



Scientific Development Branch

Crime Investigation and Officer
Safety Sector

Fingerprint Development and Imaging Newsletter

October 2005

Publication No. 47/05

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Grand Opening of HOSDB Fingerprint Laboratories

On 16 July 2005, CC Michael Baxter, QPM, officially opened the refurbished laboratories at Sandridge. Guests were invited from the National Fingerprint Board and Fingerprint Development and Imaging User Group to join in the celebration and tour the facilities.



Chief Constable Michael Baxter, QPM, with Alan Pratt, Director of HOSDB at the official laboratory opening

The refurbished laboratories offer considerable benefits over the previous arrangement. While the space remains the same, it has been rearranged to be used more effectively. For example, the room originally designed for vehicle inspection and used little in recent years is now a large working laboratory. This alone presents a greater opportunity for visiting practitioners to spend time at HOSDB.



The old vehicle bay converted into useful laboratory space

As part of the refurbishment there are purpose-built facilities for carrying out fluorescence examination and a new digital

imaging suite. Both include non-fluorescent benchtops, walls and floors. This is to ensure that any reflected stray light or consequent fluorescence is eliminated, so giving optimum conditions for fluorescence examination of fingerprints.



Steve Bleay demonstrating IRIS in the new digital imaging suite to visitors during the laboratory opening

We also have dedicated storage space for the large number of surfaces used in our experiments and a room assigned for more delicate analytical equipment.



Racking in the storage area

Current Programme of Work

The programme of work of the fingerprint team has suffered some disruption during the refurbishment but is now back on course.

We have two students working with us until next August: Stuart Wright from Strathclyde University is working with Vaughn on a revised formulation for Physical Developer. Tom Hardy from Bradford University is working with Helen on the powders project, looking at the use of different powders on difficult surfaces.

The portable Nd:YAG has been used operationally in the last six months and, as predicted, has demonstrated benefits over other high intensity light sources. If forces wish to make use of the laser, they should contact Helen Bandey.

Newly started projects in this year's programme include fingerprint and DNA recovery from items contaminated with chemical, biological or radiological agents. We are also planning to introduce some work on footwear development and imaging.

Following a workshop in May, operational requirements have been defined for aspects of digital imaging which will be included in our programme of work: these include imaging standards for scene capture of fingerprints and image processing.

The success of wet powder suspensions has been claimed by a number of forces and we have conducted a scoping study. We will be proposing to the Fingerprint Development and Imaging User Group that we undertake a full study of this technique. This will enable us to give advice on the best sequence for its use, which is currently not available. In the meantime, it is suggested that if all other treatments have been done in line with the recommendations in the Manual of Fingerprint Development Techniques without success, wet powder suspensions might be tried as a final treatment.

Assistance to Forces Regarding Laboratory Designs

We regularly assist forces with laboratory designs, either for new builds or refurbishments. Occasionally, problems have been encountered when changes have been made to the original plans. This has resulted in a request for HOSDB to be more prescriptive in its advice. The following response was put to the National Fingerprint Board earlier this year.

‘HOSDB Fingerprint Development and Imaging Team regard the assistance they can offer regarding laboratory design as an essential part of their support to police fingerprint laboratories. Laboratory designs that enable staff to work safely, effectively and efficiently and recommendations for equipment which is fit for purpose are fundamental parts of this advice. It is given on the understanding that it will improve the effectiveness of the laboratory and the results it delivers.

New police fingerprint laboratories are designed from time to time and if we can offer assistance it is preferable for us to be involved at the start of the project and at key stages of the development. Advice can be given to laboratory staff about equipment and its positioning, best use of space, use of materials and health and safety considerations. The Manual of Fingerprint Techniques gives information on all these aspects and we know of forces which have satisfactorily employed this advice with good results. We have occasionally been asked more fundamental questions, e.g. regarding drainage requirements, but are unable to help with these more general building issues.

