



Home Office

Scientific Development Branch

Investigation, Enforcement and Protection Sector

Fingerprint Development and Imaging Newsletter:

Special Edition

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April 2006

Publication No. 26/06

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ABSTRACT

This newsletter summarises work carried out by HOSDB with the aim of identifying best practice for the development of fingerprints on articles retrieved from fire scenes. The report will highlight those conditions where fingerprints are likely to survive, the best processes for removing smoke and soot from contaminated surfaces and the best processes for subsequent fingerprint development.

The results of HOSDB studies show that fingerprints can be retrieved from fire scenes even from exhibits situated close to the seat of fire and that soot removal and fingerprint development processes can be optimised to improve the chances of obtaining useful marks. The newsletter is intended for use by both scene of crime officers and fire investigators, providing advice about what types of exhibit are most likely to yield marks and how to treat them.

INTRODUCTION

The destruction caused by fire in both domestic and commercial settings has a significant negative effect on UK society both in terms of economic cost and social disruption. While fires may have an accidental cause, recent figures suggest that in many regions of the country the percentage of deliberately started fires (arsons) is upwards of 50 to 60% of all cases of fire. The Arson Control Forum states that in an average week in the UK, arson results in 3,600 deliberately started fires, 60 injuries, 2 deaths and a cost to society of at least £40 million. In some cases of arson the fire is set in order to cover up evidence of another crime where the offenders are more interested in the perceived ability of the fire to destroy potential forensic evidence and/or in an attempt to conceal victim identification than in the crime of arson itself.

Currently many agencies such as the police, fire brigade, fire investigation specialists, the forensic science services and researchers are involved in combating the arson problem. However, the clearance rate for arsons remains low (less than 10% in many regions of the country) with conviction rates even lower.

This may in part be because of the perception amongst those involved in fire investigation that the fire environment will cause destruction of most or all physical evidence in the conventional sense and it will therefore be difficult to obtain sufficient evidence against a specific individual.

There is at present little published information on the recovery of fingerprints from arson scenes. No recorded attempt has been made to carry out a thorough analysis of the temperatures and timescales that latent prints can survive and there is no published best practice for removal of soot from various types of substrates exposed to heat and fire. Similarly, the best technique(s) for the development of latent fingerprints after fire is not known. Details of studies that have been published in this area are summarised below.

Work carried out by Harper[1] in 1938 demonstrated the possibility of detecting latent fingerprints on objects subjected to 100 - 200°C. Tests were carried out by putting microscope slides with deposited prints in a sooty Bunsen burner flame. Prints were developed by brushing off the soot to reveal soot particles adhering to the deposit. Tests were also carried out on latent prints on enamelled metal and wood, painted and unpainted wood, nickel and cadmium plates, and porcelain. It was found that if the surface became covered by carbon particles prior to the print residue evaporating, the print could be developed and was identifiable even after exposure to temperatures which caused permanent damage to the surface. However, if the deposit evaporated to dryness prior to soot build-up, it did not develop. Harper also demonstrated that further amounts of soot could be removed by washing in a stream of water and suggested that it may be possible to develop marks in some areas not covered in soot by conventional techniques such as brushing with powders.

Similar procedures were still being recommended 40 years later - in 1979 Vaughn [2] proposed rinsing soot covered articles in a mild flow of water to remove soot and to reveal prints. The technique was effectively applied to pre-sooted doorknobs and windows, and to fragments of a 'Molotov cocktail', although the effectiveness of the technique was reduced by the presence of kerosene or gasoline on both sides of the container.

In the early 1980s, Thornton and Emmons[3] demonstrated the use of a smooth flow of water and lifting tape as an effective method for soot removal from a latent print. Good results were obtained for metal and glass surfaces which had been exposed to soot. Latent marks on items that were only exposed to heat and not soot-covered were developed by powdering and also by re-humidification (i.e. breathing on the mark). The heat from the fire dried out the latent print and by re-introducing moisture from warm breath, the latent print had a tendency to absorb more powder.

Spawn[4] investigated the recovery of fingerprints from household objects that were placed in a simulated house fire. Running water and lifting tape were used to remove soot. The results of this experiment indicated that objects close to the seat of the fire had no visible prints but that objects a few feet away from the seat of fire were more likely to yield prints after treatment. It was also observed that soot build-up appeared to protect the print deposits.

There are few references to techniques other than water rinsing followed by lifting or powdering for obtaining fingerprints at scenes of fire. Tyranski and Petraco [5] report a case where the interaction between petrol and the material used as the accelerant container by the arsonist resulted in a fingerprint impression in the plastic.

In addition to fingerprints on objects at arson scenes, there have been two studies to investigate the recovery of fingerprints from incendiary devices, in particular fuel filled glass bottles used as 'Molotov Cocktails' [6,7].

The forensic science division of the Israel National Police carried out research into the recovery and development of fingerprints from incendiary bottles. Shelef et al[6] tested the assumption that latent prints on glass surfaces are destroyed by washing with an inflammable liquid. Fingerprints were deposited on glass bottles and glass slides, which were then immersed in various inflammable liquids

(e.g. petrol, kerosene, diesel oil, turpentine and toluene). Development of marks was attempted using a number of different techniques. Small Particle Reagent (SPR) was the most successful technique and further tests were carried out to optimise its composition so as to recover the maximum number of fingerprints from incendiary glass surfaces. A high frequency ultrasonic bath was investigated as a means of soot removal. A series of liquid media were evaluated in the ultrasonic bath (e.g. water, toluene, xylene and ethanol) and the best results were obtained with toluene.

Rimmer[7] reported results of a study carried out in Germany on Molotov Cocktails using different types of bottles and fuel mixes. Prints were placed on both the glass and label of the bottle and ignited. Soot removal was carried out by compressed air, light brushing and taping, none of which were satisfactory. It was determined that long term immersion in fuel tended to destroy the mark on the glass but ninhydrin gave results on the label in every case.

Current, and ongoing work, conducted over the past three years by Jack Deans, Gardiner Associates at their Fire Training Ground at Wethersfield has demonstrated that marks can survive on a wider variety of surfaces, articles and at higher temperatures than previously thought, and that even objects in very close proximity to the seat of fire may yield useful marks if the surface has been protected from the direct effects of the fire. This may include contact with other surfaces (e.g. table tops and carpets) or being covered by fallen debris. It was shown that articles that appear badly damaged by the fire on the upward facing side were relatively undamaged on the reverse side and subsequent treatment of these surfaces yielded identifiable marks.

The work has also shown that marks can be produced on items that were wet due to the extinguishing processes and on surfaces covered/immersed by accelerant, e.g. tapers and wicks. Marks in dirt and engine oil could also survive the effects of fire.

Guidance to Crime Scene Examiners and Fire Service Investigators about the best practice for retrieval of fingerprint evidence from fire scenes has been conveyed by Mr Deans on the training courses provided by Gardiner Associates, on his presentations to several forensic institutions and on Police Force training days. A summary of this work has been submitted for publication [8]. His findings have been confirmed by the experiments conducted in the preparation of this HOSDB report.

It is apparent that there is the potential to increase the number of marks retrieved from fire scenes, and by supplying those investigating such scenes with current best practice guidelines the number of identifications will increase. The following report describes tests carried out to establish best practice for fingerprint development and provides a summary of techniques giving best results in the studies.

OBJECTIVES

The primary objective of this report is to confirm guidance to Scene of Crime Officers and Fire Investigators about best practice for the retrieval of fingerprint evidence from fire scenes and to provide information on optimum development techniques. There is currently no published guidance within the UK for this type of scenario. In order to produce this guidance, experiments were carried out to obtain answers to several more fundamental questions. These are outlined below.

Current guidance given in the Manual of Fingerprint Development Techniques suggests that drying of both latent fingerprints and fingerprints in blood at temperatures in excess of 30°C may be detrimental to recovery of useful marks, but there has been no study within the UK to establish at what temperatures fingerprint residues actually begin to degrade and development processes become ineffective. The first two objectives were therefore:

- *to establish at what temperatures and exposure periods latent marks can survive exposure to heat*
- *to establish at what temperatures and exposure periods marks in blood can survive exposure to heat*

Even if some of the fingerprint residues do survive to high temperatures, they may be modified by oxidation or other reactions. This may mean that existing fingerprint development processes may not work as anticipated and the processes recommended for use on marks exposed to ambient conditions may not be the same as those giving the best performance after exposure to a fire. The next objective was therefore:

- *to establish the effectiveness of existing fingerprint treatment processes in developing heat-affected marks*

In addition to the effects of heat alone (which are easily replicated in a laboratory), in real conditions the action of smoke and soot will also play a role in whether an identifiable mark can be recovered from a particular surface. The final objectives for the work were therefore:

- *to determine what changes are needed to existing fingerprint development processes to take account of soot/smoke*
- *to identify best practice for soot/smoke removal.*

The results of the practical work carried out by HOSDB in addressing these questions has been collated and used as the basis of this Best Practice Guide. It should be noted that this guidance is based on current knowledge and that further work is required on aspects such as sequential processing and the effect of fires and soot removal processes on retrieval of other evidence (in particular DNA) before the guidance can be considered comprehensive.

