



Home Office

Fingerprint Visualisation Manual



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Centre for Applied Science and Technology
(CAST)

99th International Educational Conference,
International Association of Identification
Minneapolis, Minnesota

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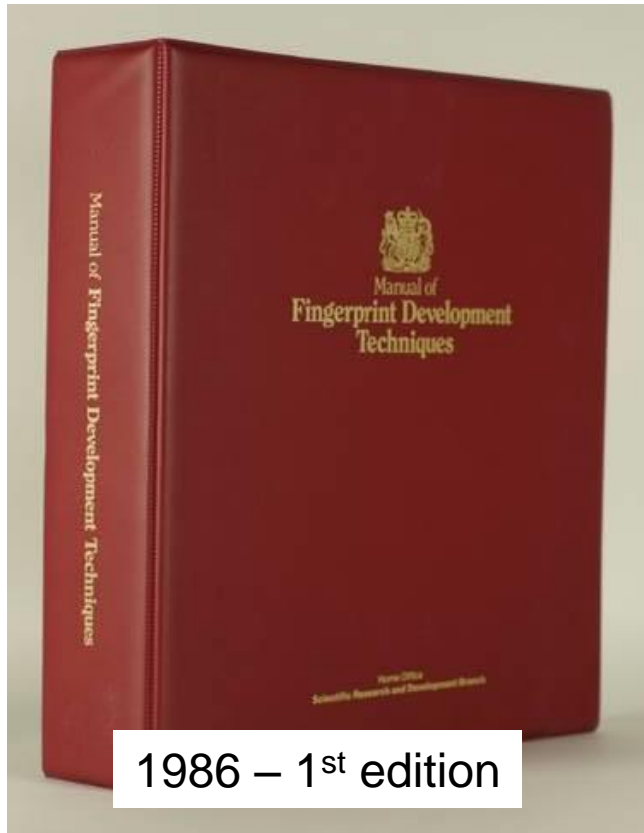
Contents

- Background
- FVM Key Points
- Live Demo
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- Feedback
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- Winston Churchill Memorial Trust



Background

The Manual of Fingerprint Development Techniques



1986 – 1st edition



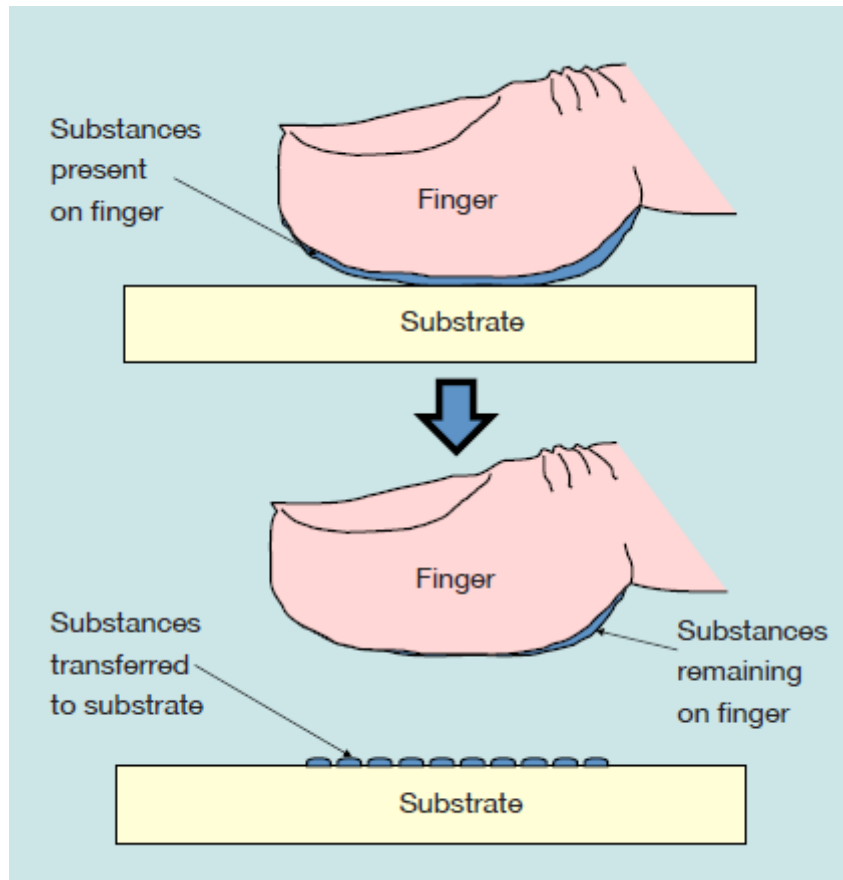
1998 – 2nd edition

Regular name changes, but always 'Home Office'

- **SRDB** – *Scientific Research and Development Branch*
- **PSDB** – *Police Scientific Development Branch*
- **HOSDB** – *Home Office Scientific Development Branch*
- **CAST** – *Centre for Applied Science and Technology*

Background

The Complexities of Fingerprint Visualisation



Variables

- Fingerprint
- Substrate
- Environment
- Time

Visualisation Processes

- Chemical
- Physical
- Optical
- (Biological)

Fingerprint Visualisation Manual

4 Key Points

(1) Target Audience

- Promotes good practice by those involved in the use of fingerprints
 - Predominately lab staff but equally applicable to CSIs
 - Also sections relevant for Identification staff, Photographers, Managers etc.

(2) Integrated Forensics

- More emphasis on the integration of fingerprint evidence recovery with other forensic disciplines
 - Context
 - Awareness of other forensic disciplines
 - Communication and good planning

Fingerprint Visualisation Manual

4 Key Points continued...

(3) ISO 17025

- Compiled for those seeking (or already have) ISO 17025 accreditation
 - BUT it is not an ISO 17025 Manual!
 - Big emphasis on **competence** for (1) planning, and (2) execution
 - More background information
 - Offers less 'prescriptive' solutions, instead offers guidance and advice for confident decision making
 - More routine and non-routine processes with enough information for informed choices
 - Generic process instruction for routine processes will assist in writing local instructions

Fingerprint Visualisation Manual

4 Key Points continued...

(4) Format and Style

- Designed to be used electronically
 - Interactive pdf
 - ~ 14,000 links
- Layout suitable for printing
 - 932 pages!!!
- Visually more appealing
 - Colour
 - Flow diagrams
 - 1000 images
 - 140 schematics & drawings



LIVE DEMONSTRATION OF FVM

Implementation

The Official Launch Event in the UK

- 29th January, CAST and Hertfordshire Constabulary
- Launched by Norman Baker MP (Minister for Crime Prevention)



