Jordanian Accreditation System
نظام الاعتماد الأردني
Accreditation Unit

ACCREDITATION UNIT

POLICY FOR ESTIMATION OF MEASUREMENTS UNCERTAINTY & ITS IMPLEMENTATION

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Purpose

To demonstrate the procedure for estimation of measurements uncertainty and its implementation

Scope

Accreditation Unit (AU) requirements pertaining to measurement uncertainty are described. This document is intended for all AU accredited and enrolled calibration and testing laboratories.

Authorship

This publication has been written by the Technical Committee, and approved by the Accreditation Director.

Official language

The text may be translated into other languages as required. The English language version remains the definitive version.

Copyright

Further information

This policy is mandatory for laboratories, and shall be implemented within two months from its issuance date.
For further information about this publication, kindly contact AU.
This document is also available at our web site where you can check updates directly.

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1 Introduction

The formal definition of the term “uncertainty of measurement” is as follows:

“Non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used”. [6]

- Notes:
  1- The parameter may be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.
  2- Uncertainty of measurement comprises, in general, many components. Some of these components may be evaluated from the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.
  3- It is understood that the result of the measurement is the best estimate of the value of the measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standard, contribute to the dispersion.

2 Terms and Definitions

For the purpose of this document, the relevant terms and definitions given in the “International Vocabulary of Metrology – Basic and General Concepts and Associated Terms” (VIM) [6][7] and the following apply:

2-1 Calibration Laboratory

In this policy, "calibration laboratory" further means a laboratory that provides calibration and measurement services.

2-2 Calibration and Measurement Capability

Calibration and Measurement Capability (CMC) is a calibration and measurement capability available to customers under normal conditions as described in the laboratory’s scope of accreditation.

3 Estimation of Uncertainty of Measurement

According to ISO/IEC 17025:

3.1 A calibration laboratory, or a testing laboratory performing its own calibration, shall have and shall apply a procedure to estimate the uncertainty of measurement for all types of calibrations and measurements covered by their scope of accreditation. The estimated uncertainty of measurements shall comply with the "Guide to the expression of Uncertainty in measurement" (GUM), including the supplement documents and/or ISO Guide 35.

3.2 Testing laboratories shall have and shall apply procedures for estimating uncertainty of measurement. In certain cases the nature of the test method may preclude rigorous, metrologically and statistically valid, calculation of uncertainty of measurement. In these cases the laboratory shall at least attempt to identify all the components of uncertainty and make a reasonable estimation, and shall ensure that the form of reporting of the result does not give a wrong impression of the uncertainty. Reasonable estimation shall be based on knowledge of the performance of the method and on the measurement scope and shall make use of, for example, previous experience and validation data.

- Note:

  The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

  - The requirements of the test method.
  - The requirements of the client.
  - The existence of narrow limits on which decisions on conformance to a specification are based.

  In those cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied this clause by following the test method and reporting instruction.

3.3 When estimating the uncertainty of measurement, all uncertainty components which are of importance in the given situation shall be taken into account using appropriate methods of analysis.

3.4 The predicted long-term behavior of the tested and/or calibrated item is not normally taken into account when estimating the measurement uncertainty.

3.5 The required depth of the uncertainty estimations may be different in different technical fields. Factors to be taken into account include:

- Common sense.
- Influence of the result (appropriateness of the determination).
- Appropriateness.
- Classification of the degree of rigor in the determination of uncertainty of measurement.

4 Factors Contributing to Uncertainty of Measurement

The calibration and testing laboratory should take into consideration the different factors which may contribute to the overall uncertainty. Some examples are given below:

1- Definition of the measurand.
2- Sampling procedure.
3- Transportation, storage and handling of samples.
4- Preparation of samples.
5- Environmental and measurement conditions.
6- Human error.
7- Variation in the test procedure.
8- Measuring instruments.
9- Calibration standards or reference materials.
10- Software and/or, in general, methods associated with the measurement.
11- Uncertainty arising from correction of the measurement results for systematic effects.

4 Policy on the Implementation of the Concept of Uncertainties

5.1. Only uncertainty of measurement in calibration and quantitative testing are considered for the time being. A strategy on handling results from qualitative testing has to be developed later.

