

## ASCLD/LAB Policy on Measurement Uncertainty

ASCLD/LAB-*International* is a program of the  
American Society of Crime Laboratory Directors / Laboratory Accreditation Board  
**ASCLD/LAB**

Copyright © 2011 by ASCLD/LAB

Approval Date: August 5, 2011  
Approved By: ASCLD/LAB Executive Director  
Effective Date: July 1, 2012  
ASCLD/LAB Document Control Number: AL-PD-3051 Ver. 1.0

ASCLD/LAB customers should use this document in conjunction with AL-PD-3055 and AL-PD-3056 for conformance with ASCLD/LAB Measurement Uncertainty policy requirements.

**NOTE** AL-PD-3008 *Estimating Uncertainty of Measurement Policy* and AL-PD-3033 *Updated Approach to Uncertainty of Measurement Requirements* are withdrawn, effective August 5, 2011, and should no longer be used for conformance with ASCLD/LAB measurement uncertainty requirements.

## Document History / AL-PD-3051

Date	Version	Description of Activity or Revision	Approved By	Effective Date
March 1, 2011	1.0	Initial review and adoption by the ASCLD/LAB Board of Directors	Board of Directors	July 1, 2012
March – July 2011	1.0	Initial draft approved by the Board was not released when the need for additional revisions was noted	N/A	N/A
July 19, 2011	1.0	Revisions reviewed and adopted by the ASCLD/LAB Board of Directors	Board of Directors	July 1, 2012
August 5, 2011	1.0	Reviewed and approved for distribution by the ASCLD/LAB Executive Director	Executive Director	July 1, 2012

All intellectual property rights in this publication are the property of the  
**American Society of Crime Laboratory Directors / Laboratory Accreditation Board**  
**ASCLD/LAB**

ASCLD/LAB  
 139 J Technology Drive  
 Garner, North Carolina 27529  
 USA  
 919-773-2600

## 1 Purpose

- 1.1 This policy is intended for ASCLD/LAB-*International* accredited testing and calibration laboratories and laboratories working to achieve accreditation under the ASCLD/LAB-*International* programs that provide to their customers quantitative (i.e., numerical) measurement results having an estimated uncertainty associated with their reported values.
- 1.2 It is ASCLD/LAB's intention to conform to the Guide to the Expression of Uncertainty in Measurement (GUM),<sup>1</sup> including applicable GUM supplements and the International Vocabulary of Metrology (VIM),<sup>2</sup> which are widely accepted as de facto international standards.
- 1.3 ASCLD/LAB does not prescribe a specific method or formula for assessing measurement uncertainty. However, ASCLD/LAB expects uncertainty estimations to conform to the principles set forth in the GUM and in any applicable GUM supplements.

## 2 Scope

- 2.1 ASCLD/LAB requires that the laboratory estimate the measurement uncertainty<sup>3</sup> for any area of testing or calibration where the customer makes the request or the jurisdiction or statute requires such. At a minimum, ASCLD/LAB requires the laboratory to assess the measurement uncertainty when quantitative values are reported for: 1) the quantity (mass or volume) of a controlled substance, or the presence of a controlled substance when it is reported as a percentage (mass or volume fraction) of the whole sample; 2) the concentration (mass or volume fraction) of a drug in a toxicology sample, including values reported for blood alcohol; 3) the barrel length of a firearm and/or the overall length of a firearm; and 4) the calibration of breath alcohol measuring instruments and calibration of breath alcohol reference materials.
- 2.2 The requirements for estimation of measurement uncertainty outlined in this policy are not intended to apply to situations where test results are not numerical (e.g., pass/fail, positive/negative, or other qualitative examinations). However, this limitation should not be taken as an indication that the concepts discussed are technically unsuited for such situations.
- 2.3 The measurement uncertainty reported may be of concern to customers and others, unfamiliar with uncertainty concepts, but who nonetheless must make decisions based on the result(s) reported. Therefore, consultation with customer(s) to determine the level of uncertainty acceptable is also an important part of the process, since those who use forensic results will assess the reliability of laboratory tests and calibrations.

## 3 The Measurement Uncertainty Concept

- 3.1 Estimation of measurement uncertainty provides the customer with a quantitative characterization of how well laboratory personnel know the value of a measurand.<sup>4</sup> The ISO/IEC 17025:2005<sup>5</sup> clauses most relevant to measurement uncertainty are 5.4.6, 5.10.3.1 (c) and 5.10.4.1 (b).
- 3.2 The GUM,<sup>1</sup> internationally recognized and widely accepted, establishes general rules for evaluating and expressing measurement uncertainty and describes a standardized method for measurement uncertainty estimation.
- 3.3 Contributions from all recognized sources of uncertainty shall be evaluated.

- 3.3.1 These contributions must be evaluated using Type A methods (that is, by a statistical analysis of measured values obtained under defined measurement conditions such as repeatability and/or reproducibility, including measurement assurance data) and Type B methods (that is, by other means of analysis of components from such things as instrument readability, calibration certificate reported uncertainty, etc.).
- 3.4 Laboratories that are either already *ASCLD/LAB-International* accredited or are seeking accreditation under the *ASCLD/LAB-International* programs must identify and record the following elements for each test or calibration method, as required in the Scope section of this policy, when estimating measurement uncertainty:
- a) The measurand and its measured value,
  - b) The measuring device(s) and/or instrument(s) used,
  - c) All significant components, corrections, and correction factors that contribute to the sources of uncertainty, their calculation and combination shall be detailed in the uncertainty budget,<sup>6</sup>
  - d) Components that are negligible in practice (and which may differ from case to case) shall be noted but may not have to be quantified and incorporated in the uncertainty,
  - e) Data used to estimate repeatability and reproducibility,
  - f) The schedule to maintain and/or recalculate the measurement uncertainty,
  - g) Statute/jurisdiction and customer requirements for reporting uncertainty, and
  - h) The uncertainty attributed to the value of the measurand, an expanded uncertainty, and the specific coverage probability.