The first copy being handed over to Chief Constable Andy Bliss

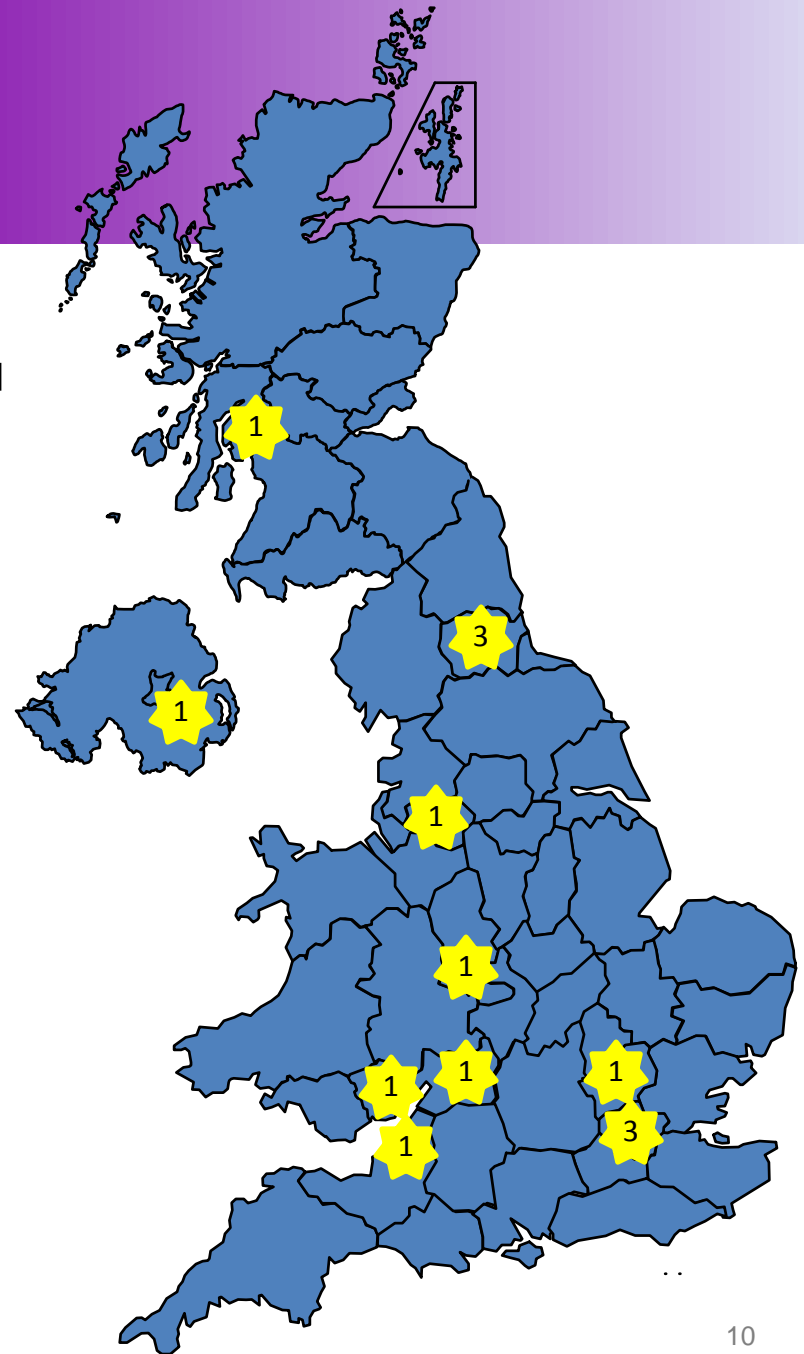


The event included a tour of Hertfordshire's fingerprint laboratory, where the operational benefits of the new manual could be clearly shown.

Implementation Workshops

Target Audience

- **Laboratory, crime scene and bureau practitioners**
- Managers
- Trainers
- Forensic Scientists



Implementation

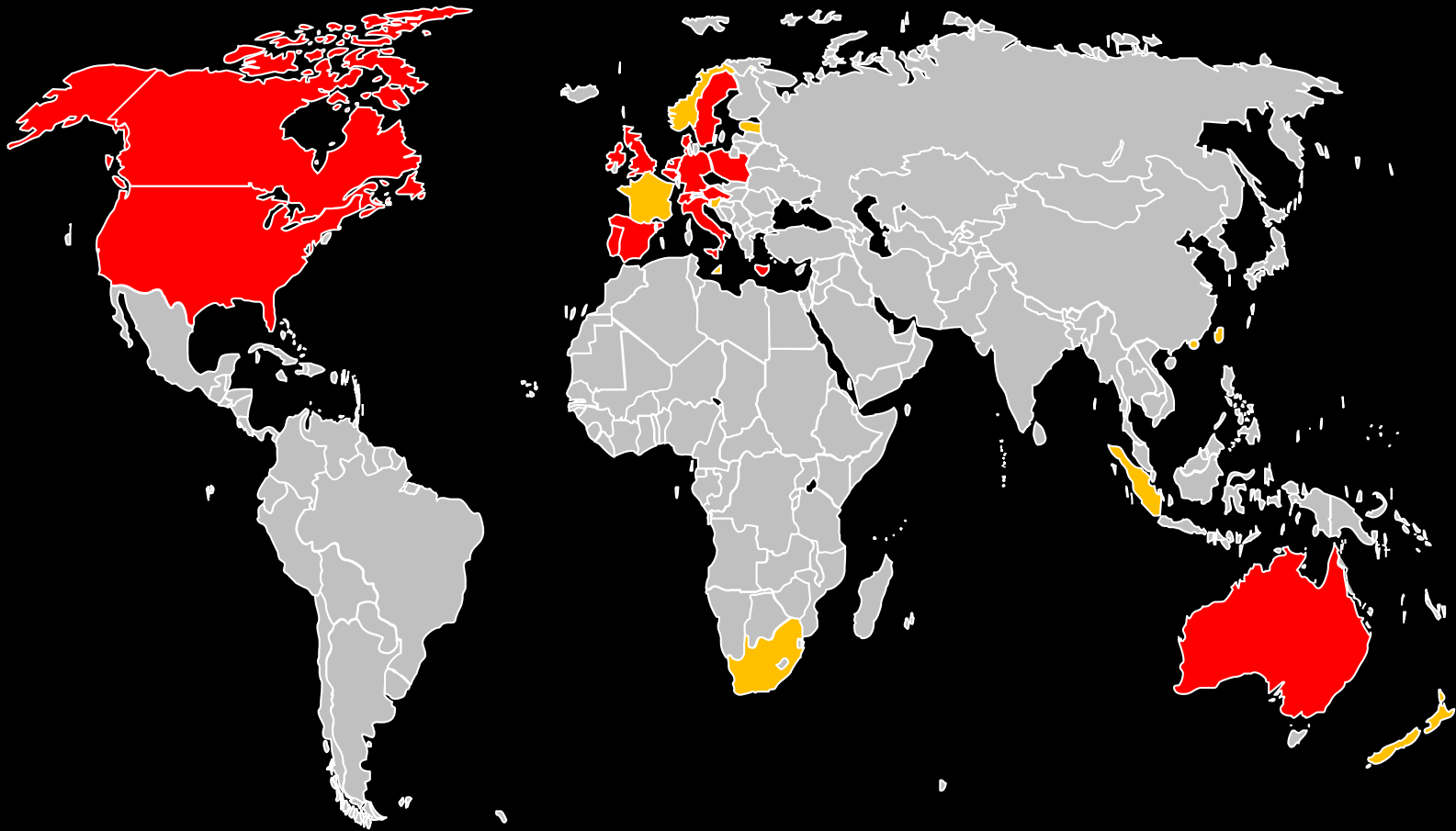
Availability outside of UK policing

Purchase Options

- The Stationary Office (TSO) – only licensed distributor
- TSO have a stand in the exhibition hall (stand no. 226)
- Several purchase options depending upon requirements
 - Single electronic copy
 - Multiple electronic copies
 - Networked license
 - Universities, via JISC banding structure
 - Single paper copy (NOT RECOMMENDED)



International Sales (April - July 2014)



A selection of feedback comments

'...the thing that amazes me is how much I keep finding really good piece of work and it is being used operationally, despite us being old dogs...'