5.2. Uncertainty of measurement has to be taken into account when testing procedures and/or testing results are compared with each other or against specification.

5.3. An understanding of the concept of uncertainty of measurement is important in order to choose the testing methods that are fit for purpose.

5.4. The overall uncertainty of measurement should be consistent with the given requirements.

5.5. The economic aspects related to the methods have always to be taken into consideration.

5.6. Testing laboratories must report uncertainty estimates where specified by the method, where required by the client and/or where the interpretation of the result could be compromised by a lack of knowledge of uncertainty. This should at least be the case where testing results have to be compared to other testing results or other numerical values, such as specifications.

5.7. In any case, the testing laboratories should know the uncertainty associated with a measurement whether it is reported or not.

5.8. As a general rule, the implementation of the concept of uncertainty of measurement should go in line with the implementation of ISO/IEC 17025.

5.9. It is understood that there are some areas where the implementation of uncertainty is difficult to apply. In these cases, the laboratory should try to develop an acceptable procedure for the estimation of uncertainty.

5.10. Where uncertainty calculations are applicable, it is required that testing and calibration laboratories calculate measurement uncertainty in accordance with the "ISO Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation (ISO 21748:2010)" **as well as UKAS Guideline M3003 (Expression of Uncertainty and Confidence in Measurement) and European Guideline EA-4/02 (Evaluation of the Uncertainty of Measurement in Calibration).** These uncertainties must be supported by uncertainty budgets, and they will be represented as expanded uncertainties typically using a coverage factor of k=2 to give approximately 95% confidence level.

5.11. If a calibration certificate or testing report contains a statement of the measurement result and the associated uncertainty, then the uncertainty statement must be accompanied by an explanation of the meaning of the uncertainty statement. An example of such an explanation might be the statement "Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2". Statements of uncertainty which do not specify at least the coverage factor and the

confidence level are incomplete and they are inadequate for the purpose of demonstrating that measurement traceability has been achieved.

5.12. Calibration Laboratories have to calculate their CMC (Calibration and measurement capability); this has to be calculated and will be checked and approved completely during initial assessment and frequently during surveillance. The CMC will be noted on the annex of the accreditation certificate for the scope (e.g. for customer information). Calibration laboratories have to give a statement of measurement uncertainty of the calibration on each calibration certificate.

When using a standard test method there are three cases:

- When using a standardized test method, which contains guidance to the uncertainty evaluation, testing laboratories are not expected to do more than to follow the uncertainty evaluation procedure as given in the standard.
- If a standard gives a typical uncertainty of measurement for test results, laboratories are allowed to quote this figure if they can demonstrate full compliance with the test method.
- If a standard implicitly includes the uncertainty of measurement in the test results there is no further action necessary.

Testing laboratories should not be expected to do more than take notice of, and apply the uncertainty-related information given in the standard, i.e. quote the applicable figure, or perform the applicable procedure for uncertainty estimation. Standards specifying test methods should be reviewed concerning estimation and statement of uncertainty of test results, and revised accordingly by the standards organization.

6 Example of guidance document:

- UKAS M3003, ***edition 3: September 2012***, available from www.ukas.com
- EA-4/02 ***M: 2013***, Expression of the Uncertainty of Measurement in Calibration, available from www.european-accreditation.org.

7 References

[1] ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.

[2] ILAC-G17:2002, Introducing the concept of uncertainty of measurement in testing in association with the application of the standard ISO/IEC 17025.

[3] A2LA Policy on measurement traceability, October 2003.

[4] ISO Guide 35:2006, Reference materials – General and statistical principles for certification.

[5] JCGM 100:2008 GUM 1995 with minor corrections, Evaluation of measurement data – Guide to the expression of uncertainty in measurement. (Available from www.BIPM.org).

[6] ISO/IEC Guide 99:2007, International vocabulary of metrology - Basic and general concepts and associated terms (VIM).

[7] JCGM 200:2012 International vocabulary of metrology – Basic and general concepts and associated terms (VIM) (Available from www.BIPM.org).

[8] ILAC-P14:01/2013ILAC Policy for Uncertainty in Calibration