VOLATILES ANALYSIS

TRAINING MANUAL

-BLOOD-

Table of Contents

Revision History

Revision #	Description of Changes
1	Original version implementation into Qualtrax template
2	Formatting changes to footer- no content revisions
3	Converting to pdf in Qualtrax – no content revisions
4	Added Sections 18.2.3, 18.2.4, 18.4.4 and 18.4.5. Changes were made to 1.4, 1.8, and 1.9
5	No Changes
6	Changes made to 1.6, 3.1.1, 7.4.2, added sign off checklist

1.0 Introduction

This manual is designed to give the Trainee with no experience in the field of forensic alcohol analysis the tools necessary to analyze evidence for the quantitative presence or absence of ethanol and the qualitative presence of volatile substances in samples submitted to the laboratory, and testify as an expert in the field of blood alcohol analysis and physiology in court. After a general overview of the laboratory and safety procedures the typical trainee with start with the sections needed to perform Volatile Substance analysis on fluids submitted to the lab. Once that is completed then the other sections can be pursued. No particular order of completion is required although trainees may find going following the order will make it easier. If a trainee has experience then some sections may progress faster than others.

1.1 In order to address the training plan questions, the suggested reading cited should be consulted if the Analyst in Training is not familiar with the subject matter.

1.2 The trainee is also reminded that during and upon completion they are responsible for keeping their knowledge current through continual literature review. This must include relevant journals, newsletters and text books.

1.3 Where applicable the Trainer will provide the trainee with practice samples so that the techniques can be mastered.

1.4 At the discretion of the trainer the trainee can begin working on case samples as the "Hands of the Analyst" (HOA). Since the case always belongs to the trainer they will observe and verify each step of the analysis up until the case is signed and submitted for review. It will be noted in the case record any case where the trainee conducted any part of the analysis. The number of HOA cases will depend on the abilities of the Trainee and the comfort level of the Trainer/Technical Leader (no less than 30 cases).

1.5 At the end of most sections there is a test. This test may be either verbal (in the form of a mock court) or written. The expectation is 100% correct answers on each test but not necessarily on the first attempt. Any incorrect answers may be corrected by discussion with the Trainer/ Technical Leader. At the trainer's discretion further study or practice may be required until mastery of the subject can be demonstrated.

1.6 After the training plan is completed, a competency test and mock court will be conducted that covers the training plan comprehensively. Failure of any part of the competency test will necessitate the test to be rerun in part or in whole.

1.7 When all parties agree it is appropriate, a mock court will be held. The trainee will be evaluated on both content and presentation.

1.8 After the successful completion of the mock court the trainee will be signed off to perform supervised casework and/or supervised instrument calibrations. The exact number of cases is determined by the Trainer and Technical Leader on a case-by-case basis. The stated number may change if difficulties arise (no less than 30 cases).

1.9 Technical Review training can begin any time after completion of the trainee's supervised cases.

2.0 Roles and Responsibilities

2.1 Supervisor

The supervisor in coordination with the Technical Lead, Trainer, and the Trainee will set up a schedule outlining expectations for the trainee and will then monitor the progress of the trainee.

2.2 Technical Lead

The Technical Lead (TL) will appoint a Trainer and monitor the trainee's progress. The TL will report to the supervisor any delays to the training schedule. The TL will be available to the trainer to answer any questions. The TL will review results from the exercises, arrange and grade competency tests, and mock courts.

2.3 Trainer

The Trainer will provide the trainee with the materials necessary to complete training. Materials include but are not limited to samples, equipment and most importantly knowledge. They will keep the TL up to date on the progress of the trainee.

2.4 Trainee

In order to get the most out of this training it is important for trainees to realize that the information provided through this manual is only a portion of what will be needed in order to not only become proficient but also to become a productive member of the team. It is incumbent on the trainee to utilize not only the information presented but also knowledge learned in school and/or from previous work experience. The use of outside sources of information is encouraged as are questions.

3.0 Evidence Handling

3.1 Background and Theory

3.1.1 Evidence and instrumentation need to be handled and stored in order to preserve the integrity of the samples. There are several factors that can contribute to the potential degradation of a sample or an instrument's condition. Recognizing these issues, their potential for harm, and the potential detrimental effect that they could have on the evidence and instrument are paramount to understanding the handling and preservation of the evidence and instrumentation.

3.2 Objectives, Principles, and Knowledge

3.2.1 The Trainee should, upon completion of this section, understand the issues and hazards associated with the handling of evidence and instruments within the laboratory. This includes the potential long term storage concerns and the issues that may present themselves should the samples or instruments be subject to conditions that fall outside the prescribed guidelines.

3.3 Health and Safety Hazards

3.3.1 In handling of blood and other biological fluids, the trainee should follow the Universal Precaution Rules and the guidelines that are set forth in the Health and Safety Manual.

