

Footwear Marks Recovery Manual

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1. INTRODUCTION

This Footwear Mark Recovery Manual aims to provide information on how to optimise the recovery of footwear marks from crime scenes. Throughout, it provides the operational Crime Scene Investigator (CSI) with information on a number of issues specifically relating to footwear mark recovery, including step by step procedures of methods currently available for recovering footwear marks from scenes of crimes.

The manual will illustrate why, in relation to footwear mark evidence, it is important to gather as much information as possible about the crime prior to attending the scene, and how carrying out an initial assessment on arrival at the scene will aid in locating latent and visible footwear marks.

The manual will demonstrate how footwear marks can be used to investigate crime scenes, establish the movements of perpetrators locate further forensic opportunities and place intelligence and evidence into the context of the crime.

It will explain how different contaminants can be transferred from one area to another by an item of footwear by either depositing and/or removing contaminants causing footwear marks to be formed, and how the surface/contaminant relationship can have an effect on the formation of footwear marks.

Information regarding the application of chemical treatment of footwear marks will be available at a later date.

2. MAXIMISING THE RECOVERY OF FOOTWEAR MARKS

All crime scenes present the potential for the recovery of footwear marks and their intelligence and evidential value should never be underestimated. The Forensic Science Service states that; "Footwear marks are the second most common evidence type left at crime scenes and the new technology will give police immediate information on what make and model of shoe has left the crime scene mark in question. It can also help them link crime scenes to potential suspects, searching for links at local and national level."

Using footwear marks to track movements of suspects within each scene can lead the CSI to other forms of evidence, and so assist in placing all forensic evidence into the context of the crime, and ultimately ensure a full scene investigation takes place. To maximise the recovery of footwear marks and other evidence a 'Scene Assessment' should take place. The scene assessment should be used to produce an 'Evidence Recovery Plan' as shown in the diagram (Figure 2.1).

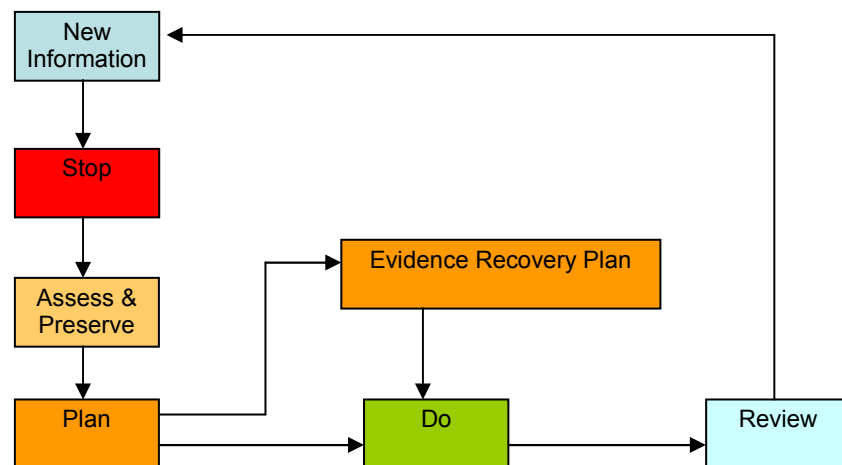


Figure 2.1

New information could be the initial information you receive when you are requested to attend the scene. It could also be anything, from any source during the course of your investigations.

2.1 STOP

It is important to gather as much initial intelligence/information as possible about the crime prior to, and on attending the scene.

- **Where?**

Locate areas of interest e.g. possible approach route and hiding place/s, direction of travel, (look for points of reference to indicate direction of movement, such as doors and windows).

- **When?**
Establish the time the alleged crime was committed and if other people have visited/attended the scene since the alleged incident.
- **What?**
Establish what is known at the present time, i.e. has other crime been reported in the area, what items have been moved since the crime was reported?
- **Why?**
Establish why it may have happened. Keep an open mind; listen to those who are providing information, assume nothing, believe no one and check everything, always question the information.
- **Who?**
Gather information on suspects, person/s arrested, witnesses, officers attending the scene and victim.
- **How?**
Modus Operandi – all enquiries should be in proportion to the offence.

The above is not a full definitive list, rather examples of the type of questions that may be answered to gain relevant information before attending a crime scene.

2.2 ASSESS AND PRESERVE

Consider how each suspect footwear mark may have been formed, e.g. surface type and contaminant transfer, how each may be recovered, order of priority of retrieval. The following should also be included in the 'assess and preserve' phase.

- Work from information received and establish how many different surfaces a suspect may have come into contact with during the alleged crime.
- The constituents of each of the possible contaminants that may have been transferred to the surfaces identified above (The contaminant is often that which lies on or forms the previous surface)
- Weather conditions at the time of the crime (wet or dry)
- Likely weather conditions during the retrieval process
- Identify movable/recoverable items and prioritise their recovery
- Identify footwear marks which relate to the context of the crime
- Identify footwear marks for elimination (through enquiries)

During this stage the CSI should be aware that there is increased potential for both visible and latent footwear marks in the following areas:

- Near to the boundary of a surface change
- Close to a foreign contaminant (e.g. blood or dust)
- Near to a boundary where a surface changes from wet to dry

Take actions to preserve footwear marks where necessary.

2.3 PLAN

Before implementing any forensic procedures consideration should be given in respect to risk assessment, lighting, equipment and personnel required.

2.4 EVIDENCE RECOVERY PLAN

Devise a sequential Evidence Recovery Plan which takes into account other forms of potential forensic evidence.

With respect to footwear mark evidence the recovery plan should prioritise vulnerable footwear marks and take into account the application of sequential recovery techniques. When necessary incorporate this plan into a full forensic strategy proportional to the crime. Consider undertaking the following techniques in order to optimise evidential potential:

- Oblique lighting
- Darken the area to be searched for increased contrast
- Constantly change line of sight (horizontally and vertically), to achieve different angles of viewing during search
- If visible footwear marks are found, do not stop searching. Latent footwear marks may provide more information (visible footwear marks may be overloaded with a contaminant)
- Use ESLA and Gel Lifters to search areas in which latent footwear marks may be found
- If item is removable take whole of the item, although it is essential to preserve any potential footwear marks before moving the item (photographs, ESLA etc)

If necessary consider calling the chemical laboratory or footwear mark expert to the scene.

2.5 REVIEW

New information can come to light at any time during the investigation so always be prepared to revisit decisions made during the **STOP, ASSESS & PRESERVE**, and **PLAN** stages. Every step taken by a perpetrator of a crime offers the potential for the recovery of a footwear mark, it is up to the crime scene investigator to locate and recover them. Remember poor quality footwear marks can be useful as they may lead to better quality footwear marks and other forensic evidence.

2.6 RECORD

All information should be recorded contemporaneously at each of the above stages. Consider recording the following information.

- **Information received prior to attending**
Record all available information prior to attending the scene. Consider further investigation before attending.

- **Scene assessment and recovery plan**
Note the potential for recovering evidence, justify your actions and proposed sequential recovery techniques ensuring they are proportional to the offence.
- **Areas searched**
Note all areas searched within the crime scene and what methods were used during the search e.g. oblique lighting and Electrostatic Lifting Apparatus. Any areas where the search is non-productive should also be recorded.
- **Type of surfaces**
Record the type of surface to assist the Forensic Footwear Specialist to differentiate between footwear pattern and surface texture/pattern.
- **Location of all footwear marks recovered**
Photographs should include a long view, a mid view and a close up view. Diagrams, measurements and location arrows must also be included where relevant.
- **Footwear eliminated**
Consider the use of a physical recovery method to record any footwear patterns that may be considered for elimination.

3. HOW FOOTWEAR MARKS ARE FORMED

3.1 TRANSFER OF A CONTAMINANT

For a two dimensional footwear mark, in just one step alone, when the outer sole area of an item of footwear comes into contact with a surface it is highly likely that trace material and/or contaminants present on that surface, will be deposited and/or removed from the surface to produce either a visible or latent footwear mark.

For the criminal who walks through a crime scene making numerous contacts with a number of different surfaces, causing the deposition and/or removal of contaminants the chance for the CSI of retrieving footwear marks is very high, although there is some work involved in their location and retrieval.

Contaminants can include many different material's both liquid and solid. If a contaminant is transferred to a surface which contains similar material types then it is unlikely that a visible footwear mark will be formed. However, when a contaminant is transferred to a surface with a contrasting contaminant, a visible footwear mark is much more likely to be formed.

During the process of walking, items of footwear are pressed onto various surfaces often creating a small temporary static charge. This process is currently of little value to crime scene examiners, however the static charge can at times facilitate in the transfer of certain contaminants such as dust.

For an item of footwear which is clean, dry and free from contaminants and remembering that 'every contact leaves a trace' the outer sole itself may become the contaminant that forms the footwear mark.

3.2 POSITIVE AND NEGATIVE FOOTWEAR MARKS

Footwear outer soles can remove or deposit a contaminant from one surface to another to produce either a negative or positive footwear mark. See Figure 3.1 for an illustration of this.

Negative Footwear Mark - The outer sole of the footwear item **removes** a contaminant from a surface which leaves a footwear mark that represents some or the entire outer sole pattern.

Positive Footwear Mark - The outer sole of the footwear item **deposits** a contaminant onto a surface which leaves a footwear mark that represents some or the entire outer sole pattern.

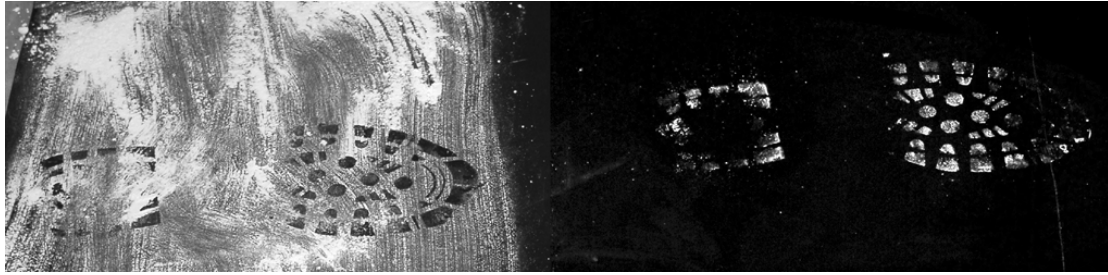


Figure 3.1 Illustrates how the outer sole of an item of footwear has come into contact with a dusty surface and removed some of the contaminant to produce a negative footwear mark (left). The same item of footwear bearing the dust contaminant has then come into contact with a dust free surface, depositing the dust to produce positive footwear mark (right).

3.3 WET AND DRY ORIGIN FOOTWEAR MARKS

A wet origin footwear mark is when the item of footwear or the surface with which it makes contact is wet or damp.

A dry origin footwear mark is one in which both the outer sole and the surface is dry.

Wet origin footwear marks are more likely to adhere to surfaces due to the moisture being drawn or forced into the surface, making them more durable than dry origin footwear marks.

As a wet origin footwear mark is likely to be more durable it makes them more suitable for transportation. This should be taken into account when formulating an evidence recovery plan. (See Figure 3.2)

Wet or Dry Origin	Type of Surface	Footwear Mark
Wet	Porous	Durable
Dry	Porous	Fragile
Wet	Non-porous	Durable
Dry	Non-porous	Fragile

Figure 3.2

N.B. A trail of footwear marks changing from wet to dry has a good potential for successful recovery.

3.4 THREE DIMENSIONAL FOOTWEAR MARKS

Three dimensional footwear marks are formed when an item of footwear is forced into a soft surface.

Soft surfaces can be classed as **stable** e.g. mud, soil and sand and **unstable** e.g. carpet and damp or dry grass.

The stable soft surface will hold the footwear mark for some time, as long as it is not disturbed, and is suitable for the recovery process of 'casting'. It has the potential for holding the fine detail required for identification of a particular item of footwear.

An unstable soft surface will only hold the footwear mark for a very short time and may never hold the fine detail required for identification of a particular shoe, although it does have its benefits as it can give an idea of direction of travel, and may possess a surface contaminant that can be transferred to another surface.

For both the stable and unstable soft surfaces, the surface contaminant is an important factor as it can be picked up by the outer sole of the footwear and deposited onto the adjoining surface, leaving either a positive or negative, latent or visible footwear mark.

