshop software
    a. General use and procedures
    b. Sizing to natural size
        i. Distortion
    c. Processing for enhancement
    d. Stitching images (e.g. tire test impressions)
    e. Contact sheets
        i. Annotating contact sheets digitally
    f. Digital superimposition of questioned and known impressions
4. Printing questioned and known impression images
    a. Maximizing resolution and quality

8.3 READINGS

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- ☐ Witzke D **(2008)** "Calibrating Your Images" and "Stitching Calibrated Images Together" from *Advanced Digital Imaging: doing more with your digital images* course sponsored by Foray Technologies.
- ☐ Witzke D **(2023)** "Digital Processing of Footwear Evidence", training course sponsored by Foray Technologies, May 2023.

8.4 STUDY QUESTIONS

1. Describe some best practices when processing digital images for forensic purposes.
2. What does ADAMS stand for and what is the purpose of ADAMS?
3. What images are required to be stored in ADAMS?
4. Can images stored in ADAMS be used for comparison purposes at a later time? Explain.
5. Describe the difference between Adobe's file management software (Bridge, Lightroom) and Photoshop software.
6. True or False. Color digital images have more enhancement options in Photoshop than images captured in black and white.
7. What is the purpose of digitally processing images?
8. What type of Photoshop processes or tools should not be used with forensic images?
9. Describe the different variables that can affect the resolution of a printed image, when using both different and the same printers.

8.5 PRACTICAL EXERCISES

Note: Attending one or more approved professional level Forensic Digital Imaging course is strongly recommended. Any practical exercises listed below covered by a professional course does not need to be repeated upon successful demonstration of understanding by the trainee upon return. The trainer must approve the content substitution.

1. Complete the following portions of the step-by-step Bridge and Photoshop reference book for software familiarization, unless the trainer assesses the trainee is already proficient in one or more of the skills. The Video Lessons are required unless there is no access to O'Reilly's website (the videos are only available on O'Reilly's website through a paid subscription). Techniques used during the lessons must be approved by the trainer prior to use for forensic purposes.

   McClelland D **(2007)** Adobe Photoshop CS5 One-on-One, deke Press O'Reilly. All content can be found online at O'Reilly's website.

   PREFACE – HOW ONE-ON-ONE WORKS

   - ☐ Read, Watch, Do (reading)
   - ☐ One-on-One Installation and Setup
   - ☐ Structure and Organization (reading)

   LESSON 1 – OPEN AND ORGANIZE

   - ☐ Video Lesson 1: Browsing in the Bridge
   - ☐ What is Photoshop? (reading)
   - ☐ Opening an Image
   - ☐ Interface and Image Window (reading)
   - ☐ Organizing and Examining Photos
   - ☐ Using Metadata
   - ☐ Batch Renaming
   - ☐ What did you learn?

   LESSON 2 – STRAIGHTEN, CROP, AND SIZE

   - ☐ Video Lesson 2: Navigation
   - ☐ Whole-Image Transformations
   - ☐ Straightening a Crooked Image
   - ☐ Using Rotate View with the Crop Tool
   - ☐ Resizing an Image
   - ☐ Changing the Print Size (reading)
   - ☐ What did you learn?

   LESSON 3 – MAKING SELECTIONS

   - ☐ Video Lesson 3: The Selection Tools
   - ☐ Isolating an Image Element (reading)
   - ☐ Selecting an Irregular Image
   - ☐ Selecting Regions of Continuous Color
   - ☐ Quick Selection and Quick Mask Mode (latter topic optional)
   - ☐ What did you learn?

LESSON 5 – WORKING WITH LAYERS

- ☐ Video Lesson 5: Layer Manipulations
- ☐ The Benefits and Penalties of Layers (reading)
- ☐ Arranging and Modifying Layers
- ☐ Using Blend Modes and Specialty Layers (optional, recommended for digital overlay method)
- ☐ What did you learn?

LESSON 6 – ADJUSTING COLOR AND LUMINANCE

- ☐ Video Lesson 6: Color Adjustments
- ☐ What are Hue and Saturation? (reading)
- ☐ Brightness, Contrast, and Levels (reading)
- ☐ Fixing a Color Cast
- ☐ The Visible-Color Spectrum Wheel (reading)
- ☐ Tint and Color
- ☐ Converting an Image to Black and White (reading)
- ☐ Adjusting Brightness Levels
- ☐ The Nature of Channels (reading)
- ☐ How to Read and Respond to a Histogram (reading)
- ☐ Correcting with Curves
- ☐ Compensating for Flash and Backlighting
- ☐ What did you learn?

LESSON 7 – SHARPENING AND SMART OBJECTS

- ☐ Video Lesson 7: Introducing Filters
- ☐ The Subterfuge of Sharpness (reading)
- ☐ Sharpening an Image

LESSON 8 – TRANSFORM AND DISTORT

- ☐ Applying Free Transform to Scale and Align Perspective

LESSON 9 – PRO PHOTOGRAPHY TOOLS

- ☐ Video Lesson 9: Exploring Camera Raw
- ☐ The Raw Power of Adobe Camera Raw (reading)
- ☐ Adjusting White Balance in ACR
- ☐ Exploring High Bit Depths (reading)
- ☐ Luminance, Crop, and Color

LESSON 11 – TEXT AND SHAPES

- ☐ Video Lesson 11: Creating Vector Art
- ☐ The Vector-Based Duo (reading)
- ☐ Creating and Formatting Text

2. Complete the following tasks in ADAMS with the trainer. Discuss and document all procedural requirements for each task.
    a. Adding a new folder (case)
    b. Acquiring the first image asset to a new case folder
    c. Acquiring an additional image asset to a case folder (to include at least one Photoshop processed image)
    d. View the file history (metadata), chain of custody, and camera data info of an processed image vs. non-enhanced image asset
    e. Exporting one or more image assets out of ADAMS, both with and without changing their file format
    f. Initiate and complete Photoshop processing of an image asset
3. Obtain multiple digital images of impressions with no perspective distortion that include a ruler from your trainer. Re-size to natural size the images using Photoshop software and the ADAMS calibration tool. Demonstrate to your trainer that they were successfully re-sized both digitally and printing copies compared to an actual ruler.
4. Photograph and scan a known (relatively flat) impression exam quality. Then photograph it from at least two different, incorrect angles. Re-size all images to natural size. Compare the size of the impression in the images with perspective distortion compared to impression in the images that had none and to the original impressions. Describe the effect that image perspective distortion would have on a comparison if that were the only image available.
5. Photograph an impression with a scale at the same plane as the bottom of the impression (image A). Then re-photograph with the scale approximately ½ inch above or below it (image B), and again approximately 1 inch above or below it (image C). Additional heights/depths may be done at the trainer's discretion.

    Re-size all images to natural size. Compare the size of the impression in images B and C to the size of the impression in image A. Describe the effect that differing scale depth had on the perception of natural size. Also, compare to the actual size of the impression, if it is available.
6. Obtain from your trainer an image of an impression that includes a non-standard scale (e.g., a pen, business card, etc.). Attempt to resize to natural size. Discuss with your trainer the accuracy of your outcome and the pros and cons of this scaling method.
7. Obtain multiple digital images of impressions from your trainer. Complete the following Photoshop tasks using specific Photoshop software tools and techniques described by your trainer.
    a. Selections
        i. Isolating areas of interest with selection tools (e.g. marquee, lasso, magic wand, etc.)
        ii. Modifying selections (e.g. feathering, etc.)
        iii. Making changes to selections (e.g. filling, deleting, adjustments, etc.)
    b. Color and Contrast Adjustments
        i. Adjusting hue and saturation
        ii. Adjusting levels and curves
        iii. Adjusting contrast (including making black and white)
        iv. Choosing the appropriate color mode and/or channel – color isolation techniques
    c. Crop and rotate an image and a layer
    d. Highlight an area or feature

e. Add arrows, circles, text, or other annotations

8. Print the same digital impression image to all available color printers, varying the paper quality and printer settings when possible. Describe the pros and cons of the various results and which combination performed the best overall.
9. Print (or scan and print) a test impression onto transparency film, varying the scan and/or print settings when possible. Describe the pros and cons of the various results and which combination performed the best overall.
10. Print a high quality impression image that is larger than 8½" x 11". Optionally, print a high quality impression image that is custom sized, approximately 6" x 12".
11. Prepare a digital contact sheet of multiple different images using the following methods:

    a. Bridge, Lightroom – Output

    b. Photoshop – File > Automate > Contact Sheet II

    c. PowerPoint

    What differences were observed between the different methods of making contact sheets?
12. Obtain examination quality images of the heel and toe of the same footwear impression, or adjacent tire impression sections. Digitally stitch the images together using Photoshop and review the result with your trainer.
13. Obtain from your trainer at least two sets of questioned impression images of examination quality and corresponding known test impressions images. Prepare the known test impressions and questioned impressions into digital, overlaid compositions, as if they were to be subsequently compared using the digital superimposition method. Show your final, layered compositions to your trainer for evaluation and discussion.