3.3.2 The trainee should also follow the Health and Safety Manual when handling volatile, flammable, acidic or caustic substances as may be required within the discipline.

3.4 Reading and Practical Exercises

3.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

3.4.2 Describe the procedures followed for the intake and transfer of specimens specifically submitted for alcohol and/or volatiles analysis.

3.4.3 Describe the barrier protection measures required when handling biological samples and unknown liquids.

3.4.4 Describe the types of commonly available blood collection tubes and containers.

3.4.5 Describe the IDAPA 11.03.01 requirements for blood collection, including the tube requirements.

3.4.6 Discuss why the preservative and anticoagulant required for IDAPA-compliant blood collection tubes/containers are necessary.

3.4.7 Discuss how ISP-FS kits comply with the requirements set forth in IDAPA 11.03.01.

4.0 Solution Preparation

4.1 Background and Theory

4.1.1 Preparing a solution of known concentration is perhaps the most common activity in any analytical lab. The method for measuring out the solute and solvent depend on the desired concentration unit and how exact the solution's concentration needs to be known. Pipets and volumetric flasks are used when a solution's concentration must be exact; graduated cylinders, beakers and reagent bottles suffice when concentrations need only be approximate.

4.2 Objectives, Principles, and Knowledge

4.2.1 Demonstrate an ability to prepare, and record the preparation of, solutions required in the analysis of alcohol and other volatiles. This includes how to operate the top-loading balance and pipetters.

4.3 Health and Safety Hazards

4.3.1 This section is covered in section 3.3 of this training manual.

4.4 Reading and Practical Exercises

4.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

4.4.2 The Analyst in Training must explain the nomenclature and calculations involved in the determination of weight percent and volume percent solutions.

5.0 Gas Chromatography Theory and Operation

5.1 Background and Theory

5.1.1 In 1942, Martin and Synge developed a partition method of chromatography, in which the solute (material to be chromatographed) is partitioned between a stationary liquid phase absorbed on an inert support and a moving liquid, which is only partially miscible with the stationary phase. At that time, they pointed out that the moving liquid phase could be replaced with a gaseous one. Martin and James exploited this suggestion and, in 1952, published a paper that marks the birth of gas chromatography. Development of the technique was rapid, with the petroleum industry, in particular, playing a large part in its advance.

5.1.2 Gas chromatography is a common type of chromatography used in analytical chemistry for separating and analyzing compounds that can be vaporized without decomposition. Typical uses of GC include testing the purity of a particular substance, or separating the different components of a mixture (the relative amounts of such components can also be determined). In some situations, GC may help in identifying a compound. Chromatography can also be used to prepare pure compounds from a mixture, when the fractions are collected from the exit of the column and detected utilizing a non-destructive technique (like ultraviolet spectrophotometry).

5.1.3 In gas chromatography, the mobile phase is a carrier gas, usually an inert gas such as helium or an unreactive gas such as nitrogen. Helium remains the most commonly used carrier gas in about 90% of instruments although hydrogen is preferred for improved separations. The stationary phase is a microscopic layer of liquid or polymer on an inert solid support, inside a piece of glass or metal tubing called a column. The instrument used to perform gas chromatography is called a gas chromatograph.

5.2 Objectives, Principles, and Knowledge

5.2.1 The Analyst in Training must have a comprehensive background and knowledge in regard to the principles of GC.

5.3 Health and Safety Hazards

5.3.1 This section is covered in section 3.3 of this training manual.

5.4 Reading and Practical Exercises

5.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

5.4.2 Provide a brief explanation of GC in terms understandable to a layperson.

5.4.3 Describe the influence carrier gas flow has on the efficiency of a GC-FID.

5.4.4 Define the following terms as they relate to GC.

-Resolution
-Area Under the Curve
-HETP
-Sensitivity versus Specificity

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

5.4.6 Discuss measures to alleviate peak tailing.

5.4.7 Describe how amount ratios and response ratios are used to construct a calibration curve.

5.4.8 Discuss the major advantages of using an internal standard method.

5.4.9 Demonstrate their ability to operate a GC equipped with a flame ionization detector (FID) through both the system software and the instrument controller.

5.4.10 Demonstrate a working knowledge of the operating software for the gas chromatograph. This must include the ability to utilize the system software to develop an analysis method, set processing parameters to optimize peak detection and integration, prepare an analysis sequence, reprocess data, and modify the analysis report format.

5.4.11 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.

6.0 Headspace Theory and Operation

6.1 Background and Theory

6.1.1 Headspace Gas Chromatography uses headspace gas injected directly onto a gas chromatographic column. Chemists often use the phrase "standard temperature and pressure or "STP" to convey that they are working at a temperature of 25 °C and one atmosphere of pressure. There are three states of matter under these conditions: solids, liquids and gases. Although all three are distinct states both solids and gases can dissolve (or disperse) in liquids. The most commonly occurring liquid is water. All components of the atmosphere are capable of dissolving in water to some degree.

