Forensic Science Regulator
Overseeing Quality

Guidance

The Control and Avoidance of Contamination In Crime Scene Examination involving DNA Evidence Recovery

FSR-G-206

DRAFT ISSUE

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1. INTRODUCTION

1.1.1 For the purposes of this appendix, contamination is defined *as "the introduction of DNA, or biological material containing DNA, to an exhibit at or after the point when a controlled forensic process starts"*. This is distinct from the adventitious transfer of biological material to an exhibit that can also occur, usually prior to the exhibit or sample being recovered[1] and before investigative agencies have intervened.

1.1.2 From a forensic science perspective, crime investigation activities can be considered as two distinct phases:

a. the pre-submission phase (scene/victim/suspect), during which investigative agencies are involved in locating, recovering, packaging, storing and transporting exhibits; and

b. the analytical phase (laboratory) in which the recovered exhibit is processed within a laboratory.

1.1.3 Contamination can occur at any point in these investigation phases. The principal sources of DNA contamination are:

a. from personnel to the exhibit/DNA sample;
b. from contaminated consumables (for example, swabs, tubes) to the exhibit/DNA sample; and
c. from exhibit to exhibit or DNA sample to DNA sample.

1.1.4 Contamination may occur as follows:

a. directly[2] (for example, saliva or dandruff from an examiner falling on to an exhibit), or
b. Indirectly[3] (for example, biological material present on the outside of exhibit packaging being transferred on to the gloves of an examiner who opens the package and fails to change their gloves before handling the contents, resulting in the indirect transfer of contamination to the exhibit).

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1 Often referred to as background DNA.
2 Also described as primary transfer.
3 Also described as secondary transfer.

1.1.5 Contamination may be sporadic, that is resulting from an incident affecting just one DNA sample from a number in a batch or 'blanket' contamination resulting from an event that affects a whole batch or series of DNA samples at the same time.

1.1.6 Anti-contamination measures fall into two core areas of activity.

a. Prevention of contamination as far as is practicable. Preventative measures involve:

   i. minimising the chance of contamination occurring by, for example, staff using barrier clothing;
   ii. restricting access to areas containing exhibits;
   iii. cleaning scene examination equipment and laboratory surfaces;
   iv. rendering consumables free from detectable levels of DNA; and
   v. ensuring that equipment used at scenes of crime is adequately decontaminated between scenes.

b. Detection of contamination primarily involves:

   i. comparison of DNA profiles generated from items against a database of reference DNA profiles from personnel from whom there is a significant risk of contamination;
   ii. comparison of DNA profiles to results detected from quality assurance (QA) testing of reagents and consumables and from laboratory controls;
   iii. cross-checking of profiles within the same batch of samples and from different batches of samples processed within the same laboratory;
   iv. investigation of unexpected results; and
   v. incorporation of appropriate laboratory controls into the forensic process.

1.1.7 It is recognised that DNA contamination incidents cannot be eliminated completely, given the prevalence of human DNA within the living and working environment, and the issue is exacerbated by the increasing sensitivity of DNA analytical techniques.

1.1.8 Nothing can be done to reduce background DNA at scenes of crime (SOC), but it is essential that everyone in the investigative process is:

a. aware of the importance of maintaining the integrity of evidence; and
b. takes appropriate steps to minimise the risks posed by the inadvertent addition or the transfer of DNA during crime scene examination or other stages of the forensic analysis process.

1.1.9 Therefore, an effective DNA anti-contamination process requires a combination of approaches both to minimise the opportunity and therefore the risk of occurrence and to maximise the ability to detect contamination when it does occur.

1.1.10 The purpose of this document is to provide guidance on how to control and avoid the incidence of DNA contamination during crime scene examination, including the recovery of items, their packaging, transportation and storage prior to submission for forensic examination.

1.1.11 This appendix should be read in conjunction with FSR-P-302: *DNA contamination detection: The management and use of staff elimination databases* (Forensic Science Regulator,); PAS 377:2012: *Specification for consumables used in the collection, preservation and processing of material for forensic analysis*; and ISO 18385 (in draft) *Minimizing the risk of human DNA contamination in products used to collect, store and analyse biological material for forensic purposes*.

1.1.12 The interaction of the Forensic Science Regulator's (FSR's) guides together with the consumable standards is shown in Figure 1.

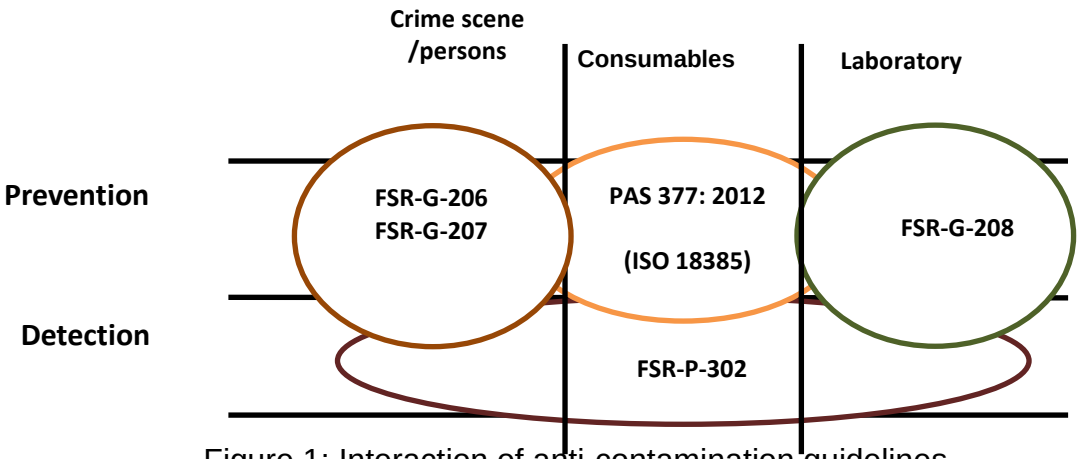

Figure 1: Interaction of anti-contamination guidelines.