9 ANALYSIS

9.1 OBJECTIVES

- To successfully locate and assess the number and types of impressions present on evidence or in scene images
- To understand the specific features of a footwear outsole (e.g., outsole design, physical size, wear, randomly acquired characteristics, etc.) and their significance
- To accurately assess the features of an impression, recognizing any limitations as appropriate
- To successfully assess an impression's suitability for comparison

TIRES

- Same as above
- To successfully analyze tire track evidence

9.2 TOPIC AREAS

1. Class characteristics (footwear and tire)
   a. Outsole design (footwear)
   b. tread design (tires)
   c. Noise treatment (tires)
   d. Physical size
   e. Wear
2. Randomly acquired characteristics (footwear and tire)
   a. Damage, embedded material, signs of wear, etc. (footwear and tire)
   b. Schallamach (footwear)
3. Significance and persistence of characteristics (footwear and tire)
4. Analysis and assessment of questioned evidence
   a. Determination of number of outsole designs
   b. Determination of number of impressions
5. Analysis of a questioned impression
   a. type (e.g. footwear impression, possible footwear impression, etc.)
   b. features
      i. substrate, matrix, partiality, kind of impression (e.g. 2D/3D, positive/negative), possible class characteristics, possible characteristics of use, etc.
   c. quality
   d. limitations
   e. assessment for comparison suitability
6. Selection for comparison
7. Tire track evidence

9.3 READINGS

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- ☐ John J and Swofford H **(2020)** "Evaluating the accuracy and weight of confidence in examiner minutiae annotations" *Journal of Forensic Identification* 70(3): 289-309.
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- ☐ Keijzer J **(1990)** "Identification value of imperfections in shoe with polyurethane soles in comparative shoeprint examination" *Journal of Forensic Identification* 40(4): 217-223.
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TIRES

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9.4 STUDY QUESTIONS

1. What do most class characteristics have in common?
   a. They are acquired over time and with use
   b. They can be searched in a database operated by the FBI
   c. They are microscopic in nature
   d. They are manufactured features

2. Which common class characteristic is an exception to Question #1?

3. Explain why specific outsole design is important to analyze.

4. How can design change with outsole size (the design-size relationship) and why is this important to the impression analysis and comparison process?

5. Is there a point where wear can become a randomly acquired characteristic? If so, explain when this occurs and show an example.

6. Explain the significance of specific (location of) wear and why that feature is important.

7. Describe what a Schallamach pattern is and how it is formed.

8. Is a Schallamach pattern a class characteristic or a randomly acquired characteristic?

9. Explain how long these various footwear outsole features might persist. Be clear to delineate between time and usage.

    a. Outsole design
    b. Physical size
    c. Wear
    d. Small scratch (RAC)
    e. Deep gouge (RAC)
    f. Stone hold
    g. Gum adhering to outsole
    h. Schallamach pattern

10. List several specific types of randomly acquired characteristics that might be encountered on footwear outsoles. Discuss with your trainer those that are most commonly encountered in casework.

11. Position, size, shape, and orientation are independent features of which characteristic or feature analyzed in an impression or outsole? Explain each feature and use a photographed example for illustration.

12. Everything else being equal, which would be analyzed as more valuable: one large, unique shaped RAC or four smaller, indistinct shaped RACs. Explain.

13. What are some visual indicators that a feature you are analyzing in a questioned impression is a possible RAC and not background noise or substrate interference?

14. What are some visual indicators that you are analyzing a negative impression vs. a positive impression?

15. How does a feature in a questioned impression get confirmed as being a randomly acquired characteristic and what is the importance of this?

TIRES

16. Define each of the following terms in writing. Also, find an example of each Tire Tread Features term and document it with an image. If significant conflicting definitions are found for any of the terms, cite the sources and describe the differences.

    a. Tread block
    b. Pitch length
    c. Pitch sequence
    d. Noise treatment
    e. Wear (bar) indicator
    f. Rolling circumference
    g. Overall diameter
    h. Shoulder
    i. Vent holes

17. What is the purpose of noise treatment on tires?

18. Explain the difference between directional and non-directional noise treatment. How would this be determined on a submitted tire or tire test impression?

19. What is the forensic significance of a questioned impression having been made by a tire with directional noise treatment?

20. Name several factors that can influence the wear on tires.

21. Explain how wear is forensically significant to the tire impression examination and comparison process.

22. How might wear appear on two dimension and three dimensional tire impressions?

23. When traveling forward in a straight line, the rear tires will _____ most of the front tire impressions.

24. Which tires track inside the others when a vehicle is turning?

    a. Front tires inside rear tires
    b. Rear tires inside front tires
    c. Right tires inside left tires
    d. Left tires inside right tires

25. Describe how you determine which tires are attributable to the rear tires when presented with tire tracks from all four tires, and the tracks indicate the vehicle was turning. Show by illustration.

26. Describe how one can determine that a tire track was made from a steering tire.

27. Which tires are most likely to spin without traction on a vehicle and why?

28. Define the following:
    a. Wheelbase
    b. Tire width
    c. Track width or “stance”

29. Describe how one determines the wheelbase of a vehicle from the tire tracks it leaves behind, and what type of tracks need to be present at a scene for this to be determined. Show by illustration.

30. Describe the conditions necessary to measure the turning diameter of a vehicle based on the track evidence at a scene. How would it be possible to ensure these conditions have been met?

31. Explain how assigning tires to track marks at a scene is helpful to the comparison process when tire impression evidence collection from those tracks is submitted later.

9.5 PRACTICAL EXERCISES

1. Find examples of class characteristics and randomly acquired characteristics on shoe outsoles. Document and describe these for your instructor.

2. Look at the outsole designs of as many of your co-workers on a given day. Document how many designs (make/models) were observed. If the same tread design is encountered, record any similarities or differences.

3. Search for and photograph footwear exhibiting various wear conditions.

4. Examine at least two footwear outsoles or impressions of the same outsole design but of different shoe sizes (ideally adjacent sizes). Focus on the design details; describe the specific differences you observe.

5. Complete Bodziak’s training Footwear Exercises CE-1, CE-2, CE-3, CE-6, CE-7, CE-8 and CE-9.

6. Obtain from your trainer at least two different sets of crime scene images taken by the laboratory’s crime scene personnel that included footwear images. Analyze and document how many impressions are present, how many different outsole/tread design types are present, how they were marked at the scene, and where the marked impressions were located in the scene and relative to each other.

7. Repeat previous exercise but using scene images taken and submitted by law enforcement agency personnel.

8. Obtain multiple impression images from your trainer to determine the impression type. Analyze and document the features, and determine if the impression is a footwear impression, a possible footwear impression, a patterned impression, or not a patterned impression.

9. Obtain multiple impression images from your trainer and assess the quality of the impressions. Document any limitations that affect impression quality, if present, along with your support for each assessment.

10. Assessment of Questioned Impression Features

    a. Obtain multiple questioned impression images. Analyze and document potential features for comparison using the color coding method (green, yellow, or red) to assess the weight or confidence of features seen as described in the article by John and Swofford (2020). When finished, discuss your analysis with the trainer.

    b. Obtain from your trainer the corresponding known test impression and/or outsole. Compare your Q assessments to the provided K features. Ground truth known source and known non-sources may be provided. Discuss your results with your trainer. Were objectively similar features consistently marked and assessed when the Q and K were the same? Did this change if/when the Q and K were different?

11. Obtain from your trainer images of a worn footwear outsole. Find on the internet an image of new (unworn) outsole for the make and model of footwear provided. Document what features were observed on the K outsole and/or test impression that appear different from the unworn outsole image, including an assessment of the actual or potential cause for those changes. Focus both on class and randomly acquired characteristics. Discuss with your trainer.

12. Obtain multiple impression images from your trainer. Analyze and document the following features, if visible, in each image.

    a. 2D or 3D
    b. Positive or negative
    c. Partial, complete, nearly complete, etc.
    d. Quality of image itself (exam quality image? Limitations?)
    e. Deposit type, wet/dry origin
    f. Substrate type, quality, limitations
    g. Impression location
        i. Tire position (if tracking evidence available)
    h. Prior impression enhancement visible?
    i. General description of apparent design
        i. Right vs. left, toe vs. heel if readily obvious (if footwear)
        ii. Noise treatment, directional vs. non directional, symmetrical vs. asymmetrical (if tire)
        iii. Logos, lettering, etc.
    j. Quality
        i. Areas of best/worst detail
        ii. Quality limitations
        iii. Distortion
    k. Possible Wear
    l. Possible RACs

13. Determine the suitability for comparison and select which impressions would be compared first for the impressions analyzed in the previous practical exercise (quantity to be determined by the trainer).

14. Obtain from your trainer Practical Exercise A, which are two images of footwear impressions. Analyze and document each impression fully using the criteria in Practical #12 as a guide, and retain the analysis for Comparisons and Evaluations chapter.

15. Obtain an object from your instructor with numerous footwear impressions on it, some of which are overlapping and distorted. Fully analyze the impressions, document and label them, and properly image them. Take exam quality photos for at least 3 impressions. Further document:
    a. How many different outsole designs are present?
    b. How many impressions are present?
    c. Which (if any) are suitable for comparison?
    d. Make selections as to which you would compare in the first round of comparisons (or the order you would compare them if selecting all).

TIRES

16. Perform practical exercises 1, 12, and 13 as applied to tire treads or tire impressions.

17. Examine at the tread design of the tires in the lab parking lots. Be sure to evaluate all four tires on the vehicle. Document how many tread designs (make/models) were observed and how many times a single vehicle has more than one tire type on it. If the same tread design is encountered, record if there were differences in tire size.

18. Find and document an example of noise treatment on multiple tire treads.

19. Obtain from your trainer at least one set of crime scene images that includes tire tread images. Analyze and document how many impressions are present, how many different tread design types were present, how they were marked at the scene, and where the marked impressions were located relative to the scene and each other.

20. Measure the wheel base and stance of some of the vehicles in the crime lab parking lot. How many of these vehicles have similar measurements even though they are different models?

21. Use a car or truck to make the tightest turns possible for that vehicle in snow, soil, or on a surface that would enable a recording of track width, turning diameter, and wheel base. Measure the dimensions, as possible, and compare the data with the reference material for that vehicle type. Also, measure the track width and wheel base from the vehicle used to make the marks and compare them to the measurements recorded in the snow or sand. (The completion of this particular practical exercise will not prevent successful completion of this chapter or the training program as a whole.).

22. Complete Track Exercises #1 – 7 provided by your trainer.

10 TEST IMPRESSIONS AND FEATURE REPRODUCIBILITY

10.1 OBJECTIVES

- To successfully describe and analyze known footwear and footwear outsoles
- To understand the different methods of preparing test impressions and be able to successfully perform them.
- To understand how and why features vary and reproduce on test impressions.
- To learn how to identify wear, class, and RACs versus stray marks on a test impression.

TIRES

- Same as above
- To successfully collect partial tire test impressions via imaging and adhesive lifting
- To successfully create rolled, full circumference tire test impressions

10.2 TOPIC AREAS

1. Known footwear analysis and description
2. Test impressions creation
    a. Footwear outsole test impressions
        i. Inkless systems (e.g., SolePrint)
        ii. Fingerprint powder and adhesive lifts
        iii. How created (hand pressed, walking, dynamic, etc.)
    b. Tire test impressions
        i. Partial
            1. Imaging tire treads
            2. Adhesive lifting
        ii. Full circumference (rolled)
            1. Vaseline and magnetic powder
            2. Inked
3. Test impression reliability
4. Test impression reproducibility
        i. Variation

10.3 READINGS

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- ☐ SWGTREAD 05 **(03/2005)** Guide for the Preparation of Test Impressions from Footwear and Tires, Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ WSP CLD CSRT Technical Procedures Manual **(current edition)** [read chapter(s) on Impressions]
- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapter on Impressions]

10.4 STUDY QUESTIONS

1. When should photographs of the outsoles be taken during the examination/comparison process?

2. What methods are acceptable to make footwear outsole test impressions? Describe each method's pros and cons.

3. When should a disposable fingerprint brush and uncontaminated/clean fingerprint powder be used when creating powder/lift exemplars from footwear outsoles?

4. How many test impressions should be initially made from a pair of suspect shoe outsoles to be compared to a questioned impression and explain why? What method(s) should be used to make them?

5. Explain the purpose of comparing duplicate test impressions to each other and to the known outsole.

6. Is it acceptable to throw away and not document exemplars that you will not use or did not have the desired result?

7. What are acceptable ways for test impressions to be stored for final disposition?

8. You receive a pair of shoes with clumped, dried mud stuck to the outsole. The shoes were seized a week after the questioned impression was deposited and were not excluded after initial analysis. You cannot make a test impression as significant portions of the outsole are obscured. How do you proceed?

9. What should be done with debris that accidentally falls off footwear during the examination?

10. Describe the limitations of receiving only images of a suspect footwear outsole instead of the actual seized shoes.

11. What caution should be exercised when using elimination images of first responder footwear to not select certain questioned impressions for comparison?

TIRES

12. Why is it important to collect two full circumference test impressions from offset starting points around the tire circumference?

13. What facility, space, and supplies requirements are necessary to roll inked, full circumference, tire exemplars from a vehicle? Is this something that can be done on the spur of the moment or at most crime scenes, or must this be an arranged event?

14. What are the similarities and differences between the test impressions created from ink on wet media film, and powdered petroleum jelly on wet medial film?

15. What is the benefit or purpose of marking the tire into segments A-H (or comparable) prior to rolling full circumference tire test impressions and recording those designation locations on the test impression itself? What other markings should be recorded on the test impression?

16. Describe what the resulting test impression should look like for it to be deemed acceptable for use and not need to be re-rolled.

17. Why is it generally more difficult to assess the variability and reproducibility of tire test impressions than footwear outsole test impressions?

10.5 PRACTICAL EXERCISES

1. Obtain several pairs of footwear from your trainer. Analyze and document the following features, if present:

    a. General description of color, condition of uppers and outsoles, staining, markings
    b. Make and model
    c. Tag information such as size (men's vs. women's), style number, SKU #s, etc.
    d. Date of collection
    e. Visible damage, wear, mold characteristics
    f. Obvious RACs
        i. Embedded or adhering debris, apparent hair, etc.
        ii. Obvious Schallamach pattern
    g. Limitations of footwear or outsoles
    h. Outsole design

2. Create known test impressions from of the provided footwear*, using various methods including powder/lift, inkless kit, pressing methods (outsole pressed onto lifts or vice versa), and stepping methods (someone wears shoe and steps to make test impressions). Scan and print on transparency sheets. Be sure to include one test impression that is too large to print on a single 8½ x 11 sheet.

    Note *: At least one pair of shoes should have relatively hard, unflexible outsoles while another should have relatively soft, flexible outsoles. Most of the provided footwear should be worn (not new/unused).

    a. Analyze the created test impressions with the corresponding outsole for the following additional features:
        i. General wear
        ii. Specific (location of) wear
        iii. Smaller embedded or adhering debris
        iv. Manufacturer texture
        v. Mold defects
        vi. Smaller RACs (use a stereobinocular microscope, if necessary)

    b. Create additional test impressions using the same methods and same footwear outsoles, but vary the deposit angle, pressure or force, hardness of the support substrate, shape of the support substrate, etc. Analyze all test impressions with the outsole and document the variation and reproducibility of the outsole features, including fine detail and RACs, depending on the conditions, type of outsole, or factors.

TIRES

3. Obtain from your trainer Practical Exercise A, which are duplicate tire test impressions from the same tire section collected one after the other. Examine the test impressions and locate any apparent sand particles based on their appearance and possible lack of persistence between replicates. Discuss how to avoid confusing these as potential RACs with your trainer.

4. Comparison of features between the same and different tire segments.

    a. Obtain from your trainer Practical Exercise B, which are two imprints from the same tire section (S1 and S2). Mark all features in S1 and S2 that appear similar between the two, then all features that appear different between the two. Evaluate the similar features and the dissimilar features, and compare the two groups of marks to determine if there is an objective way to determine that they came from the same tire if the ground truth was not known. Discuss with the trainer.

    b. Obtain one imprint from the same tire section from a different tire (D1) that has the same tread design and physical size as S1 and S2. Repeat the above, using either S1 or S2 and D1. Evaluate if there is an objective difference in the amount or quality or similar (or dissimilar) marks between the two non-matching tire impressions vs. the two matching tire impressions. Discuss with your trainer.

5. Collect partial tire test impressions from all tires on a vehicle via imaging. Image each tire position and sidewall information using mid-range photography, followed by a closeup of that tire's tire tread using exam quality photography. Repeat in sequence for all tire positions.

6. Collect partial tire test impressions from all tires on a vehicle using the adhesive lift method. Attempt lifting just the indigenous debris from the tire and also powdering first.

7. Discuss with your trainer the pros and cons of the following:

    a. Various partial tire test impression methods (e.g. imaging vs. adhesive lifting).

    b. Partial test impression vs. rolled full circumference test impression.

    c. One rolled full circumference test impression vs. two offset, full circumference test impressions.

    d. Full circumference test impression on chart board vs. full circumference test impression on roll wet media film.

8. Using roll transparency film, create full inked exemplars on one front tire and one rear tire of a vehicle (all four tires are not required). Ensure that two exemplars per tire with offsetting starting points around the circumference are created. Mark the tire as one would in casework. Document the process including any challenges encountered. (It recommended that this exercise be coordinated with CSRT and as a group effort with other Impressions analysts/trainees).

9. Analyze the duplicate test impressions created in previous exercise (practical #8) in the same orientation and document the variation and reproducibility of the tread design features, including fine detail and apparent RACs.