Example: A perpetrator walks across a damp lawn and then onto a long dry dusty concrete path. During his journey across the lawn the outer sole of the footwear becomes wet, once he steps onto the path the wet outer sole removes dust from the path, hence leaving a negative footwear mark. Walking along the path the outer sole dries and becomes laden with dust. The dust begins to shed from the outer sole, and is deposited onto the surface leaving a positive footwear mark. In this scenario the footwear marks left in the unstable soft surface of the damp lawn are unsuitable for recovery but lead to the potentially useful 2-dimensional footwear marks on the concrete path.

3.5 TWO DIMENSIONAL FOOTWEAR MARKS

Hard surfaces can be classed as **porous** or **non-porous** both have good potential for holding footwear marks. The general rule is that the smoother the surface the greater the potential for holding fine detail.

3.6 LATENT AND VISIBLE FOOTWEAR MARKS

There are many determining factors for the formation of positive or negative latent or visible footwear marks including:

- Surface type
- The contaminant
- Wet or dry origin
- Length of surface
- The item of footwear
- The amount of contact time
- The amount of contact pressure

All the above information should be taken into account during scene assessment in order for the implementation of a successful Evidence Recovery Plan to take place.

The point of entry (POE) to a building can be a significant site for the retrieval of footwear marks and other evidence types, and is often a good starting place for the scene investigation. If a footwear mark is recovered at the POE the investigation should continue as it is **very unlikely** that this footwear mark is the only one at the scene. It is important for the CSI to determine whether this is in fact the case. The CSI should always

consider the journey taken by the suspect prior to and after the POE, as latent footwear marks of better quality may be located elsewhere within the scene. These footwear marks may be used to complement any POE footwear mark.

4. TRACKING FOOTWEAR MARKS TO ASSIST SCENE INVESTIGATION

4.1 INTRODUCTION

Footwear marks can be used to track a criminal's movements within the crime scene. This can be very useful as not only can it lead to the location of other forms of evidence, but also assist in placing all evidence into the context of the crime.

When assessing a scene as to its potential for footwear marks evidence it is always good practice to first establish a likely route that the criminal may have taken. Working either forward or backward from visible footwear marks or from the POE can give an indication of direction of travel.

Any information regarding possible routes taken by the suspect/s should be investigated; consideration should be taken to establish if any contact has been made between the outer sole of the footwear item of the suspect and the different surfaces and contaminants. For each surface and contaminant a separate assessment is required.

The following two plans illustrate hypothetical crime scenes where the criminal's steps have been highlighted using different colours. Each of the different colours represents a surface or contaminant change. These changes will each require a separate assessment, during which the scene investigator should consider the determining factors for creating footwear marks.

It is important to stress that many of these footwear marks will be latent. Once the scene has been assessed a recovery plan can be considered. The plan should allow for sequential recovery techniques to optimise the potential of each mark. See following scenarios (Fig. 2 & 3) and tables for examples of tracking footwear marks and devising evidence recovery plans based on how the footwear marks appear to have been made.

4.2 SCENARIO ONE - BURGLARY DWELLING

The diagram (Figure 4.1) depicts a plan view of a dwelling house and its grounds, in which a perpetrator has gained access to the property via the back wall of the garden and entered the property after smashing the glass in the kitchen window. The direction of travel is represented by a set of colour coded footwear marks. These have been made visible to the reader in order to demonstrate the many different types of footwear marks that can be formed at just one scene. Most footwear marks in this scene have been formed via the transfer of a surface contaminant, i.e. a material/substance that would normally occur on a surface. It is acknowledged that at crime scenes most of the footwear marks will be latent.

The plan also demonstrates how tracking of even poor quality marks can lead the CSI to other areas of interest and possibly other forms of evidence.

The footwear marks have been colour coded to represent a set of variables. The CSI should attempt to identify these variables during the scene assessment in order to construct an Evidence Recovery Plan (For variables see Figure 4.2)

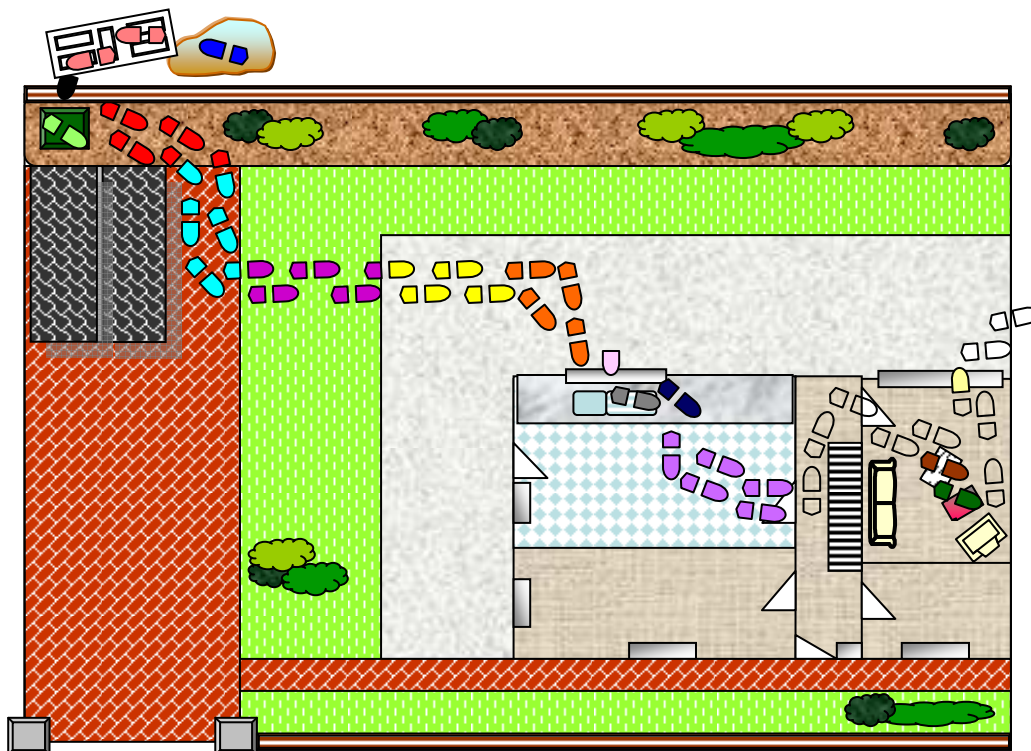


Figure 4.1

	SURFACE ON WHICH FOOTWEAR MARK DEPOSITED		FOOTWEAR MARK				
KEY COLOUR	DESCRIPTION OF SURFACE	POROUS OR NON-POROUS SURFACE	WET OR DRY ORIGIN	CONTAMINANT	LATENT OR VISIBLE MARK	POSITIVE OR NEGATIVE TRANSFER	2 OR 3 DIMENSIONAL
Navy blue	Muddy puddle	Porous	Wet	N/A	Visible	Positive	3
Pink	Painted wood (discarded door)	Non-porous	Wet	Water/mud	Visible	Positive	2
Black	Smooth concrete coping stone	Porous	Wet	Water/mud	Visible	Positive	2
Light green	Heavy duty PVC wheelie bin	Non-porous	Wet	Water/mud	Visible	Positive	2
Red	Soil	Porous	Wet	N/A	Visible	Positive	3
Light blue	Block paving driveway	Porous	Wet	Soil	Visible	Positive	2
Purple	Grass	Porous	Wet	N/A	Visible (temp)	Positive	3
Yellow	Smooth paving stones	Porous	Wet	Water/ grass residue?	Latent	Negative	2
Orange	Smooth paving stones	Porous	Dry	Dust	Latent	Positive	2
Pink	Dirty glass from smashed window	Non-porous	Dry	No	Latent	Negative	2
Grey	Clean stainless steel sink	Non-porous	Dry	Dirt from window glass	Latent	Positive	2
Dark Blue	Clean, textured work surface	Non-porous	Dry	Possible contaminants from window glass	Latent	Positive	2
Lilac	Clean ceramic tiled kitchen floor	Non-Porous	Dry	Contaminants from shoe itself	Latent	Positive	2
Clear	Short pile carpet	Porous	Dry	Dust and fibres	Latent	Negative/ Positive	2
Brown	Newspaper	Porous	Dry	Dust and fibres from carpet	Latent	Positive	2
Dark Green	Glossy magazine	Porous	Dry	Dust and fibres from carpet	Latent	Positive	2
Light Yellow	UPVC Patio Door Step	Non-porous	Dry	Dust and fibres from carpet	Latent	Positive	2
White	Smooth paving stones	Porous	Dry	Dust and fibres from carpet	Latent	Positive	2

Figure 4.2

4.3 SCENARIO TWO – MURDER

The diagram (Figure 4.3) depicts a plan view of a shop/post office, in which a perpetrator has gained access to the property via the front door, climbed over the counter and entered the rear of the shop where an attack has taken place, causing the death of the shop/post office clerk.

The direction of travel is represented by a set of colour coded footwear marks. These have been made visible to the reader in order to demonstrate the many different types of footwear marks that can be formed at just one scene. Most footwear marks in this scene have been formed via the transfer of a surface contaminant, i.e. a material/substance that would normally occur on a surface. This scene also contains a foreign contaminant, i.e. a material/substance that would not normally occur on a surface, and would be considered foreign to that surface e.g. blood. Also depicted in this scene are footwear marks on human skin and clothing which highlights the possibilities for footwear mark recovery.

It is acknowledged that at crime scenes most of the footwear marks will be latent.

The footwear marks have been colour coded to represent a set of variables. The CSI should attempt to identify these variables during the scene assessment in order to construct an Evidence Recovery Plan (For variables see Figure 4.4)

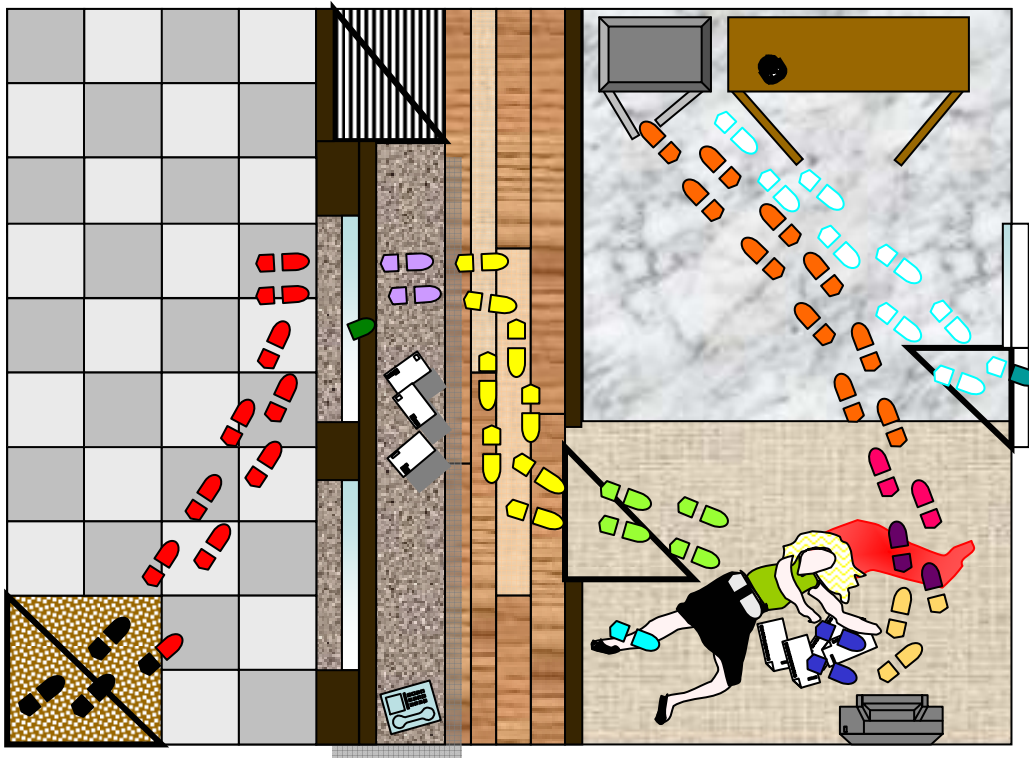


Figure 4.3

	SURFACE ON WHICH FOOTWEAR MARK DEPOSITED		FOOTWEAR MARK				
KEY COLOUR	DESCRIPTION OF SURFACE	POROUS OR NON-POROUS SURFACE	WET OR DRY ORIGIN	CONTAMINANT	LATENT OR VISIBLE MARK	POSITIVE OR NEGATIVE TRANSFER	2 OR 3 DIMENSIONAL
Black	Coconut matting	Porous	Dry	Trace material and dust	Latent	Negative	2
Red	Laminate floor tiles	Non porous	Dry	Trace material and dust	Latent	Positive	2
Dark Green	Grained wood frame	Porous	Dry	Trace material and dust	Latent	Positive	2
Lilac	Counter top	Non porous	Dry	Trace material and dust	Latent	Positive	2
Yellow	Waxed wood floor	Non porous	Dry	Trace material and dust	Latent	Positive	2
Green	Short pile carpet	Porous	Dry	Trace material and dust	Latent	Negative	3
Turquoise	Human skin	Non porous	Dry	Trace material and dust	Latent	Positive	2
Grey	Cotton fabric (smooth)	Porous	Dry	Trace material and dust	Latent	Positive	2
Mid Blue	Copy paper	Porous	Dry	Dust	Latent	Positive	2
Light Tan	Short pile carpet	Porous	Dry	Trace material and dust	Latent	Negative	3
Purple	Short pile carpet	Porous	Wet	Blood	Latent	Negative	3
Pink	Short pile carpet	Porous	Wet	Blood	Visible	Positive	2
Orange	Linoleum flooring	Non porous	Wet	Blood	Visible	Positive	2
White	Linoleum flooring	Non porous	Wet	Blood	Latent	Positive	2
Jade	Painted wood threshold	Non porous	Dry	Trace material and dust	Latent	Positive	2

