**PL SM 7.1-01-2023**

**POLICY ON**

**MEASUREMENT UNCERTAINTY OF THE**

**RESULTS PROVIDED BY ACCREDITED LABORATORIES**

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*This document defines the policy of the Republican Unitary Enterprise "Belarusian State Accreditation Center" (hereinafter - BSCA , accreditation body) regarding the expression of measurement uncertainty of results issued by accredited laboratories.*

*The policy applies to the activities of the BSCA and accredited laboratories.*

This Policy has been developed taking into account the requirements of international documents:

ILAC-P14:09 ILAC Policy for Measurement Uncertainty in Calibration;

EA-4/02 M Evaluation of the Uncertainty of Measurement in calibration”;

ILAC-G17:01 ILAC Guidelines for Measurement Uncertainty in Testing;

ILAC-G8:09 Guidelines on Decision Rules and Statements of Conformity.

Measurement uncertainty is a non-negative parameter that characterizes the dispersion of quantity values assigned to the measured quantity based on the information used.

Calibration and testing laboratories must be aware of the accuracy characteristics of their calibration and test methods and apply procedures for assessing measurement uncertainty in relation to the quantitative measurement methods included in their scope of accreditation.

**1** BSCA assesses the competence of its accredited calibration and testing laboratories in performing measurement uncertainty assessments for calibrations and tests included in their scope of accreditation, excluding non-quantitative methods.

**2** When conducting a competency assessment, the BSCA must ensure that accredited calibration laboratories conduct measurement uncertainty assessments in accordance with the Guide to the Expression of Uncertainty of Measurement (GUM) and/or [GOST ISO Guide 35-2015](http://ips/TnpaDetail.php?UrlId=491138) .

As a document agreed with GUM and harmonized with ILAC - P 14:09, EA -4/02 M , BSCA applies STB 8077-2017 (EA-4/02 M:2022, NEQ) (ILAC-P14:09/2020 , NEQ) in developing mandatory criteria and practical recommendations to ensure that BSCA accredited laboratories performing calibration activities assess measurement uncertainty in accordance with GUM ( [GOST 34100.3-2017/ISO/IEC Guide 98-3:2008](https://tnpa.by/#!/DocumentCard/379098/521347) ) [[1]](#footnote-1)as this is required by policy ILAC-P14:09.

**3 Formation of the scope of accreditation of calibration laboratories**

**3.1** The scope of accreditation of a BSCA-accredited calibration laboratory includes calibration and measurement capabilities available to customers under normal conditions (CMC) in the form of:

* codes of objects/types of calibration and names of measured quantities */standard samples;*
* calibration objects (names of measuring instruments/ *material* subject to calibration */measurement);*
* measurement range and, if necessary, additional parameters (for example, frequency of applied voltage);
* expanded measurement uncertainty U with a certain coverage coefficient and coverage probability;
* documents establishing calibration methods [[2]](#footnote-2).

**3.2** There shall be no ambiguity in the expression of the CMS in the field of accreditation and the smallest measurement uncertainty that can be achieved by the laboratory during the performance of calibrations or measurements.

**3.3** In cases where the quantity being measured is within a range of values or within a range of values, then one or more of the following methods shall be used to express uncertainty:

* a single value that is valid over the entire measurement range;
* measurement range. In such a case, the calibration laboratory must ensure that linear interpolation is appropriate [[3]](#footnote-3)to find the uncertainty at intermediate values;
* explicit function of the measured quantity and/or parameter;
* a matrix where the uncertainty values depend on the values of the measured quantity and additional parameters;
* a graphical representation that provides resolution on each coordinate axis to provide at least two significant figures of uncertainty.

**3.4** Open intervals (for example, "0<U<x" or "for a
resistance interval of 1 ohm to 100 ohms, the uncertainty is set to less than 2 µohm /ohm") are not allowed in CMC expressions.

**3.5** The uncertainty included in the VMS should be expressed as an expanded uncertainty having a probability of coverage of approximately 95%.

The units of measurement of uncertainty, as a rule, must correspond to the units of the measured quantity or be relative to it (for example, %, μV/V or dimensionless relative quantities, for example, 10 -6 ). Due to the ambiguity of definitions, the use of ppm and ppb is not recommended [[4]](#footnote-4).

