Forensic Science Regulator
Overseeing Quality

Codes of Practice and Conduct

Fingermark Development and Image Capture

FSR-C- 127

Consultation

This is a consultation issued to allow comments from interested parties; all comments will be given consideration when finalising the final document prior to publication. Comments should be sent to FSRConsultation5@homeoffice.gsi.gov.uk and should be submitted by **16 September 2016**. This mailbox is not for general correspondence and is not routinely monitored so no acknowledgement will normally be sent.

1. INTRODUCTION

1.1.1 The purpose of this appendix to the Forensic Science Regulator's *Codes of Practice and Conduct for Forensic Science Providers and Practitioners in the Criminal Justice System* (the Codes) [A] is to establish the specific requirements for fingermark development/enhancement laboratories to operate within the context of accreditation to BS EN ISO/IEC 17025:2005 [B] and the Codes.

1.1.2 Adherence to these requirements will promote higher standards within the fingerprint profession and enable the laboratories to provide a robust and reliable service to the criminal justice system and the public.

2. SCOPE

2.1.1 The scope of this appendix includes generic requirements relating to friction ridge detail visualisation processes as used within the fingermark enhancement laboratories (for example, ninhydrin, fluorescence examination, etc.) and the fingermark image capture and image processing. It also includes activities relating to decision making prior to visualisation (i.e. what process should be selected and why) and post-visualisation (i.e. what area of friction ridge detail should be progressed for comparison and/or searching, usually conducted by the fingerprint bureau).

2.1.2 This appendix covers fingermark visualisation work that is carried out in a laboratory environment only – it does not cover fingermark visualisation at scenes.

2.1.3 The term 'friction ridge detail' includes all areas of the friction ridge skin system on the fingers, palms, phalange and plantar.

3. IMPLEMENTATION

3.1.1 This appendix is available for incorporation into a provider's quality management system from the date of publication. The Regulator requires that the Codes [A] and this appendix are included in the provider's schedule of accreditation by October 2017.

4. MODIFICATION

4.1.1 This is the consultation version of this document.

5. TERMS AND DEFINITIONS

5.1.1 The word ‘shall’ has been used in this document where there is a corresponding requirement in BS EN ISO/IEC 17025:2005 [B] or the Forensic Science Regulator’s Codes [A]; the word ‘should’ has been used to indicate generally accepted practice in fingerprint examinations.

5.1.2 For the purposes of this document, the term ‘process’ refers to the entire method/actions of recovering areas of friction ridge detail whilst ‘technique’ refers to individual visualisation methods, for example, ninhydrin.

5.1.3 For further definitions please refer to the primary glossary in the Codes [A], the *Fingerprint Examination – Terminology, Definitions and Acronyms* FSR-I-402 [C] and the Scientific Working Group on Digital Evidence (SWGDE)/Scientific Working Group on Imaging Technology (SWGIT) *Digital and Multimedia Evidence Glossary* [D].

6. ORGANISATIONAL RESPONSIBILITY (ISO/IEC 17025:2005 ref. 4.1)

6.1 General

6.1.1 A nominated senior responsible person shall be identified, in terms of top management as specified in BS EN ISO/IEC 17025:2005, to support a quality standards environment for fingermark development/enhancement laboratories. This person shall be accountable for ensuring that the requirements set out in this appendix are met. This individual shall be at top management level, i.e. chief executive or chief officer level within the organisation.

6.1.2 It is the responsibility of the organisation to recognise the different areas of competence required for a range of tasks within the workflow, and to implement a training and competency programme to ensure the continual development of its practitioners.

6.1.3 The organisation shall recognise that fingermark visualisation processes involve elements of professional judgement and decision making that may be prone to cognitive bias. For example, when ‘marking up’ areas of ridge detail for comparison and/or searching the laboratory practitioners may be influenced in their decision making by extraneous factors and irrelevant information.

6.1.4 Where possible, the organisation should implement control measures to safeguard against the risk of cognitive bias, see *Cognitive Bias Effects Relevant to Forensic Science Examinations,* FSR-G-217 [E]. This may include a level of training in cognitive bias that is proportional to the laboratory practitioner's level of responsibility and exposure to situations that may be prone to bias.

