Physical Evidence Bulletin

IMPRESSION EVIDENCE

Introduction

The Bureau of Forensic Services provides analytical support to law enforcement agencies through the examination of footwear, tire, and other impression evidence. Forensic examination may identify, associate, or eliminate evidence such as shoes, tires or other objects as the source of an impression left on a scene, object, or individual associated in an investigated event.

Impression evidence is commonly encountered at crime scenes in soil, snow, on counters, hard floors, doors, and paper. Impression evidence may also be formed on individuals (e.g. marks left on skin that transfer an impression pattern). These impressions can be compared to known sources of shoes, tires, or other objects to determine the level of association between an impression and possible sources. The evidentiary value of a comparison depends upon the quality of the impression, the manner in which it is documented, the length of time passed after the event, and the collection method of the known shoes, tires, or objects.

The Physical Evidence Bulletin (PEB) is a guideline intended for law enforcement agencies to follow when submitting evidence to Bureau of Forensic Services (BFS) Laboratories. PEBs are not intended to be used in lieu of training in the collection of evidence.

Contact a BFS laboratory for specific case questions or additional information.

Scope of Testing

Refer to the current *Certificate of Accreditation* issued to BFS by the ANSI National Accreditation Board (ANAB), to obtain a list of BFS laboratories that are accredited to conduct various testing types (Certificate # FT-0334).
https://search.anab.org/

Based upon the BFS Scope of Accreditation, BFS offers the following types of accredited examination types for the Impressions discipline:

- Enhancement (Footwear, Tire, Physical Item)
- Physical Comparison (Footwear, Tire, Physical Item)

Safety

Scenes, evidence, and methods of processing evidence can be the source of various hazards, including biological, chemical, physical, and environmental hazards. Appropriate safety precautions and personal protective equipment (PPE) are recommended for both the wearer's safety and to protect the integrity of the evidence. Articles of PPE may consist of, but are not limited to, gloves, protective clothing, masks, eye protection, and respiratory equipment.

Consider respiratory protective equipment when reagents are applied using aerosols. Proper handling and disposal procedures should always be followed for any chemicals and chemical waste materials.

Universal precautions should be taken to prevent contact with biological materials that may be present in evidence. Protective suits and gloves may need to be worn when rolling tire test impressions.

Use appropriate eye protection and avoid close skin exposure during examinations with an ultraviolet or other alternate/forensic light sources.

Electrostatic dust lifters carry the potential for electrical shock. Follow manufacturer's instructions when using these devices.

Photography and Documentation

While photography should be the initial method for documenting footwear, tire impressions, and other miscellaneous types of 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.

Familiarity with the specific camera equipment used is essential, especially in impressions photography, where accurate, life-sized images are critical in comparing characteristics such as size. Understanding the camera's sensor type- whether full-frame or crop sensor- ensures selection of the correct focal length in examination quality photography. A crop sensor applies a magnification factor (commonly 1.5x or 1.6x) to lenses, altering the effective field of view. To achieve a "normal" 50 mm focal length equivalent on a crop sensor camera, divide 50 mm by the crop factor (e.g., for a 1.5x crop factor, use a 33 mm focal length). A professional or prosumer (mid-entry level) quality SLR or mirrorless digital camera is adequate. **Instant, fixed-focus, or cell phone cameras are not suitable for impression photography.**

General Scene Photography and Documentation

Refer to your agency's specific guidance on general scene photography (overall, midrange, close-up photos etc.) and documentation requirements.

Selecting Impressions to Photograph

Evaluate the overall scene and available information to determine locations of footwear, tire, and other impressions to be photographed.

Documentation for Future Reconstructive Value

A sketch of the scene and impressions within may also be needed on a case-by-case basis, especially when reconstructing the paths and movement of people, or direction and movement of vehicles or other objects.

Examination Quality Impression Photography - Footwear

Capture examination quality images of the footwear impressions:

1. Set camera mode to Manual or Aperture Priority and focus mode to Manual
2. Set the camera to capture images in a high-quality format (e.g., TIFF, RAW, or high quality JPEG).
3. Set the camera to an appropriate ISO level to mitigate image noise and graininess.
4. Position camera on a tripod or quadrapod (4-legged copy stand) with its focal plane parallel to the impression plane. Bubble levels are helpful with even surfaces, and angle finders can be helpful on uneven surfaces.
5. Place a thin rigid L-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.
6. Include a label that uniquely identifies the impression in each photograph (e.g., impression number, case number, date etc.)
7. 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.
8. Fill the camera frame with the impression and scale.
9. Set the f-stop (aperture) to an appropriate setting to ensure sufficient depth of field that captures the entire impression in focus.

