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Implementation of 3D Technologies in Forensic Firearm and Toolmark Comparison Laboratories

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Foreword

This standard was revised, prepared, and finalized by the Firearms and Toolmarks Consensus Body of the AAFS ~~ASB. The~~Standards Board The draft of this standard was developed by the Firearms and Toolmarks Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science, and determined this document is part of a series of documents jointly submitted to include:

- ASB Standard 061, *Firearm and Toolmarks 3D Measurement Systems and Measurement Quality Control*
- ASB Standard 062, *Standard for Topography Comparison Software for Firearm and Toolmark Analysis*
- ASB Standard 063, *Implementation of 3D Technologies in Forensic Firearm and Toolmark Comparison Laboratories*

The purpose of these standards is to ensure the production of reliable data and statistically based conclusions and is applicable to all forensic science service providers that provide conclusions regarding toolmark-related evidence. The documents establish performance expectations for new technologies while allowing legacy systems to coexist in the lab. The hardware document specifically refers to 3D scanning hardware and does not apply to legacy 2D type systems. The software document specifies three categories (levels) of software. Legacy systems are Category 0 whereas systems which provide validated statistical measures are Category 2. The implementation document outlines the necessary steps to ensure the proper implementation of 3D technologies.

ASB Standard 063, *Implementation of 3D Technologies in Forensic Firearm and Toolmark Comparison Laboratories* outlines the necessary steps to ensure the proper implementation of 3D technologies (software and/or hardware) / technical procedure(s) required in a forensic toolmark laboratory. Technology implementation will include three validation stages: Developmental Validation, Deployment Validation, and Ongoing Performance Checks. Developmental validation takes place at least once to establish the core operational elements of the technology. Each laboratory will conduct their own deployment validation during the initial implementation of a new technology. Each laboratory will conduct ongoing quality/performance checks at regular intervals to demonstrate instrument and procedure reliability.

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The following applies to all ASB documents:

the term **'shall'** indicates that a provision is mandatory, and can be audited for compliance

the term **'should'** indicates that a provision is not mandatory, but recommended as good practice.

All hyperlinks and web addresses shown in this document are current as of the publication date of this standard.

Keywords: *3D, topography, measurement, algorithm, quality assurance, firearms, toolmarks, identification, comparison, implementation.*

Table of Contents

Implementation of 3D Technologies in Forensic Firearm and Toolmark Comparison Laboratories

1 Scope

This document provides requirements for the proper implementation of 3D technologies (software and/or hardware)/technical procedure(s) required in a forensic toolmark laboratory. This standard includes requirements for setting up the physical environment for the instrumentation as well as requirements for instrument calibration and validation.

2 Normative References

There are no normative reference documents. Annex A, Bibliography, contains informative references.

3 Terms and Definitions

3.1
competency tests
A test used to demonstrate an individual's ability to successfully conduct an examination(s) prior to performing casework.

3.2
deployment validation
The demonstration that a developmentally-validated technology performs as expected within a specific laboratory or organization. It involves the acquisition of test data using the proposed methods and procedures to demonstrate that the expected outcome is reproducible and achieves reliable results.

3.3
developmental validation
The acquisition and evaluation of test data for the determination of the conditions and/or limitations under which a novel method will achieve consistent results.

3.4
ongoing performance checks
Procedures performed to verify that the technology or technical procedure is working as expected.

3.5
records
Objective evidence of a condition, result, work performed, activity conducted, and/or quality of a system or process for archival purposes.

3.6
technical review
The review of notes, data, and other supporting records that form the basis for the reported conclusions.

3.7
technical reviewer
An individual with the knowledge/expertise to conduct the technical review to determine if the appropriate examinations have been performed, support the results/conclusions of the development and/or deployment validations, and that the reported results are consistent with the recorded data and are within the scope of testing.

3.8
validation
The process of performing a series of tests that establishes the efficacy, reliability, and reproducibility of a technique or procedure.

3.9
validation review
A review used to determine the limitations of the method/procedure; conditions under which reliable results can be obtained; critical aspects of a procedure/method that must be controlled and monitored; and the scope and accuracy of the procedure to meet the needs of a given application.

4 Requirements

4.1 Developmental Validation (Mandatory)

4.1.1 General

Prior to any 3D technology being introduced into forensic casework or the development of a new forensic protocol employing 3D technology, the technology or procedure shall be validated by at least one organization with appropriate knowledge and/or expertise.

4.1.2 Method

4.1.2.1 Developmental validation is required prior to the use of new 3D technologies or technical procedures as specified in documents specific to the application. This includes established procedures or technologies that have not been previously utilized in a specific forensic application.

4.1.2.2 Developmental validation shall be required for existing 3D technologies or technical procedures already in use in forensic laboratories.

4.1.2.3 Developmental validation shall be a planned and documented activity. The developmental validation plan shall be recorded and any changes to the plan will be communicated to all those involved in conducting the validation.

4.1.2.4 The plan for developmental validation study shall include the following:

a) the limitations of the procedure;

b) the conditions under which reliable results can be obtained;

c) critical aspects of the procedure that shall be controlled and monitored;

d) the ability of the resulting procedure to meet the needs of the given application.

