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Standard for Education, Training, Continuing Education, and Certification of Forensic Toxicology Laboratory Personnel

Standard for Education, Training, Continuing Education, and Certification of Forensic Toxicology Laboratory Personnel

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This document may be downloaded from: www.aafs.org/academy-standards-board

Foreword

This document was developed to provide minimum requirements for the qualifications and development of personnel in forensic toxicology ~~laboratory personnel~~ testing and ~~individuals performing evidentiary breath alcohol instrument~~ calibration laboratories. Thus, when "laboratory" is used in this document, it is implied that both forensic toxicology testing and calibration laboratories ~~should be~~are included.

Defining appropriate educational requirements is important when ~~evaluating~~assessing prospective ~~employees to work in a~~ laboratory personnel. This ~~ensures~~helps ensure they ~~have~~possess a solid foundation that can be further ~~enhanced~~developed through ~~a robust~~comprehensive training ~~program~~. Training ~~includes evaluation of competency~~involves evaluating competencies as the trainee ~~progresses~~advances through the program. ~~After~~Even after completing ~~a~~ training ~~program~~, personnel continue to learn, ~~remain current~~stay updated on relevant topics, and ~~stay~~remain engaged ~~through~~with ongoing professional development ~~activities~~. Certification ~~of~~for laboratory personnel ~~provides an avenue for external evaluation of the person's~~offers a way to externally evaluate their knowledge and training.

The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2015 with a vision of safeguarding Justice, Integrity, and Fairness through Consensus Based American National Standards. To that end, the ASB develops consensus--based forensic standards within a framework accredited by the American National Standards Institute (ANSI), and provides training to support those standards. ASB values integrity, scientific rigor, openness, due process, collaboration, excellence, diversity, and inclusion. ASB is dedicated to developing and making freely accessible the highest quality documentary forensic science consensus Standards, Guidelines, Best Practices, and Technical Reports in a wide range of forensic science disciplines as a service to forensic practitioners and the legal system.

This document was revised, prepared, and finalized as a standard by the Toxicology Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Forensic Toxicology Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

Questions, comments, and suggestions for improving this document can be sent to the AAFS-ASB Secretariat at asb@aafs.org or 410 N 21st Street, Colorado Springs, CO 80904.

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

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Keywords: *forensic toxicology, personnel requirements, training, continuing education, professional development, certification, breath alcohol instrument calibration*

Table of Contents *(to be updated when the document is finalized)*

Standard for Education, Training, Continuing Education, and Certification of Forensic Toxicology Laboratory Personnel

1 Scope

This document provides minimum requirements for educational qualifications, training, competency, experience, continuing education, and certification of laboratory personnel performing, interpreting, or overseeing forensic toxicology ~~analyses~~testing or evidentiary breath alcohol instrument calibrations. It applies to the following sub-disciplines: postmortem toxicology, human performance toxicology (e.g., drug-facilitated crimes and driving-under-the-influence of alcohol or drugs), non-regulated employment drug testing, and other forensic testing (e.g., court-ordered toxicology, general forensic toxicology). The following are outside the scope of this document: personnel who exclusively perform administrative or non-technical duties; individuals working as breath alcohol instrument operators; individuals performing calibration adjustments to breath alcohol instruments; or individuals who solely perform instrument maintenance activities.

2 Normative References

The following references are indispensable for applying this standard. For dated references, only the edition cited applies. For undated references, the document's latest edition (including any amendments) applies.

~~ANSI/ASB Standard 017, *Standard for Metrological Traceability in Forensic Toxicology*[a]~~

~~ANSI/ASB Standard 036, *Standard Practices for Method Validation in Forensic Toxicology*[a]~~

~~ANSI/ASB Best Practice Recommendation 037, *Guidelines for Opinions and Testimony in Forensic Toxicology*[a]~~

~~ANSI/ASB Standard 053, *Standard for Reporting in Forensic Toxicology*[a]~~

~~ANSI/ASB Standard 054, *Standard for a Quality Control Program in Forensic Toxicology Laboratories*[a]~~

~~ANSI/ASB Standard 055, *Standard for Breath Alcohol Measuring Instrument Calibration*[a]~~

