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Best Practices for Specimen Collection and Preservation for Forensic Toxicology

Guidelines for Specimen Collection and Preservation for Forensic Toxicology

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Foreword

While many specimen containers are available (particularly in a clinical setting), inappropriate handling (collection, container, storage) may impact the test methods available and/or the outcome of forensic toxicological test results. The intent of this document is to provide general guidance on the collection and appropriate containers for common biological specimens used in forensic toxicological analysis. Recommended specimen amounts and containers have been listed so the forensic toxicology laboratory has the broadest ability to perform analysis. When multiple specimen types are listed (e.g., whole blood and urine), there is no intent that all listed specimens must be collected for every case. Alternative specimen collection could be considered in instances of degradation or limited specimen availability. Communication with the forensic toxicology laboratory is necessary to ensure appropriate handling based upon the testing requested and methodology used by the laboratory. Often, specimen types may be dictated by regulatory or jurisdictional mandates; therefore, individuals must be familiar with those requirements prior to specimen collection.

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 Toxicology Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

Questions, comments, and suggestions for the improvement of this document can be sent to AAFS-ASB Secretariat, asb@aafs.org or 401 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, specimens, collection, specimen preservatives, specimen storage*

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Best Practices for Specimen Collection and Preservation for Forensic Toxicology

1 Scope

This document delineates guidelines for the collection of forensic toxicology specimens, their amounts, preservatives, and storage conditions. This guideline applies to specimens collected for laboratories performing forensic toxicological analysis in the following sub-disciplines: postmortem toxicology, human performance toxicology (e.g., drug-facilitated crimes and driving-under-the-influence of alcohol or drugs) and other forensic testing (e.g., court-ordered toxicology, general forensic toxicology). It is not intended for the area of breath alcohol toxicology.

2 Normative References

The following reference is a document that is indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASB Standard 053, *Standard for Report Content in Forensic Toxicology*[1]

3 Terms and Definitions

For purposes of this document, the following definitions apply.

3.1
court-ordered toxicological testing
The analysis of specimens from subjects within the judicial system or part of an active investigation to determine the presence or absence of drugs or other chemical substances.

3.2
human performance toxicology
The analysis of specimens for driving while impaired cases, drug-facilitated crimes, and other impairment cases (e.g., child custody).

3.3
infant or child welfare
The analysis of specimens from children or their caregivers in cases of suspected exposure to harmful substances.

3.4
non-regulated occupational testing
The analysis of specimens to determine the presence or absence of specific substances from employees that are not mandated under federal statutes.

[1] Available from: https://www.aafs.org/academy-standards-board

3.5
postmortem toxicology
The analysis of specimens from decedents to determine the presence of drugs or other chemicals for the purpose of medico-legal death investigation.

3.6
suspected poisoning toxicology
The analysis of specimens from living subjects to determine the presence or absence of toxic substances.

3.7
universal precautions
Measures taken to ensure safety under the assumption that any unknown materials or situations present the most dangerous scenario possible.

4 General Specimen Handling Guidelines

4.1 All specimens should be collected and handled using universal precautions.

4.2 As a general rule, specimens should not be collected in expired tubes. It is recognized, however, that the expiration date may not reflect the suitability of a particular collection tube.

4.3 Except in postmortem cases, blood specimens should be collected using aseptic techniques and a suitable non-alcohol based antiseptic (e.g., povidone-iodine, hydrogen peroxide, aqueous chlorhexidine).

4.4 Specimens should be stored in containers that mitigate leakage and limit the headspace above any fluid. Containers should be checked for a tight seal before transport.

4.5 Unless otherwise specified in this document, specimens should be collected and stored in glass or plastic containers. Consult with the laboratory for any potential effects the type of container may have on a specific drug or toxin. If specimens stored in glass are to be frozen, care must be taken to mitigate the potential loss of specimen due to breakage (e.g., plastic sleeve around container).

4.6 For collection tubes containing additives (e.g., anticoagulants and/or preservatives):

a) the presence and labeled identity of any additive should be visually confirmed prior to collection, and

b) capped tubes should be inverted a minimum of eight times immediately after collection.

