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Standard Practice for Determining and Expressing Precision of Measurement Results, in the Analysis of Water, as Relative Standard Deviation, Utilizing DQCALC Software¹

This standard is issued under the fixed designation D7729; 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.

^{ε1} NOTE—The Keywords section was added editorially in August 2018.

1. Scope

1.1 This practice describes a procedure for developing a graphical model of relative standard deviation versus concentration for analytical methods used in the analysis of water (methods that are subject to non-additive random errors) for the purpose of assigning a statement of noise or randomness to analytical results (commonly referred to as a precision statement), in either a manual or an automated fashion.

1.2 Data analysis and modeling is done with Committee D19 Adjunct DQCALC² (a Microsoft Excel³-based tool).

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

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Introduction

2.1 An understanding of the uncertainty associated with measurement results is necessary for evaluating the utility of those results. Without a reported uncertainty estimate, users of

measurement results are unable to determine if the data are sufficiently precise for any specific data use.

2.2 Measurement uncertainty (MU) is most generally understood to be “a parameter characterizing the dispersion of the quantity values being attributed to a measurand” (from VIM 2.26). This definition can be implemented as an expression (“uncertainty statement”) associated with an reported measurement that represents the statistically based (Type A estimate) dispersion of experimental results around a reported value.

2.3 There is no universally agreed upon format or nomenclature for uncertainty statements. The literature offers suggestions ranging from simple expressions of standard deviation or “fractional uncertainty” (standard deviation divided by reported result) to confidence intervals to detailed “uncertainty reports.”

2.4 In addition to the “random” errors encompassed in the ideas expressed in 1.1 and 1.2, there are also “systematic” errors, biases, that can be considered as part of uncertainty. The literature is not consistent on how unknown bias is considered in an uncertainty statement. For purposes of this practice, bias is assumed to have been corrected for or insignificant in the reported results, and bias is not specifically incorporated in the proposed uncertainty statement.

2.5 For purposes of this practice, the terms *MU*, *uncertainty statement*, or *measurement uncertainty* will be used synonymously to designate the expression accompanying measurement results for the purpose of assessing the utility of those results.

2.6 This practice proposes the use of fractional uncertainty or relative standard deviation (RSD) as the expression of MU.

2.7 Traditionally, in the generation and publication of data related to the analysis of water, a continuous function (model) describing the relationship of uncertainty (as standard deviation) to concentration is not available. To compensate for this lack, discrete points bounding certain levels of uncertainty are calculated, for example, “detection limits” (typically around 33 % RSD) and “quantitation limits” (often around 10 %

¹ This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.02 on Quality Systems, Specification, and Statistics.

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² Available from ASTM International Headquarters. Order Adjunct No. ADJDQ-CALC. Original adjunct produced in 2007.

³ Microsoft Excel is a trademark of the Microsoft Corporation, Redmond, WA.