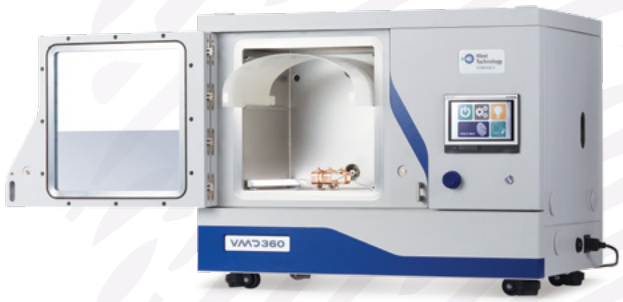
LATENT FINGERMARK DEVELOPMENT

VMD360



VMD560

VMD1260

FORENSIC VMD

West Technology FORENSICS

West Technology are the world's leading manufacturer of forensic VMD systems.

Our systems have been designed in consultation with leading forensic scientists to ensure ease of operation and consistent, uniform development of latent fingermarks.

Easy to use

Operating the VMD system could not be easier, using the intuitive, icon-based, full colour, touch-control screen.

The innovative design of the system provides quick and easy mounting and processing of evidence, with a typical cycle time, from start to finish, of less than 10 minutes.

Innovative design

Our VMD systems are self-contained, and only require an electrical supply for simple installation.

The innovative design of our systems provide the precise control of the deposition process to optimise the development of latent fingermarks across a wide variety of evidence substrates, including fabrics, metal, plastic, paper, polymers, ammunition and many more.

The unique configuration of the evaporation sources * enables a choice of any combination of 3 metal depositions, e.g., gold + zinc + silver, giving the operator maximum flexibility during a single VMD process.

The range, from the compact bench top VMD360 to the larger VMD560 and VMD1260 systems, means there is a system available to suit any customer's budget and laboratory space.

Other key features include:

A timed start function to ensure that the systems can always be ready to use, so that evidence can be processed immediately, optimising work flow and saving valuable time.*

A secure Ethernet connection, allowing for system software upgrades and remote diagnostics to be carried out no matter where in the world the system is located.

The systems require minimal maintenance with no need for costly filtration replacements.

Unlike some other forensic processes, VMD is extremely safe, with no health risk to the operator.

The latest generation of our VMD systems feature a fully automatic evaporation process at the push of a button.

New features

Using forensic VMD to process evidence has never been so simple, thanks to our unique automatic evaporation feature.

This groundbreaking innovation means that the operator can choose to automatically evaporate the gold metal on to the evidence, simply by pressing a button. Then other metals, such as zinc or silver, can also be automatically evaporated and the deposition instantly terminated by the operator.

*VMD560 and VMD1260

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THE NEW

VMD160

West Technology FORENSICS

Developing fingermarks using VMD® has never been easier thanks to the VMD160, the worlds only portable VMD system. Designed for use in both smaller forensic laboratories or mobile crime scene investigation laboratories.

The new VMD160 is operated via an intuitive, simple to use icon based touch screen. The unique control system and advanced vacuum technology provides convenient and easy processing of evidence.

The portable VMD160 is ideal for laboratories where space and budgets are limited, whilst giving them the capability to develop fingermarks on non-porous and semi-porous evidence.

Rapid evidence processing – in typically less than 15 minutes from start to finish.

Smaller items can be processed such as fired or unfired ammunition, small knives, bank notes, credit cards, thermal receipts, drug wraps and more.

The VMD process is a non-destructive process enabling subsequent DNA processing and ballistics testing.

FORENSIC VMD®

VMD160

Quick & Simple Operation

The VMD160 system takes seconds to start up meaning that evidence can be processed immediately, increasing work flow and saving valuable time. The VMD160 is operated via an intuitive, simple to use icon-based touch control screen. The unique control system and advanced vacuum technology provides processing times typically less than 15 minutes from start to finish on a non-porous item.

Evidence can be safely mounted by the use of magnets on a retractable evidence holder.

The evidence holder is placed within a stainless steel vacuum chamber, equipped with a clear acrylic door to enable the observation of the VMD process and the development of the latent finger prints or marks.

