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REPRODUCTION OF FOOT AND TIRE TRACKS BY PLASTER OF PARIS CASTING

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Occasionally, tire tracks or foot prints are found at various crime scenes. The preservation of this evidence can most generally be easily solved by the use of plaster of paris properly applied to the impressions left at the crime scene. Plaster of paris will reproduce in good detail, a foot print or tire track, imprinted in mouldable materials such as snow, moist clay, dry or moist garden soil, mud, and mud covered by water, etc.

Plaster of paris is a very suitable medium with which to attack this problem of reproducing foot prints or tire tracks because it is easy to use, costs very little money, and takes only a little practice to learn the various techniques necessary to make a good cast. The cast can be made and taken out of the mouldable material (depending upon what it is) in a short time—thirty minutes to two hours. A little training, patience, and effort on the part of a field investigator will pay big dividends.

The various pieces of equipment (listed below) used in making plaster casts, as well as the various procedures (suggested later on throughout the article) have been used many times by the writer. The subject material in this article represents the subject areas of plaster of paris casting as it is taught to the police officers attending the training sessions of the Southern Police Institute.

EQUIPMENT NEEDED TO HANDLE THE VARIOUS SITUATIONS

1. Water.
2. Plaster of paris.
3. Wooden paddle or large spoon for stirring and pouring.
4. Container(s) for carrying and mixing the plaster of paris and water. (A #2 can or larger is most suitable.) A large rubber ball cut into halves is very desirable. Three empty tin cans of different sizes, packed into each other make a most desirable unit as the plaster of paris can be carried in the smallest of the three. The next larger one can be filled with water prior to mixing the plaster of paris with water, and the largest is used to mix the two mediums of water and plaster of paris to the proper consistency for the impression to be cast.
5. Green twigs, wire mesh screen, or other non-porous material for cast re-inforcement.
6. Fine sieve (window screen size) for sifting plaster of paris.
7. Liquid plastic solutions (aerosol bomb type).
8. Sewing machine oil and hand sprayer.
9. Talcum powder and cloth bag for fine dusting of an impression.
10. Flit gun for spraying water.
11. Galvanized iron metal strips (20″ x 4″) for shaping retaining walls.
12. Small pill box or clean envelope for earth samples.
13. Protective covering—boxes, boards, etc.—to protect impressions prior to casting.

USUAL PROCEDURE WHEN CASTING WITH PLASTER OF PARIS

After the impression has been properly prepared and protected from the elements, measure enough water into your mixing container to more than fill the impression. Always be sure to mix enough plaster of paris so that it will fill up the impression and flow out over the edges of the impression in the ground. The excess mixture should be confined by a suitable retaining wall, slightly larger than the impression's dimensions.

For every half pint of water (8 fluid ounces) add six to seven ounces of plaster of paris. When mixing, add the plaster of paris slowly to the water and stir constantly. When all of the lumps have disappeared and the mixture is smooth and has a thick gravy consistency, the plaster is ready for pouring.

When your plaster of paris has reached the

proper consistency, and not before, pour the mixture slowly and evenly into the impression. It is recommended that you poor the mixture against the stirring paddle or spoon so as to remove any air bubbles in the mixture. If the cast is to be a large one (more than a heel impression), you should insert reinforcing material into the impression after about half of it has been filled, then pour in the rest on top of the reinforcing material.

Allow the cast to set. This should take about twenty minutes. When the top of the cast is firm but not hard, inscribe your initials, date, time, location, and case number of the offense. This can be done with a small nail, the point of a pocket knife, or some other small sharp object. As the cast continues to set and harden, it will generate heat. This is normal and will not cause you any trouble if you have properly prepared your impression ahead of time. Carefully read the instructions later on in this article regarding snow impressions.

When the cast is completely firm to finger pressure (on top of the cast), it can be removed from the impression. After the cast has been taken up from the ground, it should be removed to a safe place for further drying and hardening. When it is completely hard on the under side, then and only then should the cast be cleaned with a small low volume of water running over the cast to remove any dirt which clings to it. Brushing and rubbing should be avoided except when necessary and only then with a small paint brush.

Preparation and Examination of an Impression Before Casting

Many good impressions will be found in some mouldable material such as earth, mud, sand, clay, snow, etc. Protect the impression from alteration or destruction by adequate coverage with boxes, boards, and the like. Protect all impressions from running water, drifting snow or dirt, etc.

Casts should be made if they contain details of value for identification such as signs of wear, characteristic fittings or marks of lost fittings, injuries to the heel, sole or circumference of the sole or heel, repair marks such as half soles, etc.

In serious crimes, casts should be made even though they do not show details, in the interest of thoroughness. Preservation of impressions should be accomplished by either photographing or casting, in important cases by both methods.

Remove all loose foreign material (by tweezers, fingers, or by brushing or blowing with one's breath onto a piece of paper) that it is possible to without damaging or altering the impression. Embedded rocks, grass, leaves, etc. should not be removed as they form a part of the impression, and no details will be found under them.

A word of caution at this point: impressions found in snow which has a frozen surface layer will not produce identifying details because the coarse grains of ice in the surface layer will not reproduce details. Also since the hard snow is broken and pressed down at points a considerable distance outside the outer contour of the shoe or tire, it is not possible to obtain any useful information of size by measuring the impression.

Removal of an Impression that Has Been Cast

In loose earth or fine sand, remove the cast by spreading out the extended fingers of both hands along one edge and raise up the cast.

Deep impressions or firmly seated impressions should be removed by digging away the earth, etc. from around the cast so that the cast is resting on a small pedestal immediately underneath it. This pedestal is then cut off, and the cast and the top part of the pedestal lifted out as one piece.

When lifting, the underside of the cast should not be touched, as details may be destroyed where the plaster has not fully hardened.

Dirt, sand, earth, etc. adhering to the cast should not be removed for several hours after the cast has been removed from the ground. The cast should then be cleaned by careful washing with running water—brushing and rubbing should be avoided if possible.

Examination and Comparison of a Cast with Suspected Shoe or Tire

Impressions are seldom of the same size as the shoe or tire that made them, because of the slipping or movement in the mouldable material or because the impression has dried out or started to dry out prior to casting. The impression of a shoe in movement (such as walking, running, skidding motion when turning) can be as much as one half inch longer than an impression from the same shoe in a standing position. An impression in wet earth or clay will become smaller as the earth or clay dries out.

Identification is based on characteristic marks or details in the sole, heel, or tire tread. Examination is made by direct comparison of the evidence im-

pression that has been cast and the suspected shoe or tire. Both should be photographed at the same horizontal distance from the camera. Similar and identical characteristic details of each photograph then should be marked out in a clockwise manner on both photographs and given the same number on each photograph for each individual detail.

In establishing identity, too much significance should not be attached to the dimensions of the cast as against the suspected shoe or tire for the reasons cited in the first paragraph of this section of the article. A search should be made for similarly or identically placed identifying characteristic details in the cast as against the suspected shoe or tire.

The final comparison should be made by a recognized expert. However, this does not prevent police officers or detectives from making preliminary and identifying examinations.

In all instances, samples of the dust, dirt, earth, sand, etc., should be taken immediately from the cast's under side and placed in a suitable container and properly identified. The comparison of this sample with the dirt, etc., that may be later removed from the suspect's shoe or tire, may in itself help to identify the suspect.

Casting in Compact Wet Snow

The impression does not need to be prepared. However, it is advisable to box the impression with the suggested galvanized iron strips to control the spread of the plaster of paris mixture.

Snow should be placed in the mixing water to cool it. When the water is as cold as possible, the snow sludge should be removed before mixing in the plaster of paris, which should also be as cold as possible. If necessary, spread it out on a newspaper laid on the snow.

The mixture of water and plaster of paris should be thick and heavy, but still pour easily. If the mixture is thin, it will filter down between the grains of snow and ice and into the bottom of the impression, leaving the under side of the cast porous and with lack of detail.

The cast should be left at least one hour to harden and should be reinforced. Screen wire or other suitable nonporous material that will not absorb moisture should be used. This will avoid or prevent the reinforcing material from swelling and cracking the cast.