Figure 4.4

5. PHOTOGRAPHY OF FOOTWEAR MARKS

5.1 INTRODUCTION

Crime scene photography is a non-destructive method of recovery of footwear marks. The CSI should always photograph footwear marks discovered at crime scenes before any other recovery techniques are used and additionally at each stage where sequential techniques are.

5.2 LOCATING FOOTWEAR MARKS USING PHOTOGRAPHY

To establish the location of footwear marks and place them within the context of the crime each mark should be recorded in long view, mid view and close-up view.

5.3 USING THE SCALES

The majority of detailed views will be captured at less than actual size and will require a rigid scale to be included to enable the mark to be reproduced as an actual size print. Use an L-shaped rigid scale and place on the same plane of the footwear mark. The scale should conform to both length (1st dimension) and width (2nd dimension).

5.3.1 Using the Scales - Three Dimensional Footwear Marks

When photographing three dimensional footwear marks i.e. those that have a measurable depth (3rd dimension), it is essential that the depth is sharply represented in its entirety. To achieve the required sharpness it is usually necessary to take a series of photographs with the scale positioned at several different depths.

The first photograph of the series should be taken with the scale conforming to the area of the mark which is closest to the lens. The last photograph of the series should be taken with the scale conforming to the depth of the mark which is furthest from the lens. It will be necessary to dig the scale into the ground during this process. Three dimensional footwear marks are seldom on a flat even surface making it difficult to set the camera square to the mark. However the scale must be square to the lens at all times to produce a series of sharp photographs that represent the entire depth of the mark.

5.4 THE IDENTIFICATION LABEL

An identification label must always be included and the following information recorded:

- Location of offence
- Location of footwear mark
- Date
- CSI name
- Exhibit number

5.5 THE ORIENTATION ARROW

An orientation arrow should be placed near to the footwear mark in order for it to be included within the photographic image to assist in the orientation of the footwear mark in relation to the scene.

5.6 THE ANGLE SETTER

An angle setter is an adjustable spirit level and is used to determine the angle of a footwear mark. Correct use of the angle setter will ensure that the necessary care has been taken for the capture/film plane, rigid scale, label and footwear mark to be on the same plane, and in view.

5.7 THE TRIPOD

The tripod allows the CSI to set the camera at the correct angle and distance from the subject. Using a tripod also allows the CSI to free up hands in order to manage the necessary lighting and exposure, as shown in Figure 5.1. The setting up of photographic equipment is the most exacting and time consuming aspect for close up mark photography. However when photographing a series of footwear marks, once the tripod and camera is in place it is easier to move from one mark to another.



Figure 5.1

From the start, it is vital that there is an appreciation of the aim of the photographic image, that is to say, 'To produce a photograph capable of forensic comparison.'

Forensic Footwear Specialists require scale enlargements of footwear marks to be produced which are correct to one percent, or less in both directions, that is allowing the error margin of not more than 1 millimetre in 10 centimetres. Therefore, no attempt should be made to rush and take shortcuts, it is important that time is taken over the photographic procedure in order to produce accurate images.

5.8 THE VIEWFINDER

In order to ensure that the angles, image size, framing and focus are all correct the CSI should continually look through the camera's viewfinder. Once the CSI is confident about these only then can the issues of lighting and exposure be attempted.

5.9 APERTURES

When photographing three dimensional footwear marks the camera aperture should be set to accommodate the depth (3rd dimension) of the footwear mark F16 to F22 is suitable.

When photographing two-dimensional footwear marks on a flat surface there is no measurable 3rd dimension, a camera aperture at around F8 to F11 is suitable.

5.10 THE FILM

When photographing footwear marks, Forensic Footwear Specialists prefer slow speed monochromatic film images, as they produce a greater resolving detail. If colour film is used it should not exceed 400 ISO. If a digital capture system is used then the images should be in colour which can be converted to monochrome at a later stage.

5.11 FILE TYPE

Reference should be made to force policy with regards to file type.

5.12 LIGHTING AND LIGHT SOURCES

The aim of lighting is to achieve the maximum contrast between a footwear mark and its surface. Contrast can be achieved using the following light sources:

- Natural light
- Reflectors
- White Knight type light
- Crime light
- Slide Projector
- Camera flash
- Oblique LED
- Oblique Fibre Optics
- Polarised light
- Contrast filters

In more serious cases, it may be useful to deploy Ultra Violet, Infrared or High Intensity Light systems.

An evaluation of the available natural light through the camera viewfinder should always be undertaken to see if it is suitable before introducing artificial lighting.

Utilising reflectors or screens can improve the quality of the natural light. If the surface is highly reflective it is advised not to use flash light but to consider the use of soft diffuse, natural or artificial lighting instead.

Again, looking through the camera's viewfinder prior to making an exposure will enable the CSI to assess the suitability of lighting.

5.13 THE INVERSE SQUARE LAW AND FOOTWEAR MARKS

When photographing footwear marks the CSI should experiment with any lighting that is introduced, although it is important to remember the 'Inverse Square Law', which for footwear marks means that: If a light source is obliquely positioned along the length of the footwear mark, i.e. the heel end being closest to the source of light. The heel end of the footwear mark may be over exposed and the toe end of the mark or that part, which is furthest away from the light source, may be under exposed. (See Figure 5.2)

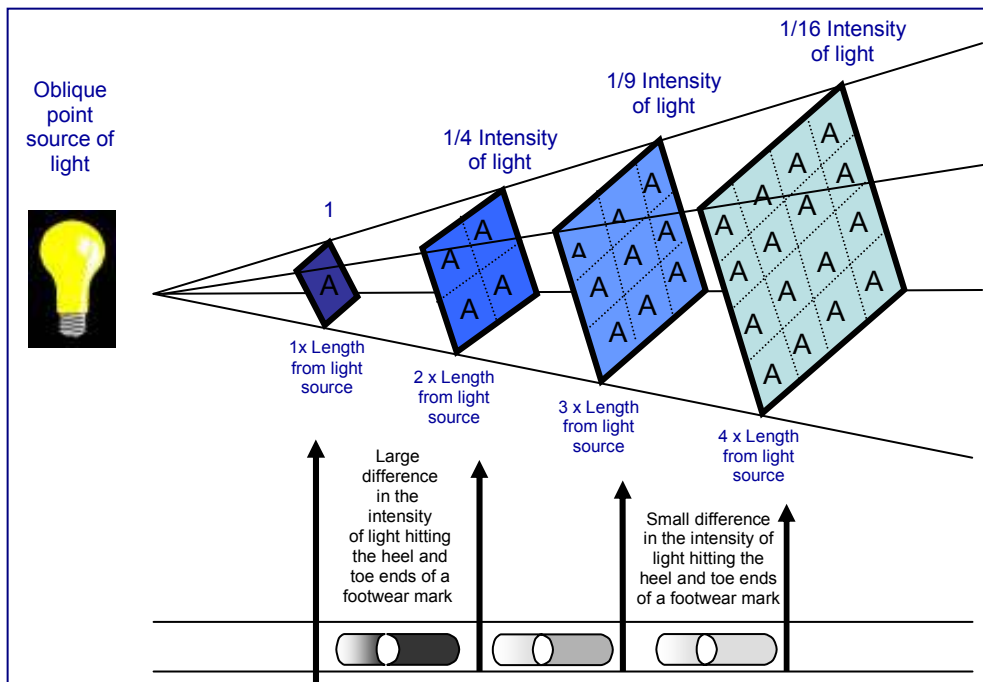


Figure 5.2

Moving the light source away from the footwear mark decreases the difference of the light intensity across the surface of the footwear mark allowing for a more uniform exposure in image capture.

5.13.1 Light Source and the Three Dimensional Footwear Mark

For three dimensional footwear marks, the CSI should aim to create shadows within the footwear mark to achieve maximum contrast between each of the pattern features.

The method recommended to create shadows within a footwear mark is the use of a single oblique point source of light. It is good practice that the CSI experiments, using a hand held lamp to establish the best angle of lighting. The angle should be high enough to give sufficient detail but not so low that long shadows interfere with detail within the mark.

For **shallow** three dimensional footwear marks, for example a footwear mark picked out of fine dust on a tile, the best lighting angle is usually very low/oblique. For **medium/deep** three dimensional footwear marks, for example a footwear mark impressed in soil, the lighting angle should be raised, in order to reduce the length of the shadows within the footwear mark.

All three dimensional footwear marks will require the taking of several photographs and for each separate image the direction of the point light source should be repositioned. Additionally, for each exposure the CSI should experiment with the angle of light to ensure all pattern features of the footwear mark are correctly exposed.

5.13.2 Light Source and the Two Dimensional Footwear Mark

For two dimensional footwear marks, the CSI should aim to achieve an evenly exposed image with maximum contrast between the footwear mark and its surface.

The method recommended to create the contrast is the use of oblique lighting. It is good practice that the CSI experiments, using a hand held lamp to establish the best angle of lighting.

Two dimensional footwear marks are often formed by very light deposits of a dust type contaminant, making them almost invisible in normal daylight or artificial light. It is good practice to reduce or eliminate the ambient light falling onto the footwear mark, and then selectively introduce artificial lighting. Two lights at an oblique angle on opposite sides of the footwear mark can give a good flat evenly exposed result.

Most digital cameras are equipped with creative lighting systems where a flash can be positioned away from the camera and then remotely triggered. Two remote flashes positioned at opposite directions to the footwear mark can be used to obtain an evenly exposed image. It should be remembered that both the camera and flash need to re-set after remote use.

5.14 COLOUR FILTERS AND LIGHT

5.14.1 Colour Filters

Colour filters work by selective absorption or transmission of the light reflected from the mark or its surface. A filter will transmit its own colour and absorb or block its opposite colour. The filter has an effect on the final monochrome print in that its own colour will be lighter shade and its opposite colour will be darker shade. This effect may be further enhanced when photographing in a darkened room, using a coloured light source is used in conjunction with a filter. This can be of great use when photographing footwear marks on a coloured background.

A set of six colour filters is required to lighten or darken any colour. The six filters comprise of three primary colours; RED, GREEN and BLUE and three secondary filters; CYAN, MAGENTA and YELLOW.

The colour wheel (Figure 5.3) shows the three primary colours and opposing secondary colours.