VMD Process

The VMD160 system can be used for single or multi-metal development techniques on non-porous or semi-porous evidence materials.

Specification

Case

- IP67 rated HPX Polymer
- 2 inline wheels with telescopic handle
- Height 62.5cm (24.6")
  Width 50.0cm (19.7")
  Depth 29.7cm (11.7")
- Total product weight 37kg (81 lbs)

Evidence Vacuum Chamber

- 2 Evaporation Boats
- Height 200mm (7.9")
  Width 150mm (5.9")
  Depth 100mm (3.9")

Evidence Holder

- White enamel coated Magnetic stainless steel
- Contoured for easy viewing of evidence
- Working area:
  Height 160mm (6.3")
  Width 130mm (5.1")
- Light weight 650g (1.4 lbs)

The VMD process is a non-destructive process enabling subsequent DNA processing and ballistics testing.

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THE PROCESS

Vacuum Metal Deposition

West Technology FORENSICS

Vacuum Metal Deposition (VMD) is the most powerful latent fingermark development technique available and has been approved by The Home Office Centre for Applied Science and Technology (CAST) as a Category A Process.

The technique is widely used to develop latent fingermarks on non-porous, semi-porous and porous exhibits. Fingermarks developed using VMD are a much higher quality (often with 3rd level detail), with excellent contrast and ridge clarity when compared to other methods available to forensic scientists.

The standard VMD process employs the sequential vacuum deposition of atomic layers of gold followed by zinc. Exciting new research has expanded the VMD technique to include single metal deposition processes, e.g., silver, sterling silver and copper, plus new multi-metal deposition processes, e.g., gold/zinc/silver and silver/zinc. These new processes are particularly successful on recycled and biodegradable plastics.

VMD has been proven to develop latent fingermarks on aged exhibits, including cold cases. The technique has also provided remarkable results on exhibits that have been submerged in water, buried underground or have been subjected to high temperatures, e.g., fired ammunition casings and arson.

VMD is the best technique for a wide range of exhibits, including – but not limited to – flexible plastic packaging, plastic bottles, glass, fabrics, firearms & fired ammunition, wood, glossy paper, thermal paper, polymer & paper bank notes.

Key research has shown that VMD can develop fingermark ridge detail on tight weave fabrics, e.g., Egyptian cotton. In addition, VMD has been used to to determine the sequence of events within a crime by visualising contact areas, e.g., grab impressions on fabrics, with the possible application to aid targeted DNA sampling.

The VMD process can also be used sequentially with other development techniques, making it ideal for processing cold cases that have been previously treated unsuccessfully using other development techniques.

The VMD process is very rapid (typically less than ten minutes) and produces high quality fingermarks that can be photographed straight away. The standard technique is very stable, developing fingermarks that will not fade and can be imaged many days later, if stored appropriately.

The use of alternative light sources has been identified as an excellent method to further enhance VMD developed fingermarks, e.g., reflected infrared imaging on substrates with complex printing and co-axial lighting on substrates with a reflective surface.

Photograph editing software can further enhance ridge details on substrates.

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KEY RESEARCH

Fired handgun ammunition

West Technology FORENSICS

Recent research carried out at West Technology Forensics' laboratory concluded that high quality ridge detail could be consistently developed from a range of fired rifle and shotgun cartridges using the forensic Vacuum Metal Deposition (VMD) process.

Our latest exciting research concentrated on fired cartridges from revolvers and semi-automatic pistols.

Visualising fingermarks on fired handgun cartridges has always been considered problematic, especially from semi-automatic pistols.

Amongst the possible reasons cited are the conditions within the chamber during firing, where the cartridge is exposed to high temperatures, excessive friction forces and the rapid expansion and contraction of the metal casing. Other possible factors include the loading of the magazine and the automatic ejection of the cartridge case after firing.

For this research, in collaboration with the UK Royal Armouries, five different revolver and semi-automatic pistol models were chosen, including a Colt M1911 and Smith & Wesson 29.

As with the previous research, fingermarks were deposited onto a range of cartridges including 357 Mag., 9mm, .44 Rem. Mag. and 45ACP.

Natural or sebaceous marks were placed onto cartridge samples and then the samples were allowed to naturally age for different time periods prior to firing.

