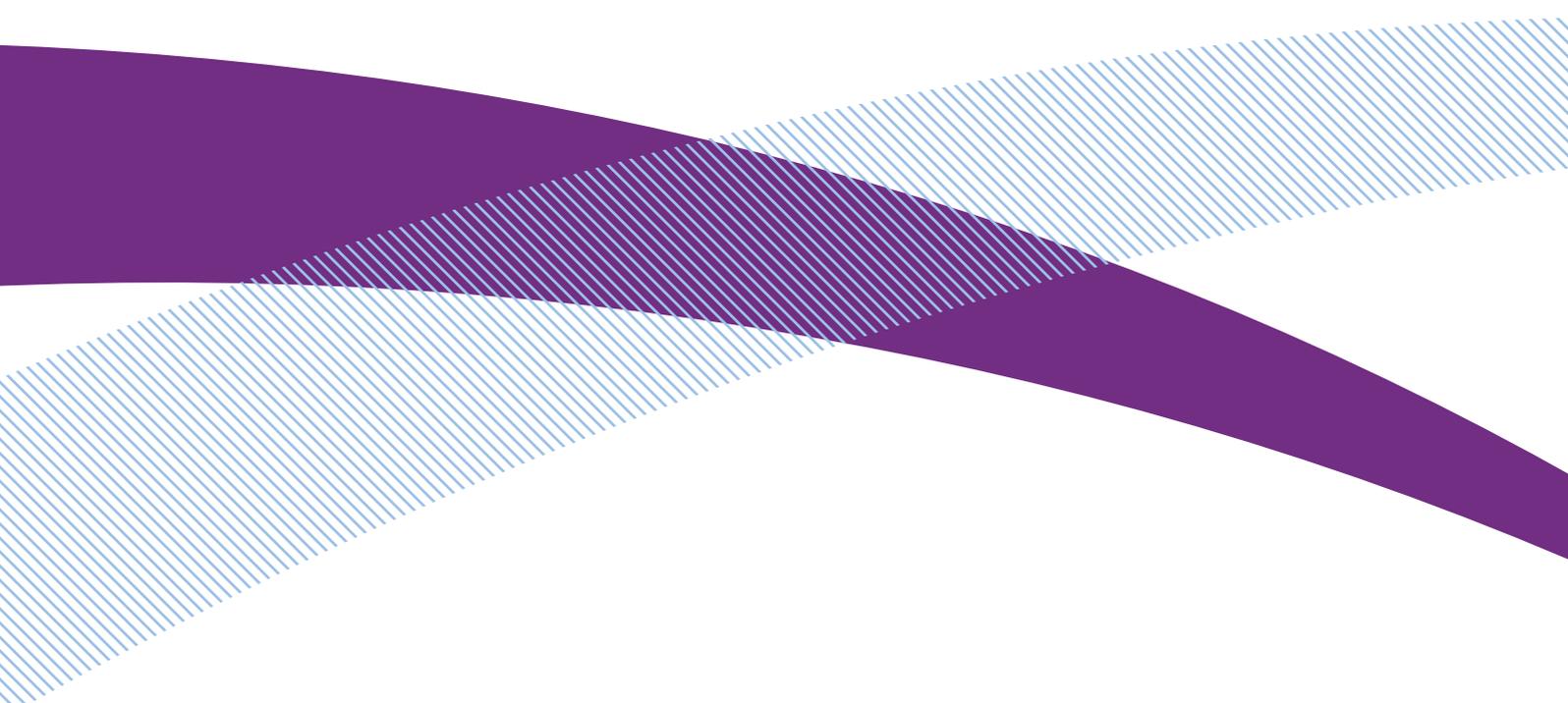




Home Office

Fingerprint Source Book

S M Bleay
V G Sears
H L Bandey
A P Gibson
V J Bowman
R Downham
L Fitzgerald
T Ciuksza
J Ramadani
C Selway



Authorisation

This *Fingerprint Source Book* has been signed off to my satisfaction and is authorised for circulation, as appropriate.

