Idaho State Police
Forensic Services

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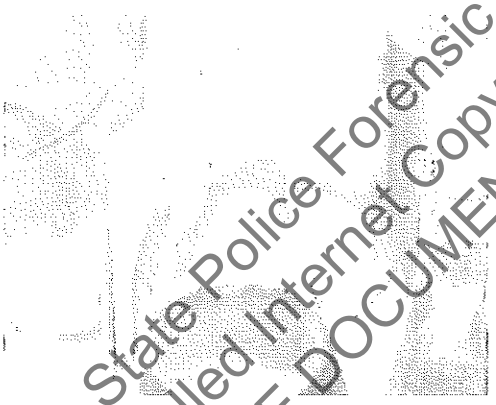

Discipline/Name of Document: Toxicology Training Manual
Section One – Blood and Urine

Revision Number: 3

Issue Date: 2/05/2009

APPROVED BY: _____
Quality Manager

2/5/09
Date Signed

Idaho State Police
Forensic Services

Toxicology Discipline Training Plan

Section One – New Analyst Training

Detection of Drugs in Blood and Urine

Trainee: _____
Forensic Scientist ____

Trainer: _____
Forensic Scientist ____

Trainer: _____
Forensic Scientist ____

Issuing Authority: Quality Manager
Rev. 3 Issued: 02-05-2009
SECTION 1-Blood and Urine Toxicology Training Plan – Rev 3.doc

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

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Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.1 TRAINING OBJECTIVES

1.1.1 Introduction

This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed as a guide to provide a forensic Trainee with the background necessary to process blood and urine specimens to detect and confirm the presence of drug compounds other than ethanol. This plan 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 Trainee must possess a working knowledge of drug metabolism and a fundamental understanding of the pharmacology of psychoactive compounds. This training will culminate when the analyst qualifies as an expert witness in each particular subdiscipline.

1.1.2 Approach to Training

1.1.2.1 In order to address the training plan questions, The *Background Reading* cited, or equivalent, must be consulted if the Trainee is not familiar with the subject matter. Both the education and work experience of the Trainee must be considered, however, at least a verbal review of material for the trainer must be done to the satisfaction of the Trainer.

1.1.2.2 Answers to training plan questions may be provided verbally and/or in written form. This choice is at the discretion of the trainer.

1.1.2.3 Sign-off for training plan topics that involve more than one toxicology subdiscipline urine and blood toxicology and/or alcohol/volatiles (Training Plan Section Two), need not be repeated. These sections only need to be signed-off once, just note on the check list where the training sign-off is located. Note that Section 1.9- Thin Layer Chromatography, applies only to urine testing.

1.1.2.4 Although all training does not have to proceed in the order used in this training plan, Section 1.2 must be signed-off prior to additional sections.

1.1.2.5 It is not necessary to complete the entire training manual at one time, only the sections that apply to a particular Analytical Method.

1.1.2.6 Training for all Analytical Methods does not have to be pursued concurrently. Some Analytical Methods are utilized infrequently; therefore training can be completed prior to sign-off on all listed analytical methods.

1.1.3 Hands-on Analysis during Training Defined

1.1.3.1 As part of the training process, the Trainee will perform hands-on analysis only on control samples and "old" proficiency tests.

1.1.3.2 Due to the nature of the analysis of biological fluids to detect drug and drug metabolites, no "hands of the trainer" casework will be pursed during the training process.

1.1.3.3 The trainee will observe the trainer performing casework and can assist the trainer with preparation for analysis, solution and reference material preparation as well as data analysis print-out (non-interpretive) but until the Trainee has successfully completed all relevant training, the required competency test and signed off by the quality manager, no supervised case work will be performed.

1.1.4 Additional Training for Experienced/Signed-off Analyst

1.1.4.1 For training of an experienced analyst (Forensic Scientist II or III) in a new or updated technique or instrument, the training is to be commensurate with the magnitude of changes with consideration of the analyst's existing background. The extent of training to be required will be agreed upon by the discipline leader and quality manager with input from the analyst.

1.1.4.2 If a separate training plan section has been created for the training topic and/or analytical method then it must be utilized, otherwise the appropriate portions of this training plan section must be used.

1.1.5 Continual Awareness of Relevant Literature

The new or experienced analyst is reminded that this training plan only addresses the core of training for toxicological analysis. After the completion of training, the analyst is responsible for keeping their knowledge current through continual literature review. This must include relevant journals, newsletters and text books.