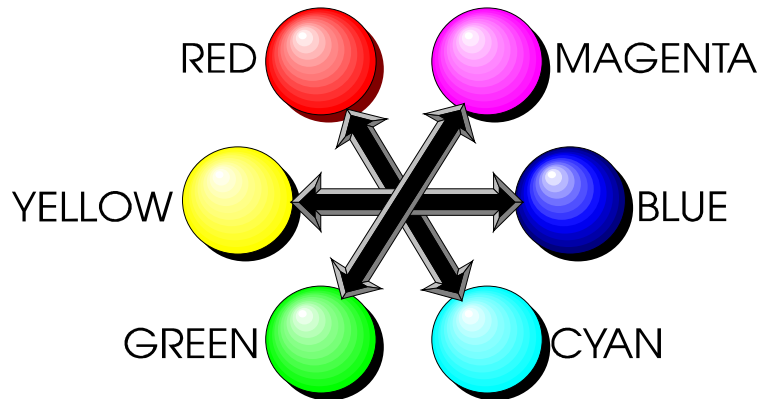


Figure 5.3

Colour filters are used with black and white panchromatic film; with some digital capture systems it is possible to convert colour images to monochrome within the camera. It is better however to shoot in colour mode, use the appropriate filter for black and white film and have the photographic lab convert the image to greyscale post capture. The image viewed on the monitor will look strange but the enhanced effect will be similar to using black and white film.

5.14.2 Coloured Light

The use of coloured light will have a similar effect to the use of a colour filter in that it will lighten its own colour and darken its opposite colour. The CSI should experiment using filters and coloured light sources to optimise the contrast within the captured footwear mark image

5.15 REDUCING UNWANTED REFLECTIONS

When photographing the close up view of a footwear mark it is necessary for the camera to be placed at 90 degrees to the subject. It is often difficult to reduce unwanted reflections as there is no choice as to the position of the camera in relation to the footwear mark the following options may be considered.

5.15.1 Use of a Polarising Filter

A polarising filter may be used provided that

- The reflecting surface is not unpainted metal
- The camera is not at 90 degrees to the reflecting surface

A three dimensional footwear mark underwater is an example of an occasion where a polarising filter may be of use, but only if the footwear mark is not on the same plane as the surface of the water.

5.15.2 Use of Dulling Spray

Whilst having regard to other evidence commercially available 'Dulling Spray' should remove unwanted reflection.

5.15.3 Removing Light Source Causing Unwanted Reflection

Unwanted reflections may also be removed by blocking the source of light causing the reflection. Placing the lens of the camera through a hole cut in a piece of black card and introducing light from a low oblique angle can also reduce unwanted reflection.

5.16 COMPOSING A FOOTWEAR MARK IMAGE

When photographing footwear marks it is advised that the guidelines below are followed. These will provide the sequential methodology to produce high quality professional images capable of forensic comparison.

- 1.** Handhold the camera to determine the tripod position, image size and access.
- 2.** Place grey ridged 'L' scale alongside footwear mark so it conforms to length and width.
- 3.** Ensure 'L' scale is on the same plane as the footwear mark.
- 4.** For three dimensional footwear marks a series of photographs will need to be taken with the 'L' scale at the various depths and angles, which represent all the depths and angles of the footwear mark.
- 5.** Include directional arrows on the label.
- 6.** Install the tripod and camera – ensure everything is stable.
- 7.** Align the camera, footwear mark and scale accurately using the angle setter.
- 8.** Set the camera so the footwear image is as large as possible in the view finder and within the printing parameters.
- 9.** Select an aperture with appropriate depth of field.
- 10.** Select appropriate lighting or shading.
- 11.** For two dimensional footwear marks consider the use of reflectors to obtain a more even distribution of light across the footwear mark.

- 12.** Consider restricting any ambient light (natural or artificial) falling onto the footwear mark area in order to achieve the best effect of oblique light.
- 13.** Work out exposure time to suit aperture and lighting selected.
- 14.** Take several photographs, change position of the source of light to ensure that all areas of the footwear mark are correctly exposed.

5.17 PHOTOGRAPHING FOOTWEAR MARKS RECOVERED USING THE ELECTROSTATIC LIFTING APPARATUS AND GELATIN LIFTERS

Footwear marks recovered using the Electrostatic Lifting Apparatus (ESLA) or a Gelatine Lifter should be photographed in a darkened room using oblique lighting. It is often the case that additional features or footwear marks not originally seen in ambient light will become visible in these conditions.

An L-shaped rigid scale and identification label must always be included when photographing footwear marks in the laboratory.

In conclusion, the quality of images will be proportional to the care and accuracy that are set by the photographer, the measure of these efforts being the successful achievement of a footwear mark comparison.

6. ELECTROSTATIC LIFTING APPARATUS

6.1 INTRODUCTION

A dust like contaminant can be deposited or removed from a surface by the outer sole of an item of footwear, thus forming a positive or negative footwear mark. Dust like contaminants may be recovered using an Electrostatic Lifting Apparatus (ESLA).

The ESLA operates by applying a high voltage electrostatic charge onto a 'lifting mat' which is placed over a footwear mark. Dust particles under the lifting mat are attracted to the high voltage electrostatic charge. ESLA devices are capable of producing a charge in the range of 10,000 to 15,000 volts, however the current is negligible.

The 'lifting mat' known as 'Mylar Foil' is a double sided laminated sheet. The silver side of the foil consists of a conductive material which holds the electrostatic charge. The black side of the foil consists of a non-conductive material and is the side which captures the attracted dust particles.

6.2 HEALTH AND SAFETY

- ESLA can affect implanted pace makers
- The manufacturers operating instructions should be followed
- ESLA should not be used in damp or wet conditions
- Do not touch earth plate or Mylar Foil when the ESLA is switched on
- When used on conductive surfaces the earth plate must be insulated (See instructions below regarding earth plate)
- The electrostatic charge produced by the ESLA increases in proportion to the foil surface area (as advised by HOSDB)

6.3 PERSONAL PROTECTIVE EQUIPMENT

'Good Practice' procedures in relation to Personal Protection Equipment at scenes of crime should be followed.

- It is recommended that insulating gloves are worn during use of the ESLA.

6.4 APPLICATIONS FOR USE THE USE OF THE ESLA

- The recovery of footwear marks in dust
- To carry out speculative searching for latent footwear marks in dust
- To clean and/or remove dust and fingerprint powders from footwear marks before the application of subsequent recovery techniques such as Gel Lifters, powders or chemical processes.

6.5 SURFACES COMPATIBLE FOR THE USE OF THE ESLA

- On most dry, porous and non-porous surfaces
- Internally e.g. short pile carpets, upholstery, flooring including ceramic and laminate, and externally e.g. stone and concrete.
- On surfaces with conductive properties such as cars, and metal filing cabinets.
- On fragile surfaces such as old flaky paint
- Cadavers

6.6 ADVANTAGES

- Generally considered to be a non-destructive recovery technique. However, if area is to be considered for subsequent examination such as DNA, allow for the possibility of the Mylar Foil introducing contaminants.
- Can be used to 'clean' footwear marks of unwanted surface dust/powder in preparation for the use of subsequent recovery techniques.
- Can be used for speculative searching of large surface areas.

6.7 DISADVANTAGES

ESLA cannot be used in wet conditions. When time is at a premium the use of ESLA on dried, wet origin footwear marks, (other than 'cleaning out' the mark), is often an unproductive process. The electrostatic charge has insufficient power to lift a contaminant which has bonded to the surface due to the moisture present at the time the mark was made. For situations of this type the use of a Gel Lifter to recover the footwear mark is a more productive use of time.

6.8 SEQUENTIAL TREATMENTS

For surface transfer footwear marks in suitable conditions following photography, ESLA should be the first procedure considered in a recovery plan.

Using ESLA prior to other techniques can remove unwanted surface dust/powder to improve the quality of the footwear mark. In some instances this may benefit subsequent processes used on the same mark.

ESLA should be used on portable objects such as paper items and glass prior to their removal. These objects will have been identified with surface contaminant transfer potential during the scene assessment.

6.9 INSTRUCTIONS FOR USE OF THE ESLA

The following procedure is for the recovery of dry surface contaminant transfer footwear marks on horizontal and vertical surfaces and surfaces with conductive properties. (See Figures 6.1, 6.2 and 6.3)

1. Photograph footwear mark as recommended in the photography section of this manual.
2. Place the Mylar Foil on the area to be examined with black side facing downwards.
3. Use a permanent marker pen or similar to label the silver side of the film with relevant details and direction arrow.
4. If the footwear mark is sited on a **vertical surface** secure the Mylar Foil with low tack adhesive tape.
5. Place the earth plate within 5cm (approx. 2" of the Mylar Foil)
6. On vertical surfaces secure the earth plate with tape.
7. If the surface has **conductive properties** place a polycarbonate sheet (a fingerprint acetate sheet is suitable) under the earth plate. Allow 6 mm (approx. ¼") overlap of the acetate sheet beyond the earth plate. Place the earth plate within 25mm (approx. 1") of the Mylar Foil.
8. **Do not switch on the apparatus.** Place the ESLA high voltage electrode onto the Mylar Foil, the negative electrodes should be in contact with the earth plate.
9. **Switch on the apparatus.** The high voltage charge will cause a visible attraction between the foil and the surface. Ensure that maximum adhesion is achieved for a short time. If arcing occurs or sparks are seen reduce the voltage. This is more likely to occur on surfaces with conductive properties.
10. If adhesion of the Mylar Foil is not achieved this may be due to a poor earth plate connection. If this is the case consider the use of an earth bonding lead kit, which attaches to the side of the ESLA. The earth bonding lead plugs into a wall socket to allow earth connection. Alternatively, consider placing the earth plate in contact with other earthed items such as radiator pipes etc.
11. Use a suitably insulated roller to eliminate any trapped air under the Mylar Foil.
12. Allow approximately 10 seconds for the dust to absorb the charge.

13. Switch off the ESLA and leave in position for approximately 30 seconds to allow the charge to dissipate. Remove the device from the film and place in a safe position before removing the earth plate.
14. Pack and preserve all lifts carefully.
15. Photograph the Mylar Foil in studio conditions as soon as possible.

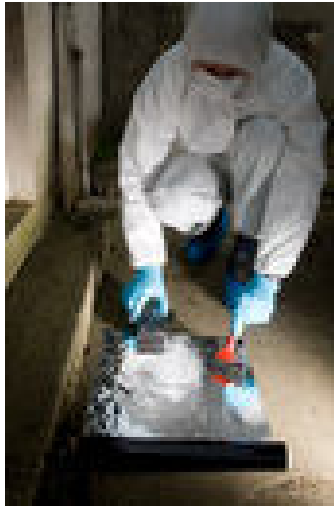


Figure 6.1

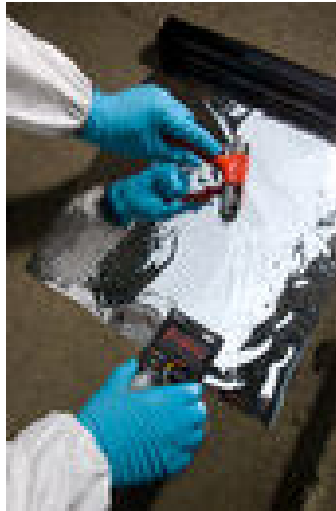


Figure 6.2



Figure 6.3

6.10 USING THE ESLA FOR SPECULATIVE SEARCHING

CSI's using the Stop, Assess, Plan and Review process will identify surfaces with potential for transference of dust like contaminants and in many cases contaminant transfer marks will remain latent to the various recommended lighting techniques. However, some of these surfaces will be suitable for the use of ESLA to search for latent footwear marks and large areas can be searched with rolls of Mylar Foil as described in the steps below:

1. Consider photographing the area to be searched
2. Place the roll of Mylar Foil on the area to be examined.
3. Roll out approximately 15cm of foil.
4. Use permanent marker pen or similar to label the silver side of the foil with relevant details and direction arrow.
5. Place the earth plate within 5cm (approx. 2" of the Mylar Foil)
6. **Do not switch on the apparatus.** Place the ESLA high voltage electrode onto the Mylar Foil, the negative electrodes should be in contact with the earth plate.