Personnel who seek to develop a procedure for using 3D technology shall record and/or reference any other technical work relied upon for supporting the usage of the novel methodology or process. Such records should include peer reviewed publications, presentations at scientific meetings, symposia, standards, or research studies that evaluate the 3D technology and/or technical procedure.

4.1.3 Review

4.1.3.1 A technical reviewer(s) shall evaluate the completed procedure to ensure that it is fit for the intended purpose.

4.1.3.2 The technical reviewer(s) shall document the developed procedure and his/her assessment of the developed procedure. The documentation shall include his/her name and initials or signature and the date of the review.

4.1.3.3 Peer-reviewed publication of the underlying scientific principle(s) of a technology shall be required.

4.1.3.4 Peer-reviewed publication (or other means of dissemination to the scientific community, such as a peer-reviewed presentation at a scientific meeting) of developmental validation studies shall be required.

4.1.3.5 In all cases, the data from a development validation study shall be made available upon request.

4.1.3.6 If a conflict arises between the parties involved in validating a 3D technology or procedure, and an agreement cannot be reached, resolution will be achieved via the use of a mutually agreed upon technically-qualified third party.

4.2 Deployment Validation (Mandatory)

4.2.1 General

All developmentally validated technical procedures shall be further validated by the implementing laboratory prior to use for forensic examinations. Prior to beginning a deployment validation study, a validation method shall be prepared and recorded.

4.2.2 Method

4.2.2.1 Prior to applying a new or existing 3D technology or technical procedure to the examination of evidence, validation records shall demonstrate that the procedure performs as expected in the laboratory. Deployment validation shall be a planned and documented activity.

4.2.2.2 The laboratory shall define and/or reference the requirements for the validation of 3D technologies. The validation study shall determine the following:

a) the limitations of the procedure;

b) the conditions under which reliable results can be obtained;

c) critical aspects of the procedure that must be controlled and monitored;

d) the ability of the procedure to meet the needs of the given application.

4.2.2.3 When validating a 3D technology or procedure, only known source samples shall be used.

4.2.2.3.1 For software this means the use of samples for which the source tool is known.

4.2.2.3.2 For hardware this means the use of traceable reference standards.

4.2.3 Review

4.2.3.1 A technical reviewer(s) shall evaluate the validation study before use of the procedure in the laboratory.

4.2.3.2 The technical reviewer(s) shall document the developed procedure and his/her assessment of the developed procedure. The documentation shall include his/her name and initials or signature and the date of the review.

4.2.3.3 If a conflict arises between the parties involved in validating a 3D technology or procedure, and an agreement cannot be reached, resolution shall be achieved via the use of a mutually agreed upon qualified third party.

4.2.4 Laboratory Deployment

Once the Deployment validation study has been technically reviewed, the technical method or procedure shall be written into Standard Operating Procedures (SOPs) for use in forensic examinations. These SOPs shall be reviewed by the Laboratory's quality assurance program/ representative to ensure that it meets the requirements of their laboratory system.

4.3 Ongoing Performance Checks (Mandatory)

4.3.1 Quality Control Checks

4.3.1.1 Each laboratory shall utilize an appropriate quality control (QC) check process. The documentation shall contain a record/list of the traceable standard(s) used. Each laboratory shall maintain a measurement history for each traceable standard used in a control chart [1]. The laboratory shall determine the length of time the measurement history is retained.

4.3.1.2 Quality control checks shall occur on a regular schedule established by each individual lab.

4.3.2 Quality Control Failure

When a quality control check fails, appropriate measures shall be taken in accordance with the laboratory policy.

4.4 User Training (Mandatory)

Technical personnel shall demonstrate that they have been trained to operate a particular instrument or complete a technical procedure and records of this training shall be maintained. Training shall be provided to the examiners/technicians prior to their receiving a competency test. Training shall be conducted by either the developer of the technical procedure or another qualified personnel which has successfully completed a competency test.

4.5 Competency Test (Mandatory)

After the validation process on a 3D technology or procedure is completed, each examiner and/or technician who will apply the new method or procedure to casework shall successfully complete a competency test. The competency test shall be completed prior to applying those new methods or procedures to casework. This test shall demonstrate that the examiner and/or technician can accurately perform the technical method or procedure. A record of this competency test shall be maintained by the laboratory for review.

4.6 Proficiency Tests (Mandatory)

Qualified personnel shall complete proficiency tests relevant to the implemented 3D technology on a regular schedule as established by each laboratory. A record of this proficiency test shall be maintained by the laboratory for review. Proficiency testing shall be conducted in a manner consistent with laboratory policies.

Annex A
(informative)

Bibliography

This is not meant to be an all-inclusive list as the group recognizes other publications on this subject may exist. At the time this standard was drafted, these were the publications ~~available~~used for reference. Additionally, any mention of a particular software tool or vendor as part of this bibliography is purely incidental, and any inclusion does not imply endorsement.

~~1] Guide to control charts by the American Society for Quality available for free at http://asq.org/learn-about-quality/data-collection-analysis-tools/overview/control-chart.html~~

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