Casting in Loose Snow

The impression should be prepared before pouring the plaster of paris. The cast preparation involves covering the impression with a thin surface layer which will harden and strengthen the cast, so that the weight of the plaster of paris will not distort the detail and size of the impression. Use a liquid plastic spray such as Print-Loc uniformly over the impression to strengthen it. Allow the material sprayed over the impression to dry and harden. This preparation should be repeated at least twice. If the preparation layer of plastic is too thick, it is liable to alter or damage small details in the impression. Preparation is sometimes unavoidable, as without it, casting could not be done at all.

Make a test impression close by, to check your technique for allowing the plastic spray to dry and harden. The evidence impression and your test impression can both be sprayed at the same time, but you only have to check the test impression for strengthening and drying factors prior to applying the plaster of paris mixture. The humidity in the air will determine the amount of time it takes the plastic spray to dry.

The plaster of paris is applied in the following manner. First, sift into the impression (after it has been boxed with suitable material such as galvanized iron or cardboard strips) a layer of dry plaster of paris approximately ¼″ thick, then spray cold water onto the dry plaster, soaking it thoroughly, until none of the plaster remains dry.

Then add a second layer of dry plaster, sifting it as you did for the first layer. This layer can be ½″ to ¾″ in depth. This layer should be reinforced with screen wire or other suitable non-porous material that will not absorb water. Several layers of cheese cloth are next laid on top of the dry plaster of paris and water is then slowly poured onto the cheese cloth so that the plaster of paris becomes thoroughly soaked. When this has been accomplished, you are ready to add the last layer of plaster of paris.

For the third and last layer, do not apply sifted dry plaster as before, but add a thick mixture of plaster of paris and water, pouring or spreading it over the two previous layers. The cheese cloth should be removed prior to the third layer of plaster. The cast should now be allowed to remain undisturbed approximately two hours before it is to be removed.

Removal of Casts Made in Snow

The cast should be removed carefully because some snow and/or ice will be on the underside of the cast. The underside will also be loose, and not

very hard. It should be transported and placed with the underside of the cast towards the ground or floor and in a horizontal position. Unless properly handled, the movement of the snow or ice when the cast is being moved, or later on when the ice or snow is melting, the details of the cast will be injured. *Allow at least 24 hours drying time indoors at room temperature before examining the cast.*

It would be well for all casts made in snow to be made oversized, (that is to say, an extra large border made all around the impression's sides, so that it can be adequately handled and transported in a horizontal position with the underside of the cast down). Oversized borders will allow adequate room for supports to properly hold the cast for transportation and drying.

Casting of Water-Filled Impression

Frequently impressions of tire or shoe tracks are found in puddles of water, melting snow, marshy ground, etc. If the area of water is large and/or deep, strips of galvanized iron should be used to mark off the area of the impression. When possible and convenient excess water should be drained off or dipped out. Also, in this particular instance, small wooden pegs, properly and visually marked, should be placed in a vertical position near the edge of the impression, so that when the proper amount of plaster of paris has been added to the impression, it will be known visually by watching the marker (piece of string, or rubber band, etc.) on the vertically placed indicator.

After the above has been accomplished, sift dry plaster of paris on the water surface over the impression area. Slow sifting will allow the plaster of paris to sink gradually to the bottom of the impression. Sifting should continue until the cast is sufficiently thick—your visual or physical marker is very handy for this purpose. Also, this cast should be reinforced with suitable screen wire or non-porous material. The mass of sifted plaster should remain undisturbed for at least two hours before removing. The addition of small amounts of table salt to the plaster of paris from time to time will speed up the hardening process.

The white milky appearance of the water (after sifted plaster of paris has fallen through it) soon clears. To speed up the operation of applying a sufficient amount of plaster of paris, the caster can use his fingers to search out the string or rubber band on peg marker, testing by feel for the depth of plaster of paris that has settled into the casting area. The marker should be at the required depth of plaster that will be needed to make the cast.

When removing a cast of this type, dig away the mud, snow, etc., from underneath the cast, so that it stands on a small piling or pedestal of the material on which the impression was made. This pedestal area is then cut off and the cast and pedestal area lifted out as one piece. Testing the hardness of the plaster of paris with one's finger on the top side of the cast will let you know when it is hard enough to be removed safely.