Time period (from placement to firing)

< 5 minutes
1 hour
1 day
7 days
28 days

Metal processes tested

The previous research on fired rifle and shotgun cartridges had concluded that, of the 6 original VMD processes used, the most effective were 2 single metal and 2 multi-metal processes:

Silver
Sterling silver
Gold/zinc
Copper/zinc

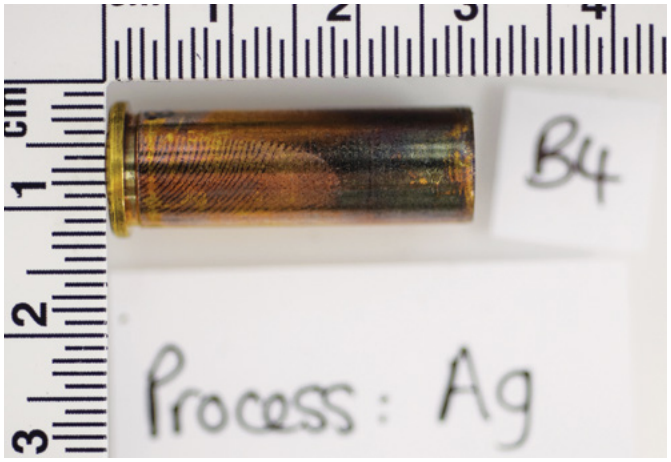
Results

The developed marks were assessed using a grading scale, as recommended by the UK Home Office.

The results of this study clearly showed that the most well-known gold/zinc VMD process was the least effective for fired handgun cartridges.

The most effective VMD process was silver; however, both the copper/zinc and sterling silver VMD processes also produced excellent results.

The grades for ridge detail developed from fired revolver cartridges were higher when compared to the semi-automatic pistol cartridges and further research is required to investigate the disparity. It was found that the larger calibre pistol ammunition had a greater success for fingermark visualisation, which could be due to the larger surface area.



Ridge detail was developed on 49% of samples processed. High quality, identifiable ridge detail was developed on 12% of handgun cartridges.

It was interesting that, as with the previous research on fired rifle and shotgun cartridges, the ageing of marks did not have a noticeable effect on the ability to develop ridge detail.

The overall success rates for developing and visualising ridge detail on fired handgun cartridges were reduced when compared to the results for rifle and shotgun cartridges; however, the success rate is still much higher than the <1% cited in existing published literature for other forensic techniques.

Other added benefits of the VMD process include:

- A much higher definition of ridge detail compared to other, more traditional techniques
- Quick processing of cartridges, in as little as 5 minutes
- Process 50 to 100+ cartridges in a single process (system dependant)
- Does not affect subsequent DNA testing
- Extremely safe process with no filtration needed
- Low cost per run
- Used operationally by Law Enforcement worldwide
- UK Home Office - Category A fingermark development process

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KEY RESEARCH

Fired ammunition

West Technology FORENSICS

Vacuum Metal Deposition (VMD) is known for its ability to develop high quality fingermarks on difficult substrates. West Technology Forensics undertook a two-month research study to test VMD's capabilities to develop fingermarks on fired ammunition – a notoriously challenging exhibit to recover fingermarks from.

Literature and operational forensic laboratories worldwide have noted the difficulty in developing sufficient ridge detail from fired cartridges, with the success rate for developing identifiable fingermarks typically <1%. It has been postulated that the mechanism of firing ammunition creates both high temperatures and abrasive friction on the surface of the cartridge, which removes any biological fingermark residue greatly reducing the development of latent fingermarks present and potential DNA recovery.

Ridge detail was developed on 82% of samples processed. High quality ridge detail was developed on 72% of shotgun cartridges and 65% of rifle cartridges.

The research work carried out at West Technology Forensics Laboratory aimed to determine if ridge detail could be developed from fired cartridges using the VMD technique[1]. Different metal processes were tested to establish if a particular metal or multi-metal combination might be superior over the others.