4.7 Tubes containing a gel separator (e.g., orange, red/gray, gold, light green, green/gray) should not be used.

4.8 Head hair should be cut as close to the scalp as possible (do not pull). Collect one lock, approximately ¼ in. (6.35 mm) in diameter, about the size of a pencil, from the crown of the head. If hair is less than 1.5 in. (38.1 mm) in length, collect additional locks for a larger specimen.

After collecting hair, secure the bundle(s) with foil or paper to maintain orientation. The proximal (root) end(s) should be designated and kept together.

4.9 Containers shall be labeled with sufficient information to link the specimen to a specific individual. The specimen type (e.g., heart blood), date and time of collection, and identity of the collector should also be provided to the laboratory (e.g., on the label, in a requisition form, within chain of custody documentation).

4.10 Unless immediately transported, specimens should be stored following the guidelines in the tables below.

4.11 Specimens should be sealed in a secondary container and transported in a timely manner to the laboratory.

4.12 Specimens should be packaged to prevent damage during transport (e.g., protect tubes in Styrofoam sleeves or other protective material).

5 Responsibilities of the Forensic Toxicology Laboratory

5.1 Laboratories should provide instructions to customers regarding specimen collection and storage criteria based on the scope of testing. This may include storage conditions and timelines that could minimize degradation.

5.2 Laboratories should inform customers of any test-specific requirements regarding specimen collection beyond the tables in this document.

5.3 Laboratories should inform customers of the reason(s) they have rejected a specimen for analysis.

5.4 When results may have been compromised by inappropriate use of specimen containers or storage conditions (e.g., vitreous chemistry profile requested on a specimen collected in a gray top container), the current version of ANSI/ASB Standard 053 *Standard for Report Content in Forensic Toxicology* shall be followed for reporting requirements.

5.5 Laboratories should inform customers under what circumstances a specimen may be consumed during testing.

6 Human Performance Toxicology

Table 1 lists the common specimens that may be submitted for human performance toxicological testing.

Table 1—Common Specimens for Human Performance Toxicology

Specimen	Recommended Minimum Amount	Preservatives/ Collection Information	Storage
Whole Blood	2 × 10 mL	Sodium Fluoride: 1% to 2% Potassium Oxalate: 0.2% (e.g., gray top tube) Immediately invert*	≤ 8°C
Urine	20 mL	Either no preservative or 1% to 2% sodium fluoride	≤ 8°C
Oral Fluid	Based on device requirements	Follow device requirements for collection Entire device to be submitted to the laboratory	≤ 8°C
Head or Body Hair	100 mg	Secure bundle(s) Identify root end of hair*	Room temperature

*See Section 4, General Specimen Handling Requirements.

7 Postmortem Toxicology

Table 2 is not all encompassing of the specimen types that may be collected in a postmortem investigation (e.g., bone, meconium, etc.); contact laboratory for specific collection requirements.

Table 2—Common Specimens for Postmortem Toxicology

Specimen	Recommended Minimum Amount	Preservatives/Collection Information	Storage
Central (e.g., Heart, Subclavian, Inferior Vena Cava) Blood	20 mL*	Sodium Fluoride: 1% to 2% Potassium Oxalate: 0.2% (e.g., gray top tube) Immediately invert**	≤ 8°C
Peripheral (Femoral, Iliac) Blood	20 mL*	Sodium Fluoride: 1% to 2% Potassium Oxalate: 0.2% (e.g., gray top tube) Immediately invert**	≤ 8°C
Hematoma	All available	No preservative	≤ 8°C
Decomposition Fluid or Chest Cavity Blood/Fluid	20 mL	Sodium Fluoride: 1% to 2% Potassium Oxalate: 0.2% (e.g., gray top tube) Immediately invert**	≤ 8°C
Urine	20 mL	No preservative or 1% to 2% sodium fluoride	≤ 8°C

