Home Office

Fingermark Visualisation Manual

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Presented by: Rory Downham
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International Association for Identification, Rhode Island, 4th - 10th August 2013

Centre for Applied Science & Technology
part of the UK Home Office

- The Home Office is a government department that:

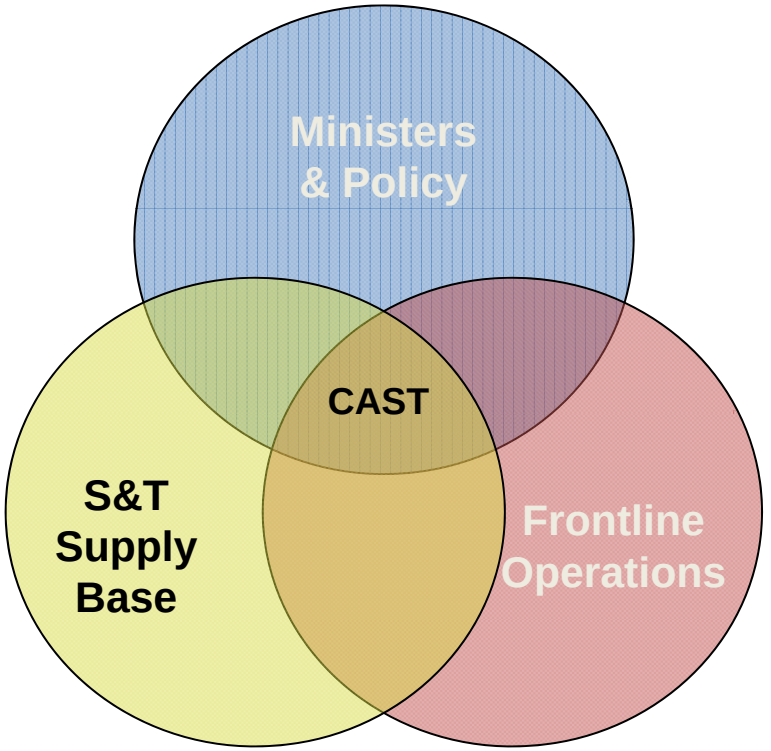
  '…leads on immigration and passports, drugs policy, crime policy and counter-terrorism and works to ensure visible, responsive and accountable policing in the UK'

- CAST: a team of specialists using science and technology to deliver Home Office priorities:

  - ❑ driving frontline efficiencies with effective technology
  - ❑ reducing crime with new techniques and sharing best practice
  - ❑ tackling organised crime and terrorism
  - ❑ securing our borders
  - ❑ reaching across the criminal justice system

The role of CAST

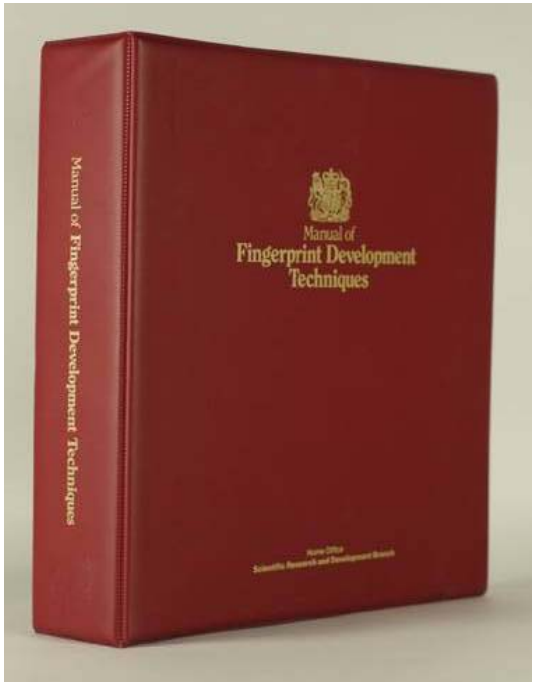
- To act as the primary science and technology interface between:
  - Home Office Ministers and policy makers
  - frontline operational decision makers
  - external suppliers of S&T
- Operating where others cannot for reasons of impartiality, national security or market failure
- One of our primary customers is the police
  - guidance



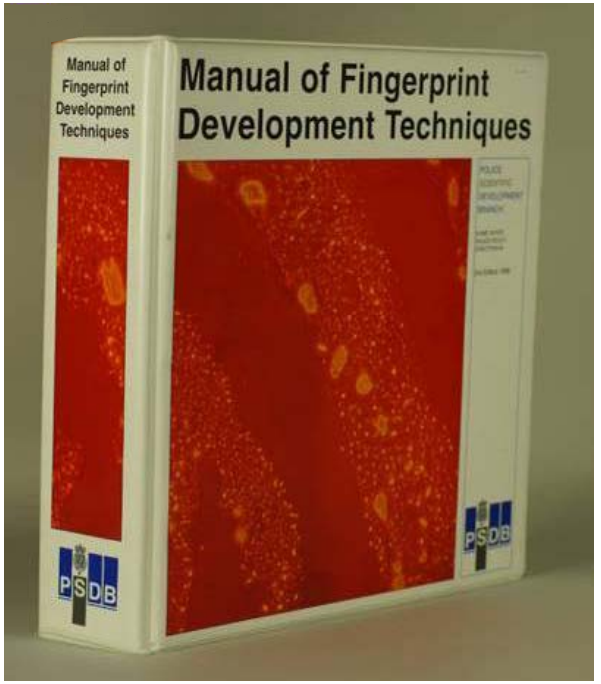
The Manual of Fingerprint Development Techniques – a brief history

- **SRDB** – *Scientific Research and Development Branch*
- **PSDB** – *Police Scientific Development Branch*
- **HOSDB** – *Home Office Scientific Development Branch*