'...You have managed to include a vast amount of very helpful information on a wide range of topics. You can quickly get used to the format and easily find the subjects you're looking for...'

'...A few years ago I visited CAST and spent the day with Steve Bleay. He was incredibly patient with me as I bombarded him with numerous questions. If that had been today, I think this manual would have answered pretty much all my questions...'

'... As a footwear mark expert, I don't routinely use these chemicals/techniques but awareness of them will be very beneficial in future. Great resource!...'

'...incredible achievement with a lasting legacy - It'll be invaluable in my work here and overseas...'

Fingermark Visualisation Manual

Contributors

Home Office

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National Crime Agency
College of Policing
Health and Safety Executive

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Manlove Forensics Ltd
Forensic Focus Ltd
Public Health England



WINSTON
CHURCHILL
MEMORIAL
TRUST



Winston Churchill Memorial Trust

Travel to make a difference



Home Office

Fingermark Visualisation Manual



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EXTRA SLIDES AND SAMPLE FVM PAGES

Fingermark Visualisation Manual

Chapters

NEW

Chapter 1

About this Manual

NEW

Chapter 2

Forensic Evidence
Recovery

REVISED

Chapter 3

Safe and Effective
Implementation of
Processes

REVISED

Chapter 4

Process Selection

REVISED

Chapter 5

Category A
Processes

NEW

Chapter 6

Category B-F
Processes

NEW

Chapter 7

Integrating
Forensic Processes

NEW

Appendices

Case Studies;
Fingermark
Research



How to navigate around the Manual

User Guide

The Manual Contents Page gives access to the start of each chapter and each section.

Contents	1 About this Manual	2 Forensic Evidence Recovery	3 Safe and Effective Implementation of Processes	4 Process Selection	5 Category A Processes	6 Category B-F Processes	7 Integrating Forensic Processes	Appendices	Glossary	Index
Contents	1	2	3	4	5	6	7	8	9	10
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Chapter 2: Forensic Evidence Recovery		1								
Chapter 3: Safe and Effective Implementation of the Processes			1							
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Chapter 6: Category B-F Processes						1				
Chapter 7: Integrating Forensic Processes							1			
Appendices								1		
Glossary									1	
Index										1

The banner at the top of each page gives access to the start of each chapter.

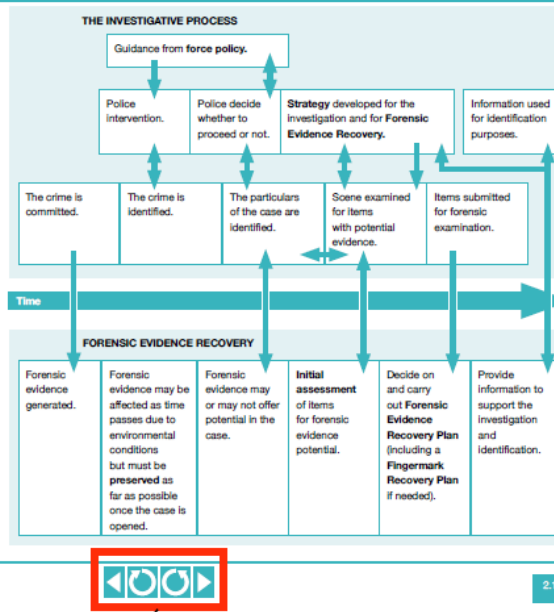


Section 2.1: An Introduction to Forensic Evidence Recovery

The investigative process
A useful way of viewing the contribution of forensic evidence recovery to an investigation is to consider the passage of time from the moment the crime was committed and the various sequences of activities that follow with respect to:

- the investigation itself;
- the fate and recovery of forensic (including fingerprint) evidence left at the crime scene.

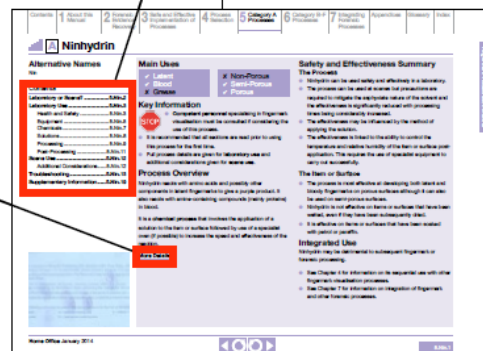
The activities undertaken will ideally be subject to a dynamic interaction, ensuring a good flow of information between all the practitioners involved in the investigation. The diagram on the right aims to illustrate this.



An Index provides an indication of where specific information can be found.

Fingerprint Visualisation Manual

On individual pages, links provide easy access to other information. References to particular chapters are not linked as they can be easily assessed via the banner at the top of the page.



Arrows can be used to navigate page by page, or through history.

How to use the Manual for Fingerprint Visualisation

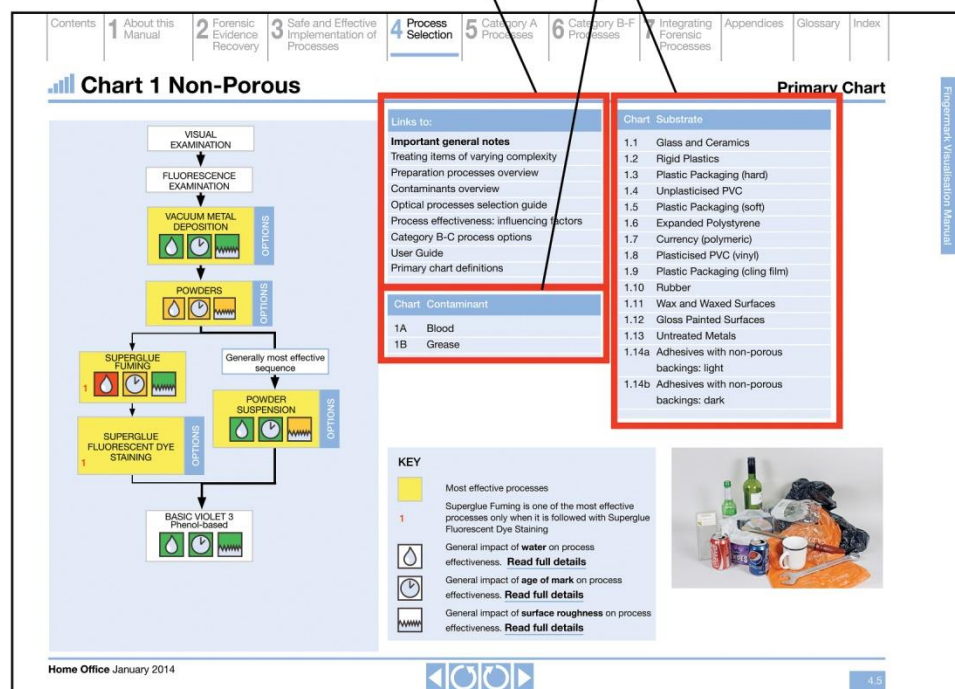
User Guide

Using Chapter 4 for planning continued

Step 3 is to use knowledge about the item or surface to access further Manual information by using links in the Primary Charts to **supporting information** and **secondary charts**.

a) Links to Supporting Information

b) Links to Secondary Charts



Supporting information

Step 3a: Use links to access supporting information.

