

ANSI/ASB Best Practice Recommendation 050, First Edition
2021

Errata 1, 2022

**Best Practice Recommendation for Photographic
Documentation of Footwear and Tire Impression
Evidence**



Best Practice Recommendation for Photographic Documentation of Footwear and Tire Impression Evidence

ASB Approved November 2020

ANSI Approved August 2021



410 North 21st Street
Colorado Springs, CO 80904

This document may be downloaded for free at: www.aafs.org/academy-standards-board

This document is provided by the AAFS Academy Standards Board. Users are permitted to print and download the document and extracts from the document for personal use, however the following actions are prohibited under copyright:

- *modifying this document or its related graphics in any way;*
- *using any illustrations or any graphics separately from any accompanying text; and,*
- *failing to include an acknowledgment alongside the copied material noting the AAFS Academy Standards Board as the copyright holder and publisher.*

Users may not reproduce, duplicate, copy, sell, resell, or exploit for any commercial purposes this document or any portion of it. Users may create a hyperlink to www.aafs.org/academy-standards-board to allow persons to download their individual free copy of this document. The hyperlink must not portray AAFS, the AAFS Standards Board, this document, our agents, associates and affiliates in an offensive manner, or be misleading or false. ASB trademarks may not be used as part of a link without written permission from ASB.

The AAFS Standards Board retains the sole right to submit this document to any other forum for any purpose.

Certain commercial entities, equipment or materials may be identified in this document to describe a procedure or concept adequately. Such identification is not intended to imply recommendations or endorsement by the AAFS or the AAFS Standards Board, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose.

*This document is copyrighted © by the AAFS Standards Board, LLC. 2020 All rights are reserved.
410 North 21st Street, Colorado Springs, CO 80904, www.aafs.org/academy-standards-board.*

Foreword

This document was revised, prepared, and finalized as a standard by the Footwear and Tire Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Footwear and Tire Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science. This document is a revision of the SWGTREAD Guide for the Forensic Documentation and Photography of Footwear and Tire Impression Evidence at the Crime Scene.

The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2015 with a vision of safeguarding Justice, Integrity and Fairness through Consensus Based American National Standards. To that end, the ASB develops consensus based forensic standards within a framework accredited by the American National Standards Institute (ANSI), and provides training to support those standards. ASB values integrity, scientific rigor, openness, due process, collaboration, excellence, diversity and inclusion. ASB is dedicated to developing and making freely accessible the highest quality documentary forensic science consensus Standards, Guidelines, Best Practices, and Technical Reports in a wide range of forensic science disciplines as a service to forensic practitioners and the legal system.

Questions, comments, and suggestions for the improvement of this document can be sent to AAFS-ASB Secretariat, asb@aafs.org or 401 N 21st Street, Colorado Springs, CO 80904.

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

ASB procedures are publicly available, free of cost, at www.aafs.org/academy-standards-board.

Keywords: *footwear; tire impressions; photography; documentation.*

Table of Contents

1	Scope.....	1
2	Normative References.....	1
3	Terms and Definitions.....	1
4	Recommendations.....	1
4.1	Equipment and Materials.....	1
4.2	Documentation and Photography of Footwear Impressions at the Scene.....	2
4.3	Documentation and Photography of Tire Impressions at the Scene.....	4
4.4	Photography of Footwear and Tire Evidence in the Laboratory.....	6
	Annex A Image Resolution Calculations.....	7
	Annex B (informative) Bibliography.....	10
	Figure A.1—Definition of Variables Assuming a “Pinhole” Camera.....	7

Best Practice Recommendation for Photographic Documentation of Footwear and Tire Impression Evidence

1 Scope

This document provides the best practice recommendations for personnel responsible for photographic documentation footwear and tire impressions for future examinations. Deviations from this document may/may not preclude examination of captured images. The procedures included in this document may not cover all aspects of footwear and tire photography. This document is not intended as a substitute for training in the documentation and photography of footwear and tire track evidence.

2 Normative References

There are no normative reference documents; Annex B, Bibliography, contains informative references.

3 Terms and Definitions

Please refer to terms and definition included in ASB Technical Report 097, *Terminology Used for Forensic Footwear and Tire Evidence*, First Edition 2019^a.