- 7. Switch on the apparatus.** The high voltage charge will cause a visible attraction between the foil and the surface. Ensure that maximum adhesion is achieved for a short time. If arcing occurs or sparks are seen reduce the voltage.
- 8.** Roll out the Mylar Foil using insulating rulers or roller.
- 9.** If adhesion of the Mylar Foil is not achieved this may be due to a poor earth plate connection. If this is the case consider the use of an earth bonding lead kit, which attaches to the side of the ESLA. The earth bonding lead plugs into a wall socket to allow earth connection. Consider placing the earth plate in contact with other earthed items such as radiator pipes etc.
- 10.** Use a suitably insulated roller to eliminate any trapped air under the Mylar Foil.
- 11.** Allow approximately 10 seconds for dust to absorb the charge,
- 12.** Switch off the ESLA and leave in position for about 30 seconds to allow the charge to dissipate. Remove the device from the film and place in a safe position before removing the earth plate.
- 13.** Cut ESLA foil to remove roll from the used section.
- 14.** Package and label all lifts carefully.
- 15.** Photograph the Mylar Foil in studio conditions as soon as possible.

6.11 CLEANING OUT FOOTWEAR MARKS

ESLA is generally considered to be a non-destructive recovery process and can be useful for the removal of dust which may have settled over a mark or for the removal of fingerprint powder for over powdered marks. Where ever possible consider the use ESLA to clean out marks prior to the use of other recovery processes.

6.12 PACKAGING AND LABELLING

The integrity of the exhibit should be a priority at all times therefore exhibit labels must be on the outside of any packaging for the purpose of continuity. An ESLA lift should always be considered a fragile object and handled with care at all times. Contact with the black side of the foil should be avoided.

6.12.1 Mylar Foil sheets

Footwear marks recovered onto a single Mylar Foil sheet should be secured in a shallow cardboard box using adhesive tape. Ensure the box is free from dust before the lift is placed inside. Seal the box using adhesive tape and fix a fully completed exhibit label to the outside of the box.

6.12.2 Mylar Foil Rolls

Footwear marks recovered onto rolls of Mylar Foil should be packaged by carefully re-rolling the foil (silver side outwards). The rolls should be secured with adhesive tape to prevent unwanted movement within the roll and placed into a container such as a cardboard box. . A fully completed exhibit label should be secured to the outside of the container.

Do not use plastic type containers such as knife tubes to store rolls of Mylar foils, as they can cause a static charge which may damage footwear marks.

6.13 STORAGE OF ESLA LIFTS

At present it is recommended that ESLA lifts should be stored in a secure cool, dust free environment. Research is currently being undertaken to determine optimum storage of ESLA lifts.

7. GELATIN LIFTERS

7.1 INTRODUCTION

Gelatin Lifters (Gel Lifters) comprise of three separate layers, a backing sheet often made from rubberised linen, a low tack gelatin layer and a removable transparent polyester film.

Gel Lifters are available in a number of different colours (black, white and clear) to allow for a contrast in colour between the lifted contaminant and the Gel itself.

Due to their elasticity they can be used to lift dust like contaminants and wet origin contaminants. They may also be used to lift fingerprint powders from porous, non-porous, textured, curved and uneven surfaces.

7.2 HEALTH AND SAFETY

Please adhere to the products' Safety Data Sheet where appropriate.

7.3 PERSONAL PROTECTIVE EQUIPMENT

'Good Practice' procedures in relation to Personal Protection Equipment at scenes of crime should be followed.

7.4 APPLICATIONS FOR THE USE OF GELATIN LIFTERS

- Searching for latent footwear marks
- Lifting footwear marks in dust like contaminants
- Lifting enhanced footwear marks
- Second lifting – a technique where two or more lifts are taken from one mark in order to obtain a set of lifts, each having their own different quality. The first lift generally produces the highest levels of contrast but less fine detail; subsequent lifts will have less contrast but more fine detail.

7.5 SURFACES COMPATIBLE FOR THE USE OF GELATIN LIFTERS

- Porous surfaces including cardboard, and with care most types of paper
- Non – porous surfaces
- Textured and grained surfaces including wood or kitchen worktops
- Curved and round surfaces, e.g. glass and plastic bottles

7.6 ADVANTAGES

- Can be used on damp surfaces and in damp/wet conditions (will not work under water)
- Can be used on wet origin marks, (ESLA may be used to clear footwear marks prior to lifting with Gel Lifter)
- Second lifting

7.7 DISADVANTAGES

- It is unusual but in some cases the gel can have a damaging effect on subsequent treatments
- Less practical than ESLA for speculative searching of large areas

7.8 SEQUENTIAL TREATMENTS

Gel lifters should be the next process considered in the recovery plan following photography and ESLA.

Gel lifts should be considered for use on portable objects such as paper items and glass prior to their removal. These objects will have been identified with surface contaminant transfer potential during the scene assessment.

7.9 SURFACE/FOOTWEAR MARK CHANGES DUE TO GEL LIFTERS

If, during a sequential recovery plan, a gel lifter is used a number of changes can occur to the footwear mark. These changes are due to the transference of material from the gel lifter to the surface, or removal of contaminants from the surface.

7.9.1 Enhancement of a Negative Footwear Mark

A negative footwear mark is formed when surface contaminants are removed and transferred onto the outer sole of an item of footwear leaving the footwear pattern as a 'clean' area on the surface.

When a gel lifter is applied to a negative footwear mark the gel can cause two separate, simultaneous forms of transfer.

- Surface contaminants surrounding the 'clean' footwear mark are removed and transferred to the gel
- Material from the gel is transferred to the 'clean' surface areas of the footwear mark

Using a fingerprint powder after the application of a gel lifter to this type of mark can cause the fingerprint powder to adhere to the material from the gel lifter, resulting in a positive representation of the footwear mark.

7.9.2 Enhancement of a Positive Footwear Mark

A positive footwear mark is formed when contaminants are transferred to a surface from the outer sole of an item of footwear.

When a gel lifter is applied to a positive footwear mark it can have the following effects

- The contaminants forming the footwear mark are removed and transferred to the gel
- Material from the gel may be transferred to the area surrounding the footwear mark

Using a fingerprint powder after the application of a gel lifter to this type of mark can cause the fingerprint powder to adhere to the material transferred from the gel lifter to the area surrounding the footwear mark resulting in a negative representation of the footwear mark.

7.9.3 Damage to Positive/Negative Footwear Marks

It is unusual but in some cases the footwear mark may be damaged, the gel can affect all contaminants resulting in a loss of the footwear mark.

7.10 INSTRUCTIONS FOR USE OF THE GELATIN LIFTER

Footwear marks on vertical and horizontal non-porous surfaces

- 1.** Photograph mark prior to the undertaking of any lifting technique. (See Photography chapter in this manual)
- 2.** Before lifting is attempted consider cleaning out the mark using Electrostatic Lifting Apparatus, (See chapter on ESLA)
- 3.** Select the appropriate colour of the Gel Lifter to provide maximum contrast between mark and lifter. It may be necessary to do a test lift before selecting colour
- 4.** Cut the gel lift to size, ensuring that the mark and the area immediately around the mark can be captured onto the gel
- 5.** Remove the transparent backing sheet from the Gel Lifter and secure an edge of the gel to the surface, slightly away from the mark
- 6.** Carefully smooth down the remainder of the Gel Lifter over the mark rubbing it with your thumb to avoid trapping any air bubbles between the surface and the gel. A roller may be utilised, however care must be taken to avoid applying too much pressure, as this will stretch the Gel Lifter and cause distortion of the mark

7. Using a permanent marker pen place an orientation arrow on the back of the gel lift
8. Leave the gel over the footwear mark for approximately ten minutes to aid adhesion of the contaminant
9. Carefully and slowly remove the Gel Lifter from the footwear mark starting at one of its corners. Avoid stretching the Gel Lifter during the removal process.
10. Package and label all lifts carefully
11. Photograph the Gel Lifter in studio conditions as soon as possible

7.11 PACKAGING AND LABELLING

The integrity of the exhibit should be a priority at all times therefore exhibit labels must be on the outside of any packaging for the purpose of continuity. A Gel Lifter should always be considered a fragile object and handled with care at all times, additionally; contact with the sticky side of the lifter should be avoided.

7.11.1 Dust Contaminants and Granular Powders

Gel lifters used to recover footwear marks in dust or footwear marks which have been developed using granular powders should be secured in a shallow cardboard box using adhesive tape. Ensure the box is free from dust before the lift is placed inside. Seal the box using adhesive tape and fix a fully completed exhibit label to the outside of the box.

7.11.2 Flake Powders

Gel Lifters used to recover footwear marks which have been developed using a flake powder should be placed onto an acetate sheet. The CSI should then secure, score and sign each of the edges in a similar manner to that of a finger mark lift, and fix a fully completed exhibit label to the acetate sheet.

7.12 STORAGE OF GEL LIFTERS

Prior to their use Gel Lifters should be stored within their packaging in a cool place. This will ensure that destruction due to over heating will not occur and keep the tackiness of the lifter in its optimum state.

The gelatin layer will begin to melt above 40°C and therefore in hot climates it is advised a cool box be utilised for transport of the Gel Lifters. Lifters can be used at freezing temperatures, although the removal of the cover sheet may be a problem. To overcome this, the Gel Lifters should be placed into a warm environment prior to use.

After use Gel Lifters should be stored in a secure cool, dust free environment.



The above image depicts a Gel Lifter being used to recover a dried, wet origin footwear mark on a horizontal surface.

8. ELECTROSTATIC DETECTION APPARATUS

8.1 INTRODUCTION

The Electrostatic Detection Apparatus (ESDA) is a device which can be used on paper items to make visible, areas of indentation or damage. It does so by creating an invisible electromagnetic charge across the area of indentation or damage which is then made visible by the application of charge sensitive toners.

Indentations occur in paper when pressure is applied to it. Stepping on a piece of paper may leave indentations or damage representing the outer sole of the item of footwear.

8.2 HEALTH AND SAFETY

- Anyone suffering from a heart condition should not use ESDA
- The manufacturers operating instructions should be followed
- The ESDA should not be used in damp or wet areas

8.3 PERSONAL PROTECTIVE EQUIPMENT

'Good Practice' procedures in relation to Personal Protection Equipment in the laboratory should be followed.

8.4 APPLICATIONS FOR THE USE OF THE ELECTROSTATIC DETECTION APPARATUS

- Searching for latent footwear marks on paper
- Recovery of indented footwear marks on paper

8.5 SURFACES COMPATIBLE FOR THE USE OF THE ELECTROSTATIC DETECTION APPARATUS

- Paper
- Thin card

8.6 ADVANTAGES

- ESDA is a non-destructive process, as all of the procedures involving the apparatus are carried out with a thin protective sheet placed over the original item.

8.7 DISADVANTAGES

- Humidity can be used to improve results but will reduce the effectiveness of subsequent enhancement processes.

8.8 SEQUENTIAL TREATMENTS

ESDA may develop latent footwear marks on paper identified with potential damage. However, paper may also hold unstable footwear marks in dust transferred from the previous surface. Any recovery plan should allow for the possibility of latent marks in dust and the following non-destructive techniques should be considered before the use of ESDA.

- Lighting techniques
- Photography
- Electro Static Lifting Apparatus (ESLA)
- Gel Lifter (see below)

Gel Lifters have been known to cause damage to some paper items. Consideration should be taken to how any potential footwear marks may have been formed to assist any recovery plan decisions in respect of using the Gel Lifters before ESDA.

8.9 INSTRUCTIONS FOR THE USE OF THE ELECTROSTATIC DETECTION APPARATUS

There are some variations in ESDA apparatus and developments continue however below is a general guide for use.

1. Photograph the item.
2. Switch on vacuum pump.
3. Place item on the vacuum bed with the side of interest facing upwards.
4. Draw the imaging film across the item, and carefully lower over the item of interest.
5. If the imaging film creases, discard and try again.
6. Cut the imaging film from the reel.
7. Press the corona timing indicator, this will illuminate.
8. Whilst the timing indicator remains constantly illuminated slowly passing the corona bar approximately 3 – 5 cm above the whole of the item. Make several passes over the item as if the corona bar was a paint roller building several layers of paint.
9. When the timing indicator begins to flash place the corona wand to one side.
10. The electrostatic charge will be fully formed when the timing indicator stops flashing.

- 11.** Apply the charge sensitive toner.
- 12.** Photograph any marks developed.
- 13.** Whilst the item is in situ carefully apply a fixing film to the ESDA image to secure, smooth down gently with cotton wool or similar.
- 14.** Turn off vacuum pump.
- 15.** Remove the fixed ESDA image from the original document
- 16.** Package and label all images carefully.
- 17.** Photograph the ESDA image in studio conditions as soon as possible.

