INDIANA STATE POLICE LABORATORY DIVISION

PHYSICAL EVIDENCE BULLETIN

FOOTWEAR & TIRE IMPRESSIONS

Patterns of footwear and tires may be found at crime scenes, usually in the form of 3-dimensional impressions in soil, mud, and snow, or as 2-dimensional impressions on floors, glass, doors, etc. By examining characteristics specific to a given shoe or tire, it is possible to identify or exclude them as having made the impression in question.

A. Photography of Footwear/Tire Impression Evidence

1. **Recommended Equipment to Photograph Footwear/Tire Impression Evidence**

    a. Camera with macro lens

    b. Electronic flash with extension cord

    c. Shutter release extension cable

    d. Tripod

    e. Level

    f. Scale (L-scale preferred)

    g. Measuring tape

    h. Numbered markers/labels

    i. Black cloth, screen, or cardboard to block sunlight

    j. Markers to indicate direction of flash (e.g., golf ball markers, thumb tacks, pebbles, etc.).

2. Each item of evidence should be photographed with a photo evidence marker, as well as, photographed both with and without a scale.

3. All impressions should be photographed prior to any attempt to lift or cast them.

4. Take close-up comparison quality photographs.

    a. A scale should always be included in comparison quality photographs. An L-scale should be used in addition to the measuring tape. The measuring tape is beneficial in piecing together longer impressions, such as tire impressions.

    b. The scale should be in the same plane as the impression. It might be necessary to dig a trench next to the impression to be able to place the scale in the same plane as the impression.

    c. Comparison quality photographs should be taken from directly overhead using a tripod so that the back of the camera is parallel to the impression. This allows the photograph to be sized accurately to 1:1.

    d. If possible, the camera should be set to Aperture Priority (A) to control the depth of field when taking comparison quality photographs. An F-stop of F/11 or F/16 is recommended. A tripod should be used. If a tripod cannot be used, then the shutter speed should be set at 1/60 of a second to prevent blurriness from movement.

    e. For photographs with multiple impressions, the photograph should have each impression labeled with a unique identifier (number or letter) to differentiate the impressions from one another.

    f. Images should be captured, stored, and transmitted without compression or with lossless compression.

        1) Examples of common file formats that meet this requirement are TIF, RAW, and BMP. TIF is the preferred file format for submission of footwear/tire impression digital images to the Laboratory Division for examination.

        2) When an image is captured in a RAW format (e.g., NEF), it may be necessary to convert the file to TIF or BMP format prior to submission to the Laboratory Division. The Laboratory Division may not have the capability to view that particular RAW format.

        3) JPG (jpeg) is a compression file format that can result in pixels being altered in the image. Therefore, it should not be used to capture an image that is to be used for comparison.

    g. Images should be captured at the highest resolution setting available on the camera. The impression should be photographed so that it fills the frame of the view finder. It may be necessary to take multiple photographs of the impression to achieve high resolution images.

1) When an entire footwear impression is present, first photograph the full footwear impression. Then photograph sections of the impression, toe area and heel area, to achieve maximum resolution.

2) For long continuous tire impressions, place a tape measure along the length of the impression.

i. Take overlapping photographs along the impression for at least eight feet (approximately the full circumference of most tires). Overlap the photographs by approximately 2 inches.

ii. Move a small scale and tape measure along the length of the impression while photographing to ensure accuracy in sizing. The small scale should be on the same plane as the impression.

h. For three-dimensional impressions, use a detachable flash held at approximately 25°, 45°, and 65° angles approximately three feet away from the impression. Take at least one photograph of the impression at each angle, repositioning the flash around the sides of the impression (between tripod legs), for a total of nine photographs of the impression.

i. All comparison quality digital photographs of the footwear and/or tire impressions can be submitted to the Laboratory Division for analysis by the following methods:

1) Burn digital photographs to a CD or DVD and submit as an item of evidence.

2) Electronic submission of digital photographs through the department email address at esubmission@isp.in.gov or file sharing site as directed by Laboratory Division personnel.

i. Digital photographs shall be uniquely identified by the contributor by file name.

ii. All electronic evidence submissions shall be accompanied by a completed Request for Laboratory Examination Form.

iii. All electronic items shall have their file names associated with an agency item number on the Request for Laboratory Examination Form and each item shall be described as electronically submitted.

iv. Digital photographs should comply with requirements in section A. 4. f 1) – 3) of this document and shall be a minimum of 1000 pixels per inch (ppi). Any deviations in image quality require the approval of the Microanalysis (Trace) Unit Supervisor or an Electronic Evidence Custodian.

j. Only submit photographs where footwear/tire impressions are present and analysis is requested. Do not submit photos of the crime scene in which footwear/tire impressions are not present.

k. Agencies need to prove that the digital images have not been altered prior to submission to the Laboratory Division. Agencies must have adequate policies and documentation procedures in place to meet this requirement.