A request was made for a more prescriptive approach to our input in the strategic review circulated earlier in the year. HOSDB generally offers advice via laboratory staff. If the responsibility for the build of the laboratory is subsequently handed over to a contractor, as frequently happens, the installation may deviate from the original plans for a variety of reasons.

If changes are planned which are contrary to the original advice or in conflict with the

general advice given in Chapter 2 of the Manual, we would suggest that you or your contractor contact us. This could avoid unnecessary additional costs or subsequent delays which might be needed to make later corrections.’

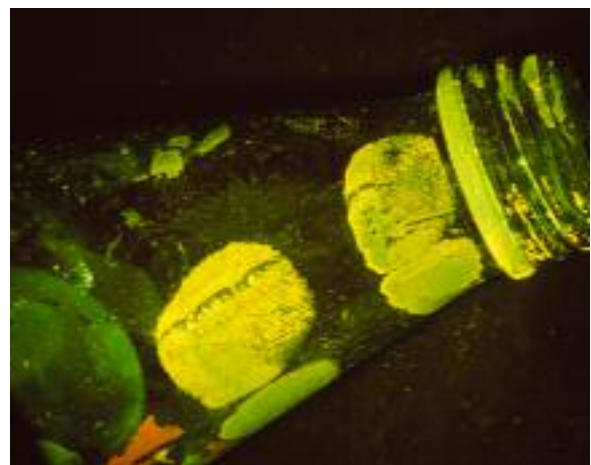
We understand that it may be necessary to look for cost-savings as the project progresses from the initial design phase. However, the risks attached to any specification changes must be assessed carefully to ensure the best outcomes. We will, of course, endeavour to highlight those areas of the design which should not be compromised, in order to avoid any confusion.

Success for New Blood Enhancement Reagents

While we have been involved with the laboratory refurbishments, the new blood enhancement reagents which were introduced at the beginning of the year have been received with great acclaim.



Fingerprints in blood on a bottle



Fingerprints in blood developed with Acid Yellow 7

One force reported immediate success by developing a fingerprint with Acid Yellow 7 on a black Maglight torch, something that they were unable to do previously.

Wireless Transmission of Fingerprint Images

Over the past few months, HOSDB has been assisting the National Fingerprint Board and the Police Standards Unit in the assessment of technology for the wireless transmission of fingerprint images. This has involved the design and execution of a number of experiments to enable an independent assessment of suitability of scanners, data gathered to date and the effect of storage of compressed images on Ident1. These experiments have required assistance from many force fingerprint bureaux, both in the provision of lifts to be scanned and in the use of resources to load, mark up and search images. The experiments are now nearing completion and the NFB and PSU are in the process of preparing roll-out procedures for the implementation of wireless transmission technology. Part of this programme is to ensure that the Generic Mark Camera Interface is sufficiently robust to manage the number of marks which might be imported to Ident1 using this technology.

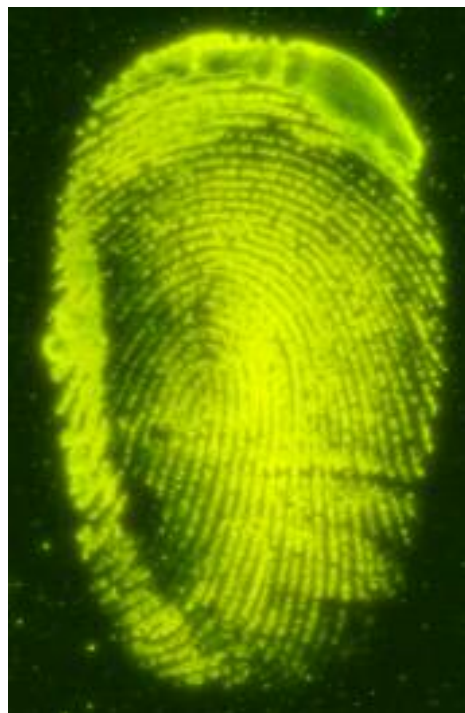
We would like take this opportunity to thank all of the bureaux that have offered and provided assistance throughout this study, without whose efforts the work would not have been possible.

