

**Forensic Science Regulator
Codes of Practice and Conduct – Draft Appendices**

HOS/12/027 TOOLMARKS - INVITATION TO TENDER

Background

The Forensic Science Regulator (the Regulator/FSR) has published, for consultation, a draft standard entitled “Codes of Practice and Conduct” (the Codes). The Codes will be structured as a core document supplemented by appendices. The core shall deal with all general issues and build on the requirements of the International Standard ISO 17025.

The appendices shall set out how the Codes operate within a specific scientific discipline (e.g. entomology), evidence type (e.g. fibre examination) or issues within forensic science (e.g. interpretation of evidence). There may also be appendices to address issues which are not common across the UK (e.g. specific legal requirements) or issues on which further clarification or guidance is considered valuable (e.g. validation).

The appendices may, in some cases, be sub-divided into separate documents to cover different specialist examinations with a specific area.

Appendix

This document seeks tenders for the production of a draft appendix covering the following area.

Marks - Toolmarks

Approach

The appendix for each area/subject should contain the following material

- Quality standards/requirements which apply in addition to the provisions of ISO 17025 and the Codes.
- The definition of what the requirements of ISO 17025 and the Codes mean in relation to a particular area of work.
- Guidance on how the requirements of ISO 17025 and the Codes should be met in a particular area of work.
- Guidance on the minimum requirements to meet the requirements of ISO 17025 and the Codes in a given area of work.

The appendix should be organised to match the structure of the ISO 17025 standard. In particular the numbering and section headings of the standard should be employed.

In areas of the ISO 17025 standard where there is no need to expand upon the general standard the appendix should have no content.

General requirements which go beyond, or clarify, the content of ISO 17025 are reflected in the Codes. It is, therefore, not necessary to set out the detail of that material in the appendices.

In areas of the ISO 17025 standard where there is a need to explain what the standard means in the context of that area (e.g. examination type), or to provide detail of the requirements in that area, (and this has not been dealt with, or sufficiently dealt with, in the Codes) the appendix should identify the relevant paragraph of ISO 17025 standard followed by the additional material that is required.

Where author believes there needs to be further explanation of the requirement, beyond that in the Codes, it is appropriate to set out the text in the appendix

An example of the type of document that is required is provided at Annex 1 below. It is stressed that this is not provided as a completed appendix but a draft appendix to show the general structure, format and level of detail required.

In each case the draft appendix prepared by the contractor shall be subject to development and public consultation before being finalised. This process shall not be part of the contract.

Timetable

The contract will start from 5 November 2012.

The following timetable for selecting the successful contractor will be followed.

Milestone	Timescales
Receipt of tender	8 October 2012
Decision on award of contract	29 October 2012

The draft appendix must be prepared within three months of the start of the contract.

Requirements

Tenders are sought from persons or organisations that wish to produce the appendix specified above. Any person or organisation bidding for this work will be expected to meet the above timescale.

In addition the following requirements will apply.

- The bidder must be able to demonstrate a clear understanding of, and familiarity with, the operation of ISO standards particularly ISO 17025.
- The bidder must be able to demonstrate familiarity with the ILAC document G19 and, where specified, other ILAC documents.

- The bidder must be able to demonstrate a clear understanding of and familiarity with the provision of forensic science services to the Criminal Justice System in England and Wales including an appreciation of the legal requirements which attach to such work.
- The bidder must be able to demonstrate skills related to the production of high quality documents relating to the quality of forensic science. This may be quality management documents but books in the relevant area would be treated as an equivalent.
- The bidder must be able to identify the staff who will be allocated the work.
- The bidder must set out a proposed structure and content for the appendix.
- The bidder must provide an indicative costing for the generation of an appendix.
- The bidder must provide indicative times for preparation of an appendix.
- The bidder must be able to prepare the appendix in English.
- The bidder must be able to submit appendices electronically in MS-Word format or format that can be imported into MS-Word.
- A fully costed proposal including the number of days required to produce the standard and the relevant day rate

Submitting a Tender

If you are interested in submitting a tender for this work it must be submitted by **no later than Noon on Monday 8 October 2012**. The tenders shall be evaluated against the ability to meet the requirements set out above.