Links to:

Important general notes

Treating items of varying complexity

Preparation processes overview

Contaminants overview

Optical processes selection guide

Factors that modify process effectiveness

Category B-C process options

User Guide

Primary chart definitions

The links all go to additional information that may be used to develop a plan basing any decision on the information gathered about the item or surface.

- The important general notes **must** be consulted since the sequences shown must be supplemented with additional general advice.
- Is the item simple to treat or more **complex**?
- Does the item need to be **prepared** before it can be treated?
- How should **contaminations** be managed in the plan?
- Which optical process(es) might be the best ones to include in the plan?
- How might the history of the item affect **process effectiveness**?
- Are there any additional processes (**Category B and C**) that could be used?
- Is an **integrated forensic recovery plan** required?

Section 2.2: Understanding Fingermarks

Generation of fingermarks continued

Negative mark

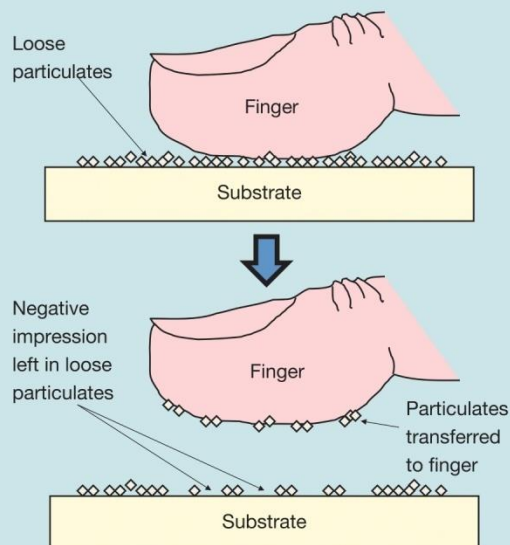
If the substrate **condition** is poor and covered in loose particulate material (e.g. dust) or a continuous layer of contaminant, the ridges of the finger may pick up some of this material, thus leaving a negative (or reverse) mark on the substrate.

Negative marks are not found frequently on operational material and may be extremely fragile.



Image of negative mark in dust.

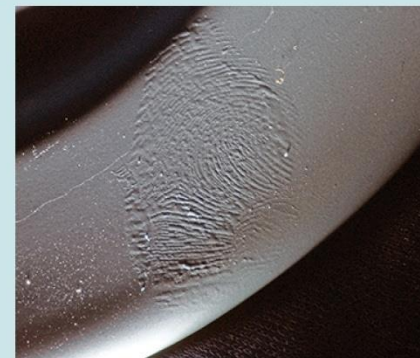
Generation of a negative mark.



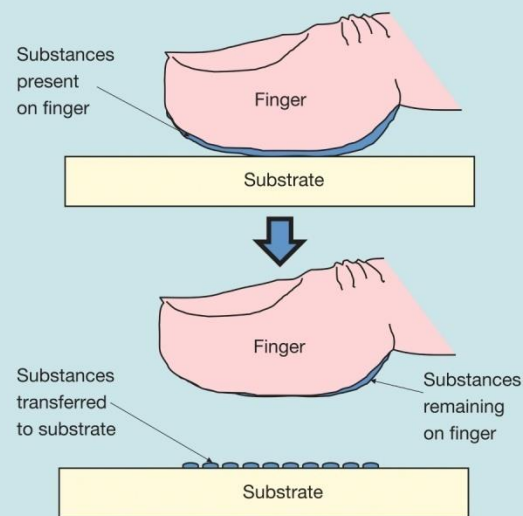
Positive mark

During contact between the finger and the substrate, **material is transferred** from the ridges of the finger to the substrate, thus leaving a positive mark.

Image of positive mark on the rim of a plate (right).



Generation of a positive mark.



Section 2.3: Fingerprint Visualisation Processes

Classification of processes

Although there have been many optical, chemical and physical fingerprint visualisation processes reported extensively in the literature, not all will have been comprehensively developed for operational use by the police. Those that the Home Office considers to have been fully evaluated for current routine application by the police have been nominally classified as **Category A processes** for the purpose of this Manual, with full process instructions given in Chapter 5.

References are made to other processes in the Manual but these have been placed in **Categories B-F**, according to the Home Office view of their state of maturity, relative effectiveness and associated health and safety issues. More information, with appropriate levels of detail, can be found in Chapter 6.

A summary of the classifications and possible use of all categories of process are indicated in the table on the right. While the remainder of this section primarily focuses on Category A processes, the principles discussed will apply for all processes.

Category	Description	Use
A	Processes extensively evaluated by the Home Office and considered suitably effective to be incorporated into processing charts in Chapter 4.	Standard processes for routine operational use. They must be used in preference to other category processes where possible.
B	Established processes known to be generally less effective than alternative options or processes that are likely to offer benefit but have not been fully evaluated by the Home Office.	Optional processes for occasional operational use. Possible reasons for use: no other options available; all Category A options have been exhausted; niche application; or lack of equipment for other processes.
C	Processes at a developmental stage exhibiting potential as an effective fingerprint recovery process.	Optional processes for occasional operational use. Possible reasons for use: no other options available; all Category A options have been exhausted; niche application.
D	Processes extensively evaluated by the Home Office and considered unsuitable for incorporating into processing charts in Chapter 4.	Corrective Action Processes. Not generally for routine use but may be used to recover marks in situations where initial selection of processes has resulted in undesirable consequences.
E	Processes that are known to be less effective than alternative processes with no obvious niche application , or those with no reliable data on the success rate and no reason to believe that they are as good as or significantly better than other processes.	Processes with no known operational benefits .
F	Processes with known health and safety issues . The process uses chemicals and/or conditions that expose operators to unacceptable health hazards.	Processes should not be used for health and safety reasons .

Section 2.3: Fingerprint Visualisation Processes

Process effectiveness: influencing factors

As indicated in [Section 2.2](#) of this chapter, exposure of items to **water** or **elevated temperature**, the **age** of the mark and the **texture** of the surface are the four main factors which could impact on the composition and properties of fingerprints. The resultant changes may alter the effectiveness of the visualisation processes used: therefore knowledge of both the history of the item and the likely impact on the effectiveness of the process will be needed to guide the choice of which process(es) to use.

The summary below is followed by more detailed information on the impact of each of these factors on the fingerprint and the visualisation processes: this is important in applying the recommended sequences of processes, given in Chapter 4 (from which there is a link back to these reference pages).

Has the item or surface been exposed to **water**?

If yes, this will have a significant impact on the effectiveness of some visualisation processes. It may remove some of the mark constituents (see [‘what happens to the fingerprints’](#)). The degree of impact will depend upon the extent of wetting e.g. light shower for a short period of time vs. immersion for weeks and the age of the fingerprint prior to wetting. See [‘impact on processes’](#).



How **rough** or **textured** is the surface?

The surface roughness will have an impact on the effectiveness of most visualisation processes for one of two reasons: firstly, the ridge detail may be discontinuous, with the quantity and quality of any detail decreasing as the texture increases (the visualisation process can only develop what is there); secondly, the texture may inhibit the application of some processes. See [‘what happens to the fingerprints’](#) and [‘impact on processes’](#).



Has the item or surface been exposed to **elevated temperatures**?