BEST PRACTICE GUIDE

Where to look for evidence

As indicated earlier, initial assessment of a fire scene may suggest that many potentially useful exhibits will have been destroyed, or at least exposed to conditions where the retrieval of fingerprint evidence will be made considerably more difficult.



Typical interior of a simulated fire scene (photograph reproduced courtesy of Gardiner Associates)

However, the studies carried out by HOSDB, Jack Deans and others [8,9,10,11] demonstrate that evidence can survive, and there are regions of a fire scene where recovery of such evidence is more probable. General rules to observe are:

- Marks are more likely to survive if the exhibit has not been exposed to temperatures $> 300^{\circ}\text{C}$. Fire Investigators may be able to provide guidance about which temperatures different areas of the scene have been exposed to so that exhibits can be selected accordingly.
- Survival rates for marks are considerably increased if the surface has been protected in some way from the direct effects of heat and smoke.
- Marks are easier to develop on articles that are relatively clean and have only light soot coverage. Techniques are available for removal of heavy smoke and soot coatings, but in general these will significantly reduce the chances of finding marks.
- More marks will be recovered on articles or regions of articles that have not been wet, so again evidence retrieval should focus on areas that have been protected from the direct effects of water used when extinguishing the fire.

All these points are for guidance only, and no article or surface should be entirely discounted if it does not meet the criteria above. Marks have been found on articles with heavy soot coatings that have been exposed to temperatures in excess of 700°C and soaked in water.



Upper surface of telephone exposed to fire scene, showing melting and heavy soot coverage (photograph reproduced courtesy of Gardiner Associates)



Underside of telephone, showing that protected surface is relatively undamaged and more likely to yield marks. (photograph reproduced courtesy of Gardiner Associates)

Techniques for soot removal

A range of soot removal techniques has been investigated, and several of these are effective in removing even heavy deposits. A sequential soot removal process can be proposed in which the least aggressive techniques are tried first, with those likely to be most destructive to both fingerprints and complementary evidence (e.g. DNA) tried last.

The following points should be observed in the selection of a soot removal process:

- Techniques utilising water should be used as a last resort, because this will destroy some marks. The exception to this is if the process has the effect of removing soot and developing fingerprints at the same time (e.g. Black or White Powder Suspension, Small Particle Reagent).
- Soot removal techniques should be applied gradually, with any marks that are revealed being photographed before any repeat application of the process.
- Sodium hydroxide solution is potentially destructive to DNA evidence and should not be used if DNA recovery is to be attempted at a later stage.

Provisional sequential processing flow charts for soot removal from porous and non-porous surfaces are given at the end of this section. A description of each technique and its means of application are given below:

Light Brush

Loose debris and soot deposits on the sample can be removed by gentle sweeping with a soft brush, for example the 'Squirrel' type brushes used for application of fingerprint powders. In most cases this will not remove sufficient surface deposits for any marks to be revealed, but will clean the surface sufficiently so that subsequent soot removal processes will be more effective.

Lifting tape

The best type of lifting tape for removal of soot is the more flexible Scotch tape produced by 3M. The reason for this is that the tape appears to form better to the surface contours of the article being treated, and the tape is less prone to splitting on removal than the 'J-Lar' tapes. The technique is most suited to flat surfaces or articles with simple shapes. The tape is used as follows:

- 1) Apply tape to the surface and smooth in place
- 2) Using a roller, apply pressure to the tape to eliminate air bubbles and ensure good adhesion across the entire area of application.
- 3) Peel the tape off the substrate, removing any loose soot from the surface.

Lifting tape can be reapplied to the area by repeating steps 1 - 3, but in general most of the soot that can be removed in this way will have been removed after the third application of tape.



a)



b)



c)



d)



e)

Soot removal using lifting tape; a) applying lifting tape to the surface, b) & c) use of roller to smooth in place and remove air bubbles, d) removal of tape, and e) amounts of soot removed by successive applications of tape.

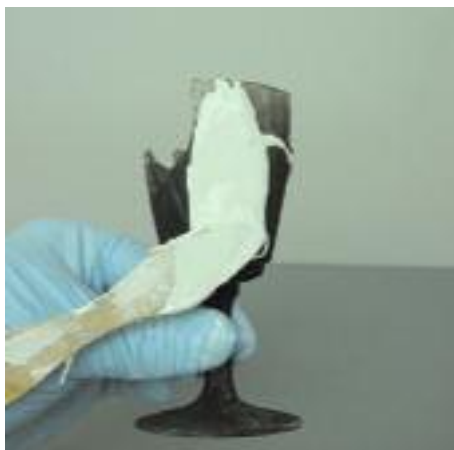
Silicone rubber casting compounds

Casting compounds traditionally used for obtaining toolmark impressions or striations from cartridge cases (e.g. Mikrosil, Isomark) can be effective in soot removal. This is especially true if the article is a complex shape, where the ability to apply the moulding compound as a paste is invaluable in ensuring that soot can be removed from the entire surface area. The FSS have developed a sprayable version of the Isomark product which can be used to coat large areas at scenes [12]. For use in the laboratory, the following steps should be followed:

- 1) Mix compound according to the manufacturer's instructions
- 2) Apply blended compound over entire soot covered surface of article to be treated (using spatula,

- application gun or other applicator provided by manufacturer)
- 3) Once the compound has set (typically in about 30 minutes), it can be peeled from the surface of the article.
 - 4) Examine both cleaned surface and surface of silicone rubber mould for evidence of fingerprints before chemical treatment.

This procedure will remove loose soot. In practice, it has been shown that repeat applications of lifting tape will remove more soot than a single application of casting compound, but casting compound may also be reapplied to the soot covered area.



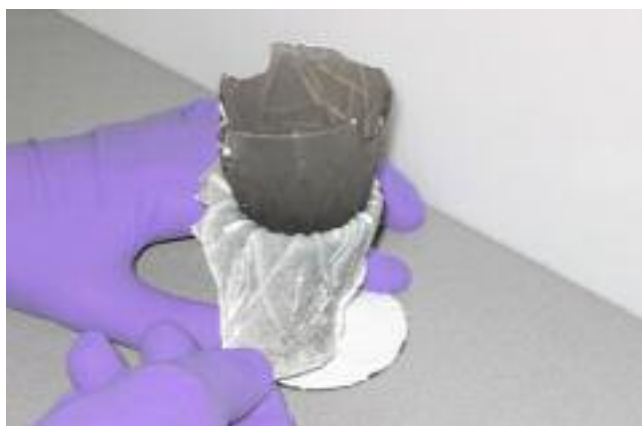
a)



b)



c)



d)



e)

Soot removal using Mikrosil; a) application of paste to the article, b) articles coated with Mikrosil and allowed to set, c) & d) removal of the Mikrosil layer, and e) treated article with removed cast

Sodium hydroxide solution

Sodium hydroxide solution has been used effectively in operational work by several police forces [10,13]. The process involves immersion of the exhibit in sodium hydroxide (or washing sodium hydroxide solution down the surface of the sample), followed by a water wash. The process may act to loosen heavy soot deposits from the surface, or may make the wetted soot more 'transparent' for photography. The use of sodium hydroxide will be detrimental to any DNA evidence present, and its use may not be appropriate if subsequent DNA analysis is to be attempted. The process currently recommended is:

- 1) Immerse exhibit in 1% 5-Sulphosalicylic acid for a maximum of 30 seconds
- 2) Remove exhibit and immerse in 0.5% sodium hydroxide solution for 15 seconds
- 3) Remove exhibit and rinse under stream of running water
- 4) Allow to air dry

The use of 5-Sulphosalicylic acid is not conclusively proven to be essential to the soot removal process, and good results have also been obtained with the use of sodium hydroxide solution alone. The concentrations recommended to make up the solutions are:

1% 5-Sulphosalicylic acid solution: 10 g of 5-Sulphosalicylic acid in 1000 ml distilled water

0.5% Sodium hydroxide solution: 5 g of sodium hydroxide in 1000 ml of distilled water

Rubber

In situations where a possible mark is visible under a heavy soot deposit, and other soot removal techniques do not remove sufficient soot to enable the mark to be imaged, a soft pencil rubber may be used to rub away surface soot. This technique should only be used if the mark appears to be 'baked on' to the surface, because otherwise it may be rubbed away with the soot deposit. The mark should be examined after each application of the rubber, and the process should be stopped as soon as the ridge detail appears to start degrading.