6.1.2 The bulk of the stable natural components of the atmosphere are nitrogen, oxygen, carbon dioxide, gaseous water, argon and other trace gases.

6.1.3 Materials that exist primarily in the gas phase at STP are referred to as "volatile." Examples of volatile chemicals of interest within this discipline include ethanol, methanol, isopropanol, acetaldehyde, acetone, difluoroethane (DFE), tetrafluoroethane (TFE), and n-propanol.

6.2 Objectives, Principles, and Knowledge

6.2.1 Analyst in Training must possess a working knowledge of the theory and practice of headspace analysis.

6.3 Health and Safety Hazards

6.3.1 This section is covered in section 3.3 of this training manual.

6.4 Reading and Practical Exercises

6.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

6.4.2 The Analyst in Training must describe how *the proportionality* known as *Henry's Law,* is utilized in headspace analysis.

6.4.3 The Analyst in Training must demonstrate their ability to operate Headspace Analyzer.

6.4.4 The Analyst in Training must be acquainted with how the headspace method parameters in conjunction with GC cycle time must be optimized.

6.4.5 The Analyst in Training must demonstrate their understanding of the system software as it applies to the headspace analyzer including setting up the HS analysis method.

6.4.6 The Analyst in Training must discuss the maintenance of headspace analyzer including troubleshooting techniques and the documentation thereof.

7.0 Auto-Dilutor Intermediate Checks

7.1 Background and Theory

7.1.1 An automated pipetting system is generally a device which performs programmed transfers of liquid in specified amounts.

7.1.2 The word "pipetting" is referring to the laboratory manual tool called a pipette, which is commonly used in the transfer of precise amounts of liquids in biology, analytical chemistry, and medical testing.

7.1.3 Automated pipetting systems, or auto-dilutors, can be utilized when two different liquids are to be transferred to the same vessel in precise amounts at the same time. The use of an auto-dilutor helps to eliminate the handling time by dispensing two liquids at the same time into a single container.

7.2 Objectives, Principles, and Knowledge

7.2.1 The analyst must understand the use and principles of the auto-dilutor, and demonstrate proficiency in its use and performing the intermediate checks.

7.3 Health and Safety Hazards

7.3.1 This section is covered in section 3.3 of this training manual.

7.4 Reading and Practical Exercises

7.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

7.4.2 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 (Piston Operated Volumetric Apparatus).

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

7.4.4 The Analyst in Training must convey their understanding of the gravimetric checks associated with the AM.

7.4.4.1 What is the frequency of checks associated with the Auto-dilutor?

7.4.4.2 When are gravimetric checks required for the Auto-dilutor?

8.0 Analytical Method – Analysis of Volatiles by GC-HS

8.1 Background and Theory

8.1.1 Headspace sampling is essentially a separation technique in which volatile material may be extracted from a heavier sample matrix and injected into a gas chromatograph for analysis.

8.1.2 The composition of a biological sample containing volatile compounds may be highly complex containing water, alcohol, and other biological materials. If we inject such a sample directly into a typical GC injector and column, we would get a particularly dirty spectrum as a result.

8.1.3 A lot of time may be wasted in producing a chromatogram by eluting compounds that we have no interest in. Furthermore, many of these compounds may not be suited to gas chromatography and will gradually contaminate the system or even react with the stationary phase in the column so their presence is unwelcome.

8.1.4 If we put a biological samples into a sealed vial and heat it to a constant temperature for a period of time, what happens to the volatile molecules in the sample inside the vial? The more volatile compounds will tend to move into the gas phase (or headspace) above the perfume sample.

8.1.5 The more volatile the compound, the more concentrated it will be in the headspace.

8.1.6 Conversely, the less volatile (and more GC-unfriendly) components that represent the bulk of the sample will tend to remain in the liquid phase. Thus, separation has been achieved.

8.1.7 If we can extract some of the headspace vapor and inject it into a gas chromatograph, there will far less of the less-volatile material entering the GC column.

8.1.8 A headspace sampling system automates this process by extracting a small volume of the headspace vapor from the vial and transferring it to the GC column.

8.2 Objectives, Principles, and Knowledge

8.2.1 The Analyst in Training must convey their understanding of the analysis protocol in the Blood Alcohol Analytical Method #1: Analysis for Volatiles by Headspace GC.

8.3 Health and Safety Hazards

8.3.1 This section is covered in section 3.3 of this training manual.

8.4 Reading and Practical Exercises

8.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

8.4.2 Analyst in Training must describe the types of samples which qualify for analysis with Blood Alcohol Analytical Method #1. Describe the circumstances when a BAC would not be determined for a case that was submitted for analysis.