2. SCOPE

2.1.1 The scope of the Forensic Science Regulator's *Codes of Practice and Conduct for Forensic Science Providers and Practitioners in the Criminal Justice System* (the Codes) encompasses initial forensic science activity at scenes of crime, which includes the following:

a. the scene examination strategy;
b. the recovery, preservation, transport and storage of exhibits; and
c. screening tests for use in the field.

It is widely acknowledged that ISO/IEC 17020 – *General criteria for the operation of various types of bodies performing inspection* is the international quality standard most appropriate to scenes of crime work.

2.1.2 Guidance on the application of this standard to scene of crime examination is provided by both the UK Accreditation Service (UKAS) and the European Network of Forensic Science Institutes (ENFSI) in the documents RG201 *Accreditation of Bodies Carrying out Scene of Crime Examination: Edition1; April 2013* and ILAC G19:08/2014 *Modules in a Forensic Science Process*. These provide high level requirements with regard to anti-contamination measures including:

a. demonstrating that reagents and kits used at scenes are fit for purpose;
b. a risk assessment of issues surrounding the potential for cross-contamination between samples; and
c. an assessment of each individual scene to ensure that suitable anti-contamination measures are in place.

2.1.3 Whilst there is considerable guidance available on scenes of crime operating policies and procedures, relatively few publications specifically address DNA contamination issues and the most informative of these are included in the bibliography (section 16). This document collates the latest thinking on DNA anti-contamination measures and correlates this against the relevant sections of the ISO/IEC 17020 standard to assist in accreditation assessment.

2.1.4 This document provides requirements and guidance regarding anti-contamination measures to be taken at crime scenes. These include:

a. recovery and packaging of exhibits;
b. transportation and storage of exhibits prior to submission to a laboratory facility for subsequent examination; and
c. recovery of evidence, which may be undertaken either within the police force facilities or by a forensic science provider (FSP).

2.1.5 Within the scope of this document is the use of drying cabinets, given that these may be used as an interim processing stage prior to the submission of items to a laboratory for assessment and analysis. Outside of the scope is the recovery of evidence and taking of reference samples from either victims or arrestees, which will be covered in a separate guidance document.

2.1.6 This appendix applies to England and Wales. Scotland and Northern Ireland should also institute parallel arrangements for their jurisdictions.

3. IMPLEMENTATION

3.1.1 This appendix is available for incorporation into an organisation's standard operating procedures and quality management system from the date of publication. The requirements set out in this document comes into effect from October 2016.

4. MODIFICATION

4.1.1 This is a draft consultation issue of this document. The finalised document post-consultation will form part of the review cycle as determined by the Forensic Science Regulator.

5. TERMS AND DEFINITIONS

5.1.1 The terms and definitions set out in the *Codes of Practice and Conduct for Forensic Science Providers and Practitioners in the Criminal Justice System* (Forensic Science Regulator) *and DNA contamination detection: The management and use of staff elimination DNA databases*, FSR-P-302 (Forensic Science Regulator) apply.

5.1.2 The word 'shall' has been used in this document where there is a corresponding requirement in ISO/IEC 17020 or the Forensic Science Regulator's *Codes of*

Practice and Conduct for Forensic Science Providers and Practitioners in the Criminal Justice System; the word 'should' has been used to indicate generally accepted practice and the word 'may' has been used as recommendations.

6. ANTI-CONTAMINATION STRATEGY (ISO/IEC 17020 Clause 10.2, 10.6[4])

6.1 Crime Scene Anti-Contamination Strategy

6.1.1 At scenes of crime the risk of contamination shall be minimised as far as is practically possible. A key element of this, especially for serious and major crimes, i.e. where a Crime Scene Manager (CSM) or equivalent is deployed, is to manage activities both within and outside the scene and at other relevant locations in a strategic and coherent fashion to ensure that contamination risks are understood and mitigated as far as practically possible.

6.1.2 This applies not just to a particular scene or secondary scene, but across a case or linked cases, addresses and vehicles.

NOTE: The anti-contamination strategy should not be seen to cover health and safety risk assessments in a scene; these are separate issues.

6.1.3 For each serious and major scene of crime (SOC) an overall and fully documented forensic strategy is required. The anti-contamination strategy is a component of this and shall:

a. be tailored around the known circumstances of the investigation;
b. commence at the earliest practicable opportunity following first receipt of case-specific information;
c. be subject to continual review and modification as the investigation develops;
d. be properly documented and effectively communicated to all relevant staff.

6.1.4 Factors that shall be considered and written into the anti-contamination strategy include the following:

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[4] RG201 (2013) *Accreditation of Bodies Carrying out Scene of Crime Examination,* sections 7.1.2 and 7.1.6 stipulate that the organisation shall have collated data to demonstrate the suitability of the whole process of scene examination including strategy setting. The scene strategy needs to be documented for each scene and be made specific to the scene in question where a generic strategy is deemed not to meet the requirements.

a. prior to scene attendance
b. environmental factors
c. staff deployment
d. cordons and scene protection
e. scene assessment
f. contamination risks between different parts of the same scene
g. use of dogs
h. handovers
i. release of a scene

Prior to scene attendance

6.1.5 This shall apply to all individuals including investigators, witnesses, suspects or other members of the public. Physical proximity of the scene to a suspect or victim's address or vehicle, and any personal protective equipment (PPE) worn by the above shall be recorded.