Removal of soot from a 'baked on' mark using a rubber

'Absorene'

'Absorene' is a dough-like material that is marketed as a commercial product for removing soot and dust from paper products. The technique works well for surface soot on porous surfaces, where the reactive constituents of the mark have diffused into the substrate and surface deposits can be removed without degrading the mark. The application of Absorene is carried out as follows:

- 1) Take a handful of the dough, work it between hands until soft and pliable

- 2) Lightly wipe in one direction on the surface, brushing clear all crumbs of dough
- 3) Repeat application until all loose soot has been removed

Once all loose soot has been removed using Absorene, more deeply ingrained soot deposits can be removed using a soft rubber. However, the use of a soft rubber is more damaging to the surface than Absorene and may begin to damage fingerprints.



a)

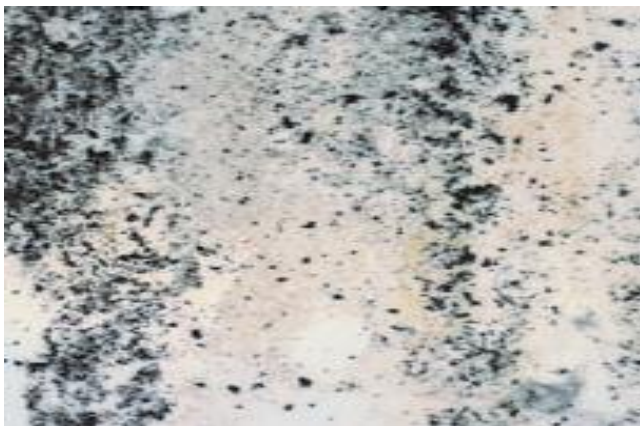
b)



c)

Soot removal using Absorene; a) wine bottle label before use of cleaning technique, b) single pass with Absorene, and c) wine bottle label after full cleaning process.

Definitions of soot coverage



a)



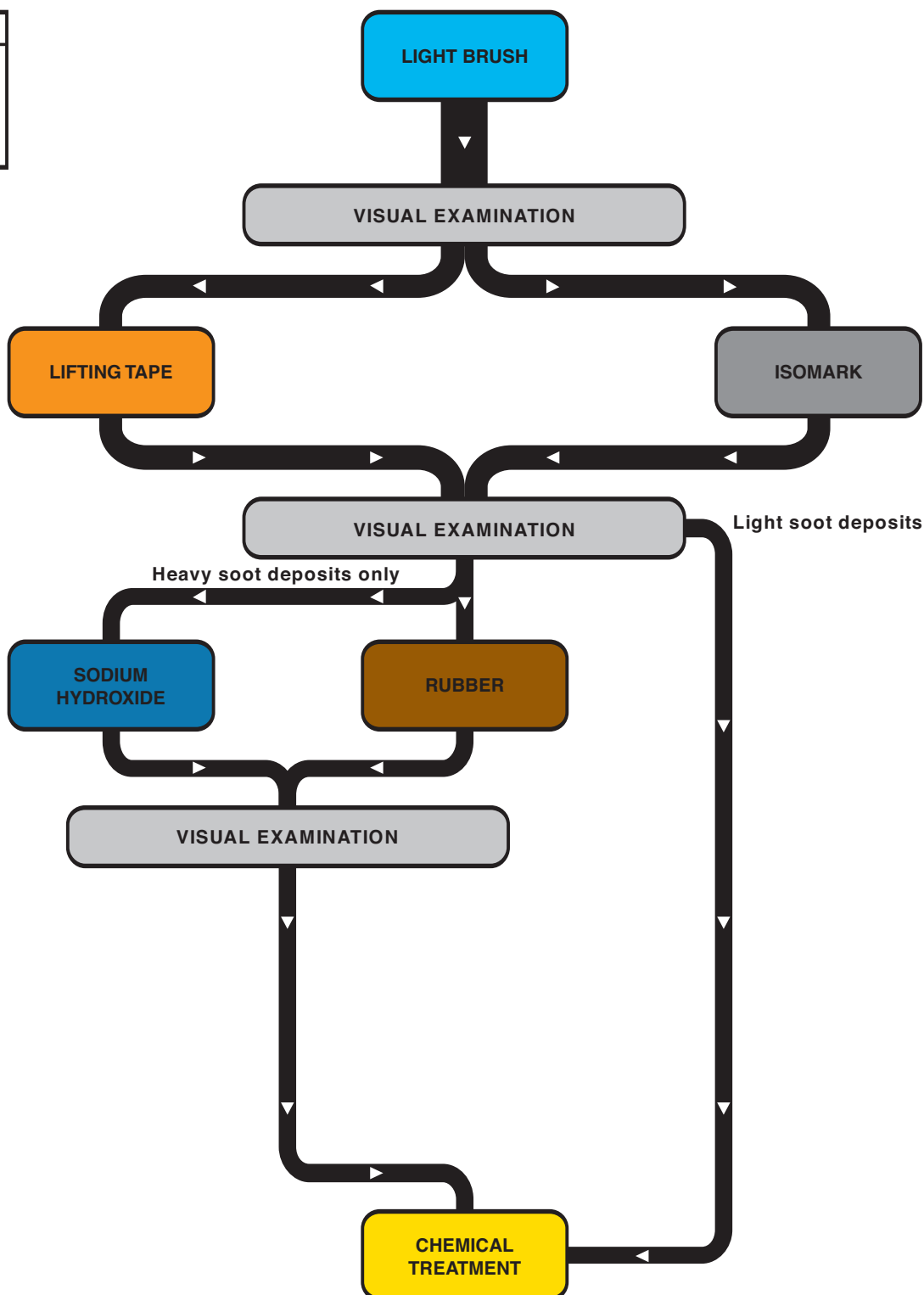
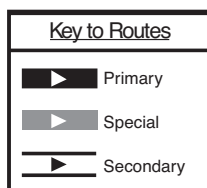
b)



c)

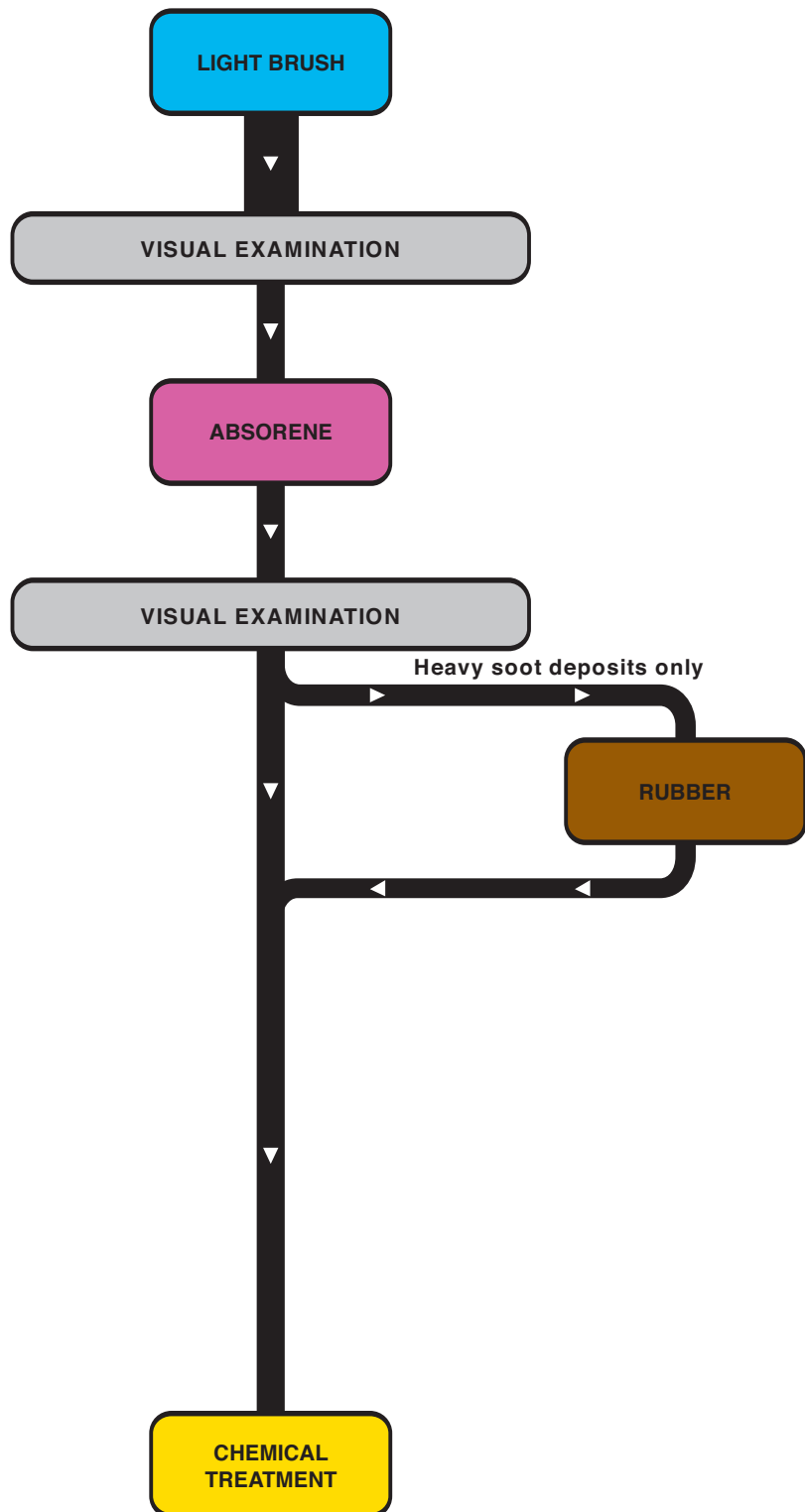
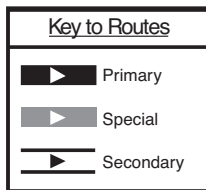
Levels of soot coverage; a) Light soot, discontinuous deposits across surface, background clearly visible, b) Medium soot, continuous deposit across surface, but background still visible, and c) Heavy soot, continuous deposit across surface, background no longer visible