## 4 Reporting Requirements

- 4.1 The estimated measurement uncertainty, communicated as an expanded uncertainty, including the coverage factor and the coverage probability, must be in the test or calibration report or in an attachment to the report that is communicated to the customer.

For certain testing applications, the laboratory may have an agreement with the appropriate legal or judicial customer(s) that the estimated uncertainty is not required in a test report unless the measurement result (considering the expanded uncertainty) falls within a certain range around a legal specification. Such an arrangement is acceptable to ASCLD/LAB as long as the agreement with the appropriate customer(s) is in writing; is readily available for review in the laboratory; and is scientifically/mathematically reasonable. The existence of such a written agreement to limit the testing laboratory's reporting of measurement uncertainty does not excuse the laboratory from estimating the measurement uncertainty of the test method.

- 4.1.1 This measurement result shall include the measured quantity value,  $y$ , along with the associated expanded uncertainty,  $U$ , and this measurement result shall be reported as  $y \pm U$  and be consistent with the units of  $y$ .

4.1.1.1 **NOTE** For asymmetrical uncertainties, presentations other than  $y \pm U$  may be needed. This also concerns cases when uncertainty is determined by Monte Carlo simulations (propagation of distributions) or with logarithmic units.<sup>7</sup>

- 4.1.2 The coverage probability shall not be less than approximately 95%.

- 4.2 The numerical value of the expanded uncertainty shall be reported to at most two significant digits.
- 4.2.1 The laboratory shall establish a procedure for the process of rounding the reported uncertainty.
- 4.2.1.1 The usual rules for rounding of numbers must be used, subject to the guidance on rounding provided in Section 7 of the GUM, which recognizes the appropriateness of rounding uncertainties upwards rather than to the nearest digit, or subject to the guidance on rounding provided in ISO 80000-1:2009<sup>8</sup> or as stipulated by statute.
- 4.3 It is recognized that some Calibration and Measurement Capabilities (CMC)<sup>9</sup> are based on the use of the “best measurement instrument.” If the “best measurement instrument” is not used for a measurement or calibration, the reported uncertainty shall reflect the appropriate contribution to the measurement uncertainty based on the measurement instrument used.

---

## NOTES

- <sup>1</sup> Joint Committee for Guides in Metrology (JCGM), *Evaluation of measurement data – Guide to the expression of uncertainty in measurement (GUM)* (GUM 1995 with minor corrections). (Sèvres, France: International Bureau of Weights and Measures [BIPM]-JCGM 100], September 2008). Available at <http://www.bipm.org/en/publications/guides/gum.html>.

Even though the electronic version of the 2008 edition of the GUM is available free of charge on the BIPM's website, copyright of that document is shared jointly by the JCGM member organizations (BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP and OIML).

- <sup>2</sup> JCGM, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*, 3rd ed. (Sèvres, France: BIPM-JCGM 200, 2008). Available for download at <http://www.bipm.org/en/publications/guides/vim.html>.

Even though the electronic version of the 3rd edition of the VIM is available free of charge on the BIPM's website, copyright of that document is shared jointly by the JCGM member organizations (BIPM, IEC, IFCC, ILAC, ISO, IUPAC, and OIML).

- <sup>3</sup> **VIM Definition - Measurement uncertainty:** “non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.”

- <sup>4</sup> **VIM Definition - Measurand:** “The quantity intended to be measured.”

- <sup>5</sup> International Organization for Standardization (ISO), *ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories* (Geneva, Switzerland: ISO, 2005). Available for purchase at [http://www.iso.org/iso/iso\\_catalogue.htm](http://www.iso.org/iso/iso_catalogue.htm) or from other authorized distributors.

Additional information about ISO is available at <http://www.iso.org/iso/home.html>.

- 
- 6 **VIM Discussion - Uncertainty budget:** *“NOTE: The uncertainty budget should include the measurement model (mathematical relation among all quantities known to be involved in a measurement), estimates, and measurement uncertainties associated with the quantities in the measurement model, covariances, type of applied probability density functions, degrees of freedom, type of evaluation of measurement uncertainty, and any coverage factor.”*
- 7 International Laboratory Accreditation Cooperation (ILAC), *ILAC-P14:12/2010 ILAC Policy for Uncertainty in Calibration* (ILAC: Rhodes, Australia, 2010). Available for download at [http://www.ilac.org/documents/ILAC\\_P14\\_12\\_2010.pdf](http://www.ilac.org/documents/ILAC_P14_12_2010.pdf).
- Additional information about ILAC is available at <http://www.ilac.org/>.
- 8 ISO, *ISO 80000: 2009, Quantities and Units; Part 1: General*. (Geneva, Switzerland: ISO, 2009) Available for purchase at [http://www.iso.org/iso/iso\\_catalogue.htm](http://www.iso.org/iso/iso_catalogue.htm) or from other authorized distributors.
- 9 **ASCLD/LAB Explanation - CMC:** a calibration and measurement capability available to customers under normal conditions as described in the laboratory's scope of accreditation granted by ASCLD/LAB as a signatory to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA).