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Best Practice Recommendation for Casting Footwear and Tire Impression Evidence at the Crime Scene

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Foreword

This document was developed to provide best practice recommendations for personnel responsible for casting footwear and tire impressions. Following the recommendations set forth in this document will optimize the recovery of impressions.

The methods included in this document may not cover all aspects of unusual or uncommon conditions. Deviations from this document may preclude examination of recovered impressions.

This document is not intended as a substitute for training in the casting of footwear and tire track evidence. Completion of a training program and experience in these skills is essential to understanding and applying the principles outlined in this document.

While this document mentions other methods such as photography, physical and chemical development and lifting, it is not intended to give specific instructions on the selection of devices or use of these techniques.

This document does not cover safety measures related to casting impression evidence. Personnel must refer to their agency safety protocols and the operating instructions of the equipment they utilize.

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 Track Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

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 https://www.aafs.org/academy-standards-board.

Keywords: *casting footwear and tire impressions, casting impression evidence, three-dimensional impressions, casting.*

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1 Scope

This document provides best practice recommendations for casting of footwear and tire impression evidence by appropriate personnel. Following the recommendations set forth in this document should result in the optimal recovery of impressions. Deviations from this document may/may not preclude examination of recovered impressions. The procedures included in this document may not cover all aspects of unusual or uncommon conditions. This document is not intended as a substitute for training in the detection of footwear and tire track evidence. Completion of a training program and experience in these skills is essential to understanding and applying the principles outlined in this document.

2 Normative References

There are no normative reference documents. Annex A Bibliography contains informative references.

3 Terms and Definitions

For purposes of this document, the following definitions apply.

3.1
cast
A method of preserving and recovering an impression utilizing an appropriate casting material.

3.2
casting material
Dental stone, snow print powder, sulfur, or other suitable materials specifically used to accurately recover three-dimensional impressions. Some casting materials are also successful for lifting two dimensional impressions.

3.3
dental stone
A generic gypsum product generally having a strength rating of 8,000 psi (55 mega pascal) or higher, commonly used to cast footwear and tire impressions.

3.4
dry casting
A method utilizing the layering of dry dental stone powder and misted water.

3.5
fixative
A process or reagent that helps secure the blood to the substrate or secures the substrate itself (e.g., snow, sand, etc.) so that it is not destroyed or degraded during chemical enhancement.

3.6
release agent
Any product that prevents substrate material from adhering to the cast.

3.7
snow impression wax
Aerosol waxes used to coat the surface of snow impressions prior to casting.

3.8
snow print powder
snow print plaster
An accelerated plaster that is applied in a prescribed way and is capable of casting all forms of snow impressions.

3.9
sulfur cement
A reinforced modified sulfur material, available in flake form that is a safer, stronger alternative to using pure sulfur in casting snow impressions.

3.10
three-dimensional impression
An impression made on surfaces such as soil, sand, snow or mud with dimensions of length, width, and depth.

4 Recommendations

4.1 Materials

The following is a list of materials used in casting three dimensional footwear and tire impressions. Not all materials listed below will be used in every method:

a) casting materials;

b) mixing containers;

c) resealable plastic type bag;

d) appropriate size bucket (e.g., 5 gallon (18.9 liter) or larger volume);

e) water;

f) measuring cup;

g) stirring apparatus;

h) stove or hot plate (sulfur casting);

i) potassium sulfate;

j) aerosol wax;

k) release agents and fixatives;

l) weigh scale;

m) sifter;

n) spray bottle, and

o) casting frame.

4.2 Procedure

4.2.1 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.

4.2.2 Document and photograph impressions prior to casting.

4.2.3 When casting, care should be exercised as to minimize any potential damage to the impression. For fragile impressions observed in fine substrates (e.g., flour, soil, etc.) an aerosol fixative may be applied by misting over the impression and allowing the fixative to fall into the impression.

4.2.4 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.

4.2.5 Make up the casting material according to the manufacturer's guidelines.

4.2.6 The resulting mixture viscosity is dependent upon the circumstances (location, substrate, etc.) of the impression; most impressions will require a viscosity similar to pancake batter. The viscosity of the mixture may need to be adjusted based upon the nature of the impression (e.g., fragile impressions may require a thinner mix, impressions on an angle may require a thicker mix).

4.2.7 Carefully pour casting material outside the perimeter of the impression and direct the flow into the impression. Ensure the impression is completely filled and/or covered evenly. In the event that 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 add thickness.

4.2.8 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.