Use for any surface where soot obscures marks	SOOT REMOVAL (NON-POROUS)
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The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

Use for any surface where soot obscures marks	SOOT REMOVAL (POROUS)
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The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

Techniques for fingerprint development

The current study has investigated the effectiveness of many of the fingerprint development techniques currently recommended in the HOSDB Manual of Fingerprint Development Techniques [14], in addition to some processes previously discounted from the MoFDT or currently under investigation. In general, it was found that many of the techniques continued to function to some extent for exposure temperatures up to 200°C, although their effectiveness was reduced.

When marks were exposed to in excess of 200°C, the number of techniques still giving positive results decreases significantly and the outline sequential processing charts presented below reflect this. It is expected that above 200°C most of the organic components of latent marks will have been destroyed, leaving only the inorganic salts. If the surface has not been wet, these salts will be present to react with superglue. In other situations, the fact that a fingerprint has been present to protect the surface from oxidation may result in a subtle difference in surface composition/texture between regions of ridge and regions of unprotected surface, which can be detected by sensitive techniques such as Vacuum Metal Deposition.

Those techniques recommended for practical use are:

Visual Examination

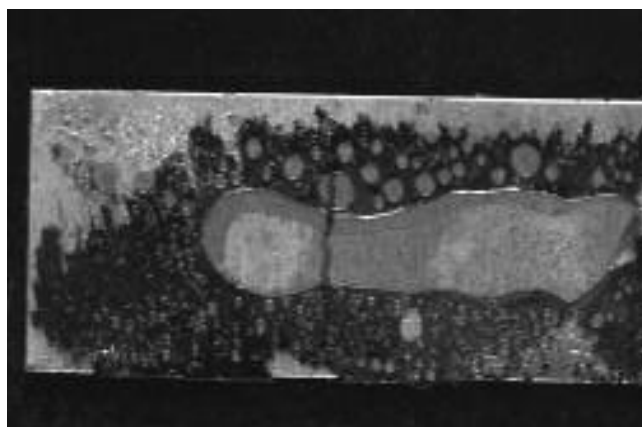
This should always be used for exhibits recovered from arson scenes because there are many ways in which marks may be developed by the action of heat and soot. Examples observed are preferential soot deposition on fingerprint ridges, heat development of marks on paper, and marks becoming 'baked' onto metal surfaces.



a)



b)



c)

Marks detected by visual examination; a) marks developed by soot deposition on ceramic tile, b) marks developed by heat alone on glossy card, and c) marks developed by fumes from burning plastic on metal strip.

<u>Black Magnetic Powder</u>	Significantly better than aluminium powder in developing marks on non-porous surfaces, but effectiveness drops significantly for articles exposed to temperatures in excess of 200°C.
<u>Black Powder Suspension</u>	The best performing treatment for non-porous surfaces exposed to temperatures up to 200°C. Can be used at a scene of crime or in a laboratory. Detergent in the formulation also acts to assist in the soot removal process during treatment.
<u>White Powder Suspension</u>	See comments above for Black Powder Suspension.
<u>Small Particle Reagent</u>	Similar to BPS and WPS, but spray development at scenes expected to be worse in performance than the other two particle suspensions. Dish development in the laboratory also yields slightly less useful results than powder suspensions.
<u>Superglue + BY40</u>	Effective at temperatures up to 500°C on non-porous surfaces, but only if surface has not been wet.
<u>Vacuum Metal Deposition</u>	Extremely effective for non-porous surfaces, and has been shown to detect marks after exposure to 900°C. However, soot deposits and areas where water has dried will all show up during treatment and it may be difficult to resolve marks in practical situations.
<u>Gentian Violet</u>	Has been shown to develop marks on soot covered samples, but does not appear to be as effective as powder suspension techniques. Use of GV has been observed to cause background staining on several painted surfaces, and fluorescence was required to visualise marks[10]. Background staining may make visualisation of marks obtained from subsequent development techniques difficult.
<u>DFO</u>	The best performing reagent for porous exhibits in laboratory trials, but performs poorly in simulated fire scenes because paper is mostly wetted.
<u>Ninhydrin</u>	Also develops some marks on porous exhibits, but less than DFO and Physical Developer. Performs poorly in simulated fire scenes because paper is mostly wetted.
<u>Physical Developer</u>	The best reagent for paper exhibits recovered from simulated fire scenes. Can develop marks on charred regions of paper.

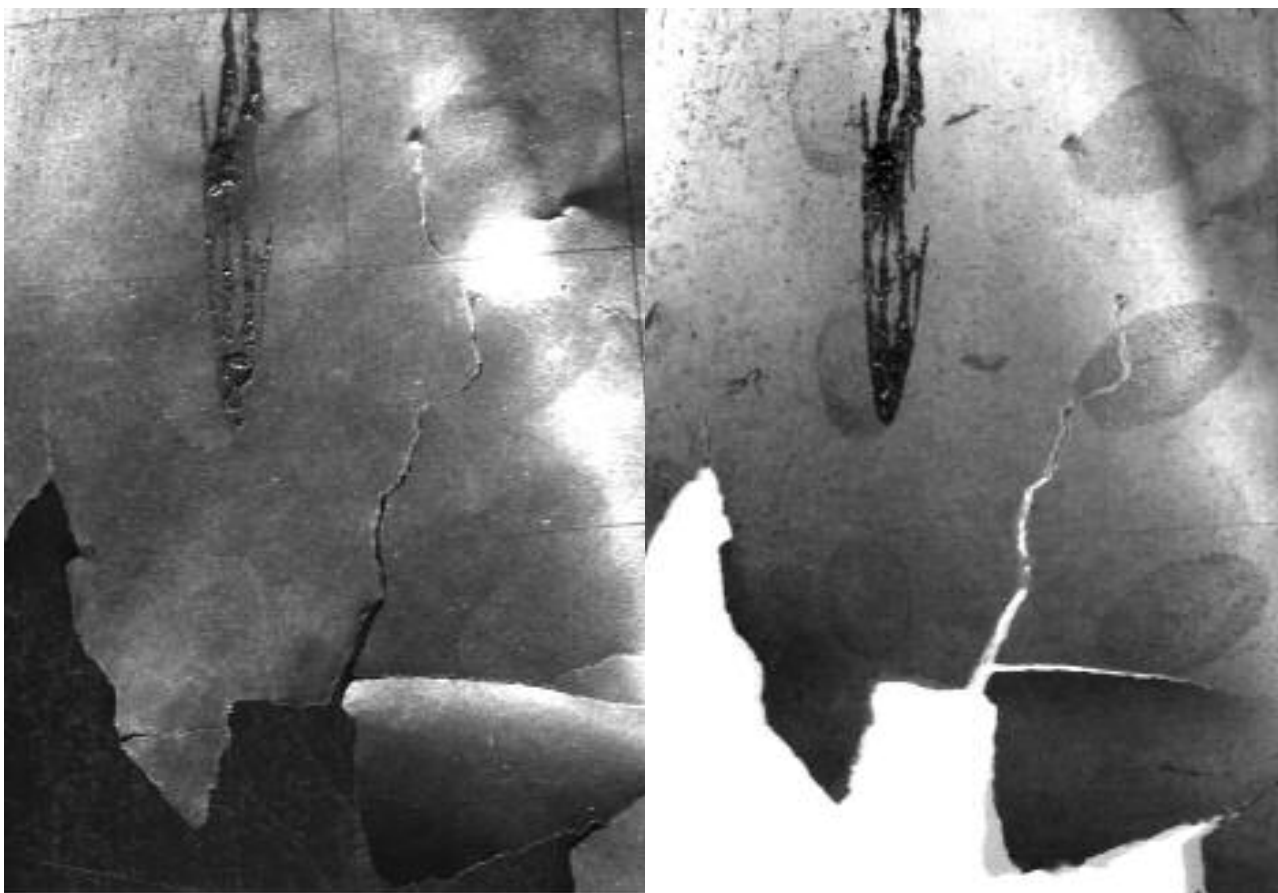
Blood dyes:

Acid Black 1,
Acid Violet 17,
Acid Yellow 7

All blood reagents continue to give good results on the surfaces recommended in the Manual provided that exposure temperature does not exceed 200°C. Positive (but much weaker) development has been observed for all reagents after 8 hours at this temperature [11]. For exposures above this temperature, blood reagents will no longer give positive results but the surface in the regions blood has been present will have been modified and processes such as VMD are capable of detecting marks.