8.4.3 Analyst in Training must detail their approach in determining if a blood tube/container is compliant with IDAPA 11.03.01.

8.4.4 Analyst in Training must describe the proper storage of blood, urine and vitreous humor samples in the laboratory.

8.4.5 Analyst in Training must describe the quality assurance requirements described in Blood Alcohol Analytical Method #1.

8.4.6 Analyst in Training must describe the acceptance criteria for an analysis run.

8.4.7 Analyst in Training must describe how quality assurance data is monitored and where it must be stored.

8.4.8 Analyst in Training must describe how blood, urine and vitreous humor alcohol concentrations must be reported.

8.4.9 Describe the use and application of the different qualifier statements used on alcohol reporting.

8.4.10 The Analyst in Training must discuss the different types of alcoholic beverages and their respective alcohol content.

8.4.11 Analyst in Training must describe how alcohol concentrations must be reported in alcoholic beverages, simulator solutions and unknown solutions.

8.4.12 Analyst in Training must describe how qualitative volatiles must be reported.

8.4.13 The Analyst in Training must describe the intermediate check procedure for the balance(s) and auto-dilutors utilized for preparation of solutions for alcohol/volatiles analysis.

9.0 Analytical Method – Authentication

9.1 Background and Theory

9.1.1 Authenticated reference materials are a critical component of any identification method; from morphology to chemistry, to the most-cutting- technology, a method is only as reliable as the materials used as references.

9.2 Objectives, Principles, and Knowledge

9.2.1 The Analyst in Training must describe the requirements for the authentication of ethanol reference materials.

9.3 Health and Safety Hazards

9.3.1 This section is covered in section 3.3 of this training manual.

9.4 Reading and Practical Exercises

9.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

9.4.2 The Analyst in Training must describe the requirements for the authentication of blood matrix controls.

9.4.3 The Analyst in Training must describe the requirements for the authentication of qualitative reference materials that have a *Certificate of Analysis* available.

9.4.4 The Analyst in Training must describe the requirements for the authentication of qualitative reference materials that do not have *Certificate of Analysis* available.

10.0 Analytical Method – Volatiles Testing Guidelines

10.1 Background and Theory

10.1.1 Samples may be submitted to the laboratory from a number of different jurisdictions, and for a variety of reasons.

10.1.2 These reasons may or may not be valid, or within the testing guidelines for the laboratory for the analysis of the samples.

10.1.3 The guidelines are set forth within the Idaho State Police Forensic Services in order to best utilize the resources that are available with the laboratory to efficiently process casework in a timely, consistent and high quality fashion.

10.1.4 These guidelines are meant to eliminate needless analysis of samples that may yield results with little to no evidential value to the client or submitting agency.

10.2 Objectives, Principles, and Knowledge

10.2.1 The Analyst in Training must be aware of the testing guidelines for volatiles analysis set forth in Blood Alcohol Analytical Method #3

10.3 Health and Safety Hazards

10.3.1 This section is covered in section 3.3 of this training manual.

10.4 Reading and Practical Exercises

10.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

10.4.2 The Analyst in Training must describe the guidelines for using a breath alcohol test to determine if additional analysis is warranted.

10.4.3 The Analyst in Training must describe the guidelines for using a blood alcohol concentration to determine if additional analysis is warranted.

11.0 Analytical Method – Criteria for IDAPA Testing Site Approval

11.1 Background and Theory

11.1.1 The Idaho Administrative Code (IDAPA) is a compilation of all final and temporary administrative rules affecting the citizens of Idaho that have been promulgated and adopted in accordance with the requirements of the Idaho Administrative Procedure Act.

11.1.2 IDAPA rules have the force and effect of law, and derive their authority from the state law (Idaho Code).

11.1.3 The relevant section of IDAPA for use within this discipline is IDAPA 11 TITLE 03 Chapter 01 IDAHO STATE FORENSIC LABORATORY 11.03.01 - RULES GOVERNING ALCOHOL TESTING.

11.2 Objectives, Principles, and Knowledge

11.2.1 The Analyst in Training must be aware of the how alcohol testing sites are approved as set forth in Blood Alcohol Analytical Method #5.

11.3 Health and Safety Hazards

11.3.1 This section is covered in section 3.3 of this training manual.

11.4 Reading and Practical Exercises

11.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

11.4.2 The Analyst in Training must describe the procedure for testing site approval.

11.4.3 The Analyst in Training must describe how proficiency tests are evaluated for IDAPA approval.

12.0 Analytical Method – Blood Volatiles Proficiency and Competency Testing

12.1 Background and Theory

12.1.1 Proficiency testing determines the performance of an individual and laboratory system for its performance in the analysis within a specific discipline.

12.1.2 Proficiency testing is the process of analyzing an unknown sample provided by an approved provider, and obtaining the correct results from analysis. As this term implies, proficiency testing compares the measuring results obtained by different laboratories.