**3.6** The stated CMCs must include components from the best available equipment to be calibrated so that the stated CMCs are readily implementable.

*Note 1: The term “best available equipment” refers to the equipment to be calibrated that is commercially or otherwise available to purchasers, even if it has special characteristics (stability) or has a long calibration history.*

*Note 2: When it is possible that the best available equipment may have uncertainty contributions associated with repeatability equal to zero, this value may be used in estimating the CMC. However, it is necessary to include other fixed uncertainties associated with the best existing equipment.*

*Note 3: In exceptional cases, such as the presence of a very limited number of CMCs in the KCDB, it is recognized that “best available equipment” does not exist and/or the uncertainty contributions attributed to the equipment may significantly influence the uncertainty. If such equipment contributions to uncertainty can be separated from other contributions, then such equipment contributions can be excluded from the CMC. However, in such a case, the scope of accreditation should clearly state that uncertainty contributions from equipment are not included.*

**3.7** In the case where the laboratory provides services for establishing (assigning) values of quantities to reference materials, the uncertainty included in the CMC should, as a rule, contain factors associated with the measurement procedure as it will be performed on the sample, i.e. Typical matrix effects, interference, etc. must be considered. The uncertainty included in the CMS generally does not include contributions arising from instability or heterogeneity of the sample/material. The CMC should be based on an analysis of the assigned method characteristics for stable and homogeneous samples.

*Note: The uncertainty described in the CMS when assigning values to reference materials is not identical to the uncertainty associated with the reference material provided by the reference material manufacturer. The expanded uncertainty of a certified reference material will generally be higher than the uncertainty described by the CMC assigned to the values of the reference material quantities.*

**4 BSCA policy on indicating measurement uncertainty in calibration certificates**

**4.1** Accredited calibration laboratories in the calibration certificates they issue must present measurement uncertainty in accordance with the requirements of the GUM Guide , paragraphs 4.2 - 4.6 of this Policy, and, in the case of calibration of measuring instruments for the purpose of their application in the field of legal metrology and use in accredited testing laboratories (centers), declare the compliance of the measuring instrument based on calibration results with mandatory metrological requirements [[5]](#footnote-5)).

**4.2 The measurement result** shall include the value of the quantity **y and** the associated expanded measurement uncertainty **U.** In the calibration certificate (certificate), the measurement result must be presented in the form y **± U** together with the units of measurement **y** and **U. The measurement result can be presented in the form of a table; if necessary, the relative expanded uncertainty U/|y|** can also be given. . The calibration certificate must indicate the coverage factor and the probability of coverage. An explanatory note should be added to them as follows:

*“The expanded uncertainty is obtained by multiplying the total standard uncertainty by the coverage factor k=\_\_\_\_, corresponding to a probability of coverage approximately equal to \_\_\_\_% assuming a \_\_\_\_\_\_\_\_\_\_\_ distribution. The assessment of measurement uncertainty is carried out in accordance with the Guide to the Expression of Uncertainty of Measurement ( GUM )* ."

*Note: Asymmetric uncertainties may require representation in a form other than y ± U. This also applies when the uncertainty is determined using Monte Carlo (transformation of distributions) or in logarithmic units.*

**4.3** The numerical value of the expanded uncertainty should be given to no more than two significant figures. If it is necessary to round a measurement result, this rounding must be applied after all calculations have been completed and only then can the resulting values be rounded when presented. The rounding process should use the normal rules for rounding numbers contained in rounding guidelines, including those found in the GUM.

**4.4** The uncertainty contributions given in the calibration certificate shall include relevant short-term contributions arising during the calibration process and contributions that can be reasonably attributed to the customer's equipment. Where appropriate, the uncertainty shall cover the same uncertainty contributions considered in the uncertainty assessment presented in the CMC, except that the uncertainty contributions estimated for the best existing equipment shall be replaced by those associated with the customer's equipment.

Therefore, the uncertainties indicated in the calibration certificate (certificate) are, as a rule, greater than the uncertainty presented in the CMS. Contributions that cannot be known to the laboratory, such as uncertainties associated with transportation, are generally not included in the reported uncertainty. However, if the laboratory expects that such contributions will have a significant impact on the uncertainties attributed to the laboratory, the user should be notified in accordance with the sections of ISO/IEC 17025 concerning the consideration of requests, tenders and contracts.

**4.5** As defined by the CMC, accredited calibration laboratories must not indicate in their calibration certificates an uncertainty that is less than the uncertainty presented in the CMC for the scope of the laboratory accreditation.

**4.6 \_** In accordance with the requirements of GOST ISO/IEC 17025 (ISO/IEC 17025), accredited calibration laboratories must present measurement uncertainty using the same units as for the measurand, or in a relative form with respect to the measurand (for example, as a percentage).

**5 BSCA Policy on Expression of Uncertainty by Testing Laboratories**

**5.1** Understanding measurement uncertainty is important for laboratories, their customers and all interested parties who use measurement results obtained using quantitative methods in assessing the conformity of a test item.

**5.2** Measurement uncertainty is influenced by statistical and systematic factors. Where possible, the influence of systematic factors should be reduced.

The degree of care in calculating uncertainty depends on the following:

* test/measurement method requirements;
* customer requirements;
* interpretation of the results in the event of a decision being made on the compliance of the test object with the established requirements.

**5.3** Methods for assessing measurement uncertainty for test methods included in the scope of accreditation are developed directly in the laboratory, taking into account all contributions to uncertainty.

**5.4**Consideration should be given to the various sources of uncertainty that may affect the overall standard measurement uncertainty (but, in many cases, not all of these are explicit).

These factors may be:

* determination of measured quantities (parameters) of an object (tests/measurements);
* sampling/sampling;
* transportation, storage and handling of specimens/samples;
* sample/sample preparation;
* environmental and measurement conditions;
* testing personnel;
* measurement techniques;
* measuring equipment;
* certified and control samples;
* software used as part of the measurement methodology.

**5.5** While some laboratories may use the GUM Guide to Measurement Uncertainty ( [GOST 34100.3-2017/ISO/IEC Guide 98-3:2008](https://tnpa.by/#!/DocumentCard/379098/521347) ) 1 or similar documents, the BSCA recognizes that there is a wide range of applications for the documents for estimating measurement uncertainty in the tests specified in section 5 of ILAC-G17:01, which are defined in a specific test area at the international or national level.

For example, EURACHEM/CITAC, EUROLAB and Nordtest have some documents on measurement uncertainty, including the measurement of uncertainty arising during the sampling process. Other fields, such as microbiology, may also include papers on estimating measurement uncertainty.

In some areas of testing in which uncertainty cannot be expressed as expanded uncertainty for test results (for example, qualitative testing or research), other ways of estimating measurement uncertainty, such as the probability of a false positive or false negative test result, may be more relevant.

1. *On the territory of the Republic of Belarus, GUM operates in the form of* [*GOST 34100.3-2017/ISO/IEC Guide 98-3:2008*](https://tnpa.by/#!/DocumentCard/379098/521347) *Measurement uncertainty. Part 3: Guidance on expressing measurement uncertainty.* [↑](#footnote-ref-1)
2. *When performing calibration work for the purpose of using measuring instruments in the field of legal metrology and use in accredited testing laboratories (centers) in accordance with the Resolution of the State Committee for Standardization of the Republic of Belarus dated April 23, 2021 No. 42 “On approval of the Rules for the implementation of metrological assessment in the form of work on calibration of measuring instruments”, calibration methods established by international, interstate and state standards, as well as calibration methods developed by authorized legal entities for calibration based on a hierarchical calibration scheme, can be used as calibration methods.* [↑](#footnote-ref-2)
3. *By applying the least squares method according to the recommendations of GOST 34100.1-2017/ISO/IEC Guide 98-1:2009, JCGM 107 Evaluation of measurement data. Application of the least squares method (under development).* [↑](#footnote-ref-3)
4. *When expressing measurement uncertainty, it is necessary to take into account the provisions* [*of the Resolution of the Council of Ministers of the Republic of Belarus dated November 24, 2020 No. 673 “ On units of quantities approved for use in the Republic of Belarus ” .*](http://www.oei.by/pagevalues/view?model_id=4&node_id=116) [↑](#footnote-ref-4)
5. *The need to draw up a conclusion on compliance is determined by Resolution of the State Committee for Standardization of the Republic of Belarus dated April 23, 2021 No. 42 On approval of the Rules for metrological assessment in the form of calibration of measuring instruments.* [↑](#footnote-ref-5)