Infra-red Imaging

In some circumstances, the use of infra-red imaging may make visualisation of some developed marks easier. Some regions of charring and soot deposition may be more transparent when viewed using an infra-red sensitive camera and appropriate filter (filters with cut-on wavelengths of 715nm or above work best). IR Imaging will work best for techniques where the developed mark remains visible in the IR region, in particular Physical Developer.



Charred paper exhibit illuminated with tungsten light; a) imaged without IR filter, and b) imaged with RG850 filter

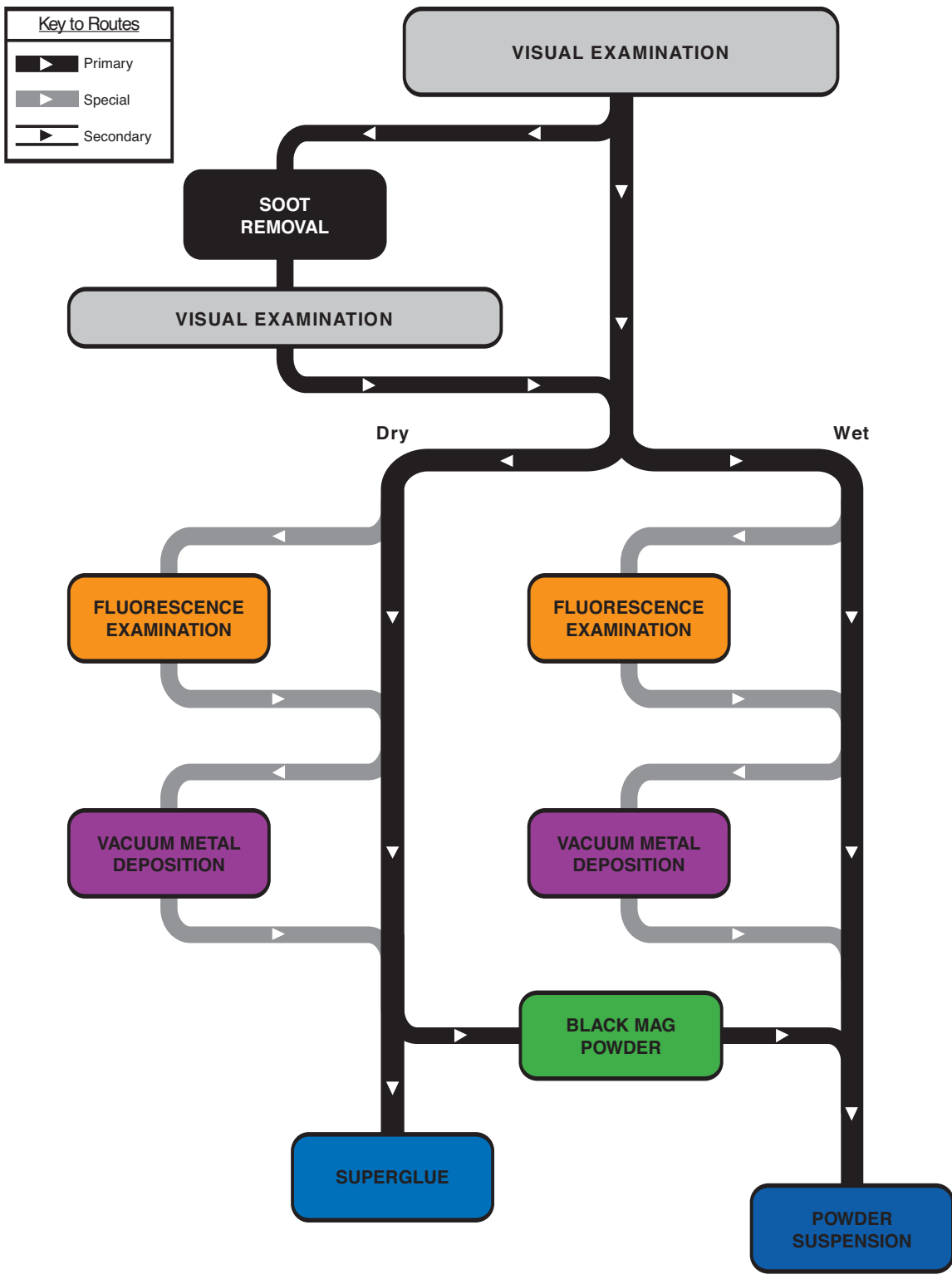
Techniques not recommended

Some techniques are not recommended for use on exhibits recovered from fires. Those omitted from the current processing charts are:

<u>Rehumidification</u>	Although suggested as a means of improving visualisation by some workers [3], this must not be used as a way of enhancing marks because it has been shown to destroy dry residues.
<u>Aluminium powder</u>	Performs noticeably less well than Black Magnetic Powder on exhibits exposed to heat, marks become 'reverse developed' and process ceases working effectively when exhibits have been exposed to temperatures above 100°C.
<u>Leuco Crystal Violet</u>	Haem-specific dyes such as LCV and other presumptive tests that may be used for blood are less sensitive than the protein dyes AB1, AY7 and AV14, and stop working at a lower temperature (~ 150°C).

Sequential processing flow charts have been generated for different types of substrate, outlining the advice based on practical results to date and these are illustrated on the following pages.

If there are marks in blood see appropriate charts	<h2 style="margin: 0;">NON POROUS SURFACES (up to 200°C)</h2>
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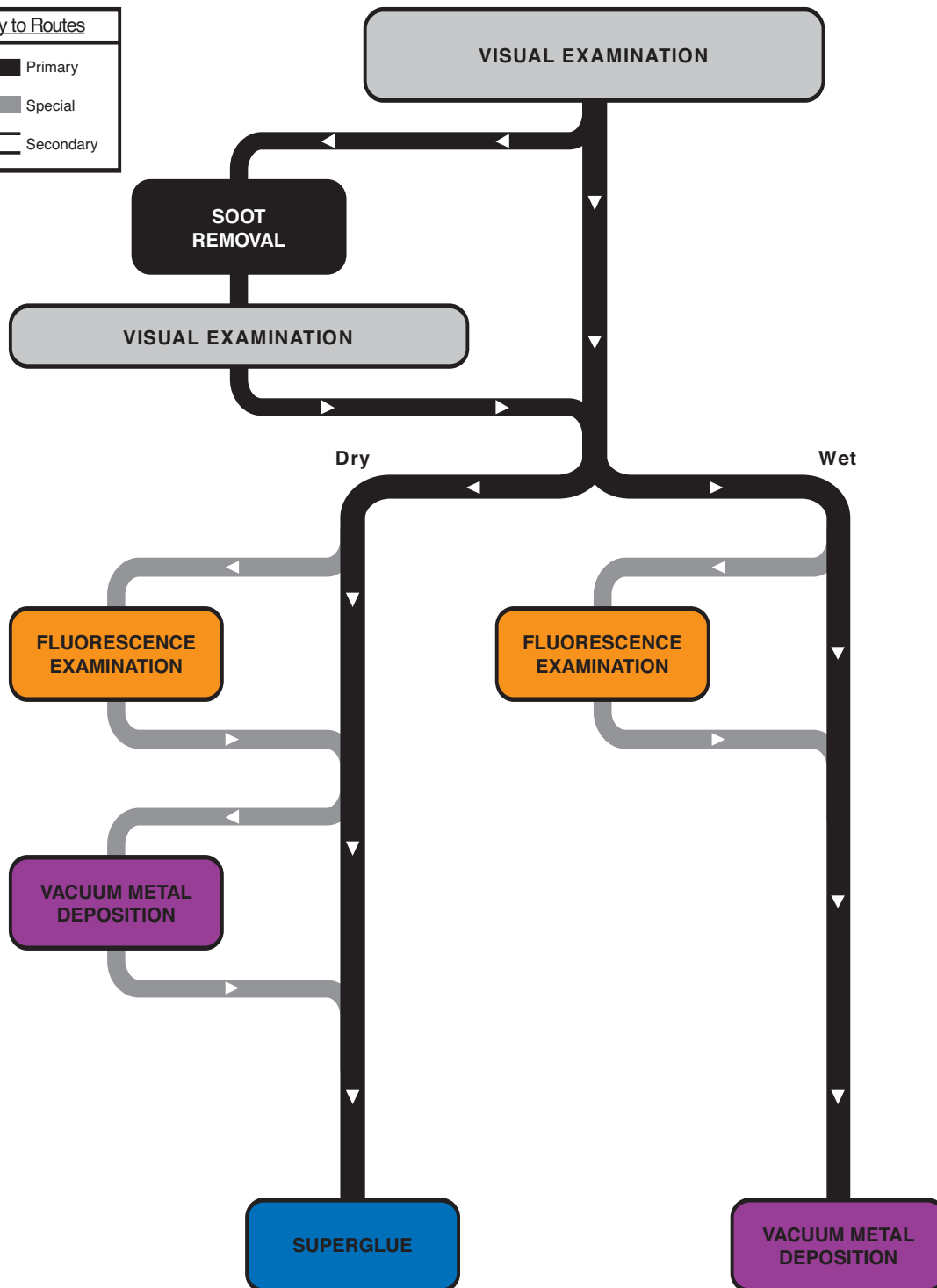
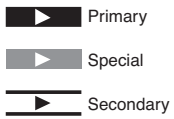


