

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No.  
TOX\_P500\_Version 6

Approved by:  
Lab Director

Effective Date:  
03/19/2024  
Status: Active

**Page 1 of 16**

### TABLE OF CONTENTS

- 1.0 [Purpose and Scope](#)
- 2.0 [Responsibility](#)
- 3.0 [Quality Assurance](#)
- 4.0 [Simulator Solution Preparation](#)
- 5.0 [Headspace GC/FID Analysis of Ethanol Simulator Solutions](#)
- 6.0 [Solution Certification and Review](#)
- 7.0 [Estimation of Uncertainty of Measurement](#)
- 8.0 [References](#)

[Appendix A](#)

[Appendix B](#)

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 2 of 16</b>
--------------------------------	------------------------------	---	---------------------

### 1.0 Purpose and Scope

- 1.1. The purpose of this procedure is to describe the process used by Vermont Forensic Laboratory (VFL) staff for the creation and certification of Certified Reference Materials (CRM), specifically wet bath simulator solutions for use with the DMT infrared breath alcohol analysis instruments.
- 1.2. The scope of this manual includes preparation of the simulator solutions, preparation of vials for analysis, instrument set-up, data review and release, documentation, and quality control criteria.

### 2.0 Responsibility

- 2.1. All analysts authorized to prepare and certify CRMs are responsible for following these procedures as written.
- 2.2. These procedures are reviewed periodically by the Toxicology Section staff. Revisions are made at that time or when there is an identified need to change this written manual to be compatible with changing needs in the analytical process. In the event that there are changes to be made to this manual, the changes must be reported in detail to the Toxicology Section Supervisor in a timely manner.
- 2.3. All analysts performing these procedures and reporting analytical results for forensic purposes must be fully trained and demonstrate initial competency in the use of these procedures in accordance with the applicable training manual(s).
- 2.4. Analysts will ensure that an adequate amount of supplies are on hand at all times. Orders should be placed when supplies are low to ensure that new stock arrives before supplies are completely empty.

### 3.0 Quality Assurance

- 3.1. It is expected that the analyst will report any unacceptable or anomalous behavior of any analytical system immediately to the Toxicology Section Supervisor. It is further expected that appropriate actions will follow as soon as possible and be properly documented.
- 3.2. Equipment
  - 3.2.1. Balance
    - 3.2.1.1. The analytical balance will be maintained in accordance with QA\_P100\_6.4\_Equipment QC.
    - 3.2.1.2. Any similar balance maintained to the same standard may be used.
  - 3.2.2. Pipettes
    - 3.2.2.1. Measurements made by the Toxicology Section using pipettes are critical.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 3 of 16</b>
--------------------------------	------------------------------	---	---------------------

3.2.2.2. Pipettes used by the Toxicology Section, including fixed and variable volume pipettes will be maintained in accordance with QA\_P100\_6.4\_Equipment QC.

### 3.3. Instrumentation

3.3.1. All maintenance performed, including routine and preventative maintenance as well as troubleshooting activities, should be recorded in the Instrument Maintenance Log.

#### 3.3.2. Day of use

3.3.2.1. Ensure that the helium carrier gas is turned on with an appropriate delivery pressure (approximately 80 psi). Replace the cylinder if the remaining pressure in the tank is insufficient for analysis.

3.3.2.2. Ensure that the air compressor and zero air generator are turned on with an appropriate delivery pressure (approximately 45 psi).

3.3.2.3. Ensure that the hydrogen generator is turned on and that the deionized water reservoir is sufficiently full. If not, add deionized water to the reservoir.

3.3.3. See TOX\_P100 for additional routine and annual maintenance procedures.

3.3.4. All equipment and materials, including the instrument maintenance log, are located in room 265 unless otherwise stated.

3.3.4.1. Perkin Elmer Clarus 580 gas chromatograph with flame ionization detector and Elite BAC-1 and BAC-2 Advantage columns, or equivalent.

3.3.4.2. Perkin Elmer TurboMatrix 110 headspace autosampler.

3.3.4.3. Desktop PC and printer with TotalChrom Workstation Software.

3.3.4.4. Hydrogen generator, or equivalent hydrogen supply.

3.3.4.5. Compressed UHP grade helium.

3.3.4.6. Air compressor and Zero Air generator, or equivalent air supply.

### 3.4. Reference Materials

#### 3.4.1. Calibration Standards

3.4.1.1. NIST traceable aqueous ethanol standards are used for calibration. Calibration standards with concentrations of 0.010, 0.020, 0.050, 0.080, 0.200, and 0.500 g/100 mL are purchased from an ISO 17034 accredited supplier.