~~ANSI/ASB Standard 056, *Standard for Evaluation of Measurement Uncertainty in Forensic Toxicology*[a]~~

~~ANSI/ASB Standard 098, *Standard for Mass Spectral Analysis in Forensic Toxicology*[a]~~

~~ANSI/ASB Standard 113, *Standard for Identification Criteria in Forensic Toxicology*[a]~~

~~ANSI/ASB Best Practice Recommendation 122, *Best Practice Recommendation for Performing Alcohol Calculations in Forensic Toxicology*[a]~~

ANSI/ASB Technical Report 208, *Forensic Toxicology: Terms and ~~Definitions~~[a] Definitions* [b]

~~[a] Available from https://www.aafs.org/academy-standards-board.~~
[b] Available from https://www.aafs.org/academy-standards-board

3 Terms and Definitions

For purposes of this document, the following terms and definitions apply. Additional applicable terms are defined in ~~ANSI/~~ASB Technical Report 208*, Forensic Toxicology: Terms and Definitions*.

3.1
analyst
Individual, however named, who conducts, directs, or reviews the analysis of forensic toxicology samples and/or breath alcohol instrument calibration activities. ~~Analysts evaluate and interpret observations and calculations and may sign a report for court or investigative purposes. The analyst may testify but does not provide opinions. Duties and responsibilities may include those of a technician.~~

NOTE 1 The work of an analyst can include the evaluation and interpretation of observations and calculations or issuing a report for court or investigative purposes.

NOTE 2 An analyst can be requested to testify related to their work.

NOTE 3 An analyst's duties and responsibilities can include those of a technician.

3.2
certification
~~Procedure by which a third party gives written assurance that a person, product, process, or service conforms to~~ Formal credential awarded to individuals who demonstrate proficiency in a specific skill, knowledge area, or profession by passing an examination and meeting other requirements~~.~~ set by an independent certification body.

3.3
competency
~~Technical~~Knowledge, skills, and ~~knowledge~~abilities necessary to perform duties successfully.

3.4
continuing education
CE
Educational activity (e.g., class, lecture series, conference, seminar, or short course) that expands or updates participants in ~~their~~ relevant ~~area~~or new areas of knowledge.

3.5
course
Program of instruction taught through an accredited college or university program in which an official record of the institution documents the student's successful completion.

3.6
credential
Formal recognition (e.g., diploma, license) of a professional's knowledge, skills, and abilities.

3.7
experience
Direct observation of and participation in the practice of a discipline.

3.8
laboratory personnel
Individuals who perform ~~analytical or~~ laboratory-based duties of a technical nature.

NOTE 1 Laboratory personnel include individuals who perform, interpret, or oversee breath alcohol instrument calibration duties.

NOTE 2 Laboratory personnel include consultants who provide factual information, interpretations, and opinions related to the results of toxicological tests or breath alcohol instrument calibrations for court or investigative purposes.

3.9
professional development
Education and training that contributes to career advancement and succession planning (e.g., administration, leadership, management, and fiscal responsibility).

3.10
qualifications
Combined education, training, and experience of an individual.

3.11
technician
Individual, however named, who performs basic analytical duties but does not evaluate and interpret observations and calculations.

NOTE 1 Technicians ~~may~~can also perform instrumentation verification, adjustment, and calibration duties. ~~They may~~

NOTE 2 Technicians can be named in reports to indicate their contribution to the work.

~~3.11~~3.12
toxicologist
Individual, however named, who provides factual information, interpretations, and opinions related to the results of toxicological tests for court or investigative purposes. ~~Duties and responsibilities may also include those of an analyst.~~

NOTE ~~May~~1 Toxicologist duties and responsibilities can also include those of an analyst.

NOTE 2 The role of the toxicologist can be further ~~defined~~specified by ~~roles~~subspecialties [e.g., toxicologist (general), toxicologist (alcohol), toxicologist (breath alcohol calibration)].

3.13
toxicology technical leader
Individual, however named, who is responsible for the technical oversight of the toxicology and/or breath alcohol calibration laboratory. ~~Duties~~

NOTE Toxicology technical leader duties and responsibilities ~~may~~can also include those of a toxicologist.