Specimen	Recommended Minimum Amount	Preservatives/Collection Information	Storage
Vitreous Humor	All available, collect from each eye (Both eyes can be combined)	No preservative	≤ 8°C
Tissue (e.g., Liver, Brain, Muscle, Lung)	15 g	No preservative	≤ 8°C
Gastric Contents	10 mL of a representative sample (document total volume)	No preservative	≤ 8°C
Bile	5 mL	No preservative	≤ 8°C
Antemortem Specimens	All available		≤ 8°C
Head or Body Hair	100 mg	Secure bundle(s) Identify root end of hair**	Room temperature
Nails	Excise the entire nail(s) taking care not to collect skin tissue	Place each nail in a separate envelope and designate the anatomic origin (e.g., left index finger)	Room temperature
Entomological Specimens (e.g., Maggots)	15 g	No preservative	≤ 8°C

*If multiple blood specimens are collected within a case, when available, a minimum total volume should be 20 mL.
**See Section 4, General Specimen Handling Requirements

8 Court-Ordered Toxicological Testing

Table 3 lists the common specimens that may be submitted for court-ordered toxicological testing.

Table 3—Common Specimens for Court-Ordered Toxicology

Specimen	Recommended Minimum Amount	Preservatives/Collection Information	Storage
Urine	45 mL	No preservative	≤ 8°C
Oral Fluid	Based on device requirements	Follow device requirements for collection Entire device to be submitted to the laboratory	≤ 8°C
Head or Body Hair	100 mg	Secure bundle(s) Identify root end of hair*	Room temperature

*See Section 4, General Specimen Handling Requirements.

9 Non-Regulated Occupational Testing

Table 4 lists the common specimens that may be submitted for non-regulated occupational testing.

Table 4—Common Specimens for Non-Regulated Occupational Testing

Specimen	Recommended Minimum Amount	Preservatives/Collection Information	Storage
Urine	45 mL	No preservative	≤ 8°C
Oral Fluid	Based on device requirements	Follow device requirements for collection. Entire device to be submitted to the laboratory	≤ 8°C
Body or Head Hair	100 mg	Secure bundle(s) Identify root end of hair*	Room temperature

*See Section 4, General Specimen Handling Requirements.

10 Suspected Poisoning Toxicology

Table 5 lists the common specimens that may be submitted for toxicological testing in suspected poisonings. Contact the laboratory before collecting any specimen to determine the appropriate specimen, preservative and collection information, and storage requirements based on the suspected poison.

Table 5—Common Specimens for Toxicological Testing in Suspected Poisonings

Specimen	Recommended Minimum Amount	Preservatives/Collection Information	Storage
Whole Blood	10 mL	Contact laboratory for specific requirements based on suspected poison	≤ 8°C
Serum	10 mL	Separate serum from other blood components within two hours (e.g., red top tube) DO NOT USE A SEPARATOR GEL	≤ 8°C
Plasma	10 mL	EDTA or another anticoagulant (e.g., purple top tube) Separate plasma from other blood components within two hours DO NOT USE A SEPARATOR GEL	≤ 8°C
Urine	10 mL	No preservative	≤ 8°C

*See Section 4, General Specimen Handling Requirements.

11 Infant or Child Welfare

Table 6 lists the common specimens that may be submitted for toxicological testing in infant and child welfare cases.

Table 6—Common Specimens for Toxicological Testing in Infant and Child Welfare

Specimen	Recommended Minimum Amount	Collection Information	Storage
Urine	10 mL	No preservative	≤ 8°C
Umbilical Cord	6-in. segment	No preservative Avoid contact with ethyl alcohol	≤ 8°C
Body or Head Hair	100 mg	Secure bundle(s) Identify root end of hair*	Room temperature
Fingernails, Toenails	100 mg to 200 mg	Place in an envelope and designate the anatomic origin of each nail (e.g., left index finger) Do not combine clippings from fingernails and toenails	Room temperature
Meconium	3 g to 5 g	No preservative Avoid contact with ethyl alcohol	≤ 8°C

*See Section 4, General Specimen Handling Requirements.

Annex A
(informative)

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