B. Casting Footwear/Tire Impressions

1. Recommended Materials for Casting

a. Dental Stone

1) Dental Stone (Do not use Plaster of Paris.)

2) One gallon plastic water jug

3) Bowls or large plastic bags for mixing Dental Stone solution

4) Casing frame (e.g., aluminum foil, collapsible frame, twigs, cardboard, etc.)

5) Aerosol can of lacquer, shellac, or hairspray

6) 1 to 4 cup capacity kitchen strainer or flour sifter (optional)

7) Large spoon (optional)

8) For snow impressions only: Snow Print Wax or spray paint

b. Great Stuff Window & Door® spray foam

1) Great Stuff Window & Door® spray foam

2) Weighted board (e.g., 12 inch x 16 inch piece of plywood)

3) Large plastic evidence bag

2. Casting Soil Impressions

a. Photograph using procedures described in Section A before casting.

b. Inspect the impression for debris.

1) Sticks, stones, and leaves, which have been pressed into the impression as it was made, should not be removed prior to casting.

2) Debris which has fallen loosely into the impression after it was made can be carefully picked out.

c. If on a sloped surface, set up a small dam or frame around the impression and force it into the soil at least one inch from the edges of the impression. This frame may be made of aluminum foil, collapsible frame, twigs, cardboard, etc.

d. Prepare the Dental Stone following the mixing instructions provided by the manufacturer. (Note: the general guideline is to mix 2 pounds of dental stone with 12 ounces of water to cover one entire footwear impression.)

    1) A plastic bag may be used for mixing the dental stone and water.

    2) Knead the mixture to prevent trapping air bubbles and to make sure there are no lumps.

    3) More Dental Stone or water can be slowly added until the mixture has the consistency of pancake batter.

e. Pour the Dental Stone mixture into the impression slowly, so it flows evenly and smoothly over the impression.

    1) The stream of liquid can be deflected by using a spoon or flat stick.

    2) Once pouring begins, do not pour directly onto the impression; instead, pour onto the previously poured casting material so as not to disturb the impression.

    3) The Dental Stone should be poured to a thickness of about 1 inch and allowed to harden (approximately 20 – 30 minutes). It is not necessary to add reinforcement to the Dental Stone.

    4) If the poured Dental Stone mixture is too thin, sprinkle dry Dental Stone powder on top of the cast to absorb the excess water.

    5) If the poured Dental Stone mixture is too thick and will not cover the entire impression, try spreading the top layer of the casting material by tapping it with a stick to cover the remaining impression. If the Dental Stone starts to disturb the impression, mix a new batch of Dental Stone and pour on top of the already poured cast.

f. Wait until the cast is dry, and then label the cast with the agency case number, date, location, and initials of the person making the cast by inscribing carefully into the cast, or using a permanent marker.

g. Lift the cast after the Dental Stone has set, meaning it is firm to the touch (approximately 20-30 minutes).

    1) Do not remove any soil which may be adhering to the cast itself. This process should be left to the Laboratory Division analyst.

2) Casts must be thoroughly dried before packaging. Do not package in a plastic bag. Casts should be packaged and secured within a cardboard box with something to protect them from breaking, such as exam paper.

h. If the cast was broken during the lifting process, this should be noted on the Request for Laboratory Examination Form.

3. **Casting Sandy Soil Impressions**

If a loose soil or dry sand impression is located, it should be pre-treated prior to casting.

a. Use an aerosol can of lacquer, shellac, or hairspray to harden the impression.

b. Hold the can approximately 18 inches above the impression and spray parallel to the impression.

c. Allow a fine mist to settle on the impression.

d. Let it dry.

e. Repeat the procedure above until the top layer of particles are held in a hard film binder. When thoroughly dried, the lacquer/shellac film will protect the impression from a gentle pouring of properly mixed Dental Stone.

f. See previously described instructions in Section B-2 for using Dental Stone.

4. **Casting Snow Impressions**

Heat generated by curing Dental Stone will melt snow unless special precautions are taken. Impressions in snow can be cast using one of the following methods: Great Stuff Window & Door® spray foam, Snow Print Wax with Dental Stone, or Dry Casting.

a. Great Stuff Window & Door® spray foam

1) Photograph using procedures described in Section A before casting.

b. Inspect the impression for debris.