~~3.12~~3.14

training

Formal, structured teaching and assessment process, through which personnel reach ~~a~~the level of ~~scientific knowledge and expertise~~competency required to perform specific duties.

~~3.13~~3.15

training ~~records~~record

Record used to document ~~employee~~personnel completion of the training program, continuing education, and professional development; maintained separately from other records (e.g., assessments, certifications, or discipline-related ~~employment~~personnel records).

4 Minimum Requirements for Personnel

4.1 Educational Qualifications

4.1.1 General

4.1.1.1 Upon publication of this document, all new hires and internal promotions in laboratories adopting this standard should meet the educational requirements specified below.

4.1.1.2 Laboratories shall ensure that all current ~~employees~~personnel meet the educational requirements no later than December 31, 2035.

4.1.1.3 Official academic transcripts shall be required as proof of credentials, including degree(s) awarded.

4.1.2 Technician

Personnel in Technician positions shall have an Associate's degree or higher in natural science, applied science, or technology from an accredited institution. ~~An equivalent number of semester hours can be substituted for an Associate's degree.~~

NOTE 1 An equivalent number of semester hours can be substituted for an Associate's degree.

NOTE 2 Minimum standards for education are summarized in Annex B for each personnel position.

4.1.3 Analyst

Personnel in Analyst positions shall have~~:~~

- a Bachelor's degree or higher in natural science (~~preference in~~preferably chemistry, toxicology, biochemistry, pharmacology, or biology) or applied science (~~e.g.,~~such as forensic science~~,~~ or medical sciences) from an accredited institution; and ~~have~~
- successfully completed general and organic chemistry courses with associated laboratory classes.

NOTE Minimum standards for education are summarized in Annex B for each personnel position.

4.1.4 Toxicologist and Toxicology Technical Leader

Personnel in Toxicologist and Toxicology Technical Leader positions shall have~~:~~

— a Bachelor's degree or higher in natural science (preference in chemistry, toxicology, biochemistry, pharmacology, or biology) or applied science (e.g., forensic science, medical sciences) from an accredited institution ~~and have successfully completed general and organic chemistry courses with associated laboratory classes, at least one (1) college-level course from column A, and one (1) 36-hour workshop or college-level course from column B located in Annex C.~~;

~~**4.1.5 Toxicology Technical Leader**~~

— ~~Personnel in Toxicology Technical Leader positions shall have a Bachelor's degree or higher in natural science (preference in chemistry, toxicology, biochemistry, pharmacology, or biology) or applied science (e.g., forensic science, medical sciences) from an accredited institution and have~~ successfully completed general and organic chemistry courses with associated laboratory classes~~,~~; and

— successfully completed at least one (1) college-level analytical science course ~~from~~ (column A, Annex C) and one (1) 36-hour interpretive science workshop or college-level course ~~from~~ (column B ~~located in,~~ Annex C~~.~~).

NOTE 1~~:~~ See the additional experience requirement for Toxicology Technical Leaders in 4.2.4.

NOTE 2~~:~~ Minimum standards for education are summarized in Annex B for each ~~employment category~~personnel position. Applicable scientific topics are listed in Annex C.

4.2 Training, Experience, and Competency

4.2.1 General

~~4~~.2.1.1 The laboratory shall ensure technical personnel are trained and demonstrate competency in each assigned technical duty before being authorized for independent work in that duty.

NOTE Duties ~~may~~can include, but are not limited to, handling test and calibration items, instrument maintenance, preparation of reference material, conducting and reviewing testing/calibration activities, evaluating data, reaching conclusions, signing reports, and providing testimony.

~~4.2.1.1~~4.2.1.2 The length of training should consider the scope of work to be performed, as well as the individual's qualifications and experience.

4.2.2 Initial Training

4.2.2.1 The laboratory shall have a documented training program addressing the ~~scientific~~ knowledge, skills, and ~~expertise~~abilities necessary to perform assigned job duties.

~~**4.2.2.2 Training elements shall include the applicable content as summarized in Annex A.**~~

~~4~~.2.2.2 Training sources may be internal and external to the forensic laboratory.