4.2.9 Larger quantities of dental stone can be mixed in a bucket to cast large segments of tire or multiple impressions.

4.2.10 Tire casts should be long enough to capture the entire circumference of the tire, usually 6 ft (1.8 m) to 8 ft (2.44 m). If it is not practical to make one 6 ft (1.8 m) long cast, two 3 ft (0.91 m) long segments should be made to allow for an optimum comparison examination. Smaller casts (e.g., 12 in. (30 cm), 18 in. (46 cm), and 24 in. (61 cm) long segments) can also be made if the proper training, experience, and/or equipment is not available to make a larger cast.

4.2.10.1 *Casting Submerged Impressions in Standing Water:* Attempt to dam the impression and remove as much water as possible without damaging the impression. Sift or sprinkle an 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.

4.2.10.2 *Casting Impressions in Snow:* Prior to casting or enhancing an impression in snow, the impression should be documented photographically. A highlighting spray such as paint or aerosol wax may be used to increase the contrast and the impression should be re-photographed. The highlighting medium should be applied by spraying obliquely 8 in. (20.32 cm) to 12 in. (31 cm) away from the impression.

4.2.10.2.1 *Casting 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. The first layer should be sifted slowly and evenly to absorb the moisture from the snow. Only sift enough to absorb the moisture. To help ensure the dental stone mixture is as cool as possible when it is applied to the impression, techniques such as cooling the dental stone and the water may be utilized. In colder temperatures it may be necessary to add potassium sulfate (K_2SO_4) 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. When the impression in snow is excessively wet, is melting quickly or has standing ground water, two to three fine layers of dry dental stone should be sifted onto the impression prior to casting.

4.2.10.2.2 *Casting with Snow Print Plaster:* Sift a base layer (approximately 10% or 3 oz (85 gm) of the product) of Snow Print Plaster powder over the impression. Mix the remaining powder quickly with water and apply to the impression. Fill the impression with the mixture and wait until it begins to harden. To ensure an even cure the cast should be covered with suitable material, and then covered with snow to insulate the cast until it hardens.

4.2.10.2.3 *Casting with Sulfur Cement:* Caution should be used as this technique requires that the user be familiar with safety issues regarding the melting/heating of sulfur. Melt the sulfur, remove from heat and stir constantly as it cools. Crystals form and the liquid thickens as it cools. In general, the time to pour is when crystals have formed, but the sulfur is a liquid suspension. Pour from the perimeter, allowing the melted sulfur to flow into the impression. Due to the extremely brittle nature of sulfur casts, dental stone may be poured over the back of the cooled sulfur cast to reinforce it prior to lifting. The cast may be removed when it is cool.

4.3 Marking and Collecting the Cast Impressions

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

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

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

4.3.4 Carefully lift the cast from the substrate. It may be necessary to excavate around the perimeter of the cast to avoid breakage.

4.3.5 Casts should not be cleaned at the scene.

4.3.6 Casts must be thoroughly dry before storage or packaging.

4.3.7 Casts and any adhered substrate should be adequately packaged to avoid breakage during storage or shipping.

4.4 Cleaning Dental Stone Casts

4.4.1 Casts should be cleaned in the laboratory by the examiner no sooner than 48 hours after collection.

4.4.2 If necessary, prior to cleaning, preserve any soil or other evidence attached to the cast.

4.4.3 Soil and sand can be cleaned from casts using water and a soft brush.

4.5 Stone Casting Material Specifications

4.5.1 Stone material should have a water to powder ratio of 35 or less. Product specifications should indicate a compressive strength of at least 8,000 psi (55 mega pascal).

4.5.2 Alternate casting materials may be suitable if they meet the following criteria:

a) able to record fine detail and have negligible shrinkage or expansion;

b) will flow evenly into the impression without being absorbed by or seeping through the substrate;

c) have a reasonable set time (e.g. 1 hour or less depending on manufacturer's recommendations and environmental conditions);

d) will release from the impression substrate, and

e) can be cleaned without damage and resulting loss of detail.

4.6 Documentation

Procedures utilized and evidence collected should be documented.

Annex A
(informative)

Bibliography

The following bibliography is not intended to be an all-inclusive list, review, or endorsement of literature on this topic. The goal of the bibliography is to provide examples of publications addressed in the standard.

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SWGTREAD documents can be downloaded from:

http://treadforensics.com/images/swgtread/standards/current/swgtread_11_casting_200703.pdf

[1] https://www.aafs.org/academy-standards-board

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