6.1.6 The strategy should provide a record of previous entry to the scene and their activities, for example, where did they go and what did they touch before control was established?

6.1.7 Environmental factors such as:

a. hot conditions that introduce a higher risk of contamination (for example, scenes where extreme heat introduces the risk of contamination due to perspiration whilst undertaking recovery activities); and
b. linking of environments such as communal corridors, waterways or streets.

Staff deployment

6.1.8 Avoidance of utilising the same personnel, vehicles or equipment that have attended a scene related to the same offence, a linked scene or incident, or have been involved in laboratory examination of items recovered from the same case.

6.1.9 Where operational imperatives dictate that utilising the same staff cannot be avoided, due consideration before deployment shall be given to:

a. the risks and possible transfer mechanisms for material to pass from one scene to another and how these can be mitigated (such as the use of

different vehicles and equipment) to provide support to examination at different scenes associated with the same crime or a linked crime; and

b. showering and change of clothes for practitioners, and ensuring adherence to strict cleaning and decontamination measures for equipment between scenes.

6.1.10 Due consideration should also be given to the closeness of scenes with interrelated cross-contamination risks, such as nearby properties where there is a risk that staff may attend the wrong scene or area by mistake.

Cordons and scene protection

6.1.11 Cordons shall be sufficient and positioned appropriately as a key anti-contamination measure.

6.1.12 The scene cordon, and scene log, shall be assessed by the first attending Crime Scene Investigator (CSI)/SOC Officer (SOCO) and amended if evidence or forensic opportunities are in imminent risk of loss or contamination. Appropriateness shall also be checked by the Crime Scene Manager (CSM).

6.1.13 Control of the cordon shall be maintained by officers who are aware of what their role entails.

6.1.14 Access to the scene should be controlled as a single point of entry, and wherever possible a common approach path is established.

6.1.15 Utilising scene entry tents is an example of good scene management. These can be separated into different areas for putting PPE on and taking it off, and for packaging and disposing of dirty PPE.

6.1.16 It is the responsibility of the CSM to ensure that the minimum number of people required to undertake the effective examination of the scene are admitted.

Scene assessment

6.1.17 In the initial assessment of the scene appropriate precautions shall be taken to preserve evidence on floors, for example, by using cleaned stepping plates or identifying a controlled pathway through the scene.

6.1.18 This shall identify what parts of the scene are under protection and the anti-contamination measures required within these including:

a. parts where PPE shall be worn;
b. parts where PPE shall not be worn (for example, where overshoes must be removed);
c. protection of ground surfaces including where stepping plates are to be deployed;
d. designated areas for disposal of waste such as used PPE.

6.1.19 Where an exhibit is assessed to be too great a biohazard to be handled, transported and/or stored, relevant professionals should be deployed to deal with it in accordance with Health and Safety regulations.

6.1.20 Contamination risks between different parts of the same scene

a. Inadvertent movement of material from one part of a scene to another constitutes a contamination risk, for example, communal living areas or shared/public areas within scenes or where rooms within a scene have been ascribed particular significance by witnesses. Under these circumstances, additional measures to avoid cross-contamination shall be considered:

    i. to control entry to and exit from specific areas within the scene;
    ii. examination of different rooms on different days or by different personnel;
    iii. change of PPE and/or other equipment between different parts of the same scene. Under these circumstances PPE/other equipment should be retained to allow for subsequent assessment as to whether cross-contamination may have occurred.

Use of dogs

6.1.21 Where the use of dogs for locating body fluids within a scene of crime is being considered, the risks of contamination shall be assessed along with the feasibility of utilising less contamination-prone alternatives.

6.1.22 Dogs may introduce DNA from outside the scene including:

a. from individuals who have handled the dogs;
b. transferring material from one part of a scene to another;
c. transferring material out of the scene; and

d. potentially compromising the capability of obtaining DNA results by contaminating items with their own oral mucus, which strongly inhibits the DNA amplification polymerase chain reaction (PCR).

6.1.23 It is recognised, however, that for certain scenarios such as searching large woodland areas, there may be no viable alternative to canine searches. Where this is the case the sequence of activities should be included in the case strategy and notes taken regarding where and when the dogs were used together with a note of the contamination risks.

Handovers

6.1.24 During the handover of responsibilities to new staff, briefing shall be provided on the anti-contamination strategy and anti-contamination measures.

Release of a scene

6.1.25 Prior to the release of a scene, sufficient steps shall be taken to minimise the risk of material relating to the offence remaining and being inadvertently transferred once the scene is released. This includes, for example, cleaning blood and other body fluids from communal or publicly accessible areas.

6.2 Anti-Contamination Strategy Across a Case

6.2.1 Throughout the duration of an investigation specific notes should be made of each scene including:

a. dates and times of examinations;
b. all the anti-contamination measures implemented and reasons for these, including measures to minimise the risk of specific identified contamination risks;
c. the personnel deployed and for what purpose.

These provide the basis on which to assess contamination risk and to formulate and manage the case anti-contamination strategy.

7. PERSONNEL (ISO/IEC 17020 Clause 6.1.3)

7.1.1 All personnel whose role includes attendance at scenes shall be trained and fully competent with regard to DNA anti-contamination measures.