#### 3.4.2. Aqueous Ethanol Controls

3.4.2.1. NIST traceable aqueous ethanol standards are used for within-run controls in all analytical batches. High and low aqueous ethanol standards of a different lot than the calibration standards are purchased from an ISO 17034 accredited supplier. The

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 4 of 16</b>
--------------------------------	------------------------------	---	---------------------

concentration of these standards may vary depending on commercial availability, but should be at forensically relevant levels challenging the low and high end of the calibration curve.

- 3.4.3. Prior to using a new lot of aqueous ethanol standard, one vial from the lot should be run as a sample (in duplicate) to verify the lot falls within  $\pm 5\%$  of the manufacturer's certified concentration. A new shipment of the same lot does not require verification.
- 3.4.4. After a new lot of aqueous ethanol standard is verified, the data package from the analysis will undergo a technical review and be kept on file with the Toxicology Section. Completed verification packages should include the manufacturer's COA, calculation summary sheet, and all documents generated during the analysis as described in Section 6.
- 3.4.5. All reference materials are stored in the refrigerator unless otherwise noted.
- 3.4.6. Verifications of reference materials will be documented in the Reagent Preparation Log.
- 3.4.7. Results from each analysis of aqueous ethanol controls will be documented in the GC/FID Control Chart.

### 3.5. In-House Preparations

- 3.5.1.1. Solutions prepared in-house for use in CRM certification will be performance checked prior to use in casework. Specifications for these solutions and their respective performance checks are defined in Section 5 of TOX\_P100.

## 4.0 Simulator Solution Preparation

- 4.1. Reagents (ACS reagent grade or better)
  - 4.1.1. Ethanol (200 proof)
  - 4.1.2. Acetone
  - 4.1.3. Methanol
  - 4.1.4. Isopropanol
  - 4.1.5. Copper sulfate ( $\text{CuSO}_4$ )
  - 4.1.6.  $\text{dH}_2\text{O}$
- 4.2. Apparatus
  - 4.2.1. Analytical balance
  - 4.2.2. Pipettes or syringes for aliquotting solutions
  - 4.2.3. Volumetric flasks
  - 4.2.4. Plastic carboy with spigot (20 L)

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 5 of 16</b>
--------------------------------	------------------------------	---	---------------------

- 4.2.5. Erlenmeyer flasks
- 4.2.6. Plastic round bottles (500 ml)
- 4.2.7. Parafilm or seals
- 4.2.8. Induction sealing machine
- 4.2.9. Easy peel white mailing labels (size 1" x 2 5/8")
- 4.2.10. Adhesive plastic sleeves
- 4.3. Aqueous Ethanol Solution Preparation
  - 4.3.1. The water to air partition ratio ( $K_{w/a}$ ) is used to convert aqueous ethanol concentrations to vaporous concentrations at a fixed temperature.
    - 4.3.1.1. The  $K_{w/a}$  for an aqueous ethanol solution was determined to be 2587 at 34°C.
    - 4.3.1.2. Using this ratio, the following equation can be used in the preparation of reference materials:  
Concentration<sub>w</sub> = [Concentration<sub>a</sub> \* 2587] ÷ 2100  
Where,  
Concentration<sub>w</sub> = concentration in the water phase (g/100 mL)  
Concentration<sub>a</sub> = concentration in the air phase (g/210 L)  
2587 = conversion factor of 2587 water: 1 air at 34°C  
2100 = conversion factor for g/210 L to g/100 mL (mL/g)
  - 4.3.2. See Appendix B for common preparation recipes.
  - 4.3.3. Partially fill an appropriately sized volumetric flask with diH<sub>2</sub>O.
  - 4.3.4. Gravimetrically dispense the calculated amount of absolute ethanol into glassware which is partially filled with diH<sub>2</sub>O.
  - 4.3.5. Transfer the ethanol/water mixture into the volumetric flask and fill to volume with diH<sub>2</sub>O. Invert to mix thoroughly.
  - 4.3.6. Assign a simulator solution lot number for each solution using the scheme YY-NN-XXX; where:
    - 4.3.6.1. YY = The last two digits of the year in which the solution was made;
    - 4.3.6.2. NN = The next sequential solution number for the year.
    - 4.3.6.3. XXX = The target concentration expressed to three decimal places (ex. a concentration of 0.080 would be expressed as 080; a concentration of 0.160 would be expressed as 160).
  - 4.3.7. Record all solution information in the Reagent Preparation Log.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 6 of 16</b>
--------------------------------	------------------------------	---	---------------------