    Note: Save the created test impressions for Chapter 11 (Comparisons and Evaluations).

10. Repeat the above exercise, using petroleum jelly and magnetic powder instead of ink on roll transparency film.

11 COMPARISONS AND EVALUATIONS

11.1 OBJECTIVES

- To understand the different methods of conducting comparative examinations and to successfully perform them
- To accurately evaluate the information gained from the comparison process
- To formulate and articulate correct conclusions derived from the comparison process.
- To know how and when shoe size comparison to reference objects may be performed and what information can be provided
- To understand when to request a verification and how to perform a verification

TIRES

- Same as above.
- To successfully locate potential area(s) on a known tire based on noise tread sequence or other tread design features, for further comparison purposes

11.2 TOPIC AREAS

1. Methods of comparisons
   a. Side by side
   b. Superimposition
   c. Digital vs. printed
2. Performing comparisons
   a. Comparison to reference objects (shoe size determination)
   b. Comparison to known objects
3. Evaluation of the comparison
   a. Distortion effects
   b. Tire deflection (tires only)
4. Conclusion formation
   a. SWGTREAD conclusion scale
5. Verification
   a. When to request
   b. How to perform

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- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapters on Impressions and chapters of related Instruments and Techniques].
- ☐ WSP FLSB Forensic Services Guide **(current edition)** [read about Impressions submissions].
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11.4 STUDY QUESTIONS

1. Describe the scientific method and how the impression comparison process generally fits the scientific method.

2. Define what ACE-V stands for and the benefits of following this methodology.

3. Describe different ways an impression may become distorted and how distortion may influence the comparison.

4. True or False? Portions of distorted impressions may still be suitable for examination to an extent that they may even be identified to a known outsole.

5. True or False? A partial impression may be of more value to a comparison than complete impression.

6. Discuss the significance of determining the manufacture date of a known shoe before performing a comparison.

7. Why is the time elapsed between when the questioned impression was deposited to when the known footwear was collected significant information to have when evaluating the comparison data?

8. True or False? A questioned impression can be excluded from being produced by a known outsole based on general wear differences alone. Explain your answer.

9. Explain why a comparison of a questioned impression to a known shoe is not just a simple visual examination that could be made by an untrained lay person.

10. Discuss when and why you should attempt to reproduce or duplicate the questioned impression using the known outsole, and whether duplication of the questioned impression is necessary during a comparison.

11. You created test impressions of known outsoles using the SolePrint inkless kit for comparison purposes. For which of the questioned impression types will you have to reverse the test impressions to ensure proper orientation during the comparison process?

    a. Lifted black gel lift
    b. Image of the lifted black gel lift
    c. Bloody impression on piece of cardboard
    d. Black powdered impression, lifted with latent lift tape and secured to white paper
    e. Image of a 3D impression in soil
    f. Cast of the 3D impression
    g. Image of a soil impression on bathroom counter
    h. White backed adhesive lift of a soil impression, with clear/colorless cover on it

12. Place the following features in the order they are compared in most cases (acknowledging there may be exceptions).

    a. Physical size
    b. Randomly acquired characteristics
    c. General wear
    d. Outsole design
    e. Manufacture applied texture

13. Does the comparison of physical size require the full length or width of the questioned impression to be present? Explain.

14. Explain how many randomly acquired characteristics need to “match” in order to arrive at an identification conclusion. Is there a minimum number?

15. Examine each level of conclusion in the SWGTREAD Range of Conclusion Standard and determine what key portions within the definitions differentiate one conclusion from the next closest options. Summarize in a short and organized way for future reference.

16. Explain how the following features might be evaluated during a comparison for conclusion formation:

    a. manufacture applied texture
    b. mold defect
    c. air bubbles that appeared design related
    d. air bubbles that did not appear design related (exposed from wear)
    e. a feature that you couldn’t determine if it were a RAC or mold defect
    f. a common outsole design
    g. an uncommonly encountered outsole design

17. When the term the “population” of shoes is mentioned in a conclusion in the SWGTREAD Range of Conclusion Standard, it is referring to:

    a. All shoes submitted in the same case
    b. All shoes in the crime scene
    c. All shoes seen in one’s casework experience
    d. All shoes seen in a geographical region
    e. All shoes in the world

18. Multiple choice. When is an analyst required to obtain a verification on a comparison conclusion?

    a. All comparison conclusions, regardless of the conclusion, are required to be verified
    b. Only identification conclusions are required to be verified
    c. Only identification and exclusions other than for outsole/tread design differences are required to be verified
    d. None of the above

19. What materials must the analyst provide to the verifier for the verification? Are digital images alone acceptable?

20. True or False? Verifications are required to be performed “blind”, meaning the verifier is unaware of the original analyst’s conclusion.

21. True or False? Verifications are an independent examination by another qualified analyst to ensure a valid conclusion, by independently comparing the evidence in the same manner that the original analyst did.

22. If the verifier comes to a different conclusion than the original analyst, and it is not an administrative error, then explain how that is resolved and documented (assuming consensus is reached it does not rise to a Technical Difference of Opinion).

23. What materials must be included in the case file after the verification is complete.

24. Are the notes generated by the verifier numbered pages or part of the administrative packet?

TIRES

25. Place the following features in the order they are compared in most cases (acknowledging there may be exceptions).

    a. Physical size
    b. Potential locations based on noise treatment correspondence
    c. Randomly acquired characteristics
    d. General wear
    e. Tread design

26. Describe the process by which one can narrow down the possible locations on a known tire circumference, to compare to a small section of questioned tire impression?

27. Describe how a tire comparison process might differ from a routine footwear impression comparison, given the challenges of collecting inked tire exemplars and the actual tires/wheels. What is a good work approach to such cases, to be efficient and effective yet not waste unnecessary time and effort collecting exemplars or tires/wheels that did not require collection?

28. What features can be compared on a tire impression that is an acceleration or skid mark and what limitations does this type of impression have for the comparison process?

29. What is tire deflection and how does it impact the forensic comparison of tire impressions?

30. Explain how tire wear (bar) indicators may assist the Impressions analyst in a tire impression comparison.

31. How do the conclusions in the SWGTREAD Range of Conclusion Standard need to be modified to apply to tire impression comparisons instead of footwear impression comparisons?

11.5 PRACTICAL EXERCISES

1. The instructor will provide numerous impression comparison exercises in advancing levels of difficulty to build skills and confidence, in Group order. The comparison exercises in Group A must include the listed criteria. Perform the comparisons, evaluate the data, and arrive at the most appropriate conclusions. All steps must be documented.

    a. Group A – Prepared Samples with Ground Truth Answers. This group must include several samples including actual known footwear and questioned impressions on physical objects (not just images).

        i. Multiple CTS or other external proficiency test samples
        ii. Comparison Practical Exercise A. Compare the two impressions from Chapter 9 Practical Exercise 14 to images from two known outsoles (three outsole images and one test impression from each outsole, provided by your trainer). Evaluate the data and arrive at the most appropriate conclusions.
        iii. Comparison Practical Exercise B. Compare the two impressions in to the images from the one pair of known outsoles. Evaluate the data and arrive at the most appropriate conclusions.
        iv. a gel lift
        v. a tape lift
        vi. a cast
        vii. a Schallamach pattern
        viii. manufacture texture
        ix. image of deep 3D impression
        x. a bloody impression requiring chemical enhancement (process if necessary)
        xi. a powdered impression
        xii. a negative impression
        xiii. a soil impression
        xiv. a distorted impression
        xv. an imaged impression with perspective distortion (scale included)
        xvi. impression on curved surface
        xvii. impression on textured surface
        xviii. impression on fabric

    b. Group B – Case Re-Works with Consensus Answers. This group may not include actual known footwear.

        i. Complete some or all of the Bodziak training class exercises provided by your trainer: CE-21, CE-22, CE-25, CE-28, CE-32, CE-32A, CE-45, CE-45A, CE-54, CE-54A, CE-55, CE-66, CE-80, CE-81 and 82, CE-98, CE-107.

    c. Group C – Case Re-Works with No Ground Truth Answers. This group may not include actual known footwear and present with additional limitations.

        i. a case where only images of the outsoles were provided, not the actual shoes
        ii. at least one of the sets of crime scene images analyzed in Chapter 8 Practical #6 (WSP processed)
        iii. at least one of the sets of crime scene images analyzed in Chapter 8 Practical #7 (agency processed)

2. Obtain a questioned impression with a known make/model of impression. Using known footwear of various sizes from the same or similar make/model, perform a comparison and determine the shoe size that best corresponds to the questioned impression. What are the pros and cons of this process and how does it affect conclusion formation?

3. Review several comparison case files that include verification notes, including at least one where there was a differing opinion by the verifier that required discussion or additional work to reach consensus. Discuss with your trainer the workflow of the verification, communication, and structure of the case file overall.