[1] Brewer, E.R.; *The Capability of Forensic Vacuum Metal Deposition for Developing Latent Fingermarks on Fired Ammunition: A Preliminary Study Comparing Alternative Metal Processes.* Journal of Forensic Identification. 2019, 69 (3), 299-327

Metal processes tested

Gold/zinc
Silver
Silver/zinc
Sterling silver
Copper/zinc
Aluminium/zinc

Fingermarks were deposited onto 12 bore, fibre wadded shotgun cartridges and Winchester Super X 243 rifle cartridges. Natural and sebaceous (using a reference pad) marks were deposited onto each of the cartridge samples prior to firing.

The samples were allowed to naturally age for different time periods prior to firing.

Time (from deposition to firing)

< 5 minutes
1 hour
1 day
7 days
28 days

Developed marks were assessed using a grading scale similar to that used by the UK Home Office.

Grade	Description of mark
0	No obvious ridge development
1	Evidence of touch
2	Low quality or limited ridge detail
3	Moderate quality ridge detail
4	High quality ridge detail resembling fingermark

For rifle cartridges, the silver VMD process was the most successful at developing ridge detail, with 80% of deposited marks being visualised to grade 3 or above. For sebaceous deposits, 100% of marks were developed to grade 2 or above by all metal processes tested.

Silver was the most successful metal process on rifle cartridges. No obvious deterioration in mark quality was observed for older samples.

Gold/zinc was the most successful metal process on shotgun cartridges. The quality of development increased over time for sebaceous marks.

Development on shotgun cartridges was graded in two stages due to the mix of plastic and brass material. Overall, gold/zinc was the most successful metal process, developing 70% of deposited marks. Silver, sterling silver and copper/zinc were also particularly successful at developing high quality marks on the brass material.

The aging of marks did not have a noticeable effect on the development of sebaceous marks for either ammunition type tested. Development quality reduced for natural marks after seven days.

The results of the study show that VMD offers strong capabilities in developing identifiable ridge detail on both ammunition types, with all metal processes successfully developing both natural and sebaceous marks.

Fingermarks developed by VMD are of a much higher definition (often to 3rd level detail) and have better contrast than marks developed using other techniques. The VMD process can also be used sequentially with many other traditional techniques.

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KEY RESEARCH

Knives – harsh conditions

West Technology Forensics recently carried out research on the development of latent fingermarks on knives that had been subjected to harsh environmental conditions to realistically simulate the challenging crime scenes where the evidence can be buried, subjected to high temperature, e.g., arson or discarded into a water source, e.g., river or lake.

Forensic Vacuum Metal Deposition (VMD) has repeatedly proven its capability in developing fingerprints on metallic items, such as fired cartridge casings, knives and firearms, which is one of the reasons why the UK Home Office recommends the forensic VMD as the 'go to' development process for untreated metals[1]. Their other recommendations for the VMD process include:

- Items exposed to high temperatures up to 900°C (1,652°F)
- Items where fingermark residue may have been removed
- Items that have been previously wetted or submerged

Based on these recommendations, forensic scientists at West Technology's Application Laboratory undertook a short research project to investigate the recovery of fingerprints from 30cm (12") steel knives subjected to harsh environmental conditions.

Metal processes tested

Initially three VMD metal processes were evaluated:

Gold/zinc
Silver
Silver/zinc

The next stage of the research was conducted using only the silver VMD process, as silver developed the best quality of ridge detail on both the knife blade and handle.

Natural marks from five donors were placed onto each side of the knives. One side was left untouched after deposition and the other was wiped with a paper towel after 15 minutes.

Each knife was then subjected to a different environmental condition:

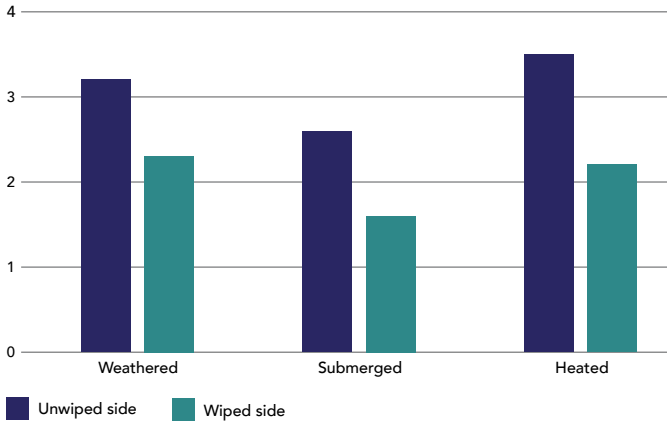
Submerged	Placed in a pond for 48hrs
Weathered	Buried in soil and leaves for 36 hrs
Heated	Placed into open fire at 270 °C (518°F) for 10 minutes

