Idaho State Police
Forensic Services

Toxicology Training Manual

Updated: 08/2004

Idaho State Police
Forensic Services
Toxicology Section

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Idaho State Police
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Toxicology Training Manual –
Section One: Urine and Blood Toxicology

Revision #	Issue Date	History
0	12-31-00	Original Issue
1	05-30-00	Reformatted

Approval

Technical Leader: _____ **Date:** _____

Issuance

QC Manager: _____ **Date:** _____
Rick D. Groff

Commander: _____ **Date:** _____
Major Ralph W. Powell

Idaho State Police
Forensic Services
Toxicology Section

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Approval

Technical Leader: _____ **Date:** 05/30/00

Issuance

QC Manager: _____ **Date:** _____
Rick D. Groff

Commander: _____ **Date:** 7-24-00
Major Ralph W. Powell

Idaho State Police
Forensic Services
Toxicology Section

Section One

Blood and Urine Toxicology

1.1 Training Objectives

This section of the toxicology training manual is designed as a guide to provide a forensic chemist with the background necessary to process blood and urine specimens for the presence of drug compounds. This manual addresses each of the various stages of sample processing, from the initial sample checkout to screening, confirmation and finally report generation. To properly interpret the results of analysis, the analyst should possess a working knowledge of drug metabolism and a fundamental understanding of the pharmacology of psychoactive compounds.

Section One

Blood and Urine Toxicology

1.2 Understanding of Toxicology Program

1.2.1 The trainee should possess an understanding of the over-all toxicology program. Their knowledge should include how specimens are processed, the agencies served, the programs involved (DRE, NJDT) and casework expectations for analyst.

Date of Completion

Trainee

Trainer

Section One

Blood and Urine Toxicology

1.3 Evidence Handling

1.3.1 The trainee should demonstrate an understanding of the procedures followed for the receiving of toxicology specimens and subsequent specimen handling considerations.

Date of Completion _____ Trainee _____

Trainer _____

1.3.2 References

1. ASTM E1459-92, *Standard Guide for Physical Evidence Labeling and Related Documentation.*

2. Kippenberger, D.J. and Selavka, C.M. *Training in Specimen Handling*. pp. 33-54, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology, 1994.

Section One

Blood and Urine Toxicology

1.4 Solution Preparation

1.4.1 Basic Chemical Calculations and Nomenclature

Define the following terms and address the questions.

1.4.1.1 *Solute*

1.4.1.2 *Solvent*

1.4.1.3 *Mole*

If you have the weight of a substance, how is the *number of moles* calculated?

1.4.1.4 *Molarity (M)*

How many *moles* per liter is in a 2M solution?

1.4.1.5 *Normality (N)*

How may equivalents in a 2N solution?

1.4.1.6 *Equivalents*

1.4.1.7 *Weight per Volume Percent (%w/v)*

1.4.1.8 *Weight per Weight Percent (%w/w)*

1.4.2 The trainee should be familiar with solution preparation including the preparation of hydrolysis agents, buffers and extraction solvents used in all stages of specimen analysis.

Date of Completion _____ Trainee _____

Trainer _____

1.4.3 References

1. Shugar, J., Shugar, R.A. and Bauman, L. *Chemical Technicians' Ready Reference Handbook.* pp. 127-139 and 145-154, NewYork:McGraw-Hill, 1973.

2. Habben, K.H. *Basic Analytical Reference – Chapter 19.* pp. 1-9, *in*: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting, 1994.

Section One

Blood and Urine Toxicology

1.5 Enzyme-Linked Immunosorbent Assay (ELISA)

1.5.1 ELISA – Theory

1.5.1.1 The trainee should be completely versed in the basic theory of ELISA analysis *{Toxicology Program Procedure Manual Section 1.1}*.

1.5.1.2 Define the following terms:

1.5.1.2.1 *Enzyme*
1.5.1.2.2 *Antigen*
1.5.1.2.3 *Antibody*
1.5.1.2.4 *Hapten*
1.5.1.2.5 *Cross-reactivity*
1.5.1.2.6 *Antigenic Determinant*

Date of Completion _____ Trainee _____

Trainer _____

1.5.1.3 References

1. Sections Covering *Immunoassay and ELISA* pp. 130-152, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC,1998.

2. *Background and Standard Operating Procedure for Blood and Urine Screening by Enzyme Immunoassay*, Idaho State Police, Forensic Services Procedure Manual, Section One, 2000.

3. Spiehler, V. *Immunoassays in Toxicology*. pp. 55-98, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology, 1994.

4. Liu, R.H. *Evaluation of Commercial Immunoassay Kits for Effective Workplace Drug Testing*. pp.67-130, *in*: Handbook of workplace Drug Testing. Liu, R.H. and Goldberger, B.A. eds., Washington D.C.:AACC Press, 1995.

5. *Enzymatic Labeling and Detection* – Technical section providing by STC Technologies description of enzyme utilized for STC micro-plate assay.

6. Perrigo, B.J. and Joynt, B.P. *Use of ELISA for the Detection of Common Drugs of Abuse in Forensic Whole Blood Samples.* Can. Soc. Forens. Sci. J., **28 (4):**261-269,1995.

7. Williamson, S.C. *Enzyme Immunoassay Techniques.* Graduate presentation for Biopharmaceutical Analysis II, 9/94.

Section One

Blood and Urine Toxicology

1.5 Enzyme-Linked Immunosorbent Assay (ELISA)

1.5.2 ELISA – Practice

1.5.2.1 Demonstrate a knowledge of the general operation and maintenance of BioChem ImmunoSystems PersonalLAB™ instrumentation *{Toxicology Program Procedure Manual Section 1.1-1.7}*.

1.5.2.2 Familiarization with, and use of, STC Technologies micro-plate assay *{Toxicology Program Procedure Manual Section 1.4}*.

1.5.2.3 The trainee should possess the ability to operate a Hamilton MICROLAB® or equivalent dilutor.

Date of Completion _____ Trainee _____

Trainer _____

Section One

Urine Toxicology

1.6 Thin Layer Chromatography (TLC)

1.6.1 TLC– Theory

1.6.1.1 The trainee should be completely versed in the theory of thin layer chromatography.

1.6.1.2 Define the following terms as they relate to TLC:

- 1.6.1.2.1 *Capillary Action*
- 1.6.1.2.2 *Stationary and Mobile phases*
- 1.6.1.2.3 *R_f - Retardation/Retention Factor*
- 1.6.1.2.4 *Elution/Developing Solvent*
- 1.6.1.2.5 *Partition Coefficients (K_d, K)*
- 1.6.1.2.6 *Visualization Techniques*

1.6.1.3 Discuss the distribution of drug compounds between the stationary and mobile phases.

1.6.1.4 Describe factors which affect TLC separations.

Date of Completion _____ Trainee _____

Trainer _____

1.6.1.5 References

1. Sections Covering *Thin Layer Chromatography*. pp. 93-94, 101-103, 255, 257, 277, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 1998.

2. Branum, G.D. *Thin Layer Chromatography*. pp. 99-124, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training, 1994.

3. Moffat, A.C. *Thin Layer Chromatography*. pp. 160-177, in: Clarke's Isolation and Identification of Drugs. Second Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 1986.

4. Fessenden, R.J. and Fessenden, J.S. *Techniques and Experiments for Organic Chemistry*. pp. 108-110, Boston: Willard Grant Press, 1983.

5. Giddings, J.C. *Theory of Chromatography*. pp. 27-44, *in:* Chromatography. Third Ed. Heftmann, E. ed. New York: Van Nostrand Reinhold Co., 1975.

6. Stahl, E. and Mangold, H.K. *Techniques of Thin-Layer Chromatography*. pp. 164-186 *in:* Chromatography. Third Ed., Heftmann, E. ed. New York: Van Nostrand Reinhold Co., 1975.