Fingerprints at Arson Scenes

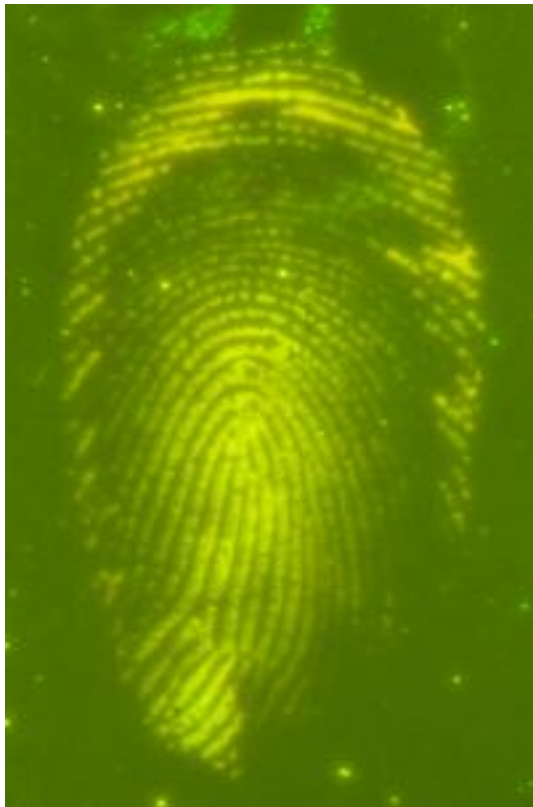
Research into the recovery of fingerprints from arson scenes continues to yield significant results. Further test panels have been placed into burn scenarios at the Gardiner Associates' facility at MDP Wethersfield and these are being analysed to

provide statistics on survival rates and processing techniques.

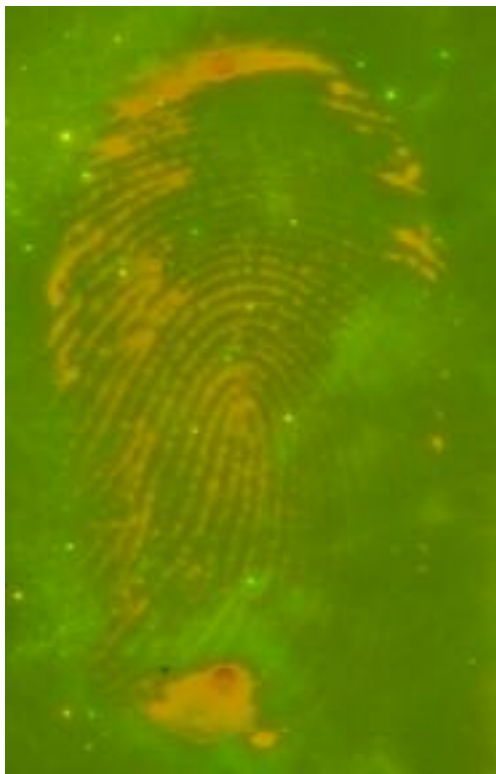
Work on the survival of marks in blood has been conducted by Jennifer Moore, an MSc student on placement from Strathclyde University. The results from this study indicate that marks in blood can survive exposure to 100°C for at least eight hours without affecting the effectiveness of the blood reagents. Positive results can also be obtained after exposure to 200°C, but the effectiveness drops off significantly as exposure time increases. Above this temperature the blood reagents cease giving positive results, but other development techniques are capable of revealing fingermark impressions.