1.2 ADMINISTRATIVE ISSUES

1.2.1 The Analyst in Training must be familiar with relevant sections of the Idaho State Police Employee Handbook.

1.2.2 The Analyst in Training must be knowledgeable of the content and application of the Idaho State Police Forensic Services ISO/IEC 17025:2005 Compliant Quality/Procedure Manual. ISP Quality/Procedure Manual Exam must be successfully completed prior to pursuing additional training.

1.2.3 The Analyst in Training must be well informed in the content and application of the Idaho State Police Forensic Services Health and Safety Manual. The Health and Safety Manual Exam must be successfully completed prior to pursuing additional training.

1.2.4 Background Reading

1. Idaho State Police Employee Handbook (http://intranet/.htm or equivalent)

2. Idaho State Police Forensic Services ISO/IEC 17025:2005 Compliant Quality/Procedure Manual (I:\International Management System)\

3. Idaho State Police Forensic Services Health and Safety Manual. (I:\International Management System)\

1.3 EVIDENCE HANDLING

1.3.1 The Trainee must describe the procedures followed for the intake of toxicology specimen collection kits, transfer of samples, required paperwork, and subsequent specimen handling considerations.

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

1.3.3 The Trainee must describe the agencies served by their laboratory and the programs involved.

1.3.4 The Trainee must describe the barrier protection measures required when handling biological samples.

1.3.5 Background Reading

1. 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.

2. Idaho State Police Forensic Services Health and Safety Manual. (I:\International Management System)\

1.4 BALANCE OPERATION

1.4.1 The trainee should be familiar with the operation of any analytical or top-loading balances used to prepare toxicology solutions and reference material.

1.4.2 Describe the basic steps involved in the weighing of a material.

1.4.3 Background Reading
1. Manufacturer manual for all balances to be used by the Trainee.

1.5 PIPETTE INTERMEDIATE CHECK THEORY AND OPERATION

1.5.1 ARTEL PCS 2™ Pipette Calibration System

1.5.1.1 The Analyst in Training must have a working knowledge of how to prepare the ARTEL PCS 2™ Pipette Calibration System to perform an intermediate check of the status of a POVA's (piston operated volumetric apparatus) calibration.

1.5.1.2 The Analyst in Training must describe the operating principle of the PCS 2™ Pipette Calibration System.

1.5.1.3 The Analyst in Training must demonstrate their ability to operate the PCS 2™ Pipette Calibration System through completing an intermediate check on the syringes for the sample dilutor.

1.5.1.4 The Analyst in Training must explain the routine maintenance performed on the PCS 2™ Pipette Calibration System.

1.5.1.5 Background Reading
1. Analytical Method 5.1.1, PCS 2 Pipette Calibration.
2. Standard Operating Procedure for the PCS 2™ Pipette Calibration System, Artel Document #310A2715A, April 1997,
3. PCS 2™ Pipette Calibration System Procedure Guide, Artel Document # 15A2135, Version 5.1, 03-28-1997.
4. College Chemistry/Biochemistry Text, chapter(s) discussing Absorption Spectrophotometry.
5. Curtis, R.H., *Performance Verification of Manual Action Pipets: Part I,* Am. Clin. Lab. 12(7):8-9; 1994.
6. Curtis, R.H., *Performance Verification of Manual Action Pipets: Part II,* Am. Clin. Lab. 12(9):16-17; 1994.

1.5.2 Gravimetric Pipette Intermediate Checks

1.5.2.1 The Analyst in Training must describe the principle, equipment and calculations involved when using the gravimetric method to perform an intermediate check of a POVA.

1.5.2.2 The Analyst in Training must demonstrate their ability to perform an intermediate check on the syringes for the sample dilutor.

1.5.2.3 Background Reading

1. ISO 8655-6:2002, Piston-operated volumetric apparatus – Part 6: Gravimetric method for the determination of measurement error.

1.6 SOLUTION PREPARATION

1.6.1 Basic Chemical Calculations and Nomenclature

Define the following terms and address the questions.

1.6.1.1 *Solvent*
1.6.1.2 *Molarity (M)*
1.6.1.3 *How many moles per liter are in a 2M solution?*
1.6.1.4 *Normality (N)*
1.6.1.5 *How may equivalents in a 2N solution?*
1.6.1.6 *Weight per Volume Percent (%w/v)*
1.6.1.7 *Weight per Weight Percent (%w/w)*

1.6.2 The trainee must be familiar with solution preparation and documentation. This must include the preparation of hydrolysis agents, buffers and extraction solvents used in all stages of specimen preparation for analysis.