4 Recommendations

4.1 Equipment and Materials

Recommended equipment and materials that should be used to document and photograph footwear and tire impressions are listed as following:

- a) a digital camera with interchangeable lens and with the following features:
 - 1) minimum 12 megapixel (approximately 23 mm × 15 mm) sensor (see Annex A);
 - 2) manual focus capability;
 - 3) off camera flash capability;
 - 4) a fixed normal focal length lens (50 mm equivalent on a full frame sensor), or a zoom lens appropriately set to the normal focal length;
 - 5) built-in timer, shutter release cable cord, or other remote control;
- b) flash or other evenly distributed white light source. Flashlight illumination is not recommended;
- c) tripod/quadrupod capable of various angles and positions;

^a www.aafs.org/academy-standards-board

- d) angle finder;
- e) object to indicate direction of light/flash (golf ball marker or similar);
- f) compass;
- g) objects/material (e.g., dark cloth or umbrella) to block sun or bright ambient light;
- h) rigid tape measure (of sufficient length to cover the length of the tire impression) with mm and/or $\frac{1}{8}$ in. gradations;
- i) thin rigid "L-shaped" scale for footwear and straight flat scale for tire impressions;
- j) level;
- k) evidence markers bearing numbers or letters;
- l) labels to indicate evidence marker number, case number, and an arrow pointing north, etc.

NOTE Video recording equipment, although adequate for providing documentation of the scene and evidence, is not adequate for examination quality photographs.

4.2 Photographic Documentation of Footwear Impressions at the Scene

These procedures should be followed, as appropriate, for documenting and photographing footwear impressions. The order of the following steps may vary.

While photography should be the initial method for documenting footwear and tire impressions, it is not a substitute for casting or lifting of footwear and tire impressions. Photography complements other recovery processes to capture the most information from an impression.

- a) Capture overall images of the crime scene in-situ before moving evidence or including any photographic evidence markers.
- b) Evaluate the overall scene and available information to determine locations of footwear impressions to be photographed.
- c) Include the case number, date, time, location of scene, conditions at scene and scene responders in the field notes.
- d) A sketch of the scene and the footwear impressions within may also be required on a case by case basis, especially when reconstructing the paths and movement of persons leaving the impressions.
- e) Place evidence markers next to the impressions.
- f) Capture overall, medium range and close-up images of the footwear impressions as follows.
 - 1) Overall images should be captured from at least four different (approximately perpendicular) angles around the perimeter of the scene.

- 2) Medium range images should show relationships among fixed items in the scene and other impressions or evidence. To show the spatial relationship between two items, images should be captured perpendicular and mid-point to a straight line that connects the items of interest.
 - 3) Close-up images should be captured to associate an impression with the evidence marker.
- g) Capture examination quality images of the footwear impressions as follows.
- 1) Set the camera to capture images in an uncompressed or in a lossless format (e.g., TIFF or RAW).
 - 2) Set the camera to its lowest native ISO.
 - 3) Position camera on tripod or quadrapod with focal plane parallel to the impression plane. This will require the use of an angle finder.
 - 4) Place “L-shaped” scale next to and along the length of the impression on the same plane as the bottom of the impression ensuring that no part of the scale is on top of the actual impression.
 - 5) Include a label that uniquely identifies the impression in each photograph (e.g., impression number, case number, date, photographer’s identifier and an orientation indicator).
 - 6) If a zoom lens is used, set the focal length as close as possible to a normal lens (50 mm equivalent on a full frame sensor) to prevent distortion and adjust the tripod or quadrapod height until the viewing frame is filled.
 - 7) Fill the camera frame with the impression and scale. Impressions should be captured at a minimum resolution of 300 ppi (see Annex A).
 - 8) Set the camera f-stop to an appropriate setting to ensure sufficient depth of field to capture the entire impression in focus.
 - 9) Focus on the mid-plane of the impression.
 - 10) Capture at least one image with ambient light.
 - 11) Use an object/material to block bright sun or ambient light from striking the impression.
 - 12) Photograph the impression with the light source held at an angle. The use of angled light is intended to produce shadowing to create contrast in the impression. A deeper impression will require a higher angle of light and a shallower impression will require a lower angle (oblique lighting).
 - 13) Hold the light source at approximately 4 ft to 5 ft away and direct it at the impression.
 - 14) Capture images with the light source being held at the appropriate angle from at least three different positions around the impression (i.e., toe to heel, side to side, diagonally across the impression).

- 15) Use highlighting sprays, aerosol wax or aerosol paint for impressions in snow when contrast needs improvement and re-photograph the impression.