The contract will be awarded using standard Home Office Service Terms and Conditions.

Please e-mail tenders to HOSProcurement@homeoffice.gsi.gov.uk quoting reference **HOS/12/027 Toolmarks Appendix** in the subject line.

EXAMPLE OF AN APPENDIX¹

TEXTILE FIBRES

1 Introduction

This Appendix provides further explanation of some of the requirements of the Codes specifically pertaining to the detection, recovery and examination of textile fibres and the use of textile fibre evidence. It is complementary to the Codes and Appendix 3 on Scene Examination. It does not add any new requirements.

3 Terms and definitions

The terms and definitions used in this Appendix are listed in the Glossary at Appendix 1 of the Codes

5.2 Personnel.

Codes Paragraph 6 on Page 16 - Competence

The competence of staff shall be routinely reassessed at intervals to ensure that it has been maintained and is up to date.

The provider shall ensure that all staff engaged in the examination of textile fibres understand the high risk of cross-transfer and environmental contamination with this type of evidential material, and take the appropriate measures required to minimise these risks.

In addition, the provider shall ensure that all staff performing any analytical technique² understand the scientific and theoretical basis for the technique, and the limitations of the technique in relation to fibre analysis, and that they are competent in:

- the handling and preparation of fibres for examination;
- the operation of the relevant analytical equipment, including any software;
- the requirements for calibration of the equipment; and
- the classification of textile fibres; and
- the recognition of artefacts and treatments.

¹ This appendix is based on draft 0.55 of the Codes.

² The analytical techniques include, but are not limited to low power microscopy (for searching), bright field, polarising, fluorescence and comparison microscopy (for the identification of fibre type, measurement of birefringence and comparison of fibres), solvent tests, TLC, HPLC, pyrolysis GC, UV/Visible spectroscopy, vibrational spectroscopy (including FTIR and Raman) and SEM/EDX.

Staff responsible for providing interpretation of results or opinions for inclusion in reports or statements shall have (in addition to appropriate qualifications, training, experience and satisfactory knowledge of the work carried out) relevant knowledge of:

- the technology used for manufacturing the items, materials or products to be examined (e.g. firearms, footwear, vehicle components), or the way they are used or intended to be used, and the effects of degradations or defects that can occur in service, so as to be able to identify deviations from normal manufacture or use, and their potential consequences and significance, and
- the scientific methodology available to investigate the incident (e.g. DNA analysis, fingerprint identification) to be able to understand how it shall be employed, the limitations of its use and any potential problems that could arise with its use.

In particular the provider shall ensure that staff responsible for providing interpretation of results, opinions for inclusion in reports or statements also have the relevant knowledge and understanding of:

- the philosophy and practices underpinning the provision of forensic science expert opinion;
- knowledge of the general requirements expressed in legislation, regulations or standards;
- case assessment and interpretation;
- the manufacture of fabrics and clothing, dyeing processes, surface treatments, etc,
- fading and other characteristics of normal wear;
- transfer and persistence of textile fibres; and
- relevant fibre population databases.

5.3 Accommodation and Environmental Conditions

Codes Paragraph 4 on Page 18 – Contamination avoidance, monitoring and detection.

The provider shall have risk based policies and procedures for the prevention, monitoring and detection of contamination. The steps

e. establishing preventative and corrective actions (e.g. when acceptable or control limits are found to be exceeded);

The provider shall ensure that:

- there is adequate spacing between benches where exhibits are examined to minimise the risk of fibre transfer from one exhibit to another;

- separate laboratories are available and used for the examination of exhibits between which fibre transfer evidence could be significant (e.g. exhibits from suspects and victims, from different suspects, from different victims, from the scene and a suspect or victim); and
- air flow within and between laboratories is kept to a level that will minimise the risk of fibres being transferred from one exhibit to another or to the laboratory environment generally.