12.2 Objectives, Principles, and Knowledge

12.2.1 The analyst is expected to understand the reasoning behind proficiency testing as well as the evaluation process of the tests themselves.

12.3 Health and Safety Hazards

12.3.1 This section is covered in section 3.3 of this training manual.

12.4 Reading and Practical Exercises

12.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and references to support the answers to the exercises within this training manual.

12.4.2 The Analyst in Training must describe how competency and proficiency tests are evaluated.

12.4.3 The Analyst in Training must be aware of the requirements for volatiles analysis competency test and proficiency tests set forth in Blood Alcohol AM #6, Volatiles Analysis Competency and Proficiency Tests.

13.0 Analytical Method – Uncertainty of Measurement for Volatiles Analysis

13.1 Background and Theory

13.1.1 In metrology, measurement uncertainty is a non-negative parameter characterizing the dispersion of the values attributed to a measured quantity. All measurements are subject to uncertainty and a quantitative measurement result is complete only when it is accompanied by a statement of the associated uncertainty.

13.1.2 This uncertainty has a probabilistic basis and reflects incomplete knowledge of the true quantitative value.

13.1.3 The measurement uncertainty is often taken as the standard deviation of a state-of-knowledge probability distribution over the possible values that could be attributed to a measured quantity.

13.1.4 Relative uncertainty is the measurement uncertainty relative to the magnitude of a particular single choice for the value for the measured quantity, when this choice is nonzero. This particular single choice is usually called the measured value, which may be optimal in some well-defined sense (e.g., a mean, median, or mode).

13.1.5 Thus, the relative measurement uncertainty is the measurement uncertainty divided by the absolute value of the measured value, when the measured value is not zero.

13.2 Objectives, Principles, and Knowledge

13.2.1 The Analyst in Training must possess a working knowledge of statistics applied to analytical data.

13.3 Health and Safety Hazards

13.3.1 This section is covered in section 3.3 of this training manual.

13.4 Reading and Practical Exercises

13.4.1 Discuss the following terms as they relate to analytical data:

13.4.1.1 Population mean versus sample mean

13.4.1.2 Population Standard deviation versus sample standard deviation.

13.4.2 Discuss the following terms as they are applied to analytical data:

13.4.2.1 Independent Variable
13.4.2.2 Linear Regression Analysis
13.4.2.3 Correlation Coefficient

13.4.3 Describe how variance and standard deviation are related.

13.4.4 Discuss the following terms as they relate to analytical data:
13.4.4.1 Normal Distribution
13.4.4.2 Confidence Interval

13.4.5 Describe how the population mean and population standard deviation are used to define a Gaussian curve.

13.4.6 Define the following terms as they are applied to analytical data:
13.4.6.1 Accuracy
13.4.6.2 Precision

13.4.7 Answer the following questions:
13.4.7.1 Can sample data be precise but not accurate?
13.4.7.2 Can sample data be accurate but not precise?

13.4.8 Contrast Random and Systematic Error.

13.4.9 Discuss the concept of measurement uncertainty.

13.4.10 Describe how the difference between error and uncertainty would be explained to a jury and/or a judge. Develop and write a good analogy for explaining this concept.

13.4.11 The Analyst in Training must be aware of the requirements for uncertainty of measurement reporting set forth in Blood Alcohol AM #7, Uncertainty of Measurement for Volatiles Analysis.

13.4.12 The Analyst in Training must describe the current approach to uncertainty of measurement for quantitative ethanol reporting.

14.0 Case Record Preparation

14.1 Background and Theory

14.1.1 Documentation is one of the pillars of the scientific community as well as the forensic world.

14.1.2 The documentation requirements set forth in this discipline are derived from the international ISO 17025 standards, as well as the ISPFS quality manual.

14.2 Objectives, Principles, and Knowledge

14.2.1 The analyst must know that standards of documentation for care records as it pertains to all aspects of the discipline. From technical records, administrative records, authentication data, and batch analytical records, the analyst must understand the requirements and importance of each, as well as the potential for changes in their retention policies.

14.3 Health and Safety Hazards

14.3.1 This section is covered in section 3.3 of this training manual.

14.4 Reading and Practical Exercises

14.4.1 The Analyst in Training must describe which documents, data and completed information is required to be included in an alcohol/other volatiles analysis case record.

14.4.2 The Analyst in Training must describe the worksheets and data that are to be compiled for a centrally stored QA file for each analysis run.

14.4.3 The Analyst in Training must describe requirements for administrative and technical review of casefile and analysis report.

14.4.4 The Analyst in Training should work closely with the training and perform pre-review duties while in training in order to familiarize themselves with the administrative and technical review documentation and review process.