4.3 Photographic Documentation of Tire Impressions at the Scene

These procedures should be followed, as appropriate, for documenting and photographing tire impressions. The order of the following steps may vary.

- a) Capture overall images of the crime scene in-situ before moving evidence or including any photographic evidence markers.
- b) Evaluate the overall scene and available information to determine locations of tire impressions to be photographed.
- c) Include a label in each image (e.g., impression number, case number, date, photographer's identifier, an arrow pointing north, etc.).
- d) A sketch of the scene and the tire impressions within may also be required on a case by case basis, especially when reconstructing the direction and movement of vehicles leaving the impressions.
- e) Place evidence markers next to the impressions.
- f) Capture overall, medium range and close-up images of the tire impressions as follows.
 - 1) Overall images should be from at least four different angles around the perimeter of the scene.
 - 2) Medium range images should show relationships among fixed items in the scene and other impressions or evidence. To show the spatial distance between two items, photographs should be captured perpendicular and mid-point to a straight line that connects the items of interest.
 - 3) Close-up images should be captured to associate an impression with the corresponding evidence marker.
 - 4) For long sections of tire impressions to be captured, a tape measure should be utilized to indicate the section being photographed. Once placed down this tape measure should not be moved until the entire series of images are captured. These images can be stitched together using software.

Where practical, photograph the entire length of the tire impression. To allow for a proper comparison, at a minimum, a representation of the entire circumference of the tire should be photographed.

- 5) Position the camera on a tripod or quadrapod with the focal plane parallel to the impression plane. This will require the use of an angle finder. Tire impressions are usually wide and may require the tripod to be adjusted so it is over the impression.

- 6) Place the scale next to and along the length of the impression on the same plane as the bottom of the impression ensuring that no part of the scale is on top of the actual impression.
 - 7) Include a label that uniquely identifies the impression in each photograph (e.g., impression number, case number, date, photographer's identifier, an orientation indicator).
 - 8) Fill the camera frame with impression, tape measure, and scale.
 - 9) Select the resolution necessary to capture the smallest feature of interest in the impression. In the absence of additional or a priori information, a minimum of 300 ppi is suggested (see Annex A).
 - 10) If a zoom lens is used, set the focal length as close as possible to a normal lens (50 mm equivalent on a full frame sensor) to prevent barrel distortion and adjust the tripod or quadrapod height until the frame is filled.
 - 11) Set the camera f-stop to an appropriate setting to ensure sufficient depth of field to capture the entire impression in focus.
 - 12) Focus on the mid-plane of the impression.
 - 13) Use an object/material to block sun or bright ambient light from striking the impression.
 - 14) Photograph the impression using a flash held at an angle. The use of angled light is intended to produce shadowing to create contrast in the impression. A deeper impression requires a higher angle of light and a shallower impression will require a lower angle (oblique lighting).
 - 15) Hold the light source at approximately 4 ft to 5 ft away and direct it at the impression.
 - 16) Capture images with the light source held at the appropriate angle from at least three different positions around the impression (i.e., parallel to the long axis of the impression, perpendicular to the long axis of the impression, and diagonally across the impression).
 - 17) For a long tire impression capture a series of overlapping images. Each image should capture the maximum length of the impression possible, while maintaining the minimum resolution of 300 ppi, and overlap by at least 1 in. Include the scale and the tape measure indicating the section of the tire impression.
 - 18) Use highlighting sprays, aerosol wax or aerosol paint for impressions in snow when contrast needs improvement and re-photograph the impression.
- g) Capture examination quality images of the tire impressions as follows:
- 1) set the camera to capture images in an uncompressed or in a lossless format (e.g., TIFF or RAW);
 - 2) set the camera to its lowest native ISO.

4.4 Photography of Footwear and Tire Evidence in the Laboratory

These procedures should be followed as appropriate, for documenting and photographing footwear and tire evidence. The order of the following steps may vary.