[1] CAST Fingerprint Visualisation Manual 2014

Grade	Description of mark
0	No obvious ridge development.
1	Some evidence of contact but no ridge detail.
2	Low quality or limited ridge detail. Suitable for exclusion.
3	Moderate quality ridge detail. Suitable for identification.
4	High quality ridge detail resembling fingermark. Suitable for identification.

Table 1: Grading scale for assessment of developed fingermarks

Summary of results



Grade 4 ridge detail with clear ridge definition, including sweat pore position and shape, was developed on an average of 35% of the total prints deposited.

VMD revealed 83% on untouched side and 61% on wiped side fingermarks with a Grade 2 or higher ridge detail.

Conclusion

The silver forensic VMD process offers great potential for developing latent fingermarks on metal substrates, such as knives, even when the surface of the substrate has been exposed to harsh environmental condition.

The successful development of ridge detail on the wiped side of the knife blade confirms that the forensic VMD process is a very effective process whether there is any biological residue from the fingermark present or not; this fact is corroborated by the results from the successful development of ridge detail on the knives that were heated.

VMD also successfully developed ridge detail on the plastic handles of the knives. This highlights the flexibility and sensitivity of the process across a wide range of substrate types.

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KEY RESEARCH

Glassine bags (stamp bags)

West Technology FORENSICS

Glassine bags (otherwise known as stamp bags) are small wax packets that are used to distribute illicit drugs, most commonly heroin. They are sometimes stamped with a logo by drug dealers to market their contents. The stamps on the heroin bags can provide important clues to investigators that often lead to the source of the drugs.

Introduction

Forensic Vacuum Metal Deposition (VMD) has repeatedly proven its capability in developing fingerprints on paper and polymer-based substrates. It was brought to the attention of our Forensic Scientists at West Technology's Application Laboratory that conventional forensic processes such as ninhydrin or cyanoacrylate fuming were unsuccessful in developing latent fingermarks on glassine bags.

A short research study was undertaken with the objective of investigating the potency of forensic VMD to develop identifiable ridge detail on a variety of glassine bags with and without stamps.

Metal processes tested

Initially 5 VMD metal processes were evaluated to determine the three processes that gave the best results:

Gold/zinc *
Silver
Silver/zinc *
Sterling silver
Copper/zinc *

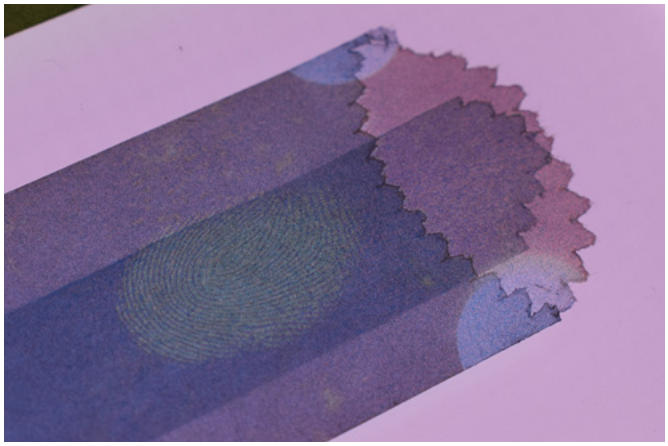
* Developed the best quality of ridge detail