Fingerprint in blood on a ceramic tile exposed to 100°C for 8 hours, subsequently developed with Acid Yellow 7



Fingerprint in blood on a ceramic tile exposed to 200°C for 1 hour and subsequently developed with Acid Yellow 7



Fingerprint in blood on a ceramic tile exposed to 200°C for 8 hours and subsequently developed with Acid Yellow 7

During processing of exhibits with latent marks, another significant observation has been made. Whilst using Physical Developer on a charred paper exhibit, pale marks were noted appearing on the burnt area of the paper.

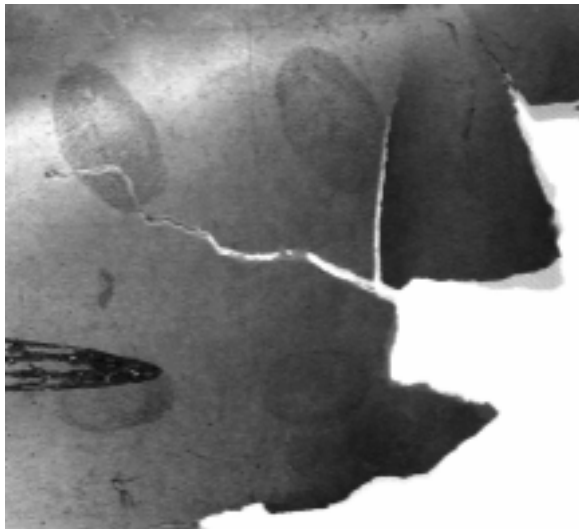


Fingerprints on charred paper following treatment with Physical Developer

These were still visible after drying and could be imaged using a cold-light illuminator held at an oblique angle. This implies that the fingerprint constituents targeted by Physical Developer are not destroyed by the charring of the paper and marks could conceivably be developed on samples previously thought to be too badly damaged to process. It was also found that the marks could be readily visualised in the Infra Red region using IRIS, where the charred region became much paler and the developed marks remain darker than the background.



Close-up of charred region of paper, showing developed marks illuminated by oblique light.

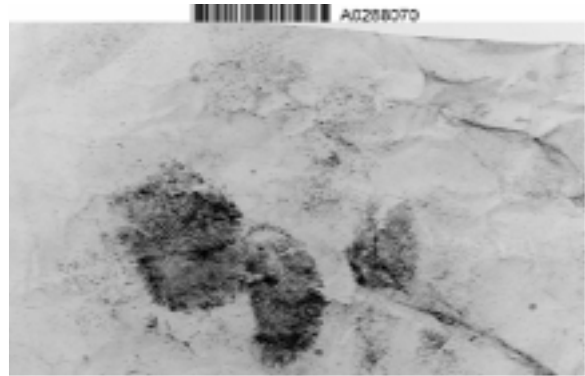


Marks imaged in the Infra Red region

IRIS Update

The IRIS workstation continues to generate interest and there are now seventeen systems in operational use with a further system at NTC Centrex. The ongoing software development programme has added functionality and many of the forces operating IRIS are now taking advantage of the 'Import Image' function. This allows the import of images taken on a wide range of digital Scene of Crime cameras and rescaling to a 1:1, 500 pixel per inch image. Accepted file formats are currently TIFF and JPEG, but the software will soon be able to accept direct import of RAW files from Nikon, Canon and Kodak cameras.

Another function requested by forces is the ability to read barcodes and to reprint barcodes within the image. The IRIS system can now be linked to a barcode reader and can automatically populate selected data fields from the scanned barcode. An example of a barcode reproduced within the image is shown below. This function is most suited for use with the Locard system, where the barcode directly reproduces the number printed below it.



IRIS image with barcode

Interest in linking IRIS to IDENT1 via the Generic Mark Camera Interface (GMCI) has also increased and many operators are either using or exploring this option. To facilitate the transfer of information via the GMCI, the next version of IRIS Imager will incorporate an option to crop out the region of interest around the mark. The cropped image will have a considerably reduced filesize, whilst retaining an audit trail to the original image. This will speed the transmission of images and reduce the bandwidth and storage space required on the force LAN.