1.6.3 The trainee must have a working knowledge of pH meter operation and documentation. The trainee must standardize a series of pH buffers and perform a pH check during the preparation of a buffer solution for the trainer.

1.6.4 Background Reading

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

2. Seamonds, B. and Byrne, E.A. *Basic Laboratory Principles and Techniques* pp. 3 - 43. *in:* Clinical Chemistry: Theory, Analysis, Correlation. Mosby, 2003.

3. Shugar, G.J., Shugar, R.A. and Bauman, L. *Grades of Purity of Chemicals* pp. 145-154, *pH Measurement.* pp. 232-234. *in:* Chemical Technicians' Ready Reference Handbook, McGraw Hill: New York, 1973.

4. 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.

5. Operation Manual for pH Meter.

1.7 IMMUNOASSAY

1.7.1 Describe the competitive binding process as it applies to immunoassay.

1.7.2 The trainee must define and discuss the following terms as they related to Enzyme Immunoassay (EIA):

1.7.2.1 *Enzyme*
1.7.2.2 *Antigen*
1.7.2.3 *Antibody*
1.7.2.4 *Hapten*
1.7.2.5 *Cross-reactivity/analytical specificity*
1.7.2.6 *Antigenic Determinant*
1.7.2.7 *Cut-off*

1.7.3 Discuss specificity versus sensitivity as it applies to EIA.

1.7.4 Discuss the major differences between homogeneous and heterogeneous enzyme immunoassays.

1.7.5 The trainee must demonstrate a working knowledge of theory and application of enzyme-multiplied immunoassay technique (EMIT).

1.7.5.1 Describe the basic EMIT process.
1.7.5.2 Discuss the attributes and limitations of EMIT.

1.7.6 Background Reading

1. Thompson, S.G., *Principles for Competitive Binding Assays*. pp. 246 – 264. *in:* Clinical Chemistry: Theory, Analysis, Correlation. Mosby, 2003.

2. Sections Covering *Immunoassay and EMIT.* pp. 34-35, 119-139, 212, 234-235, 249, 268-269, 271, 288-292, *in:* Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC,2006.

3. Analytical Methods 1.1 and 1.2: Enzyme Immunoassay Screening for Drugs of Abuse.

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

5. 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.

6. Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 995-998, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.8 INSTRUMENTATION: VIVA AUTOMATIC CHEMISTRY ANALYZER

1.8.1 The Trainee must demonstrate their ability to apply the Viva system software to operate the analyzer.

1.8.2 The Trainee must demonstrate a thorough understanding of the required periodic and as needed maintenance for the Viva analyzer.

1.8.3 The Trainee must demonstrate a thorough understanding of troubleshooting techniques for the Viva analyzer.

1.8.4 Background Reading: Viva Junior™ Operation and Maintenance:

1. Viva-Jr™ Operator's Manual, Article No.: 6002-940-410, Version number: 01/04-06.

2. Viva-Jr™ System Operations Guide, T268, 6/25/07, D01373.

1.8.5 Background Reading: Viva-E™ Operation and Maintenance

1. Viva-E™ Operator's Manual, Article No.: 6002-380-410-01, Version number: 1.0/08-04.

2. Viva-E™ System Operations Guide, T216, 6/4/07, D01320.

1.9 THIN LAYER CHROMATOGRAPHY (TLC)

(Urine Only)

1.9.1 The trainee must be well versed in the theory of thin layer chromatography.

1.9.2 Define the following terms as they relate to TLC:

1.9.2.1 *Capillary Action*

1.9.2.2 *Stationary and Mobile phases*
1.9.2.3 *R_f Retardation/Retention Factor*
1.9.2.4 *Elution/Developing Solvent*
1.9.2.5 *Partition Coefficients (K_d, K)*
1.9.2.6 *Visualization Techniques*

1.9.3 Discuss the distribution of drug compounds between the stationary and mobile phases for TLC.

1.9.4 Describe factors which affect TLC separations.

1.9.5 Background Reading

1. Sections Covering *Thin Layer Chromatography.* pp. 92, 98-99, 196-197, 235, 250, 269, 288. *in:* Principles of Forensic Toxicology. Second Ed., Levine, B. ed., AACC, 2006.