- a) Take documentation images of the footwear and tire evidence including, but not limited to: overall images of evidence, footwear uppers, labels, tire sidewall, overall tire tread, trace evidence, and condition of the evidence upon receipt.
- b) Take examination quality images of the footwear and tire evidence as follows.
 - 1) Set the camera to capture images in an uncompressed or in a lossless format (e.g., TIFF or RAW).
 - 2) Set the camera to its lowest native ISO.
 - 3) Set up the camera with the focal plane parallel to the impression, outsole, or tread (i.e., use a copy stand, tripod, quadrapod).
 - 4) Include a label in each image (e.g., impression number, case number, date, photographer's identifier, etc.).
 - 5) If a zoom lens is used, set the focal length as close as possible to a normal lens (50 mm equivalent on a full frame sensor) to prevent barrel distortion and adjust the camera to subject distance until the frame is filled.
 - 6) Fill the camera frame with the impression, outsole, or tread and scale.
 - 7) Select the resolution necessary to capture the smallest feature of interest in the impression. In the absence of additional or a priori information, a minimum of 300 ppi is suggested. For capturing detail, a smaller region of interest within the impression or known footwear/tire should fill the frame in order to optimize resolution in these areas (e.g., Schallamach pattern).
 - 8) Place the scale on the same plane as the impression, outsole, or tread.
 - 9) Photograph electrostatic and black gelatin lifts in a dark room using oblique, or other appropriate lighting to enhance contrast. If necessary tape electrostatic lifts flat to eliminate undesirable reflections.
 - 10) Scanners can be used as a substitute method for capturing images of impressions. Scans should be captured in an uncompressed or in a lossless format (e.g., TIFF) and minimum 300 ppi resolution. For capturing detail, a smaller region of interest within the impression or known footwear/tire should be captured at a higher resolution (e.g., Schallamach pattern).
 - 11) If necessary, other lifts such as adhesive lifts can be photographed using ambient, overhead, or other appropriate lighting to enhance contrast.

Annex A (informative)

Image Resolution Calculations

The following instructions represent the steps to calculate the final resolution of an image given the camera used to capture the image.

Assumptions:

1. Pinhole camera
2. Set focal length to normal lens (50 mm equivalent on a full frame sensor)
3. No dead space between pixels
4. Variables as defined as in Figure A.1 (sketch)
5. Field of view on the order of 14 in. (length) = 355.6 mm

What you need:

1. Camera sensor size
2. Camera pixel pitch

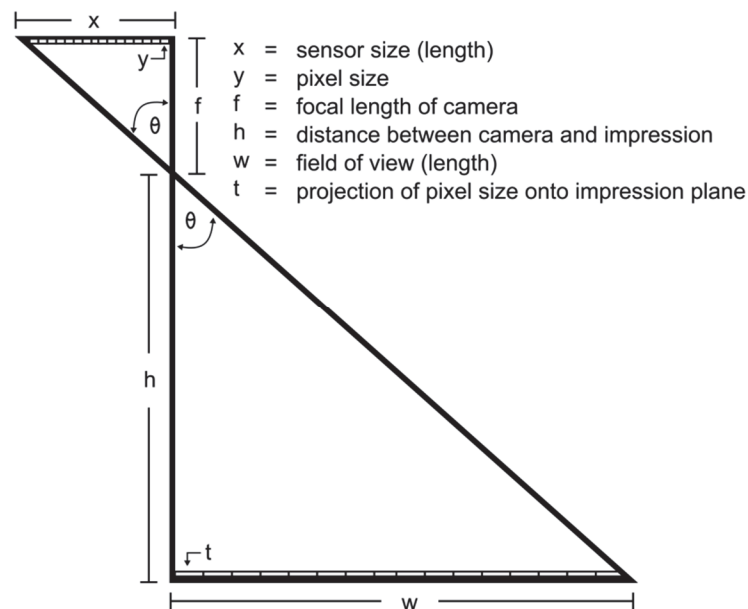


Figure A.1—Definition of Variables Assuming a “Pinhole” Camera

Step 1: Calculate h (distance between camera and impression)

$$\tan \theta = \frac{x}{f} = \frac{w}{h} \therefore h = \frac{w \cdot f}{x} \quad \text{A.1}$$

Step 2: Calculate t (projection of pixel size onto plane of impression)

$$\tan \theta = \frac{y}{f} = \frac{t}{h} \therefore t = \frac{y \cdot h}{f} \quad \text{A.2}$$

Step 3: Calculate PPI (pixels per in.)

$$PPI = \frac{1}{t} \quad \text{A.3}$$

NOTE An alternative method is to take the pixel dimensions of the sensor and divide by 300 ppi, the result will be the largest area one could document and still have the recommended resolution (e.g., 4000 by 3000 pixels divided by 300 ppi equals 13.3 by 10 in. The largest area that can be captured is 13.3 by 10 in.).