1986 – 1st edition



1998 – 2nd edition



New name: **'Fingermark Visualisation Manual'**

Drivers for Change

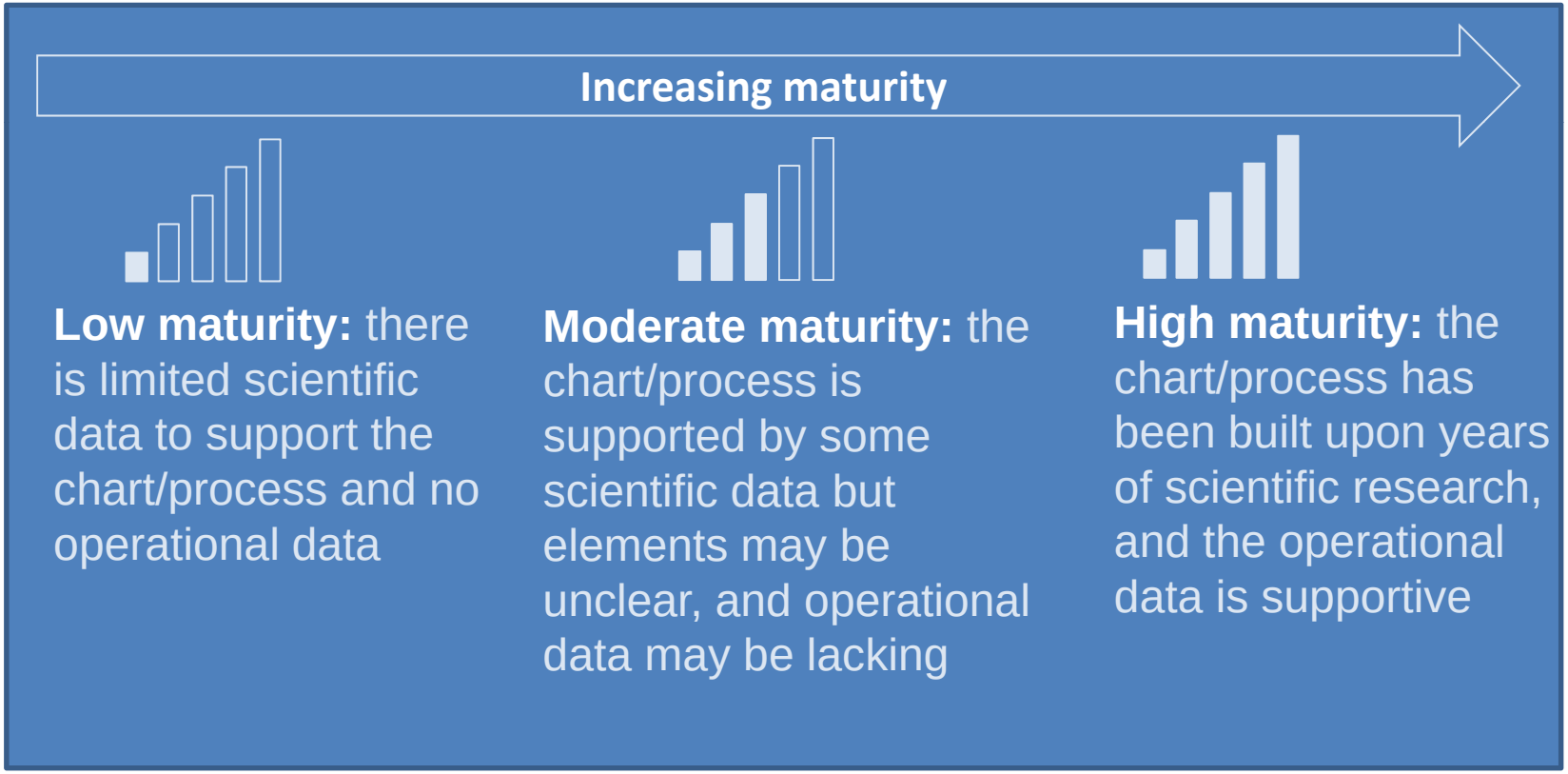
- Content and style of 2nd edit MoFDT are out-of-date
- Significant changes in the operations of UK police labs
  - ISO 17025 accreditation
    - Mandatory for EU fingerprint laboratories
    - Big emphasis on the **competency** of the practitioner
  - Integrated Forensic Approach
- There was a need for a more radical overhaul

Main Changes

- Format will be electronic and interactive
- The new manual is compiled for those seeking (or already have) ISO 17025 accreditation
- It will be less ‘black and white’
  - We will provide as much information as we can about fingermark visualisation
  - It will provide limited information on integrating forensic processes
  - The practitioner will use this, along with local needs, to produce sensible forensic/fingermark recovery plans
- It aims to set a high minimum standard for good practice
- This is a significant repositioning of the MoFDT

Example

Charts and Process Maturity Levels



Chapters 1- 4
Summary

1. About this Manual

   ~25 pages, new chapter

2. Forensic Evidence Recovery

   ~100 pages, new chapter

3. Safe and Effective Implementation of Processes

   ~100 pages, 50% new information, different style

4. Process Selection

   ~75 pages, 50% new information, different style

Chapters 5 - 7
Summary

5. Category ‘A’ Processes

   The big one! ~500 pages, 70% new information, different style

6. Category ‘B-F’ Processes

   ~100 pages, new chapter

7. Integrating Forensic Processes

   ~20 pages, new chapter

Chapter 2
Forensic Evidence Recovery

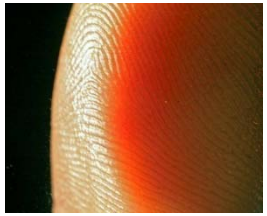
- Contains general background information about fingermark evidence and its recovery in the wider context of the investigative process and the recovery of other forensic evidence
- Provides background information required for an understanding of the remainder of the Manual

- 5 Sections
  - Section A:
    - The investigative process
    - Preservation of forensic evidence
    - Initial assessment
    - Forensic evidence recovery strategy and plans
    - Constraints and limitations

Chapter 2
Forensic Evidence Recovery

Section B: Understanding fingermarks

Generation





Persistence




Visualising

Introduces the concept of finding marks with **optical**, **chemical** and **physical** processes

Chapter 2
Forensic Evidence Recovery

Section C: Fingermark visualisation processes

- Classification of Processes (A-F)
- Category A processes
  - When processes were introduced
  - What they target

Process	First reported use	First use in UK	First inclusion in Home Office Manual	Latest modification in Home Office Manual
Ninhydrin	1954	Late 1950s	1986	2001
Powders	Late 1800s	Early 1900s	1986	2013
Superglue Fuming	Late 1970s	1980	1986	1986

Chapter 2
Forensic Evidence Recovery

Section C: Fingermark visualisation processes continued…

- Sequential processing
  - Rules and general understanding
- Process Effectiveness
  - Influencing factors




Process effectiveness: effect of water

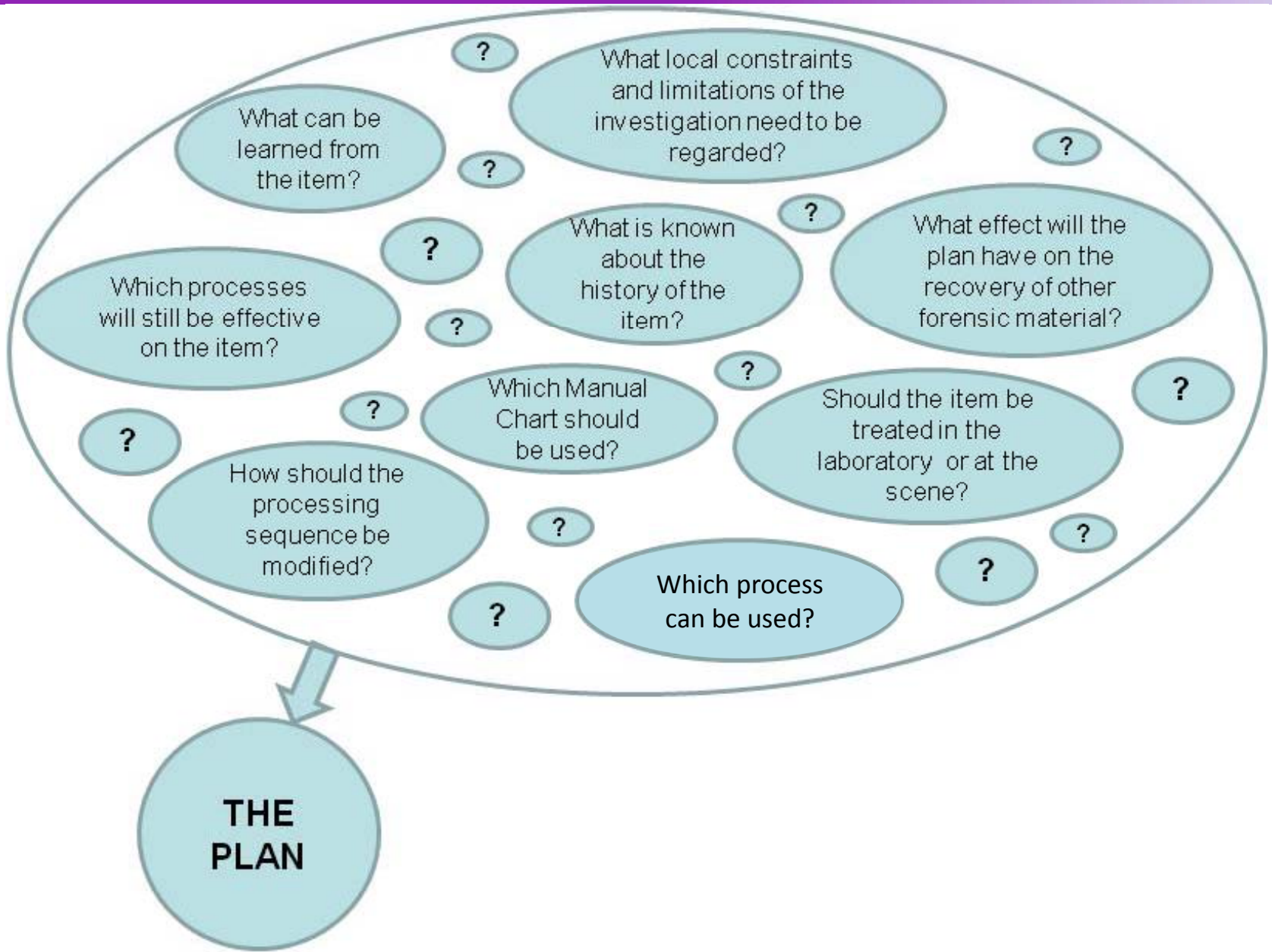
Process	Indicator	Impact of Water on Process Effectiveness
Basic Violet 3; Small Particle Reagent		The effectiveness of these processes is not altered by exposure of the item or surface to water as their target constituents (sebaceous sweat or oily contaminants) remain in the mark.
Powders		Powders adhere to a broad range of components within marks including moisture and sebaceous components. Removal of the water-soluble components may have some impact on the effectiveness of the process although the extent is likely to depend upon the age of the mark.
Superglue Fuming		Superglue Fuming is generally ineffective on items or surfaces exposed to water as it only targets water-soluble components. Older fingermarks (i.e. those present on the surface for some time prior to exposure to water) are more resistant to damage by exposure to water than fresh fingermarks and may occasionally be developed although there will be more effective processes.
DFO; Ninhydrin		These processes are ineffective on items or surfaces exposed to water as they only target water-soluble components. They also target water-soluble components in blood. See **Acid Dyes** for general notes for recovery of marks in blood.

