



# **TENNESSEE BUREAU OF INVESTIGATION**

## *Forensic Services Division*

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### Breath Alcohol Unit Standard Operating Procedures Manual Estimation of Uncertainty

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## **ESTIMATION OF THE UNCERTAINTY OF MEASUREMENT FOR INSTRUMENT CALIBRATIONS**

### 6.1. Scope

An overall estimate of the uncertainty of measurement shall be determined for Breath Alcohol instrument certifications (calibrations) for all evidentiary breath alcohol instruments used in the State of Tennessee.

The estimation of uncertainty of measurement is a representation of the confidence, or certainty, associated with the certification procedure.

### 6.2. Documentation

6.2.1. All calculations related to the estimation of the uncertainty of measurement for breath alcohol instrument certification shall be maintained on the TBI share drive with restricted access by Breath Alcohol personnel and the TBI Quality Manager.

6.2.2. The estimation of uncertainty of measurement will be re-evaluated when a significant change occurs in the budget. Uncertainty budgets and/or measurements should be reviewed on an annual basis.

### 6.3. Estimating the Uncertainty of Measurement

6.3.1. The measuring instruments are the Intoximeter EC/IR II and Intoximeter Alco-Sensor V XL, using current TBI approved software/firmware.

6.3.2. The measurand is the concentration of ethanol expressed as grams per 210 liters (g/210L).

6.3.3. Measurement traceability is established using reference materials obtained from an ISO/IEC 17025:2005 accredited laboratory with an appropriate scope of accreditation.

6.3.4. Uncertainty budget

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- A budget is the written representation of factors that contribute to the source of uncertainty. It also includes the statistical calculations, the final calculated uncertainty, and the expanded uncertainty.

#### 6.3.5. Uncertainty Budget Components

The uncertainty budget for the calibration shall include Type A uncertainty.

- A. Random (Type A) uncertainty results from measurement values being scattered in a random fashion due to laws of chance and thus has normal shaped distribution.
- B. Random (Type A) uncertainty is best determined by historical data of many repeated measurements.
- C. Data will be collected from the standards analyzed during the certification procedure for breath alcohol instrumentation in use during the evaluation time period.
- D. Data from a minimum of 33% of total instruments will be used to calculate the mean, standard deviation and coefficient of variation.

6.3.5.D.1. The data will be representative of the instrumentation that is used in the field.

6.3.5.D.2. Multiple measurements are performed on the dry gas standard used.

6.3.5.D.3. The results from each sample, for each standard value, will be normalized to represent non pressure adjusted target values (pressure at 760 mm Hg). This is conducted using the instrument's software.

6.3.5.D.4. Reported sample concentration  $\times$  760 mm Hg/barometric pressure (at the time of sampling) = Normalized sample value.

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6.3.5.D.5. Normalized sample values will be used in any further calculations.

6.3.5.D.6. The results of the normalized sample values for each standard value are averaged (mean).

- The Standard Deviation (SD) will be calculated. The SD =

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$

6.3.6. The uncertainty budget for the calibration shall include Type B uncertainty

- Systematic uncertainty results from the inherent biases in measuring systems and quantitative analytical methods. These uncertainties may be reduced by optimizing the method or measuring system but can never be completely eliminated.

6.3.7. Ethanol Dry Gas Standards

- Uncertainty of measurement, distribution type and coverage factor will be found on the manufacturer's calibration certificate.

6.3.8. Barometric Pressure

- Uncertainty of measurement, distribution type and coverage factor will be found on the manufacturer's calibration certificate.

#### 6.4. Reporting the Estimated Uncertainty of Measurement

The reported uncertainty will be converted to units of concentration of grams per 210 liters (g/210L). Since the uncertainty of measurement is only an estimate, it will be reported to three (3) significant digits past the decimal.

The coverage factor shall be k=3. The coverage probability shall be 99.73%.

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The above results and supporting data are maintained within the Breath Alcohol Section and available upon request.