5.4.2 Selection of Methods

Codes Paragraph 1 on Page 19 – Selection of methods

All test/sampling/analysis methods are required to meet the needs of the different layers of the CJS which collectively is the end-user; this is demonstrated through validation.³

Fibre classification

The providers shall have accredited methods and procedures capable of classifying the fibre according to its groups, fibre type and fibre sub-type as tabulated below:

CLASS	GROUP	FIBRE	SUB-TYPE
Natural	Animal	Silk	
		Wool	
		Hair	Alpaca
			Camel
			Goat
			Horse
			Rabbit
			Vicuna
			Other
	Vegetable	Seed	Cotton

³ The actual work that is carried out in individual cases should be determined by the requirements of the case and will depend on the seriousness of the alleged offence and the value of any other evidence which may be available. But a systematic approach should always be adopted, to ensure consistency of delivery of services and that they are fit for purpose and provide value for money. Whatever work is done, the examiner/analyst should always use the combination of techniques available that offers the greatest potential for identifying or discriminating between the samples, taking into account the sample size and the desirability of leaving some material available for any possible future examination.

			Kapok
			Coir
			Other
		Bast	Flax
			Hemp
			Jute
			Kenaf
			Ramie
			Other
		Leaf	Abaca
			Manila
			Henequen
			Phormium
			Tenax
			Sisal
			Other
Man-Made	Synthetic Polymer	Polyolefin	Polyethylene
			Polypropylene
		Polyvinyl Derivatives	Acrylic
			Modacrylic
			Chlorofibre
			Vinylal
			Fluorofibre
		Polyurethane	
		Polyamide	
		Aramid	
		Polyester	
		Synthetic	
	Natural Polymer	Alginate	
		Rubber	
		Regenerated Protein	Animal

			Vegetable
		Regenerated Cellulose	Viscose
			Cupro
			Modal
			Lyocell
		Cellulose Ester	Acetate
			Triacetate
	Other	Carbon	
		Glass	
		Metal	
		Other	

For the following fibre types or fibre sub-types, the accredited methods and procedures shall be capable of providing further discrimination as follows.

FIBRE (SUB) TYPE	POLYMER
Acrylic	Acrylonitrile polymer
	Acrylonitrile vinyl acetate copolymer
	Acrylonitrile methyl acrylate copolymer
	Acrylonitrile methyl methacrylate copolymer
Polyamide	Nylon 6
	Nylon 6 6
	Nylon 4
	Nylon 6 10
	Nylon 6 12
	Nylon 11
	Nylon 12
	Quiana
	Nomex

The identification of all fibre types shall be made by reference to authenticated reference samples.

Man-made fibres shall be identified using polarized light microscopy together with a minimum of one other independent microscopical method or an appropriate analytical technique (e.g. vibrational spectroscopy, pyrolysis-GC, thermal microscopy or solubility tests).

Animal fibres shall be identified on the basis of the medullary structure, medullary ratio, scale patterns, scale distribution, pigmentation, cross-sectional shape and length of the hairs.

Vegetable fibres shall be identified on the basis of their lumen and its relative width, cross markings, type and distribution of pits, crystals and the shape and cross section of the ultimates. Other physical and chemical tests may also be used.

Other examinations and tests

Where examination and analysis of the control samples shows there to be a number of distinct groups of control fibre types to be present, at least one fibre from each group shall be subjected to the full range of examination and analysis methods pertinent to that type of fibre and the range of transferred fibres involved.

Colour determination

The colour of each group of control fibres shall be determined as a simple description of its perceived colour.⁴

The provider shall have accredited methods and procedures for recording the visible spectra of coloured fibres over at least the range 390-710nm with a wavelength resolution of, no greater than, 1nm. For natural fibres, at least 10 spectra shall be recorded from different fibres as the data set for comparison against controls. For man-made fibres, at least 5 spectra shall be recorded from different fibres.

The provider shall have accredited methods and procedures for determining the individual colour components present in dye mixtures (e.g. by TLC or HPLC)

The provider shall have accredited methods and procedures to ensure that the analytical results are not affected by known artefacts (e.g. Woods anomaly or the orientation of the fibre).

Identification of delustrants, surface treatments and other surface morphological features

The provider shall have accredited methods and procedures (e.g. fluorescence microscopy and SEM/EDX), or access to such accredited methods and procedures, for examining materials used in the dyeing and finishing of textile fibres, for the viewing of surface morphological features and fibre damage, and for determination of elements (e.g. flame retardants) added to the fibre for specific purposes.