7. Skoog, D.A. and Leary, J.J. *Principles of Instrumental Analysis*. pp. 579-585, 663-667, 4th edition, Fort Worth: Saunders College Publishing, 1992.

Section One

Blood and Urine Toxicology

1.6 Thin Layer Chromatography (TLC)

1.6.2 TLC– Practice

1.6.2.1 The trainee should demonstrate proficiency in the application of T0XI-LAB® TOXI-LAB-A method for the detection of basic and neutral drugs by TLC *{Toxicology Program Procedure Manual Section 2.2.1}.*

1.6.2.2 The trainee should demonstrate proficiency in the application of T0XI-LAB® TOXI-LAB-B method for the detection of acidic and neutral drugs by TLC *{Toxicology Program Procedure Manual Section 2.2.2}.*

1.6.2.3 The trainee should demonstrate proficiency in the application of T0XI-LAB® AMINE DIFFERENTIATION method for the detection and differentiation of sympathomimetic amines by TLC *{Toxicology Program Procedure Manual Section 2.2.3}.*

1.6.2.4 The trainee should demonstrate proficiency in the application of T0XI-LAB® THC II-PLUS method for the detection of Δ^9-THC-COOH by TLC *{Toxicology Program Procedure Manual Section 2.2.4}.*

1.6.2.5 The trainee should demonstrate proficiency in the application of T0XI-LAB® Benzoylecgonine method for the detection of the cocaine metabolite, benzoylecgonine by TLC *{Toxicology Program Procedure Manual Appendix I., 2.2.5.1}.*

Date of Completion _____ Trainee _____

Trainer _____

1.6.2.6 References

1-5. ANSYS, Inc., TOXI-LAB TLC procedures for Toxi-A, Toxi-B, Sympathomimetic Amine Separation and THC-II-Plus and Benzoylecgonine.

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.1 Liquid-Liquid Extraction – Principle

1.7.1.1 The trainee should be well versed in the principles involved with liquid-liquid extraction.

1.7.1.2 Describe the properties that are involved in a solvent's ability to extract a particular analyte.

1.7.1.3 Describe the following processes as they relate to liquid-liquid extraction:

1.7.1.3.1 *Basic Extraction*
1.7.1.3.2 *Acidic Extraction*
1.7.1.3.3 *Buffering*

Date of Completion _____ Trainee _____

Trainer _____

1.7.1.4 References

1. Sections Covering *Liquid-liquid Extraction.* pp. 71-77, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC,1998.

2. Stafford, David T. *Liquid/Liquid Extraction in Toxicology –chapter 14.* pp. 1-13, *in*: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting. 1994.

3. Pavia, D.L., Lampman, G.M. and Kriz, G.S. *Technique 5, Extraction, The Separatory Funnel, Drying Agent.* pp. 525-530, *in*: Introduction to Organic Laboratory Techniques., Philadelphia: W.B. Saunders Co., 1976.

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.2 Liquid-Liquid Extraction of Blood – Practice

1.7.2.1 The trainee should demonstrate proficiency in the extraction procedure for neutral and basic drugs-of-abuse in blood for qualitative confirmation by GC/MS. *{Toxicology Program Procedure Manual 3.6.1}.*

Date of Completion _____ Trainee _____

Trainer _____

1.7.2.2 The trainee should demonstrate proficiency in the extraction procedure for acidic drugs in blood for qualitative confirmation by GC/MS. *{Toxicology Program Procedure Manual 3.6.2}.*

Date of Completion _____ Trainee _____

Trainer _____

1.7.2.3 The trainee should demonstrate proficiency in the procedure for extraction and derivatization of amphetamine and methamphetamine in blood for qualitative confirmation by GC/MS. *{Toxicology Program Procedure Manual 3.6.3}.*

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.2 Liquid-Liquid Extraction of Blood – Practice

1.7.2.4 The trainee should demonstrate proficiency in the procedure for extraction of barbiturate class drugs in blood for qualitative confirmation by GC/MS. {*Toxicology Program Procedure Manual 3.6.4*}.

Date of Completion _____ Trainee _____

Trainer _____

1.7.2.5 The trainee should demonstrate proficiency in the extraction and derivatization procedure for carboxy-THC in blood for qualitative confirmation by GC/MS. {*Toxicology Program Procedure Manual 3.6.5*}.

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.3 Liquid-Liquid Extraction of Urine – Practice

1.7.3.1 The trainee should demonstrate proficiency in the application of T0XI-LAB® TOXI-LAB-A method towards the extraction of basic and neutral drugs for GC/MS analysis *{Toxicology Program Procedure Manual 2.4.1}*.

Date of Completion _____ Trainee _____

Trainer _____

1.7.3.2 The trainee should demonstrate proficiency in the application of T0XI-LAB® TOXI-LAB-B method towards the extraction of acidic and neutral drugs for GC/MS analysis *{Toxicology Program Procedure Manual 2.4.1}*.

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.3 Liquid-Liquid Extraction of Urine – Practice

1.7.3.3 The trainee should demonstrate proficiency in the application of liquid-liquid extraction for the confirmation of the extraction of benzodiazepines for GC/MS analysis *{Toxicology Program Procedure Manual 2.4.3}.*

1.7.3.3.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.7.3.3.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.7 Liquid-Liquid Extraction

1.7.3 Liquid-Liquid Extraction of Urine- Practice

1.7.3.4 The trainee should demonstrate proficiency in the liquid-liquid extraction of 11-nor-Δ^9-carboxy-THC (Carboxy-THC) for qualitative GC/MS analysis *{Toxicology Program Procedure Manual 2.4.4}*.

1.7.3.4.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.7.3.5 The trainee should demonstrate proficiency in the liquid-liquid extraction of 11-nor-Δ^9-carboxy-THC (Carboxy-THC) for quantitative GC/MS analysis *{Toxicology Program Procedure Manual 2.4.5}*.

1.7.3.5.1 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Solid Phase Extraction (SPE)

1.8.1 SPE – Principle

1.8.1.1 The trainee should be knowledgeable about the principles involved with solid phase extraction (SPE).

1.8.1.2 Describe the advantages of SPE over liquid-liquid extraction methods.

1.8.1.3 Define the following terms as they relate to SPE.
1.8.1.3.1 Van der Waal Forces

1.8.1.4 Discuss the sorbent options for SPE columns in regards to the types available, their target compounds and the interactions which they participate in.

1.8.1.5 List the six typical steps involved in a SPE procedure.

1.8.1.6 Discuss how to prepare the sample for optimum analyte retention on a particular SPE column.

Date of Completion _____ Trainee _____

Trainer _____

1.8.1.7 References

1. Sections Covering *Solid Phase Extraction.* pp. 77-79, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 1998.

2. Sears, R.M. *Liquid/Solid Extraction in Toxicology – chapter 15.* pp. 1-51, *in*: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting. 1994.

3. Platoff, G.E. and Gere, J.A. *Solid Phase Extraction of Abused Drugs from Urine.* Forensic Science Review. **3(2):**119-132. 1991.

4. Chen, X.H., Franke, J.P. and Zeeuw, R.A. *Principles of Solid-Phase Extraction.* pp. 1-22, *in:* Handbook of Workplace Drug Testing. Washington, D.C.:AACC Press, 1995.

5. Gere, J.A. and Platoff, G.E.. *Solid-Phase Extraction of Abused Drugs in Urine.* pp. 23-44, *in:* Handbook of Workplace Drug Testing. Washington, D.C.:AACC Press, 1995.

6. Automated SPEC® Solid Phase Extraction Protocols for Drugs of Abuse Using the RapidTrace™ SPE Workstation. Ansys, Inc and Zymark Corporation. 1996.

