News from the JCGM-WG1

MEETINGS The JCGM-WG1 used to meet face-to-face twice per year, normally at the BIPM. Following the COVID-19 pandemic, one of the biannual meetings is held remotely. Other online meetings devoted to specific subjects are held when needed, typically with a reduced number of members. During 2023 the JCGM-WG1 met online in May and in November. The latest meeting was from 21 to 24 May at the BIPM.

MEMBERSHIP Torgny Carlsson, Chair of ISO/TC 12, Quantities and units, joined JCGM-WG1 in June 2023, representing ISO. Olha Bodnar (IUPAC), Juris Mejia (IUPAC) and Antonio Possolo (IEC) resigned in February 2024. Ivo Leito (University of Tartu) and Francesca Pennecchi (INRiM) are the new IUPAC representatives.

Complete membership can be found here.

GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT - NEW PERSPECTIVE

Under the New Perspective, "the GUM" is the whole suite of documents published by the JCGM-WG1, thus broadening the scope of the first edition of that fundamental document. A first document, GUM Part 6, has been published (see below). Existing documents, suitably updated, will be renumbered and re-published as parts of the suite and new parts will be added to meet the evolving needs in the field of measurement uncertainty evaluation. To cite just an instance, there is a growing awareness that the result of the examination of nominal properties is not complete without a statement concerning the measurement uncertainty associated with the examination.

DOCUMENTS IN PREPARATION

JCGM GUM-5:202x Guide to the expression of uncertainty in measurement – Part 5: Examples of uncertainty evaluation

The idea of a separate evolving examples document was endorsed by the JCGM. This choice will allow greater flexibility whenever new examples will be made available. The examples will illustrate various methods of measurement uncertainty evaluation, thus concerning the whole suite of documents published by JCGM-WG1. They will also cover various areas of measurement.

JCGM GUM-5 is considered as an informative annex in the GUM suite and as such has special status regarding the approval process of its updates following the first publication. The latter would contain an initial set of examples and will be subject to the usual approval procedure, whereas the subsequent updates including new examples will undergo a simplified procedure.

A first Committed Draft is expected to be ready for circulation among member organsations and NMIs by spring 2024.

JCGM GUM-7:202x Guide to the expression of uncertainty in measurement – Part 7: Propagation of distributions using a Monte Carlo method

This document will be the re-publication of JCGM 101:2008 (see under "Publications" below) in the new perspective. The parent document, JCGM 101:2008, is being revised both editorially and technically. An advanced working draft is under discussion.

OTHER BUSINESS

- **JCGM logo.** The JCGM has now a logo, shown in the first page of these Newsletters. The logo is intended to strengthen the image of the JCGM and its documents, by improving their commonality. The logo would be used in the front page of internal JCGM documents such as reports from working groups, as well as in presentations and in websites, similarly to the JCTLM logo in the current BIPM website page devoted to joint Committees.

- **Definitions of terms related to measurement uncertainty.** JCGM-WG1 held several extra meetings devoted to the specific topic of definitions of terms related to measurement uncertainty, to be offered to JCGM-WG2. Currently, joint WG1-WG2 meetings are being held to find a consensus on the key definitions. Those that were so far discussed and for which there is consensus are

measurement uncertainty
uncertainty of measurement

doubt about the value of the measurand that remains after making a measurement

NOTE 1 Measurement uncertainty can be described fully and quantitatively by a probability distribution on the set of possible values of the measurand.

NOTE 2 For scalar measurands, measurement uncertainty can be summarised by, for example, the standard uncertainty, a coverage interval with specified coverage probability, or by selected quantiles of the probability distribution in Note 1. For multivariate measurands, measurement uncertainty can be described, for example, by the covariance matrix or by a coverage region, with specified coverage probability.

standard uncertainty
standard measurement uncertainty

measurement uncertainty expressed by a standard deviation

coverage interval

interval believed to contain the value of the measurand with stated probability

NOTE Generally there is more than one coverage interval for a stated probability.

coverage probability

probability chosen in constructing a coverage interval or a coverage region

expanded uncertainty
expanded measurement uncertainty

half width of a coverage interval symmetric about the measured value

NOTE An expanded uncertainty can be obtained as the product of the standard uncertainty and a coverage factor.

coverage factor

numerical factor used to multiply the standard uncertainty to obtain an expanded uncertainty

NOTE 1 A coverage factor is chosen to give an intended coverage probability.