- 4.3.8. Solution expires two years from date of preparation.
  - 4.3.9. Solutions should be stored in a controlled environment at room temperature.
  - 4.3.10. Analyze and certify the solution as described in Sections 5 and 6.
  - 4.3.11. After the solution is certified and documentation reviewed, add approximately 0.25 g of cupric sulfate per 2 L of solution to the flask and swirl until all crystals are dissolved.
  - 4.3.12. Transfer the solution to appropriately labeled 500 mL screw-cap, narrow mouth, chemical resistant bottles and seal.
  - 4.3.13. These bottles will receive three lot number labels (See Appendix A for example). One label will be affixed to the bottle, and the other two labels will be placed in the plastic card holder, which is attached to the bottle.
- 4.4. Quality Control Solution Sample Preparation
- 4.4.1. A simulator solution of 0.10 g/210 L is used as a quality control sample on DMT instruments in the field. 20 L batches are made and certified at the VFL and are distributed to DMT agencies for field use.
  - 4.4.2. Add appropriate weight of absolute ethanol into a flask, which is partially filled with diH<sub>2</sub>O.
  - 4.4.3. Fill the 20 L plastic carboy using four additions of diH<sub>2</sub>O from a 5 L class A volumetric flask, adding the ethanol/water mixture to the second 5 L addition of diH<sub>2</sub>O. Mix well.
  - 4.4.4. Assign a simulator solution lot number.
  - 4.4.5. Record all solution information in the Reagent Preparation Log.
  - 4.4.6. Solution expires two years from date of preparation.
  - 4.4.7. Solutions should be stored in a controlled environment at room temperature.
  - 4.4.8. Analyze and certify the solution as described in Sections 5 and 6.
  - 4.4.9. After the solution is certified and documentation reviewed, add approximately 2.5 g of cupric sulfate to it. Mix the carboy until the crystals have dissolved.
  - 4.4.10. Transfer the solution to appropriately labeled 500 mL screw-cap, narrow mouth, chemical resistant bottles and seal.
  - 4.4.11. These bottles will receive three lot number labels (See Appendix A for example). One label will be affixed to the bottle, and the other two labels will be placed in the plastic sleeve attached to the bottle.
  - 4.4.12. At least one bottle from each batch will be stored in a controlled environment at room temperature for the lifetime of the lot or until the last bottle is used.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 7 of 16</b>
--------------------------------	------------------------------	---	---------------------

### 4.5. Interference Solution Preparation

- 4.5.1. Interference solutions containing acetone, methanol, or isopropanol may be prepared in water or a previously certified ethanol solution.
- 4.5.2. Interferent vapor concentrations are estimated using Henry's Law at a temperature of 34.00°C. The target concentration of an interferent corresponds to an intended apparent ethanol reading when analyzed by the DMT. Suggested preparations of various interferent solutions are outlined in Appendix B.
- 4.5.3. Solutions will be prepared gravimetrically by adding the appropriate mass to the aqueous standard.
- 4.5.4. Partially fill a volumetric flask with diluent. Diluent could be either certified ethanol solution or diH<sub>2</sub>O, depending on the solution being prepared.
- 4.5.5. Add diluent to a small Erlenmeyer flask and add the correct mass of interference material (acetone, methanol, or isopropanol) to achieve the desired concentration.
- 4.5.6. Pour the diluent/interferent into the volumetric flask and rinse the Erlenmeyer flask 2-3 times into the volumetric flask using additional diluent to ensure all material has transferred.
- 4.5.7. Fill the volumetric flask to the fill line using diluent and mix.
- 4.5.8. Assign a simulator solution lot number for each solution using the scheme YY-NN-XXICC; where:
  - 4.5.8.1. YY = The last two digits of the year in which the solution was made;
  - 4.5.8.2. NN = The next sequential solution number for the year.
  - 4.5.8.3. XX = The target ethanol concentration expressed to two decimal places.
  - 4.5.8.4. ICC = The interferent present in the solution followed by the target apparent ethanol reading on the DMT.
  - 4.5.8.5. E.g. 24-01-08A01 where 24 is the year, 01 is the first solution prepared that year, 08 refers to 0.08 g/210 L ethanol, A refers to Acetone, and 01 refers to the apparent ethanol reading on the DMT due to acetone.
- 4.5.9. Record all solution information in the Reagent Preparation Log.
- 4.5.10. One vial of a newly prepared interference solution is analyzed via GC/FID and deemed acceptable for use when each compound in the mixture is detected with baseline separation and the retention times are consistent with the components of the mixture.
- 4.5.11. Interferent solutions do not need to be run with quantitative controls, but must be run with opening and closing blanks and a timing mix. Interferent solutions may be processed