NOTE Sources for external training ~~may~~can include government agencies, academic institutions, training academies or institutions, private sector organizations, manufacturers, and professional societies.

4.2.2.3 The training program shall specify:

— training elements and applicable content as summarized in Annex A

— objectives that ~~define~~identify the specific elements in which the trainee needs to demonstrate competency from Annex A;

— instructor qualifications that include competency and area(s) of expertise for specific training elements;

— trainee requirements to include the actions required of the trainee to meet the objectives of the training program (e.g., reading of specified literature; minimum number of surrogate test and calibration items analyzed~~)~~);

— required periodic assessments of the trainee (practical, written, or oral) with performance metrics to be met (e.g., predetermined grading criteria and passing criteria); and

— defined criteria for successful completion of the training program.

4.2.2.4 The training program shall be reviewed for relevancy, efficacy, and content at an interval established by the laboratory, not to exceed every two years.

4.2.3 Ongoing Competency

4.2.3.1 After an individual assumes independent casework testing or breath alcohol instrument calibrations, ongoing evaluations shall be used to help demonstrate their continued competency.

4.2.3.2 To demonstrate ongoing competency of personnel, the laboratory shall:

— define appropriate activities ~~(~~, based on job duties~~),~~ to monitor the competency of personnel (e.g., participation in proficiency testing, retesting, direct observation);

— establish a predetermined, acceptable level of performance;

— monitor the competency of personnel continuously and document annually; and

— establish ~~remediation and~~ corrective action plans when expected outcome(s) are not achieved.

4.2.4 Experience for Technical Leaders

Technical Leaders shall have at least three years of experience performing independently as a Toxicologist.

4.3 Continuing Education and Professional Development

4.3.1 General

It is important for laboratory personnel to remain current within the discipline through continuing education and professional development activities appropriate for the scope of their job duties.

~~4.3.2 Laboratory Responsibilities~~

4.3.2 Continuing Education and Professional Development Resources and Support

4.3.2.1 The laboratory shall ensure that the following resources are available and accessible to laboratory personnel:

— reference texts in key subject areas (e.g., analytical chemistry, toxicology, pharmacology);

— reference literature containing physical, chemical, pharmaceutical, and/or analytical data; and

— relevant periodicals and peer-reviewed journals.

4.3.2.2 Laboratory management shall provide ~~financial~~ support~~, time, and/or opportunities~~ for continuing education and professional development.

NOTE Support can be financial, paid time, or providing in-laboratory opportunities.

4.3.3 Minimum Continuing Education and Professional Development Requirements

~~4.3.3.1 The minimum number of required CE units varies by position (see Annex B).~~

~~4.3.3.2~~4.3.3.1 Technicians shall obtain at least 1.5 CE units per calendar year relevant to their job duties, forensic toxicology, or other professional development in the field, with at least 0.25 CE units from sources external to the laboratory~~.~~ (see Annex B).

~~4.3.3.3~~4.3.3.2 Analysts shall obtain at least 2 CE units per calendar year relevant to forensic toxicology, with at least 0.5 CE units from sources external to the laboratory~~.~~ (see Annex B).

~~4.3.3.4~~4.3.3.3 Toxicologists and Toxicology Technical Leaders shall obtain at least 4 CE units per calendar year relevant to forensic toxicology, with at least 1 CE unit from sources external to the laboratory~~.~~ (see Annex B).

4.3.4 Sources of Continuing Education and Professional Development

4.3.4.1 The laboratory shall define the activities that may be counted toward continuing education and professional development activities, the appropriate number of CE units assigned to each activity, the participation required to receive credit, and whether the activities are considered as internal or external training sources.