14.4.5 Administrative and Technical review competency testing will be covered in a future section, and the sign off for 'technical review of casework' will occur later.

15.0 Pharmacology and Impairment Detection

15.1 Background and Theory

15.1.1 In 1910, New York was the first state to adopt a law against drinking and driving, with California and other states soon following. These early DUI laws simply prohibited driving while intoxicated, but there was so set definition of what level of intoxication qualified as drunk driving.

15.1.2 In 1936, after the repeal of prohibition in 1933, Dr. Harger, an Indiana University professor of toxicology and biochemistry, patented the Drunkometer. The device was balloon-like and people breathed into it to determine intoxication. The color of the air, when mixed with a chemical solution, determined the amount of intoxication.

15.1.3 In 1938, thanks to research by the American Medical Association and the National Safety Council, 0.15 percent became the first commonly-used legal limit for blood alcohol concentration (BAC).

15.1.4 In 1953, Robert Borkenstein, a former police captain and university professor, invented the Breathalyzer. This machine used chemical oxidation and photometry to determine alcohol concentration. All a person would have to do is blow into the machine and it would measure the alcohol vapors in their breath. This would show the level of alcohol in their blood. The Breathalyzer was easier to use and more accurate than the Drunkometer, which made it the perfect test for police officers to use when determining whether someone had too much to drink.

15.1.5 In 1980, Mothers Against Drunk Drivers, or MADD, was founded by Candy Lightner after her 13-year-old daughter was killed on her way home from a school carnival by a drunk driver. The driver had three previous DUI convictions and was out on bail from a hit-and-run arrest two days earlier. When MADD was founded in 1980, more than 21,000 people were killed in drunk driving crashes each year. Lightner and MADD helped to change the public's attitudes about drunk driving. The group pushed for tougher legislation for those convicted of driving under the influence of alcohol and drugs. MADD also successfully pushed to have the legal drinking age raised.

15.1.6 In 1984, The National Minimum Drinking Age Act required states to pass individual legislation raising the drinking age to 21.

15.1.7 In 1998, as part of TEA-21, a new Federal incentive grant was created to encourage states to adopt a .08 BAC illegal per se level.

15.1.8 In 2000, Congress adopted .08 BAC as the national illegal limit for impaired driving.

15.1.9 In 2012, Alabama became the last state in the U.S. to pass and execute an ignition interlock law for those arrested and/or convicted of impaired driving.

15.1.10 Alcohol intoxication is the result of alcohol entering the bloodstream faster than it can be metabolized by the liver, which breaks down the ethanol into non-intoxicating byproducts.

15.1.11 Some effects of alcohol intoxication (such as euphoria and lowered social inhibitions) are central to alcohol's desirability as a beverage and its history as one of the world's most widespread recreational drugs.

15.1.12 Despite this widespread use and alcohol's legality in most countries, many medical sources tend to describe any level of alcohol intoxication as a form of poisoning due to ethanol's damaging effects on the body in large doses.

15.1.13 Symptoms of alcohol intoxication include euphoria, flushed skin, and decreased social inhibition at lower doses, with larger doses producing progressively severe impairments of balance, muscle coordination (ataxia), and decision-making ability (potentially leading to violent or erratic behavior) as well as nausea or vomiting from alcohol's disruptive effect on the semicircular canals of the inner ear and chemical irritation of the gastric mucosa. Sufficiently high levels of blood-borne alcohol will cause coma and death from the depressive effects of alcohol upon the central nervous system.

15.2 Objectives, Principles, and Knowledge

15.2.1 The Analyst in Training must demonstrate a working knowledge of the pharmacology of alcohol and other commonly encountered volatiles. This must include an understanding of the factors affecting absorption, distribution and elimination.

15.3 Health and Safety Hazards

15.3.1 This section is covered in section 3.3 of this training manual.

15.4 Reading and Practical Exercises

15.4.1 The Analyst in Training must describe the situation when the alcohol content of arterial blood exceeds that of venous blood.

15.4.2 The Analyst in Training must be familiar with the metabolism of ethanol and other commonly encountered volatiles. This must include how metabolism relates to toxicity.

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

15.4.4 The Analyst in Training must describe their understanding of postmortem changes and their effect on alcohol concentration.

15.4.5 The Analyst in Training must be comfortable with the development, performance and interpretation of Standardized Field Sobriety Tests (SFST) and a Drug Recognition Exam (DRE).

16.0 Practical Analysis

16.1 Background and Theory

16.1.1 In order to analyze a sample within the laboratory, any analyst must utilize the standardized Analytical Method. The techniques acquired during training should be honed and perfected in order to maintain consistent results and analytical technique.

16.1.2 Through the application of practice sample analysis, a new trainee may acquire such skill so that they may start their analytical career with a baseline consistency in order to produce accurate results.