8.10 PACKAGING AND LABELLING

8.10.1 Original Exhibit

- 1.** Protect the item from further damage
- 2.** Place item into a cardboard folder or similar
- 3.** Make a note where and how the item was positioned at the scene paying particular attention to that side to be examined.
- 4.** For blank paper items, place a small pencil mark on the reverse side of that which is to be examined. Document the position of the mark.
- 5.** Place into a suitable sized paper envelope
- 6.** Do not fold item or envelope
- 7.** Do not stick or staple anything onto the item
- 8.** Seal envelope. Do not use excessive amounts of adhesive tape
- 9.** Place a 'fragile' sticker onto the envelope
- 10.** Do not write on the envelope, but fix exhibit label in a position so that it can be updated without causing damage to the item inside

8.10.2 ESDA Image

- 1.** Place in a suitable sized envelope
- 2.** Do not fold item or envelope
- 3.** Do not stick or staple anything onto the item
- 4.** Fix exhibit label

8.11 STORAGE OF ITEMS

Store any items prior to and after ESDA analysis, away from:

- Direct sunlight
- Excess heat
- Damp environments

9. CASTING A THREE DIMENSIONAL FOOTWEAR MARK

9.1 INTRODUCTION

Casting a three dimensional footwear mark using the correct materials and techniques can provide more detail than photographs alone, as some damage characteristics may themselves have a measurable depth in the third dimension, providing more information than a two dimensional image, although the quality of the final cast is dependent on many variables, these being:

- Quality of the casting material used
- Mixture ratio of the casting materials
- Mixing technique
- The application of the casting material
- The material in which the footwear mark has been deposited
- Drying time
- The method of storage of the cast
- Handling

There are a number of different casting mediums available, however due to Health and Safety issues and product reliability most of these are not recommended. Presently, there are two main types of casting agents which are of good quality and have proved to be both safe and reliable. These being the gypsum based dental stone and silicone based products, although of these two, the dental stone has a wider scope for its application.

9.1.1 Dental Stone

Plaster is a generic term used to describe all Gypsum based products including modelling plaster and dental stones. The term 'stone' is used to describe the harder setting qualities of a stone over a plaster. Dental stone is again, a generic term that may be applied to a number of products used for casting footwear marks at scenes of crimes. It is recommended that a dental stone with a dry, compression strength of around 8,000 psi is suitable for scenes of crime work. However, it is accepted that the best strength that can be expected in the field by hand mixing is 4,000 psi (Bodziak 2000).

9.1.2 Silicone Based Products

Silicone based footwear mark casting products are newly available in the UK and full trials are still ongoing. There are a number of different manufacturers nationally and internationally who produce silicone based casting mediums, with different methods of application e.g. pouring or via a dispensing gun.

9.2 HEALTH AND SAFETY

Always refer to the Safety Data sheets for each product. In general:

9.2.1 Dental Stone

In dry, unmixed form, avoidance of raising dust particles should be ensured. If inhaled or comes into contact with eyes may cause irritation. In wet mixture form non-hazardous.

9.2.2 Silicone Based Products

All ingredients are classed as non-hazardous.

9.3 PERSONAL PROTECTION EQUIPMENT

For both products, 'Good Practice' procedures in relation to Personal Protection Equipment at scenes of crime should be followed. For Dental Stone please see below:

9.3.2 Dental Stone

When handling dental stone in powder form it is a requirement to wear a dust mask, eye protection and gloves.

9.4 APPLICATIONS FOR THE USE OF DENTAL STONE AND SILICONE BASED PRODUCTS

- Surfaces compatible for casting a footwear mark include any surface that will yield to the pressure applied by an item of footwear during their contact.
- Dental stone and silicone based products can be used to recover footwear marks that have been impressed into a surface or a contaminant, producing a mark with a measurable depth (three-dimensional footwear mark). These surfaces include soil, sand and snow; contaminants may include fine dust or flour.
- Silicone based products can be used to lift enhanced footwear marks, which can be useful for marks on heavily textured surfaces, as the consistency of the product allows it to make contact with all levels of the textured surface.
- Dental stone may be used to recover footwear marks that are fully immersed in water or partially filled with water or liquids with similar viscosity.
- Silicone based products can be used to recover footwear marks partially filled with water or liquids with a similar viscosity.

9.5 ADVANTAGES

9.5.1 Dental Stone

- Proven casting medium
- Captures results in various conditions
- Holds the fine details required for a successful comparison

9.5.2 Silicone Based Products

- Clean and easy to use
- Easy to lift away from footwear mark
- Cast can be cleaned immediately after setting
- Can use permanent marker on its surface to record details
- Non-porous; easy to pack and store
- Quick drying in low ambient temperatures
- Non-breakable if dropped

9.6 DISADVANTAGES

9.6.1 Dental Stone

- Requires time, care and patience when mixing and pouring
- Difficult to remove from footwear mark
- Requires a long setting time prior to cleaning
- Porous; issues with packaging and storage
- Fragile

9.6.2 Silicone Based Products

- Unproven casting medium
- Unproven success in comparison procedures

9.7 SEQUENTIAL TREATMENTS

Three dimensional footwear marks should be cast after photographic capture of the mark.

9.8 INSTRUCTIONS FOR THE GENERAL USE OF DENTAL STONE

1. Photograph the footwear mark as found.
2. Do not attempt to remove debris which has become embedded into the footwear mark, e.g. stones, twigs, or leaves, as their removal will cause damage to the mark. Items which may have fallen into the mark after its deposition and are not embedded into the mark may be removed with care. Consider the use of a canned compressed air duster for its removal. Use the air duster to

carry out a test on similar debris close to the mark to establish a suitable non-destructive distance for its use.

3. If any loose debris is removed the footwear mark should be re-photographed.
4. Prepare the casting material by following the product guidelines. It is essential to adhere to the guidelines as the correct dental stone/water mix ratio, mixing technique, mixing time, pouring of the mixture and drying time will ensure the production of a good quality cast. If the recommended guidelines are not followed the quality of the cast will be reduced and in turn the effectiveness of its use in comparison procedures.

Some important considerations are mentioned below:

- **Dental stone/water mix ratio** – If ratio is not known the mixture should acquire the consistency of thick cream. *As a general guide a full footwear mark will require 1 kg of dental stone to 400ml of warm water (do not use warm water when casting in snow).*
- **Mixing technique** – The two ingredients should be mixed together in a heavy duty polythene bag, bucket or any type of pouring container. Using two zip lock bags one inside the other is also sufficient when carrying out the mixing process. Continued agitation will ensure complete and thorough water absorption and the initiation of the required exothermic reaction.
- **Mixing time** – To ensure the water is completely absorbed by the dental stone, it is advised that no less than 3 minutes should be spent on the mixing process.
- **Pouring technique** – Do not pour directly into the footwear mark as this will cause damage. The container or bag should be held as near to ground level as possible and the casting stone poured onto the ground close to, but outside the footwear mark. When pouring the casting stone the flow should be steady, smooth and constant and the entire mark should be filled to overflowing. If there is insufficient casting material, make up more mixture and add to the mark using the same procedure. (See Figure 9.1)
- **Removal of air bubbles** – Once the casting material has been poured into the footwear mark consider the use of a spatula type implement to gently tap along the top of the cast. This will cause any trapped air bubbles to rise to the surface and be expelled from the casting medium. (See Figure 9.2)

- **Drying time** – Allow sufficient undisturbed drying time. This can take between 20 – 90 minutes depending on a number of variables such as the type of casting stone, amount of water, temperature of water, ambient temperature, and ground temperature.



Figure 9.1
Casting material is poured from the outside of the footwear mark



Figure 9.2
Gently tapping the surface of the casting medium dispels air bubbles

- 5.** After the dental stone has been poured into the mark and allowed the correct amount of time to set, just before the point of solidification of the dental stone while it remains in situ, the following details should be etched onto its surface:

- Exhibit Reference
- Date
- Orientation arrow

Alternatively the details can be written onto an acetate sheet with a permanent pen and the acetate sheet securely and carefully embedded into the back of the cast.



Figure 9.3 Footwear cast removed from ground, ready for packaging.

- 6.** Once the casting medium is sufficiently set it should be carefully removed from the ground. It may be necessary to dig under the cast to aid its release.
- 7.** There is likely to be some adherence of background material to the cast. Heavy residue including living organisms should be removed although complete cleaning of the cast should not be attempted at this stage. (See Figure 9.3)

8. To preserve and protect the cast against damage during transportation it should be covered with an absorbent material such as tissue paper, and placed into a ventilated cardboard box with the footwear mark facing upwards.
9. Once back at base the cast should be removed from the box and allowed to dry 'naturally' in a designated drying area. The drying process should be allowed to continue for a further 24 - 48 hours and during this time the cast should be considered a fragile object.
10. Once the cast is completely dry, review packaging. If moisture from the cast has been absorbed by the packaging during transportation, place the cast into a clean cardboard box.
11. Seal the packaging using adhesive tape and attach a fully completed exhibit label to the outside of the packaging.

9.9 INSTRUCTIONS FOR THE GENERAL USE OF A SILICONE BASED PRODUCT

As the use of silicone based products for footwear mark casting is a relatively new idea, different manufacturers are developing different mixing and pouring techniques which result in different drying times. Therefore, it is recommended that users of silicone based products refer to the manufacturers guidelines.

Silicone based products can be susceptible to trapped air bubbles within the cast and therefore, once the casting material has been poured into the footwear mark consider the use of a spatula type implement to gently tap along the top of the cast. This will cause any trapped air bubbles to rise to the surface and be expelled from the casting medium.

9.10 CASTING A FOOTWEAR MARK IN A FRAGILE MATERIAL OR CONTAMINANT

If the footwear mark has been deposited in a material or contaminant which is fragile such as flour or dust, consideration may be given to the application of a spray type, fixing agent prior to applying the casting medium. The fixing agent should be applied with great care by spraying across and above the footwear mark, and allowing the spray to fall and settle into the mark. Do not spray directly onto the mark as this will cause the shift of the fine material/contaminant in which the footwear mark has been deposited and obscure or damage important detail in the mark. When removing air bubbles from a cast in a fragile material or contaminant extra care will be needed.

9.11 CASTING A FOOTWEAR MARK SITED ON AN INCLINE

If the footwear mark is sited on an incline it is advised to place a rigid support or form around the mark in order to control the flow of the casting

medium. The form should be placed approximately 5cm away from the footwear mark to avoid disturbance or damage to the mark. Commercial forms are available from crime scene products suppliers, although cutting the base out of a bucket or using garden edging can prove just as efficient as the commercially made supports.

9.12 CASTING IN SNOW - ADVICE

Often footwear marks in snow can disappear rapidly due to thawing. In order for the deceleration of this process and to preserve these types of footwear marks for as long as possible, it is advised that the footwear mark is:

- Not covered unless weather conditions dictate
- Shielded from the sun or any other heat generating source e.g. air vents

9.13 PROCEDURE FOR CASTING IN SNOW USING DENTAL STONE

1. Photograph the footwear mark.
2. For a mark that has been filled or obscured with fresh snow or other non-embedded debris consider the use of a canned compressed air duster for its removal. Use the air duster to carry out a test on similar snow or debris close to the mark to establish a suitable non-destructive distance for its use.
3. If any loose snow or debris has been removed re-photograph the footwear mark.
4. 'Fixing' of the footwear mark should now be undertaken using a commercial 'Snowprint' Wax. The manufacturer's guidelines should be followed, and in general this will be:
 - **Temperature of Snowprint Wax** - Must be at room temperature before use; this may be achieved by placing the can in lukewarm water. If the can is too cold the pressure of the propellant will be too low.
 - **Spraying technique** - The Snowprint Wax should be sprayed at an angle at a distance of 10 – 15 cm away from the footwear mark in order to highlight the raised areas and the sides of the footwear mark. It should also be applied around the entire edge of the mark to fix any overspill of the casting medium and so prevent damage to the footwear mark during the casting process.
 - **Application** - The can should be shaken before use. The footwear mark should be covered with 2 – 3 layers of the wax with intervals of 1 – 2 minutes between each application. After each layer of Snowprint Wax

the footwear mark should be photographed. On the final application of the Snowprint Wax allow a drying time of no less than 10 minutes.