7.1.2 Key to this is being trained in and demonstrating knowledge through assessment of:

a. contamination issues including contamination theory and understanding the mechanics of contamination, the rationale behind anti-contamination measures, and practical knowledge of any anti-contamination-related standard operating procedures (SOPs) employed at scenes to avoid contamination;
b. issues relating to contamination risks and their avoidance in specific processes and methods shall be an integral part of staff training documentation and the relevant issues shall be included within the training plans and manuals.

This appendix to the Codes (Forensic Science Regulator) shall be introduced to all scene-going investigators.

7.1.3 All personnel attending a scene shall be made fully aware of the risks specific to the scene and how they are to be mitigated. Aside from police investigators this may include the following categories: forensic scientists; exhibits officers; CID officers; Family Liaison Officers; Forensic Pathologists; Police Search Advisers and licensed search officers; staff from forensic science providers (FSPs); undertakers; and personnel from other emergency services including paramedics and fire service staff. It is the responsibility of the Crime Scene Manager (CSM) to ensure that all individuals attending the scene are aware of, and conform to, the anti-contamination measures specific to the crime scene in question as defined in the scene anti-contamination strategy.

7.1.4 Anyone suffering from a short-term medical condition that causes the shedding of body fluids or particles (for example, colds, coughs, influenza, elevated temperature promoting sweating or hay fever) should be actively discouraged from attending the scene. There is also an increased risk of contamination from individuals who are naturally heavy shedders of or have certain skin conditions. This increased risk may be acceptable provided that it is effectively managed by the use of appropriate personal protection equipment (PPE) and adherence to anti-contamination procedures and that the DNA profile of the affected

individual is available for searching against on the relevant elimination database (7.1.6, 11.1.4).

7.1.5 All staff called to a scene shall ensure that they have sufficient equipment to undertake their duties including taking effective anti-contamination measures. This includes:

a. sufficient PPE;
b. sufficient consumables including recovery and packaging equipment;
c. sufficient cleaning materials (for example, Trigene or a bleach-based cleaner);
d. equipment that has been effectively cleaned since the last deployment to a scene.

7.1.6 All staff working in the forensic process should, where practicable, have had a DNA sample taken from them for submission to the relevant staff elimination database. With some organisations this will be a mandatory requirement, for others the absence of such a sample should be recorded (see section 11).

8. EQUIPMENT AND CONSUMABLES

8.1 Personal Protective Equipment

8.1.1 Personal protection equipment (PPE) serves a double purpose:

a. to protect the wearer from contact with hazardous materials; and
b. to protect exhibits from contamination by the wearer.

For serious crimes on entering the scene PPE shall consist of the following:

c. Over-suit: This shall be worn at all times, including the hood, at the scene. It shall not be modified by making holes or openings in the suit that expose skin or clothing, or be otherwise handled unnecessarily at the scene.
d. Overshoes: These shall be worn at all times within the scene unless otherwise directed by the Crime Scene Manager (CSM). Exposure of skin or clothing between the scene suit and overshoes should be avoided, if necessary by taping them together. Overshoes shall be removed or changed when exiting locus or entering a separate area of interest within the same scene.

e. Face mask: This shall be a barrier type mask that is effective at preventing DNA transfer. The wearer shall refrain from talking whilst sampling, or when recovering samples, or when in close proximity to possible sources of DNA evidence. The wearer shall also avoid having to adjust or otherwise manipulate the face mask (or glasses if worn) whilst at the scene. Where this cannot be avoided, the outer gloves should be replaced immediately.

f. Mob cap/hairnet: A mob cap or hairnet, or the hood of the scene suit shall be worn at all times in the scene to prevent shed hair or skin flake contamination by the examiner.

g. Gloves: Two pairs shall be worn at all times. These shall be disposable and powder free[5] latex or nitrile gloves. Exposure of skin or clothing shall be avoided by for example:

   i. taping the inner pair to the scene suit; or
   ii. inserting the thumb through a hole in the cuff to prevent the suit sleeve from rucking up and wearing gloves over the top.

h. The outer gloves shall be changed regularly at a designated place away from the area being examined, and always after handling individual items that may be submitted for DNA analysis.

8.1.2 The order of putting on PPE shall be as follows:

a. face masks should be put on before any other protective clothing to avoid the latter from being contaminated with saliva aerosols; followed by
b. mob cap/helmet (if required);
c. first pair of gloves;
d. over-suit;
e. overshoes; and finally
f. second pair of gloves.

8.1.3 For volume crimes the following PPE shall be worn as a minimum:

a. face mask;

[5] The powder in many types of gloves has been found to inhibit subsequent DNA analysis and can potentially contaminate items being handled, therefore powdered gloves should be avoided.

b. gloves, a second pair is required when potentially recovering DNA from scene.

8.1.4 The wearing of gloves and face masks at all scenes of crime regardless of their seriousness is essential, as most contamination occurs by:

a. handling items without gloves or where the gloves are torn; or
b. talking, sneezing or coughing over the items.

This is because current (as at January 2015) DNA techniques can readily generate profiles from DNA found in minute saliva aerosols or in skin cells deposited on handled items.

8.1.5 Due consideration should also be given to wearing additional PPE depending on the specific Health and Safety requirements of each scene.