7. RapidTrace™ SPE Workstation Quick Reference Guide. Zymark Corporation, 1996.

8. SPEC® Instructions for Use for SPEC® Solid Phase Extraction Columns. ANSYS, Inc., 1996.

9. Hearne, G.M and Hall, D.O. *Advances in Solid-Phase Extraction Technology.* American Laboratory, January 1993.

10. Blevins, D.D. and Henry, M.P. *Pharmaceutical Applications of Extraction Disk Technology.*

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE) –Practice

1.8.2 SPE of Blood – Practice

1.8.3.1 The trainee should demonstrate proficiency in the application of SPE for the confirmation of neutral and basic Drugs in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.4.1}.*

1.8.3.2 The trainee should demonstrate proficiency in the application of SPE for the confirmation of benzodiazepine class compounds in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.4.2}.*

1.8.3.3 The trainee should demonstrate proficiency in the application of SPE for the confirmation cocaine and benzoylecgonine in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.4.3}.*

1.8.3.4 The trainee should demonstrate proficiency in the application of SPE for the confirmation of opiate class compounds in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.4.1}.*

1.8.3.5 The trainee should demonstrate proficiency in the application of SPE for the confirmation of hydrocodone in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.5.1}.*

1.8.3.6 The trainee should demonstrate proficiency in the application of SPE for the confirmation of propoxyphene and norpropoxyphene in blood by GC/MS using the UCT 200 mg CLEAN SCREEN® Extraction Column. *{Toxicology Program Procedure Manual 3.6.1}.*

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE) –Practice

1.8.3 SPE of Urine – Practice

1.8.3.1 The trainee should demonstrate proficiency in the application of SPE for the confirmation of amphetamine and methamphetamine *{Toxicology Program Procedure Manual 2.3.1.1}*.

- Option One: ANSYS® Diagnostics, Inc SPEC-PLUS™ 3mL DAU
- Option Two: UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.1.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.1.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.2 The trainee should demonstrate proficiency in the application SPE for the confirmation of benzodiazepines (Enzyme Hydrolysis) *{Toxicology Program Procedure Manual 2.3.1.2}*.

- Option One: ANSYS® Diagnostics, Inc SPEC-PLUS™ 3mL DAU
- Option Two: UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.2.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.2.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine – Practice

1.8.3.3 The trainee should demonstrate proficiency in the application of SPE for the confirmation of cocaine and the cocaine metabolite benzoylecgonine *{Toxicology Program Procedure Manual 2.3.1.3}*.

- Option One: ANSYS® Diagnostics, Inc SPEC-PLUS™ 3mL DAU
- Option Two: UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.3.1 Qualitative Analysis

_____ _____
Date of Completion Trainee

_____
Trainer

1.8.3.3.2 Quantitative Analysis

_____ _____
Date of Completion Trainee

_____
Trainer

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.4 The trainee should demonstrate proficiency in the application of SPE for the confirmation of codeine and morphine/opiate (Enzyme Hydrolysis) *{Toxicology Program Procedure Manual 2.3.1.4}*.

- Option One: ANSYS® Diagnostics, Inc SPEC-PLUS™. 3mL DAU
- Option Two: UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.4.1 Qualitative Analysis

_____ _____
Date of Completion Trainee

_____
Trainer

1.8.3.4.2 Quantitative Analysis

_____ _____
Date of Completion Trainee

_____
Trainer

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.5 The trainee should demonstrate proficiency in the application of SPE for the confirmation of 6-monoacetylmorphine *{Toxicology Program Procedure Manual 2.3.1.5}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.5.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.5.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.6 The trainee should demonstrate proficiency in the application of SPE for the confirmation of phencyclidine *{Toxicology Program Procedure Manual 2.3.1.6}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.6.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.6.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.7 The trainee should demonstrate proficiency in the application of SPE for the confirmation of THC metabolite/carboxy-THC (Alkaline Hydrolysis) *{Toxicology Program Procedure Manual 2.3.1.7}.*

- Option One: ANSYS® Diagnostics, Inc SPEC-PLUS™. 3mL DAU
- Option Two: UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.7.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.7.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.8 The trainee should demonstrate proficiency in the application of SPE for the confirmation of barbiturates *{Toxicology Program Procedure Manual 2.3.1.8}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.8.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.8.2 Quantitative Analysis

Date of Completion _____ Trainee _____

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Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine - Practice

1.8.3.9 The trainee should demonstrate proficiency in the application of SPE for the confirmation of propoxyphene *{Toxicology Program Procedure Manual 2.3.1.9}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.9.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.9.2 Quantitative Analysis

Date of Completion _____ Trainee _____

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Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine- Practice

1.8.3.10 The trainee should demonstrate proficiency in the application of SPE for the confirmation of acidic and neutral Drugs (general) *{Toxicology Program Procedure Manual 2.3.1.10}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.10.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.8 Manual and Automated Solid Phase Extraction (SPE)

1.8.3 SPE of Urine- Practice

1.8.3.11 The trainee should demonstrate proficiency in the application of SPE for the confirmation of γ-hydroxybutyrate (GHB) *{Toxicology Program Procedure Manual 2.3.1.11}*.

- UCT 200 mg CLEAN SCREEN® Extraction Column

1.8.3.11.1 Qualitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

1.8.3.11.2 Quantitative Analysis

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.9 Instrumentation and Devices

1.9.1 Gas Chromatography (GC)

1.9.1.1 The trainee should have comprehensive background in regards to the principles of GC.

1.9.1.2 The trainee should demonstrate their ability to operate and maintain a GC-Flame Ionization Detector (FID) and/or GC-Nitrogen Phosphorus Detector (NPD). This includes an understanding of the system's software, inlet and detector maintenance, column installation, and troubleshooting techniques.

1.9.1.3 Compare the sensitivities of the FID and the NPD.

1.9.1.4 Describe the influence carrier gas flow has on the efficiency of a GC.

1.9.1.5 Define the following terms as they relate to GC.
1.9.1.5.1 *Resolution*
1.9.1.5.2 *Area Under the Curve*
1.9.1.5.3 *HETP*

1.9.1.6 Discuss which GC parameters affect resolution. Describe how to approach a lack of resolution.

1.9.1.7 Discuss how to alleviate peak tailing.

1.9.1.8 The trainee should possess an understanding of the principles and application of quantitative analysis.

1.9.1.9 Describe the major advantages of using an internal standard.

Date of Completion _____ Trainee _____

Trainer _____

1.9.1.10 References

1. Sections Covering *Gas Chromatography*. pp. 93-101, 103-114, 122-129, and *Mass Spectrometry*. pp. 153-169, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 1998.

2. Stafford, David T. *Introduction to Chromatography – chapter 2.* pp. 1-39, *in*: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting, 1994.

Section One

Blood and Urine Toxicology

1.9 Instrumentation and Devices

1.9.2 Gas Chromatography/Mass Spectrometry (GC/MS)

1.9.2.1 The trainee should have a working knowledge of the theory and technique of the GC/MS. The understanding of this technique should include the operation of instrumentation and operating software.

1.9.2.2 Discuss the maintenance that is to be performed on the GC/MS involving the injection port, ion source, vacuum pump, and column.

1.9.2.3 Describe the ionization process.

1.9.2.4 Discuss the differences between SIM and Full-scan acquisition of data.

1.9.2.5 Discuss the advantages of derivatizing drug compounds.

1.9.2.6 Evaluate an Antotune report.

Date of Completion _____ Trainee _____

Trainer _____

1.9.2.7 References

1. Sections Covering *Gas Chromatography*. pp. 93-101, 103-114, 122-29, and *Mass Spectrometry*. pp. 153-169, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 1998.

2. Stafford, David T. *Introduction to Chromatography – chapter 2*. pp. 1-39, *in*: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting. 1994.