Examination Quality Impression Photography – Footwear (continued)

10. Focus on the bottom plane of the impression.
11. Capture at least one image with ambient light.
12. Use an object or material to block bright sunlight or ambient light from striking the impression.
13. 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).
14. Hold the light source at 4 ft to 5 ft away and direct it at the impression.
15. Capture images with the light source being held at the appropriate angle from at least three different positions around the impression (e.g. toe to heel, side to side, diagonally across the impression.
16. Use highlighting sprays, aerosol wax or aerosol paint for impressions in snow when contrast needs improvement and re-photograph the impression.

Examination Quality Impression Photography - Tire

Measurements of vehicle track width, turning diameter, and wheelbase of tire impressions should be collected prior to examination quality photography.
For long tire impressions, capture a series of overlapping images. To retain detail, it is recommended that each image captures no more than 18 inches of length. Each sequential image in the series should have a minimum overlap of approximately 1 inch. These images can be later stitched together using photoimaging software.
Use a tape measure to indicate the section being photographed. Once placed, the tape measure should not be moved until the entire series of images are captured. To allow for proper comparison, at a minimum, a representation of the entire circumference should be captured in examination quality images.
To capture examination quality images of the tire impressions, use photographic techniques similar to photographing footwear impressions. Additional considerations and techniques include:

1. Tire impressions are usually wide and may require the tripod to be adjusted so it is over the impression.
2. Place a thin rigid 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. This scale will typically be referenced to later sizing the image 1:1, *not the tape measure that marks the sections*.
3. Fill the camera frame with the impression (up to 18” long sections), tape measure, rigid scale, and appropriate labeling.
4. Capture overlapping images (at least 1 inch) along the entire impression, or until it is estimated that a representation of the entire circumference has been photographed.

Examination Quality Impression Photography (Other Impressions)

Capture examination quality images of other types of impressions beyond footwear and tire using similar examination quality photographic techniques as appropriate.

After Photography

After the initial photography, carefully remove any vegetation or stones which may have fallen into the impression **after** it was made. Any debris that was pressed into the soil with the impression should not be disturbed.

Photograph the impression again with the debris removed. Submit all digital images and printed photographs to the Laboratory regardless of their apparent quality.

3-Dimensional Impressions

Impression Casts

Casting provides a tangible actual-size mold of the original evidence impression capturing sidewall or mid-sole information not always reproduced by photographs. Dental stone, Traxtone™, or other gypsum-based materials are typically used to cast three-dimensional impressions. Although Plaster of Paris is a gypsum-based material, it is not recommended, since the physical characteristics of these casts are brittle, chalky and less durable compared to other available gypsum-based casting materials. Plaster of Paris can be used, however, absent the availability of a more durable gypsum-based casting material.

Debris that is part of the impression or that was present when the impression was made should not be removed. After photographing the original conditions, debris that has clearly fallen into the impression *after* it was made may be carefully removed. Debris should not be removed if its removal could damage the impression.

When casting, care should be exercised to minimize potential damage to the impression. For fragile impressions in fine substrates (e.g., flour, soil, etc.) an aerosol fixative may be applied to misting over the impression.

A releasing agent (e.g., talcum powder, spray oil) can be used to prevent the substrate (e.g., soil, sand and shale) from adhering to the surface of the cast.

General Casting Procedure

Prepare the casting material according to manufacturer's guidelines. Adjust water to achieve the preferred viscosity. Most impressions can be suitably cast with a casting mixture that has a viscosity like thin pancake batter. Fragile impressions may require a thinner mix, and impressions on an incline may require a thicker mix. Premeasured amounts of casting material may be stored in plastic bags for ready mixing.

Carefully pour casting material outside the perimeter of the impression and direct the flow into the impressions. Ensure the impression is completely filled and/ or covered evenly. If the casting material does not flow completely into the impression, the top surface of the casting material can be carefully agitated to help it flow. Casts should be of sufficient thickness to avoid breakage. If necessary, additional casting material may be poured over the top of the original cast to complete the cast and/ or thickness.

For fragile and shallow impressions, pour casting material from outside the perimeter so that it rapidly flows over the impression. A thinner mixture of casting material is necessary for this technique, avoid pouring directly onto the impression until a sufficient layer of material has accumulated over the impression.