6.1.5 The fingermark enhancement laboratory should not operate in isolation. The organisation should recognise the laboratory practices and procedures as part of the whole of the fingerprint workflow.

6.2 Professional Responsibility

6.2.1 All personnel have a legal duty to the court; part of this duty is defined in the *Criminal Procedures Rules* [F] Part 19.

6.2.2 Practitioners shall understand the implications of the work undertaken as it relates to current law, legal obligations [G], the organisation's policies, operating procedures and guidelines that are relevant to:

a. the evaluation of forensic materials within their area of examination;
b. health and safety, information and data handling, other related legislative requirements and the criminal justice system;
c. the level of authority required to access information, and where additional authority may be needed; and
d. maintaining effective communications with others.

6.3 Fingerprint Evidence and its Place in the Criminal Justice System

6.3.1 The practitioner should provide accurate and relevant information to the customer (for example, the fingerprint bureau). The organisation should have the technical practitioner/expert capability to provide the level of technical information to assist with requests to enable activity[1] level or evaluative[2] level reporting as appropriate. For example, providing information and additional observations to assist in determining how a fingermark was deposited or to

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1 Expressing an opinion about the action(s)/movements of the object by the donor for whom the fingermark obtained is assigned.

2 Expressing a judgment, for example, the fingermark was made with blood or assigning a value to the fingermark.

substantiate or refute evidence of a latent mark being transplanted or transferred.

7. TECHNICAL RECORDS (ISO/IEC 17025:2005 ref. 4.13.2)

7.1.1 The organisation shall have procedures for the production of technical records. Records may include photographs, hard copies of any documentation or electronic images and records. If electronic record keeping is used and/or case management systems are used they shall be capable of recording examination notes contemporaneously in a format that is clear and auditable.

7.1.2 The method(s) used for the electronic capture, storage and transfer of images shall maintain the identity, security and integrity of the data.

7.1.3 Documented procedures shall define and reference the documentation (also referred to as case notes) associated with the fingermark visualisation process.

7.1.4 In the rare event where an applied process falls outside the defined parameters or requires special techniques or conditions in order to achieve the best results in a particular case, this should be documented within the examination notes to assist in reproducing the process. The decision made to deviate from the normal process shall only be made by an appropriate competent individual. The laboratory shall evaluate whether further validation [H] or re-validation of the technique is required; for example, where an item is too large to fit into a chamber, oven or tank.

7.1.5 Common strategies shall be recorded within the procedures. If as in (b) below a practitioner deviates from documented strategies to develop case specific fingermark recovery plans, they shall document their decision to select particular techniques, and the order and priority of techniques applied within the parameters of the case.

7.1.6 The strategy and plans may need to be reviewed and revised accordingly as the case progresses, for example, if more information comes to light. The level of detail in the documentation shall be sufficient to allow for an appropriate audit trail.

7.1.7 All records shall include the following.

a. Exhibit reference and description of the item to be treated.

b. A rationale for treatments and examinations to be carried out. This is particularly important when a practitioner deviates from the documented procedure, or where a bespoke specific case strategy is agreed and implemented on a case by case basis.

c. A chronological record of all treatments and examinations carried out, including a record of the date and the practitioner carrying out the process.

d. A record of the friction ridge detail/exhibits created as a result of each examination.

e. A record of any enhancements made to the image of the friction ridge detail.

f. A full record of the continuity of the movement and storage of original exhibits and movement of any developed friction ridge detail.

7.1.8 The organisation shall have a procedure or shall document within a procedure, the actions to be taken following a positive or negative outcome of an examination. The practitioner shall record the result of the examination according to the organisation's procedure.

7.1.9 The procedure shall cover guidance for the laboratory practitioners on what and how to prepare the ridge detail (lift, photograph or digital image) for subsequent comparison and/or search activities.

8. PERSONNEL (ISO/IEC 17025:2005 ref. 5.2)

8.1 Practitioner Competence

8.1.1 The organisation shall establish, own and sign off a competency testing framework for all laboratory practitioners against the organisation's defined criteria.

8.1.2 The organisation shall determine the level of practitioner competence required for each job role.

8.1.3 The details of a structured training programme to attain initial competence and a continuous programme of assessment to demonstrate ongoing competence shall be documented.

8.1.4 This framework shall include the ongoing process of training, assessment and review to ensure the maintenance of practitioner competence.

8.1.5 This framework shall also include the process for managing individuals whose competence has lapsed.

8.1.6 There are many areas requiring competence based on different skill sets. These depend on the responsibilities of the practitioner and the scope of accreditation. This may include but is not limited to:

a. receipt of exhibits and creation of records;
b. initial decision making, for example, the production of fingermark recovery plans;
c. carrying out the processes within the plan, such as enhancement techniques, post-enhancement examinations, imaging;
d. selecting appropriate friction ridge detail for comparison and searching purposes.

8.1.7 The training required to carry out processes may vary depending upon the following.

a. The level of complexity of the process. For example, ‘powder suspension’ is relatively simple, whilst ‘multi-metal deposition’ is considered more complex.
b. The level of practitioner input based on observations and skill. For example, ‘vacuum metal deposition’ and ‘physical developer’ require close monitoring of development and a knowledge of when to stop further development; fluorescence examination requires a knowledge of which light sources to use and methodical search methods.

8.1.8 The practitioner shall have received the correct level of training for the task, and this shall reflect the level of complexity of the process/task. Training and ongoing competence assessment shall be determined by the organisation and may include:

a. demonstrating the practitioner’s knowledge of the procedures;
b. demonstrating knowledge of the health and safety aspects of all processes in use;
c. selecting and deciding the most appropriate technique or sequence of techniques;
d. the correct application of the technique(s);

e. competence for deciding and selecting the appropriate areas of developed friction ridge detail to exhibit (marking up process) for comparison and searching;
f. an appreciation of the role of the fingerprint examiner/expert and their requirements for search and comparison;
g. awareness of the limitations of the process or the potential impact it could have on other evidence types, for example, areas of ridge detail on paper may be damaged or compromised by the prior application of particular chemicals;
h. awareness and an understanding of the concept of image quality and the effects that lighting, scales, perspective and optical resolution have on image quality for post-production processes and appropriately managing the risk of error.

9. ACCOMMODATION AND ENVIRONMENTAL CONDITIONS (ISO/IEC 17025:2005 ref. 5.3)

9.1.1 The facilities shall be appropriate for the safe and effective implementation of the fingermark visualisation processes used within that laboratory. See chapter 3 of the Home Office *Fingerprint Source Book* [I].

9.1.2 The fingermark enhancement laboratory shall have but is not limited to the following.

a. Space for managing items submitted for fingerprint evidence recovery, including storage and handling areas.
b. Areas for carrying out the processes including:
    i. dedicated areas for the optical processes;
    ii. ‘wet’ and ‘dry’ areas for the preparation chemical and physical processes.
c. Installed fixed equipment, for example, fume cupboards, wet benches.
d. The equipment used to capture fingermarks for subsequent search and comparison purposes shall be fit for the required purpose(s).
e. Suitable storage for equipment and chemical products.

f. Controlled areas of access, for example, where there are health and safety precautions required to operate a technique or where secure areas of restricted access are required.

10. TEST AND CALIBRATION METHODS AND METHOD VALIDATION (ISO/IEC 17025:2005 ref. 5.4)

10.1 Fingermark Enhancement

10.1.1 The organisation shall demonstrate competency and understanding of the requirements for validating its processes for friction ridge detail visualisation and the subsequent image capture process; this incorporates development and enhancement of ridge detail from all areas of the friction ridge system.

10.1.2 Validation shall be undertaken by the organisation to ensure the reliability of examination outcomes.

10.1.3 The information provided in this section is supplementary to the validation guidance provided in FSR-G-201 [H].

10.1.4 The organisation and practitioners shall demonstrate an understanding of the requirements for validation of their processes. Practitioners shall understand their data, limitations of their data and the value of their findings.

10.1.5 Processes described within the *Fingermark Visualisation Manual* [J] have varying amounts of testing and data supporting their use. It is the organisation's responsibility to ensure that the validation data are relevant to the organisation's processes and are sufficient for operational work.

10.1.6 The Home Office Centre for Applied Science and Technology (CAST) have made documents available (https://www.gov.uk/government/collections/centre-for-applied-science-and-technology-information#fingermark-documents) in order to assist with determining whether the FVM validation data is sufficient for operational activities.