TIRES

4. Overlay duplicate tire tread exemplars created in Chapter 9 in opposite orientations and determine in how many locations the same noise treatment sequence repeats (i.e., the tread design overlays precisely in opposite directions over all ribs) for tread sections measuring 5 inches or longer.

5. Obtain a tire impression cast and an exemplar created from the known tire. Compare the noise treatment sequences to locate all potential spots on the known tire circumference, in either direction, that could have made the section casted. (Do not mark on the exemplar with ink.)

6. Have your trainer provide you several CTS or comparable external vendor provided proficiency test samples (those have known, ground truth answers), starting with basic and moving to more advanced examples. Successfully complete the exercises by utilizing the comparison methodology and obtaining the correct conclusions.

7. Complete Bodziak's training Tire Exercises 201, 202, 210, 211, 217

8. The instructor will provide numerous impression comparison exercises in advancing levels of difficulty. The comparison exercises will include at least one of the following. Perform the comparison, evaluate the data, and arrive at the most appropriate conclusion. All steps must be documented.

    a. a cast
    b. an imaged 3D impression in soil
    c. a 2D soil/mud impression on asphalt,
    d. an impression on fabric

12 MAKE/MODEL SEARCHES

12.1 OBJECTIVES

- To successfully analyze footwear and tire impressions to determine potential make/model of source for investigative leads
- To become familiar with a variety of footwear types, brands, outsole designs, and logos
- To gain an understanding of current sneaker culture and trends, and how this knowledge may assist in make/model investigative searches
- To become proficient in the use of the SoleMate FPX3 software
- To become aware of resources for searching for possible sources of footwear and tire impressions

TIRES

- Same as above.

12.2 TOPIC AREAS

1. Impression analysis
   a. General footwear types (e.g., athletic, skate, boot, lugged, etc.)
   b. General tire types (e.g. all-season, all-terrain, studded, wet weather, etc.)
   c. Logo identification
   d. Common outsole designs
2. SoleMate FPX3
   a. Coding
   b. Searching
   c. Links and link documentation
   d. Record entry
3. Online resources
   a. Retailer websites
      i. Zappos.com, shoemall.com, onlineshoes.com, walmart.com, footlocker.com, cabelas.com, whistleworkwear.com, etc.
   b. Manufacturer websites
      i. Vans, Converse, Adidas, New Balance, Nike, etc.
   c. Resale websites
      i. eBay, Goat.com, stockx.com, etc.
   d. Outsole websites
      i. Vibram B2B, Alibaba
4. Brick and mortar stores
   a. Bridgestone, Les Schwab, etc.
   b. Costco, Walmart, Big 5, Target, etc.
5. Book resources
   a. Tread Design Guide
   b. Who Makes It? And Where?

12.3 READINGS

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- ☐ SoleMate FPX3 User Manual **(current edition)**.
- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapters on Impressions and SoleMate].
- ☐ WSP FLSB Forensic Services Guide **(current edition)** [read about SoleMate requests].

12.4 STUDY QUESTIONS

1. Describe how you can search using SoleMate FPX3. How do you document each search in your case notes?

2. What are the acceptable ways for make/model impression evidence to be submitted to the laboratory and is it the same or different than impression evidence submitted for comparison purposes?

3. What are the requirements for entering electronically submitted images (email) by those performing the SoleMate FPX search? How do these requirements differ between cases with submitted physical evidence vs. cases with emailed images?

4. How might you report make/model footwear search results when SoleMate FPX3 was used but the lack of distinctive information in the impression prevented finding a potential source (e.g. a partial zig-zag pattern only was present)?

5. How would you report the results of a potential make/model that was located from an internet website rather than from SoleMate FPX3?

6. How should information about a potential make/model provided from another colleague be documented?

7. When would you not attempt a make/model search on a submitted questioned impression?

8. How does having a better understanding of current sneaker culture relate to investigative exams and make/model searches?

TIRES

9. You received a make/model tire impression case with an incident date of four months ago. What year of the Tread Design Guide would you start with? What is the oldest year that you might consider looking through? Explain your answers and general approach.

10. Review the different tire types from the practical completed in Chapter 3 as well as additional ones (e.g., all-season, all-terrain, studded, wet weather or rain, construction or agricultural, etc.) Describe what tire tread design elements differentiate the tire types from one another and how those tread elements serve their intended purposes.

12.5 PRACTICAL EXERCISES

1. Examine several outsoles of the following different types of footwear. Describe what features of the outsole design and tread design elements might differentiate footwear impressions from each of these categories during analysis. Show by example.
    a. Work boots (including law enforcement and first responder footwear)
    b. Athletic shoes
        i. Basketball
        ii. Skateboard
        iii. Running or general training
    c. Non-slip shoes or boating shoes
    d. Sandals, flip-flops, etc.
    e. Raised heel vs. flat soled

2. Search the Internet for photos of athletic shoe outsoles and evaluate their outsole designs. Include common brands encountered in casework such as Nike, Converse, Vans, Adidas, FILA, Reebok, New Balance, Sketchers, DC, among others. Document the following:
    a. design features that a particular manufacturer seems to repeatedly use on their shoes or a model line of their shoes
    b. outsole design features that are commonly observed regardless of manufacturer
    c. the manufacturer logos and typefaces encountered

3. Search the Internet for footwear marketed for skateboarding. Document what brands are commonly sold and their outsole design features and logos. Document what websites or search terms/tools are helpful to find this information and images.

4. Refer to the Supplemental Document referring to Sneaker Culture/Trends on the CLD portal and review the resources listed. Discuss with your trainer what current sneakers are popular, why they are collected, their resale value, and how they coordinate with fashion and culture.

5. Look up Vibram soles, including the Vibram B2B website, and review the different outsoles they make. Create an image composite of several example outsoles that might be encountered.

6. The instructor will provide multiple logos. Identify what they are using the SoleMate FPX3 software or other resources.

7. The instructor will provide multiple, high quality footwear outsoles designs. Code them in SoleMate FPX as you would a questioned impression.
    a. Find the footwear record in the SoleMate database
    b. Compare your coding steps to the entry in the reference database, and describe how they were similar or different.

8. The instructor will provide numerous footwear impressions that are similar to the quality encountered in casework (or are case sample re-works). Analyze the impressions and find the possible sources of the impressions using various resources including SoleMate FPX, internet resources, retail stores, etc., if possible. Document the process.

9. Review several footwear make/model search case files from other qualified analysts. Focus on work flow and case structure. Describe what methods were successful and unsuccessful for each search.

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10. Review the most current years available of the following references:
    a. Tread Design Guide, Product Book, Tire Guides, Inc., Boca Raton, Annual Publication
    b. Who makes it? And Where? Directory, Product Booklet, Tire Guides, Inc., Boca Raton, Annual Publication.

11. Review several tire make/model search case files from other qualified analysts. Focus on work flow and case structure. Describe what methods were successful and unsuccessful for each search.

12. Obtain one or more tire tread impressions of varying quality, including approximate date the impression was made (if applicable), from your instructor. Use the resources available to you to find what make/model of tire created the impression.

13. Complete Tire Exercises 1-4.

13 MISCELLANEOUS IMPRESSION COMPARISONS

13.1 OBJECTIVES

- To learn how to analyze, compare, and evaluate impressions created from other manufactured patterned objects such as fabric, weapons, etc.
- To learn how to compare patterned impressions on skin
- To understand how skin substrates affect impression formation and retention
- To be aware of what can be done with barefoot impressions and which discipline would be responsible for those analyses
- To understand the limitations of shoe size estimations from crime scene impressions and estimating the height and weight of an individual based on impression size

13.2 TOPIC AREAS

1. Miscellaneous patterned objects
   a. Fabric
      i. Clothing (e.g. jeans, t-shirt, socks, etc.)
      ii. Footwear uppers
   b. Other sources
   c. Weapons (e.g. iron, bicycle chain, belt buckle, etc.)
   d. Textured plastic objects
      i. Footwear midsoles or foxing strips
   e. Vehicle parts
   f. Other sources
2. Skin substrate
   a. Blunt force trauma injury patterns
      i. Formation of impressions
   b. Burn patterns
   c. Limitations of skin impressions
3. Other related examinations
   a. Barefoot (shape and size) comparisons
   b. Barefoot ridge detail comparisons
   c. Height, weight, shoe size estimations

13.3 READINGS

- ☐ Adolf FP **(1999)** “Chapter 2: The Structure of Textiles: an Introduction to the Basics” in *Forensic Examination of Fibres*, 2nd edition, Eds. Robertson J and Grieve M, Taylor and Francis, Philadelphia.
- ☐ Bailey R, Curran MJ, and Vernon DW **(2017)** “An investigation into whether a bare footprint alters in length and width after jumping from a fixed height” *Journal of Forensic Identification* 67(1): 31-44.
- ☐ Baker HC, Marsh N, and Quinones I **(2013)** “Photography of faded or concealed bruises on human skin” *Journal of Forensic Identification* 63(1): 103-125.
- ☐ Bodziak WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read pp 88-91 from chapter 3].

