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Standard Guide for Analysis of Calibration Data for Nuclear Instruments¹

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1. Scope

1.1 This guide describes data analysis for efficiency calibrations of nuclear instruments using radioactive sources. It includes the calculation of the calibration parameters, evaluation and use of their uncertainties and covariances, and testing of the calibration data for outliers and overall lack of fit. It also provides guidelines for summarizing and reporting the results of a calibration.

1.2 The instrument counting efficiency is assumed to be independent of the radiation emission rate.

1.3 Guidance is provided for both single-point calibrations and calibration curves.

1.4 The guidance presumes the existence of measurement uncertainty models to provide statistical weighting factors for the calibration data.

1.5 This guide does not cover calibrations involving physically-based computer simulations.

1.6 The system of units for this guide is not specified. Dimensional quantities in the guide are presented only as illustrations of calculation methods. The examples are not binding on products or test methods treated.

1.7 *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.*

1.8 *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. Referenced Documents

2.1 ASTM Standards:²

- D1129 Terminology Relating to Water
- D7282 Practice for Setup, Calibration, and Quality Control of Instruments Used for Radioactivity Measurements
- D7902 Terminology for Radiochemical Analyses
- D8293 Guide for Evaluating and Expressing the Uncertainty of Radiochemical Measurements

2.2 JCGM Documents:³

- GUM:JCGM 100:2008 Evaluation of measurement data—Guide to the expression of uncertainty in measurement
- JCGM 102:2011 Evaluation of measurement data—Supplement 2 to the “Guide to the expression of uncertainty in measurement”—Extension to any number of quantities
- VIM:JCGM 200:2008 International vocabulary of metrology—Basic and general concepts and associated terms (VIM)

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this practice, refer to Terminologies D1129 and D7902, Practice D7282, GUM:JCGM 100, JCGM 102, and VIM:JCGM 200.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *calibration curve, n*—functional model that calculates counting efficiency from the value of a predictor variable and one or more model parameters; also known as an *efficiency curve*.

3.2.1.1 *Discussion*—A calibration “curve” might be a linear or nonlinear function of the predictor variable.

3.2.2 *calibration parameter, n*—any of the parameters in a calibration model whose values are determined by a calibration

¹ This guide is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.04 on Methods of Radiochemical Analysis.

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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 www.bipm.org.