4.3.4.2 Assigned CE units for commonly recognized sources of continuing education and professional development activities should be consistent with the following:

— performing laboratory inspections (audits, assessments) – *5 CE hours per inspection*

— presenting at a conference – *5 CE units*

— publishing scientific articles – *5 CE units*~~;~~

~~— presenting at a conference – 5 CE units;~~

- ~~presenting at a workshop – *1 CE unit/contact hour*;~~
- ~~performing a literature review – *0.25 CE unit per article*;~~
- ~~peer-reviewing a technical manuscript – *1 CE unit per manuscript*;~~
- ~~peer-reviewing a technical abstract – *0.25 CE unit per abstract*;~~
- formal mentoring students or other toxicologists – *1 CE unit/contact hour (maximum of 5 CE units per year*~~);~~*)*
- instruction of a seminar, lecture, or class – *1 CE unit/contact hour*~~;~~
- peer-reviewing a technical manuscript – *1 CE unit per manuscript*
- presenting at a workshop – *1 CE unit/contact hour*
- service on scientific committees and working groups – ~~*1 CE unit/ year;*~~
- ~~attending seminars, lectures, professional meetings, and classes – *0.25 CE unit/contact hour;*~~
- ~~attending instrument operation or maintenance courses – *0.25 CE unit/*~~ *contact hour*~~;~~
- attending distributed learning:
  - ~~on-line~~online education – *0.25 CE unit/contact hour*~~;~~
  - webinars – *0.25 CE unit/contact hour*~~;~~
- attending instrument operation or maintenance courses – *0.25 CE unit/contact hour*
- attending seminars, lectures, professional meetings, and classes – *0.25 CE unit/contact hour*
- participating in independent learning – *0.25 CE unit/contact hour*~~;~~
- peer-reviewing a technical abstract – *0.25 CE unit per abstract*
- performing a literature review – *0.25 CE unit per article*
- ~~performing laboratory inspections (audits, assessments) – *5 CE hours per inspection*.~~

NOTE~~:~~ If an individual is certified (see Section 4.4) or licensed, the certification or licensing body has the authority to assign different CE units for the above activities.

4.3.5 Components of Continuing Education and Professional Development Activities

4.3.5.1 Laboratories shall ensure that continuing education and professional development activities are structured by including the following components, as applicable:

- written goals and objectives for the activity;

— the use of subject matter expert instructors; and

— written syllabus or program description.

4.3.5.2 Laboratories shall establish an assessment mechanism to ensure that the outcomes of continuing education and professional development activities are measurable.

NOTE~~:~~ Assessment mechanisms may include oral or written examinations, ~~time spent on a training activity,~~ instructor or presenter evaluation, an oral or written summary of what was learned from a training activity, practical exercises, observation of technical performance, and criteria for passing tests.

4.4 Certification

NOTE 1 Certification provides the public and the judicial system with a means of identifying practitioners who possess the ~~education and~~ minimum knowledge ~~appropriate for their field~~and experience as defined by the certifying body. Certifying bodies also provide guidance for professional conduct and ethical behavior.

NOTE 2 Minimum standards for certification are summarized in Annex B for each personnel position.

4.4.1 Analysts and toxicologists should obtain certification commensurate with job duties.

4.4.2 Toxicology Technical Leaders shall obtain relevant certification within three (3) years of their appointment to the position or a laboratory's adoption of this standard.

~~NOTE: These minimum standards for certification are summarized in Annex B for each employment category.~~

4.4.3 An acceptable certification program is one that:

— is accredited under ISO/IEC 17024;

— has a formal application process;

— verifies minimum educational qualifications;

— reviews official transcript(s) from accredited colleges or universities that are sent directly to the certification body;

— reviews professional references from practitioners with knowledge of the applicant's experience in forensic toxicology submitted directly to the certification body;

— verifies required training and experience;

— requires a statement of adherence to a professional code of conduct and ethical behavior;

— performs a proctored ~~written~~ examination appropriate to the level of certification and predefines criteria for successful completion; and

— has a periodic requalification process and a process to reapply for certification if an individual does not qualify.

5 Documentation of Training, Competency, Continuing Education, Professional Development, and Certification

5.1 General

The laboratory shall have a policy to maintain records of ~~employees'~~personnel's training, competency, continuing education, professional development, and certification.

5.2 Documentation of Training

5.2.1 Records that demonstrate ~~an employee's~~personnel's completion of the requirements of the laboratory's training elements or program (~~Section~~section 4.2.2.1) shall permanently be maintained unless superseded by state statute, regulation, or law.