If yes, this will have a significant impact on the effectiveness of some visualisation processes. It may move or destroy some of the mark constituents (see [‘what happens to the fingerprints’](#)). The degree of impact will depend upon the temperature and time of exposure. See [‘impact on processes’](#). There may be additional problems if contaminants such as soot are also present.



*Note: Exposure of marks to **sub-zero temperatures** is not thought to be detrimental to fingerprints and may slow decomposition of constituents, provided they can be kept frost and condensation free at all times. In practice this is difficult to achieve.*

How **old** is the fingerprint?

The age of the fingerprint will have an impact on the effectiveness of some visualisation processes. The composition of fingerprints will change as time passes. The extent of this change will depend upon the environmental conditions to which the mark has been exposed and the time period itself. See [‘what happens to the fingerprints’](#) and [‘impact on processes’](#).



Section 3.1: Requirements for Implementation

Laboratory requirements

Superglue Fuming cabinet

The Superglue Fuming cabinet has two purposes. The first is to provide a **safe** means of using the process by containing and then purging the fumes developed during the heating of the superglue. The second is to develop an **effective** environment in which the superglue fumes can develop and visualise fingermarks.

The cabinet is often installed in the 'wet' area of the laboratory but it is more important to ensure it can be installed in a position where temperature variation across the cabinet can be minimised. The position relative to windows or radiators must therefore be considered when selecting a suitable location.

Many cabinets have an internal filtration system for purging the fumes when processing is complete but others will require a local exhaust ventilation system to extract the fumes to the exterior. In the latter case, appropriate ducting to meet appropriate legislation will be needed and may further compromise the possible positions for the equipment.

A correctly positioned Superglue Fuming cabinet.



Wet bench, with integral dyeing facility

A wet bench may be useful for a number of processes, proving more versatile than smaller laboratory sinks for handling some items.

A wet bench with an integral dyeing facility may be used to carry out the Superglue Fluorescent Dye Staining process. If an ethanol dye formulation is used a flammability hazard will be introduced unless the vapour is kept below the lower explosive limit (LEL), using the methods indicated below. Also see **working with flammable liquids**.

A wet bench with integral dyeing facility **should**:

- be made from a chemical-resistant material of suitable thickness and suitably sealed to prevent leaks;
- contain a dye tank fitted with a drain to facilitate disposal of contaminated dye and for cleaning purposes;
- have a catch tank large enough to collect all the dye from a ruptured dye tank;
- contain a dye tank designed so that wide and tall items can be easily treated - an L-shaped dye tank may be suitable as larger items can be treated (and minimising the quantity of stored ethanol, if used);
- contain a dye tank covered by a lid when not in use to reduce evaporation of ethanol and build-up of highly flammable vapours in the laboratory; the evaporation of ethanol can be further reduced by use of a floating bath lid or floating spheres;
- incorporate a similar wash tank with water inlet and outlet valves so that the flow of water is sufficient to remove excess dye; alternatively a hose or shower head can be used to rinse items.

An extraction hood **must**:

- be installed if assessments of the LEL indicate that the provision of local exhaust ventilation, located behind the tank to draw vapours away from the practitioner, is not sufficient to reduce the ethanol vapour to a concentration below the flammability limits;
- be positioned at a height above the bench to allow enough space to work.

The dye tank can be filled with a suitable dye solution and topped up when required. This opposes the general recommendation for repeat use of working solutions (**using chemicals**).

A typical wet-bench (top) and (bottom) an integrated dye tank with floating spheres.



Section 3.2: Working Safely

Recovering fingerprint evidence safely

Physical hazards associated with the processes continued

Working with flammable liquids



Comprehensive information on the storage and use of flammable substances can be found on the HSE website (www.hse.gov.uk), which should be consulted for definitive information.

There are instances where the processes require the use of flammable liquids. If they are used in a laboratory environment where there is sufficient ventilation, such as that provided by a fume cupboard or **local exhaust ventilation** (LEV), the flammability of the liquids should pose no hazard.

Ventilation of a work area outside a fume cupboard or without LEV may be achieved simply by opening doors and windows to disperse the fumes.

If flammable liquids are used without adequate ventilation, such as in confined areas of a scene, the vapour concentration will increase. If the concentration of the vapour exceeds a lower explosive limit (LEL) a fire may start if the surfaces being treated reach very high temperatures or if an ignition source, such as a naked flame, a spark from electrical equipment or electrostatic discharge is present. The use of anti-static PPE, infrared thermometers and equipment suitably designed to offer protection in flammable atmospheres should be included

in the control measures for any process involving the use of flammable liquids.

If there is a risk of the working temperature exceeding a critical temperature identified for the process being used, flammable gas monitors must be used. They will indicate whether the vapour levels are approaching the LEL and alert practitioners of the increased risk to themselves and others in the area. This will allow them time to evacuate the area until the vapour can be reduced to a safe level.

Any flammable liquid has the potential to create a flammable atmosphere, **whatever the flash point** of the solution, if it is sprayed. The spraying of any flammable solution must not be considered for the processes used for visualisation of fingerprints. A safer method of application must be used, as indicated in the Chapter 5 process instructions.

Processes that pose particular hazards with regard to flammability are:

Acid Dyes

Solvent Black 3

Superglue Fluorescent Dye Staining

Further information on the specific hazards associated with their use can be found in the relevant section of Chapter 5.

Hazards from air depletion

It is possible to develop fingerprints with DFO and Ninhydrin without the use of development ovens. However, hydrofluoroether (HFE), the principal solvent in these processes, produces vapour that is much heavier than air and can displace it. Where adequate ventilation cannot be provided, e.g. when working in confined spaces at scenes, a risk of **asphyxiation** may be introduced.

Air depletion should not occur where there is adequate ventilation, but treating even small areas without adequate ventilation may reduce oxygen availability to a level that requires the use of breathing apparatus.

The application of the working solutions for both DFO and Ninhydrin by spraying is not recommended as the atomisation of HFE can increase the possibility of air depletion in areas with insufficient ventilation.

Hazards from handling liquid nitrogen

Liquid nitrogen is required for Numberplate Splitting and presents a number of hazards, which if not controlled through careful handling can put practitioners at risk from:

- pressure build-up and explosions if not stored in pressure-relief vessels;
- material brittleness causing many common materials such as carbon steel, plastic and rubber to become brittle or possibly fracture under stress;
- frostbite and tissue damage, which may be permanent;
- asphyxiation if not used in well-ventilated areas.

Metal jewellery and watches should be removed from

Section 3.3: Working Effectively

Imaging

File format

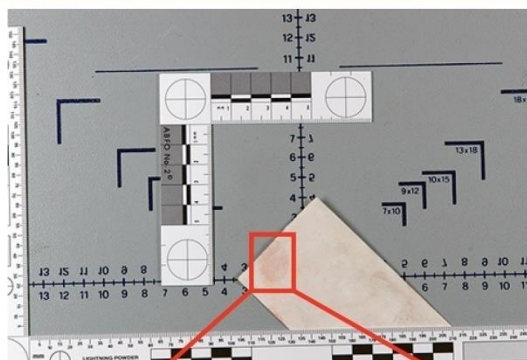
The file format for image capture must be selected to take into account both the requirement to keep a master copy of the image and to produce a working copy that is capable of being transferred onto the national fingerprint database.