Chapter 2
Forensic Evidence Recovery

Section D: Fingermark evidence recovery planning

- Gathering information
- Initial planning and the Manual charts
- Complex scenarios
  - Little is known about the item
  - Multiple types of mark / substrate etc.
- Additional considerations
  - Health and safety
  - Scene or Lab?
  - Time available vs. effort etc.
- Developing the plan…

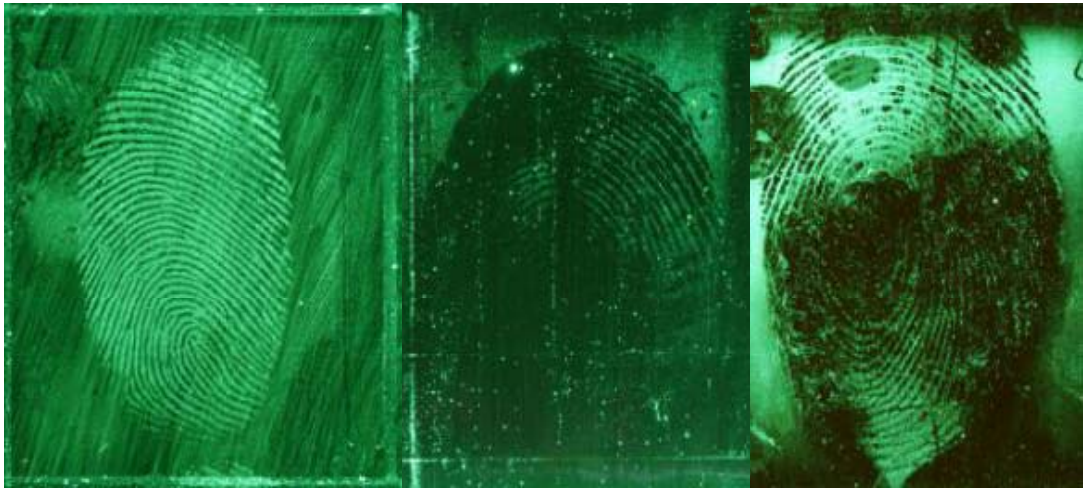
Developing the plan



Chapter 2
Forensic Evidence Recovery

- Section E: Factors influencing identification
  - Communication between practitioners
  - Interpretation
    - Substrate effects; deposition pressure; reverse direction marks; distorted marks; enhancement post capture etc.

Vacuum metal deposition

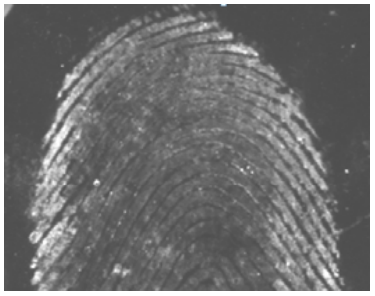


Superglue fuming and dye staining

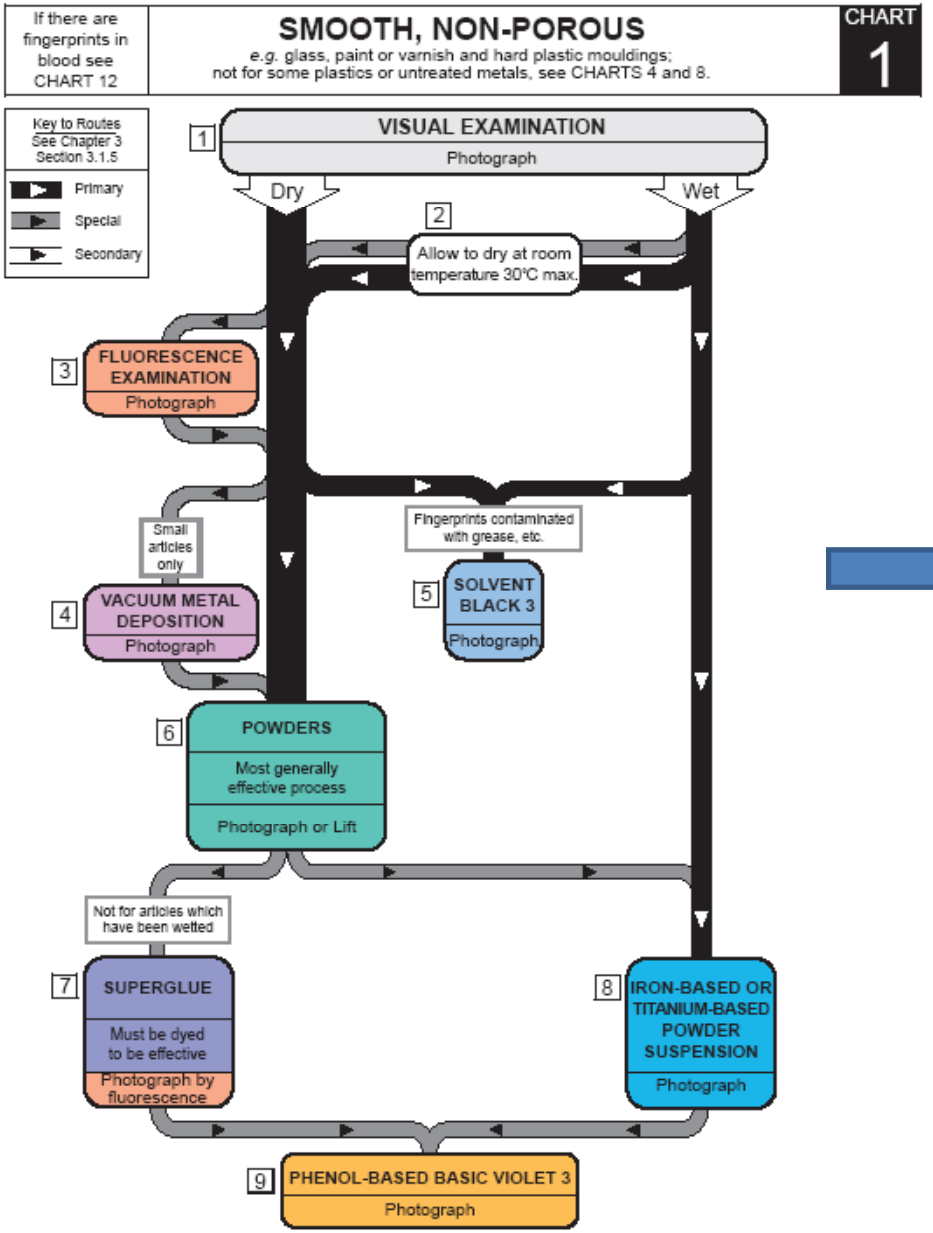
Chapter 3
Safe and Effective Implementation of Processes