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 8 of 16</b>
--------------------------------	------------------------------	---	---------------------

using a historical calibration provided the internal standard and timing mix are the same lots.

- 4.5.12. Create an Interference Solution Certificate of Analysis (TOX\_F500\_1) and lot number labels (See Appendix A for label example).
- 4.5.13. Solutions prepared using a previously certified ethanol solution may already contain cupric sulfate. If not, all solutions must have approximately 0.25 g cupric sulfate per 2 L of solution added prior to bottling.
- 4.5.14. Transfer the solution to appropriately labeled 500 mL screw-cap, narrow mouth, chemical resistant bottles and seal.
- 4.5.15. Interference solution bottles will receive three lot number labels. One label will be affixed to the bottle, and the other labels will be placed in the plastic sleeve, which is attached to the bottle.
- 4.5.16. The chromatograms from the analysis will be reviewed and documentation of passing QC recorded in the Reagent Preparation Log. The Interference Solution Certificate of Analysis, Reagent Preparation Log, and labels are reviewed and approved by the Toxicology Section Supervisor or their designee prior to use. Analytical results will be kept on file with the Toxicology Section.
- 4.5.17. Solutions expire two years from date of parent solution preparation.
- 4.5.18. Solutions should be stored in a controlled environment at room temperature.

### 5.0 Headspace GC/FID Analysis of Ethanol Simulator Solutions

- 5.1. Ethanol simulator solution analysis will be performed by two different analysts. Ten vials per lot of simulator solution will be analyzed by each analyst.
- 5.2. Prior to sampling a 20 L batch, rinse the spigot with fresh solution by pouring off and discarding a small amount of simulator solution.
- 5.3. Each analyst will pour off a small aliquot of simulator solution from the spigot when analyzing the 20 L batch on the day of analysis. This aliquot will be used to prepare sample vials.
- 5.4. See TOX\_P100 for sample preparation criteria and instrument setup procedures.
- 5.5. Label one 20 mL round bottom headspace autosampler vial for each of the following:
  - 5.5.1. Opening aqueous blank.
  - 5.5.2. Each of the six calibration standards (A-E and G).
  - 5.5.3. Timing mix.
  - 5.5.4. A sufficient number of aqueous ethanol controls.
    - 5.5.4.1. Aqueous ethanol controls will consist of a low and high concentration standard.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 9 of 16</b>
--------------------------------	------------------------------	---	---------------------

5.5.4.2. High level controls shall be analyzed in duplicate after the calibration and prior to simulator solution. At minimum, low level controls will be analyzed in duplicate after every 10<sup>th</sup> vial throughout the analytical batch and following the last vial of simulator solution.

5.5.5. Vials for each lot of simulator solution being analyzed.

5.5.6. Closing aqueous blank.

5.6. Simulator solution results will be divided by a partition coefficient of 1.2319 to convert aqueous ethanol concentration to equivalent concentration of ethanol in 210 L of air at 34°C.

### 6.0 Solution Certification and Review

6.1. Generate data output files from the TotalChrom workstation attached to the GC/FID for each analytical batch and enter this raw data into the Simulator Solution Worksheet (TOX\_F500\_2) to generate the QC summary and CRM worksheet.