16.2 Objectives, Principles, and Knowledge

16.2.1 The analysis of samples within the laboratory requires the analyst to have skill in pipetting in order to maintain consistency, eliminate any cross contamination, and to ensure that the results are accurate.

16.3 Health and Safety Hazards

16.3.1 This section is covered in section 3.3 of this training manual.

16.4 Reading and Practical Exercises

16.4.1 Practical exercises and samples will be provided to the trainee by the trainer.

16.4.1.1 Samples may be provided from control samples, old proficiency test samples, and/or training samples may also be obtained in the following way.

16.4.1.2 A forensic scientist assigned to a case may take an additional sample from casework that the trainee may analyze for training purposes. The sample may only be taken if the reserve after removing the second sample is greater than ½ (½ meaning: ½ of the total sample of that type submitted, if two grey top blood tubes are submitted it would be half of the total blood in the two tubes, but if a purple and a grey top tube are submitted it would be the ½ of the volume of the blood in one of the tubes submitted.

16.4.2 When the trainer is comfortable with the trainee's technique and skill, the trainee will participate in Hands of the Analyst sample analysis.

16.4.2.1 The trainee will complete no less than one full sequence run consisting of no less than 30 individual samples, complete with the creating of an independent calibration curve.

16.4.2.2 The 30 samples must be divided into a minimum of at least two analysis runs.

16.4.3 A copy of the worklist will be kept with the trainees training records to document the case numbers corresponding to the HOA cases.

17.0 Analytical Method –Competency Test

17.1 Background and Theory

17.1.1 Competency testing assesses the performance of an individual for performing analysis within a specific discipline, and measures their competency in the application of that knowledge to effectively perform their duties.

17.1.2 Competency testing is the process of analyzing an unknown sample provided to the trainee, and obtaining the correct results from analysis. The results are known by the trainer, who is responsible for providing the sample.

17.1.3 Competency is measured in a more abstract sense, in that it is a comprehensive testing of both the analytical capabilities of the analyst, but al so the application of the knowledge base obtained through training to their interpretation and testimony about their analysis.

17.2 Objectives, Principles, and Knowledge

17.2.1 This module will begin upon the completion of modules 1-15.

17.2.2 The analyst is expected to complete a comprehensive competency test.

17.2.3 Passing is required with 100% accuracy.

17.2.4 If the initial attempt at completing the competency test is not successful, further training and attempts may be undertaken at the discretion of the Supervisor, Technical Lead, Trainer and Trainee, or a combination of the aforementioned individuals.

17.3 Health and Safety Hazards

17.3.1 This section is covered in section 3.3 of this training manual.

17.4 Reading and Practical Exercises

17.4.1 Maintaining a knowledge base within the discipline is an ongoing process. There is an appendix following this manual with suggested reading materials that cover the discipline as a whole, with many of the treatises covering multiple topics and sections. The discipline also maintains an ongoing and continually updated technical library. This will be referenced in the appendix as well. Refer to this for citations and

references to support the answers to the exercises within this training manual.

17.4.2 The Analyst in Training must describe how competency and proficiency tests are evaluated.

17.4.3 Whole blood specimens containing a wide range of appropriate alcohol concentrations and a minimum of one commonly encountered other volatile will be analyzed by the analyst.

17.4.4 At the discretion of the Trainer, trainee, supervisor and technical lead, the trainee will be provided with a competency test.

17.4.5 Refer to Blood Alcohol AM #6 for more testing guidelines and evaluations.

17.4.6 Upon completion and sign off for casework, the new analyst will begin a period of technical review training. This will consist of "pre-reviewing" casework from other analysts, documenting items that were found to be in non-compliance, and then forwarding the comments and cases onto technical review to another trained analyst.

17.4.7 Technical review training will continue for no less than one month's time, or 100 cases reviewed, whichever comes first. Completion of technical review training is at the discretion of the technical lead, with input from the other analysts in which the trainee had reviewed.

17.4.7.1 Technical review documentation shall consist of either start and end dates or the worklists that were reviewed.

18.0 Mock Court

18.1 Background and Theory

18.1.1 A mock trial is an act or imitation trial. Mock trials simulate lower-court trials. Trainees use a mock to hone their testimony skills and delivery of complex scientific concepts to a jury of non-scientists.

18.2 Objectives, Principles, and Knowledge

18.2.1 The trainee should be able to answer all of the discipline related questions posed to them about their case.

18.2.2 The trainee should also be able to recognize when the questioning approaches and/or goes into territory that it outside of the realm of their expertise.

18.2.3 During the course of the mock court testimony training, the trainee will be responsible for knowing and understanding the basics of the criminal and civil law procedures.

18.2.4 The trainee will also be responsible for understanding proper court attire, knowing the procedures for referring to your notes/evidence/reports in court and show their ability to present evidence in court in a clear manner to the mock jury.