10.1.7 Validation shall be undertaken in all cases in which the organisation has deviated from previously validated processes as set out within the *Fingermark Visualisation Manual* [J] or any other validation study.

10.1.8 Verification shall be undertaken by the organisation to ensure the reliability of the examination and capture of the friction ridge detail.

10.1.9 Validation studies should rigorously evaluate the performance of new or altered techniques and procedures against current methods in order to assess suitability for potential operational use, and they should be planned with reference to published guidelines [K, L,M] and Appendix 2 in *Fingermark Visualisation Manual* [J].

10.1.10 The organisation shall hold documentation for each validation and/or verification exercise that it completes. Validation documentation should include but is not limited to:

a. a detailed process description;
b. the science behind the process;
c. acceptance criteria for the organisation to utilise the process;
d. the formulation;
e. the processing parameters (such as time, temperature, humidity);
f. compatible surfaces;
g. the effectiveness of the technique;
h. the use of the technique in sequence with other processes;
i. standard operating procedures used during comparative studies.

10.1.11 The organisation shall ensure that where external validation studies have been used, these have been reviewed by the organisation and the strengths, weaknesses and any limitations are fully understood and addressed.

10.1.12 If a technique is to be used on a substrate not tested within the validation plan, a competent practitioner will be able to determine if additional validation data are required. For example, the evaluation could be based upon the similarity of the substrate (porosity, colour, texture) to those tested. The decision to conduct further studies or to extend the scope of an existing study shall be documented with an appropriate rationale.

10.1.13 Validation or verification studies shall incorporate all areas of the friction ridge system. They can include a depletion series to assist in determining the limits of detection but should also include natural marks that is representative in reality.

10.1.14 A validation or verification study shall also be conducted to determine whether any preventative methods, for example, the gloves worn by practitioners, are fit for purpose.

10.2 Image Capture

10.2.1 Images can be captured on many different devices using a multitude of memory storage media. Image quality shall be validated and performance tests carried out to ensure suitability for examining friction ridge detail.

10.2.2 The compression type and any file format used shall be validated and performance tests carried out to ensure suitability for the analysis of friction ridge detail.

10.2.3 The method used to allow for the re-sizing of images for downstream processing shall be validated and demonstrate suitability for examining friction ridge detail.

10.2.4 The organisation shall determine the optical resolution required to distinguish, as a minimum, a ridge from a furrow. It shall also demonstrate that the resolution of the image is able to distinguish the level of detail (for example, first, second or third level detail) that the fingerprint analysis and comparison relies on to form an opinion or reported outcome.

10.2.5 The method(s) used for the electronic capture, storage and transfer of the fingerprint images shall be validated including appropriate calibration.

10.2.6 Calibration, maintenance and authorised usage shall be recorded for critical equipment. For example, consideration should be given to ensuring:

a. authorised scales are correctly calibrated; and
b. use of resolution test charts that provide some measure of the optical resolution by determining the line pairs per millimetre (lppm) for a processed image.

11. ESTIMATION OF UNCERTAINTY OF MEASUREMENT (ISO/IEC 17025:2005 ref. 5.4.6)

11.1.1 The recovery of fingermark evidence relies on the retrieval of ridge detail of sufficient quality to enable a comparison or search. A calculation to provide an

estimation of the uncertainty of measurement is therefore not possible. However, there are elements of uncertainty within the recovery process of ridge detail and its subsequent selection that may adversely affect the search and comparison processes downstream.

11.1.2 Many factors may influence the effectiveness of forensic evidence recovery methods, such as chemicals used in preparing reagents, consumables, environmental conditions, performance of equipment, personal protective equipment, storage conditions and staff competence. The organisation should recognise the components of uncertainty. It should use its initial validation of its processes to ascertain any possible error rates and limitations so that these can be monitored and the process assessed for consistency.

11.1.3 The organisation shall identify any areas of risk and shall have appropriate plans or procedures in place to monitor and manage these risks.

12. CONTROL OF DATA (ISO/IEC 17025:2005 ref. 5.4.7)

12.1.1 Procedures shall be in place to protect and secure both the paper and electronic data generated by the organisation. These may relate to:

a. case management systems;
b. digital image transfer and storage systems; and
c. use of digital images and processing tools.

12.1.2 Policies and procedures shall be in place for the digital capture, storage, retrieval, display, and transmission of images used as evidence.