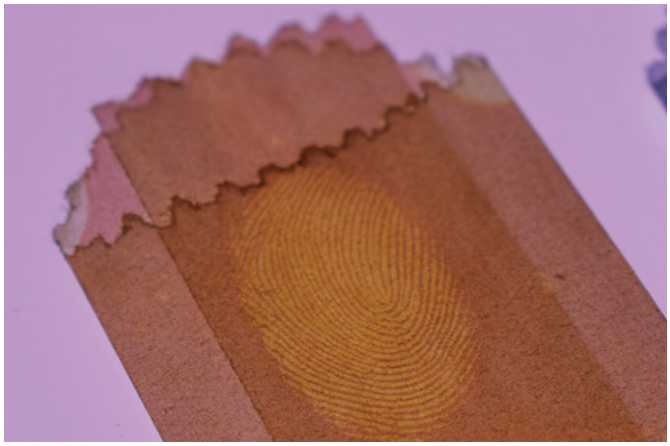
For this research, eight different glassine bag types were used. 4 solid colour plain bags and four stamped bags with mixed colours.

Natural fingermarks from three donors were placed onto each of the 288 samples and allowed to naturally age for different time periods.

Time (from deposition to processing)

1 day
7 days
14 days
28 days





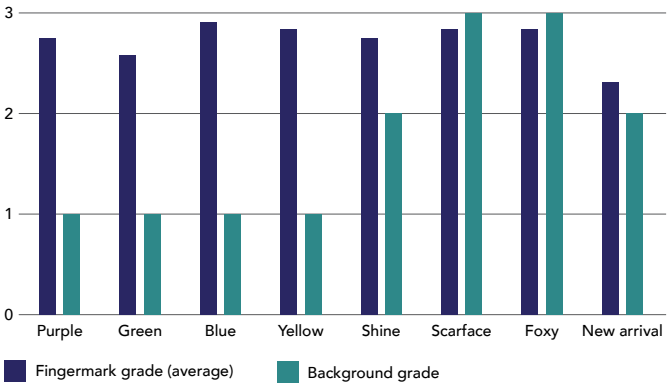
Results:

Every single fingermark from all donors was successfully developed with all three VMD processes, however some metal were more effective than others.

Grade	Description of mark
0	No obvious ridge development.
1	Some evidence of contact but no ridge detail.
2	Low quality or limited ridge detail. Suitable for exclusion.
3	Moderate quality ridge detail. Suitable for identification.
4	High quality ridge detail resembling fingermark. Suitable for identification.

Table 1: Grading scale for assessment of developed fingermarks

Summary of silver/zinc results



Silver/zinc VMD process developed grade 3+ ridge detail on 75% of the bags.

Grade	Description of background
0	No ink/pattern interference.
1	Some ink pattern details, light colour.
2	Up to 50% of developed fingermark obscured by background ink / pattern.
3	More than 50% of developed fingermark obscured by background ink / pattern / colour.
4	About 80–100% of fingermark obscured by background.

Table 2: Grading scale for assessment of background pattern

The most effective VMD process across the eight different bags was silver/zinc. Gold/zinc was the least effective of all three processes and copper/zinc developed good ridge detail but with less contrast.

It was noted however, that the use of additional infra-red imaging improved the contrast and could remove the background pattern. The results of this study show that forensic VMD is highly effective in developing fingerprints on glassine bags and offers an alternative to ninhydrin or cyanoacrylate fuming.

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KEY RESEARCH

Touch marks on fabrics

West Technology FORENSICS

Fabrics have been problematic substrates for developing latent fingermarks or areas of touch for all development techniques in the forensic field. The density of the fabric weave and the length of time between handling the fabric and subsequent analysis are important factors that can reduce the ability of a technique to develop latent fingermarks.

Forensic VMD is a proven forensic technique for developing latent fingermarks on fabrics. The developed fingermarks, often have identifiable ridge detail, but even if no ridge development is possible, the technique will develop areas of touch, e.g., grab marks, for DNA sampling. Forensic VMD has a very low interference with any subsequent DNA testing, making it the best technique for analysing fabrics.

The most well-known VMD process currently is the gold and zinc development, and this has shown some good results on a range of fabrics; however, scientists at West Technology undertook research to investigate the latest single metal and metal combinations that have been successfully used on other substrates, such as plastics and polymers.

The research used eight different single metal/metal combinations on a range of six different fabric types to investigate the best process for each fabric type.

Fingermarks from seven different donors plus a control print were deposited on the fabrics and the samples were allowed to naturally age for 1, 7, 14 and 28 days.