Comparison of transferred and control fibres

The provider shall have an accredited method and procedure for comparing the microscopical and analytical results from suspected transferred fibres and control

⁴ There is no requirement to determine the colour of the control fibre by any numerical system (e.g. chromaticity co-ordinates or complementary chromaticity co-ordinates).

fibres and determining whether they constitute a match.⁵ A transferred fibre shall only be considered indistinguishable from the control fibre group if:

- the transferred and control fibres are of the same type and sub-type, as determined by microscopic examination (including birefringence);
- the morphology of the transferred fibre is within the range of morphology observed in the control fibre group;
- the appearance of the transferred fibre falls within the range observed in the control fibre group when compared by comparison microscopy under three different types of illumination (one of them being ultraviolet); and
- where the fibres are coloured, the visible spectrum of the transferred fibre is considered to be within the range of the spectra for the control fibre group.

Where the recovered fibre is classified as a man-made fibre it shall only be considered to be indistinguishable from the control fibre type if the classification of type and sub-type are confirmed by an analytical technique. Where the control fibre type has been subject to analysis of polymer type (e.g. acrylic or polyamide) then the recovered fibre shall only be considered indistinguishable if it has also been subject to analysis of polymer type and is of the same polymer type as the control fibre group.⁶

5.7 Sampling

Control Fibres

Control samples of fibres shall be taken so as to ensure that all relevant possible variations in the fibres within the garment (or other source) are represented.⁷ Where there are apparent differences in the same fibre at different locations in the garment (or other source) and circumstances of the case indicate that this has potential value, then different control fibre samples shall be obtained from these different locations and the location from which each different control sample originated shall be recorded.

⁵ The comparison of transferred fibres and control fibres is a sequential process with fibres which can be distinguished from the control being eliminated at each stage.

⁶ Where there are a number of recovered man-made fibres or polymer fibres from one exhibit which appear to have a common source then only one of those fibres needs to be subject to the analytical confirmation of the classification.

⁷ Garments and other sources of textile fibres (e.g. car seat covers) may not be created from identical fibres (e.g. the sleeve of a jumper may be from a different batch of blue wool from the body). Subsequent treatment of the garment (e.g. washing or exposure to sunlight) may create further differences.

Transferred fibres

Transferred fibres may be recovered picking the fibres off individually with forceps, taping, combing, brushing, vacuuming or scraping.⁸

Automated fibre finders or low power microscopy shall be used to identify fibres of similar visual appearance to a control sample. A representative proportion of these individual fibres shall be removed with forceps and mounted singly on microscope slides. A proportion of those found to be indistinguishable by bright field microscopy shall then be further examined. The provider shall have an accredited procedure for determining the proportion of fibres to take forward at each stage of the recovery, examination and analysis protocol.

5.8 Handling of Test and Calibration Items

Codes Paragraph 6 on Page 32 Case assessment and prioritisation

In developing the examination strategy, as appropriate and as far is practicable the practitioner shall:

- *select and prioritise the examinations according to the needs of the investigation, or the instructing solicitor, and with consideration to the exhibits available..*

For fibres evidence, this shall require consideration of the types of fibres involved⁹, the potential for contamination, the likelihood of fibre transfer in the proposed circumstances¹⁰, the likelihood of fibre loss in the time available¹¹ and the extent to

⁸ The recovery of transferred fibres is best carried out, where possible, in the laboratory environment. Combing is a convenient alternative to taping for removal of fibres from head hair. Brushing may be a useful alternative for collecting fibres from areas that are heavily contaminated with dirt and debris (e.g. uncarpeted floors, commercial vehicles, etc.). Vacuuming is not a recommended recovery technique as it collects huge amounts of background material which masks and dirties the trace material. It also collects long-term debris, it is extremely difficult to search the recovered material effectively and it gives no detailed information about the exact point of recovery.

Scraping is not a recommended recovery technique as it is relatively inefficient and will release large quantities of background fibres into the air which will contaminate search rooms.

⁹ Certain types of textiles, with smooth shiny surfaces, have very limited capacity for donating or retaining fibres.

¹⁰ The opportunity for fibre transfer between textile items will depend on the area of contact, the duration of the contact and the pressure involved in the contact. It will also depend on the construction and nature of the surface of the textiles or other items involved.