6.2. The certifying analyst must perform a primary data review of the package.

6.3. The completed package includes:

6.3.1. Certified Reference Material Review Checklist (QA\_F100\_7.7\_14).

6.3.2. Certificate of Analysis (TOX\_F500\_3).

6.3.3. Simulator solution lot number labels.

6.3.4. Analyst raw data sheets, QC Summary, and CRM worksheet from the Simulator Solution Worksheet (TOX\_F500\_2).

6.3.5. Batch sequence lists.

6.3.6. Instrument calibration graphs.

6.3.7. All chromatograms generated during the analytical process.

6.3.8. If multiple simulator solutions are analyzed in the same analytical batch, a CRM batch file containing all shared documentation may be generated and referenced within each specific simulator solution data package.

6.4. Analyst Review

6.4.1. Aqueous blanks, timing mix, and aqueous ethanol controls should adhere to quality control criteria as outlined in TOX\_P100.

6.4.2. The six certified ethanol calibration standards must fall within 10% of the following concentrations when rounded to 3 decimal places:

STD A	0.010 g/100 ml
STD B	0.020 g/100 ml

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No.  
TOX\_P500\_Version 6

Approved by:  
Lab Director

Effective Date:  
03/19/2024  
Status: Active

Page 10 of 16

STD C	0.050 g/100 ml
STD D	0.080 g/100 ml
STD E	0.200 g/100 ml
STD G	0.500 g/100 ml

6.4.2.1.1. The correlation coefficient of the calibration line for each channel must be 0.99 or greater. If not, the calibration must be repeated.

6.4.3. Simulator solutions not meeting quality control criteria may be reanalyzed provided that they are accompanied by bracketing aqueous blanks and aqueous ethanol controls, the same internal standard lot number is used, and the samples are run within 24 hours of the original calibration.

6.4.4. Ten analytical vials of simulator solution must meet the following criteria:

6.4.4.1. All analysis results must fall within 5% of the mean of all replicates, rounded to four decimal places.

6.4.4.2. All analysis results must fall within 3 standard deviations of the mean of all replicates, rounded to four decimal places.

6.4.4.3. All analysis results must yield a coefficient of variation below 5%, calculated as:

$$\%CV = \frac{s}{\text{mean response}}$$

Where  $s$  is the standard deviation of all channel results for the analytical batch and the mean response is the average of all analysis results, rounded to four decimal places.

6.4.5. Surrogate compound concentrations for each sample must fall between 0.900 and 1.100.

6.4.6. Internal standard peaks for quantitative samples must fall within  $\pm 20\%$  of the average internal standard peak area from the current calibrators.

6.4.7. Ensure that all samples are quantified against the correct calibration curve.

6.4.8. Replicate results from both batches must meet the following criteria:

6.4.8.1. All analysis results must fall within 5% of the grand mean of all replicates, rounded to four decimal places.

6.4.8.2. All analysis results must fall within 3 standard deviations of the grand mean of all replicates, rounded to four decimal places.

6.4.8.3. All analysis results must yield a coefficient of variation below 5%.

6.4.8.4. Reported solution concentration will be rounded to three decimal places before measurement uncertainty is calculated, as outlined in Section 7.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	Page 11 of 16
--------------------------------	------------------------------	---	---------------

- 6.4.8.5. Calibration and Quality Control solutions must have a reported concentration within 3% of the target value to be acceptable. All other solutions must have a reported concentration within 5% of the target value.
- 6.4.9. Individual outlying replicates may be omitted on a case by case basis with approval from the Toxicology Section Supervisor.
- 6.5. Technical Review:
  - 6.5.1. The assigned reviewer must perform a technical review of the complete data package.
  - 6.5.2. Ensure that forms are complete and accurate. The reviewer will confirm that the information on the storage bottle labels (lot #, concentration, prepared date) matches the information in the Reagent Preparation Log.
  - 6.5.3. Confirm all calculations that are not part of a validated worksheet.
  - 6.5.4. If data quality issues have been identified during data review, the reviewer must attempt resolution through discussion with the analyst and/or Toxicology Section Supervisor. If issues cannot be resolved, it may be necessary to repeat the analytical procedure.
  - 6.5.5. Solutions not meeting acceptance criteria will be discarded.
- 6.6. Administrative and Director Review
  - 6.6.1. Upon completion of the technical review, an administrative and director review of the data package will be completed.
- 6.7. All review criteria must be met before the Certified Reference Material may be approved for use on the DMT evidential breath testing instruments.