DSLR cameras and image capture systems allow the image files to be saved in various file formats, including JPEG (.JPG) (Joint Photographic Experts Group), JPEG2000 (.JP2), RAW (the general term for proprietary raw formats although each manufacturer has its own, e.g. Nikon's .NEF and Canon's .CR2) and TIFF (.TIF) (Tagged Image File Format).

Common terms

Bit depth refers to the number of discrete levels of grey that can be represented in an image, where the number of possible levels equals the number two raised to the power of the quoted number, hence an 8-bit image can represent 28 or 256 levels of grey and a 16-bit image can represent 216 or 65,536 levels. Colour images are, in effect, combinations of three greyscale images – one for each of the primary colour channels: red, green and blue (RGB). The resulting numbers of possible colours are then $256 \times 256 \times 256$ and $65,536 \times 65,536 \times 65,536$ respectively. Confusingly, an 8-bit colour image may also be referred to as a 24-bit image because $3 \times 8 = 24$. Bit depth is related to, but is distinct from, dynamic range.

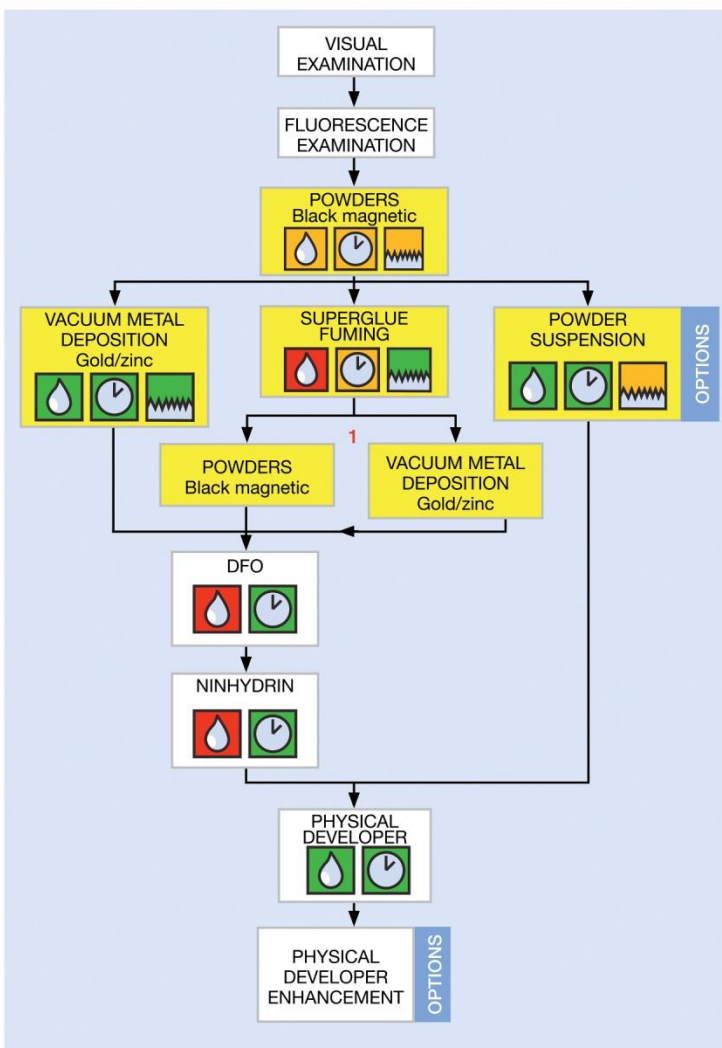
Dynamic range relates to the overall range of exposure that may be recorded whereas bit depth relates to the number of separate levels that may be coded within that range.



Images of a fingerprint visualised using Ninhydrin captured at 250 ppi (left) and 2000 ppi (right), showing the original image (top) and the image converted to greyscale and enlarged (below). The enlarged 250 ppi image shows lack of clarity in second-level detail, whereas the enlarged 2000 ppi image shows clear second-level features and defined pore structure in the ridges.

Chart 3 Semi-Porous

Primary Chart



KEY



Most effective processes

1 Superglue Fuming is one of the most effective processes only when it is followed with VMD or Powders (as enhancement processes). VMD is likely to be more effective in this regard.



General impact of **water** on process effectiveness. [Read full details](#)



General impact of **age of mark** on process effectiveness. [Read full details](#)

Links to:

Important general notes

- Treating items of varying complexity
- Preparation processes overview
- Contaminants overview
- Optical processes selection guide
- Process effectiveness: influencing factors
- Category B-C process options
- User Guide
- Primary chart definitions

Chart Substrate

3.1	Paper (white, glossy)
3.2	Printed paper and card
3.3	Silk/satin-painted walls and wood
3.4	Adhesives with semi-porous backings
3.5	Adhesives with cellulose backings
3.6	Fabric
3.7	Non-paper-based wallpaper (notes only)
3.8	Cellophane packaging (notes only)
3.9	Leather and leatherette (notes only)
3.10	Bricks and concrete (notes only)
3.11	Skin (notes only)

Chart Contaminant

3A	Blood
3B	Grease

Chart 2.6 Untreated Wood

Secondary Chart

General information:

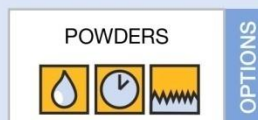
- This surface type describes predominantly untreated wood. The category includes both wood and wood-based products such as chipboard and fibreboard (MDF). The main materials present are the cellulose and lignin forming the wood structure, and for natural wood there are variations in the level of porosity according to the type of wood. Soft woods (e.g. pine) are highly porous, whereas harder woods (e.g. mahogany) are significantly less so, and this affects the way in which the fingerprint residues are absorbed. Where other substances such as wood preservatives and binders (for chipboard) are present, these may interact with fingerprint development reagents.
- It is unclear how effective the chart is for wood that has been treated with oil or preservative.
- If wooden surfaces are varnished, polished, or coated with wax they should be treated as non-porous (see [Chart 1](#)).

Typical items:

- Tool handles, wood carvings, baseball bats, tree branches, planks, untreated interior doors, floor boards, fencing, furniture, chipboard and fibreboard panels.

Use Chart 2 with a MINOR modification:

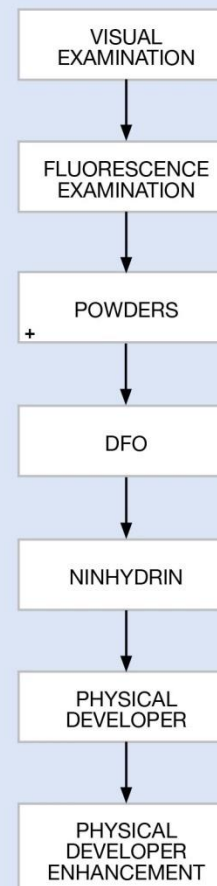
- + Powders may detect fresh or heavy fingerprints on smooth untreated wood or wood that has been treated with oil or preservative. Magnetic powders are likely to be more effective than other powder types.



Additional considerations:

N.B. Wood may fluoresce significantly during Fluorescence Examination, especially with shorter wavelengths. This may obscure marks developed using DFO, or may give benefits in visualising dark-coloured marks.

No information is available on which processes are the most effective.