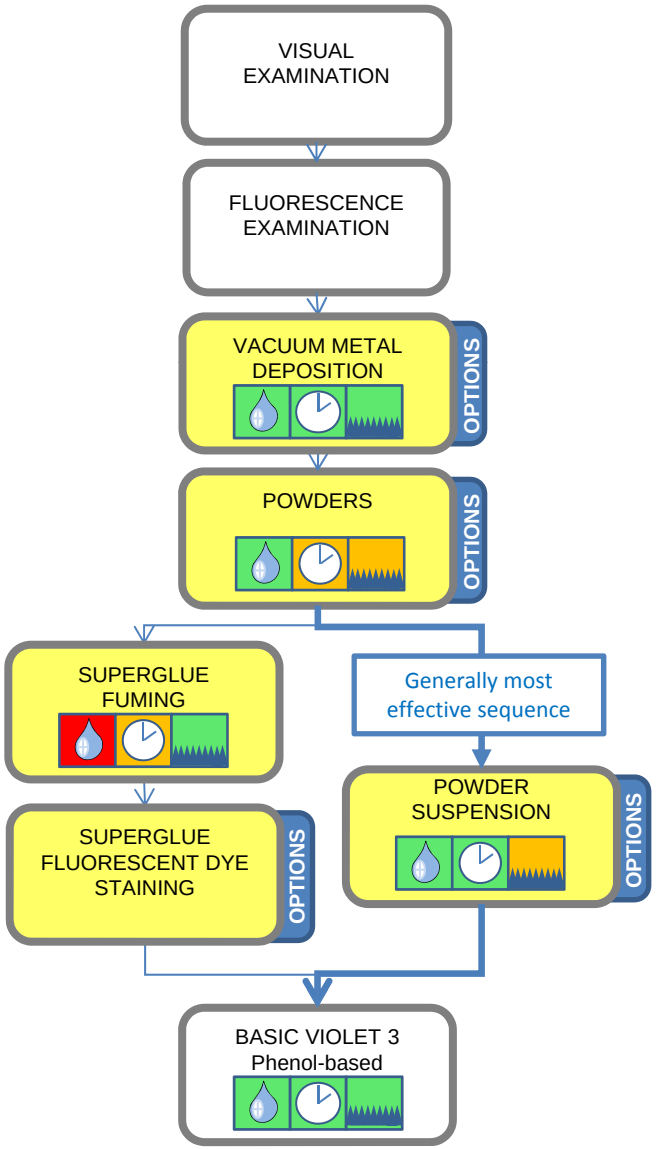
- Divided into three sections;
  - A - Requirements for implementation
    - Training and competence
    - Installation of ‘fixed’ equipment
    - Storage of chemicals & solutions
  - B - Working safely
    - Identification and classification of hazards
    - Personal protective equipment
  - C - Working effectively
    - Maintenance of equipment
    - Guidance on chemical and solution quality
    - Maintaining evidence integrity
    - Imaging

Process	Use in wet area	Use in dry area	Use of fume cupboard	
			Prep	App
Acid Dyes	✓		✓	✓
Basic Violet 3	✓		✓	✓
…	…	…	…	…



Chapter 4 – chart development





Chapter 4
Process Selection

– 3 Primary Charts

CHART 1: Non-Porous

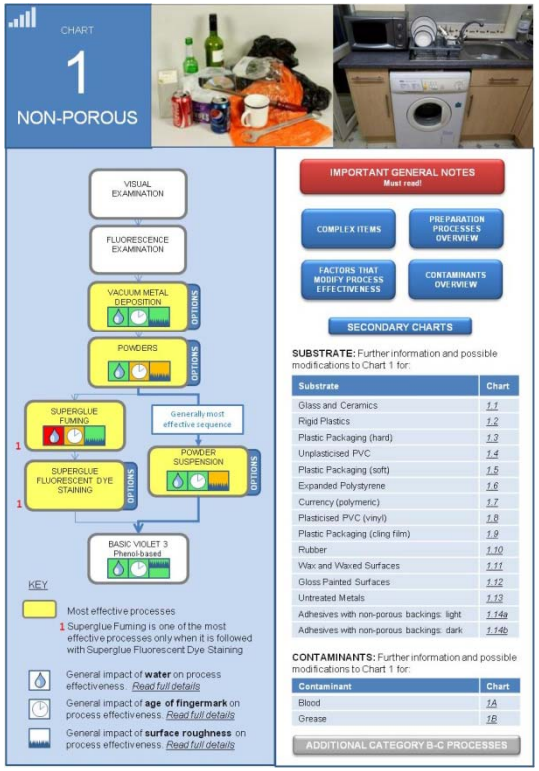


CHART 2: Porous

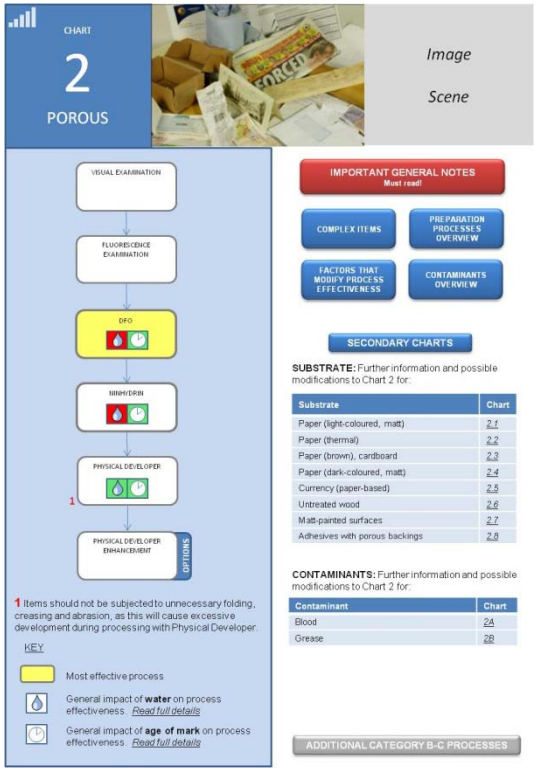
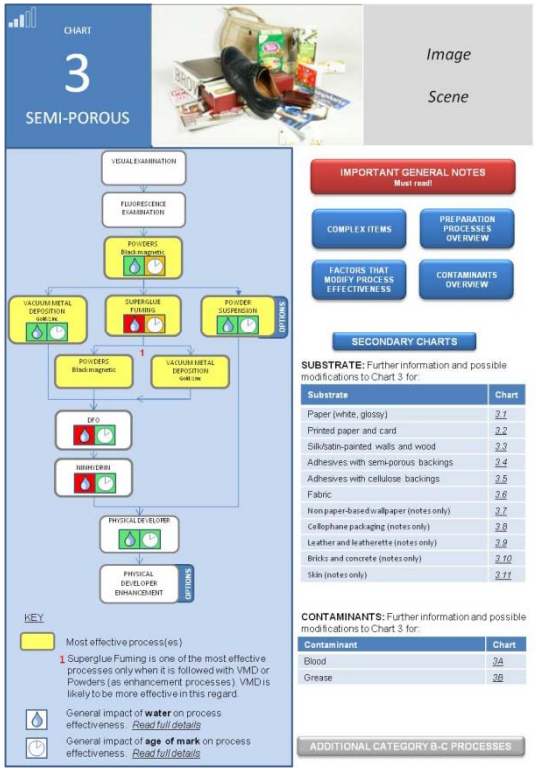
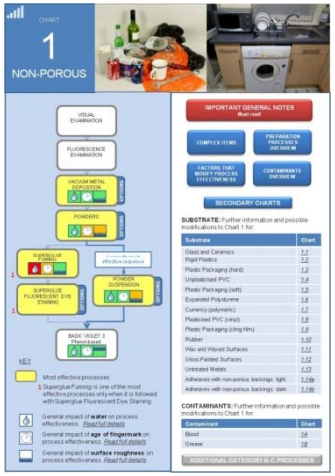