18.3 Health and Safety Hazards

18.3.1 This section is covered in section 3.3 of this training manual.

18.4 Reading and Practical Exercises

18.4.1 The trainee should engage in mini-mock court sessions on a regular basis.

18.4.2 The trainer should schedule the mini-mock court on a regular basis upon completion modules 1-15, but they may start earlier upon discretion.

18.4.3 The mock court should cover a broad range of topics to include, but not be limited to: absorption, distribution, elimination, rising BAC, Widmark calculations, beverage alcohol samples, urine/serum conversions, storage conditions, in vivo fermentation)

18.4.4 Trainee should read Idaho Code section 18-8004 and IDAPA 11.03.01

18.4.5 Trainee should prepare their CV.

19.0 Core Training

19.1 Background and Theory

19.1.1 Core training is essential for the new trainee to understand how the different disciplines work together in the analysis of a case.

19.1.2 Understanding the basic functionality of the forensic lab system is good general knowledge.

19.2 Objectives, Principles, and Knowledge

19.2.1 The objective of the core training is to attain an overall understanding of the different arms of the forensic laboratory system and how they all work in unison to process evidence through the system, provide timely results, and maintain transparency to the public and court system.

19.3 Health and Safety Hazards

19.3.1 This section is covered in section 3.3 of this training manual.

19.4 Reading and Practical Exercises

19.4.1 The trainee should complete the core training as described within the quality manual during their training.

19.4.2 It is not an absolute requirement that the core training be completed prior to the assumption of casework, but it is recommended to avoid any delays in the full completion and sign off on the training plan with the discipline

20.0 Comprehensive Course on Alcohol Testing

20.1 Background and Theory

20.1.1 The volatiles analysis discipline is much like many of the other disciplines within forensics, in that it is highly technical, and specialized.

20.1.2 The discipline is also historically one of the most litigious and contentious in court.

20.1.3 The ever changing environment as it pertains to the testing of volatile impairing substances requires the discipline to remain diligent in its acquisition of current and applicable knowledge and not stagnate.

20.1.4 By sending all new trainees to a national comprehensive course on alcohol testing, the acquisition of new knowledge pertinent to the discipline can be assured.

20.2 Objectives, Principles, and Knowledge

20.2.1 The trainee should attend and pass a nationally recognized comprehensive course on alcohol testing.

20.2.2 Upon return from the course, it is the trainee's responsibility to disseminate any newly acquired knowledge or novel concepts throughout the discipline.

20.2.3 Through this regular practice, the trainee and the discipline in general can remain current in the knowledge of any new trends that may be occurring outside the borders of our state, but still of importance to our state.

20.3 Health and Safety Hazards

20.3.1 This section is covered in section 3.3 of this training manual.

20.4 Reading and Practical Exercises

20.4.1 Within one-year of starting training in volatiles analysis, or prior to starting training, the trainee must attend and successfully complete a nationally recognized course on alcohol testing and related medico-legal matters.

VOLATILES ANALYSIS TRAINING

BLOOD ALCOHOL MANUAL

Training and Signature documentation

2.0 Roles and Responsibilities:

Supervisor:_____ Technical Lead: _____

Lead Trainer: _____ Trainee: _____

Through observation and documentation during the training of the above named, the following signatures serve as authorization for the individual to perform the duties as a Forensic Scientist within the Volatiles Analysis Discipline - Blood Alcohol Analytical Method. Upon completion of each section/module, the trainee may assume the duties required of each position in order to complete their training in its entirety.

3.0 Evidence Handling:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

4.0 Solution Preparation:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

5.0 Gas Chromatography Theory and Operation:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

6.0 Headspace Theory and Operation:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

7.0 Auto-Dilutor Intermediate Checks: **Start date:** _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

8.0 Analytical Method – Analysis of Volatiles by GC-HS:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

9.0 Analytical Method – Authentication: **Start date:** _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

10.0 Analytical Method – Volatiles Testing Guidelines: **Start date:** _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

11.0 Analytical Method – Criteria for IDAPA Testing Site Approval:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

12.0 Analytical Method – Blood Volatiles Proficiency and Competency Testing:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

Competency Test Score: _____ Date: _____

13.0 Analytical Method – Uncertainty of Measurement for Volatiles Analysis:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

14.0 Case Record Preparation:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

15.0 Pharmacology and Impairment Detection:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

16.0 Practical Analysis:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

17.0 Analytical Method –Competency Test:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

Competency Test Score: _____ Date: _____

18.0 Mock Court:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

Mock Court: **Date:** _____

Prosecutor: _____ Trainee: _____

Defense: _____ Lead Trainer: _____

Completion date: _____

Comments:

19.0 Core Training:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____

20.0 Comprehensive Course on Alcohol Testing:

Start date: _____

Lead Trainer: _____ Trainee: _____

Completion date: _____