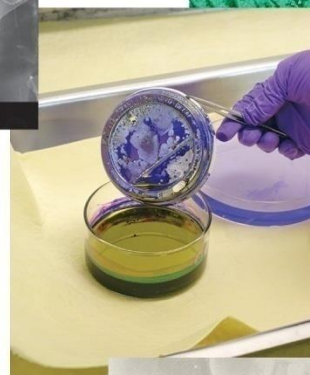
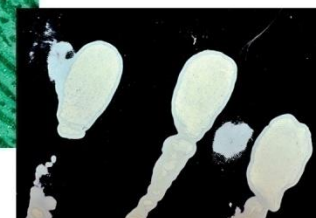
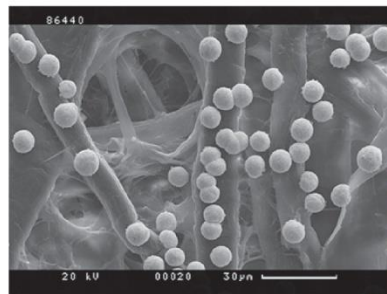
Chemical and Physical Processes

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Superglue Fuming	5.SF.1
Vacuum Metal Deposition	5.VMD.1

Introduction

The chemical and physical visualisation processes target chemicals present in fingerprints or the physical properties of the fingerprint. They can be used to visualise latent marks or further enhance previously treated items or surfaces ■



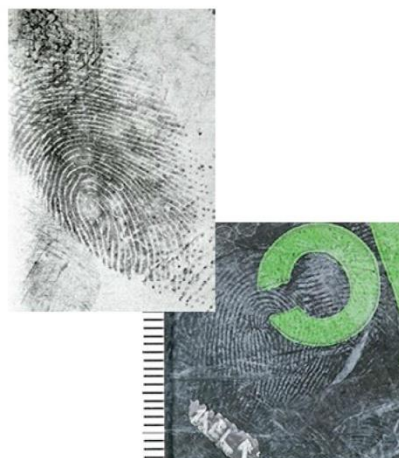
A Powder Suspension

Alternative Names

Wet Powders

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Main Uses

- | | |
|--|---|
| <ul style="list-style-type: none"> ✓ Latent ✓ Blood ✓ Grease* | <ul style="list-style-type: none"> ✓ Non-Porous ✓ Semi-Porous ✗ Porous |
|--|---|

* targets latent marks in a greasy contaminant

Key Information



- **Competent personnel** specialising in fingerprint visualisation must be consulted if considering the use of this process.
- It is recommended that all sections are read prior to using this process for the first time.
- This section contains process instructions for three Category A Powder Suspension formulations:
 - Iron oxide-based
 - Carbon-based
 - Titanium dioxide-based
- Full process details are given for **laboratory use** and additional considerations given for **scene use**.

Process Overview

Powder Suspension consists of a fine powder dispersed through a concentrated detergent and wetting agent solution. This process was initially used for treating adhesive surfaces such as tapes; however, Powder Suspension is also effective on general non-porous and semi-porous substrates. When applied, the powder is selectively deposited along fingerprint ridges but the mechanism is unknown. Iron oxide and Carbon-based Powder Suspension yield black fingerprints and Titanium dioxide-based Powder Suspension produces white marks.

It is a **chemical process** that involves applying the Powder Suspension to the item or surface followed by a water wash.

More Details

Safety and Effectiveness Summary The Process

- Powder Suspension can be used safely and effectively in a laboratory and at scenes.

The Item or Surface

- Effectiveness improves with the age of the fingerprint, over a period of several weeks.
- The effectiveness of Powder Suspension decreases with increased surface texture.
- Powder Suspension is effective on items/surfaces that have been wetted.
- Powder Suspension is effective on items/surfaces that have been subjected to moderate heating.
- Powder Suspension can stain the background of some substrates, most notably semi-porous items, causing developed fingerprints to be obscured.

Integrated Use

Powder Suspension may be detrimental to subsequent fingerprint or forensic processing.

- See Chapter 4 for information on its sequential use with other fingerprint visualisation processes.
- See Chapter 7 for information on integration of fingerprint and other forensic processes.

Ninhydrin

Laboratory Use

Equipment

Ninhydrin requires the use of some process-specific equipment for the application of Ninhydrin Working Solution and for creating the environmental conditions required for development.

If equipment is to meet the requirements as outlined below, it must be well maintained and, if appropriate, serviced regularly in accordance with the manufacturer's instructions.

General laboratory equipment that may be required is outlined in Chapter 3.

Equipment	Requirements
Processing trough	<p>A processing trough must:</p> <ul style="list-style-type: none"> be made of a material compatible with solvents used in the Ninhydrin Working Solution such as polypropylene. <p>In addition, a processing trough should:</p> <ul style="list-style-type: none"> be of suitable length to accommodate the size of items being processed; be shallow with a curved, corrugated bottom surface. <p><i>A processing trough that meets all of the above requirements allows Ninhydrin Working Solution to be applied in such a way as to minimise wastage without compromising the effectiveness of the process. The curved, corrugated surface enables small quantities of solution to be used at one time, whilst preventing paper 'sticking' due to surface tension effects if the surface were smooth. Other designs can be used effectively, but they may generate additional waste Ninhydrin Working Solution.</i></p>  <p><i>Examples of processing troughs produced for use with Ninhydrin solutions.</i></p>

Ninhydrin development oven

A Ninhydrin development oven **must**:

- maintain air temperature within the oven whilst at equilibrium at $80 \pm 2^\circ\text{C}$; maintain relative humidity of $62 \pm 5\%\text{RH}$ within the oven whilst at equilibrium;
- provide close control and rapid recovery of temperature and humidity across all shelves (see [calculating the oven recovery time and treatment time](#));
- not have air flow so strong as to blow normal paper casework items around within the oven;
- have an over-temperature safety cut-out;
- have a way of monitoring items and observing mark development whilst in the oven; solutions may include multi-glazed windows with a wiper or heated glass and with suitable lighting;
- have an adjustable airflow inlet;
- be able to be connected to a negative pressure exhaust system (see Extraction for Ninhydrin development oven);
- have a drain-pipe to remove condensed water, which must be connected with a continuous downward slope to a suitable outlet, such as an open drain and be resistant to acetic acid;
- not allow condensation to drip onto the item.

In addition, a Ninhydrin development oven **should**:

- not exceed 80% RH for more than a few seconds in the usable part of the oven;
- have a working capacity of at least 150 L;
- have interior and shelves, resistant to acetic acid vapour;
- incorporate an automatic timer that begins the cycle when the oven door is closed.

Extraction for Ninhydrin development oven

Extraction for a Ninhydrin development oven **must**:

- be connected to the oven via an extraction pipe with a continuous upward slope;
- be a negative pressure exhaust system which provides a continuous extraction rate of between five and ten times the total volume of the oven per hour;
- have an extraction pipe that is able to resist the temperature being used and acetic acid vapour mixed with steam at that temperature.

In addition, there **should**:

- be an extraction hood over the oven extending in front to beyond the door end when it is fully opened.