3. Foltz, R.L. *Mass Spectrometry.* pp. 159-190, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training. 1994.

4. Smith, R.M. *Understanding Mass Spectra.* New York: John Wiley & Sons, Inc., 1998.

Section One

Blood and Urine Toxicology

1.9 Instrumentation and Devices

1.9.3 Rapid Trace™ SPE

1.9.3.1 The trainee should have a working knowledge of the RapidTrace™ SPE Workstation Operation.

1.9.3.2 Describe the routine maintenance performed on the RapidTrace™ SPE Workstation.

Date of Completion _____ Trainee _____

Trainer _____

1.9.3.3 References

1. RapidTrace™ SPE Workstation Manual.

Section One

Blood and Urine Toxicology

1.9 Instrumentation and Devices

1.9.4 Artel Pipette Calibrator

1.9.4.1 The trainee should have a working knowledge of how to prepare the PCS 2™ Pipette Calibration System to perform pipette calibration.

1.9.4.2 Describe the operating principle of the PCS 2™ Pipette Calibration System.

1.9.4.3 Explain the routine maintenance performed on the PCS 2™ Pipette Calibration System.

1.9.4.4 List ten practices that will improve pipetting technique.

Date of Completion _____ Trainee _____

Trainer _____

1.9.4.6 References

1. PCS 2™ Pipette Calibration System Procedure Guide.

Section One

Blood and Urine Toxicology

1.9 Instrumentation and Devices

1.9.5 Hamilton MICROLAB® Dilutor

1.9.5.1 The trainee have a working knowledge of the Hamilton MICROLAB® dilutor.

1.9.5.3 Describe the routine maintenance performed on the Hamilton MICROLAB® dilutor.

Date of Completion _____ Trainee _____

Trainer _____

1.9.4.6 References

1. Hamilton MICROLAB® User's Manual.

Section One

Blood and Urine Toxicology

1.10 Interpretation of Data

1.10.1 The trainee should possess a thorough understanding of the criteria used for identification for a compound of interest.

1.10.2 The trainee should have a thorough knowledge of the compounds included under *Commonly Encountered Compounds in the Toxicology* located in the SOP Manual.

1.10.3 Discuss requirements for identification for the following techniques:

1.10.3.1 Enzyme Immunoassay.
1.10.3.2 Thin Layer Chromatography.
1.10.3.3 GC/MSD.

_____ _____
Date of Completion Trainee

_____
Trainer

Section One

Blood and Urine Toxicology

1.11 Casefile Preparation

1.11.1 The trainee should be familiar with the items that are included in a toxicology casefile.

1.11.2 The trainee should be comfortable with the worksheets used to record the results of analysis.

Date of Completion _____ Trainee _____

Trainer _____

Section One

Blood and Urine Toxicology

1.12 Basic Pharmacology and Drug Metabolism

1.12.1 The trainee should possess a basic understanding of the principles of pharmacology as they relate to drugs-of-abuse and drug compounds, which impair driving ability.

1.12.2 Define the following terms:
- 1.12.2.1 Pharmacology
- 1.12.2.2 Pharmacokinetics
- 1.12.2.3 Pharmacodynamics

1.12.3 Discuss the factors that influence the metabolism of drugs.

1.12.4 List the major metabolites for the following representative compounds. Indicate which metabolites are psychoactive.
- 1.12.4.1 Methamphetamine.
- 1.12.4.2 Cocaine alone and in combination with alcohol.
- 1.12.4.3 Diazepam
- 1.12.4.4 Clonazepam
- 1.12.4.5 Alprazolam
- 1.12.4.6 Flunitrazepam
- 1.12.4.7 Carisoprodol
- 1.12.4.8 Heroin
- 1.12.4.9 Codeine
- 1.12.4.10 Δ^9-THC
- 1.12.4.11 Imipramine
- 1.12.4.12 Amitriptyline
- 1.12.4.12 Propoxyphene
- 1.12.4.13 Tramadol

1.12.5 Characterize phase I and II drug metabolism.

1.12.6 The metabolism of 1,4-Benzodiazepine, Diazepam, yields several metabolites which in turn undergo biotransformation. Indicate which compounds result in each case:
- 1.12.6.1 N-dealkylation (P450 mediated)
- 1.12.6.2 Hydroxylation (P450)
- 1.12.6.3 Glucuronidation

1.12.7 The metabolism of Codeine yields several metabolites. Indicate which compounds result in each case:
- 1.12.7.1 O-dealkylation (P450 mediated)

1.12.7.2 N-dealkylation (P450)
1.12.7.3 Glucuronidation

1.12.8 The metabolism of Methamphetamine yields several metabolites. Indicate which compounds result in each case:
1.12.8.1 N-dealkylation (P450)
1.12.8.2 Oxidative Deamination (P450)
1.12.8.3 Aromatic Hydroxylation (P450)

1.12.9 List compounds that yield methamphetamine as a metabolite.

1.12.10 The metabolism of Cocaine yields several metabolites. Indicate which compounds result in each case:
1.12.10.1 N-dealkylation (P450)
1.12.10.2 Transesterification with alcohol (Esterase)
1.12.10.3 Ester Hydrolysis mediated by Esterases (two compounds)
1.12.10.4 Aromatic Hydroxylation (P450)

1.12.11 Define the following terms in regard to drug metabolism:
1.12.11.1 First pass effect
1.12.11.2 Half-life
1.12.11.3 Zero and first-order reactions

1.12.12 Give two examples of commonly encountered compounds that form glucuronide conjugates in phase II.

1.12.13 Describe the potential modes of excretion for drug compounds.

1.12.14 Describe how urinary pH will affect urinary methamphetamine concentration.

1.12.15 References

1. Spiehler, V. and Levine, B., *Pharmacokinetics and Pharmacodynamics*. pp. 46-66, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

2. Isenschmid, D.S. *Cocaine.* pp. 221-245, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

3. Huestis, M.A. *Marijuana.* pp. 246-264, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

4. Moore, Karla. *Amphetamine/Sympathomimetic Amines.* pp. 221-245, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

5. Kerrigan, S. and Goldberger, B.A. *Opioids.* pp. 202-220, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

6. Clarke's Isolation and Identification of Drugs. Second Edition. Moffat, A.C., Ed, London: The Pharmaceutical Press. 1986.

7. Julien,R.M., *Principles of Drug Action. in:* Primer of Drug Action, pp. 1-39, Freeman-New York, 1998.

8. Benet, L.Z., Kroetz, D.L. and Sheiner, L.B., *Pharmacokinetics: The Dynamics of Drug Absorption, Distribution and Elimination.* pp. 3-28, *in:* Goodman and Gilman's The Pharmacological Basis of Therapeutics, New York:McGraw-Hill, 1996.

Idaho State Police
Forensic Services
Toxicology Discipline

Section Two

Ethanol and Other Volatiles

Revision #	Issue Date	History
0	05-30-2000	Original Issue
1	12-16-2002	Updated to comply with Quality Manual
2	08-18-2004	Updated, refined, reformatted.
3	02-01-2005	Additional emphasis on IDAPA 11.03.01 requirements and QA.