CHART 3: Semi-Porous

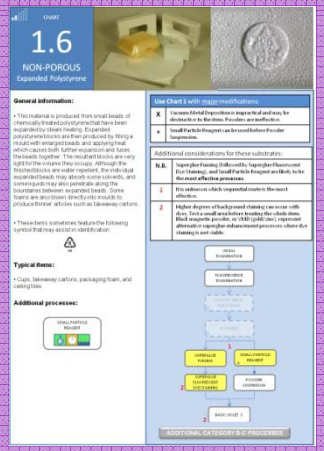


Chapter 4
Process Selection

Starting point

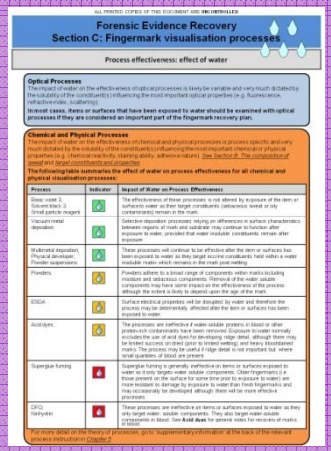


I know more about the surface



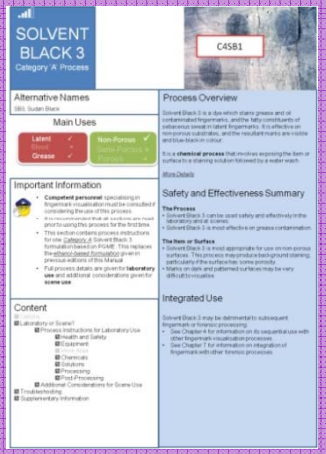
Chapter 4

My item has been wetted



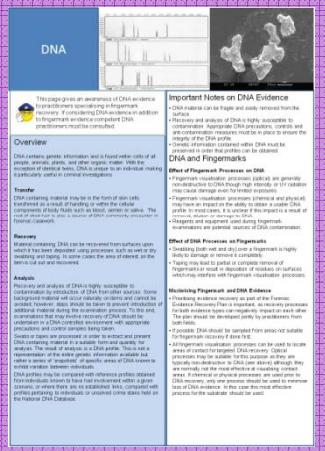
Chapter 2

I want more info about the process



Chapter 5

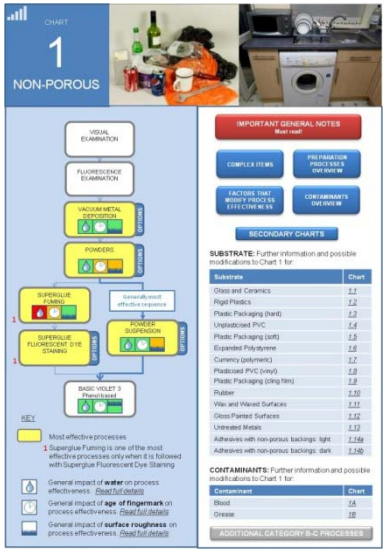
I'm also interested in DNA

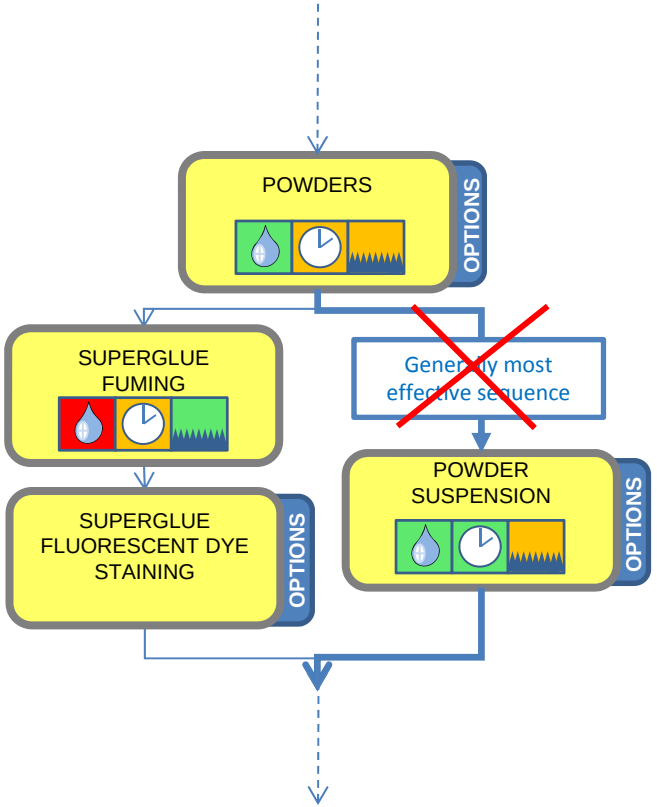


Chapter 7

Chapter 4
Process Selection

CHART 1: Non-Porous





Chapter 5
Category ‘A’ Processes

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.

Preparation Processes

For the removal of contaminants and/or interfering substances

- Soot removal
- Thermal coating removal

For the separation of surfaces

- Adhesive tape removal
- Numberplate splitting

Visualisation Processes

Optical Processes

- Colour filtration
- Fluorescence examination
- IR Reflection
- Monochromatic Illumination
- Multi-spectral imaging
- UVC Reflection
- Visual examination

Chemical/Physical Processes

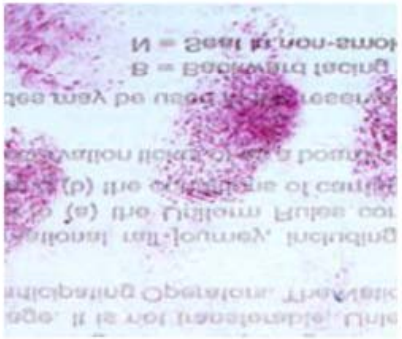
- Acid dyes
- Basic violet 3
- DFO
- ESDA
- Lifting
- Multimetal deposition
- Ninhydrin
- Physical developer
- Physical developer enhancement
- Powders
- Powder suspensions
- Small particle reagent
- Solvent black 3
- Superglue fluorescent dye staining
- Superglue fuming
- Vacuum metal deposition

A Ninhydrin

Alternative Names

Nin

Contents



Main Uses

✓ Latent	✘ Non-Porous
✓ Blood	✓ Semi-Porous
✘ Grease	✓ Porous

Key Information

- Competent personnel specialising in fingermark 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.
- Full process details are given for laboratory use and additional considerations given for scene use.

Process Overview

Ninhydrin reacts with amino acids and possibly other components in latent fingermarks to give a purple product. It also reacts with amine-containing compounds (mainly proteins) in blood.

It is a **chemical process** that involves the application of a solution to the item or surface followed by use of a specialist oven (if possible) to increase the speed and effectiveness of the reaction.

More Details

Safety and Effectiveness Summary

The Process

- Ninhydrin can be used safely and effectively in a laboratory.
- The process can be used at scenes but precautions are required to mitigate the asphyxiate nature of the solvent and the effectiveness is significantly reduced with processing times being considerably increased.
- The effectiveness may be influenced by the method of applying the solution.
- The effectiveness is linked to the ability to control the temperature and relative humidity of the item or surface post-application. This requires the use of specialist equipment to carry out successfully.