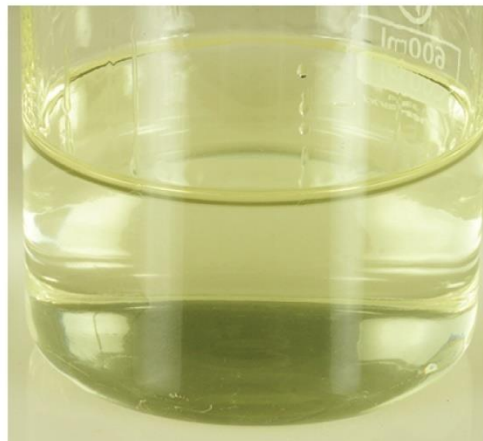
Ninhydrin

Troubleshooting

Separate Layer or Droplets on the Surface of Ninhydrin Working Solution

Recognition

A separate layer and/or 'oily' droplets have formed on the surface of the Ninhydrin Working Solution.



Ninhydrin Working Solution with thin 'oily' layer floating on the surface.



Ninhydrin Working Solution with 'oily' droplets floating on the surface.

Cause	Effect	Prevention	Correction
The separate layer and/or 'oily' droplets is actually water. Water and HFE7100 are immiscible so when Ninhydrin Working Solution becomes contaminated with water a two-phase solution is formed. The specific gravity of water is less than that of HFE7100 so it is the water that floats, but has the appearance of 'oil floating on water'. This can occur when water gets into the solution.	Ninhydrin is considerably more soluble in the water phase than the HFE phase and it becomes more concentrated there. Therefore the Ninhydrin Working Solution becomes less concentrated than intended. As a consequence: <ul style="list-style-type: none"> processed fingerprints may appear lighter and weak fingerprints may be missed; processed fingerprints may be blurred as the amino acids within fingerprints are water soluble and if the water layer comes into contact with amino acids they will dissolve or be diffused from ridge; the 'oily' layer can be transferred and leave stains which may obscure fingerprints. 	Ensure that: <ul style="list-style-type: none"> absolute ethanol $\geq 99.7\%$ is used (Ethanol 96 contains about 4% water); all equipment is thoroughly dried before use. In addition, some porous items naturally have a high water content as they absorb water from the air, especially on humid days. In this case preventing the layer or droplets from forming may prove difficult but the use of small fresh quantities of solution will help. 	There are no corrective measures. Dispose of solutions appropriately. <p>Note: Do not Filter two-phase Ninhydrin Working Solution. Although it may remove the 'oily' layer or water phase it leaves a Working Solution that contains much less Ninhydrin as that dissolved within the water phase will have been removed along with it.</p>

Fluorescence Examination

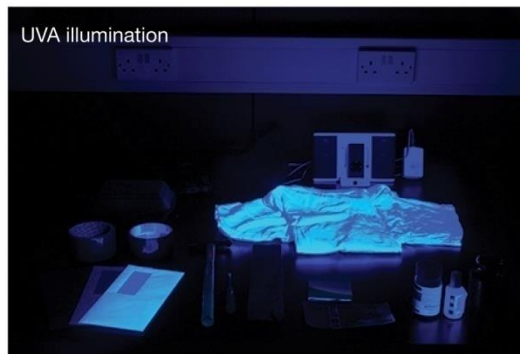
Supplementary Information

Requirements for Fluorescence Examination: The Substrate continued

The images below illustrate how a typical range of items fluoresce under various lighting conditions*. Often white items fluoresce strongly when illuminated with UVA or violet light due to the presence of optical brighteners. Overall fluorescence of surfaces typically reduces with increasing illumination wavelength.

* The relative brightness when viewed with the eye will differ to that shown in these images. See [detection systems for fluorescence](#).

White light reference image



B Palladium Deposition

Alternative Names

None

Key Information

Where this process could be used

Palladium Deposition may be of use on copper, brass and bronze items either previously treated with **Superglue Fuming** or that are grease-contaminated. See **Category B-C process options**.

Why the process is not in Category A

The process has not yet been fully evaluated and optimised. Palladium Deposition may be marginally more effective than the Category B process **Gun Blueing**.



- **Competent personnel** specialising in fingerprint visualisation must be consulted if considering the use of this process.
- Ensure all Category A process options have been explored before using this process.
- In the first instance, it is recommended that all relevant information is gathered from appropriate sources prior to considering the use of this process.

Process Overview

Palladium Deposition develops marks by electrochemical deposition of a palladium onto a copper, brass or bronze surface. Latent fingerprints, greases and some development processes such as **Superglue Fuming** protect the copper, brass or bronze surface so deposition occurs only on the background, turning it dark grey.

It is a **chemical process** that involves the application of a solution to the item followed by washing with water.

Safety and Effectiveness Summary

The Process

- Palladium Deposition can be used safely and effectively in a laboratory.

The Item or Surface

- The process is specifically suited for use on copper, and copper-based alloys such as brass and bronze.
- The process is most effective when the metal surface is protected from the palladium solution in the region of fingerprint ridges, for example by grease-contaminated marks and those developed by Superglue Fuming. In comparison, it is less effective on latent fingerprints.

Integrated Use

Palladium Deposition may be detrimental to subsequent fingerprint or forensic processing. The impact of Palladium Deposition on subsequent ballistic forensic analysis processes such as comparison of firing marks has not yet been established.

Further Reading

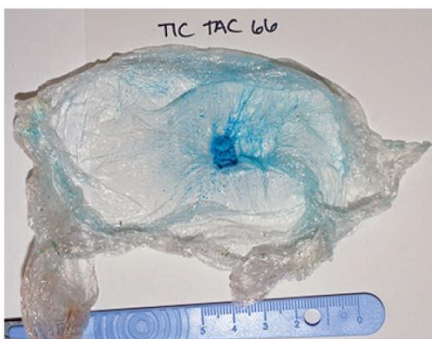
1. CAST Fingerprint Source Book, Chapter 5, Section 3.1.
2. Dominick, A. J., Laing, K. J., Forens Ident, vol 61(2), 2011, p144 ■



Drugs



Note: This page gives an awareness of drugs evidence to practitioners specialising in fingerprint recovery. If considering drugs evidence in addition to fingerprints, competent drugs practitioners must be consulted.



A selection of brown parcel tape drugs wraps (top) and a cling film drugs wrap (bottom).

Overview

An illicit drug is defined in the UK as any substance which is controlled by the Misuse of Drugs Act 1971. Drugs can be encountered as tablets, powders and liquids and often as mixtures which may contain other controlled drugs, cutting agents and adulterants. Samples of illicit drugs can be encountered in a range of different packaging materials which can be used to provide links between drug seizures, people and places through the analysis of DNA, fingerprints and any clothing fibres which may be associated with it.

It is not possible to determine whether a sample contains a controlled drug until it has been sent to a forensic drugs laboratory for identification. If a sample is suspected to contain a controlled drug it should not be opened or tampered with before it arrives at the forensic laboratory.

Trace drug contamination, for example on bank notes, can also provide intelligence information on the sample. Again, it is essential that any seizure expected to contain drug contamination is not altered in any way.

Recovery

Drugs are normally recovered encased in packaging material. The item is recovered to a suitable facility for decanting so that the drug can be analysed and the packaging be used for further forensic investigations.

Trace drug contamination is usually recovered from surfaces upon which it has been deposited using processes such as wet or dry swabbing and taping.

Analysis

There are a number of steps that a forensic chemist will carry out to analyse a substance and these depend on what information is required. Most drugs samples, however, can be analysed and quantified using GC-MS; more complex samples may require further analysis by alternative techniques such as NMR and HR- LC-MS.

See **DNA** and **Trace Evidence** for more information on these evidence types.