Approval

Discipline Leader

Susan C. Williamson _____ Date

Issuance

Quality Assurance Manager

Richard D. Groff _____ Date

Section Two
Ethanol and Other Volatiles

2.1 Training Objectives

2.2 Administrative Issues

2.3 Evidence Handling Issues

2.4 Solution Preparation

2.5 Gas Chromatography Theory and Operation

2.6 Headspace Analysis Theory and Operation

2.7 Pipette Calibrator Theory and Operation

2.8 Sample Dilutor Operation

2.9 Standard Operating Procedures

2.10 Casefile Preparation

2.11 Pharmacology and Impairment Detection

2.12 Preparation and Presentation of Courtroom Testimony

2.13 Mock Courtroom Testimony

2.14 Competency Testing

2.15 Performance of Analysis on Case Material

Idaho State Police
Forensic Services
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Section Two

Ethanol and Other Volatiles

2.1 TRAINING OBJECTIVES

This section of the toxicology training manual has many objectives. It is intended to serve as a guide for an Idaho State Police Forensic Services (ISP-FS) analyst training to perform quantitative ethanol and qualitative "other volatiles" analysis, in both biological and non-biological samples. The analysis of these samples is described in SOPs *4.1-Quantitative Analysis for Ethanol and Qualitative Analysis for Other Volatiles in Blood, Vitreous Humor and Urine by Dual Column Headspace Gas Chromatography* and *4.2-Analysis of Solutions Containing Ethanol and Common Volatiles.* The following subsections address other related issues including administrative issues, the submittal of the sample to the laboratory, collection kit requirements and documentation, instrumental analysis, preparation of laboratory notes, issuance of the analysis report and subsequent courtroom testimony. In order to address questions in court, the analyst must possess knowledge of the pharmacology of ethanol and related compounds, field testing to detect impairment and the associated Idaho Codes. The references cited, or equivalent, should be consulted if the analyst is unfamiliar with the subject matter.

To facilitate the over-all process, training for SOP 4.1 and 4.2 must be pursued concurrently. Answers to questions are to be provided verbally and/or in written form. Whether individual answers are verbal or written should depend on the background and experience of the trainee and is at the discretion of the trainer. As part of the training process, the Trainee should assist the Trainer with the preparation of samples for analysis as well as perform analysis on blood control samples. Due to the nature of the analysis of biological fluids to detect ethanol and other volatiles, the Trainee should successfully complete the required competency test prior to supervised performance of the SOPs on actual case material.

2.2 ADMINISTRATIVE ISSUES

2.2.1 The Trainee should be familiar with the Idaho State Police Policies Manual.

2.2.2 The Trainee should be knowledgeable of the content and application of the Forensic Services Quality Manual.

2.2.3 The Trainee should be well informed in the content and application of the Forensic Services Health and Safety Manual.

2.3 EVIDENCE HANDLING ISSUES

2.3.1 The Trainee should describe the procedures followed for the intake and transfer of specimens submitted for alcohol and/or volatiles analysis.

2.3.2 The Trainee should describe the barrier protection measures required when handling biological samples and unknown liquids.

2.3.3 The Trainee should describe the types of commonly available blood collection tubes and containers.

2.3.4 The Trainee should describe what IDAPA 11.03.01 mandates as the proper way to collect a blood and urine sample for a forensic ethanol analysis.

2.3.5 The Trainee should discuss the preservative and anticoagulant required for IDAPA compliant blood collection tubes/containers in terms of consequences of using an improper collection tube/container.

2.3.6 The Trainee should describe the types and applications of the toxicology collection kits distributed by ISP-FS.

2.3.7 The Trainee should discuss how ISP-FS kits comply with the requirements set forth in IDAPA 11.03.01.

2.3.8 The Trainee should describe the agencies served by their laboratory and the programs involved.

2.3.9 References

1. ASTM E1459-92, *Standard Guide for Physical Evidence Labeling and Related Documentation.*

2. Kippenberger, D.J. and Selavka, C.M. *Training in Specimen Handling*. pp. 33-54, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology. 1994.

3. IDAPA 11, Title 03, Chapter 01: Idaho State Forensic Laboratory Rules Governing Alcohol Testing.

4. Idaho State Police Forensic Services Technical Bulletin 1, February 2003.

5. Idaho State Police Forensic Services Technical Bulletin 3, February 2003.

6. Idaho State Police Forensic Services Technical Bulletin 5, February 2003.

7. Idaho State Police Forensic Services Technical Bulletin 6, February 2003.

8. Idaho State Police Forensic Services Technical Bulletin 10, September 2003.

2.4 SOLUTION PREPARATION

2.4.1 The Trainee should demonstrate the ability to prepare, and record the preparation of, solutions required in the analysis of alcohol and other volatiles.

2.4.2 The Trainee should demonstrate a thorough understanding of the nomenclature and calculations involved in the determination of weight percent and volume percent solutions.

2.4.3 References

1. College Chemistry Text, chapter(s) discussing the properties of solutions.

2.5 GAS CHROMATOGRAPHY (GC) THEORY AND OPERATION

2.5.1 The Trainee should possess a comprehensive background in regards to the principles of GC.

2.5.2 The Trainee should provide a brief explanation of GC in terms understandable to a layperson.

2.5.3 The Trainee should describe the influence carrier gas flow has on the efficiency of a GC-FID.

2.5.4 Define the following terms as they relate to GC.

2.5.4.1 *Resolution*
2.5.4.2 *Area Under the Curve*
2.5.4.3 *HETP*
2.5.4.4 *Sensitivity versus Specificity*

2.5.5 Discuss which GC parameters affect resolution. Describe how to approach a lack of resolution.

2.5.6 Discuss measures to alleviate peak tailing.

2.5.7 The Trainee should possess an understanding of the principles and application of quantitative analysis.

2.5.8 The Trainee should describe how amount ratios and response ratios are used to construct a calibration curve.

2.5.9 The Trainee should discuss the major advantages of using an internal standard method.

2.5.10 The Trainee should demonstrate their ability to operate a GC equipped with a flame ionization detector (FID) through both the system software and the instrument touch pad.

2.5.11 The Trainee should demonstrate a working knowledge of the GC operating software. The Trainee should have the ability to utilize the system software to develop an analysis method, prepare an analysis sequence, reprocess data, perform a manual calibration, and modify the analysis report format and setting processing parameters to optimize peak detection and integration.

2.5.12 The Trainee should demonstrate their ability to maintain a GC equipped with a flame ionization detector (FID). This includes inlet and detector maintenance, column installation, troubleshooting techniques and the documentation thereof.

2.5.13 References

1. Stafford, D.T. *Chromatography.* pp. 93-101, 103-114, *in:* Principles of Forensic Toxicology, edited by Barry Levin, , AACC, 1999.

2. Levine, B. *Alcohol.* pp. 170-184, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

2.6 HEADSPACE THEORY AND OPERATION

2.6.1 Trainee should possess a working knowledge of the theory and practice of headspace analysis.

2.6.2 The Trainee should describe how *the proportionality* known as *Henry's Law,* is utilized in headspace analysis.

2.6.3 The Trainee should demonstrate their ability to operate a Headspace Analyzer through both the system software and the instrument touch pad.

2.6.4 The Trainee should be acquainted with how the headspace method parameters such as the GC cycle time, thermostating time, pressurization time, etc., should be optimized.

2.6.5 The Trainee should demonstrate their understanding of the system software as it applies to the headspace analyzer including setting up the HS analysis method.

2.6.6 The Trainee should demonstrate their ability to maintain a headspace analyzer. This includes replacement of seals and sampling needle, transfer line replacement, adjustment of the hand crimper, troubleshooting techniques and the documentation thereof.

2.6.7 References

1. Stafford, D.T. *Chromatography.* pp. 93-101, 103-114, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

2. Saker, E.G. Screening and Quantitation by Headspace Technique of Some of the Vapors Most Commonly Found in Forensic Toxicology. pp. 1-33, in: Current Approaches in Forensic Toxicology, Chapter 11, SOFT Meeting, 1994.

2.7 PIPETTE CALIBRATOR THEORY AND OPERATION

2.7.1 The Trainee should have a working knowledge of how to prepare the ARTEL PCS 2™ Pipette Calibration System to perform pipette calibration.

2.7.2 The Trainee should describe the operating principle of the PCS 2™ Pipette Calibration System.

2.7.3 The Trainee should demonstrate their ability to operate the PCS 2™ Pipette Calibration System through completing a calibration check on the syringes for the sample dilutor.