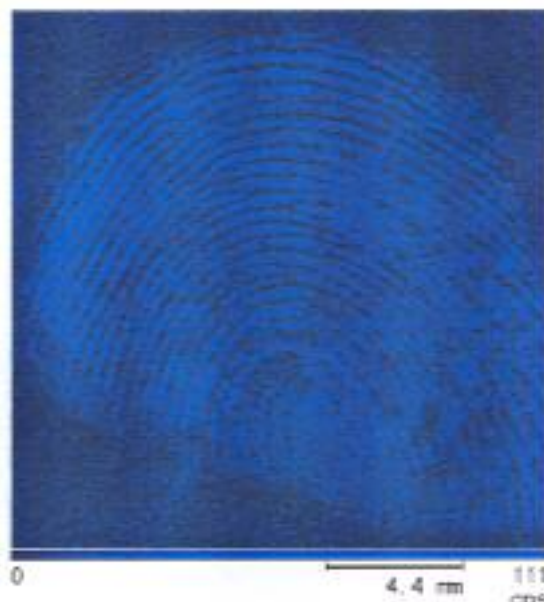
Finally, HOSDB is investigating two new generation cameras for incorporation into the IRIS workstation. The Roper Megaplug 2 offers a sensor with almost double the sensitivity of the camera currently used in IRIS, which will give further improvements in the number of fluorescent marks imaged and the corresponding image capture time. The image capture area is slightly smaller at 3 x 4 inches but this can be offset against the benefits in imaging faint fluorescent marks.

The Dalsa Pantera cameras offer larger capture areas: in theory 8 x 5 inch areas could be captured in a single image at a resolution of 500 pixels per inch. Please contact HOSDB if you would like to know more about any of these ongoing development activities.

X-ray Fluorescence Microscopy of Fingerprints

In recent years there have been significant advances in the number of techniques available that can provide chemical, physical and topographical information about surfaces of materials and several of these may be capable of offering real benefits in fingerprint detection and analysis. HOSDB has recently carried out a review of techniques now available and their capabilities, and one of these (X-ray fluorescence microscopy) was considered to merit further investigation.

A range of samples was supplied to HORIBA Jobin Yvon for analysis on a HORIBA XGT-5000 microscope. The samples were selected from processes giving significant elemental contrast between fingerprint and background, including VMD, PD, SPR and PD with iodide toning. Fingerprint ridges were detected on several samples, the best results being obtained with the iodide toned PD exhibit. The ridges could be resolved using both x-ray transmission and elemental analysis modes and the background removed from the fingerprint image. The conclusion of this study is that XRF does have potential for fingerprint analysis, and is capable of resolving fingerprint ridges on patterned and textured surfaces. Toning techniques using heavy elements can be used to enhance contrast. The technique is not one that would be used in a typical fingerprint laboratory, but it may be worthwhile identifying organisations that would allow access to facilities of this type.



XRF microscope image from silver X-ray fluorescence



XRF microscope image from iodine X-ray fluorescence



XRF microscope image of iodide toned PD mark using x-ray transmission mode

Silver VMD

Most users of Vacuum Metal Deposition will have received detailed guidance for the use of the silver VMD technique from HOSDB.

Operational trials in several forces have indicated that silver may develop additional marks if used after gold/zinc, in particular on surfaces where zinc deposition is poor. Further work by David Philipson, last year's placement student has identified optimised conditions for the process, which were highlighted in the recent letter. The process for silver VMD is reprinted here.

Method

Step 1:

Bring chamber pressure up to atmospheric pressure and open door (as in Page 5, Chapter 4 of the Manual of Fingerprint Development Techniques (MoFDT)).

Step 2:

Carefully attach articles to the workholder with minimum possible contact with the surface (as in Page 5, Chapter 4 of the MoFDT).

Step 3:

Load gold source with SILVER.