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

3. Poole, C.F., *Thin Layer Chromatography.* pp. 392-424, *in:* Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004.

4. Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 999-1000, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

5. Toxi-Lab® THC II Instruction Manual, ©1998.

6. Toxi-Lab® THC II-PLUS Instruction Manual, ©1998.

7. Toxi-Lab® TOXI-A Drug Detection System Instruction Manual, ©1989.

8. Toxi-Lab® TOXI-B Drug Detection System Instruction Manual, ©1989.

1.10 LIQUID-LIQUID EXTRACTION

1.10.1 The trainee must be well versed in the principles involved with liquid-liquid extraction.

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

1.10.3 Describe the following processes as they relate to liquid-liquid extraction:
- 1.10.3.1 *Basic Extraction*
- 1.10.3.2 *Acidic Extraction*
- 1.10.3.3 *Back Extraction*
- 1.10.3.4 *Buffering – Why are different pHs required for different methods?*

1.10.4 Background Reading

1. Sections Covering *Liquid-liquid Extraction. in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 2006.

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. Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 1005-1007, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.11 SOLID PHASE EXTRACTION (SPE)

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

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

1.11.3 Discuss Van der Waal Forces as they relate to SPE.

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

1.11.5 Discuss the six typical steps involved in a SPE procedure.

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

1.11.7 Background Reading

1. Sections Covering *Solid Phase Extraction. in:* Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC, 2006.

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

7. Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 1006-1007, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.12 PRINCIPLE: GAS CHROMATOGRAPHY (GC)

1.12.1 The trainee must have comprehensive background in the principles of GC.

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

1.12.3 Define the following terms as they relate to GC.

1.12.3.1 *Resolution*
1.12.3.2 *Area Under the Curve*
1.12.3.3 *HETP*
1.12.3.4 *Signal to Noise Ratio*

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

1.12.5 Discuss how to alleviate peak tailing.

1.12.6 The trainee must possess an understanding of the principles and application of quantitative analysis.

1.12.7 Describe the major advantages of using an internal standard.

1.12.8 Background Reading

1. Sections Covering *Gas Chromatography*. pp. refer to index, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 2006.

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. Dawling, S. *Gas Chromatography*. pp. 425-499, *in*: Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004.

4. Hearn, W.L. and Walls, H.C. Common Methods in Post-Mortem Toxicology. pp. 1000-1001, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.13 PRINCIPLE: FLAME IONIZATION DETECTOR (FID)

1.13.1 The trainee must have a through understanding of a FID works.

1.13.2 Describe the best applications of a FID.

1.13.3 Background Reading

1. Sections Covering *FID*. pp. refer to index, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 2006.

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. Dawling, S. *Gas Chromatography*. pp. 425-499, *in*: Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004.

4. Hearn, W.L. and Walls, H.C. Common Methods in Post-Mortem Toxicology. pp. 1000-1001, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.14 PRINCIPLE: NITROGEN PHOSPHORUS DETECTOR (NPD)

1.14.1 The trainee must have a through understanding of a NPD works.

1.14.2 Describe the best applications of a NPD.

1.14.3 Background Reading

1. Sections Covering *NPD*. pp. refer to index, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 2006.

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. Dawling, S. *Gas Chromatography*. pp. 425-499, *in*: Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004.

4. Hearn, W.L. and Walls, H.C. Common Methods in Post-Mortem Toxicology. pp. 1000-1001, *in:* Drug Abuse Handbook, Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.15 PRINCIPLE: MASS SELECTIVE DETECTOR (MSD)

1.15.1 The trainee must have a working knowledge of the theory of mass spectrometry and the application of a mass selective detector.

1.15.2 Describe the ionization process.

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

1.15.4 Discuss the advantages of derivatizing drug compounds.

1.15.5 Evaluate an Autotune report.

1.15.6 Background Reading

1. Sections Covering M*ass Spectrometry*. pp. refer to index, *in:* Principles of Forensic Toxicology. Levine, B. ed., AACC, 2006.

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 (or newer version).

5. Watson, D. *Mass Spectrometry.* pp. 379-391, *in*: Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004.

6. Hearn, W.L. and Walls, H.C. *Common Methods in Post-Mortem Toxicology.* pp. 1002-1003, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

7. Hearn, W.L. and Druid, H. *Strategies for Post-mortem Toxicology Investigation,* pp. 1033-1042, *in:* Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007.

1.16 INSTRUMENTATION: GC-FLAME IONIZATION DETECTOR

1.16.1 The Trainee must demonstrate their ability to operate and maintain a gas chromatograph (GC) equipped with a Flame Ionization Detector (FID).