2.7.4 The Trainee should explain the routine maintenance performed on the PCS 2™ Pipette Calibration System.

2.7.5 References

1. PCS 2™ Pipette Calibration System Procedure Guide.

2. ISP-FS Standard Operating Procedure 5.1, Pipette Calibration.

2.8 SAMPLE DILUTOR OPERATION

2.8.1 The Trainee should have a working knowledge of the Hamilton MICROLAB® dilutor.

2.8.2 The Trainee should demonstrate the operation of the Hamilton MICROLAB® dilutor.

2.8.3 The Trainee should describe the routine maintenance performed on the Hamilton MICROLAB® dilutor.

2.8.4 References

1. Hamilton MICROLAB® User's Manual.

2.9 STANDARD OPERATING PROCEDURES

2.9.1 SOP 4.1

2.9.1.1 The Trainee should convey their understanding of the analysis protocol in SOP 4.1 for the *Quantitative Analysis for Ethanol and Qualitative Analysis for Other Volatiles in Blood, Vitreous Humor and Urine by Dual Column Headspace Gas Chromatography.*

2.9.1.2 Trainee should describe the types of samples which qualify for analysis with SOP 4.1.

2.9.1.3 Trainee should detail their approach in determining if a blood tube/container is compliant with IDAPA 11.03.01.

2.9.1.4 Trainee should describe the quality assurance requirements described in SOP 4.1.

2.9.1.5 Trainee should describe the acceptance criteria for an analysis run.

2.9.1.6 Trainee should describe how quality assurance data is monitored and where it should be stored.

2.9.1.7 Trainee should describe the authentication process for both quantitative and qualitative ethanol and other volatiles standards and controls.

2.9.1.8 Trainee should describe how blood, urine and vitreous humor alcohol concentrations should be reported.

2.9.1.9 Trainee should indicate the statement that must be placed on the analysis report when the blood collection tube/container does not comply with IDAPA 11.03.01.

2.9.1.10 Trainee should indicate the statement that must be placed on the analysis report when urine is analyzed for ethanol concentration.

2.9.1.11 Trainee should describe how qualitative volatiles should be reported.

2.9.1.12 To develop their expertise in using the SOP, the Trainee will practice the SOP on control samples and/or old proficiency test samples.

2.9.1.13 References

1. ISP-FS Standard Operating Procedure 4.1, *Quantitative Analysis for Ethanol and Qualitative Analysis for Other Volatiles in Blood, Vitreous Humor and Urine by Dual Column Headspace Gas Chromatography.*

2. Idaho Administration Code, IDAPA 11.03.01, Rules Governing Alcohol Testing.

3. Christmore, D.S., Kelly, R.C. and Doshier, L.A. *Improved Recovery and Stability of Ethanol in Automated Headspace Analysis,* J. Forensic Sci. 29(4): 1038-1044; 1984.

4. Restek Applications Note #59598, Dual-Column Confirmational GC Analysis of Blood Alcohols Using the Rtx®-BAC1 and Rtx®-BAC2 Columns Optimized for the Perkin-Elmer HS-40 Headspace Autosampler, 1999.

5. Stafford, D.T., *Chromatography. in:* Principles of Forensic Toxicology, edited by Barry Levin, pp. 93-101, 103-114, AACC Press, 1999.

6. Levine, B., *Alcohol. in:* Principles of Forensic Toxicology, edited by Barry Levin, pp. 170-184, AACC Press, 1999.

7. Caplan, Y.H., *The Determination of Alcohol in Blood and Breath. in:* Forensic Science Handbook, edited by Richard Saferstein, pp. 594-648, Prentice-Hall New Jersey, 1982.

8. Saker, E.G., *Screening and Quantitation by Head Space Technique of Some of the Vapors Most Commonly Found in Forensic Toxicology*, in: Current Approaches in Forensic Toxicology, Chapter 11, SOFT Meeting, 1994.

9. Klaassen, C.D., *Inhalants, in:* Principles of Forensic Toxicology, edited by Barry Levin, pp. 341-348, AACC Press, 2003.

2.9.2 SOP 4.2

2.9.2.1 The Trainee should convey their understanding of the analysis protocol in SOP 4.2 for the *Analysis of Solutions Containing Ethanol and Common Volatiles.*

2.9.2.2 Trainee should describe the types of samples that SOP 4.2 is applied for.

2.9.2.3 Trainee should describe the quality assurance requirements described in SOP 4.2.

2.9.2.4 Trainee should describe the acceptance criteria for an analysis run.

2.9.2.5 Trainee should describe how quality assurance data is monitored and where it should be stored.

2.9.2.6 Trainee should describe the authentication process for both quantitative and qualitative ethanol and other volatiles standards and controls.

2.9.2.7 The Trainee should discuss the different types of alcoholic beverages and their respective alcohol content.

2.9.2.8 Trainee should describe how alcohol concentrations should be reported in alcoholic beverages, simulator solutions and unknown solutions.

2.9.2.9 Trainee should describe how qualitative volatiles should be reported.

2.9.2.10 To develop their expertise in using the SOP, the Trainee will practice the SOP on control samples and/or old proficiency test samples.

2.9.2.11 References

1. ISP-FS Standard Operating Procedure 4.2, *Analysis of Solutions Containing Ethanol and Common Volatiles.*

2. Christmore, D.S., Kelly, R.C. and Doshier, L.A. *Improved Recovery and Stability of Ethanol in Automated Headspace Analysis,* J. Forensic Sci. 29(4): 1038-1044; 1984.

3. Restek Applications Note #59598, Dual-Column Confirmational GC Analysis of Blood Alcohols Using the Rtx®-BAC1 and Rtx®-BAC2 Columns Optimized for the Perkin-Elmer HS-40 Headspace Autosampler, 1999.

4. Stafford, D.T., *Chromatography. in:* Principles of Forensic Toxicology, edited by Barry Levin, pp. 93-101, 103-114, AACC Press, 1999.

5. Levine, B., *Alcohol. in:* Principles of Forensic Toxicology, edited by Barry Levin, pp. 170-184, AACC Press, 1999.

6. McAnalley, B.H., *Chemistry of Alcoholic Beverages.* pp. 1-27, *in:* Medicolegal Aspects of Alcohol, edited by James C. Garriott, Lawyers & Judges, 1996.

2.9.3 SOP 5.1.1 and 5.1.2

2.9.3.1 The Trainee should convey their understanding of the Pipette Calibration options set forth in SOP 5.1.1, *PCS 2™ Pipette Calibration System* and SOP 5.1.2, *Gravimetric Pipette Calibration.*

2.9.3.2 The Trainee should outline the requirements for pipette calibration in regards to frequency and acceptance criteria.

2.9.4 SOP 5.2

2.9.4.1 The Trainee should convey their understanding of the balance calibration requirements set forth in SOP 5.2, *Balance Calibration.*

2.9.4.2 The Trainee should describe the calibration procedure for the balance(s) utilized for preparation of solutions for alcohol/volatiles analysis.

2.9.4.3 The Trainee should outline the requirements for balance calibration in regards to frequency and acceptance criteria.