¹¹ Transferred fibres are quickly lost or redistributed after the initial transfer. The rate of loss will depend on the nature of the recipient surface and the conditions to which it is subjected. Trials have shown that up to 80% of transferred fibres may be lost within the first two hours after contact.

which there are relevant databases to help interpret the significance of what may be found.

Nature of Exhibits

If samples of exhibits are taken, the provider shall ensure, as far as possible, that they are representative of the whole.

Whole items containing control fibres for reference purposes shall be recovered where possible, otherwise samples of all component fibre types and colours, including fibres from faded and unfaded areas, and worn and less worn areas, shall be obtained.¹²

Contamination avoidance, monitoring and detection

The examination of exhibits from which control fibres are to be derived shall take place in separate laboratories from those employed to examine exhibits which may be used to produce transferred fibres to be compared against the control fibres.

Prior to every use, laboratory areas used for the recovery and examination of transferred fibres from exhibits shall be monitored¹³ for the presence of fibres which may be similar to the control fibres against which the recovered fibres are to be compared,

Laboratory benches on which exhibits are examined shall be covered with a temporary protective cover which shall be replaced after the examination of each exhibit.

Practitioners shall wear suitable protective clothing to minimise the risk of fibre transfer from the examiner to the items being examined and secondary transfer between items via the examiner. This shall be replaced after the examination of each exhibit.¹⁴

Tape dispensers shall be enclosed to prevent contamination by stray airborne fibres.

¹² Reference samples of fibres from known sources with which it would be helpful to establish that the offender may have come into contact should be obtained, where appropriate. "Background" fibres should also be obtained from areas with which the offender is not thought to have had contact, to help establish whether any 'collectives' of fibres found on a victim could have originated from the victim's own environment or they could relate to textiles worn by the suspect. The background fibre populations at the crime scene is also helpful in identifying if there are textiles in the area that would be an obvious source of target fibres (bright colour/good shedding potential) which could have transferred to the offender.

¹³ This is often achieved by taping the area prior to use to allow determination (either then or later) whether there are fibres present which could be confused with the control fibres.

¹⁴ Ideally, different examiners should examine items from a victim and from a suspect, and from different victims and different suspects. When this is not possible, there must be a clear time gap and evidence of decontamination between searches.

Fibres which are to be compared against each other shall not be present in the same laboratory unless in a securely protected form (e.g. mounted on slides).

Codes Paragraph 7 on Page 32 – Exhibit handling, protection and storage

The provider shall ensure that exhibit handling policies and procedures address continuity requirements including but not limited to:

- a. that the exhibit or sub-sample can, at all times when in the possession or control of the provider, be uniquely identified;*
- b. that the exhibit can be conclusively shown to be the exhibit submitted to the provider;*
- c. any material recovered from an exhibit or subsample of an exhibit can be conclusively linked to the exhibit or sub-sample from which it came;*
- d. any results can be conclusively linked back to the exhibit or sub-sample from which it came;*

The exact original location and sequence of recovery of suspected transferred fibres shall be recorded.

Suspected transferred fibres which are selected for comparison with control fibres shall be mounted on slides individually and shall be uniquely identifiable and traceable to the original exhibit and, where appropriate, the specific location on that exhibit.

All analytical results for suspected transferred fibres and for control fibres that have been subject to the same range of analysis as the suspected transferred fibres shall be traceable to the individual fibres analysed.

5.10 Reporting of Results

Providers shall ensure that any fibre frequency database it uses is current and relevant to the issues on which an interpretation of the significance of the fibre evidence is based. Any limitations on their use shall be documented and revealed alongside any interpretation or opinion provided.¹⁵

Bibliography

¹⁵ Currently available databases include;

- the FSS collection of morphological data on man-made fibres and frequency of different fibre types in various textiles;
- the German Catalogue Database giving information on:
 - the frequency of different generic fibre types in a general population;
 - specific fibre types/colours in particular garments;
 - specific fibre types/colours in a random population of garments;
- material found in manufacturers' product range handbooks.

Forensic Examination of Fibres. J Robertson and M Grieve, 2nd Edition, Taylor and Francis 1999.

Best Practice Manual, ENFSI Fibres Working Group, 2000