1.16.2 This Trainee must demonstrate a thorough understanding of the system's software, inlet and detector maintenance, column installation, and troubleshooting techniques.

1.16.3 Background Reading

1. Current instrument manuals for each GC-FID in use.

1.17 INSTRUMENTATION: GC-NITROGEN PHOSPHORUS DETECTOR

1.17.1 The Trainee must demonstrate their ability to operate and maintain a GC equipped with a Nitrogen Phosphorus Detector (NPD).

1.17.2 The Trainee must demonstrate a thorough understanding of the system's software, inlet and detector maintenance, column installation, and troubleshooting techniques.

1.17.3 Background Reading

1. Current instrument manuals for each GC-NPD in use.

1.18 INSTRUMENTATION: GC-MASS SELECTIVE DETECTOR

1.18.1 The trainee must demonstrate their ability to operate a GC equipped with a Mass Selective Detector.

1.18.2 The Trainee must demonstrate a thorough understanding of the system's software, troubleshooting techniques, and the maintenance that is to be performed on the GC/MSD including the injection port, ion source, vacuum pump, and column.

1.18.3 Background Reading
1. Current instrument manuals for each GC-MSD in use.

1.19 CASEFILE PREPARATION

1.19.1 The Trainee must describe which documents, data and completed worksheets are required to be included in urine or blood toxicology analysis casefile.

1.19.2 The Trainee must describe the worksheets and data that are to be compiled for a centrally stored QA file for each analysis run.

1.19.3 The Trainee must describe requirements for administrative and technical review of casefile and analysis report.

1.20 BASIC PHARMACOLOGY AND DRUG METABOLISM

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

1.20.2 Define the following terms:
- 1.20.2.1 *Pharmacology*
- 1.20.2.2 *Pharmacokinetics*
- 1.20.2.3 *Pharmacodynamics*

1.20.3 Discuss the factors that influence the metabolism of drugs.

1.20.4 List the major metabolites for the following representative compounds. Indicate which metabolites are psychoactive.
- 1.20.4.1 *Methamphetamine.*
- 1.20.4.2 *Cocaine alone and in combination with alcohol.*
- 1.20.4.3 *Diazepam*
- 1.20.4.4 *Clonazepam*
- 1.20.4.5 *Alprazolam*
- 1.20.4.6 *Flunitrazepam*

1.20.4.7 *Carisoprodol*
1.20.4.8 *Heroin*
1.20.4.9 *Codeine*
1.20.4.10 *Δ^9-THC*
1.20.4.11 *Imipramine*
1.20.4.12 *Amitriptyline*
1.20.4.13 *Propoxyphene*
1.20.4.14 *Tramadol*

1.20.5 Characterize phase I and II drug metabolism.

1.20.6 The metabolism of 1,4-Benzodiazepine, Diazepam, yields several metabolites which in turn undergo biotransformation. Indicate which compounds result in each case:
1.20.6.1 *N-dealkylation (P450 mediated)*
1.20.6.2 *Hydroxylation (P450)*
1.20.6.3 *Glucuronidation*

1.20.7 The metabolism of Codeine yields several metabolites. Indicate which compounds result in each case:
1.20.7.1 *O-dealkylation (P450 mediated)*
1.20.7.2 *N-dealkylation (P450)*
1.20.7.3 *Glucuronidation*

1.20.8 The metabolism of Methamphetamine yields several metabolites. Indicate which compounds result in each case:
1.20.8.1 *N-Dealkylation (P450)*
1.20.8.2 *Oxidative Deamination (P450)*
1.20.8.3 *Aromatic Hydroxylation (P450)*

1.20.9 List compounds that yield methamphetamine as a metabolite.

1.20.10 The metabolism of Cocaine yields several metabolites. Indicate which compounds result in each case:
1.20.10.1 *N-dealkylation (P450)*
1.20.10.2 *Transesterification with alcohol (Esterase)*
1.20.10.3 *Ester Hydrolysis mediated by Esterases (two compounds)*
1.20.10.4 *Aromatic Hydroxylation (P450)*

1.20.11 Define the following terms in regard to drug metabolism:
1.20.11.1 *First pass effect*
1.20.11.2 *Half-life*
1.20.11.3 *Zero and first-order reactions*

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

1.20.13 Describe the potential modes of excretion for drug compounds.

1.20.14 Describe how urinary pH will affect urinary methamphetamine concentration.

1.20.15 Background Reading

1. Spiehler, V. and Levine, B., *Pharmacokinetics and Pharmacodynamics*. pp. 47-63, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 2006

2. Isenschmid, D.S. *Cocaine*. pp. 239-260, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 2006.

3. Huestis, M.A. *Marijuana*. pp. 261-276, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 2006.

4. Moore, Karla. *Amphetamine/Sympathomimetic Amines*. pp. 277-296, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 2006.