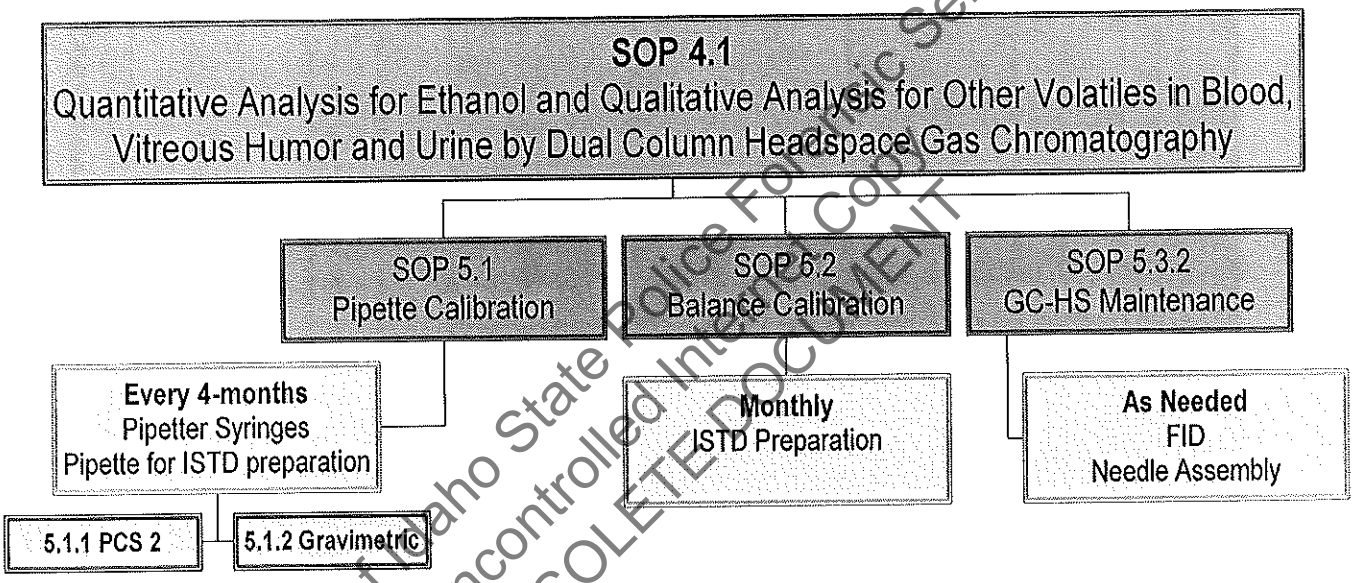
2.9.5 SOP 5.3.2

2.9.5.1 The Trainee should convey their understanding of the instrument maintenance requirements set forth in SOP 5.3.2, *PERKIN ELMER HS40xl Automatic Headspace Sampler and AutoSystem XL Gas Chromatograph.*

2.9.5.2 The Trainee should outline the requirements for periodic and as needed maintenance.

2.9.6 SOP Flow Diagram

2.9.6.1 The Trainee should explain the following flow diagram.



2.10 CASEFILE PREPARATION

2.10.1 The Trainee should describe which documents, data and completed worksheets are required to be included in an alcohol/other volatiles analysis casefile.

2.10.2 The Trainee should describe requirements for analysis worksheets and data included in casefile.

2.10.3 The Trainee should describe requirements for review of casefile and analysis report.

2.10.4 References

1. Idaho State Police Forensic Services Quality Manual, rev. 5, July 2004.

2.11 PHARMACOLOGY AND IMPAIRMENT DETECTION

2.11.1 The Trainee should demonstrate a working knowledge of the pharmacology of alcohol and other commonly encountered volatiles. This should include an understanding of the factors affecting absorption, distribution and elimination.

2.11.2 The Trainee should describe the situation when the alcohol content of arterial blood exceeds that of venous blood.

2.11.3 The Trainee should be familiar with the metabolism of ethanol and other commonly encountered volatiles. This should include how metabolism relates toxicity.

2.11.4 The Trainee should describe their understanding of the effects of alcohol and other commonly encountered volatiles on the human body. This should include how it contributes to mortality and impairment observed in DUI cases.

2.11.5 The Trainee should describe their understanding of postmortem changes and their effect on alcohol concentration.

2.11.6 The Trainee should be comfortable with the development, performance and interpretation of Standardized Field Sobriety Tests (SFST) and a Drug Recognition Exam (DRE).

2.11.7 References

1. Levine, B., *Alcohol.* pp. 170-184, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

2. Kunsman, G.W., *Human Performance Testing.* pp. 170-184, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 1999.

3. Caplan, Y.H., *The Determination of Alcohol in Blood and Breath.* pp. 594-648, *in:* Forensic Science Handbook, edited by Richard Saferstein, New Jersey:Prentice-Hall, 1982.

4. Julien, R.M., *Central Nervous System Depressants: Alcohol and the Inhalants of Abuse.* pp. 64-92, *in:* Primer of Drug Action, New York:Freeman, 1998.

5. Perrine, D.M., *Depressants: Alcohol, Benzodiazepines, Barbiturates*, pp. 113-129, *in:* The Chemistry of Mind-Altering Drugs, ACS, Washington, DC, 1996.

6. Hobbs, W.R., Rall, T.W. and Verdoorn, T.A., *Drugs Acting on the Central Nervous System - Hypnotics and Sedatives; Ethanol.* pp. 361, 386-393, *in:* Goodman and Gilman's The Pharmacological Basis of Therapeutics, McGraw-Hill, 1996.

7. Garriott, J.C., *Pharmacology and Toxicology of Ethyl Alcohol.* pp. 35-54, *in:* Medicolegal Aspects of Alcohol, edited by James C. Garriott, Lawyers & Judges, 1996.

8. Baselt, R., *Disposition of Alcohol in Man.* pp. 65-78, *in:* Medicolegal Aspects of Alcohol, edited by James C. Garriott, Lawyers & Judges, 1996.

9. Garriott, J.C., *Analysis for Alcohol in Postmortem Specimens.* pp. 151-163, *in:* Medicolegal Aspects of Alcohol, edited by James C. Garriott, Lawyers & Judges, 1996.

2.12 PREPARATION AND PRESENTATION OF COURTROOM TESTIMONY

2.12.1 The analyst should discuss proper demeanor and body language while testifying in court.

2.12.2 The analyst should describe proper attire for court.

2.12.3 The analyst should discuss ways to deal with nervousness while testifying.

2.12.4 The analyst should describe how a casefile should be reviewed in preparation for testimony.

2.12.5 The analyst should describe the typical sequence of questions pursued during direct and cross-examination.

2.12.6 The analyst should discuss the implications of the following events:
- 2.12.6.1 Stipulation
- 2.12.6.2 Objection Over-ruled
- 2.12.6.3 Objection Sustained

2.12.7 The Trainee should discuss sections of Idaho Code where the analysis of biological or unknown samples could be applied.

2.12.8 <u>References</u>

1. Osgood, C., *Osgood On Speaking.* William Morrow: New York, 1988.

2. Weingarten, H. *The Expert Witness: the Toxicologist in Court.* pp. 225- 242, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training, 1994.

3. Sannito, T., *Nonverbal Communication in the Courtroom.* Champion, Sept.-Oct., 1985.

4. Idaho Code §18-8002, §18-8004, §18-8006, §23-1333.

2.13 MOCK COURTROOM TESTIMONY

As appropriate for the SOP(s) the Trainee is training for, conduct a mock court trial for the Trainee to provide testimony for a minimum of the following situations.

1. DUI blood alcohol analysis with pharmacology questions.

2. "Open container violation" including questions about the alcohol concentration of various types of alcoholic beverages.

2.14 COMPETENCY TESTING

Upon the completion of training, the Trainee should complete a competency test consisting of the following samples:

1. ≥Six (6) whole blood specimens containing a wide range of appropriate alcohol concentrations and a minimum of one commonly encountered other volatile.

2. ≥Two (2) non-biological solutions containing appropriate ethanol concentrations.

2.15 PERFORMANCE OF ANALYSIS ON CASE MATERIAL

Upon successful completion of competency testing and when possible, proficiency testing, the Trainee should complete no less than 30 case samples under close supervision. The 30 samples must be divided into a minimum of two analysis runs. For purposes of this process, close supervision is at the discretion of the Trainer. The Trainer will cosign these case reports. A listing of the co-signed case samples should be compiled and included in training records.

