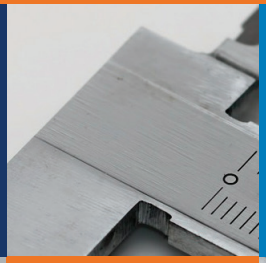
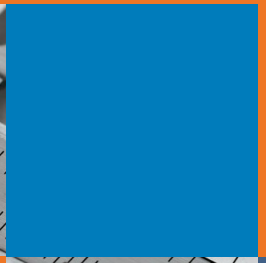




Calibration Program Handbook

Message from A2LA

Thank you for your interest in A2LA and the Calibration Program.

For our new visitors, Welcome!

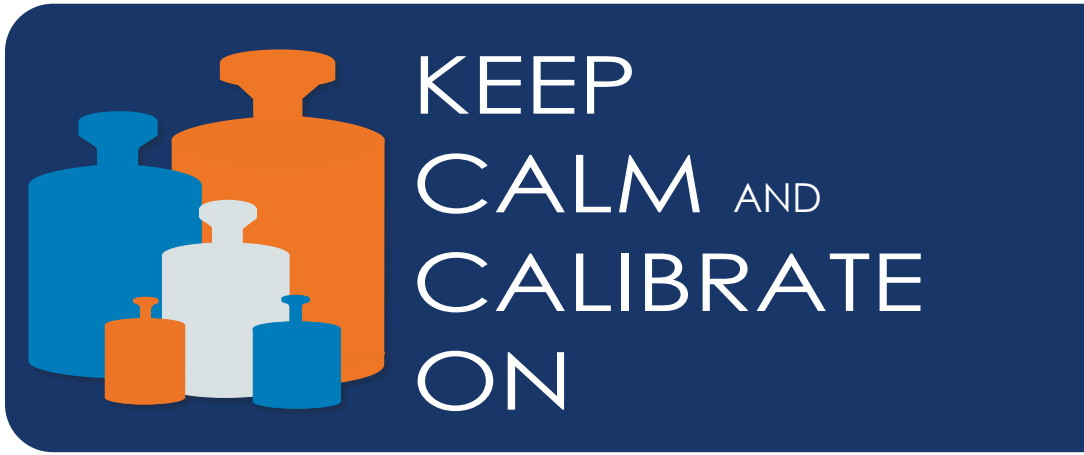
A little bit about who we are...A2LA is a non-profit, non-governmental, third-party accreditation body, offering internationally recognized accreditation services to testing and calibration laboratories, sampling organizations, inspection bodies, proficiency testing providers, reference material producers and product certifiers. We are the largest and most well-recognized accreditor of calibration laboratories in the United States.

A2LA's calibration program was established in 1988. We are proud to be part of the mission to promote and improve the field of metrology. We participate by accrediting calibration laboratories to the requirements of ISO/IEC 17025 and additional A2LA calibration program requirements. This helps to ensure that metrological traceability is being disseminated appropriately from measurement to measurement from the SI to the end user of the measurement chain.

This handbook provides guidance to our end-users on A2LA's accreditation process, required documentation associated with the calibration program, and all related technical guidance that has been developed by the A2LA Measurement Advisory Committee.

For our current customers

We really hope you like this 'one stop' of all the A2LA requirements, calibration program requirements, and guidance documentation. Many of you have requested developing something that "housed" all documents relevant to calibration laboratories, and we felt this was the best resource to generate.



What is in this handbook?

- Definitions
- A2LA Accreditation Process
- R205 – Specific Requirements – Calibration Laboratory Accreditation Program
- Guidance Documents
    a. General Guidance
    b. Dimensional Discipline Guidance
    c. Electrical Discipline Guidance
    d. Mechanical/Thermodynamics Discipline Guidance
- References

Definitions

In this handbook, the relevant terms and definitions given in ISO/IEC 17000 and the VIM apply. General definitions related to quality are given in Q9000, whereas ISO/IEC 17000 gives definitions specifically related to conformity assessment. Where different definitions are given in Q9000, the definitions in ISO/IEC 17000 and the VIM are preferred.

Accreditation (ISO/IEC 17000:2020, clause 7.7): third party attestation related to a conformity assessment body conveying formal demonstration of its competence, consistent operation and impartiality in performing specific conformity assessment activitities.