- **Photographing** - Due to gradual application of the Snowprint Wax the contrast in the footwear mark will gradually improve, therefore consideration needs to be taken regarding lighting techniques and camera settings when photographing the mark after every application.
5. Once fixing has taken place and all photographs have been taken the footwear mark should be cast.
6. Prepare the casting material by following the product guidelines. It is essential to adhere to the guidelines as the correct dental stone/water mix ratio, mixing technique, mixing time, pouring of the mixture and drying time will ensure the production of a good quality cast. If the recommended guidelines are not followed the quality of the cast will be reduced and in turn the effectiveness of its use in comparison procedures. Some important considerations are mentioned below:
- **Dental stone/water mix ratio** – If ratio is not known the mixture should acquire the consistency of thick cream. *As a general guide a full footwear mark will require 1 kg of dental stone to 400ml of cold water.*
 - **Temperature of mixture** - In order to bring the temperature of the mixture closer to that of the footwear mark, snow may be used as a substitute for some of the water although care should be taken to ensure the mixture is free from ice and of the correct consistency. (Tests carried out at the National Training Centre showed that by substituting 40% of the water with snow, the range of temperatures during the exothermic reaction was lower than that when the mixture did not have the snow substitute. Therefore, reducing the chance of the mixture melting the Snowprint Wax and the footwear mark).
 - **Mixing technique** – The two ingredients should be mixed together in a heavy duty polythene bag, bucket or any type of pouring container. Using two zip lock bags one inside the other is also sufficient when carrying out the mixing process. Continued agitation will ensure complete and thorough water absorption and the initiation of the required exothermic reaction.
 - **Mixing time** – To ensure the water is completely absorbed by the dental stone, it is advised that no less than 3 minutes should be spent on the mixing process.
 - **Pouring technique** – Do not pour directly into the footwear mark as this will cause damage. The container or bag should be held as near to ground

level as possible and the casting stone poured onto the ground close to, but outside the footwear mark. When pouring the casting stone the flow should be steady, smooth and constant and the entire mark should be filled to overflowing. If there is insufficient casting material, make up more mixture and add to the mark using the same procedure.

- **Removal of air bubbles** – Once the casting material has been poured into the footwear mark consider the use of a spatula type implement to gently tap along the top of the cast. This will cause any trapped air bubbles to rise to the surface and be expelled from the casting medium.
- **Drying time** – Allow sufficient undisturbed drying time. This can take between 20 – 90 minutes depending on a number of variables such as the type of casting stone, amount of water, temperature of water, ambient temperature, and ground temperature.

- 7.** Just before the point of solidification of the cast medium and while it remains in situ, the following details should be etched onto its surface:

- Exhibit Reference
- Date
- Direction arrow

Alternatively the details should be written onto an acetate sheet with a permanent pen and the acetate sheet securely and carefully embedded into the back of the cast.

- 8.** Once the casting medium is sufficiently set it should be carefully removed from the ground. It may be necessary to dig under the cast to aid its release.
- 9.** There is likely to be some adherence of snow and other debris in the cast. Its removal should not be attempted, as it may damage the thin layer of very fragile Snowprint Wax holding the fine detail present in the footwear mark.
- 10.** Do not allow the cast to be exposed to the sun or any other heat source as the Snowprint Wax is prone to melting.
- 11.** To preserve and protect the cast against damage during transportation it should be covered with an absorbent material such as tissue paper, and placed into a ventilated cardboard box with the footwear mark facing upwards.
- 12.** Once back at base the cast should be removed from the box and allowed to dry 'naturally' in a designated drying area. Artificial heat such as a radiator should not be use

to dry the cast as Snowprint wax is prone to melting. Allow the drying process to continue for a further 24 - 48 hours, during this time the cast should be considered a fragile object.

- 13.** Once the cast is completely dry, review packaging. If moisture from the cast has been absorbed by the packaging during transportation, place the cast into a clean cardboard box.
- 14.** Seal the packaging using adhesive tape and attach a fully completed exhibit label to the outside of the packaging.

9.14 CASTING FOOTWEAR MARKS FILLED WITH WATER

- 1.** Photograph the footwear mark.
- 2.** A Footwear mark that has been partially filled with water may be cast as explained in 9.8 or 9.9 of this manual. The removal of water from the footwear mark should not be attempted as the pouring process of the casting mixture will disperse any water present in the footwear mark.
- 3.** If the footwear mark holding water is sited on a slope it is advised to place a rigid support or form around the mark in order to control the flow of the casting medium. The form should also be one that will allow drainage of the water from the footwear mark, yet retain the casting stone within the mark. The form should be placed approximately 5 cms away from the footwear mark to avoid disturbance or damage to the mark.

Commercial forms are available from crime scene products suppliers, although cutting the base out of a bucket or using garden edging can prove just as efficient as the commercially made supports.

9.15 CASTING FOOTWEAR MARKS SUMBERGED UNDER WATER

- 1.** Photograph the footwear mark.
- 2.** For a footwear mark that is completely submerged under water, a form should be placed around the entire mark allowing a gap of approximately 5 cms from the footwear mark to avoid disturbance or damage to the mark.
- 3.** Pass the dry Dental Stone powder through a fine sieve, directly into the water and into the footwear mark.

- 4.** If the water has a current, the sieving process should be carried out slightly upstream to allow for the current to carry the Dental Stone toward and into the footwear mark.
- 5.** Once the footwear mark has been filled with 1 inch of the sieved Dental Stone a normal wet mixture of the Dental Stone should be added to further reinforce the cast. (See Section 9.8 part 4 of this manual for instructions on cast mixture preparation).
- 6.** The prepared casting mixture should then be applied by allowing it to drop through the water onto the mark to give a final cast depth of around 8cms.
- 7.** The cast should then be left for at least 1 hour before removal.
- 8.** Once the casting medium is sufficiently set it should be carefully removed from the ground. It may be necessary to dig under the cast to aid its release.
- 9.** There is likely to be some adherence of background material to the cast. Heavy residue including living organisms should be removed although complete cleaning of the cast should not be attempted at this stage.
- 10.** To preserve and protect the cast against damage during transportation it should be covered with an absorbent material such as tissue paper, and placed into a ventilated cardboard box with the footwear mark facing upwards.
- 11.** Once back at base the cast should be removed from the box and allowed to dry 'naturally' in a designated drying area. The drying process should be allowed to continue for a further 24 - 48 hours and during this time the cast should be considered a fragile object.
- 12.** Once the cast is completely dry, review packaging. If moisture from the cast has been absorbed by the packaging during transportation, place the cast into a clean cardboard box.
- 13.** Seal the packaging using adhesive tape and attach a fully completed exhibit label to the outside of the packaging.

10. USING FINGERPRINT POWDERS TO DEVELOP FOOTWEAR MARKS

10.1 INTRODUCTION

The following information is based on H.O.S.D.B. fingerprint research.

Before considering the application of a fingerprint powder to develop footwear marks it is essential that the 'stop, assess & preserve, plan and review' process is followed to ensure all other recovery methods are considered in their correct sequence and within the context of the circumstances. The use of fingerprint powders prior to other recovery methods such as photography, ESLA or gel lifters could prevent their subsequent use.

Before considering the use of a fingerprint powder the following points should be addressed when devising the Evidence Recovery Plan.

- How has the footwear mark (latent or visible) been formed?
- What surface changes have occurred due to contact with an item of footwear?
- What is the surface contaminant/s (known/unknown)?
- What is the contaminant/s forming the footwear mark?
- What non destructive techniques can be used prior to the application of a powder?
- Would chemical development be more effective than powdering?
- Is the surface smooth or textured?
- Which powder will provide the best sensitivity to the contaminant forming the footwear mark?
- Which powder will provide the best contrast between the footwear mark contaminant and the surface contaminant?
- What is the best method of application?
- Will a test of the powder need to be undertaken?
- On developing the footwear mark, what will be the best method of its recovery?

Fingerprint powders have shown to be successful in developing footwear marks formed by known/unknown contaminants deposited onto a surface (positive footwear mark/s), and those marks formed due to a substance being removed from a surface (negative footwear mark/s).

These changes to the surface material can form visible or latent footwear marks, and by applying the appropriate fingerprint powder to the surface it may be possible to develop them further.

In order to select the appropriate powder it is important to identify the constituents of both the surface contaminant and the footwear mark contaminant, although this is not always possible. By identifying the types of contaminants involved on both the surface and the footwear mark an informed choice can be made as to the type of fingerprint powder to use.

Fingerprint powders can generally be placed into one of two categories, these being flake or granular, the difference between the two is the shape of the individual particles which form the powder. Powders in both groups are available in magnetic form (applied using a magnetic wand) and non-magnetic form (applied by brush). It is generally believed that flake powders are more sensitive than granular powders.

10.2 EFFECTIVENESS OF FINGERPRINT POWDERS

One of the factors of the effectiveness of a fingerprint powder is its sensitivity.

Flake powders are generally considered to be more sensitive than granular powders due to their larger surface contact area. The large surface contact area of each particle provides a greater adherence potential when coming into contact with a contaminant and so the greater the sensitivity of the powder. Granular powders have a smaller surface contact area and are therefore less sensitive powders with less potential for adherence.

N.B. There are also differences in sensitivity within the various flake and granular powders due to their chemical composition. For example; black granular powder is generally more sensitive than white.

10.3 APPLICATION OF FINGERPRINT POWDERS

HOSDB Fingerprint and Footwear Forensics Newsletter: Special Edition, October 2006, Publication No. 67/06 demonstrates how the use of fibre brushes on textured surfaces force the powder particles into the texture resulting in the primary development of the texture as opposed to the primary development of the mark. To overcome this, the use of a magnetic wand to apply magnetic powder generally results in the primary development of the mark as opposed to primary development of the texture. It is therefore recommended when developing marks on textured surfaces a magnetic fingerprint powder should be applied using a magnetic wand.

10.3.1 Definition of a Smooth Surface

Non porous surfaces such as glass, glazed ceramic tiles, or similar items may be considered to be smooth.

N.B. U.P.V.C. such as window frames and sills are an exception, it appears to be a smooth surface but best results are generally achieved with black magnetic powders.

10.3.2 Definition of a Rough Surface

Any surface which is not defined as smooth as above should be considered rough

N.B. Most flooring surfaces are likely to be rough or have surface contamination.

10.4 ALUMINIUM AND BRASS FLAKE POWDER

Aluminium and brass powder are flaked powders and therefore should be considered to be sensitive.

HOSDB Fingerprint Powders Guidelines, March 2007, Publication No. 09/07 recommends the use of aluminium powder on clean, dry, smooth surfaces.

10.4.1 Application of Aluminium and Brass Flake Powder

Aluminium/brass flake powders should be applied using a glass fibre Zephyr brush.

- 1.** The brush should be charged using powder adhering to the sides of the container in the air space above the powder.
- 2.** Any surplus powder should be removed from the brush before applying to a surface, excess powder will cause any footwear marks to be clogged.
- 3.** The brush should be moved lightly over the surface in a manner that causes the powder to flow from the brush onto the surface
- 4.** Small amounts of powder should be applied to gradually build up layers of powder flakes
- 5.** The brush should be moved in the same direction as any lines in the pattern of the footwear mark. Moving the brush against the pattern trend will be abrasive to the mark and can cause loss of detail.
- 6.** Once the footwear mark is fully developed any 'clogged' areas of the mark should be cleaned out using a clean fibre brush or lifting tape or ESLA.

10.5 BLACK/WHITE NON-MAGNETIC GRANULAR POWDER

Black/White non-magnetic granular powders are generally considered to be less sensitive than flake powders.

They can be used on smooth clean surfaces when aluminium flake powder does not provide sufficient contrast between the surface and the footwear mark.

Granular powders are extremely messy to use, surfaces other than that to be examined should be protected from any surplus powder.

10.5.1 Application of Non-Magnetic Granular Powders

Non-magnetic granular powders should be applied using a fibre brush.

1. The brush should be fully charged with powder before application, the brush may then be moved over the area to be examined allowing the powder to develop any potential marks.
2. Any footwear marks seen should be further developed by moving the brush along the general lines of the pattern.
3. If the mark becomes over powdered or clogged it may be cleaned using a clean brush or ESLA. Lifting tape should not be used to clear granular powder as it can cause damage to the footwear mark.