Idaho State Police
Forensic Services
Toxicology Discipline

Section Two

Ethanol and Other Volatiles

Topic Completion Sign-off

2.2 ADMINISTRATIVE ISSUES

Date of Completion _____ Trainee _____

Trainer _____

2.3 EVIDENCE HANDLING ISSUES

Date of Completion _____ Trainee _____

Trainer _____

2.4 SOLUTION PREPARATION

Date of Completion _____ Trainee _____

Trainer _____

2.5 GAS CHROMATOGRAPHY (GC) THEORY AND OPERATION

Date of Completion _____ Trainee _____

Trainer _____

2.6 HEADSPACE THEORY AND OPERATION

Date of Completion _____ Trainee _____

Trainer _____

2.7 PIPETTE CALIBRATOR THEORY AND OPERATION

Date of Completion _____ Trainee _____

Trainer _____

2.8 SAMPLE DILUTOR OPERATION

Date of Completion _____ Trainee _____

Trainer _____

2.9 STANDARD OPERATING PROCEDURES

Date of Completion _____ Trainee _____

Trainer _____

2.10 CASEFILE PREPARATION

Date of Completion _____ Trainee _____

Trainer _____

2.11 PHARMACOLOGY AND IMPAIRMENT DETECTION

Date of Completion _____ Trainee _____

Trainer _____

2.12 PREPARATION AND PRESENTATION OF COURTROOM TESTIMONY

Date of Completion _____ Trainee _____

Trainer _____

2.13 MOCK COURTROOM TESTIMONY

Date of Completion _____ Trainee _____

Trainer _____

2.14 COMPETENCY TESTING

Date of Completion _____ Trainee _____

Trainer _____

2.15 PERFORMANCE OF ANALYSIS ON CASE MATERIAL

Date of Completion _____ Trainee _____

Trainer _____

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.1 Preparation and Presentation of Courtroom Testimony

3.1.1 Discuss proper demeanor and body language while testifying in court.

3.2.2 Describe the fright-fight-flight response.

3.1.3 Describe how a casefile should be reviewed in preparation for testimony.

3.1.4 Describe the typical sequence of questions pursued during cross-examination.

3.1.5 Discuss the implications of the following events:
- 3.1.5.1 Stipulation
- 3.1.5.2 Objection Over-ruled
- 3.1.5.3 Objection Sustained

3.1.6 The trainee should provide testimony in a Mock Court Trial.

Date of Completion _____ Trainee _____

Trainer _____

3.1.7 References

1. Osgood, C. *Osgood On Speaking*. William Morrow: New York, 1988.

2. Weingarten, H. *The Expert Witness: the Toxicologist in Court*. pp. 225- 242, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training, 1994.

3. Sannito, T. *Nonverbal Communication in the Courtroom*. Champion, Sept.-Oct., 1985.

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.2 Competency and Proficiency Testing

3.2.1 Upon the completion of training, the trainee should complete a competency test consisting of ≥six (6) specimens. The specimens should contain representative commonly encountered parent drug and drug metabolites.

Date of Completion _____ Trainee _____

Trainer _____

3.2.2 The trainee should participate in the next issue of the appropriate proficiency test. For urine and blood drug testing, the trainee should complete a College of American Pathologists (CAP) proficiency test. For blood alcohol analysis, the trainee should perform the Department of Transportation (DOT) proficiency test.

Date of Completion _____ Trainee _____

Trainer _____

Section Three
Ancillary Issues

3.1 Preparation and Presentation of Courtroom Testimony

3.2 Competency Testing

3.3 Proficiency Testing

3.4 Performance of Analysis on Case Material

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.1 Preparation and Presentation of Courtroom Testimony

3.1.1 Discuss proper demeanor and body language while testifying in court.

3.1.2 Describe the fright-fight-flight response and how to overcome it.

3.1.3 Describe how a casefile should be reviewed in preparation for testimony.

3.1.4 Describe the typical sequence of questions pursued during cross-examination.

3.1.5 Discuss the implications of the following events:
- 3.1.5.1 Stipulation
- 3.1.5.2 Objection Over-ruled
- 3.1.5.3 Objection Sustained

3.1.6 The trainee should provide testimony in a Mock Court Trial.

Indicate applicable discipline(s):

☐ Drug Toxicology
☐ Alcohol and other volatiles

Date of Completion _____

Trainee _____

Trainer _____

3.1.7 References

1. Osgood, C. *Osgood On Speaking*. William Morrow: New York, 1988.
2. Weingarten, H. *The Expert Witness: the Toxicologist in Court*. pp. 225-242, *in:* California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training, 1994.
3. Sannito, T. *Nonverbal Communication in the Courtroom*. Champion, Sept.-Oct., 1985.

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.2 Competency Testing

3.2.1 Competency Testing for Drug Toxicology

Upon the completion of training, the trainee should complete a competency test consisting of ≥six (6) specimens. The specimens should contain representative commonly encountered parent drug and drug metabolites.

_____ _____
Date of Completion Trainee

_____
Trainer

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.2 Competency Testing

3.2.2 Competency Testing for Alcohol and Other Volatiles

Upon the completion of training, the trainee should complete a competency test consisting of ≥six (6) specimens. The specimens should contain a wide range of alcohol concentrations and a minimum of one commonly encountered other volatile.

Date of Completion

Trainee

Trainer

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.3 Proficiency Testing

3.3.1 Proficiency Testing for Drug Toxicology

The trainee should participate in the next issue of the ASCLD/LAB approved FTC proficiency test. The FTC proficiency test is provided by the College of American Pathologist (CAP) consists of three blood specimens and one urine specimen.

Indicate appropriate specimen(s):

☐ Urine
☐ Blood

Date of Completion _____ Trainee _____

Trainer _____

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.3 Proficiency Testing

3.3.2 Proficiency Testing for Alcohol and Other Volatiles

The trainee should participate in the next issue of the proficiency test approved by ASCLD/LAB. For blood alcohol analysis, the trainee should perform the Department of Transportation (DOT) proficiency test.

_____ _____
Date of Completion Trainee

_____
Trainer

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.4 Performance of Analysis on Case Material

3.4.1 Urine Drug Toxicology

Upon successful completion of competency testing and when possible, proficiency testing, the trainee should complete no less than 72 case samples under close supervision. For purposes of this process, close supervision is defined as on-going review of all data. The trainer will cosign these case reports.

Upon completion of ≥72 case samples and associated paperwork, the trainee can begin unsupervised casework.

Date of Completion _____ Trainee _____

Trainer _____

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.4 Performance of Analysis on Case Material

3.4.2 Blood Drug Toxicology

Upon successful completion of competency testing and when possible, proficiency testing, the trainee should complete no less than 50 case samples under close supervision. For purposes of this process, close supervision is defined as on-going review of all data. The trainer will cosign these case reports.

Upon completion of ≥50 case samples and associated paperwork, the trainee can begin unsupervised casework.

Date of Completion _____ Trainee _____

Trainer _____

Idaho State Police
Forensic Services
Toxicology Section

Section Three

Ancillary Issues

3.4 Performance of Analysis on Case Material

3.4.3 Alcohol Analysis

Upon successful completion of competency testing and when possible, proficiency testing, the trainee should complete no less than 33 case samples under close supervision. For purposes of this process, close supervision is defined as constant supervision. The trainer will cosign these case reports.

Upon completion of ≥33 case samples and associated paperwork, the trainee can begin unsupervised casework.

_____ _____
Date of Completion Trainee

_____
Trainer

Idaho State Police
Forensic Services
Toxicology Section

Section Three – History Page

Ancillary Issues

Revision #	Issue Date	History
0	05-30-00	Original Issue
1	12-16-02	Updated to comply with Quality Manual

Approval

Technical Leader: _____ **Date:** _____

Issuance

QC Manager: _____ **Date:** _____
Rick D. Groff

Commander: _____ **Date:** _____
Major Ralph W. Powell