The Item or Surface

- The process is most effective at developing both latent and bloody fingermarks on porous surfaces although it can also be used on semi-porous surfaces.
- Ninhydrin is not effective on items or surfaces that have been wetted, even if they have been subsequently dried.
- It is effective on items or surfaces that have been soaked with petrol or paraffin.

Integrated Use

Ninhydrin may be detrimental to subsequent fingermark or forensic processing.

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

Chapter 5
Category ‘A’ Process Instructions – New Sections

- Laboratory or Scene?
  - Health and Safety; Effectiveness; Practicality
- Labelling solutions

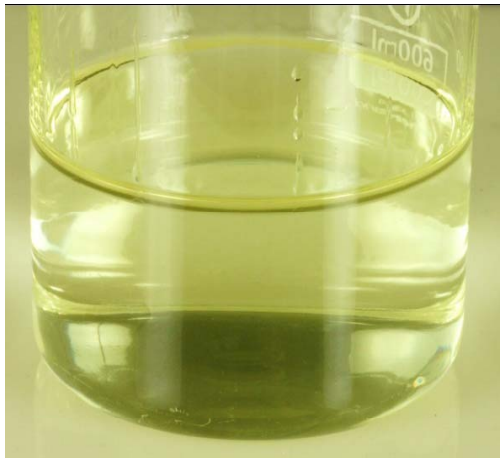
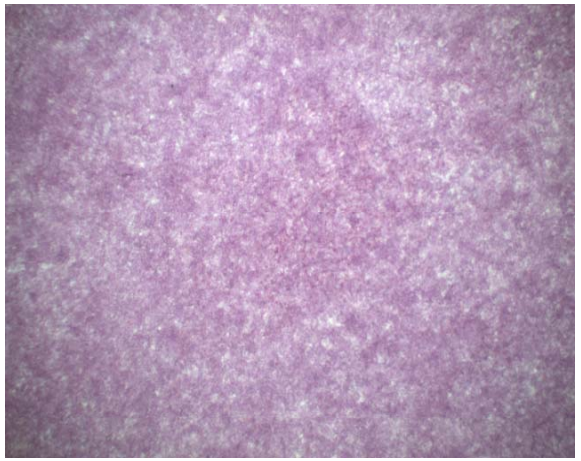
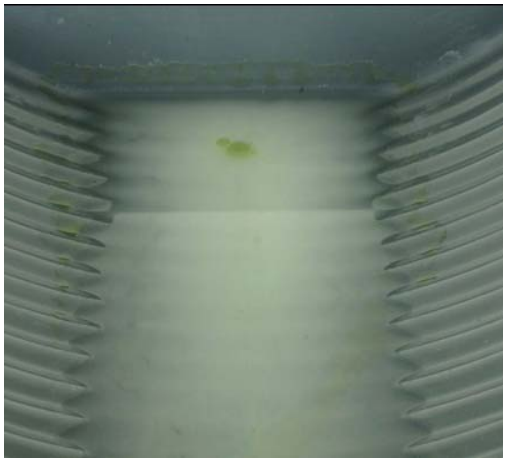
HAZARDS** typically associated with prepared SOLVENT BLACK 3 SOLUTIONS (CLP)		
Solution	**Symbols**	**Signal Word and Hazard Statements**
Working		‘DANGER’ H226 ‘Flammable liquid and vapour’ H336 ‘May cause drowsiness or dizziness’

HAZARDS** typically associated with prepared SOLVENT BLACK 3 SOLUTIONS (CHIP)		
Solution	**Symbols**	**Hazard Statements**
Working		R10 ‘Flammable’ R67 ‘Vapours may cause drowsiness and dizziness’

- Post-Processing
  - What to do with processed items and left-over solutions

Chapter 5
Category ‘A’ Process Instructions – New Sections

- Scene use of processes
  - Additional considerations and possible solutions
- Troubleshooting
  - Recognition; Cause; Effect; Prevention; Correction

- Supplementary Information

Chapter 6
Category ‘B-F’ Processes

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.

Preparation processes

- Adhesive Tape Removal (Solvent-based)
- Earth/Mud Removal
- Organic Decomposition Residue Removal

Visualisation Processes

- **Acid Dyes (water-based)**
- **DMAC**
- Europium Chelate
- Leuco Crystal Violet
- Gun Blueing
- **Indandione**
- **Iodine Fuming & Fix**
- Iodine Solution
- Natural Yellow 3
- Oil Red O
- Palladium Deposition
- Radioactive Sulphur Dioxide
- Scanning Electron Microscopy
- Scanning Kelvin Probe
- **Silver Nitrate**
- **Superglue Fluorescent Dye Staining (propanol-based)**

Chapter 6
Category ‘B-F’ Processes

C Processes at **a developmental stage** exhibiting potential as an effective fingermark 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.

Preparation processes

- Drugs Removal

Visualisation Processes

- ATR-FTIR
- Basic Violet 2
- Cartridge Electrostatic Recovery and Analysis (CERA)
- Electrochromic Enhancement
- Fluorescent Superglue
- MALDI-MSI
- Nile Red
- Powders (Fluorescent)
- S_2N_2
- SIMS
- Tagged Nanoparticles
- ThermaNin
- Thermal Development
- XRF

Chapter 6
Category ‘B-F’ Processes

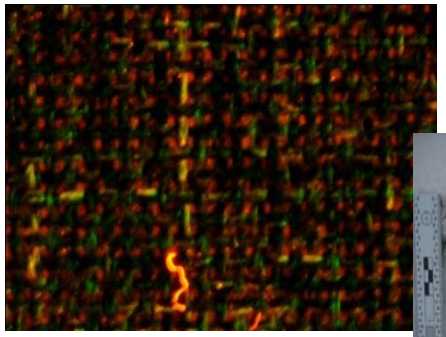
D	Processes **extensively evaluated** by the Home Office and considered **unsuitable** for incorporating into processing charts in Chapter 5.	**Corrective Action Processes**. Not generally for routine use but may be used to recover marks in situations where initial selection of processes has undesirable consequences.	• Acid dyes (methanol based) • Ninhydrin Enhancement (Zinc Toning)
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.**	• Acid dyes • Amino acid reagents • Fat and lipid reagents • Fuming and evaporation processes • Haem reagents • Powders and powder suspensions
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.**	

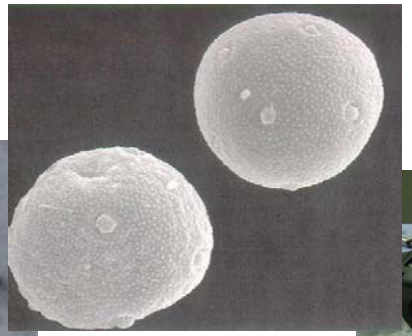
Chapter 7
Integrating Forensic Processes

- 13 forensic disciplines
  - Ballistics; body fluids; CCTV; digital forensics; DNA; documents; drugs; fibres; footwear marks; glovemarks; hairs; toolmarks; trace evidence
- *Awareness* of the forensic discipline to practitioners specialising in fingermark recovery
- Stress the need to:
  - consult competent practitioners
  - develop a joint forensic evidence recovery plan

Chapter 7
Integrating Forensic Processes

- Page layout
  - Overview of the forensic discipline
    - Transfer; recovery; analysis (where possible)
  - Important notes on XXX evidence
  - Effect of fingermark processes on XXX
  - Effect of XXX processes on fingermarks
  - Maximising fingermark and XXX evidence





Appendices and other bits

- Appendix 1
  - Example Fingermark Recovery Plans
- Appendix 2
  - Fingermark Research
- Glossary
- Index