12.1.3 An audit trail shall be created at receipt and maintained with the image(s). The original image shall be retained securely and any image processing and enhancement shall be carried out on a duplicate.

12.1.4 Images should be optimised prior to capture by using appropriate lighting, camera settings and optics rather than by post-capture image processing because in the latter some of the original fingermark detail may be lost.

12.1.5 The capture resolution should allow reproduction of the features of interest within the mark, and be compatible with the resolution requirements of the appropriate local, national or international fingerprint databases.

12.1.6 The organisation shall specify the responsibility for the handling of images provided through a third party; on receipt images shall be reviewed to check that the image is suitable for processing. At the 'point of transfer' the audit trail shall start and the continuity of image handling shall be demonstrated by ensuring that the audit trail links directly to the third party audit trail.

12.1.7 All practitioners including photographers who are responsible for image capture shall have received the relevant training and be deemed competent.

13. MEASUREMENT TRACEABILITY (ISO/IEC 17025:2005 ref. 5.6)

13.1.1 Processes that utilise measuring equipment that have the potential to impact on the effectiveness of the process, for example, a hygrometer to measure humidity, can be purchased pre-calibrated with a suitable certificate of calibration or can be calibrated by a suitable relevant supplier.

13.1.2 The organisation shall have traceable records to demonstrate the calibration has been completed and the equipment in use works as required.

13.1.3 The organisation shall produce evidence of continuing compliance of identified laboratory equipment through a schedule of re-calibration. This can be done either by an external accredited supplier or through performance checking against calibrated references, such as weights, rulers or hygrometers.

13.1.4 The laboratory shall maintain records that ensure any calibration or reference standards are traceable to an international system of units (UI).

14. SAMPLING (ISO/IEC 17025:2005 ref. 5.7)

14.1.1 Sampling in this context relates to a case assessment leading to the selection of appropriate items (whole or part exhibits) and targeting specific fingerprint recovery processes to facilitate the expedient disclosure of results based on the needs of the investigation.

14.1.2 The sampling of items or exhibits required in the fingerprint retrieval process may be determined prior to the submission of items to the laboratory. This may be documented within a standard operating procedure determined by the organisation, for example, a submission policy or a service level agreement (SLA).

14.1.3 Where the laboratory needs to sample items within an exhibit or within a submission, the sampling strategy shall be agreed with the relevant parties and shall be clearly documented. A sample of the exhibit or forensic submission may be processed for a number of reasons, for example:

a. to target or prioritise a particular item of higher evidential value;
b. sampling of item(s) too numerous to process as a whole;
c. to answer relevant questions by examination of a portion of the total;
d. to minimise the amount of work required whilst assuring that all relevant legal and scientific requirements are met;
e. other specific reasons due to the context of the case.

14.1.4 Where only a sample of the developed friction ridge detail is progressed to the comparison and/or search processes, it shall be documented either as part of the organisational procedures or in a policy document, or recorded on a case by case basis.

15. HANDLING OF TEST AND CALIBRATION ITEMS (ISO/IEC 17025:2005 ref. 5.8)

15.1.1 An audit trail shall be available to track the continuity of all case-related items. The origin of individual exhibits should be traceable at all times during the process. For example, when treating multiple items from different cases simultaneously, a mechanism such as labelling shall be in place to distinguish between exhibits where this is required.

16. ASSURING THE QUALITY OF TEST AND CALIBRATION RESULTS (ISO/IEC 17025:2005 ref. 5.9)

16.1.1 Laboratory practitioners shall wear validated and tested gloves to prevent accidental contamination of exhibits. Where the practitioner believes that the gloves have failed they shall inform the relevant personnel in the organisation (usually the fingerprint bureau) and supply their full set of fingerprint impressions for elimination purposes. The organisation should consider when screening developed friction ridge detail against a staff elimination database is required.

16.1.2 The organisation shall have documented procedures for quality assuring any friction ridge detail forwarded for comparison or search, whether the product is recorded digitally or manually.

16.1.3 Where techniques have been applied, the organisation shall provide documentation and evidence to demonstrate that the test method has worked satisfactorily. Test strips or control samples shall be appropriate to the technique and add value to the quality assurance process. Test strips or test marks (control samples) are a simple way to give an indication as to whether a technique is working, although most will only detect gross errors and not the subtleties within most fingermark visualisation processes.