NOTE 2 For a normal distribution, a coverage factor $k = 2$ gives a coverage probability of approximately 95 %.

relative standard uncertainty
relative standard measurement uncertainty

absolute value of the quotient of the standard uncertainty and the associated measured value

NOTE The relative standard uncertainty is not defined if the measured value is zero.

relative expanded uncertainty
relative expanded measurement uncertainty

absolute value of the quotient of the expanded uncertainty and the associated measured value

NOTE The relative expanded uncertainty is not defined if the measured value is zero.

- **Metrology and meteorology.** The fruitful cooperation of JCGM-WG1 with the Expert Team on Measurement Uncertainty (ET-MU) of the World Meteorological Organisation (WMO) continues. Several presentations, joint and individual, were given at the BIPM-WMO joint workshop on Metrology for Climate Action in September 2022. Several abstracts involving WG1 members were also submitted to the workshop. Members of the WG1 are actively involved in joint activities with colleagues from meteorology and climatology. Abstract involving WG1 members will as well be submitted to the forthcoming 1st Stakeholder meeting of the CIPM Sectorial Task Group on Climate Change and Environment

PUBLICATIONS

Existing publications are listed below with their current titles. All the documents published prior to the new perspective will be revised and, if needed, updated in view of their publication as parts of the GUM suite.

JCGM 100:2008. Guide to the expression of uncertainty in measurement, GUM 1995, with minor modifications

Freely available in electronic (PDF) form from the websites of BIPM, OIML and ISO; published in paper form by ISO under the name "ISO/IEC Guide 98-3:2008".

JCGM 101:2008. Evaluation of measurement data — Supplement 1 to the "Guide to the expression of uncertainty in measurement" — Propagation of distributions using a Monte Carlo method

General method for measurement uncertainty evaluation, particularly relevant for measurement models with a high level of complexity, or to evaluate a coverage interval for a non-linear model or for non-normal input quantities. In these cases, the method, being more general than that described in JCGM 100, gives more reliable evaluations.

Freely available in electronic (PDF) form from the websites of BIPM, OIML and ISO; published in paper form by ISO under the name "ISO/IEC Guide 98-3:2008/Suppl 1:2008".

This document, suitably revised, will be re-published as GUM-7.

JCGM 102:2011. Evaluation of measurement data — Supplement 2 to the "Guide to the expression of uncertainty in measurement" — Extension to any number of output quantities

Generalization of JCGM 100 and JCGM 101 to the case of multivariate output quantities.

Freely available in electronic (PDF) form from the website of BIPM, OIML and ISO**;** published in paper form by ISO under the name "ISO/IEC Guide 98-3:2008/Suppl 2:2011".

This document, suitably revised, will be re-published as GUM-8.

JCGM 106:2012. Evaluation of measurement data — The role of measurement uncertainty in conformity assessment

Guidance document to calculate acceptance limits necessary to assess the conformity of an item to a specification.

Freely available in electronic (PDF) form from the websites of BIPM, OIML and ISO**;** published in paper form by ISO under the name "ISO/IEC Guide 98-4:2012".

This document was reviewed by the WG1 in view of its re-publication as GUM-4. It was decided that the document is technically sound and only needs some minor updates in order to include recent developments in the field. This task will be undertaken at a later stage.

JCGM GUM-6:2020. Guide to the expression of uncertainty in measurement — Part 6: Developing and using measurement models

This is the first document published as a part of the GUM under the new perspective. It provides guidance on developing and using a measurement model and covers the assessment of the adequacy of a measurement model. The document is of particular interest to developers of measurement procedures, working instructions and documentary standards.

Freely available in electronic (PDF) form from the websites of BIPM, OIML and ISO; published in paper form by ISO under the name "ISO/IEC Guide 98-6:2021"

SUPERSEDED DOCUMENTS

JCGM 104:2009. Evaluation of measurement data — An introduction to the "Guide to the expression of uncertainty in measurement" and related documents

Introductory document extensively hyperlinked to the other JCGM documents.

This document was succeeded by GUM-1, described above.

JCGM GUM-1:2023 Guide to the expression of uncertainty in measurement – Part 1: Introduction

In the new perspective, GUM-1 is the overarching document in the suite of documents under the common title "Guide to the expression of uncertainty in measurement" (GUM), providing a brief introduction to the suite. Its aim is to promote appropriate methods for the evaluation of measurement uncertainty by using the GUM. This document aids the reader in identifying the relevant documents with their new numbering for addressing the problem at hand. It contains hyperlinks to documents in the suite. It also provides references to other relevant material, including that from other organizations, for a broader understanding. This document replaces JCGM 104:2009.

Freely available in electronic (PDF) form from the websites of BIPM, OIML and ISO; published in paper form by ISO under the name "ISO/IEC Guide 98-1:2024".