- ☐ Bodziak WJ **(2017)** *Forensic Footwear Evidence: Practical Aspects of Criminal and Forensic Investigations*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 6 and 18].
- ☐ Collier BJ, Bide MJ, and Tortora PG **(2008)** *Understanding Textiles*, 7th edition, Pearson Prentice Hall, New Jersey [read chapters 15, 16, 17, and 18].
- ☐ Collier I **(2009)** "How It's Made Plastic Injection Molds" YouTube video from Oct 7, 2009 (https://www.youtube.com/watch?v=seZqq1qxW30)
- ☐ Mohan R **(2016)** "Patterned bruising caused by an automobile tyre: an accurate guide to the mechanism of injury" *South African Journal of Surgery* 54(1): 49-50.
- ☐ Rao VJ **(1986)** "Patterned injury and its evidentiary value" *Journal of Forensic Sciences* 31(2): 768-772.
- ☐ Star Rapid **(2021)** "5 Methods for Applying Textures to Plastic Injection Mold Tools: Serious Engineering – Ep13" YouTube video from April 29, 2021 (https://www.youtube.com/watch?app=desktop&v=i7ERckH7t04).
- ☐ Strauch H, Wirth I, Taymoorian U, and Geserick G **(2001)** "Kicking to death – forensic and criminological aspects" *Forensic Science International* 123(2-3): 165-171.
- ☐ Tuthill H **(1987)** "Discussion of 'Patterned injury and its evidentiary value'" *Journal of Forensic Sciences* 32(2): 312-313.
- ☐ Zugibe FT and Costello JT **(1986)** "Identification of the murder weapon by intricate patterned injury measurements" *Journal of Forensic Sciences* 31(2): 773-777.

13.4 STUDY QUESTIONS

1. Can an identification be rendered from the comparison of a barefoot impression found at a crime scene to a suspected individual's foot?

    a. Who would conduct this comparison and why?

2. Can a suspect's height or weight be accurately determined from a footwear impression?

    a. Is this an examination performed by our laboratory? Explain why or why not.

3. Describe the research into the individuality of the shape and size of the human foot, and how this might assist in an investigation.

    a. How would questioned foot print evidence be collected?

    b. How would known impressions of the foot be collected?

    c. True or False? This is a routine type of Impressions comparison conducted in the laboratory.

    d. If this type of comparison were to be performed in Impressions, what Quality Assurance procedures and/or approvals would have to occur first?

4. Describe some key features of both woven vs. knit fabrics and how they are generally manufactured.

    a. What are some specific types of woven and knit fabrics?

5. What type of fabric construction type is typically used for the following?

    a. Denim
    b. T-shirts
    c. Men's button down dress shirt
    d. Ribbed tank top (under garment)
    e. Fleece sweatshirt

6. Describe generally how molded plastic parts are manufactured, include the different ways texture can be applied to the molds.

7. An apparent socked foot impression is encountered at a crime scene and is imaged for comparison. The suspect's laundered socks are submitted as the known object. Describe which discipline would handle this request and the how the Analysis, Comparison, and Evaluation phases would be applied.

8. Describe how blunt force pattern injuries are anatomically caused.

9. Describe how blunt force impressions created on skin are different than typical impressions created on floors, doors, objects, and other substrates.

10. True or False? There are typically more limitations to the comparison of blunt force pattern injuries on skin due to the substrate, nature of the patterned object, changing nature of the impression (on a living individual), position on the body, and other factors.

11. Explain why footwear or tire impressions on skin are best compared by a trained Impressions analyst and not well-intentioned investigators, pathologists, or coroners.

12. Describe how to photograph blunt force pattern injuries on skin and what challenges such substrates pose over most typical impression substrates encountered in casework.

13. Would the normal use of a fabric garment exhibit wear in such a way that it would be visible in an impression, in a manner similar to footwear outsoles and tire treads?

    a. Given the answer to the question above, would some options and/or definitions in the conclusion scale not apply or need to be adjusted for fabric comparisons? Explain your answer.

14. Re-answer questions 13 and 13a if the known object was:

    a. the patterned and textured foxing strip on a shoe

    b. the rigid plastic toy baseball bat having a textured surface

13.5 PRACTICAL EXERCISES

1. Prepare several test impressions from various fabric types, such as the ones listed in the study question 5 above. Make an impression from both sides if each side looks different. Photograph and document the results.

2. Make several questioned impressions and test impressions from various patterned or textured objects on different substrates and using different matrices. Observe and document the reproducibility and variability of the patterns and features under the different conditions used. Discuss with your trainer the results.

3. Using a rigid toy, weapon, or object having a patterned surface or shape, create test impressions using a 2D method vs. a 3D method (e.g. Biofoam, clay, etc.). Document the difference in features replicated with each method and discuss with your trainer when you might use one versus the other.

4. Your trainer will provide you images of skin injuries and other miscellaneous impressions. Analyze each for suitability for comparison and discuss your analyses with your trainer.

5. Review case files from previous analysts related to the following evidence types. Describe how the questioned impressions were collected, how the analysis and comparison was conducted and documented, and how the conclusions were reported.

    a. Fabric impressions

    b. Patterned impressions from other suspected objects

    c. Blunt force pattern injury cases or skin impressions

6. Sketch or describe what a blunt force trauma impression might look like if someone were struck with the end corner of a 2x4 piece of wood. Document and discuss with your trainer how this might change if:

    a. The angle of the wood changed

    b. The position of the individual changed

    c. The body location was different (curved body part vs flat body part, etc.)

7. If possible, observe the formation and healing of a skin contusion caused by a known patterned or shaped object. Photograph the process. Describe how consistently the contusion maintained the shape of the source object and what factors may have influenced the contusion's appearance. (The completion of this particular practical exercise will not prevent successful completion of Study Segment 10.0 or the training program as a whole, and does not imply nor suggest purposefully causing injury.)

14 MOCK CASEWORK

14.1 OBJECTIVES

- To demonstrate the ability to perform and properly document Impressions footwear casework
- To demonstrate appropriate report writing skills
- To successfully apply all previously acquired skills and abilities in this training program and demonstrate the ability to perform all tasks expected in normal casework
- To understand the verification procedure and how to successfully conduct a verification
- To understand the technical review procedure and how to successfully perform a technical review

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- Same as above.

14.2 TOPIC AREAS

1. Notes
    a. Type of documentation
        i. Handwritten, typed
        ii. Photographs
        iii. Sketches
        iv. Contact sheets, comparison sheets, overlays
        v. Hard copy, digital, or combination
    b. Organization and content
        i. Questioned evidence
            1. Documentation of evidence received
            2. Analysis of impressions and images
        ii. Known evidence
            1. Documentation of evidence received
            2. Analysis of known or reference object
            3. Analysis of test impressions
        iii. Comparison notes
            1. Observations, limitations, evaluations
            2. Use of overlays and/or photographs
        iv. Conclusion statements
            1. Limitations
        v. Final notes assembly (post-verification)
2. Report writing
    a. Organization
    b. Required elements
    c. Conclusions
        i. Limitation statements

3. Verification
   a. Methodology
      i. Materials to provide/receive
      ii. Post-verification consensus and follow-up work (if applicable)
4. Technical review

14.3 READINGS

- ☐ Found B and Edmond G **(2012)** "Reporting on the comparison and interpretation of pattern evidence: Recommendations for forensic specialists" *Australian Journal of Forensic Sciences* 44(2): 193-196.
- ☐ SWGTREAD 10 **(03/2013)** Range of Conclusions Standard for Footwear and Tire Impressions Examinations, Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ SWGTREAD 13 **(03/2008)** Guide for Casework Documentation, Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ WSP CLD MA Technical Procedures Manual **(current edition)** [read chapter on Impressions and related Appendices].
- ☐ WSP CLD Quality Operations Manual **(current edition)** [read chapter on Case Management].

14.4 STUDY QUESTIONS

1. True or False. It is best practice to report the presence of other impressions seen during the examination that were not analyzed or selected for comparison.
2. What are some of the required elements or content included in Impression reports?
3. What is the difference between the verification and technical review processes?
4. What comparison conclusions require verification? Do the verifications need to be independent?
5. Can a verification be done on images alone? Under what circumstances would the actual evidence need to be examined?
6. What qualifying statement(s) are to be included in a make/model search reports that include a list of shoes sources?
7. Under what circumstances might an opinion statement need to be reported in an impression report?
8. When would limitations need to be reported in an impressions report?
9. Discuss the technical review process and its documentation elements with your instructor. What are the roles and responsibilities of the technical reviewer and the analyst?
10. How are verifications and technical reviews accomplished when the reviewer is located in another laboratory?
11. What notes is a verifier required to take? What happens to those notes?
12. If the verifier agrees with the analyst's conclusion, what is the minimum documentation for that?
13. Assume the analyst concludes "class association" for a particular comparison, but the verifier thinks it should be "high degree of association". Also, assume both parties arrive at a consensus that a "high degree of association" conclusion is appropriate, after discussion. How should the changes be documented?