Larger quantities of casting material can be mixed in a bucket to cast large segments of tire or multiple impressions. 3 ft (0.91m) size tire casts are optimal for examination. Casting multiple adjacent 3 ft segments can capture the entire circumference of the tire. The total length of casted segments needed depends on tire size. One common tire size, 225/60/16, has a circumference of approximately 7 ft (2.13 m). Shorter segments may also be of value.

Casting Submerged Impressions in Standing Water

Sift or sprinkle and even layer of dry casting powder over the impression until the bottom is covered. Then mix and pour wet casting material into the impression. If the impression simply has water in it and is not fully submerged, casting material can be mixed and poured from the outside of the impression, allowing the casting material to flow into the impression, which will displace the water.

Casting Impressions in Snow

A highlighting spray such as paint or aerosol wax may be used to increase the contrast and the impression should be re-photographed. The highlighted medium should be applied by spraying obliquely 8 to 12 inches away from the impression. **DO NOT** clean snow casts with a brush or by rubbing the wax surface as this will destroy the impression.

Casting Snow Impressions with Dental Stone

Five to six layers of aerosol wax should be applied to create a barrier between the impression and the dental stone casting material. If there is moisture such as in wet snow conditions, sift three layers of dental stone powder over the waxed shell coating of the impression. Sift the first layer slowly and evenly to absorb moisture from the snow. Additional sifted layers may be needed if the snow is excessively wet, melting quickly, or contains standing water. Avoid melting snow (and thus impression detail) by keeping the mixture as cool as possible. In colder temperatures, it may be necessary to add potassium sulfate to the mixture to act as a catalyst. Pour the casting material from outside the perimeter and direct the flow into the impression. The surface of the casting material can be agitated to help it flow. Wait until the cast has hardened before removing.

Casting Snow Impressions with Snow Print Plaster

Sift a base layer of Snow Print Plaster powder over the impression. Mix the remaining powder quickly with water and apply it to the impression. Fill the impression with the mixture and wait until it begins to harden. Covering the cast with suitable material and then covering with snow will insulate the cast and ensure that it hardens evenly.

Documenting, Marking and Collecting Casted Impressions

Photograph the cast in place prior to lifting to show the location within the crime scene and proximity to other pertinent evidence.

Allow the casting material to sufficiently set to prevent damage prior to lifting.

Carefully lift the cast from the substrate. It may be necessary to excavate around the perimeter of the cast to avoid breakage. Casts and any adhered substrate (do not clean at scene) should be thoroughly dry and adequately packaged to avoid breakage during storage or shipping.

Casts may be cleaned after 48 hours using water and a soft brush. Alternatively, the cast can be left in its collected state for the impressions analyst to clean during examination.

Casts should be marked prior to lifting from the substrate (e.g., with permanent marker, grease pencil). Markings should include: identifier numbers/letters that link the casts to diagrams and/ or photographs, date, initials, and any other pertinent information such as case number.

2-Dimensional Impressions

Lifting Two-Dimensional Impressions

Lifting involves transferring a two-dimensional impression from its original surface for collection and preservation. Two general methods are commonly used for lifting impressions – electrostatic lifters and adhesive lifters. The examiner should consider the substrate (porous, nonporous), substrate condition (wet, dry), substrate color, and the presence of interfering material (dirt, grease) when selecting a lifting device. Because there is a risk that the impression may be destroyed during lifting attempts, photograph impressions before lifting.

Electrostatic Lifting Device (ESLD)

Electrostatic lifting is useful for the detection and lifting of dry origin dust and residue impressions. The device produces an electrostatic charge that transfers a dry origin questioned impression onto a film. Electrostatic lifting is often the first lifting technique used, as it will not prevent the subsequent use of other lifting and enhancement techniques. Several electrostatic lifting devices and materials are available. Consult the manufacturer's guideline for specific operating instructions.

There are also commercially available statically charged lifters that create their own static charge mechanically from the action of removing the lift from its release liner rather than by using an ESLD.

The ESLD or statically charged lifters should be used on impressions of dry dust or dry residue on surfaces that are clean. If the print is not lifted, then subsequent method(s) can be used. The lifting film should not be reused.

Smaller lifts can be stored in individual clean dust free containers (e.g., file folders, clean boxes, etc.). These containers should never be reused. Larger lifts can be stored by carefully rolling the non-lifting surface on the outside. After rolling, the edge can be secured with a small piece of tape.
Electrostatic lifts should be submitted for examination as soon as possible.