Example 1 - Nikon D300

12 megapixels, sensor size = 23.6 mm × 15.8 mm, pixel pitch = 0.005511 mm (5.51 μm),
w:h = 3:2, 4288 × 2848, assume 35 mm focal length.

Step 1:

$$h = \frac{w \cdot f}{x} = \frac{35.6 \text{ mm} \cdot 35 \text{ mm}}{23.6 \text{ mm}} = 527.372881 \text{ mm} \quad \text{A.4}$$

Step 2:

$$t = \frac{y \cdot h}{f} = \frac{0.00551 \text{ mm} \cdot 527.372881 \text{ mm}}{35 \text{ mm}} = 0.08302 \text{ mm} \quad \text{A.5}$$

$$0.08302 \text{ mm} \times \frac{1 \text{ in}}{25.4 \text{ mm}} = 0.003269 \text{ in} \quad \text{A.6}$$

Step 3:

$$PPI = \frac{1}{t} \cong 306 PPI \quad \text{A.7}$$

Example 2 - Nikon D3X

24.5 megapixels, sensor size = 35.9 mm × 24.0 mm, pixel pitch = 0.00592 mm (5.92 μm),
6048 × 4032, assume 50 mm focal length.

Step 1:

$$h = \frac{w \cdot f}{x} = \frac{35.6 \text{ mm} \cdot 50 \text{ mm}}{35.9 \text{ mm}} = 495. \dots \text{ mm} \quad \text{A.8}$$

Step 2:

$$t = \frac{y \cdot h}{f} = \frac{0.00592 \text{ mm} \cdot 495.2 \dots \text{ mm}}{50 \text{ mm}} = 0.05863 \dots \text{ mm} \quad \text{A.9}$$

$$0.05863 \dots \text{ mm} \times \frac{1 \text{ in.}}{25.4 \text{ mm}} = 0.002308 \dots \text{ in.} \quad \text{A.10}$$

Step 3:

$$PPI = \frac{1}{t} \cong 433 \text{ PPI} \quad \text{A.11}$$

Annex B **(informative)**

Bibliography

This is not meant to be an all-inclusive list as the group recognizes other publications on this subject may exist. At the time this document was drafted, these were the publications available for reference. Additionally, any mention of a particular software tool or vendor as part of this bibliography is purely incidental, and any inclusion does not imply endorsement.

- 1] Bandey and Bleay, "Footwear Mark Imaging Best Practice Guidelines for the Imaging of Footwear Marks." *Fingerprint and Footwear Forensics Group, Home Office Scientific Development Branch, Fingerprint and Footwear Forensics Newsletter*, February 2010.
- 2] Bodziak, W. J. "Footwear Impression Evidence." 2nd ed.; CRC Press: Boca Raton, FL, 2000.
- 3] Bodziak, W. J. "Tire Tread and Tire Track Evidence: Recovery and Forensic Examination (Practical Aspects of Criminal and Forensic Investigations)." 1st ed.; CRC Press: Boca Raton, FL, 2016.
- 4] Cassidy, M. J., *Footwear Identification*; Public Relations Branch of the Royal Canadian Mounted Police: 1980. (Reprinted by Lightning Powder Company, Inc. 1995.)
- 5] Hammer, L., Wolfe, J. "Shoe and Tire Impressions in Snow: Photography and Casting." *Journal of Forensic Identification*, 53 (6), 2003, pp. 647-655.
- 6] Hueske, Edward E. "Photographing and Casting Footwear/Tire track Impressions in Snow." *Journal of Forensic Identification*, 41 (2), 1991, pp. 92-95.
- 7] Hilderbrand, D.S. *Footwear, The Missed Evidence*, 3rd ed., Staggs Publishing Company, 2015.
- 8] IAI *Recommended Course of Study for Footwear & Tire Track Examiners*, International Association for Identification. 2006^b.
- 9] Nause, L., and G. Carroll. *Forensic Tire Impression Identification*, Canadian Police Research Centre: Ottawa, ON, Canada, 2001.
- 10] SWGDE. "Guidelines for the Digital Imaging of Footwear and Tire Impressions." Version: 1:0, Section 4, 2018^c.

^b Available from: <https://www.theiai.org>

^c Available from: https://drive.google.com/file/d/14lLqu-QIHbOnpQ3sWKpVrg_IHTt5CQe/view



ASB
ACADEMY
STANDARDS BOARD

Academy Standards Board
410 North 21st Street
Colorado Springs, CO 80904

www.aafs.org/academy-standards-board