16.1.4 Where an organisation uses filtering or vetting criteria, and/or relies on the practitioner's judgement to determine which areas of developed ridge detail should progress to comparison and/or searching, there shall be procedures in place to monitor the practitioner's adherence to the vetting criteria. These will test the quality of both the submitted ridge detail and the discarded ridge detail and/or exhibits.

16.1.5 The organisation shall determine a proportional and representative schedule of dip sampling of case files where friction ridge detail has been recovered. This shall also apply to cases where the techniques utilised have not produced any friction ridge detail, or where the friction ridge detail has not been recovered by a practitioner for comparison and/or search purposes.

16.1.6 The dip sample should be examined by an appropriately trained and competent individual. Where the laboratory and fingerprint bureau are separate units this should be part of a collaborative documented process of mark quality assessment.

16.1.7 The organisation shall participate in suitable proficiency test (PT) programmes and/or inter-laboratory comparisons (ILCs). A plan for the level and frequency of participation, and the resulting outcomes, shall be documented.

16.1.8 Process performance shall be continuously reviewed using data from dip sampling, quality control (such as test strips, commercially available or internal control samples), competency and proficiency tests. Care should be taken in

the interpretation of results from test strips as they are a crude measure of technique performance.

16.1.9 Elements of uncertainty that influence the effectiveness of forensic evidence recovery shall be mitigated as far as possible by:

a. the specification of equipment, chemicals and consumables;
b. anti-contamination procedures;
c. staff training;
d. the practical validation or verification of methods; and
e. the selection of appropriate recovery techniques for the case circumstances.

17. REPORTING THE RESULTS (ISO/IEC 17025:2005 ref. 5.10)

17.1 General

17.1.1 The outcomes of any visualisation techniques shall be recorded. All processes applied and examinations carried out should be documented, irrespective of the result.

17.1.2 The results should be communicated to the customer. It is acknowledged that this communication may not be in the form of a report or statement. Where applicable the results shall be updated/recorded on any organisational management system or communicated direct to the customer. This communication should be able to be retrieved if required.

17.2 Communication and Collaborative Working

17.2.1 The organisation should take a united approach to the recovery of friction ridge detail, acknowledging the laboratory work as part of the fingerprint examination workflow. It is important that those recovering fingermarks and those using them for identification (assuming these are differently skilled practitioners) have a good understanding of each stage in the fingerprint examination workflow in order to use any information about potential evidence to its best advantage.

17.2.2 The organisation shall have documented strategies, demonstrable as effective for communication and collaborative working when multiple evidence types are required, for example, DNA and fingermarks.

17.2.3 The organisation should consider engaging with academia or other external stakeholders where this is a potential operational benefit.

18. REVIEW

18.1.1 This document will form part of the review cycle as determined by the Forensic Science Regulator.

18.1.2 The Forensic Science Regulator welcomes comments. Please send them to the address as set out at: https://www.gov.uk/government/organisations/forensic-science-regulator, or email: FSREnquiries@homeoffice.gsi.gov.uk

19. REFERENCES

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B **BS EN ISO/IEC 17025:2005** *General Requirements for the Competence of Testing and Calibration Laboratories.*

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20. ABBREVIATIONS

Abbreviation	Meaning
CAST	Centre for Applied Science and Technology
DNA	Deoxyribonucleic acid
FSR	Forensic Science Regulator
ILCs	Inter-laboratory comparisons
ISO	International Organisation for Standardization
lppm	Line pairs per millimetre
PT	Proficiency test
SLA	Service level agreement
SWGDE	Scientific Working Group on Digital Evidence
SWGIT	Scientific Working Group on Imaging Technology
UI	International system of units

21. FURTHER READING

Lee and Gaensslen (2013) *Advances in Fingerprint Technology*, third edition, Ramotowski, R. (editor). CRC Press.

Forensic Science Regulator *Forensic Image Comparison and Interpretation Evidence*: *Guidance for Prosecutors and Investigators*. Birmingham: Office of the Forensic Science Regulator. Available at: https://www.gov.uk/government/publications/forensic-image-comparison-and-interpretation-evidence-issue-2 [Accessed 20/07/2016].

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