Adhesive lifting of impressions

Adhesive lifting covers both gelatin and tape devices and permits lifting of some impressions when the ESLD is not available or was unsuccessful. Tape devices are often referred to as simply adhesive lifts. Gelatin lifters are often referred to as gel lifts.

Gelatin lifters are used on porous or nonporous surfaces for lifting dust, residue, blood, and wet origin impressions, as well as impressions developed with fingerprint powder or some chemicals. **Remove the clear cover prior to collecting the lift.** Care should be taken when removing the cover to limit the stretch. The lifter should be allowed to rest until it returns to the original size before being applied to the impression. Gel lifts can be stored in individual clean dust free containers.

Tape devices should only be used on nonporous surfaces and work best with impressions that have been dusted with fingerprint powder. Tape device lifts should be packaged in a container that is large enough to hold and protect from damage (e.g., manila envelope, paper bag, plastic bag, etc.).

Casting Material Lifting of impressions

Casting material such as dental stone can be used to lift two-dimensional impressions (e.g., mud, blood and tire residues) from a variety of two-dimensional surfaces (e.g., concrete, tile and linoleum). A thick layer of dental stone can be poured over the impression area and lifted when dry. Ensure a release mechanism such as a stick or other device is placed at edge of impression prior to pouring. This will help with lifting the cast after hardening. Dental stone casts should be allowed to dry for approximately 48 hours prior to packaging.

Polyvinylsiloxane (PVS)/ silicone casting materials (e.g. Mikrosil, AccuTrans) can be used to lift impressions that have been enhanced with powder. These products lift the complete powdered impression and are particularly useful on textured surfaces.

Follow manufacturer's guidelines for the preparation of casting materials. Two-dimensional casts should not be cleaned. Casts should be packaged in breathable containers that prevent damage (e.g., cardboard box, etc.).

Enhancement

Chemical Enhancement

Laboratory personnel may provide chemical enhancement techniques for impressions in blood or other substances. While the exact chemical enhancement technique is left to examiner discretion, the goal of the technique selected is to increase the contrast and visibility between the impression and substrate.

Consider the following when conducting enhancements on impression evidence:

- Color of the substrate, and the color development of the enhancement chemical.
- Whether the substrate is porous or nonporous.
- Overdevelopment by allowing the evidence to remain in contact with the solution too long.
- Application of excess liquid reagent that may result in leaching of the impression.
- Background development that results in lower contrast of the impression.
- Any enhanced impression will be imaged or retained after development.

Photographs should be taken prior to any enhancement attempts.

Consider the substrate composition (paper, wood, tile, etc.), condition (wet, dry, clean, dirty), and color as well as the composition and condition of the impression itself, when selecting an enhancement chemical.

Physical Enhancement

Dusting with latent fingerprint powder may develop impressions that are not previously visible. Dusting should not be performed prior to the documentation of any visible impressions.

Alternate light sources such as UV and laser may enhance visualization and photography, especially with impression evidence.

Test Impressions

Known shoes, tires*, or other objects should be collected as soon after the incident as possible to minimize the amount of change to the tread, sole or patterned surface through additional wear. Test impressions from shoes and other objects will be made at the laboratory at the time of comparison.

It is recommended that the sole patterns of family members, law enforcement employees, and other personnel present at the scene be documented for elimination purposes. Companies that carry fingerprint identification supplies also provide products that can easily produce actual size (1:1) test impressions. Photography is also appropriate when a proper scale is included in the photograph.

*Tires should remain mounted on the suspect vehicle such that position, wear, and load duplicate the conditions at the time the evidence impression was produced. The vehicle may be transported to the laboratory, a tow-yard, or other secure facility for obtaining tire test impressions.

Vehicles with dual tire assembly should have both tire test impressions made simultaneously as to ensure that the relationship of the noise treatment between the two tires is appropriately recorded.