1) Sticks, stones, and leaves which have been pressed into the impression as it was made should not be removed prior to casting.

2) Debris which has fallen loosely into the impression after it was made can be carefully picked out.

c. To use the Great Stuff Window & Door® spray foam, a weighted cover will be needed.

1) It is recommended to use a 12 inch x 16 inch piece of plywood placed in a plastic bag.

2) The plastic bag is necessary to ensure that the weighted cover does not stick to the cast of the impression.

d. Spray the Great Stuff Window & Door® spray foam into the impression slowly, so it flows evenly and smoothly over the impression.

1) Take caution when spraying the foam to ensure the nozzle is continuously engaged in the spray foam.

2) Once spraying begins, do not spray directly onto the impression; instead, spray above, below, or to the side of the impression and then work into the impression so as not to disturb the detail of the impression.

3) Use side to side movements at a slow to moderate speed to help prevent any air bubbles that may occur.

4) Completely fill the impressions end to end with the spray foam and make sure that it is not overfilled.

5) Generally, two impressions should be able to be casted from one 12 ounce can of Great Stuff Window & Door® spray foam.

e. **Snow Print Wax with Dental Stone**

1) To use the Snow Print Wax method, cover the impression with a layer of Snow Print Wax using the same process as applying lacquer/shellac to impressions in sandy soil (as previously described in Section B-3). The impression may need 4-6 coats of Snow Print Wax.

2) Lay the Dental Stone powder out on a sheet of paper so the powder becomes as cold as possible.

3) Mix snow with water in order to make the water as cold as possible. Any un-melted snow slush should be removed from the water before adding the Dental Stone powder.

4) See previously described instructions in Section B-2, for using Dental Stone.

5) Allow the snow print cast to set up for at least two hours before removing it. Take caution not to disturb the wax because the impression is preserved in the wax, not the cast.

f. **Dry Casting**

1) To use the dry casting method, use a kitchen strainer or flour sifter to sift dry Dental Stone powder about 1/8 inch thick over the impression.

2) Using a fine mist spray bottle, spray cold water over the Dental Stone until wet.

3) Repeat approximately four times or until a good base layer is formed.

4) Cast normally using cold Dental Stone and cold water as previously described in Snow Print Wax Casting in Section B-4-e.

5. **Casting Underwater Impressions**

a. Without disturbing the impression, try removing excess water with a small cup.

b. If the water cannot be drained away/removed from the impression, slowly sift or sprinkle dry Dental Stone powder into the water above the impression. The powder will sink to the bottom and gradually build up.

c. Once the dental stone is approximately one inch thick on top of the impression, cast normally using Dental Stone as previously described in Section B-2.

C. Preserving Dust Impressions

1. Using a flashlight, shine the light at an oblique angle across the surface suspected of having a dusty impression.

2. Once an impression has been located, it should be photographed using techniques previously described in Section A, but the camera's detachable flash should be placed approximately 2-3 feet from the impression so the light from the flash passes obliquely over the impression.

3. Once photographed, the impression can be recovered using an electrostatic dust lifter, a tape lift, or gel lift.

4. Each electrostatic lift should be individually packaged. Each electrostatic lift should be packaged in a cardboard box, such as a pizza box, with the dark side (impression side) facing up. The edges of the electrostatic lift should be taped down in the box to prevent the dust particles from being disturbed.

D. Marking of Evidence

1. All evidence containers shall be marked with the agency's name, case number, and item number. The container shall be properly sealed and the initials of the person who sealed the evidence shall be written so they are partially on the seal and partially on the container. Depending upon the evidence, the container

should be marked prior to placing the evidence inside to prevent damage to the footwear/tire impression during the marking process.

2. Footwear/tire impressions that have been lifted with tape shall be marked on the back of the lifter and sealed in a manila envelope. Footwear/tire impressions that have been lifted with gel lifts shall be marked on the back of the lifter and sealed in a cardboard box. Do not place film back on the sticky side of the gel lift.

   Labeling Lifts – The following information should be included on the back of each lift:

   - Agency case number;
   - Item number;
   - Date the evidence was collected;
   - Written description of item (including inside or outside surface location);
   - Sketch of the item with the location of the impression indicated;
   - Direction/orientation of the impression on the object; and
   - Initials of the lifting officer

E. Submission of Footwear/Tire Impression Evidence

1. All evidence submitted for footwear/tire impression evidence should be submitted in appropriately sized paper envelopes, paper bags, or cardboard boxes.

   a. When appropriate, evidence should be secured within the packaging to prevent damage during transport and/or storage.

   b. Evidence submitted for footwear/tire impression comparisons (e.g., shoes, tires, lifts, casts, etc.) should **NEVER** be packaged in plastic (e.g., bags or other containers) to prevent molding of the evidence.