### 7.0 Estimation of Uncertainty of Measurement

- 7.1. The estimation of measurement uncertainty is performed using the GUM Approach as defined in the ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – Annex A.
  - 7.1.1. A 99.73% level of confidence will be used to determine the expanded uncertainty.
  - 7.1.2. The expanded uncertainty will be rounded up to two significant figures.
- 7.2. Calculate the confidence interval for each result by multiplying the measured result by the expanded uncertainty. This value will be reported along with the measured result.
  - 7.2.1. The reported estimated measurement uncertainty will be truncated to four decimal places, then rounded up to three decimal places.
- 7.3. To assist with the application of simulator solution results, the interval will be reported in the following format:

0.XXX ± 0.YYY g/210 L ethanol

- 7.4. The estimated uncertainty of measurement will be reviewed at least annually or if any

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	Page 12 of 16
--------------------------------	------------------------------	---	---------------

significant change in the expanded uncertainty is suspected.

- 7.5. The reported result is the result at the time of analysis, and does not account for changes in sample composition which may occur subsequent to or before examination.

### 8.0 References

- 8.1. DMT Adjustment and Calibration Method Validation
- 8.2. Standard for Breath Alcohol Measuring Instrument Calibration, ASB Standard 055, First Edition (Draft form), American Academy of Forensic Sciences Standards Board, 2023. Available at: [www.aafs.org/academy-standards-board](http://www.aafs.org/academy-standards-board)
- 8.3. R.Sander, "Compilation of Henry's law constants (version 4.0) for water as solvent", Atmos. Chem. Phys., 15, p. 4399-4981, 2015
- 8.4. Sander, S. P., Abbatt, J., Barker, J. R., Burkholder, J. B., Friedl, R. R., Golden, D. M., Huie, R. E., Kolb, C. E., Kurylo, M. J., Moortgat, G. K., Orkin, V. L., and Wine, P. H.: "Chemical Kinetics and Photochemical Data for Use in Atmospheric Studies", Evaluation No. 17, JPL Publication 10-6, Jet Propulsion Laboratory, Pasadena, available at: <http://jpldataeval.jpl.nasa.gov>, 2011.
- 8.5. Hwang, R., Beltran, J., Rogers, C., Barlow, J., & Razatos, G.; "Measurement of Uncertainty for Aqueous Ethanol Wet-Bath Simulator Solutions Used with Evidential Breath Testing Instruments", Journal of Forensic Sciences, Vol. 61, No. 5, Sept. 2016, 1359-1363.
- 8.6. Dubowski, K.M.; "Storage Stability of Simulator Ethanol Solutions for Vapor-Alcohol Control Tests in Breath Alcohol Analysis", Journal of Analytical Toxicology, Vol. 26, Oct. 2002, 406-410.
- 8.7. Toxicology Training Manual(s)
- 8.8. VFL Balances Equipment QA/QC Binder
- 8.9. VFL Pipettes Equipment QA/QC Binder
- 8.10. Toxicology Section Reagent Preparation Log
- 8.11. Interference Solution Certificate of Analysis (TOX\_F500\_1)
- 8.12. A.W Jones, Determination of liquid/air partition coefficients for dilute solutions of ethanol in water, whole blood, and plasma. J. of Anal. Tox. 1983.
- 8.13. Alcohol Analysis Manual (TOX\_P100)
- 8.14. Simulator Solution Worksheet (TOX\_F500\_2)
- 8.15. Certified Reference Material Review Checklist (QA\_F100\_7.7\_14)
- 8.16. Certificate of Analysis (TOX\_F500\_3)

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No.  
TOX\_P500\_Version 6

Approved by:  
Lab Director

Effective Date:  
03/19/2024  
Status: Active

**Page 13 of 16**

- 8.17. ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – Annex A; Details on the NIST 8-Step Process. ASCLD/LAB – International.