CAST recognises that the information contained within it, while believed to be correct at the time of writing, may be subject to change as more information becomes available. We would welcome feedback from those using the book, which will be subject to regular review to incorporate appropriate changes.

Chief Technical Officer (Home Office CAST) Steve Barber

Signature  Date 12 March 2012

This Page Intentionally Left Blank

Preface

This preface places the publication of this *Fingerprint Source Book* into context, and represents the situation at the time of writing (October 2011).

The *Fingerprint Source Book* was not originally intended as an external publication. It was prepared as an internal reference document, drawing together all of the information held by the Home Office Centre for Applied Science and Technology (CAST) regarding internally managed experimental work on finger mark enhancement techniques. The preparation of the document was carried out in anticipation that supporting evidence would be required for validation of the techniques within the *Manual of Fingerprint Development Techniques*, as part of the ISO 17025 accreditation of the CAST forensic laboratories. The original purpose of the document was to demonstrate to UKAS (the ISO 17025 assessors) and the Forensic Science Regulator that the processes and sequences outlined in the manual had been experimentally tested and that the advice presented in the manual was valid.

As CAST and police force laboratories have progressed with the ISO 17025 accreditation process, the *Fingerprint Source Book* has become regarded as a more widely important document. Because it provides the validation of the techniques contained within the manual, and hence the techniques used by police forces, it has become necessary for the document to be formally issued and controlled. This means that the data contained within it can be directly referred to by individual police forces seeking ISO 17025 accreditation, thus reducing the requirement on police forces to conduct lengthy validation experiments of their own (although local verification experiments will still be required). The Forensic Science Regulator has also requested that the data contained within the *Fingerprint Source Book* is made publicly available for reasons of transparency.

The document is now presented for use as a controlled document. It is not produced as a formal, numbered Home Office document because this is incompatible with the contents. However, the document has been reviewed by the Home Office communications team to ensure that fundamental formatting is acceptable, and a technical review has been carried out covering both internal and external peer reviews of the contents.

A user of the *Fingerprint Source Book* should be aware of the original purpose for which it was prepared. Although it may be a useful source of data for those wishing to conduct research or learn more about various enhancement processes, it is not intended to be a text book. It has been prepared for laboratories that are currently working to the Home Office CAST *Manual of Fingerprint Development Techniques*, therefore the principal formulations described in the source book are those recommended by CAST in the manual. Less attention is given to formulations produced by other organisations, and to processes that are not included in the manual. Significant numbers of the references may refer to reports produced by students working at CAST rather than external journal publications. The user

must therefore be aware that it will not always be possible to obtain copies of every document referred to in the text.

Most sections in the *Fingerprint Source Book* were last extensively reviewed in mid-2010. There have been developments in several areas since then, and CAST has also conducted additional research. It must therefore be recognised that the information contained within this document may not be fully up to date, although a review schedule has been put in place for ongoing maintenance of the document.

Table of contents

Authorisation	i
Preface	iii
1. Introduction	1
2. Finger mark examination techniques within scope of ISO17025	3
2.1 Visual examination	3
2.2 Fluorescence examination	16
3. Finger mark development techniques within scope of ISO17025	39
3.1 Acid dyes (acid black 1, acid violet 17, acid yellow 7)	39
3.2 Basic violet 3 (Gentian Violet)	62
3.3 1,8-Diazafluoren-9-one (DFO)	82
3.4 Ninhydrin	105
3.5 Physical developer	135
3.6 Powders	157
3.7 Powder suspensions	178
3.8 Small particle reagent	206
3.9 Solvent black 3 (Sudan Black)	219
3.10 Superglue (cyanoacrylate fuming)	233
3.11 Vacuum metal deposition	269
4. Finger mark imaging techniques	289
4.1 Ultraviolet imaging	289
4.2 Infrared imaging	300
4.3 Multispectral imaging	312
5. Alternative finger mark development techniques	322
5.1 Alternative blood reagents	322
5.2 4-Dimethylaminocinnamaldehyde (DMAC)	338
5.3 Electrochemical techniques	347
5.3.1 <i>Etching and electrodeposition</i>	347
5.3.2 <i>Heating and electrostatic powdering</i>	351
5.4 Electrostatic detection apparatus (ESDA)	354
5.5 Fuming techniques	361
5.6 Gelatine lifting	365
5.7 1,2 Indandione	378
5.8 Ninhydrin analogues	392
5.9 Miscellaneous amino acid reagents	398
5.9.1 <i>Fluorescamine</i>	398
5.9.2 <i>O-phthaldialdehyde</i>	402
5.9.3 <i>Genipin and lawsone</i>	407
5.9.4 <i>Alloxan</i>	414
5.9.5 <i>4-chloro-7-nitrobenzofurazan (NBD chloride)</i>	416
5.9.6 <i>Dansyl chloride</i>	418
5.10 Iodine	421
5.11 Multimetal deposition	442