Precautions in Casting

1. It is advisable to make an evidence photograph of each impression before casting.

2. The kind of material in which the impression is found will control the preliminary steps to be taken before the plaster is poured. Casting with plaster of paris is suitable for larger objects that do not require microscopically accurate reproduction. Therefore, footprints and the tracks of vehicles may be satisfactorily reproduced in this way. Tool marks and all structures having important microscopic features must not be cast with plaster. A good grade of plaster of paris such as is used by dental technicians is suitable for good detail reproduction. Also ordinary commercial plaster of paris may be used for most casts.

3. A retaining wall made of cardboard, boards, galvanized iron strips, etc., should be placed around the immediate area of the impression to contain the plaster in a suitable and efficient working area.

4. The plaster should be applied (poured or spooned) quickly over the entire impression area.

5. Impressions in sand, fine soil, dust, and loose snow must be strengthened with a plastic spray or other quick drying fixative. A moderately high wall should be placed around the impression and the spray should be directed over the impression rather than directly at it, so that the spray filters over the impression by gravity force and not by direct air pressure force.

6. Extreme care—and previous training—should be the technique when dust impressions are strengthened with a quick drying fixative.

7. When fragile impressions are to be cast, make a test impression; casting it first will insure your technique.

8. A fine layer of talcum powder sprinkled over the surface of a snow impression will serve to insulate the snow from the heat of the hardening plaster.

9. A frequent fault in pouring casts is to allow

CASTING IN DRY GARDEN SOIL, MOIST EARTH, DRY EARTH, SAND, MOIST CLAY, DUST

Medium	Method	Precautions
Moist soil	1. Moderate spraying with plastic sprayer—allow to dry 2. Moderate spraying with oil 3. Normal procedure and precautions	None
Dry soil	1. Spray liberally with plastic spray 2. Moderate spraying with oil 3. Normal procedure and precautions	None
Moist clay	1. Light oilspray will help when removing clay from cast 2. Normal procedure and precautions	None
Dry dust	1. Spray with plastic spray until impression is fixed and firm 2. Alternate spraying and drying 3. Light oil spray 4. Plaster mixture should be spooned into the impression—mixture should contain small amount of salt to hasten hardening of plaster. 5. Peel off plastic skin while still moist without damaging cast	1. Protect impression with suitable pasteboard box or wooden crate 2. Spray plastic spray from safe distance—at least three feet. Allow spray to fall by gravity to impression 3. Use extreme care in spooning plaster onto impression to avoid disturbing or breaking the skin 4. Photography is best medium to record this impression
Sand	1. Spray impression in sand liberally with water 2. Melted paraffin should be used in place of plaster of paris 3. Apply melted paraffin in the same manner and procedure as plaster of paris 4. Pour melted paraffin when it is cool enough for a finger to be held in the melted wax	1. If enough water is used in spraying the impression in the sand, it will prevent the large or small particles of sand from adhering in great quantity to the paraffin cast 2. Reinforce in the same manner as plaster of paris 3. Finished cast should be approximately ½″ to ¾″ thick. Reinforcing not necessary but advantageous

the plaster mixture to become too thick for pouring. The use of too thick plaster will cause imperfections that may completely obliterate identifying marks.

10. Non-porous reinforcing material only should be used in strengthening casts. Many casts break or crack because porous material used to strengthen the cast absorbs water from the plaster mixture and swells. The break may take place in a critical area or areas. Pour a ¾″ plaster thickness, reinforce, and continue pouring until the cast is at least 1½″ thick.

11. Small particles (stone, twigs, rocks, etc.) firmly imbedded in the finished cast should not be removed.

12. The finished cast should show design in detail, and reproduce minute marking which will serve to identify the cast with the evidence which produced the impression.

13. Why must some impressions be strengthened with a quick drying fixative?

a. The lack of cohesion among the particles of the mouldable material in the impression presents the danger of losing detail because of shifting under the weight of the plaster.
b. These particles or substances may be dissolved by the plaster.
c. The particles or substances may or will adhere to the plaster and cannot be washed off.

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