5.2.2 Appropriate documentation of training shall include:

— records showing progress through and completion of training modules (e.g., checklists, grids);

— results of assessments (including initial competency tests (section 4.2.2.4) of trainee's knowledge, skills, and abilities); and

— ~~Laboratory~~laboratory authorization (e.g., memorandum) for ~~employee~~personnel to perform activities affecting casework testing or breath alcohol instrument calibrations ~~(e.g., memorandum).~~covered under the scope of this standard.

5.3 Documentation of Ongoing Competency

5.3.1 Records demonstrating ~~an employee's~~personnel's completion of ongoing competency activities (section 4.2.3) shall be maintained for at least seven years unless superseded by state statute, regulation, or law.

5.3.2 Appropriate documentation of ongoing competency shall include:

— records of the activities used to monitor the competency of employees (e.g., specific proficiency tests);

— results and assessment of the competency activities; and

— remediation when the expected outcome is not achieved.

5.4 Documentation of Continuing Education and Professional Development

5.4.1 Continuing education and professional development shall be documented to count toward the minimum number of required CE units listed in 4.3.~~2.~~3 and Annex B.

NOTE~~:~~ Examples of appropriate documentation of continuing education and professional development activities include:

— verification of attendance:

— certificates of completion:

- date;
- location;
- duration of training;
- instructor;
- sponsoring organization;
- title of event;
- virtual (online) or in-person;

- scientific conference agenda;
- workshop agenda and learning objectives

- course syllabus;
- abstract of provided scientific presentation (e.g., oral or poster);
- copy of published manuscript (e.g., peer-reviewed article, white paper, application note);
- copy of continuing education credits awarded for review of manuscripts (e.g., Journal of Analytical Toxicology);
- recording of presentation, webinar, or exercise;
- number of contact hours for training activities.

~~**5.4.2** Continuing education and professional development activities shall be independently verifiable to meet the minimum requirements defined in Annex B.~~

~~**5.4.2.1**~~**5.4.1.1** In the absence of objective evidence of these activities (e.g., self-directed literature reviews), the laboratory shall define a mechanism to verify completion.

~~**5.4.2.2**~~**5.4.1.2** Records of completion of continuing education and professional development activities (~~Section~~section 4.3) shall be maintained for a minimum of seven years, unless superseded by state statute, regulation, or law.

5.4.2 Continuing education and professional development activities shall be independently verified to meet the minimum requirements defined in Annex B.

5.5 Documentation of Certification

5.5.1 Documentation of an employee's certification shall include a copy of a certificate, letter, or card from the certifying body that specifies:

— name of certificant;

— certificate number;

— name of certifying body;

— certification category;

— date certification was granted; and

— expiration date of certification.

Annex A
(normative)

Training Elements and Content (see section 4.2.2.3)

