Designation: E2764 – 11

Standard Practice for Uncertainty Assessment in the Context of Seized-Drug Analysis[1]

This standard is issued under the fixed designation E2764; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides guidance on the concept of uncertainty and its application to the qualitative and quantitative analysis of seized drugs. In this context, uncertainty encompasses limitations of qualitative methods as well as numerical ranges as applied to quantitative analyses.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E2329 Practice for Identification of Seized Drugs

E2327 Practice for Quality Assurance of Laboratories Performing Seized-Drug Analysis

E2549 Practice for Validation of Seized-Drug Analytical Methods

2.2 *ISO Standards:*[3]

ISO 3534-1:1993 Statistics—Part 1: Probability and General Statistical Terms

3. Significance and Use

3.1 *Application of Uncertainty*—Qualitative and quantitative analyses require different approaches, refer to the references for additional information. Analysts shall understand the limitations of qualitative and quantitative determinations and have tools to estimate a value for measurement uncertainty of relevant, but not necessarily all, numerical results. In this regard, efforts should be made to use the vocabulary, symbols, and formatting expressed in documents published by international standardizing organizations such as ISO and ASTM International.

3.1.1 An understanding of uncertainty is fundamental to the interpretation and reporting of results.

3.1.2 The term "uncertainty" does not imply doubt; rather, its consideration provides assurance that results and conclusions from methods and analytical schemes are fit for purpose.

3.1.3 The concept of uncertainty shall be considered for both qualitative and quantitative results.

3.1.4 Laboratory management shall ensure that uncertainty be addressed through the provision of training, procedures and documentation.

3.1.5 Laboratory management should consider customer requirements, such as a request for qualitative versus quantitative determinations, which influence the assessment of uncertainty.

3.2 The benefits of understanding and determining uncertainty in this context include:

3.2.1 Enhancing confidence through increased understanding of results,

3.2.2 Providing a mechanism to express the reliability of results,

3.2.3 Enabling the laboratory management and customer to evaluate the fitness for purpose of results,

3.2.4 Facilitating the identification of procedural limitations and providing a basis for improvement, and

3.2.5 Complying with accreditation requirements.

4. Qualitative Analysis

4.1 The identification of seized drugs requires the combination of methods to form an analytical scheme (see Practice E2329).

4.2 Individual methods have limitations and, consequently, uncertainty. Uncertainty of qualitative methods is not typically amenable to being expressed in numerical terms.

4.3 Understanding these limitations enables laboratory personnel to build an appropriate analytical scheme to correctly identify a drug or other chemical.

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[1] This practice is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.01 on Criminalistics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

4.3.1 It is expected that in the absence of unforeseen error, an appropriate analytical scheme effectively results in no uncertainty in reported identifications.

4.3.2 Relevant limitations of an analytical scheme (for example, inability to differentiate isomers, unavailability of reference standard, limits of detection and resolution) should be documented and might need to be included in the report (see reporting examples in 7.2).

5. Quantitative Measurements

5.1 Quantitative measurements have an associated uncertainty, which is defined as "an estimate attached to a test result which characterizes the range of values within which the true value is asserted to lie" (ISO 3534-1:1993).

5.2 A precise calculation of measurement uncertainty may not always be required.

5.2.1 Laboratory personnel shall understand the contributing factors of measurement uncertainty for each analytical procedure and evaluate them with respect to customer, accreditation, and jurisdictional requirements.

5.2.2 Where a value is critical, such as a weight or purity level close to a statutory threshold, an appropriate measurement uncertainty determination shall be applied.

5.3 Primary numerical values reported in the analysis of seized drugs are weight and purity. Where other values are measured (for example, size, volume, estimated tablet numbers), the same principles stated herein apply.

6. Estimation of Measurement Uncertainty for Quantitative Determinations

6.1 *Sources of Uncertainty for Weight Determinations*—The uncertainty of a reported value is dependant on the weighing process. Factors for consideration include:

6.1.1 Single versus multiple items (number of weighing operations),

6.1.2 Tare function as a separate weighing operation,

6.1.3 Extrapolation of population weight from limited sampling of multiple items,

6.1.4 Aggregate weighings,

6.1.5 Incomplete recovery of material from the packaging,

6.1.6 Balance selection (for example, readability, capacity), and

6.1.7 Balance operation (for example, sample placement on pan, environmental conditions).

6.2 *Sources of Uncertainty for Purity Determination*—The uncertainty of a reported purity value is dependant upon the entire quantitation process. Factors for consideration include:

6.2.1 *Sampling Plan* (for example, handling of multiple exhibits):

6.2.1.1 Sample homogeneity.

6.2.2 *Analytical Method:*

6.2.2.1 Sample preparation (for example, sample size, matrix effects, solubility),

6.2.2.2 Analytical technique,

6.2.2.3 Reference material (for example, purity of standard),

6.2.2.4 Equipment and instrument properties (for example, glassware, pipetters, balances, chromatographs),

6.2.2.5 Concentration of analyte, and

6.2.2.6 Environmental conditions.

6.3 *Factors Relevant to Estimation of Measurement Uncertainty*:

6.3.1 When estimating measurement uncertainty, consider the following sources of error:

6.3.1.1 *Analytical Error*—Systematic and random error both contribute to measurement uncertainty and shall be addressed through method validation and quality assurance practices (see Practices E2327 and E2549). Systematic error should be characterized and minimized for all validated procedures.

6.3.1.2 *Sampling Error*—The sample and sampling procedure are often the greatest contributors to measurement uncertainty.

6.3.2 Where appropriate, confidence levels (for example, 95 % or 99.7 %) shall be determined based on considerations relevant to the analytical context.

6.3.3 Record uncertainty information in validation documents, case records, or both.

6.4 *Approaches for Estimating Measurement Uncertainty*:

6.4.1 *Uncertainty Budget Approach:*

6.4.1.1 In this approach all sources of error are separately identified and tabulated.

6.4.1.2 A value is assigned to each source of error (collectively or individually) using either: empirical data (for example, from validation process, historical performance data, control chart data, proficiency tests); published data (for example, volumetric glassware tolerances); or combination of empirical and published data.

6.4.1.3 Where a source has an uncertainty which is insignificant compared to other sources, it can be excluded. Document the reasons for any exclusions.

6.4.1.4 The remaining significant values are used to calculate the combined standard uncertainty and expanded uncertainty.

6.4.2 *Non-Budget Approaches:*

6.4.2.1 The sources of uncertainty that are separately assessed in the budget method are collectively assessed by experimental measurement. In this approach data obtained from a statistically significant number of replicate analyses utilizing a validated method with an appropriate sampling plan may be utilized to calculate the standard or expanded uncertainty.

6.4.2.2 An alternate approach involves the use of two standard deviations (2σ) of the test method results from reproducibility data from the validation studies. This provides an approximation of the measurement uncertainty for non-critical values.

7. Reporting of Uncertainty

7.1 *Reporting*—Uncertainty should be reported when appropriate. Factors which influence the decision to report uncertainty include:

7.1.1 *Jurisdictional:*

7.1.1.1 Prevailing statutory requirement,

7.1.1.2 Relevant governing body (agency) requirements,

7.1.1.3 Customer requests, and

7.1.1.4 Potential exculpatory value.