14. What needs to occur before it is determined there is a technical difference of opinion and that quality assurance procedure is implemented?

14.5 PRACTICAL EXERCISES

1. Review previous reports that include opinion statements. Describe what the statements were and why they were included in those reports.
2. Review previous reports that include statements regarding limitations in the examination or comparison process. Describe what the statements were and why it was important to include them in those reports.
3. Review at least 5 footwear Impressions case files. A representative file from each Impressions analyst should be included in the mix. Both comparisons and make/model searches should be included in the mix. Note how the separate steps of ACE-V or make/model searches were documented. Discuss your observations with your trainer.
4. Work multiple footwear Impressions mock cases as if they were real cases. These cases should be realistic in the type of evidence submitted. At least one of the mock cases should include a footwear comparison, a footwear make/model search, and an "other" type of impression comparison. Additionally, at least one should include impression(s) in submitted image(s) and at least one should include a physical evidence object on which an impression is directly deposited. Follow the requirements of the Technical Manual and include a draft report.

   After each mock case is complete, turn it in to your trainer for review and discussion prior to completing the next mock case.
5. Perform at least 2 practice verifications as if they were real cases. Generate the documentation required by the Technical Manual.

   Review and discuss the first completed verification with your trainer prior to beginning the next one.
6. Perform at least 3 practice technical reviews, including at least 1 comparison and at least 1 make/model search. These may be done on the same cases as reviewed in practical #3 above.

   Review and discuss each completed technical review with your trainer prior to beginning the next one.
7. Discuss with your trainer and/or other qualified analysts how common it is for a technical difference of opinion to occur in Impression casework. Discuss what kinds of verification differences are most commonly encountered.

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8. Review at least 3 tire Impression case files. A representative file from each Impressions analyst should be included in the mix. Both comparisons and make/model searches should be included in the mix. Note how the separate steps of ACE-V or make/model searches were documented. Discuss your observations with your trainer.
9. Discuss with your trainer different ways to document the potential locations found on a K tire that were similar in pitch sequence to the Q impression and subsequently compared further.
10. Work multiple tire Impression mock cases as if they were real cases. These cases should be realistic in the type of evidence submitted. At least one of the mock cases should include a tire comparison and one a tire make/model search. Additionally, at least one should include impression(s) in submitted image(s) and at least one should include a physical evidence object on which an impression is directly deposited. Follow the requirements of the MATP and include a draft report.

15 HUMAN FACTORS

15.1 OBJECTIVES

- To understand human factors which can impact a forensic examination
- To understand the different kinds of bias
- To understand the sources of bias in Impressions casework and how to minimize it

15.2 TOPIC AREAS

1. Types of bias
2. Sources of bias in Impressions casework
3. Minimization of bias
4. Other human factors affecting casework

15.3 READINGS

- ☐ Dror IE, Charlton D, and Pėron AE **(2006)** "Contextual information renders experts vulnerable to making erroneous identifications" *Forensic Science International* 156(1): 74-78.
- ☐ Edmond G **(2017)** "Thinking forensics: Cognitive science for forensic practitioners" *Science and Justice* 57(2): 144-154.
- ☐ Kassin SM, Dror IE, and Kukucka J **(2013)** "The forensic confirmation bias: Problems, perspectives, and proposed solutions" *Journal of Applied Research in Memory and Cognition* 2(1): 42-52.
- ☐ Kerstholt JH, Paashuis R, and Sjerps M **(2007)** "Shoe print examinations: Effects of expectation, complexity and experience" *Forensic Science International* 165(1): 30-34.
- ☐ Morris J **(2015)** *Issues of Bias in Forensic Science*, presentation at the Impression Pattern and Trace Evidence Symposium, San Antonio, Texas.
- ☐ Sneyd D, Compo NS, Rivard J, Pena M, Stoiloff S, and Hernandez G **(2020)** "Quality of laypersons' assessment of forensically relevant stimuli" *Journal of Forensic Sciences* 65(5): 1507-1516.
- ☐ Stacey RB **(2005)** "Report on the erroneous fingerprint individualization in the Madrid train bombing case" *Forensic Science Communications* 7(1), Electronic Download on October12, 2021 from https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/jan2005/special_report/2005_special_report.htm.
- ☐ WSP CLD Materials Analysis Technical Procedures Manual, Chapters 27.
- ☐ WSP CLD Quality Operations Manual, Chapter 10.

15.4 STUDY QUESTIONS

1. Define contextual and confirmation bias.
2. Describe specific ways that bias can influence the impression examination and decision making process.
3. What are some ways to help mitigate bias in the impression discipline?
4. What were some of the root cause factors responsible for the erroneous fingerprint individualization in the Madrid Train Bombing case? Explain how these lessons are relevant to the impression comparison process.

5. List several human factors other than bias that can impact an examination. Explain why?

15.5 PRACTICAL EXERCISES

1. Discuss with your trainer and other analysts experiences they have encountered with bias in their Impressions casework.
2. Discuss with your trainer how the forensic profession has changed in its attitude about bias and its the response to bias over time.
3. Discuss with your trainer ways that human factors other than bias can impact an examination.

16 LEGAL CONSIDERATIONS

16.1 OBJECTIVES

- To understand the scientific validity and reliability of the impression discipline
- To know the proper foundation for acceptance as an expert witness in the area of footwear impression examination
- To effectively present testimony in the area of impression examinations and identifications.
- To prepare footwear impression evidence for use as demonstrative evidence in a court of law
- To successfully articulate how the ACE-V methodology and the scientific method apply to an impression comparison
- To understand what was contained in the NAS and PCAST reports related to the Impression discipline and the professional responses to those reports

16.2 TOPIC AREAS

1. Legal standards for expert testimony
   a. Frye v. United States
   b. Federal Rules of Evidence 702
   c. Daubert v. Merrell Dow Parmaceuticals, Inc.
2. Qualifications
3. Courtroom procedure
4. Scientific validity and reliability of impression comparisons
5. ACE-V and scientific c method
6. Demonstrative Evidence

16.3 READINGS

- ☐ ANSI/ASB Standard 095 **(current edition)** Standard for Minimum Qualifications and Training for a Footwear/Tire Forensic Science Service Provider.
- ☐ ANSI/ASB Standard 099 **(current edition)** Standard for Footwear/Tire Examination Proficiency Testing Program.
- ☐ ASB Technical Report 051 **(current edition)** Scope of Work for a Footwear/Tire Examiner.
- ☐ Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 **(1993)** – case decision
- ☐ Federal Rules of Evidence 702. Testimony by Expert Witnesses – link with notes at: https://www.law.cornell.edu/rules/fre/rule_702.
- ☐ Frye v. United States (**1923**) – case decision.
- ☐ Berger CEH, Buckleton J, Champod C, Evett IW, and Jackson G **(2011)** "Evidence evaluation: A response to the court of appeal judgment in R v T*" Science and Justice* 51: 43–49.
- ☐ Bodziak WJ **(2017)** *Forensic Footwear Evidence: Practical Aspects of Criminal and Forensic Investigations*, CRC Press (Taylor & Francis Group); Boca Raton [read chapters 17 and 20].
- ☐ Christensen AM, Crowder CM, Ousley SD, and Houck MM **(2014)** "Error and its meaning in forensic science" *Journal of Forensic Sciences* 59(1): 123-126.
- ☐ Eldridge H **(2019)** "Juror comprehension of forensic expert testimony: A literature review and gap analysis" Forensic Science International: Synergy 1: 24-34.

- ☐ Hilderbrand DS and D'Amour L **(2020)** *Footwear, The Missed Evidence: A Guide to the Documentation, Collection, and Preservation of Forensic Footwear Evidence*, 4rd Ed., Independently published [read chapter 12].
- ☐ Homer C **(2004)** U.S. v Mahone Daubert Presentation on Footwear Impression Evidence, Presented at the Daubert hearing of U.S. v Mahone. Electronic Download on October 8, 2021 from https://treadforensics.com/index.php/presentations
- ☐ Homer C **(2007)** Daubert Issues for Footwear Examiners, Presented at the IAI Education Conference 2007, Electronic Download on October 8, 2021 from https://treadforensics.com/index.php/presentations.
- ☐ Izraeli ES, Wiesner S, and Shor Y **(2011)** "Computer-aided courtroom presentation of shoeprint comparison" *Journal of Forensic Identification* 61(6): 549-559.
- ☐ Morrison GS **(2012)** "The likelihood-ratio framework and forensic evidence in court: A response to R v T" *The International Journal of Evidence & Proof* 16: 1-29.
- ☐ Page M, Taylor J, and Blenkin M **(2011)** "Forensic identification science evidence since Daubert: Part I – A quantitative analysis of the exclusion of forensic identification science evidence" *Journal of Forensic Sciences* 56(5): 1180–1184.
- ☐ Redmayne M, Roberts P, Aitken C, and Jackson G **(2011)** 'Forensic science evidence in question" reprinted from *Criminal Law Review* 5: 347-356.
- ☐ Robertson B, Vignaux GA, and Berger CEH **(2011)** "Extending the confusion about Bayes" *The Modern Law Review* 74(3): 430-455.
- ☐ SWGTREAD 06 **(03/2005)** Scope of Work Relating to Forensic Footwear and/or Tire Tread Examiners, Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ SWGTREAD 07 **(03/2006)** Guide for Minimum Qualifications and Training for a Forensic Footwear and/or Tire Tread Examiner, Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ Thornton JI and Murdock JE **(2020)** "Correspondence: Why is Subjective a Naughty Word?" *AFTE Journal* 52(1): 3-6.
- ☐ Wiersema S **(2004)** Daubert Factors Applied to the Examination of Footwear Evidence presented to the IAI Educational Conference in 2004, Electronic Download on October 8, 2021 from https://treadforensics.com/index.php/presentations.
- ☐ Gross (**2010**) Footwear Impression Evidence – Presentation for a Daubert Hearing, Minnesota BCA
- ☐ National Research Council **(2009)** Strengthening Forensic Science in the United States: A Path Forward (NAS Report) https://www.ojp.gov/pdffiles1/nij/grants/228091.pdf
- ☐ PCAST **(2011)** – Forensic Science in Criminal Courts – Ensuring Scientific Validity of Feature-Comparison Methods https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_forensic_science_report_final.pdf

- ☐ SWGTREAD Responses to the NAS Report at: https://treadforensics.com/index.php/nas/swgtread-to-nas
    - Current Status of the Forensic Footwear and Tire Tread Examination Discipline
    - Identification and Clarifications of Inaccuracies in the National Academy of Sciences (NAS) Report
    - Suggestions for the Advancement of the Discipline of Forensic Footwear and Tire Tread Evidence.
    - SWGTREAD (Scientific Working Group for Shoeprint and Tire Tread Evidence) 2007 Input to the National Academy of Sciences.
- ☐ Open Letter of Response to the National Academy of Sciences Report from the Scientific Working Group on Shoeprint and Tire Tread Evidence.
- ☐ OSAC Footwear & Tire Subcommittee's Response to the President's Council of Advisors on Science and Technology's (PCAST) Request for Information – Submitted December **2015** Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.
- ☐ OSAC Footwear & Tire Subcommittee's Foundational Studies Related to Footwear Impression Evidence – Electronic Download on October 8, 2021 from https://www.nist.gov/osac/footwear-tire-subcommittee.

TIRES

- ☐ Bodziak WJ **(2008)** *Tire Tread and Tire Track Evidence: Recovery and Forensic Examination*, CRC Press (Taylor & Francis Group); Boca Raton [read chapter 11].
- ☐ Nause L **(2001)** *Forensic Tire Impression Identification*, Canadian Police Research Centre; Ottawa, ON [read pp 218-222 and 246-249].

16.4 STUDY QUESTIONS

1. Describe the requirements for court testimony monitoring and the associated documentation.
2. What was determined to be the primary criteria of scientific admissibility in the Frye decision?
3. Summarize the points of scientific admissibility addressed in the Daubert decision and how an Impressions analyst might respond to each of them.
4. Who was determined to be the gatekeeper of the reliability of an expert's testimony based on an assessment of the methodology used, according to the Daubert decision?
5. Which is the standard of scientific evidence admissibility in your jurisdiction?
6. Compare the admissibility requirements of your legal standard to Daubert. Repeat question #2 for any differences in your standard vs. Daubert.
7. Summarize the statements made in the NAS and PCAST reports and the various responses made by the Impression profession. Discuss with your trainer.
8. Explain the difference between objective and subjective data or measurements. Is the comparison of impression evidence primarily subjective or objective in nature, and how is it valid?
9. Describe the procedures that help to ensure the accuracy and reliability of impression comparison conclusions in the laboratory?
10. Explain how the ACE-V methodology is applied to the impression examination and comparison process.

11. Describe what the scientific method is and how the ACE-V method is a modification of the scientific method.
12. Does the CLD meet all the requirements listed in ANSI/ASB Standard 095? If not, how and why not?
13. Review ASB Standard 099 with your Instructor and discuss how the criteria are met by the proficiency tests purchased by CLD.
14. Review SWGTREAD Daubert materials available online (Tread Forensics), specifically those related to previous trial court and appellate court testimonies, and discuss with your Instructor.

16.5 PRACTICAL EXERCISES

1. Discuss with your Instructor and other Impressions analysts their experiences testifying about Impression casework. Focus on the following situations if they occurred:
    a. scientific or evidence admissibility hearing (e.g. Daubert hearing)
    b. challenging testimony (e.g. aggressive attorneys, did not know answer to questions, stressful or long, etc.)
    c. complicated testimony (e.g. many exhibits, unprepared attorneys, terminology or words that were prohibited from use, etc.)
    d. testimony with visual aids (e.g. PowerPoint testimony, court displays)
    e. testimony with the press present
2. Discuss with your trainer what positive effects both the NAS and PCAST reports had on the Impression professional community and discipline as a whole, including what changes in methodology and research have taken place.
3. Observe Impressions related testimony in person, if possible. Zoom/Internet testimony and/or transcript review of Impression testimony is recommended. The completion of this practice exercise will not prevent successful completion of Chapter 15 or the training program as a whole.
4. Discuss with your trainer the following aspects of courtroom procedure for familiarity:
    a. Swearing in
    b. Voir dire
    c. Order of questioning, direct, cross-examination, etc.
    d. Objections, objection rulings, and how to respond
    e. Being excused (or not)
    f. How to address the judge, jury, attorneys, etc.
    g. Appropriate attire and behavior
5. Prepare a digital court display illustrating a comparison you did from one of your mock cases. Present it as you would during testimony.
6. Prepare your Impressions qualifications and verbally present them to your trainer.
7. Participate in an oral practice session giving verbal answers to typical court questions related to Impression analysis.

17 IMPRESSIONS TRAINING CHECKLIST

Trainer Name: **Trainee Name:**	Trainee Initials/Date	Trainer Initials/Date	Time for Completion
1 Introduction			
Materials on Isilon Drive			
2 Impressions Formation and Evidentiary Value			
Readings ☐ Footwear ☐ Tire			
Questions			
Exercises ☐ Footwear ☐ Tire			
3 Terminology			
Readings ☐ Footwear ☐ Tire			
Questions ☐ Footwear ☐ Tire			
Exercises ☐ Footwear ☐ Tire			
4 Manufacturing			
Readings ☐ Footwear ☐ Tire			
Questions ☐ Footwear ☐ Tire			
Exercises ☐ Footwear ☐ Tire			

Trainer Name: **Trainee Name:**	Trainee Initials/Date	Trainer Initials/Date	Time for Completion
5 Lifting and Casting			
Readings ☐ Footwear ☐ Tire			
Questions			
Exercises ☐ Footwear ☐ Tire			
6 Chemical Enhancements			
Readings			
Questions			
Exercises			
7 Imaging – Photography and Scanning			
Readings ☐ Footwear ☐ Tire			
Questions ☐ Footwear ☐ Tire			
Exercises ☐ Footwear ☐ Tire			
8 Image Processing / PS / ADAMS			
Readings			
Questions			
Exercises			

Trainer Name: **Trainee Name:**		Trainee Initials/Date	Trainer Initials/Date	Time for Completion
9	Analysis			
	Readings ☐ Footwear ☐ Tire			
	Questions ☐ Footwear ☐ Tire			
	Exercises ☐ Footwear ☐ Tire			
10	Test Impressions and Feature Reproducibility			
	Readings ☐ Footwear ☐ Tire			
	Questions ☐ Footwear ☐ Tire			
	Exercises ☐ Footwear ☐ Tire			
11	Comparisons and Evaluations			
	Readings ☐ Footwear ☐ Tire			
	Questions ☐ Footwear ☐ Tire			
	Exercises ☐ Footwear ☐ Tire			

Trainer Name: **Trainee Name:**	Trainee Initials/Date	Trainer Initials/Date	Time for Completion
12 Make/Model Searches			
Readings ☐ Footwear ☐ Tire			
Questions ☐ Footwear ☐ Tire			
Exercises ☐ Footwear ☐ Tire			
13 Miscellaneous Impression Comparisons			
Readings			
Questions			
Exercises			
14 Mock Casework			
Readings			
Questions			
Exercises ☐ Footwear ☐ Tire			
15 Human Factors			
Readings			
Questions			
Exercises			

Trainer Name: **Trainee Name:**	Trainee Initials/Date	Trainer Initials/Date	Time for Completion
16 Legal Considerations			
Readings ☐ Footwear ☐ Tire			
Questions			
Exercises			
Written Test			
Competency Exam			
Oral Testimony Exam/Moot Court			