Collecting Tire Test Impressions "Rolling Tires"

1. Clear a smooth, clean flat floor surface such as concrete, that allows enough room for the required movement of the vehicle.
2. Temporarily affix drafting film or non-waxed lab paper (minimal width: 1 ft) to chart board. Drafting film is a transparent plastic which may be purchased at any drafting supply company or through a forensic supply company. Prepare several lengths sufficient to document the entire circumference of the tire (approximately 8 to 10 feet).
3. Mark the sidewall of the tire into sections (4 or more is typical). Tread wear indicators can be used as a guide for marking sections, or the sections can be arbitrarily marked. Label each section (A, B, C, etc.) with chalk or a tire marker.
4. Using a gloved hand, cover the tread with a **thin** film of petroleum jelly. Too little petroleum jelly will result in incomplete documentation. Too much jelly will result in the filling in of fine details of the tread pattern. *The tread in contact with the ground can be coated as the vehicle moves.*
5. Line up the drafting film/lab paper attached to the chart board with the tire.
6. Place the vehicle in neutral and push to slowly roll the tire either forward or backward making an impression on the film/paper by pushing the vehicle.
7. As you roll, mark the film/paper with the corresponding sidewall sections and direction of roll. The end of the film under the body of the vehicle may need to be partially lifted to prevent overlapping with the tire on the other axle.
8. Label each test impression with the position in which the tire was mounted on the vehicle (right front, left rear, etc.) and the orientation of the vehicle relative to the test impression.
9. Develop the impression with black magnetic fingerprint powder then remove excess powder.
10. Lightly spray the entire test impression with clear lacquer or hairspray to help prevent smudging.
11. The resultant test impression may be carefully covered in a layer of lab paper to protect detail, rolled up, and packaged into a cardboard mailing tube.
12. Roll the other three tires similarly.

Record relevant identifying information on tire test impressions such as case number, item number, make, model, size, DOT number, tire location on the vehicle, rolling direction of the tire etc.

Other suitable methods of collecting tire test impressions may be used such as rolling inked tires on film or chart board.

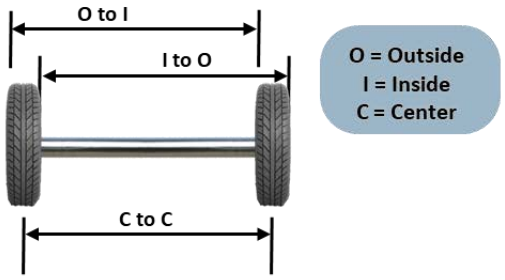
Vehicle Track Width and Wheelbase

Crime scene measurements of the vehicle track width and/or wheelbase may be searched to provide a list of vehicles which may have left the tire impressions.

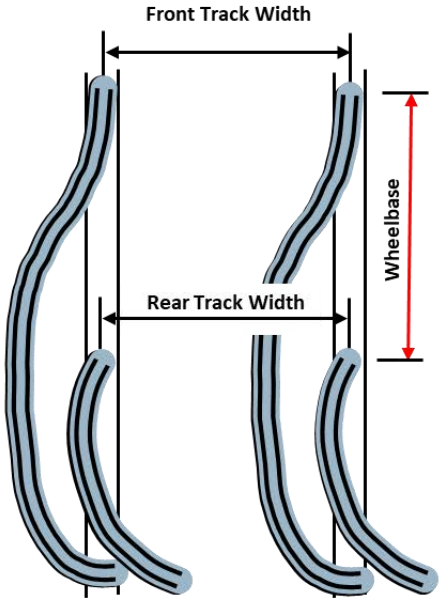
The track width of a vehicle is the distance between the center of the tire mounted on one side of the vehicle and the center of the tire mounted on the opposite side of the vehicle. The distance is most easily measured as the distance between the outside edge of the left tire impression and the inside edge of the right tire impression (see diagrams). The front and rear track width measurements may be different.

The wheelbase of a vehicle is the distance between the center of the front axle and the center of the rear axle. The distance is most easily measured as the distance between the leading edge of the front tire impression and the leading edge of the rear tire impression (see diagrams).