5.12 Oil Red O	450
5.13 Other lipid specific reagents	455
5.13.1 Ruthenium tetroxide (RTX)	455
5.13.2 Osmium tetroxide	458
5.13.3 Europium chelate	460
5.14 Radioactive sulphur dioxide	464
5.15 Silver nitrate	479
6. Specialist imaging techniques	484
6.1 Scanning electron microscopy	484
6.2 X-ray imaging	489
6.3 Other specialist imaging techniques	497
6.3.1 Secondary ion mass spectrometry (SIMS)	497
6.3.2 Scanning Kelvin probe	500

Chapter 1: Introduction

The *Fingerprint Source Book* is primarily intended to provide the background and validation for the techniques currently (up to 2011) recommended by the Home Office Scientific Development Branch (HOSDB), now the Centre for Applied Science and Technology (CAST), and to publish, in some cases for the first time, data collected over 35 years of research. It will therefore often present information in an 'CAST-centric' way, emphasising research that was carried out at Sandridge or Horseferry House, possibly sometimes at the expense of research carried out elsewhere. It is not the intention of the authors to ignore the significant contributions made by other research groups and apologies are made in advance if this sometimes appears to be the case. The document is also aimed at providing the UK Forensic Science Regulator and the United Kingdom Accreditation Service (UKAS), which will carry out ISO 17025 accreditation in the UK, with the background evidence behind the advice given in the *Manual of Fingerprint Development Techniques*.

The priorities of CAST in issuing and supporting the *Manual of Fingerprint Development Techniques* and the *Fingerprint Development Handbook* are to provide techniques that are highly effective, safe to use, and can be applied by staff who are not necessarily highly-qualified scientists. When developing formulations the approach is to maintain the effectiveness of the technique while minimising or eliminating any components that have health and safety issues associated with them. In some cases, more effective formulations or processes may be available, but if they are not felt to be safe to use they will not be recommended.

It should be emphasised that all testing and optimisation of processes by CAST has been carried out under UK climatic conditions. It is recognised that in many parts of the world the conditions of temperature and humidity will differ significantly from those in the UK and in some cases this may affect performance. It is likely that optimised formulations in different countries may differ for this very reason.

Throughout the report, references are made to the two main fingerprint research groups in the UK, CAST and the Forensic Science Service (FSS). These organisations have changed names several times in the 35 years covered, and in the text reference is usually made to the name of the group at that time. However, inconsistencies may arise. In summary, previous names for each organisation have been:

CAST

Police Research and Development Branch (PRDB) 1969 -1971

Police Scientific Development Branch (PSDB) 1971 - 1981

Home Office Scientific Research and Development Branch (HO SRDB) 1981 - 1991

Police Scientific Development Branch (PSDB) 1994 -2004

Home Office Scientific Development Branch (HOSDB) 2004 - 2011

FSS

Home Office Central Research Establishment (HO CRE) 1967 – 1988
Home Office Forensic Science Service (FSS), Central Research and Support Establishment (CRSE) 1988 - 1992
Aldermaston Laboratory closed (1992), Metropolitan Police Forensic Support Laboratory (MPFSL) absorbed by the FSS (1996). Fingerprint research subsequently split between FSS Lambeth and FSS Trident House, Birmingham.

Early research also conducted by the Atomic Weapons Research Establishment (AWRE) under contract to CAST.