Place approximately 30 milligrams of SILVER on the gold source. If 0.25mm diameter wire is used this is 60mm of wire, if 0.5mm diameter wire is used this is 15mm of wire. It is most conveniently handled by cutting the wire into 5mm lengths with a pair of scissors, and placing the cut lengths into the gold source using tweezers.

Step 4:

Turn off interior light. Pump chamber down to a pressure of 2×10^{-4} mmHg (or torr or 3×10^{-4} mbar) or lower (as in Page 5, Chapter 4 of the MoFDT).

Step 5:

Evaporate SILVER.

Switch on the silver source. Increase the current until the filament glows a yellowish white and maintain it at that temperature for 30 seconds – 1 minute. Reduce the current slightly; if any SILVER remains a dark area will be seen on the filament. If so the source temperature should be raised for a further few seconds; if none remains turn the supply off. If the filament is overheated to an intense white it will be destroyed.

Pressures lower than 2×10^{-4} mmHg (torr) will not adversely affect the evaporation of SILVER.

Step 6:

Bring system up to atmospheric pressure and open door (as for Step 9 on Page 6, in Chapter 4 of the MoFDT).

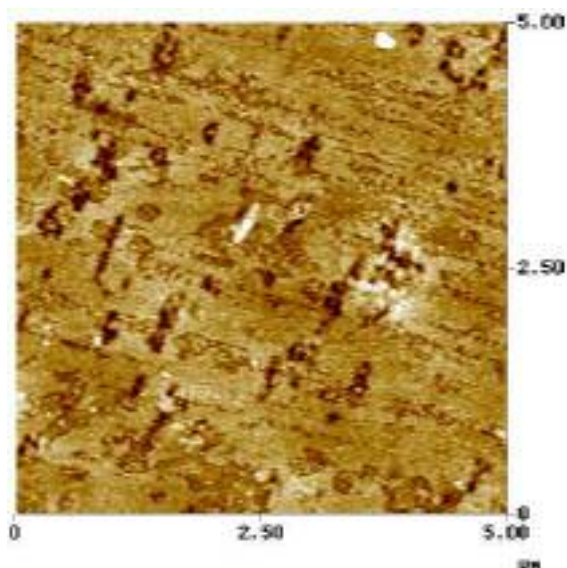
Step 7:

Remove article. Repeat from Step 2 to Step 7 for next article or carry out Step 4 if system is to be closed down.

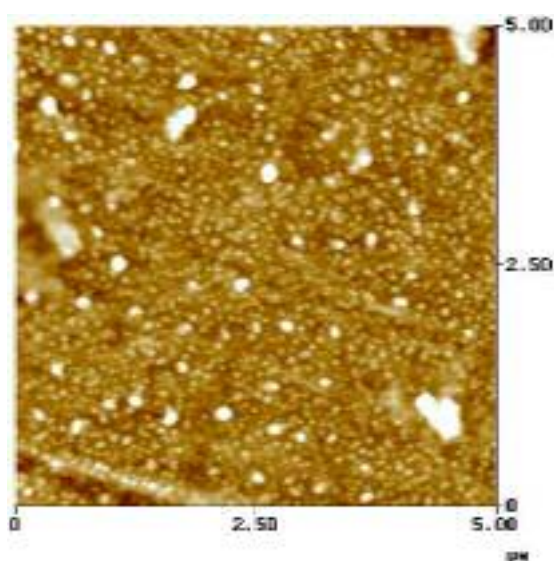
Step 8:

Examine article on a light box. Photograph any useful fingerprints immediately. Fingerprints developed with this process will fade, sometimes within a few hours. It is therefore essential to photograph them immediately. The SILVER coating is more fragile than that obtained from the GOLD/ZINC process, and more care should be taken in handling articles.

SILVER produces a uniform background stain on clear or white articles which may vary in colour from pale pink to brown or deep violet depending on the type of plastic. Ridges may appear darker or lighter than the background or a mixture of both in the same fingerprint.