8.1.6 All PPE including overshoes should be removed at the designated exit point when exiting a scene.

8.2 Consumables Including Disposable Equipment (ISO/IEC 17020 Equipment 6.2.2/6.2.3 or Process Requirement 7.1.1/7.1.2)

8.2.1 Consumables are single-use commodities used in the collection, preservation and processing of material for forensic analysis. These include tamper evident containers, swabs, and packaging that comes into direct contact with the material for forensic analysis. A consumable can also be equipment used in the collection, processing and safe handling of the material, for example, disposable tweezers and scissors.

8.2.2 Wherever possible consumables including disposable equipment that will come into direct contact with the evidential material intended for DNA analysis shall be compliant with PAS 377:2012/ISO 18385 (when issued). Where these are not available, only consumables should be used that have been quality assured to be free of detectable DNA, even when using the most sensitive DNA tests.[6]

[6] PAS 377:2012 section 3.2.3 defines this as enhanced polymerase chain reaction (PCR) and analysis conditions such as increased cycle number and/or increased capillary injection for short tandem repeat (STR) profiling as defined in Forster *et al*., *FSI Genetics* 2008, 2 (4), pp 318–28.

8.2.3 Ideally consumables/items should be individually sealed or provided as a self-contained kit comprising a set of all the required items for a specific activity. Where these are not available all reasonable efforts should be made in the storage, transport and handling of multiple packs of consumables to minimise the risk of cross-contamination post-receipt from the supplier. For example, a box of disposable gloves should be dedicated solely for use as outer gloves and should be kept in a re-sealable bag that is only opened when wearing a pair of under-gloves.

8.3 Non-Disposable Equipment

8.3.1 Equipment that is re-used at different scenes and that does not come into direct contact with items being recovered for subsequent DNA analysis shall be effectively cleaned prior to re-use. This might include, for example:

a. equipment and kits to undertake examination of the scene;
b. fingerprint brushes;
c. imaging equipment to record the scene;
d. lighting equipment;
e. stepping plates for preservation of surfaces.

8.3.2 Equipment shall be cleaned using documented standard operating procedures (SOPs) demonstrated to be effective at removing DNA. A cleaning log should also be kept.

8.3.3 The processes adopted by the end-user shall be verified to be fit for purpose in their hands, as it is the combination of cleaning agent and how it is physically used that determines its effectiveness.

Cellular contamination monitoring

8.3.4 The use of Adenosine Triphosphate- (ATP)-based[7] luminometry methods may be used as means of assessing the degree of cellular contamination on a surface in real time, by swabbing the surface and measuring the ATP activity using a hand held device.

[7] ATP is a molecule found in all living cells, including plants, animals and humans as well as bacteria, yeasts, etc. The use of ATP-based luminometry methods has been routinely used in hospitals and the food and beverage processing industry for many years as a means of assessing the degree of cellular contamination on a surface in real time.

8.3.5 Any ATP luminescence methods shall be 'calibrated' for the hand held model used against the absence and low levels of detectable DNA.

8.3.6 The monitoring of ATP activity would not be a direct replacement for all monitoring activities, but can indicate ineffective cleaning and can be used in combination with DNA profiling to allow for efficient and effective monitoring.

8.3.7 In all instances due consideration should be given to the Health and Safety implications of using these cleaning regimes, which shall be risk assessed and safe systems of work established prior to use.

9. CRIME SCENE ACTIVITIES AND PROCEDURES

9.1.1 All activities within the scene of crime (SOC) should be controlled by a suitably trained individual who has gained proficiency in the understanding of the mechanisms of contamination, assessment of risk and minimising risk whilst promoting detection. Typically this is by a Crime Scene Manager (CSM) for major incidents, whilst for less serious crimes compliance with anti-contamination procedures may be the responsibility of another nominated individual such as a Forensic Practitioner in attendance.

9.1.2 Where the controlling individual requires additional input from suitably qualified sources in relation to anti-contamination measures this input shall be documented.

a. Access to the SOC should be restricted as far as is practicable to those personnel who need access for a specific reason.
b. Movement within the SOC should be kept to the minimum possible for the work that has to be undertaken.
c. Verbal communication whilst within the SOC should be kept to a minimum despite the fact that masks are being worn.
d. The touching of spectacles, face, telephones, door handles, light switches, pens, paper, rulers, etc. without subsequently changing gloves should be avoided.
e. Mobile phones and radios shall not be used within the scene.
f. Items from which samples are taken should be handled carefully and as little as possible, and packaged at the earliest opportunity.

g. All items seized shall be packaged, sealed and labelled at the time they are taken, and wherever possible the packaging should be taken to the item and not the item to the packaging.

h. Packaging and other containers should be of an appropriate size for the items being packaged so that the item does not become damaged, nor the packaging compromised during transportation and storage.

i. Due care and consideration should be made of combining samples together (for example, cigarettes) since DNA can transfer between items within the same package.

10. DRYING CABINETS AND TEMPORARY STORAGE OF ITEMS

10.1 Introduction

10.1.1 All recovered items intended for laboratory examination should be transported to the laboratory without delay. This will minimise the potential degradation of biological evidence caused by fungal or bacterial activity prior to examination. Where immediate submission is not possible, for example, it is outside the operating hours for the forensic laboratory, items shall be held in a secure temporary storage facility.

10.1.2 All items shall be stored in such a manner so that they cannot be co-mingled, cross-contaminated, tampered with or stolen, and so that only authorised personnel have access to them. This is essential in order to ensure that the integrity of the evidence cannot be compromised and does not provide the basis of a subsequent chain-of-custody challenge.

10.1.3 Samples that are obviously stained with body fluids such as blood should be dried separately from less obviously stained items to prevent contamination by transfer of dried flakes, etc. Items considered for sensitive DNA tests should be dried away from other more obviously stained garments.