The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

If there are marks
in blood see
appropriate charts

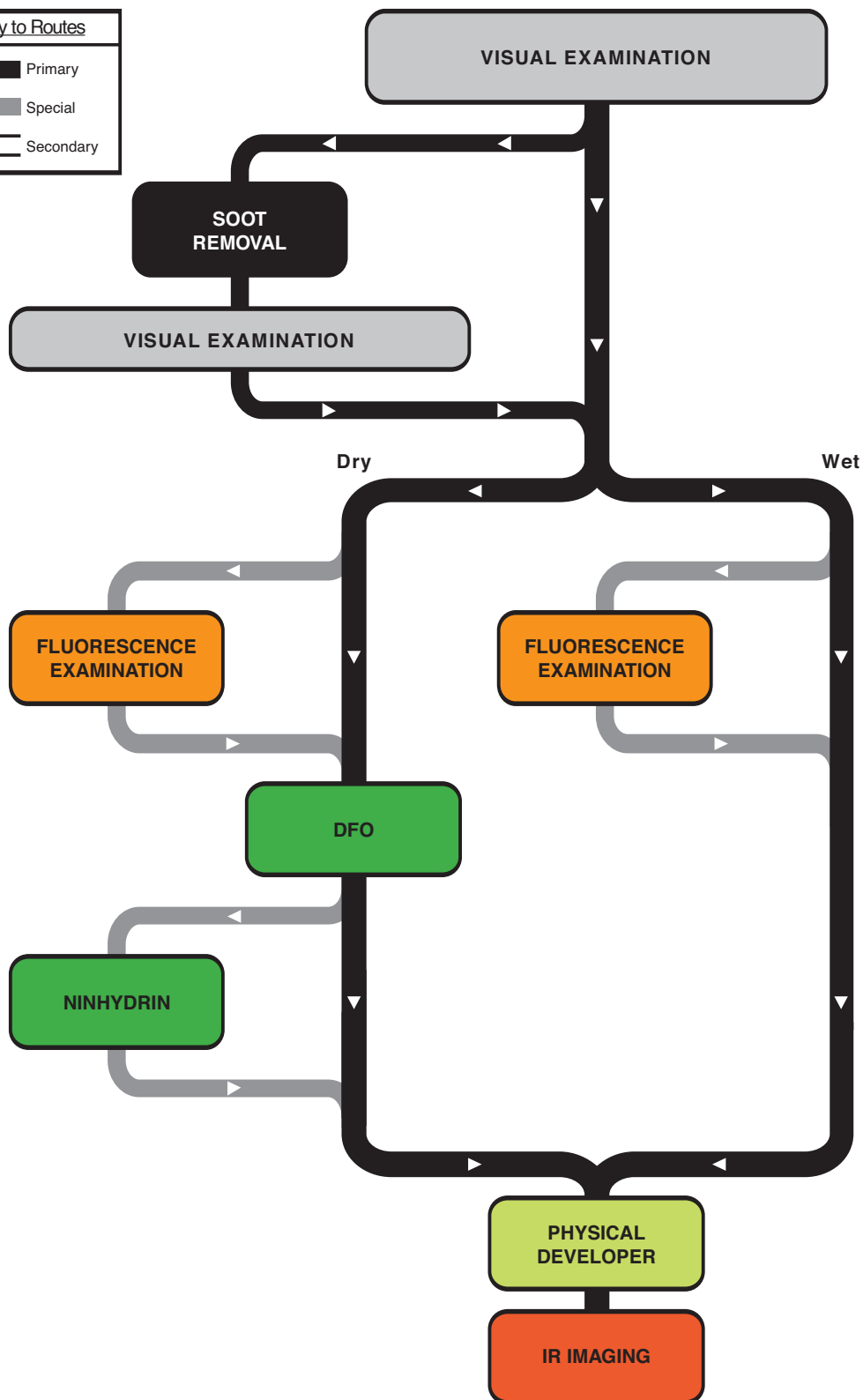
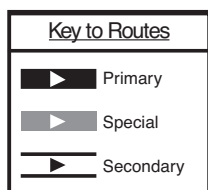
NON POROUS SURFACES (over 200°C)

Key to Routes



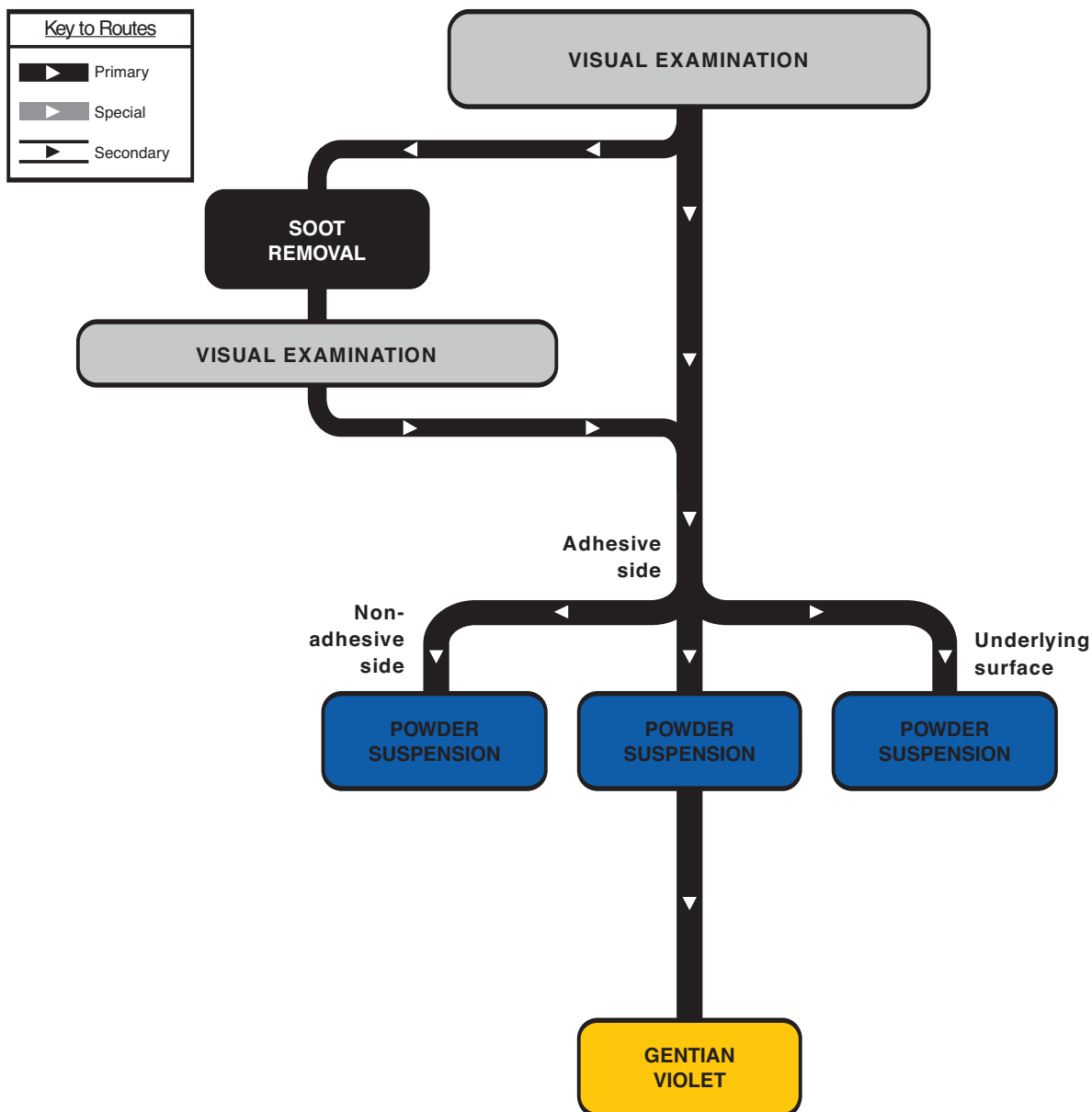
The use of FLUORESCENCE EXAMINATION after many processes
can result in improved contrast between fingerprint and background.