Single Metal/Metal Combinations

Gold/zinc *
Silver
Silver/zinc *
Aluminium/zinc *
Sterling silver
Sterling silver/zinc
Copper
Copper/zinc *

* Best results across the range of fabrics tested.

Fabrics

Felt
Polyester
Satin
Cotton
Linen
Denim

For each fabric type, a dark and a light colour material was processed.

Results

- A total of 3072 latent fingermarks were processed and graded using the Bandey Grading Scale
- 84.9% (2607) latent fingermarks were developed to at grade 1 or better (suitable for targeted DNA sampling)
- Gold/zinc developed 375 out of 384 marks (97.6%), 20% of which to identifiable details on the 1-day samples
- Metal combinations developed more aged fingermarks (95.4%) than single metals (67.4%)
- Gold/zinc metal combination developed 97.6% of fingermarks processed (375 out of 384 marks)
- Gold/zinc metal combination developed 20% of fingermarks on 1-day samples to identifiable ridge details (grade 3 or 4)
- Aluminium/zinc metal combination had the highest success rate for developing 7-day (7.1%) and 14-day (4.3%) aged fingermarks to identifiable ridge details (grade 3 or 4)
- Copper/zinc metal combination was also effective for developing 7-day (6.2%) and 14-day (4.0%) aged fingermarks to identifiable ridge details (grade 3 or 4)
- Silver/zinc and aluminium/zinc were the only metal combinations to develop marks to identifiable ridge details (grade 3 or 4) on the 28-day old samples (2%)

Conclusion

- Forensic VMD successfully developed fingermarks on all six types of fabrics, both dark and light versions
- Development of touch and fingermarks could potentially help the identification of those involved in criminal incidents through the development of ridge detail
- The results confirm that the success rate for ridge detail recovery increases with the density of the fabric weave
- Forensic VMD is a very effective technique for developing touch fingermarks which can identify points of human contact on the fabric, and can provide important information on the type of contact, e.g., touch, grab, push etc.
- Because Forensic VMD has a very low interference rate on DNA recovery, the identified touch areas can be sampled for targeted DNA profiling
- The results confirmed that the success rate for ridge detail recovery decreases as the fingermarks age

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AFTER SALES

VMD training, installation & support

West Technology FORENSICS

West Technology Forensics is committed to providing first class training to our customers. We have a specialist team of highly skilled training instructors and installation engineers. We are also dedicated to offering our customers and other VMD users detailed, effective technical application support should help be required with a particular substrate type.

West Technology Forensics is the world's leading provider of forensic VMD systems for latent fingermark development.

Our experienced and knowledgeable instructors provide full training in all aspects of forensic VMD including system operation and the application of the VMD process to a wide range of substrate types.

We offer two levels of training course:

Operational
The training covers all aspects of system use and the gold/zinc and silver forensic VMD processes.

Advanced
The training is for customers who want to learn more about alternative metal processes and imaging developed fingermarks.

We offer individual or group training packages, either at the customers premise or at West Technology's modern training facility in Yate, U.K.

A typical training course consists of the following:

- System operation
- Substrate handling
- VMD processing techniques
- Substrate type and choice of VMD process
- Sequential processing
- The basics of vacuum
- Good housekeeping practices

We are also happy to offer bespoke packages that are specifically formatted to suit our customers' exact needs.

Our modern, well equipped Application Laboratory is staffed by our team of forensic scientists.

West Technology are at the forefront of forensic VMD research with a range of projects, both in-house and collaborative with some of the world's leading forensic academic research institutes.

The breadth of our in-house research program also includes looking at key aspects of VMD system design to further improve and optimise them for use in forensic and fingerprint laboratories.

Every system is supplied with a comprehensive installation and training package as standard, something no other provider can offer.

The intense nature of the demands on forensic laboratories to process exhibits rapidly and effectively is something that West Technology Forensics puts at the heart of their technical and service support policy.

We provide unrivalled technical and service support which includes:

- Secure, internet based, remote diagnostic support
- Local support in over 50+ countries worldwide
- On-going support and servicing
- Flexible service contracts
- Remote software upgrades

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