5. Kerrigan, S. and Goldberger, B.A. *Opioids*. pp. 219-238, *in:* Principles of Forensic Toxicology, edited by Barry Levin, AACC, 2006.

6. Clarke's Analysis of Drugs and Poisons. Third Edition. Moffat, A.C., Ed, London: The Pharmaceutical Press. 2004.

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. refer to index, *in:* Goodman and Gilman's The Pharmacological Basis of Therapeutics, New York:McGraw-Hill, Most current edition available.

9. Baselt, R.C., *Disposition of Toxic Drugs and Chemicals in Man*. Seventh Edition. Foster City:Biomedical Publications, 2004.

10. Baselt, R.C., *Drug Effects on Psychomotor Performance*. Foster City:Biomedical Publications, 2001.

1.21 PREPARATION AND PRESENTATION OF COURTROOM TESTIMONY

1.21.1 The Trainee must discuss proper demeanor and body language while testifying in court.

1.21.2 The Trainee must describe proper attire for court.

1.21.3 The Trainee must discuss ways to deal with nervousness while testifying.

1.21.4 The Trainee must describe how a casefile must be reviewed in preparation for testimony.

1.21.5 The Trainee must describe the typical sequence of questions pursued during direct and cross-examination.

1.20.6 The Trainee must discuss the implications of the following events:
- 1.20.6.1 Stipulation
- 1.20.6.2 Objection Over-ruled
- 1.20.6.3 Objection Sustained

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

1.21.8 Background Reading

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

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

3. Idaho Code §18-8002, §18-8004, §18-8006, §23-1333. §37- 2732C, §33-210.

1.22 MOCK COURTROOM TESTIMONY

A mock court must be conducted to provide testimony for a minimum of a DUID case with pharmacology questions.

1.23 ANALYSIS OF CONTROLS AND "OLD" PROFICIENCY TESTS

1.23.1 To develop their expertise in using analytical methods, the Trainee will apply them to the analysis of control samples, and/or old proficiency test samples.

1.23.2 Prior to the analysis of control material and "old" proficiency test, the Trainee should complete a minimum of training plan sections 1.2 through 1.12.

1.23.3 Prior to the analysis of control material and "old proficiency tests the Trainee must be familiar with applicable analytical methods.

1.24 COMPETENCY TESTING FOR DRUG TOXICOLOGY

Upon the completion of training plan sections, the trainee must complete a competency test consisting of ≥10 specimens. The specimens must contain representative commonly encountered parent drug and drug metabolites.

1.25 PERFORMANCE OF ANALYSIS ON CASE MATERIAL

1.25.1 Upon successful completion of competency testing and the Quality Manager has reviewed and approved the training documentation, the Trainee will be responsible for the analysis casework under close supervision.

1.25.2 For the Toxicology Discipline, successful completion of competency testing is required prior to closely supervised analysis of case material, no "hands of the trainer" analysis is allowed.

1.25.3 Analysis notes for supervised analysis will be signed by the trainer.

1.25.4 Upon completion of required number of case samples and associated paperwork, the trainee can begin unsupervised casework.

1.25.5 Supervised Analysis Case Sample Requirements

1.25.5.1 **Urine Drug Toxicology**
A minimum of 50 case samples.

1.25.5.2 **Blood Drug Toxicology**
A minimum of 50 case samples.