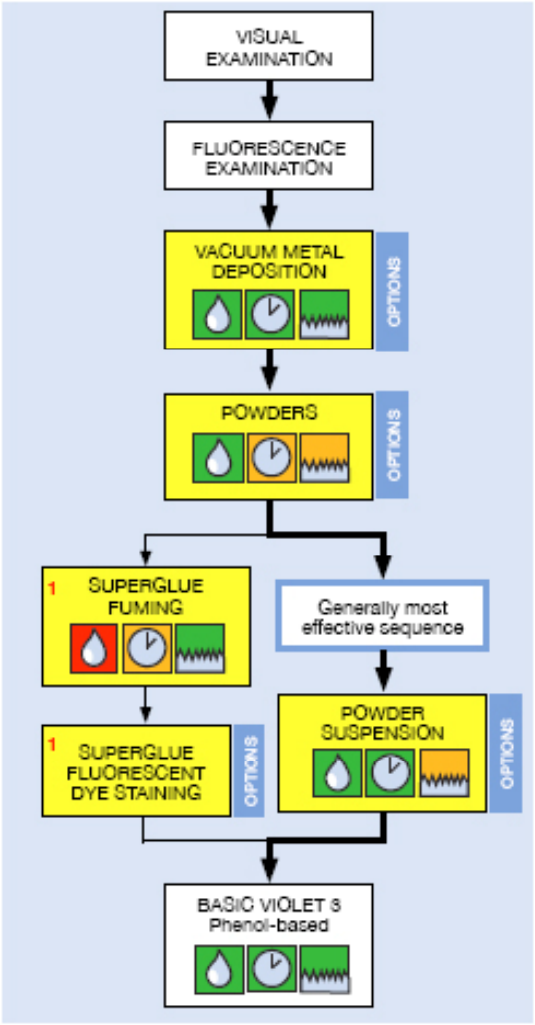
Demonstration

Sample Fingermark Visualisation Manual Pages

The following six pages are static images, not interactive pages as will be present in the electronic manual...

Chart 1 Non-Porous

Primary Chart



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Links to:	Page
Important general notes Must read!	**xx**
Preparation processes overview	xx
Complex items	xx
Factors that modify process effectiveness	xx
Contaminants overview	xx
Additional Category B-C processes	xx

Key

Most effective processes

General impact of **water** on process effectiveness. Read full details.

General impact of **age of mark** on process effectiveness. Read full details.

General impact of **surface roughness** on process effectiveness. Read full details.

1 Superglue Fuming is one of the most effective processes only when it is followed with Superglue Fluorescent Dye Staining.

Further information and possible modifications to Chart 1 for:

Chart	Substrate	Page
1.1	Glass and Ceramics	xx
1.2	Rigid Plastics	xx
1.3	Plastic Packaging (hard)	xx
1.4	Unplasticised PVC	xx
1.5	Plastic Packaging (soft)	xx
1.6	Expanded Polystyrene	xx
1.7	Currency (polymeric)	xx
1.8	Plasticised PVC (vinyl)	xx
1.9	Plastic Packaging (clingfilm)	xx
1.10	Rubber	xx
1.11	Wax and Waxed Surfaces	xx
1.12	Gloss Painted Surfaces	xx
1.13	Untreated Metals	xx
1.14a	Adhesives with non-porous backings: light	xx
1.14b	Adhesives with non-porous backings: dark	xx

Chart	Contaminant	Page
1A	Blood	xx
1B	Grease	xx

Chart 1.4 Non-Porous

Secondary Chart

Unplasticised PVC (uPVC)

General information

Unplasticised polyvinyl chloride (uPVC) is essentially a subset of the group of rigid plastics outlined in Chart 1.2. It is separated from them partly because of the high occurrence of this type of material at crime scenes (it is the principal constituent of frames for double-glazed doors and windows) and partly because it has been observed to behave slightly differently to other rigid polymers when treated using visualisation processes.

The material is prone to ageing effects and surfaces exposed to outdoor environments may become increasingly weathered, becoming matt in appearance and having powdery surface layers.

These items sometimes feature the following symbol that may assist in identification:

Typical items:

Door and window frames, fascia boards, trunking, guttering and drain pipes

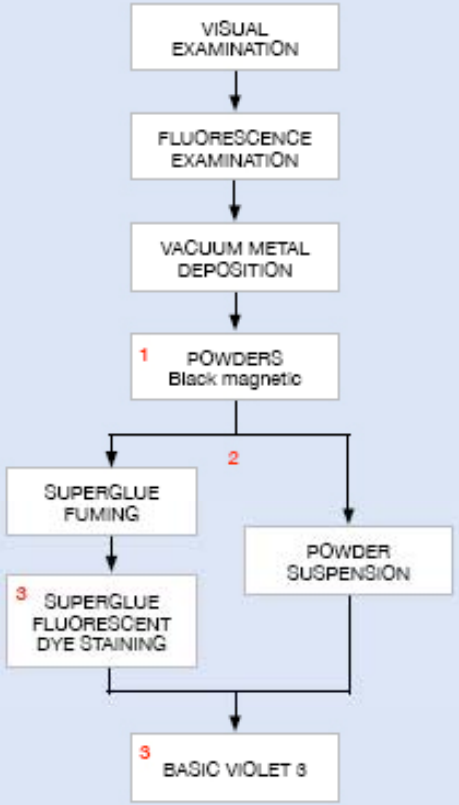
Additional considerations for these substrates:

1 Black magnetic powder is generally the most effective powder.

2 It is unknown which sequential route is the most effective.

3 Higher degrees of background staining can occur with dyes. Test a small area before treating the whole item. Black magnetic powder, or VMD (gold/zinc) represent alternative superglue enhancement processes where dye staining is not viable.

Use Chart 1 with NO modifications.



Additional Category B-C processes

A Solvent Black 3

Alternative Names

SB3, Sudan Black

Contents

Main Uses

✔ Latent	✔ Non-Porous
✘ Blood	✘ Semi-Porous
✔ Grease	✘ Porous

STOP

Important Information

- **Competent personnel** specialising in fingermark 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 one **Category A** Solvent Black 3 formulation based on PGME. This replaces the **ethanol-based formulation** given in previous editions of this Manual.
- Full process details are given for **laboratory use** and additional considerations given for **scene use**.

Process Overview

Solvent Black 3 is a dye which stains grease and oil contaminated fingermarks, and the fatty constituents of sebaceous sweat in latent fingermarks. It is effective on non-porous substrates, and the resultant marks are visible and blue-black in colour.

It is a **chemical process** that involves exposing the item or surface to a staining solution followed by a water wash.

More Details

Safety and Effectiveness Summary

The Process

- Solvent Black 3 can be used safely and effectively in the laboratory and at scenes.
- Solvent Black 3 is most effective on grease contamination.

The Item or Surface

- Solvent Black 3 is most appropriate for use on non-porous surfaces. This process may produce background staining, particularly if the surface has some porosity.
- Marks on dark and patterned surfaces may be very difficult to visualise.

Integrated Use

Solvent Black 3 may be detrimental to subsequent fingermark or forensic processing.

