

# **The Joint Committee for Guides in Metrology: Supplementing the Guide to the Expression of Uncertainty in Measurement**

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The ISO *Guide to the Expression of Uncertainty in Measurement*, now commonly referred to as the GUM, was developed by the ISO Technical Advisory Group 4 (TAG4) and first published in 1993.

The actual writing was done by Dr. Barry Taylor of the NIST Physics Laboratory, assisted by Dr. Chris Kuyatt from NIST's Radiation Physics Laboratory. The GUM rather quickly became a *de facto* standard procedure for the evaluation of uncertainties in measurements performed by National Metrology Institutes (NMIs). At NIST in particular, the GUM became Institute policy in the form of NIST Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*.

In addition to its use by the NMIs, the GUM has been increasingly adopted as a *de facto* standard procedure by calibration laboratories (see, for example ISO 17025), and is working its way towards application by industry down to the level of shop floor metrology. In the United States, the GUM has been formally adopted as a US National Standard in the form of ANSI/NCSL Z540-2-1997, *U.S. Guide to the Expression of Uncertainty in Measurement*.

In 1997, following the disbanding of ISO TAG4, the International Committee for Weights and Measures (CIPM) created a Joint Committee for Guides in Metrology (JCGM), chaired by Dr. Terry Quinn, then Director of the BIPM. The Committee had the task of assuming the duties of TAG4, which had developed in addition to the GUM, the *International Vocabulary of Basic and General Terms in Metrology* (known as the VIM).

The JCGM is composed, as was TAG4, of the BIPM together with the International Electrotechnical Commission (IEC), the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), the International Organization for Standardization (ISO), the International Union of Pure and Applied Chemistry (IUPAC), the International Union of Pure and Applied Physics (IUPAP) the International Organization of Legal Metrology (OIML), and the International Laboratory Accreditation Cooperation (ILAC). Additional members include representatives from NIST, PTB (Germany), NPL (United Kingdom), IMGC (Italy), and NIM (China).

Within JCGM two Working Groups were established:

- Working Group 1 (WG1), "Expression of Uncertainty in Measurement", has the task to promote the use of the GUM and to prepare supplemental guides for its broad application.
- Working Group 2 (WG2), "Working Group on International Vocabulary of Basic and General Terms in Metrology (VIM)", has the task to revise and promote the use of the VIM.

[A complete roster of the members of both Working Groups, together with descriptions of their activities, can be found at the BIPM website [www.bipm.fr](http://www.bipm.fr).]

The technical work of JCGM-WG1 is currently focused on three supplementary documents that complement and enhance the GUM in practical application. These documents are:

- A supplement to the GUM providing guidance on the use of computer-based Monte Carlo methods of propagating probability distributions for the evaluation of measurement uncertainty. Numerical methods can provide more reasonable uncertainty intervals where the measurement model is highly non-linear and/or various input quantities have asymmetric probability distributions.

A draft document, *GUM Supplement 1 - Numerical Methods for the Propagation of Distributions*, is currently being circulated for comments at the NMIs and other member organizations of WG1.

- A supplement to the GUM generalizing the propagation of uncertainty to multivariate models where there is more than one measurand. An example of such a model is a least-squares fit of experimental data to a straight line. Here the two measurands are the slope and intercept of the best-fit line, calculated from the common set of data. A draft version of this supplement is nearing completion.
- A supplement describing the role of measurement uncertainty in conformance testing and risk analysis. A draft document has been written, describing a generic approach to deciding conformance or non-conformance with specifications or requirements. Based on probability theory as the fundamental way for dealing with uncertainty, this work will yield a uniform way to treat conformance issues ranging from workpiece conformance inspections and measuring instrument verifications to the certification of standard reference materials and blood tests for the presence of chemical substances.

The GUM was published by ISO in the name of the seven contributing organizations. Since ISO owns the copyright, the GUM is available only at a price. The goal of JCGM and BIPM is to make the GUM Supplemental Guides freely available, preferably at the BIPM website. Various avenues towards this goal are being explored.

At some point in the future, a revised version of the GUM might be desirable in order to make it more fully consistent with the underlying principles of probabilistic inference. No such revision is under active consideration at the present time.