A)



B)

Atomic force microscope images of polythene bag after VMD, showing differences in silver nuclei density which may account for observed colour differences. A) AFM image of polythene surface, B) AFM image of ridge region

If any force would like further details or advice on how to use the process, please contact Stephen Bleay.

Report on the International Fingerprint Research Group Conference

In April 2005 members of the HOSDB Fingerprint team attended the International Fingerprint Research Group meeting in Amsterdam. The host of this year's conference was the Netherlands Forensic Institute.

The meeting was very successful, with many other international fingerprint research organisations represented. Those attending were Canada (RCMP), US (Secret Service), Germany (BKA), Israel (National Police and Hebrew University), Australia (Australian Federal Police, Sydney University), France (Gendarmerie Nationale) Netherlands (Netherlands Forensic Institute) UK (FSS).



Lesley Fitzgerald presenting at the IFRG meeting at the Netherlands Forensic Institute in April

Each organisation presented current and completed research since the last meeting held at HOSDB, Sandridge in 2003. The meeting gave the opportunity to discuss ideas for future fingerprint development and comparisons of similar work.

Ideas for new work have been presented to the Fingerprint Development and Imaging User Group and have been incorporated into the Programme Plans.

IRIS User Group Meeting at HOSDB

The inaugural IRIS User Group meeting was held at HOSDB on 28th September. This was attended by over twenty users, including representatives from almost every site using

IRIS. The meeting enabled users to discuss common issues and to identify future hardware and software enhancements that could boost the performance of the existing system. Those attending were given a demonstration of a test version of the next software upgrade and were able to tour the new Fingerprint laboratories. It is intended to hold further User Group meetings as further system enhancements become available.

The Out of Office Experience

Following last year's OOOE at Grove House Hospice in St Albans, HOSDB has continued to support the local community this year. This resulted in members of the Fingerprint Group going 'back to school', and providing a morning of talks and practical experiments on taking fingerprints and fingerprint identification at the Sandringham School in Marshalswick. This was very well received by both pupils and staff, and hopefully will have inspired some forensic scientists of the future.

HEALTH AND SAFETY ISSUES

Use of Laptop Computers at Scenes of Crime

Some time ago, HOSDB was asked to provide guidelines for the use of laptop computers at scenes of crime. The particular issues causing concern were

- the health and safety of the user
- potential loss of data due to electrical malfunction

if the laptop were exposed to high concentrations of aluminium powder.

Following consultation with PITO and the National Fingerprint Board it was thought impractical to test the integrity of laptop circuitry in the presence of quantities of aluminium powder : different laptops would present a variety of individual situations.

It was therefore agreed to issue a set of recommendations based on a risk analysis, which took into account a number of factors.

1. Aluminium has low conductivity due to stearate coating
2. Aluminium powder is of sufficiently small particle size to prevent continuous electrical contact between exposed terminals
3. Circuit boards in laptops have protective non-conducting lacquer coating
4. As long as laptop casing is intact opportunity for ingress of powder is low