2. Footwear submitted for comparison should be packaged to prevent any additional wear to the outsoles.

   a. A pair of shoes can be submitted as one item; however, the outsoles should be packaged away from each other, so they do not rub against one another.

   b. Package shoes in a paper bag or cardboard box – **NEVER** package shoes in a plastic bag.

4. The number of pieces of evidence inside an item container should be listed in the item description area of the Request for Laboratory Examination Form. For example, the item description should read, “Sealed envelope containing one tape lift with a footwear impression.”

5. Comparison Test Impressions

a. Shoe Test Impressions

i. Any shoes that are obtained or recovered during the investigation should be submitted along with the unknown footwear impression(s) for comparison.

ii. The Laboratory Division analyst will create the appropriate footwear test impressions in the laboratory.

b. Tire Test Impressions

i. Tire test impressions must be made while the tires are still on the vehicle, and can be taken in the field with the aid of an ISP CSI.

ii. After test impressions are created, tires should be removed from the vehicle and identified as to wheel position and direction of rotation, before being submitted to the Laboratory Division.

1. If tires are unable to be retained, high quality photographs of each section of each tire should be taken and submitted to the Laboratory Division.

2. Not submitting the tires or photographs of the tires will limit the analyst's examination and conclusions.

iii. Tires can be tagged for submission to the Laboratory Division instead of packaged.

c. If footwear/tire impression evidence could contain footwear/tire impressions from officers or first responders at a scene, elimination exemplars of the shoes or tires should be submitted.

6. Explanation of Results

The following are examples of results and an explanation of what each result means:

a. The footwear/tire impression was in agreement in size, shape, tread design, and identifying characteristics with the left/right shoe/tire; therefore, the impression was identified as having been made by…

This means that the unknown footwear/tire impression was made by that specific shoe/tire.

b. The footwear/tire impression disagreed in tread design with the shoes/tires; therefore, the impression was not made by …

This means that the unknown footwear/tire impression was not made by the submitted shoe/tire.

c. The footwear/tire impression was in agreement in size, shape, and tread design with the right/left shoe/tire; therefore, the impression could have been made by the right/left shoe/tire or any other right/left shoe/tire with the same size, shape, and tread design.

This means that the unknown footwear/tire impression was in agreement with class/manufacturing characteristics only, and could not be positively identified to the submitted shoe/tire. This could be due either to the quality of the unknown impression, or due to the lack of wear and identifying characteristics on the submitted shoe/tire.

d. The footwear/tire impression was in agreement in size, shape, tread design, and had limited identifying characteristics with the right/left shoe/tire; therefore, the impression could have been made by the right/left shoe/tire.

This means that the unknown footwear/tire impression has class/manufacturing characteristics in agreement with the left/right shoe/tire, and some characteristics in agreement with the right/left shoe/tire that were not from the manufacturing process; however, there was not enough of these unique identifying characteristics present to make an identification. Therefore, the result is that the shoe/tire could have made the unknown impression.

e. The footwear/tire impression was in agreement in shape and tread design with the right/left shoe/tire; however, due to the lack of a scale present in the photographs, the size of the impression was unable to be compared.

This means that the unknown footwear/tire impression shares the general tread design of the submitted shoe/tire, but without a scale, the size aspect was unable to be compared.

f. The footwear/tire impression lacks a definitive footwear/tire shape and tread design; therefore, the impression is not suitable for a make and model search.

This means that some kind of impression was observed; only one or two possible elements may have been observed and they may or may not be a footwear/tire impression. Due to this lack of information in the impression, the impression is not able to be searched to determine a possible source for the impression.

g. As a result of the make and model search, it was found that the footwear/tire impression is consistent with having been made by the tread design depicted on the outsole of a _____ (make and model of shoe/tire). If shoes/tires with a tread design resembling the outsole of

a _____ (make and model of shoe/tire) are collected, please submit them to the Laboratory Division for further analysis.

This means that the unknown footwear/tire impression appears to have the same general tread design as this make and model of shoe/tire. If during the course of the investigation shoes/tires of this make and model, or shoes/tires with the same general tread design as this make and model are collected, it should be submitted for a comparison examination.

7. Contact Information

For further information please contact the Microanalysis (Trace) Unit at the Indianapolis Regional Laboratory at 866-855-2840 or 317-921-5300.