10.1.4 Short-term storage conditions should be in accord with police force/organisational standard operational procedures (SOPs), which specify best practice for each type of evidence. Where the circumstances of the case dictate, wet or damp items should ideally be dried prior to forensic examination.

Where it is not possible to commence drying the item immediately it should be frozen in a polythene bag on receipt to minimise degradation.

10.1.5 Regardless of where they are located, drying rooms or cabinets used to dry recovered items shall conform to the same general requirements as any other room or equipment accredited to ISO/IEC17025 for body fluid searching and examination, as outlined in FSR-G-208 *Requirements and guidance on the control and avoidance of contamination in laboratory activities involving DNA evidence recovery and analysis* (Forensic Science Regulator, in draft). This requirement has been stipulated by the Forensic Science Regulator because drying necessitates opening the packaging[8] and therefore should only be undertaken in a controlled laboratory environment.

10.2 General Operational Principles

10.2.1 Sufficient drying space capacity should be made available to ensure that the drying of submitted items can commence without delay during typical daily casework demand levels. As a contingency for exceptional peaks in demand, sufficient freezer space should be kept free for storage of items until drying space becomes available. Under no circumstances should the drying processes be accelerated by using heat or with fans.

10.2.2 Items between which a link may be of evidential significance should not be dried in the same space, for example, by sequentially drying one after the other in the same cabinet or room. Current (as at December 2014) best practice operated by some police forces is to dry potentially linked items from the same case at different physical locations.

10.2.3 The drying cabinet should ideally have the following characteristics:

a. temperature controlled between 15.5^{o}C and 24^{o}C;
b. humidity controlled, relative humidity not to exceed 60 per cent;
c. under negative air pressure with 12 to 15 air changes per hour;
d. air re-circulated through an activated high efficiency particulate air (HEPA) filter;

[8] An exception to this rule is where a wet item has been packaged in a breathable polymer bag that has been demonstrated to enable the item to dry out in situ without leakage of DNA from the sealed bag.

e. drying area not in direct sunlight;

f. walls, ceiling and floor shall have surfaces that readily allow decontamination; and

g. a locking mechanism on the door to prevent access except by the assigned personnel.

10.2.4 Ideally a dedicated room(s) should be utilised, which is accessed by a lobby area for putting on/removing personal protective equipment (PPE) and is equipped with commercially manufactured drying cabinets, that are specifically designed to meet the above specification and therefore will be easier to contaminate than drying facilities that have been modified from other applications. Both the room and the drying cabinets within shall be subject to regular and effective cleaning regimes, and environmental monitoring[9].

10.3 Decontamination of Re-Usable Equipment Between Exhibits

10.3.1 The following are examples of how equipment may be decontaminated. However, it is essential that the processes adopted are documented and their effectiveness verified in the hands of the end-user.

a. For small items, gamma-irradiation or thorough cleaning with chlorhexidine /ethanol, as found in Mediwipes[10] or Microsol 3- (Trigene)-based wipes is usually sufficient to remove lightly contaminating DNA.

b. Equipment that is thought to be contaminated should be submerged in a cleaning agent such as ten per cent Microsol 3 for a period of ten minutes and then rinsed in sterile distilled water. Similarly for larger items of equipment general decontamination may be effected by soaking for at least ten minutes using, for example, ten per cent Microsol 3, Virusolve II or a one in ten dilution of thick domestic bleach.

c. Heavy soiling should be removed using the aforementioned plus a cleaning action during soaking. After treatment items should be washed thoroughly in sterile distilled water.

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9 Further details on environmental monitoring can be found in FSR-G-208,(Forensic Science Regulator, in draft).

10 Mediwipes contain ethanol and therefore should not be used in areas where breath testing is undertaken: ethanol free wipes such as Microsol 3 should be used in these areas.

10.3.2 In all instances due consideration should be given to the Health and Safety implications of using these cleaning regimes, which shall be risk assessed and safe systems of work established prior to use.

10.4 Handling Procedure For Drying

10.4.1 Between each use, the drying cabinet shall be decontaminated as detailed in 10.3.

10.4.2 Only one item should be handled at a time.

10.4.3 The packaging should be opened at the opposite end to the original seal so that the integrity of the original seal is verifiable if necessary, and this shall be undertaken outside of, but very close to, the drying cabinet.

10.4.4 Paper should be placed under the item to capture any trace evidence that might fall off while it dries. This paper should be packaged separately and submitted with the item.

10.4.5 Hangers should not be re-used.

10.4.6 Segregation of items and the handling of items potentially in the same case should be observed at all times, for example, scene and suspect, victim and suspect, different suspects, different locations within a scene, and multiple scenes.

10.4.7 Once the items have dried they should be re-packaged and re-sealed using adhesive tape. Ideally the original packaging should be re-used, but where this is not possible, the item should be re-packaged and sealed in appropriate replacement packaging, and the original packaging should be retained for continuity purposes.

10.4.8 The location of the drying cabinet and the time and date of the drying (as well as any other samples in the batch) should be recorded in the event of quality assurance (QA) investigations, etc.

10.5 Record Keeping

10.5.1 The following anti-contamination records shall be kept.

a. Cabinet logs shall be maintained for each cabinet. These shall detail the following:

   i. the exhibit number and crime reference number of each item;
   ii. the person who placed the item in the cabinet including time and date, plus confirmation that the cabinet was decontaminated beforehand;
   iii. the person who removed the item from the cabinet including time and date, plus confirmation that the cabinet was decontaminated afterwards.

b. Room access logs.
c. Competency records of staff accessing the drying facilities.
d. Cleaning logs.
e. Environmental monitoring records.
f. Case notes shall record where applicable:

   i. that the item has been dried in-force; and
   ii. all instances where contamination is suspected in the handling and drying of the item, giving details of the incident.