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 14 of 16</b>
--------------------------------	------------------------------	---	----------------------

### Appendix A

Label Examples:

<b>DMT Interference Solution</b> Lot # 24-08-00A06 0.06 g/210L Acetone in DI Water Preparation Date: 01/24/24 Expires: 01/24/26
OPENED:

<b>DMT Calibration Solution</b>		
Lot: 24-10-080	EtOH Certified Conc.	0.080
		±0.004
Prep Date: 2/4/24	Exp Date: 02/04/26	
Opened:		

<b>DMT Quality Control Solution</b>		
Lot: 24-06-100	EtOH Certified Conc.	0.100
Prep Date: 1/16/24	Exp Date: 01/16/26	
Opened:		

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No. TOX_P500_Version 6	Approved by: Lab Director	Effective Date: 03/19/2024 Status: Active	<b>Page 15 of 16</b>
--------------------------------	------------------------------	---	----------------------

### Appendix B

Target BrAC (g/210L)	Mass needed (g/L)	Target Mass (g)		
		2 L batch	5 L batch	20 L batch
0.015	0.1848	0.3696	0.9239	3.6957
0.020	0.2464	0.4928	1.2319	4.9276
0.025	0.3080	0.6160	1.5399	6.1595
0.080	0.9855	1.9710	4.9276	19.7105
0.100	1.2319	2.4638	6.1595	24.6381
0.160	1.9710	3.9421	9.8552	39.4210
0.180	2.2174	4.4349	11.0871	44.3486
0.200	2.4638	4.9276	12.3190	49.2762
0.240	2.9566	5.9131	14.7829	59.1314
0.340	4.1885	8.3770	20.9424	83.7695
0.360	4.4349	8.8697	22.1743	88.6971
0.380	4.6812	9.3625	23.4062	93.6248

Table 1. Suggested aqueous ethanol solution preparation recipes

Interferent	Target Conc. (g/210L)	Apparent EtOH (g/210L)	Target Mass (g)		
			1 L batch	2 L batch	5 L batch
Acetone	0.060	0.010	0.1147	0.2295	0.5737
	0.090	0.015	0.1721	0.3442	0.8605
	0.120	0.020	0.2295	0.4590	1.1475
Methanol	0.010	0.010	0.1403	0.2805	0.7014
	0.015	0.015	0.2104	0.4208	1.0520
	0.020	0.020	0.2806	0.5612	1.4030
	0.025	0.025	0.3507	0.7014	1.7535
	0.030	0.030	0.4208	0.8416	2.1040
Isopropanol	0.010	0.010	0.0757	0.1513	0.3783
	0.015	0.015	0.1135	0.2270	0.5675
	0.020	0.020	0.1513	0.3026	0.7565

Table 2. Suggested interference solution preparation recipes

# VERMONT FORENSIC LABORATORY

## Certified Reference Material Manual

Doc. No.  
TOX\_P500\_Version 6

Approved by:  
Lab Director

Effective Date:  
03/19/2024  
Status: Active

Page 16 of 16

DOCUMENT HISTORY			
DATE	VERSION	APPROVED BY	ACTIVITY OR REVISION
10/18/2016	1	Lab Director	Manual updated to reflect new instrumentation and procedure; ALC_P500 replaces ALC_P201; ALC_F500_1 replaces ALC_F201_1; ALC_F500_2 replaces ALC_F201_2; QA_F100_5.9_14 replaces ALC_F201_3; ALC_F500_3 replaces ALC_F201_4
10/25/2016	2	Lab Director	Appendix A added
11/5/2018	3	Lab Director	Changed all "ALC" references to "TOX" and updated manual numbers; updated sections 2.3.1 (competency), 3.2.1.5 (back up balance) and 3.2.2 (pipettes); minor formatting changes throughout; updated TOX_F500_1 (header & form number), TOX_F500_2 (form number & formula fix to allow more than one set of CCSs) and TOX_F500_3 (header & form number, removed reference to balance)
6/24/2020	4	Lab Director	Removed daily balance checks, aligned pipette QC language with equipment QC manual, updated expiry date of solutions to two years, updated label examples, referenced TOX_P100 for QC criteria requirements, added Table of Contents, minor formatting changes throughout document
8/10/2022	5	Lab Director	Updated equipment QC section, removed historical calibrations, minor formatting changes throughout; TOX_F500_2 updated to only use calibrators, not blank, for IS average calculation
3/19/2024	6	Lab Director	Removed CCS and redefined aqueous ethanol controls; renamed "external standard solution" to "quality control solution"; updated solution preparation calculations and added Appendix B; removed abbreviation section; removed requirement for each analyst to make a solution annually; minor formatting changes throughout; updated TOX_F500_1, TOX_F500_2 and TOX_F500_3