10.6 MAGNETIC FLAKE AND MAGNETIC GRANULAR POWDER

When a brush is used to apply a fingerprint powder to a rough surface, the brush can force the powder into the surface texture causing the development of the texture rather than the mark.

Magnetic powders both flake and granular are applied using a magnetic applicator or wand. The use of a magnetic applicator is an advantage when applying fingerprint powders to a rough surface, as the powder is more likely to develop the mark and less likely to develop the surface texture.

10.6.1 Magnetic Flake Powder

Magnetic flake powder is generally considered to be a sensitive powder, it may be considered for use on those areas that are clean, with a rough or smooth surface.

N.B. Many surfaces may appear to be clean, but often have a surface contaminant. It is important to test the area before use.

10.6.2 Magnetic Granular Powder

Magnetic granular powders such as black, jet black, grey and white are generally considered less sensitive than flake powders; however they have the potential to give the best result on areas with background surface contaminants. These powders are less likely to adhere to other background surface contaminants and can produce a better contrast between the footwear mark and the back ground contaminant. Magnetic granular powders should be considered for use on rough surfaces.

10.6.3 Application of Magnetic Powders

Magnetic powders should be applied using a magnetic applicator/wand.

1. Using the magnetic applicator/wand remove a workable amount of powder from its container
2. The magnetic applicator/wand should be moved carefully across the surface, allowing only the powder to touch the surface and not the tip of the applicator.

10.6.4 Cleaning Out Over-Powdered Footwear Marks

If the footwear mark becomes 'clogged' with the powder do not attempt to clean it out using a brush, this will force the powder into the texture of the surface and/or contaminant and so cause development of the surface as opposed to the footwear mark. Consider the following;

- Remove all powder from the magnetic applicator and then pass it over the footwear mark as close to the surface as possible. Do not let the applicator come into contact with the mark at any time.
- ESLA may be used to clean out over-powdered footwear marks. The excess powder can be lifted onto the Mylar foil without causing damage.
- Gel lifter may be used to remove fingerprint powder from over-powdered footwear marks; however care must be taken during their use as they may cause damage, especially if used on rough surfaces.

10.7 TEST AREA

It is advised that the fingerprint powder selected is applied to a test area to ensure its compatibility. If the powder does not achieve the desired effect, review the choice of powder and apply to a second test area.

10.8 RECOVERY OF FOOTWEAR MARKS DEVELOPED BY FINGERPRINT POWDERS

Before attempting recovery of a footwear mark developed using a fingerprint powder, it is good practice to record it using photography. This will ensure that the Forensic Footwear Specialist gains a complete appreciation of the crime scene and a true and accurate visual representation of the footwear mark.

The set of images should include the location of the footwear mark (long view); the surface type and or contaminant surrounding the footwear mark (mid view) and detailed evidential quality photographs of the footwear mark itself (close up view).

Taking evidential photographs of the footwear mark prior to its recovery will provide a workable image should any damage be caused to the footwear mark during its subsequent recovery.

10.8.1 Recovery of a Flake Powdered Footwear Mark

For footwear marks that have been developed using a flake powder, gel lifters or adhesive footwear lifting sheets can be used for their recovery. See sections 7.10 and 7.11 for the use of gel lifters; see below for the use of adhesive footwear lifting sheets

- 1.** Select the appropriate colour of adhesive footwear lifting sheet to provide maximum contrast between powder and tape.
- 2.** Remove the lifting sheet from its backing sheet and secure one of its edges to the surface, slightly away from the footwear mark.
- 3.** Carefully smooth down the lifting sheet over the mark rubbing it with your thumb to remove any air bubbles between the surface and the lifting sheet. A roller may be utilised to ensure an even contact between lifting sheet and the footwear mark.
- 4.** Using a permanent marker pen place a direction arrow on the lifting sheet, indicating a permanent point of reference.
- 5.** Carefully remove the lifting sheet from the surface, support the lifting sheet with a roller during removal to avoid striations.
- 6.** Carefully place the lifting sheet onto an acetate sheet and use your thumb or a roller to smooth out any air bubbles.
- 7.** Using a scalpel score and remove the edges of the lifting sheet, and sign across this area using a permanent marker pen.
- 8.** Use a permanent marker pen to endorse the lifting sheet with relevant details.

Care should be taken when using lifting sheets or gel lifters as the adhesive may damage or remove surface layers e.g. paint, varnish and polish. This can be avoided by using photography or in some cases ESLA as the method of recovery.

Once footwear marks have been recovered all surfaces should be cleaned unless subsequent treatments are to be used. If a fingerprint powder is allowed to remain on a surface for any length of time it becomes increasingly more difficult to remove.

10.8.2 Recovery of a Granular Powdered Footwear Mark

For footwear marks that have been developed using a granular powder the primary recovery technique should be photography.

Lifting granular powders using a lifting tape/gel lifter is not recommended, as it is likely that smudging of the footwear mark will occur. This is caused by the individual grains of powder offering a small contact area to the adhesive on the tape/gel lifter.

10.9 HEATH AND SAFETY

Refer to guidelines from HOSDB

10.10 PERSONAL PROTECTION EQUIPMENT

Appropriate gloves and dust mask should be worn.
Refer to guidelines from HOSDB

10.11 HOSDB RECCOMENDATIONS

HOSDB publication 09/07 makes the following recommendations regarding the use of fingerprint powders to develop latent finger marks.

- Scene examiners must receive appropriate training and maintain good application technique when applying powders. This is likely to be as important as powder selections for some smooth surfaces
- Aluminium powder should, where possible be applied with a glass fibre brush
- Glass should be powdered with aluminium powder unless contamination prohibits its use
- Where appropriate, a black or jet black magnetic powder should be used on textured surfaces NOT aluminium or black granular powder.
- Black or jet black magnetic powders should be used on u-PVC window and door frames.
- For serious crime, scene examiners should consult their force fingerprint development laboratory staff as chemical processing may be more effective on textured surfaces.

11. CONTACTS

Research into the use of fingerprint powders and chemical enhancement techniques to develop footwear marks is an ongoing process at the Home Office Scientific Development Branch (HOSDB), and those techniques already recommended for fingerprint enhancement have not yet proved to be transferable to footwear marks.

This manual does not include footwear recovery techniques that are still being researched, and NPIA, Harperley Hall in partnership with HOSDB will endeavour to update and disseminate to all police forces any new findings in this area. In the meantime, for immediate information about any new techniques available for specific footwear mark recovery at major crime scenes it is advised that the Crime Scene Manager (CSM) contact HOSDB or NPIA, Harperley Hall to ascertain the present status of footwear mark research.

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12. FOOTWEAR MARKS EVIDENCE TERMINOLOGY

The following list of footwear marks evidence terminology is not that which refers to this manual alone but that which should be used when dealing with footwear marks evidence. This list is not exhaustive and the authors envisage that with each new edition of this manual additional terminology will be included.

CASTING

Method of recovery of a three dimensional footwear mark. Refers to the process whereby a casting material is dispensed into the indented mark to produce a solid three dimensional representation of the footwear mark.

CHARACTERISTICS

Generic term that refers to the different types of random damage that occurs to the outer sole area of an item of footwear and can be transferred to the footwear mark. There are a number of different ways that damage occurs e.g. through wear, during manufacturing and the attachment of foreign objects.

CODING

Refers to the process whereby an outer sole pattern retrieved from a crime scene or from a prisoner footwear item is allocated a national alpha-numeric reference and recorded onto the National Footwear Database.

DENTAL STONE

Gypsum based casting material with a potential dry compressive strength of 8,000 psi. (Bodziak 2000)

DRY ORIGIN FOOTWEAR MARK

Describes a footwear mark made by the outer sole area of an item of footwear and the contact surface, where both are completely dry at the time of contact.

ENHANCED FOOTWEAR MARK

Refers to a footwear mark that has been made more visible.

ENHANCEMENT

Describes the application of any technique that will cause the footwear mark to become visible and/or more visible.

FOOTWEAR

Generic name for any item that is worn on the foot, e.g. boot, shoe, trainer

FOOTWEAR MARK	Describes that which is found at a crime scene, in which any part of the outer sole of the footwear item has come into contact with a surface, causing the transference of a contaminant to or from the footwear to produce a representation of an area of the outer sole.
FOOTWEAR MARK SCREENING	Refers to an initial comparison of scene footwear mark and suspect outer sole pattern, before a full examination takes place.
FOOTWEAR PATTERN	Refers to the manufacturers' pattern on the outer sole of an item of footwear which provides grip and/or friction. It can refer to any pattern, from heavy texture to smooth. Can refer to size, shape, style, and mold defects of the outer sole of a footwear item
FOOTWEAR PRINT	Refers to a control transfer print obtained from a prisoner's footwear, comprising of width and length.
FOREIGN CONTAMINANT	Refers to a material/substance that would not normally occur on that surface, and would be considered foreign to that surface e.g. blood on a concrete surface.
FRAGMENTED (FOOTWEAR MARK)	Describes a footwear mark where by it is not possible to say which area of the outer sole the mark represents.
FULL (FOOTWEAR MARK)	Describes a footwear mark where the outer sole toe area, outer mid sole area and heel are clearly represented.
HEEL	Refers to the back area on the item of footwear i.e. that part of the footwear that lies directly under the heel area of the foot.
INITIAL ASSESSMENT	Refers to a process where a footwear mark is assessed for its quality and subsequently its intelligence value.
KNOWN CONTAMINANT	Refers to a material/substance that can be identified.
LATENT FOOTWEAR MARK	Refers to a footwear mark full, partial or fragmented that is not visible to the naked eye and requires special lighting techniques and/or methods to locate the mark.

NEGATIVE FOOTWEAR MARK	Refers to a mark in which a surface contaminant has been removed due to the contact of any part of the outer sole area of an item of footwear. This mark may be full, partial or fragmented.
NON-POROUS	A surface or item with non-absorbing properties.
OBLIQUE LIGHTING	Describes the operation of the application of a light source, e.g. torch, flash, etc when placed at a low angle across the footwear mark in order to make more visible any marks present.
OUTER MID SOLE AREA	Term that refers to the area on the item of footwear that lies between the outer sole toe area and the heel.
OUTER SOLE	Term that refers to the entire under part of an item of footwear.
OUTER SOLE TOE AREA	Term that refers to the front area on the item of footwear i.e. that part of the footwear that lies directly under the toe area of the foot.
PARTIAL (FOOTWEAR MARK)	Describes a footwear mark that does not represent the entire outer sole, although it is possible to state whether the mark represents one or two outer sole areas.
POROUS	A surface or item with absorbing properties.
POSITIVE FOOTWEAR MARK	Refers to a mark in which a transfer contaminant has been deposited due to the contact of any part of the outer sole area of an item of footwear. This mark may be full, partial or fragmented.
REFERENCE CODE	A national alpha-numeric reference allocated to a specific outer sole pattern.
SILICON BASED CASTING AGENT	Footwear casting kits are available although presently its suitability for casting footwear marks needs to be researched.
SURFACE CONTAMINANT	Refers to any material/substance that would normally occur on that surface, e.g. concrete dust on a concrete surface.

**THREE DIMENSIONAL
FOOTWEAR MARK**

Refers to a footwear mark deposited on a soft surface where by the mark or part of the mark, be it full, partial or fragmented, is impressed into the surface, i.e. footwear mark comprises of width, length and a measurable depth.

TRANSFER CONTAMINANT

Refers to the transfer of a material/substance such as a surface or foreign contaminant to another surface by the outer sole material of the footwear item. Transfer contaminant can also include transference of some of the outer sole material of a footwear item onto a surface.

**TWO DIMENSIONAL
FOOTWEAR MARK**

Refers to a footwear mark deposited on a hard surface where by the entire mark be it full, partial or fragmented, is on the same plane as the surface, i.e. footwear mark comprises of width and length.

UNKNOWN CONTAMINANT

Refers to a material/substance that can not be identified.

VISIBLE FOOTWEAR MARK

Refers to a footwear mark full, partial or fragmented that is visible to the naked eye i.e. no special lighting techniques required to locate it.

WET ORIGIN FOOTWEAR MARK

Describes a footwear mark made by the outer sole area of an item of footwear and the contact surface, where one or both are wet the time of contact.

13. REFERENCES

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