If there are marks in blood see appropriate charts	<h2 style="margin: 0;">POROUS SURFACES</h2>
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The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

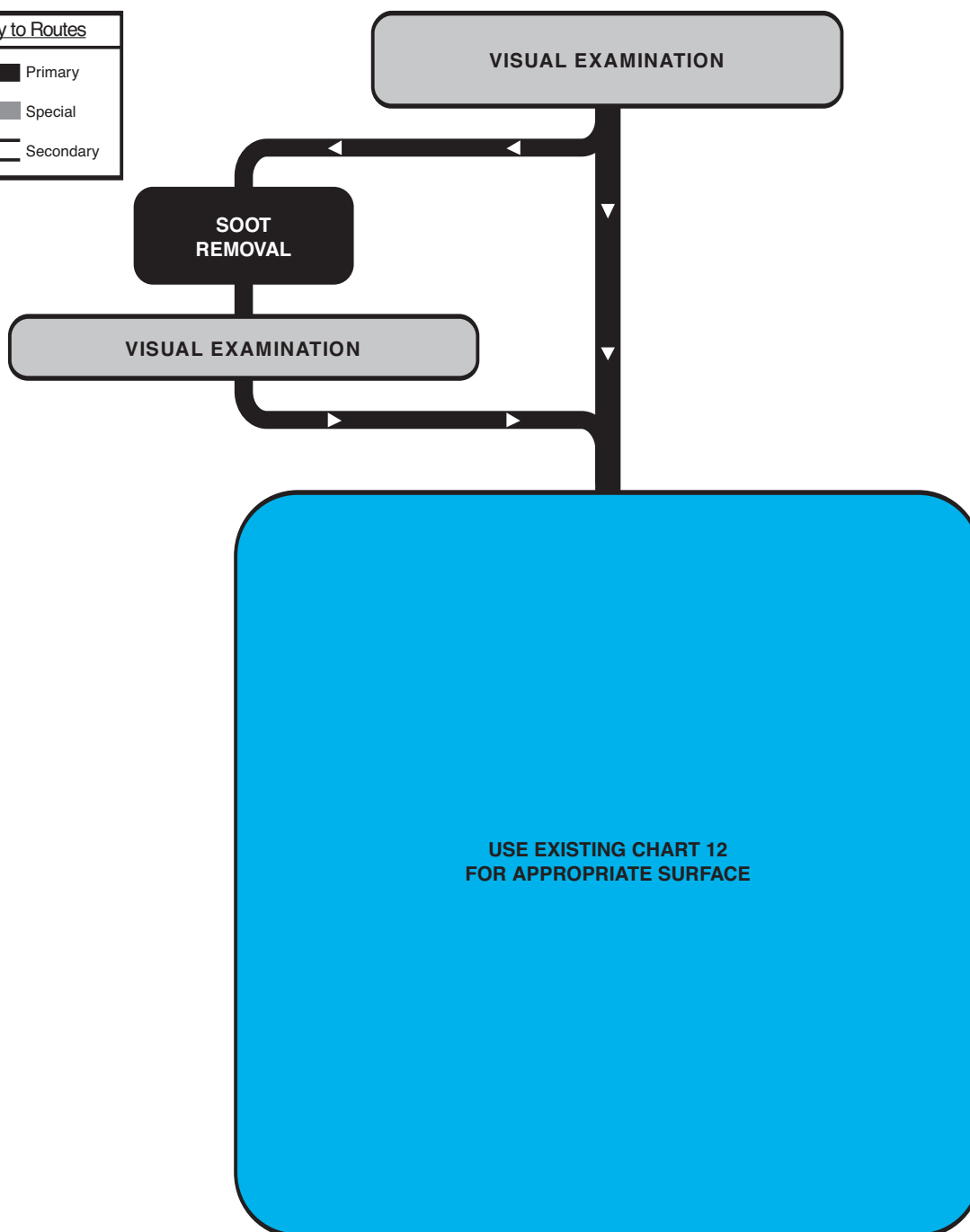
If there are marks in blood see appropriate charts	<h2 style="margin: 0;">ADHESIVE TAPES</h2>
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The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background. It may be particularly effective after GENTIAN VIOLET.

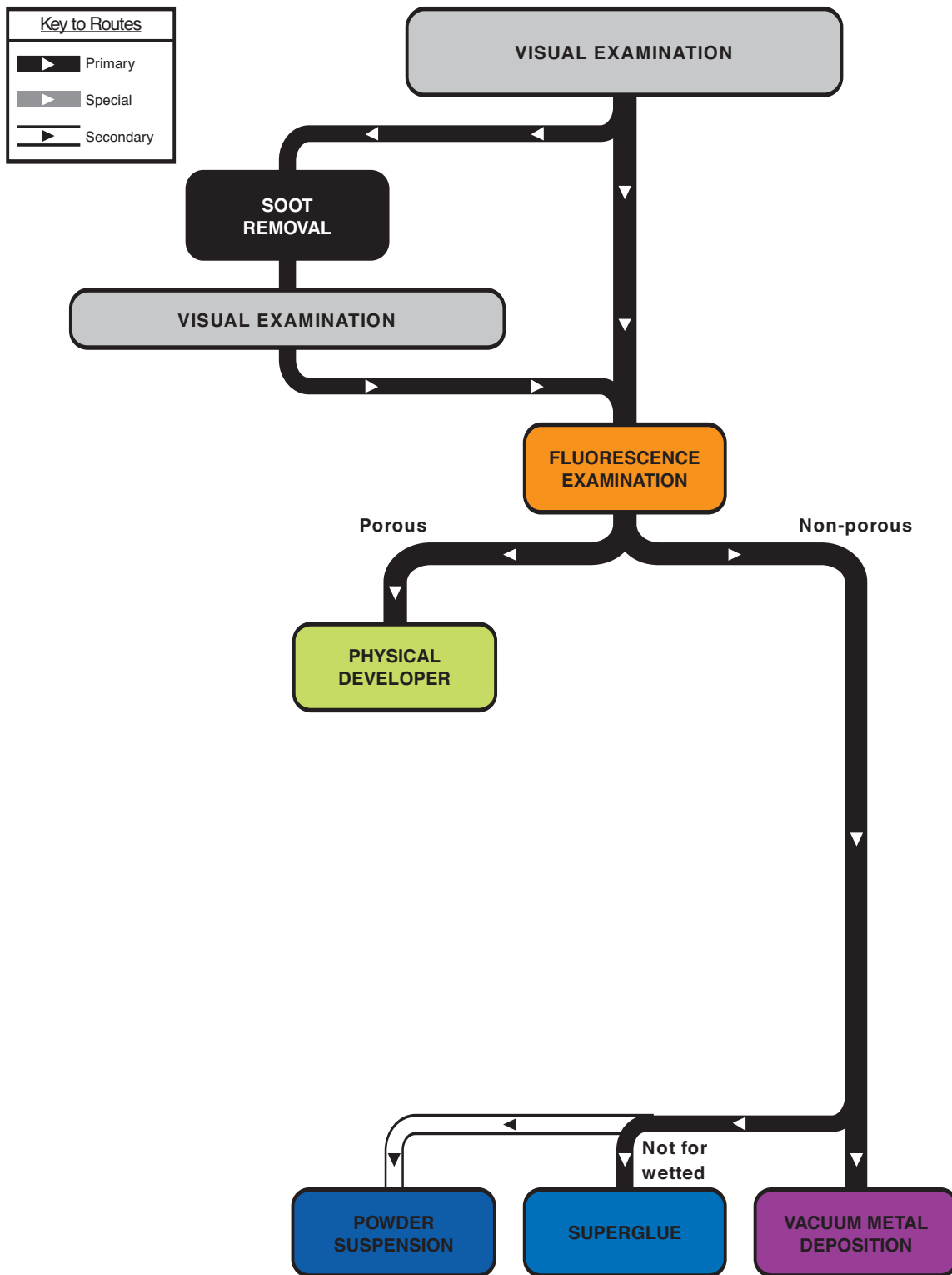
Use for any surface when fingerprints are in blood	MARKS IN BLOOD (up to 200°C)
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Key to Routes
 Primary
 Special
 Secondary



The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

Use for any surface when fingerprints are in blood	<h2 style="margin: 0;">MARKS IN BLOOD (over 200°C)</h2>
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The use of FLUORESCENCE EXAMINATION after many processes can result in improved contrast between fingerprint and background.

Additional notes on surfaces

Smooth Non-porous

This category includes ceramic, metal and plastic materials, including melamine 'kitchen unit' type surfaces. For most surfaces, Black or White Powder Suspensions are by far the most effective treatment if a single process is to be used. Powder suspensions can also be used successfully after Black Magnetic Powder or Vacuum Metal Deposition. If the surfaces have remained dry and have been exposed to high temperatures, superglue followed by dyeing may be preferable.

Rough Non-porous

For rough surfaces, the same processes recommended for smooth surfaces can be used. However, it should be noted that soot removal processes may be much less effective on this type of surface because it is very difficult to entirely remove soot from the grooves or texture, and this makes visualisation of any marks that may be developed exceptionally difficult.