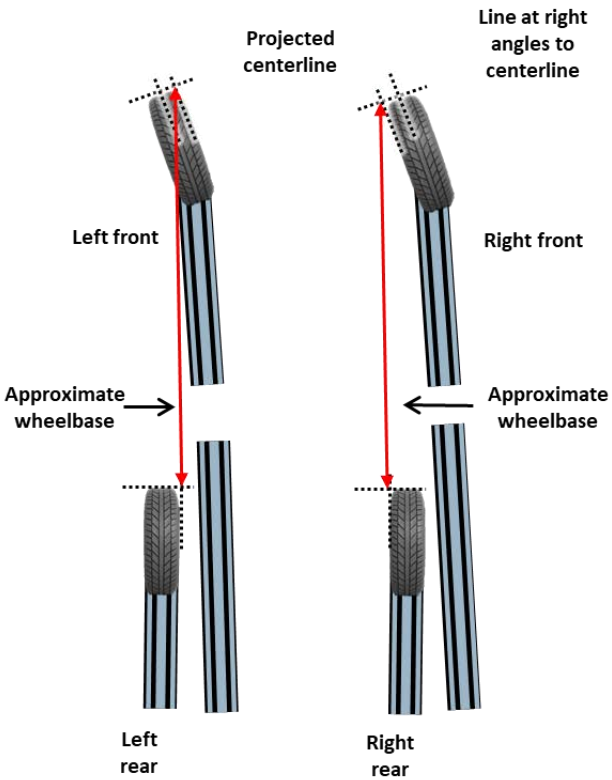
Vehicle Track Width (stance)



Wheelbase and Track Width Measurement



Measuring the Wheelbase when Front Tires are Turned



Evidence Packaging

Casts: Place casts individually in rigid containers such as a cardboard box that is appropriately cushioned (e.g. crumpled lab/butcher paper).

Digital Media: Package USB drives or optical media containing digital images in manila envelopes. Consider padded envelopes for protection from damage.

Electrostatic Dust Lifts: Store smaller individual lifts in clean dust free inner packaging such as a file folder and then placed into outer packaging, such as a manila envelope. Alternatively, a box may be used. Larger lifts may be rolled up (non-lifting surface on outside), secured with a small piece of tape and placed in a cardboard mailer tube.

Gelatin Lifters: Place in clean dust free containers such as a manila envelope.

Objects Containing Impressions: Package in appropriate containers for the object to prevent damage to the object and the impression. Examples below:

Clothing with footwear impressions in blood - carefully packaged in a breathable brown paper bag
Tile with impressions in an oily substance – placed in a rigid container such as a cardboard box

Shoes: Package each pair of shoes in one brown paper bag.

Tape Devices/ Adhesive Lifts: Store in a dust free container such as a manila envelope.

Tire Test Impressions (mylar/ lab paper): Each test impression can be covered with lab paper and rolled up into a cardboard mailer tube.

Tire Test Impressions (drafting film/ lab paper affixed to chart board/posterboard): Packaged in lab paper.
Large Items (tires, bicycles etc.): Attach an evidence tag. Packaging may not be practical.

Evidence Submittal

Packaged evidence should be labeled with agency case number, item number, and brief description as appropriate. Date and initial tape seals on containers. Evidence that is not practical to enclose in a packaging container (e.g. tire) should be tagged and labeled with the same information as packaged evidence.

Submit evidence to the laboratory along with a completed *Physical Evidence Submission Form* (BFS-1) and a case summary or report.

Evidence submission to the laboratory in-person is recommended; however, if evidence must be shipped to the laboratory, be aware of commercial courier shipping restrictions.

Additional Information

Please contact your regional BFS laboratory for further information.
List of regional laboratories: **https://oag.ca.gov/bfs/services**

Web address for current revisions of PEBs: **https://oag.ca.gov/bfs/peb**

Web address for BFS-1 form: **https://oag.ca.gov/system/files/media/bfs-1.pdf**

References

Additional resources to consider:

- OSAC-2021-N-0018, Standard for On-Scene-Collection and Preservation of Physical Evidence
- ANSI/ ASB Best Practice Recommendation 021, Best Practices for the Preparation of Test Impressions from Footwear and Tires, 1st ed. 2019
- ANSI/ ASB Best Practice Recommendation 049, Best Practice Recommendation for Lifting of Footwear and Tire Impressions, 1st ed. 2020
- ANSI/ASB Best Practice Recommendation 050, Best Practice Recommendation for Photographic Documentation of Footwear and Tire Impression Evidence, 1st ed. 2021 with Errata 1 2022
- ANSI/ASB Best Practice Recommendation 052, Best Practice Recommendation for the Detection and Collection of Footwear and Tire Impression Evidence, 1st ed. 2022
- ANSI/ASB Best Practice Recommendation 126, Best Practice Recommendation for Casting Footwear and Tire Impression Evidence at the Crime Scene, 1st ed. 2020 with Errata 1 2022
- ASB Technical Report 097, Terminology Used for Forensic Footwear and Tire Evidence, 2nd ed. 2026
- Bodziak, William J., Footwear Impression Evidence, 2nd ed., CRC Press, 2000