Element	Training Content
Administrative and Laboratory Policies	accreditation; document and record control; quality management; safety (e.g., biological, chemical, and physical hazards); security; standard operating procedures
Alcohol Toxicology	interpretation (e.g., ANSI/ASB BPR 122, *Best Practice Recommendation for Performing Alcohol Calculations in Forensic Toxicology*); pharmacodynamics; pharmacokinetics; physiology (e.g., blood-to-breath ratio)
Analytical Methodology	aliquoting; isolation techniques; qualitative analysis; quantitative analysis; requirements for identification (e.g., ANSI/ASB Std 113, *Standard for Identification Criteria in Forensic Toxicology*); theory
Calibrating Device	dry gas cylinder (e.g., barometric pressure; theory; uses/limitations; wet/dry offset); wet bath simulator (e.g., partition ratio; temperature; theory; uses/limitations)
Communication	report writing (e.g., ANSI/ASB Std 053, *Standard for Report Content in Forensic Toxicology*); verbal and nonverbal skills (e.g., non-technical; technical)
Evidence	chain of custody; collection; concepts; preservation; retention
Forensic Science	general knowledge; related disciplines
Human Factors	factors such as cognitive bias that may affect testing strategies, interpretations, reporting, and testimony; understanding the scope and limitations of methods and expertise
Instrumentation	-theory; operation; limitations; maintenance; adjustments; calibrations (e.g., ANSI/ASB Std 055, *Standard for Breath Alcohol Measuring Instrument Calibration*); troubleshooting; mass spectrometry (e.g., ANSI/ASB Std 098, *Standard for Mass Spectral Analysis in Forensic Toxicology)*
Legal Aspects	case law and applicable federal, state, or local laws and regulations; terminology; courtroom procedures; deposition and courtroom testimonies (e.g., ANSI/ASB Std 037, *Guidelines for Opinions and Testimony in Forensic Toxicology*); admissibility (e.g., *Daubert*, *Frye*); disclosure obligations (e.g., *Brady*); confrontation (e.g., *Melendez-Diaz vs Massachusetts*; *Bullcoming vs New Mexico;* and *Smith vs Arizona*)
Quality Assurance and Quality Control	ANSI/ASB Std 054, *Standard for a Quality Control Program in Forensic Toxicology Laboratories;* Method development and validation (e.g., ANSI/ASB Std 036, *Standard Practices for Method Validation in Forensic Toxicology*); metrological traceability (e.g., ANSI/ASB Std 017, *Standard Practices for Metrological Traceability in Forensic Toxicology*); reference material (e.g., uses/limitations; preparation); theory
Standards of Conduct	ethics; professionalism; confidentiality
Statistical Analysis	calculations; control charts and/or trending; measurement uncertainty (e.g., ANSI/ASB Std 056, *Standard for Evaluation of Measurement Uncertainty in Forensic Toxicology*); terminology
Toxicology	interpretation; pharmacodynamics; pharmacokinetics; physiology

Annex B
(normative)

Personnel Requirements Listed by Position

	Technician*	Analyst*	Toxicologist*	Toxicology Technical Leader*
Scope	Individual who performs basic analytical duties but does not evaluate and interpret observations and calculations. Technicians ~~may~~can also perform instrumentation verification, adjustment, and calibration duties. They ~~may~~can be named in reports to indicate their contribution to the work.	Individual who conducts, directs, or reviews the analysis of forensic toxicology samples and/or breath alcohol instrument calibration activities. ~~Analysts evaluate~~The work of an analyst can include the evaluation and ~~interpret~~interpretation of observations and calculations~~ and may sign~~, or issuing a report for court or investigative purposes. ~~The~~An analyst ~~may~~can be requested to testify ~~but does not provide opinions. Duties~~related to their work. An analyst's duties and responsibilities ~~may~~can include those of a technician.	Individual who provides factual information, interpretations, and opinions related to the results of toxicological tests for court or investigative purposes. ~~Duties~~Toxicologist duties and responsibilities ~~may~~can also include those of an analyst. The role of the toxicologist can be further specified by subspecialties [e.g., toxicologist (general), toxicologist (alcohol), toxicologist (breath alcohol calibration)].	Individual who is responsible for the technical oversight of the toxicology and/or breath alcohol calibration laboratory. ~~Duties~~Toxicology Technical Leader duties and responsibilities ~~may~~can also include those of a toxicologist.
Education	Associate's degree in ~~Natural Science, Applied Science~~natural science, applied science, or ~~Technology~~technology or equivalent number of semester hours	Bachelor's degree in ~~Natural Science (Preference~~natural science (preference in ~~Chemistry, Toxicology, Biochemistry, Pharmacology~~chemistry, toxicology, biochemistry, pharmacology, or ~~Biology~~biology) or ~~Applied Science (Forensic Science, Medical Sciences~~applied science (forensic science, medical sciences)	Bachelor's degree in ~~Natural Science (Preference~~natural science (preference in ~~Chemistry, Toxicology, Biochemistry, Pharmacology~~chemistry, toxicology, biochemistry, pharmacology, or ~~Biology~~biology) or ~~Applied Science (Forensic Science, Medical Sciences~~applied science (forensic science, medical sciences)	Bachelor's degree in ~~Natural Science (Preference~~natural science (preference in ~~Chemistry, Toxicology, Biochemistry, Pharmacology~~chemistry, toxicology, biochemistry, pharmacology, or ~~Biology~~biology) or ~~Applied Science (Forensic Science, Medical Sciences~~applied science (forensic science, medical sciences)
Required Courses	None required	General & organic chemistry with associated laboratory courses	General & organic chemistry with associated laboratory courses, one analytical course, and one interpretive course or workshop	General & organic chemistry with associated laboratory courses, one analytical course, and one interpretive course or workshop
Training and Experience	Completion of a formal, structured training program appropriate to job duties	Completion of a formal, structured training program appropriate to job duties	Completion of a formal, structured training program appropriate to job duties	3 years of experience performing independently as a Toxicologist
Certification	Not required	Recommended	Recommended	Required within 3 years of appointment to the position