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Both Urine and Blood Toxicology

1.2 ADMINISTRATIVE ISSUES

Date of Completion _____ Trainee _____

Trainer _____

1.3 EVIDENCE HANDLING ISSUES

Date of Completion _____ Trainee _____

Trainer _____

1.4 BALANCE OPERATION

Date of Completion _____ Trainee _____

Trainer _____

1.5 PIPETTE INTERMEDIATE CHECK THEORY AND OPERATION

Date of Completion _____ Trainee _____

Trainer _____

1.6 SOLUTION PREPARATION

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Both Urine and Blood Toxicology

1.7 PRINCIPLE: ENZYME IMMUNOASSAY

Date of Completion _____ Trainee _____

Trainer _____

1.8 INSTRUMENTATION: VIVA AUTOMATIC CHEMISTRY ANALYZER

Date of Completion _____ Trainee _____

Trainer _____

1.10 LIQUID-LIQUID EXTRACTION

Date of Completion _____ Trainee _____

Trainer _____

1.11 SOLID PHASE EXTRACTION

Date of Completion _____ Trainee _____

Trainer _____

1.12 PRINCIPLE: GAS CHROMATOGRAPHY (GC)

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Both Urine and Blood Toxicology

1.13 PRINCIPLE: FLAME IONIZATION DETECTOR (FID)

Date of Completion _____ Trainee _____

Trainer _____

1.15 PRINCIPLE: MASS SELECTIVE DETECTOR (MSD)

Date of Completion _____ Trainee _____

Trainer _____

1.16 INSTRUMENTATION: GC-FLAME IONIZATION DETECTOR

Date of Completion _____ Trainee _____

Trainer _____

1.18 INSTRUMENTATION: GC-MASS SELECTIVE DETECTOR

Date of Completion _____ Trainee _____

Trainer _____

1.19 CASEFILE PREPARATION

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Urine Toxicology

1.9 THIN LAYER CHROMATOGRAPHY

Date of Completion _____ Trainee _____

Trainer _____

1.20 BASIC PHARMACOLOGY AND DRUG METABOLISM

Date of Completion _____ Trainee _____

Trainer _____

1.21 PREPARATION & PRESENTATION OF COURTROOM TESTIMONY

Date of Completion _____ Trainee _____

Trainer _____

1.22 MOCK COURTROOM TESTIMONY

Date of Completion _____ Trainee _____

Trainer _____

1.23 ANALYSIS OF CONTROLS AND "OLD" PROFICIENCY TESTS

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Urine Toxicology

1.24 COMPETENCY TESTING - URINE

Date of Completion _____ Trainee _____

Trainer _____

1.25 SUPERVISED ANALYSIS OF CASE MATERIAL - URINE

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Blood Toxicology

1.14 PRINCIPLE: NITROGEN PHOSPHORUS DETECTOR (NPD)

Date of Completion _____ Trainee _____

Trainer _____

1.17 INSTRUMENTATION: GC-NITROGEN PHOSPHORUS DETECTOR

Date of Completion _____ Trainee _____

Trainer _____

1.20 BASIC PHARMACOLOGY AND DRUG METABOLISM – BLOOD

Date of Completion _____ Trainee _____

Trainer _____

1.21 PREPARATION & PRESENTATION OF COURTROOM TESTIMONY - BLOOD TOXICOLOGY

Date of Completion _____ Trainee _____

Trainer _____

1.22 MOCK COURTROOM TESTIMONY – BLOOD TOXICOLOGY

Date of Completion _____ Trainee _____

Trainer _____

Section One – New Analyst Training

Detection of Drugs in Blood and Urine Toxicology

1.26 TRAINING PLAN TOPIC COMPLETION SIGN-OFF

Topics may be not listed in order.

Training Plan Sections Applied to Blood Toxicology

1.23 ANALYSIS OF CONTROLS AND "OLD" PROFICIENCY TESTS

Date of Completion _____ Trainee _____

Trainer _____

1.24 COMPETENCY TESTING - BLOOD TOXICOLOGY

Date of Completion _____ Trainee _____

Trainer _____

1.25 SUPERVISED ANALYSIS OF CASE MATERIAL - BLOOD

Date of Completion _____ Trainee _____

Trainer _____

1.27 ANALYTICAL METHOD SIGN-OFF

Refer to method sign-off section for specific urine or blood analytical methods. To determine the understanding of each method each of the following must be addressed:

1.27.1 The trainee must fully describe the steps involved in each analysis procedure.

1.27.2 Trainee must describe the quality assurance requirements described in each Analytical Method.

1.27.3 Trainee must describe the acceptance criteria for an analysis run.

1.27.4 The trainee must possess a thorough understanding of the criteria used for the qualitative identification and/or quantitative level of a compound(s) of interest by each analytical method.