10.6 Personnel Considerations

10.6.1 Prior to being granted access to the drying cabinet facilities each member of staff shall have demonstrated competency in their operation. Key to this is being trained in and demonstrating knowledge through assessment of:

a. contamination issues;
b. the rationale behind anti-contamination measures; and
c. practical knowledge of the anti-contamination-related SOPs employed in the handling of items and operation of the drying facilities to avoid contamination.

10.6.2 Issues relating to contamination risks and their avoidance in specific processes and methods shall be an integral part of staff training documentation and the relevant issues shall be included within the training plans and manuals.

10.6.3 This appendix to the Codes (Forensic Science Regulator) shall be introduced to all new users of the drying facilities as part of their training.

10.6.4 Where a member of staff has a cold or other medical condition that risks compromising forensic casework, such as persistent coughing or sneezing, consideration should be given to excluding them from the drying area as per section 7.

10.7 Personal Protective Equipment

10.7.1 Outdoor clothing, for example, coats, gloves, scarves, and other personal belongings are not permitted within the drying facility.

10.7.2 The following protective clothing shall be worn by all individuals including staff, visitors and service engineers when entering the drying area, and all of whom should provide an elimination sample.

Laboratory coats

10.7.3 Dedicated disposable laboratory coats of either the microbiology-type or surgical gown type shall be worn and properly fastened. Alternatively a scene suit may be worn, fully fastened.

10.7.4 Coats/suits shall be changed before handling items from a different case, individual, location and where other circumstances dictate, for example, after handling a heavily stained exhibit.

a. It is acceptable not to change laboratory coats when handling different items of clothes that have been worn at the same time by the same individual.
b. For handling volume crime samples, it is acceptable to use a lower cost alternative of wearing disposable paper aprons over the laboratory coat and changing the apron between items, rather than the laboratory coat.

10.7.5 Dedicated coats shall not be worn outside the drying area to which they have been assigned.

Gloves

10.7.6 Disposable gloves shall be worn at all times in the drying area, and removed when leaving the area. Two layers of gloves shall be worn; the inner gloves may be cotton, nitrile or other suitable alternative (8.1.1g), and shall not be removed within the drying area.

10.7.7 The wrist of the glove should cover the wrist of the laboratory coat. Where this is not possible, disposable cuffs shall be used to cover the gap.

10.7.8 The outer set of gloves shall either be changed or thoroughly cleaned using a validated method for the effective removal of DNA, whenever they come into contact with a potentially contaminated surface, for example, a door handle, chair, stationery, or when retrieving items from the floor.

10.7.9 Outer gloves shall be changed between the handling of different items.

Face masks

10.7.10 When examining exhibits face masks shall be worn that are properly tied and adjusted to cover the nose and mouth.

10.7.11 Pinch-nose face masks shall be available to staff who wear glasses.

10.7.12 Touching the mask with gloved hands shall be avoided. If it is necessary to adjust the mask then the outer gloves shall be changed or wiped with a cleaning product validated to remove DNA.

Hair cover

10.7.13 Disposable mob caps or similar hair cover shall be worn entirely covering the head hair within the drying facility.

10.7.14 Where necessary, for example with bearded individuals, additional hair cover (snoods) shall be used to ensure that all facial hair is covered when used in conjunction with the face mask.

10.8 Gowning Procedure

10.8.1 Ideally the gowning/disrobing procedure shall be undertaken in a lobby area or designated area proximal to the entrance/exit of the drying facility.

10.8.2 Gowning-up shall be undertaken in an appropriate sequence, an example of which is the following:

a. on entering lobby area, immediately put a face mask;[11]
b. then put on a mob cap and ensure that all hair is secure within the cap;
c. next put on goggles or other eye protection where necessary;

[11] Do not talk at all until the mask is securely fitted.

d. then put on first pair of gloves;

e. then put on disposable laboratory coat or scene suit; and finally

f. put on second pair of gloves.

11. CONTAMINATION DETECTION MEASURES

11.1.1 It is recognised that even when all practicable precautions are taken to minimise the risk of contamination, incidents will still inevitably occur. The primary vectors for contamination transfer are personnel, equipment and consumables.

11.1.2 Due consideration should be given to the retention of personal protection equipment (PPE) to allow for subsequent sampling and analysis where transfer of contamination on the protective clothing of scene attendees is suspected. This is not seen as a default requirement in every case and the decision on how appropriate this is should form part of the anti-contamination strategy where there is a higher risk identified in relation to movement of personnel between distinctly separate scenes within a single examination site or a series of geographically separate sites.

11.1.3 As stipulated previously, PAS 377:2012 (ISO 18385 when released) compliant consumables should always be used in preference to non-complaint alternatives. This is because these consumables have been manufactured specifically to minimise the presence of DNA contamination, plus a key requirement of the publicly available specification (PAS) is that DNA profiles are generated and retained from all manufacturing and assembly staff who are at risk of contaminating, so that comparisons may be performed against these profiles to check for potential contamination. The provision of manufacturers' profiles for routine screening of crime stain profiles is described in FSR-P-302: *The management and use of staff elimination DNA databases*.