Continuing Education	1.5 units per calendar year relevant to job duties, with 0.25 units from external source(s)	~~Sufficient to maintain certification or~~ 2 units per calendar year relevant to forensic toxicology, with 0.5 units from external source(s)	~~Sufficient to maintain certification or~~ 4 units per calendar year relevant to forensic toxicology, with 1 unit from external source(s)	~~Sufficient to maintain certification or~~ 4 units per calendar year relevant to forensic toxicology, with 1 unit from external source(s)

*An individual (however named) who fulfills scope.

Annex C
(normative)

Applicable Scientific Courses

Column A Analytical Science Courses[c]	Column B Interpretive Science Courses or Workshops
Analytical Chemistry Chemical Informatics Instrumental Analysis Mass Spectrometry Quantitative Analysis Separation Science Spectroscopic Analysis	Biochemistry Drug Metabolism Forensic Toxicology Medicinal Chemistry Pharmacology Physiology Toxicology 36-hour interpretive workshop [d]

[c] This list serves as examples of acceptable course titles offered by accredited colleges or universities. It is not meant to exclude courses with similar content bearing different titles.
[d] Or time equivalent to a 3-credit hour course.

Annex D
(informative)

Bibliography

The following bibliography is not intended to be an all-inclusive list, review, or endorsement of literature on this topic. The goal of the bibliography is to provide ~~examples of~~ publications ~~addressed in~~cited informationally, and publications relevant to the standard.

1] ANSI/ASB Standard 017, Standard for Metrological Traceability in Forensic Toxicology [e]

2] ANSI/ASB Standard 036, Standard Practices for Method Validation in Forensic Toxicology [d]

3] ANSI/ASB Best Practice Recommendation 037, Guidelines for Opinions and Testimony in Forensic Toxicology [d]

4] ANSI/ASB Standard 053, Standard for Reporting in Forensic Toxicology [d]

5] ANSI/ASB Standard 054, Standard for a Quality Control Program in Forensic Toxicology Laboratories [d]

6] ANSI/ASB Standard 055, Standard for Breath Alcohol Measuring Instrument Calibration [d]

7] ANSI/ASB Standard 056, Standard for Evaluation of Measurement Uncertainty in Forensic Toxicology [d]

8] ANSI/ASB Standard 098, Standard for Mass Spectral Analysis in Forensic Toxicology [d]

9] ANSI/ASB Standard 113, Standard for Identification Criteria in Forensic Toxicology [d]

10] ANSI/ASB Best Practice Recommendation 122, Best Practice Recommendation for Performing Alcohol Calculations in Forensic Toxicology [d]

~~1~~11] ASTM 2917-19 *Standard Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs.*

~~2~~12] ISO/IEC 17024:2012 – *Conformity Assessment – General Requirements for Bodies Operating Certification of Persons.*

~~3~~13] "Scientific Working Group for Forensic Toxicology (SWGTOX) Standard for Laboratory Personnel" *Journal of Analytical Toxicology*, Volume 39, Issue 3, April 2015, Pages 241–250. [f]

~~4~~14] "Scientific Working Group for Forensic Toxicology (SWGTOX) Standard for Breath Alcohol Personnel" *Journal of Analytical Toxicology*, Volume 39, Issue 3, April 2015, Pages 211–240. [g]

[e] Available from https://www.aafs.org/academy-standards-board
[f] Available from: https://doi.org/10.1093/jat/bku125
[g] Available from: https://doi.org/10.1093/jat/bku124

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