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Standard for Implementation of 3D Technologies in Forensic Laboratories for Firearm and Toolmark Analysis



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Standard for Implementation of 3D Technologies in Forensic Laboratories for Firearm and Toolmark Analysis

Keywords: *3D, Topography, Measurement, Algorithm, Quality Assurance, Firearms, Toolmarks, Identification, Comparison, Implementation*

This document 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. This standard ensures the production of reliable 3D data and statistically based conclusions that may be used in a court of law to support opinions rendered from the comparative analysis of toolmarks.

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Foreword

This standard was proposed by the Firearms and Toolmarks Subcommittee of the Organization of Scientific Area Committees (OSAC) by submitting a request to the American Academy of Forensic Sciences (AAFS) Academy Standards Board (ASB).

This document is part of a series of documents jointly submitted to include:

1. Standard for 3D Measurement Systems and Measurement Quality Control for Firearm and Toolmark Analysis
2. Standard for Topography Comparison Software for Firearm and Toolmark Analysis
3. Standard for Implementation of 3D Technologies in Forensic Laboratories for Firearm and Toolmark Analysis

The purpose of these standards is to ensure that new technologies produce accurate measurements and a validated statistical assessment of the significance of the correspondence. 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.

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Table of Contents

Acknowledgements	iii
Table of Contents	iv
1 Scope	1
2 Normative References	1
3. Terms and Definitions	1
4. Requirements	2
4.1 Developmental Validation (Mandatory)	2
4.2 Deployment Validation (Mandatory)	3
4.3 Deployment (Mandatory)	4
4.4 Ongoing Performance Checks (Mandatory)	4
4.5 User Training (Mandatory)	5
5 Conformance	5
Annex A: Bibliography	6

DRAFT

1 Scope

This document 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.

The purpose of this standard 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.

2 Normative References

Not Applicable

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 proficiency test

A test used to simulate casework samples that evaluate a qualified individual and the laboratory's quality system.

**3.6
records**

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

**3.7
technical review**

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

**3.8
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.

**3.9
validation**

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

**3.10
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)

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.

4.1.1 Method

4.1.1.1 Developmental validation is required prior to the use of new 3D technologies or technical procedures as specified in documents specific to the application (e.g., the “Standard for 3D Measurement Systems and Measurement Quality Control for Firearm and Toolmark Analysis” and “Standard for Topography Comparison Software for Firearm and Toolmark Analysis” documents). This includes established procedures or technologies that have not been previously utilized in a specific forensic application.

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

- 4.1.1.3** Developmental validation shall be a planned 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.
- 4.1.1.4** The plan for developmental validation study shall include:
 - 4.1.1.4.1** The limitations of the procedure.
 - 4.1.1.4.2** The conditions under which reliable results can be obtained.
 - 4.1.1.4.3** Critical aspects of the procedure that shall be controlled and monitored.
 - 4.1.1.4.4** The ability of the resulting procedure to meet the needs of the given application.
 - 4.1.1.4.5** 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 may include publications, presentations at scientific meetings, symposia, standards, or research studies that support the 3D technology and/or technical procedure.
- 4.1.2 Review**
 - 4.1.2.1** A technical reviewer(s) shall evaluate the completed procedure to ensure that it is fit for the intended purpose.
 - 4.1.2.2** The technical reviewer(s) shall record his/her agreement with the developed procedure with either his/her name and initials or signature and the date of the review.
 - 4.1.2.3** Peer-reviewed publication of the underlying scientific principle(s) of a technology shall be required.
 - 4.1.2.4** Peer-reviewed publication (or other means of dissemination to the scientific community, such as presentation at a scientific meeting) of developmental validation studies shall be required.
 - 4.1.2.5** In all cases, the data from a development validation study shall be made available upon request.
 - 4.1.2.6** 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)

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.

4.2.1 Method

- 4.2.1.1** 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.

- 4.2.1.2** The laboratory shall define and/or reference the requirements for the validation of 3D technologies. The validation study shall determine:
 - 4.2.1.2.1** The limitations of the procedure.
 - 4.2.1.2.2** The conditions under which reliable results can be obtained.
 - 4.2.1.2.3** Critical aspects of the procedure that must be controlled and monitored.
 - 4.2.1.2.4** The ability of the procedure to meet the needs of the given application.
- 4.2.1.3** When validating a 3D technology or procedure, only known source samples shall be used.
 - 4.2.1.3.1** For software this means the use of samples for which the source tool is known.
 - 4.2.1.3.2** For hardware this means the use of traceable reference standards.
- 4.2.2 Review**
 - 4.2.2.1** A technical reviewer(s) shall evaluate the validation study before use of the procedure in the laboratory.
 - 4.2.2.2** The technical reviewer(s) shall document his/her agreement/disagreement with the deployment validation results.
 - 4.2.2.3** 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.
- 4.3 Deployment (Mandatory)**
 - 4.3.1** 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.
- 4.4 Ongoing Performance Checks (Mandatory)**
 - 4.4.1 Quality Control Checks**
 - 4.4.1.1** 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].
 - 4.4.1.2** Quality control checks shall occur on a regular schedule established by each individual lab.
 - 4.4.2 Quality Control Failure**
 - 4.4.2.1** When a quality control check fails, appropriate measures shall be taken in accordance with the Software and Hardware documents.

4.4.3 Proficiency Tests - Qualified personnel shall complete proficiency tests on a regular schedule as established by each laboratory.

4.5 User Training (Mandatory)

4.5.1 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.

4.5.2 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 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.

5 Conformance

The *Standard for Implementation of 3D Technologies in Forensic Laboratories for Firearm Forensics* will be accessed utilizing these documents:

ASCLD/LAB-International Supplemental Requirements for the Accreditation of Forensic Science Testing Laboratories, American Society of Crime Laboratory Directors/Laboratory Accreditation Board, Garner, NC, 2011.

ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories, International Organization for Standardization, Geneva, Switzerland, 2005.

Annex A
(informative)

Bibliography

- 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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