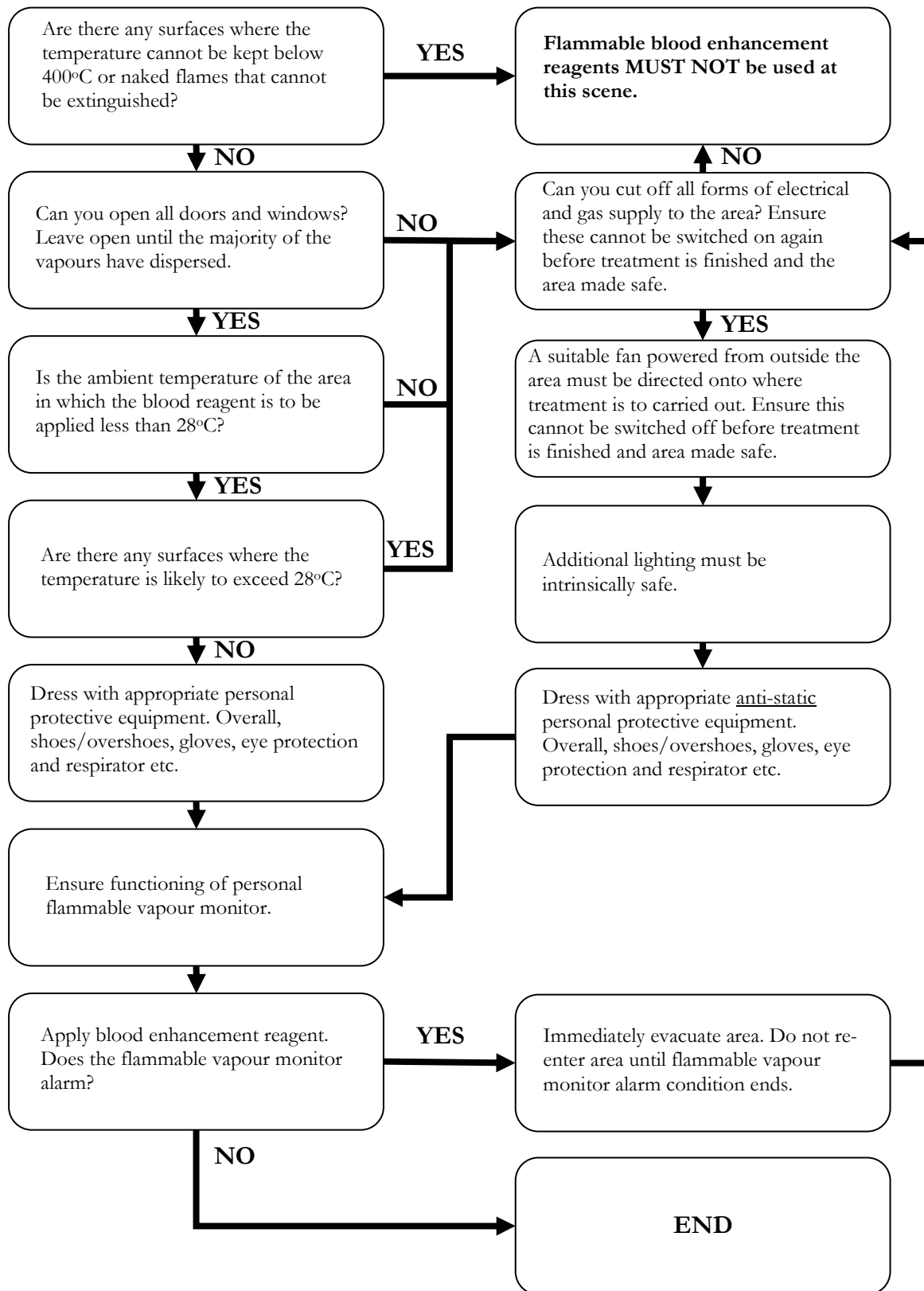
This resulted in an agreement at the National Fingerprint Board meeting in April 2005 that the following recommendations should be made.

Recommendations

1. Use laptop computers at a distance from the areas where powders are used, to minimise exposure
2. Use good powdering technique avoiding the use of excessive quantities of powder
3. Use aluminium powders bought to a specification which includes a stearate coating
4. The use of ruggedised equipment or protective covers for laptops may offer additional protection

COSHH Assessments at Scenes of Crime

Carrying out a COSHH and risk assessment before a fingerprint development process is used at a scene of crime can sometimes be difficult. Every scene is different and each has to be assessed individually. However, the assessment can be made easier by adopting a common approach. This can be done by listing all of the questions requiring yes or no answers that must be asked before a decision can be made. These can then be ordered logically and any compulsory issues, such as protective clothing added. A flowchart can then be produced like the example for the use of blood reagents at scenes of crime.



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