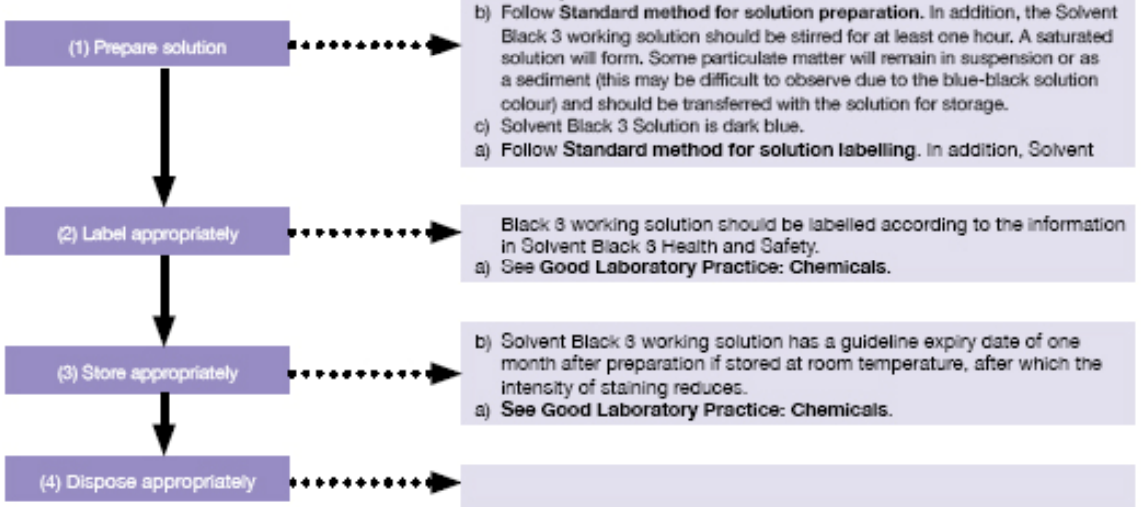
- See Chapter 4 for information on its sequential use with other fingermark visualisation processes.
- See Chapter 7 for information on integration of fingermark with other forensic processes.

Solvent Black 3

Laboratory

Solutions

Solution
Solvent Black 3 (SB3) Working Solution 10g Solvent Black 3 500ml 1-Methoxy-2- propanol (PGME) 500ml water
For other quantities see Ready Reckoner.



Ready Reckoner for Solvent Black 3			
	Quantity of SB3 Solution		
	1 L	2 L	5 L
SB3	10 g	20 g	50 g
PGME	500 ml	1 L	2.5 L
Water	500 ml	1 L	2.5 L

Solvent Black 3

Laboratory

Processing

Preparation	
(1) Work area	a) SB3 working solution must be used in a fume cupboard or well-ventilated area.
(2) Equipment and Solutions	a) Pour an appropriate amount of SB3 working solution into a suitable dish or vessel. If using a wash-bottle, ensure that no undissolved solid is transferred as this will block the nozzle. b) For dipping items: remove any metallic-looking film that appears on the surface of the SB3 working solution before use with blotting or tissue paper.
Processing	
(3) Expose item to SB3 working solution	a) Apply SB3 working solution to the item by suitable means such as immersion or pouring. Exposure times are normally between ten seconds and one minute depending upon the susceptibility of the surface to background stain. b) If immersing the item, the SB3 working solution should be replenished as necessary.
(4) Rinse item	a) Rinse item until excess dye has been removed from the background using suitable means, such as cold running water from a tap, or garden spray unit for larger items. b) For larger items, do not allow rinse water to run onto adjacent sections that are yet to be treated (see strategy for treating large areas). a) See Drying of items.
(5) Dry item	a) Visual marks are coloured blue-black.
(6) Examination	
Primary: Visual Examination	b) There are many non-destructive optical processes that can be considered when examining and imaging marks in addition to Visual Examination, particularly for low contrast marks or marks on dark or patterned surfaces. c) Mark up viable marks appropriately and capture image immediately. Fingermarks developed with this process will fade, sometimes within minutes. d) After examination, items can be retreated if necessary, but effectiveness will be dependent upon the level of background staining.

Strategy for treating large areas

Solvent Black 3 is easier to use on small areas (< 30 cm x 30 cm). Areas larger than this should be treated section by section. When applying Solvent Black 3 in this way the aim, whether applying to vertical or horizontal surfaces, is to prevent SB3 working solution and rinse water from **running or splashing onto adjacent sections which are yet to be treated.** Any visualised fingermarks should be imaged before the next section is treated.

Example: Treating a large, vertical surface.

SB3 working solution is applied in sections from the bottom up. In this way, excess dye solution runs down over areas already treated (any fingermarks found on those areas will have already been imaged).

After application of SB3 working solution, the area is rinsed with water. The rinse water flows down over section A (treated previously). Any marks developed in section B will be imaged before section C is treated.

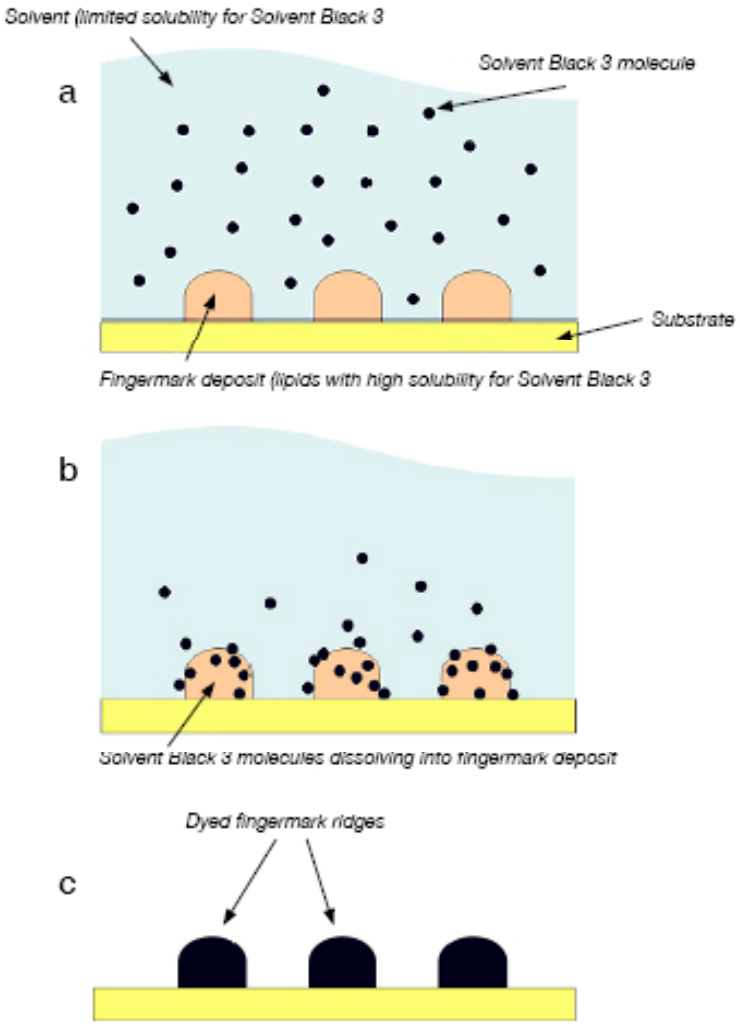
Solvent Black 3

Solutions

Solvent Black 3 formulations

Two Solvent Black 3 solutions have previously been recommended for operational use by CAST, one based on ethanol and the other on PGME. The ethanol-based formulation was only suitable for use in a laboratory because of its flammability, whereas the PGME-based formulation can be used both in a laboratory and at scenes provided that appropriate precautions are taken. Tests indicated that the performance of the PGME-based formulation is closely equivalent to if not better than the ethanol-based formulation in a laboratory environment, and therefore the ethanol-based formulation was withdrawn because it was felt that it offered no operational benefits.

The dyeing process of Solvent Black 3 is illustrated schematically on the right.



Schematic illustration of the Solvent Black 3 process a) Solvent Black 3 molecules in solvent with limited solubility b) lipophilic component of Solvent Black 3 molecule preferentially dissolving into lipids in fingermark ridges and c) fingermark after drying, leaving dyed ridges.

What and When?

- What
  - Interactive PDF, suitable for use on PCs, laptops, tablets etc.
  - Suitable for printing
- When
  - UK launch event scheduled for Jan 2014
  - Implementation to UK police forces to follow
- Availability and Cost
  - It will be available to non-UK police organisations
  - Costs and logistics
    - depends on Home Office decision on cost recovery

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Home Office

Thank you for listening

Questions?

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