11.1.4 All individuals entering the scene of crime shall be recorded in the scene log. From a contamination perspective, these fall into the following two categories.

a. All police staff whose roles routinely entail scene attendance and are therefore categorised as at high risk of contaminating crime stains with their own DNA. The routine screening of these personnel is described in FSR-P-302. This requires profiles from these individuals to be held on a police elimination database (PED) or central elimination database (CED),

and these are routinely screened against each crime stain profile relevant to their police force or area prior to the crime profile being loaded on to the National DNA Database® or reported in a particular case. All police personnel whose roles are categorised as a high contamination risk shall be included on the CED.

b. Other individuals whose roles do not include routine attendance at scenes, and are therefore not routinely screened against crime profiles for potential contamination events. These include both police (for example, first officer attending) and non-police personnel (for example, personnel from other emergency services and pathologists). These may pose an even higher risk of contamination at a particular scene than the previous category. A first officer attending will not be wearing PPE, may have only basic forensic awareness training and their first priority is to deal with the immediate situation rather than contamination avoidance. An appropriate senior police officer may authorise a search against their profiles if these are already held on the CED or, where contamination is suspected, require that these individuals provide a sample for profiling and comparison for elimination purposes as a one-off exercise.

11.1.5 No individual shall be permitted to enter the controlled scene of a serious crime unless they consent to being compared against crime stain profiles for potential contamination, where this is deemed necessary.

12. MANAGEMENT OVERSIGHT AND CONTINUOUS IMPROVEMENT

12.1.1 There shall be governance and oversight by the senior management of police, and other agencies undertaking crime scene recovery of DNA evidence, with regard to contamination avoidance, monitoring and detection, as described in this document, including the drying and temporary storage of items. This shall include a manager with appropriate technical knowledge having responsibility for:

a. assessment and review of contamination, including responsibility for undertaking investigations into contamination events to identify the root cause, and for escalating contamination issues to senior management where required;

b. maintaining a log of contamination events and periodically reviewing these to identify trends and potential for further anti-contamination measures as part of an overall continuous improvement process;

c. reviewing environmental monitoring results of non-disposable equipment to determine the ongoing efficacy of decontamination procedures;

d. ensuring that the proficiency of staff is maintained and demonstrated through periodic trials.

12.1.2 Reviews assessing contamination trends shall be made available to the Forensic Science Regulator/the Forensic Science Regulation Unit, the UK Accreditation Service and the National DNA Database® Delivery Unit to enable overall trends within the industry to be monitored.

12.1.3 There should be good communication with staff and staff ownership of contamination issues. Improvement at the team/unit level should also be encouraged with regular feedback on performance, including notification of contamination events, plus trends in contamination incidents, with a view to continuous improvement in performance.

13. ACKNOWLEDGEMENTS

13.1.1 Major contributions to this document were provided by the staff of the Metropolitan Police Service, The Forensic Science Regulation Unit, the Centre for Applied Science, Forensic Science Northern Ireland and Technology (CAST) and members of the Technical Review Group. Also, where possible, output has been used from anti-contamination workshops held on behalf of the Forensic Science Regulator and attended by representatives from most police forces within the UK.

14. REVIEW

14.1.1 This document is subject to review at regular intervals.

14.1.2 If you have any comments please send them to the address as set out on the Internet site at: www.gov.uk/government/organisations/forensic-science-regulator or email: FSREnquiries@homeoffice.gsi.gov.uk

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17. ABBREVIATIONS

Abbreviation	Meaning
ACPO	Association of Chief Police Officers of England, Wales and Northern Ireland
ATP	Adenosine Triphosphate
BS	British Standard
CED	central elimination database
CSI	Crime Scene Investigator
CSM	Crime Scene Manager
DNA	Deoxyribonucleic Acid
EN	European Standards
ENFSI	European Network of Forensic Science Institutes
FSP	forensic science provider
FSR	Forensic Science Regulator
FSRU	Forensic Science Regulation Unit
HEPA	high efficiency particulate air
HSE	Health and Safety Executive
IEC	International Electrotechnical Commission
ILAC	International Laboratory Accreditation Cooperation
ISO	International Organisation for Standardization: A network of the national standards institutes of 157 countries
NDNAD	National DNA Database®
NDU	National DNA Database® Delivery Unit
PAS	publicly available specification
PCR	polymerase chain reaction
PED	police elimination database

PPE	personal protective equipment
QA	quality assurance
SOC	scene of crime
SOCO	Scene of Crime Officer
SOP	standard operating procedure
STR	short tandem repeat
UKAS	UK Accreditation Service

18. GLOSSARY

DNA contamination: The unintended presence of DNA, i.e. the introduction of DNA, or biological material containing DNA to an item after a crime has been committed, either before, during or after its recovery from the scene of crime (or from a person).

Elimination database: Collection of DNA profiles held in a searchable format from staff whose access/role/activities are deemed to be a potential DNA contamination risk. The profiles are used solely for the purposes of detecting potential contamination events.

Forensic science provider: Organisation that undertakes any part of the DNA sample recovery and analytical process on behalf of the police or other criminal justice system customers, police evidence recovery laboratories are also included.

Investigator: A person, however named, trained to perform crime scene examinations and/or investigations. Other names used for this function are Scene of Crime Officer (SOCO), Crime Scene Investigator (CSI), Crime Scene Examiner (CSE), etc.

Un-sourced contaminant: A DNA profile identified as a contaminant for which the source has not been identified; historically most have been found to come from manufacturing staff. Unsourced contaminants are usually observed in no DNA template (negative) controls and quality control batch tests or if the DNA profiling result appears at odds with pre-expectations.

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