1.27.5 Trainee must describe how quality assurance data is monitored and where it must be stored.

1.27.6 Trainee must describe the authentication process for reference material.

1.27 ANALYTICAL METHOD (AM) SIGN-OFF

Urine Toxicology				
AM	Analytical Method	Completion Date	Trainee	Trainer
1.0	**Enzyme Immunoassay**			
1.1	Enzyme Immunoassay Screening for Drugs-of-Abuse in Urine			
1.2	Enzyme Immunoassay Screening for Drugs-of-Abuse in Blood			
2.2	**Thin Layer Chromatography**			
2.2.1	TOXI-LAB TOXI-A Drug Detection System			
2.2.2	TOXI-LAB TOXI-B Drug Detection System			
2.2.3	TOXI-LAB Amine Differentiation			
2.2.4	TOXI-LAB Carboxy-THC Detection System			
2.3	**Solid Phase Extraction – Qualitative Urine**			
2.3.4	Benzodiazepines			
2.3.6	Cocaine and Cocaine Metabolite			
2.3.8	Opiates			
2.4	**Liquid-liquid Extraction – Qualitative Urine**			
2.4.1	TOXI-A and TOXI-B			
2.4.2	GHB			
2.4.3	Benzodiazepines			
2.4.4	Carboxy-THC			

1.27 ANALYTICAL METHOD (AM) SIGN-OFF

Urine Toxicology				
AM	Analytical Method	Completion Date	Trainee	Trainer
2.5	**Identification of Compounds in Urine**			
2.5.2	Criteria for Identification of Compounds			
2.7	**Solid Phase Extraction – Quantitative Urine**			
2.7.1	6-Monoacetylmorphine			
2.7.2	Codeine and Morphine			
2.8	**Liquid-liquid Extraction – Quantitative Urine**			
2.8.1	Carboxy-THC			
2.8.2	GHB			

1.27 ANALYTICAL METHOD (AM) SIGN-OFF

Blood Toxicology				
AM	Analytical Method	Completion Date	Trainee	Trainer
3.3	**Gas Chromatographic Blood Screening**			
3.3.1	Basic and Neutral Drug Compounds			
3.3.2	Strongly Basic Drug Compounds			
3.3.3	Acidic and Neutral Drug Compounds			
3.4	**Solid Phase Extraction Methods for Qualitative GC/MSD**			
3.4.2	Selected Benzodiazepine Class Compounds			
3.6	**Liquid-liquid Extraction Methods for Qualitative GC/MSD**			
3.6.1	Basic and Neutral Drugs			
3.6.2	Acidic and Neutral Drugs			
3.6.7	High pKa Drugs			
3.9	**Liquid-liquid Extraction Methods for Quantitative GC**			
3.9.1	Δ^9-Tetrahydrocannabinol and 11-Nor-Δ^9-THC-COOH (GC-MSD)			
3.9.2	High pKa Drugs (GC-MSD and GC-NPD)			
3.9.3	Basic and Neutral Drugs (GC-MSD and GC-NPD)			
3.9.4	Acidic and Neutral Drugs (GC-MSD or GC-NPD)			

1.27 ANALYTICAL METHOD (AM) SIGN-OFF

Blood Toxicology				
AM	Analytical Method	Completion Date	Trainee	Trainer
3.10	**Solid Phase Extraction Methods for Quantitative GC/MSD Confirmation**			
3.10.1	THC and Carboxy-THC			
3.10.2	Methamphetamine and Amphetamine			
3.10.3	Free (Unbound) Codeine and Morphine			
3.10.4	Cocaine and Cocaine Metabolites			
3.10.5	GHB and GHB Metabolites			

1.27 ANALYTICAL METHOD (AM) SIGN-OFF

Quality Assurance				
AM	Analytical Method	Completion Date	Trainee	Trainer
5.1	**POVA Intermediate Checks**			
5.1.1	Artel Pipette Calibration System for Intermediate Checks			
5.1.2	Gravimetric Pipette Intermediate Checks			
5.2	Verification of Balance Calibration			
5.7	Review of Toxicology Proficiency and Competency Tests			
5.8	Quality Assurance Measures – Urine and Blood Toxicology			
5.9	Testing Guidelines			
5.10	Authentication of Reference Materials – Urine and Blood Toxicology			
5.11	Key Ions for Commonly Encountered Compounds			
5.12	Solution Preparation			

Revision History

Revision #	Issue Date	History
0	12-31-1999	Original Issue
1	05-30-2000	Reformatted
2	05-24-2007	Updated nomenclature, additional Analytical Methods added, Check-off format added.
3	02-05-2009	Updated immunoassay section, updated training objectives, defined hands-on analysis requirements, updated references, reformatted plan and sign-off.