Porous (Paper and Cardboard)

In practical situations, Physical Developer is recommended as the best performing single process because it is likely that porous exhibits will have been wetted during any fire fighting operation. PD is also capable of developing marks on regions of paper that have been charred. If a second process is to be used, DFO is preferred to ninhydrin on the basis of practical work that shows it to be more effective.



Fingerprints developed on charred region of paper exhibit using Physical Developer.

Adhesive tapes

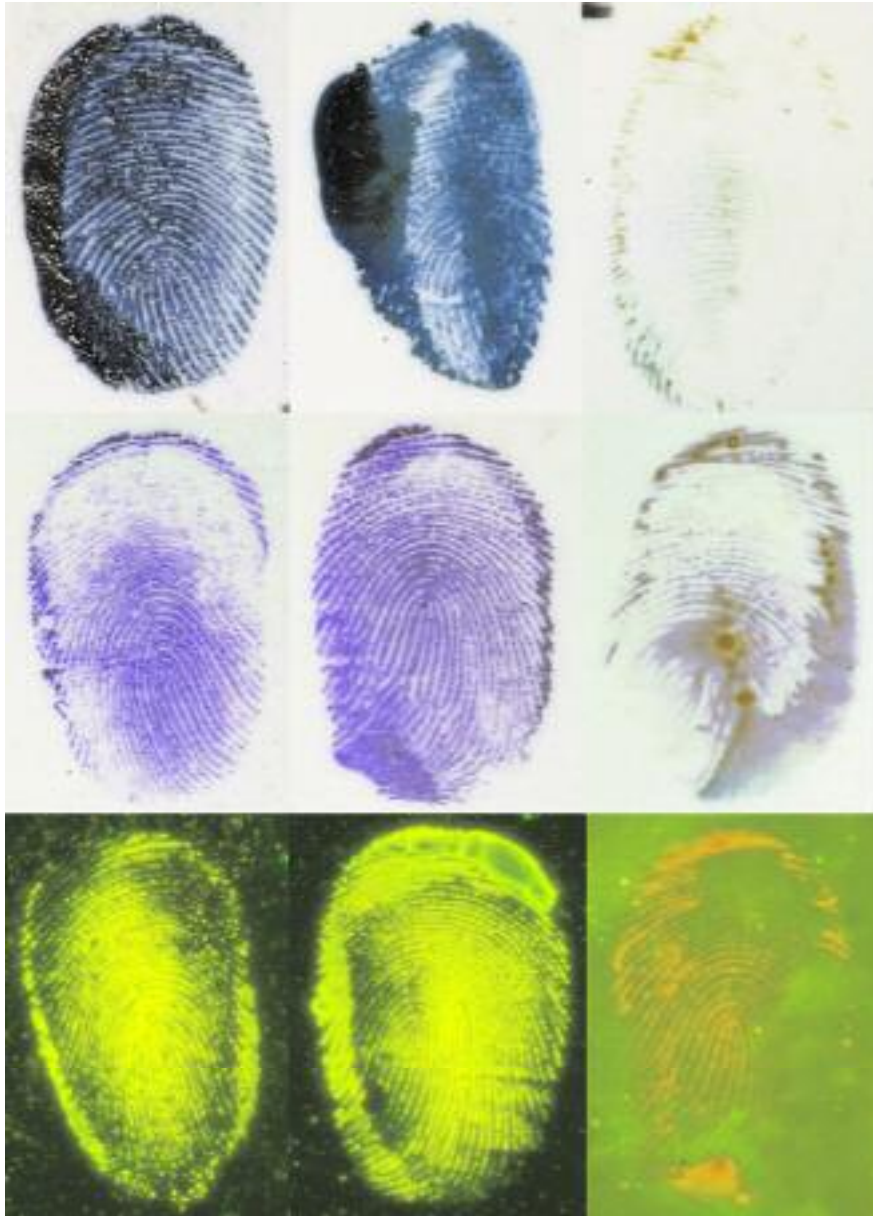
Of the tape development processes, Black Powder Suspension appears the most effective process in the limited trials conducted to date. A significant result for heat affected tapes is that the surface underneath the tape should be treated in addition to the sticky side of the tape itself. It is notable that when the tape is exposed to heat, more of the fingerprint deposits are transferred to the substrate from the sticky side of the tape and any marks developed on the underlying surface will need to be laterally reversed.



Development of fingerprints on adhesive tapes using black powder suspension. Weak development on adhesive side, stronger development of reversed mark on ceramic tile substrate.

Fingerprints in blood

None of the development processes used for development of fingerprints in blood will continue to work for exposure temperatures in excess of 200°C, and haem-specific processes cease to work at temperatures below 150°C. However, because blood deposits form a protective layer on the surface before flaking off, the difference in surface oxidation between areas of ridge detail and unprotected areas will be greater. As a consequence, processes sensitive to surface condition such as VMD are capable of detecting areas where fingerprints in blood have been even after exposure to temperatures of 900°C.



The effect of heat on fingerprints in blood; top row - Acid Black 1, middle row - Acid Violet 17, bottom row - Acid Yellow 7. Left column - control sample, middle column - 8 hours at 100°C, right column - 8 hours at 200°C

Exhibits soaked in accelerant

The effect of immersing exhibits in accelerant has not been investigated in detail in the current study. However, previous unpublished work by HOSDB indicates that ninhydrin, DFO and Physical Developer will continue to work on porous surfaces that have been exposed to accelerant, for example the wicks of petrol bombs. This has been confirmed by Deans [8] in more recent work.

CONCLUSIONS

Fingerprint residues can under certain circumstances survive the high temperature, fume filled environments experienced in fire scenes. The chances of fingerprints surviving is markedly increased if the surface has been protected from the direct action of smoke, soot and flames and extinguishing fluid.

Collaboration with Fire Investigators is essential to provide guidance on the temperatures to which different regions of the scene have been exposed. This knowledge will assist in deciding which chemical treatments are likely to be effective.

Most existing fingerprint development processes continue to be effective to some extent for exposure temperatures up to 200°C. Above this temperature, the choice of development process becomes much more limited.

The most effective soot removal techniques for light/medium sooted non-porous surfaces were found to be lifting tape and silicone rubber casting compounds. These remove much of the loose surface soot without damaging underlying marks. The best soot removal process for porous surfaces is the commercial product 'Absorene'.

More aggressive soot removal processes such as sodium hydroxide solution and rubbers are also effective, but should be used as a last resort because they may damage other evidence.

The most effective fingerprint development process for general use on non-porous surfaces is Powder suspension (both black and white variants). This can be applied both at a scene and in the laboratory. HOSDB will soon be issuing a formulation for a Black Powder Suspension. An optimised White Powder Suspension formulation will also be published, but due to limited stocks of the white powder it is only recommended for use on adhesive tapes. Operational work by Police forces suggests that of the commercial White Powder Suspension products, 'WhiteWop' appears to give the best results.

Physical Developer was found to develop the most marks on porous surfaces, possibly because most porous exhibits become wetted whilst extinguishing the fire.

A best practice guide based on current knowledge has been issued to enable more informed decisions to be made on evidence retrieval from fire scenes. This will need to incorporate information on DNA retrieval, and some preliminary work has already taken place in this area [15].

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Acknowledgements

The authors would like to thank Mick Gardiner and Gardiner Associates for access to their facilities at MDP Wethersfield and for all their helpful advice and discussions throughout this study. Special thanks is due to Jack Deans for his enthusiasm, for co-ordinating placement of exhibits, and for expert analysis of recovered marks. Thanks also to Martin Cox (Thames Valley Police) and Kenny Laing (Strathclyde Police) for their feedback on the use of soot removal and fingerprint development techniques in operational work, and to Dr Niamh NicDaeid of Strathclyde University for help in arranging the MSc placements that contribute significantly to this report.

APPENDIX 1

Suppliers

Silicone casting compounds

Isomark:

Isomark Ltd
261 Weddington Road
Nuneaton
Warks CV10 0HE

Tel. 02476 387438 Fax. 02476 320222

Mikrosil:

CSI
PO Box 260
Northampton
NN1 3SA

Tel. 0845 602 4230 Fax. 01604 791964

WA Products
87A/B Haltwhistle Road,
South Woodham Ferrers
Chelmsford
Essex CM3 5ZA

Tel. 01245 321913 Fax. 01245 321148

Other silicone rubber-based casting compounds such as Silmark, Xantopren and Silcoset are also anticipated to be effective, but have not been evaluated by HOSDB.

Absorene

Preservation Equipment Ltd
Vinces Road
Diss
Norfolk IP22 4HQ

Tel. 01379 647400 Fax. 01379 650582

Powder Suspensions

Formulations for powder suspensions and suggested suppliers for the powders has been published in a separate Newsletter detailing treatments for Adhesive tapes, HOSDB Publication 23/06, March 2006.

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