Accreditation Body (AB) (ISO/IEC 17000 clause 4.7): Authoritative body that performs accreditation.

Accredited (A2LA): When a Conformity Assessment Body (CAB) is granted accreditation by an accrediting body (e.g. A2LA) that is a signatory to the ILAC mutual recognition arrangement (MRA).

Best Existing Device (ILAC P14 4.3 Note 1): is defined as a device to be calibrated that is commercially or otherwise available for customers, even if it has a special performance (stability) or has a long history of calibration[1].

Bureau International des Poids et Mesures (BIPM https://www.bipm.org/en/about-us/): The task of the BIPM is to ensure world-wide uniformity of measurements and their traceability to the International System of Units (SI). It does this with the authority of the Convention of the Metre, a diplomatic treaty between fifty-five nations, and it operates through a series of Consultative

[1] Adapted from *ILAC P14:01/2013 ILAC Policy for Uncertainty in Calibration* https://ilac.org/?ddownload=123348

Committees, whose members are the national metrology laboratories of the signatory States, and through its own laboratory work.

The BIPM carries out measurement-related research. It takes part in, and organizes, international comparisons of national measurement standards, and it carries out calibrations for Member States.

BIPM Key Comparison Database (KCDB) (http://bipm.org/kcdb/): supports the Mutual Recognition Arrangement of the CIPM (CIPM MRA) of national measurement standards and of calibration and measurement certificates issued by national metrology institutes. The technical basis of the arrangement is the set of results obtained in the course of time through key comparisons carried out by the Consultative Committees of the CIPM, the BIPM and the regional metrology organizations (RMOs) and published by the BIPM and maintained in the key comparison database. Detailed technical provisions are given in the Technical Supplement to the arrangement.

Calibration and Measurement Capability (CMC)[2]: A CMC per the CIPM MRA-D-04, Calibration and Measurement Capabilities in the context of the CIPM MRA is a calibration and measurement capability available to customers under normal conditions:

a) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement; or

b) as published in the BIPM[3] key comparison database (KCDB) of the CIPM MRA[4].

Calibration and Measurement Capability Uncertainty (A2LA): The uncertainty of measurement described on a scope of accreditation under normal conditions.

Conformity Assessment Body (CAB)[5]: a body that performs conformity assessment activities.

NOTE: Whenever the acronym "CAB" is used, it applies to both the applicant and accredited CABs unless otherwise specified.

Dimensional Testing (A2LA): the measurement of geometric characteristics of parts or products to determine compliance with design specifications.

ILAC Mutual Recognition Arrangement (MRA) (https://ilac.org/ilac-mra-and-signatories/): The ILAC Arrangement provides significant technical underpinning to international trade. The key to the Arrangement is the global network of accredited testing and calibration laboratories, inspection bodies and proficiency testing providers that are assessed and recognized as being competent by ILAC Arrangement signatory accreditation bodies. The signatories have, in turn, been peer-reviewed and shown to meet ILAC's criteria for competence. Now that the ILAC Arrangement is in place, governments can take advantage of it to further develop or enhance trade agreements. The ultimate aim is increased use and acceptance by industry as well as government of the results from accredited laboratories and inspection bodies, including results from facilities in other countries. In this way, the free-trade goal of "a product tested or inspected once and accepted everywhere" can be realized.

Measurand (VIM3 clause 2.3): Quantity intended to be measured.

[2] Per the CIPM MRA-D-04, *Calibration and Measurement Capabilities in the context of the CIPM MRA*, Version 4 October 2013.

[3] For the BIPM KCDB see http://kcdb.bipm.org/AppendixC/country_list_search.asp?page=1&pge=4&CountSelected=US&type=T

[4] For the CIPM MRA see http://www.bipm.org/en/cipm-mra/

[5] ISO/IEC 17011:2017

Measurement Uncertainty (VIM3 clause 2.26): Non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used.

Metrological Traceability[6]: property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty.

Reference Measurement Standard (VIM3 clause 5.6): measurement standard designated for the calibration of other measurement standards for quantities of a given kind in a given organization or at a given location.

Significant (A2LA): "significant" further means a contributor whose contribution increases the CMC by five percent (5%) or greater.

Standard Contributor (A2LA): "standard contributor" refers to those items outlined in R205 Calibration Program Requirements.

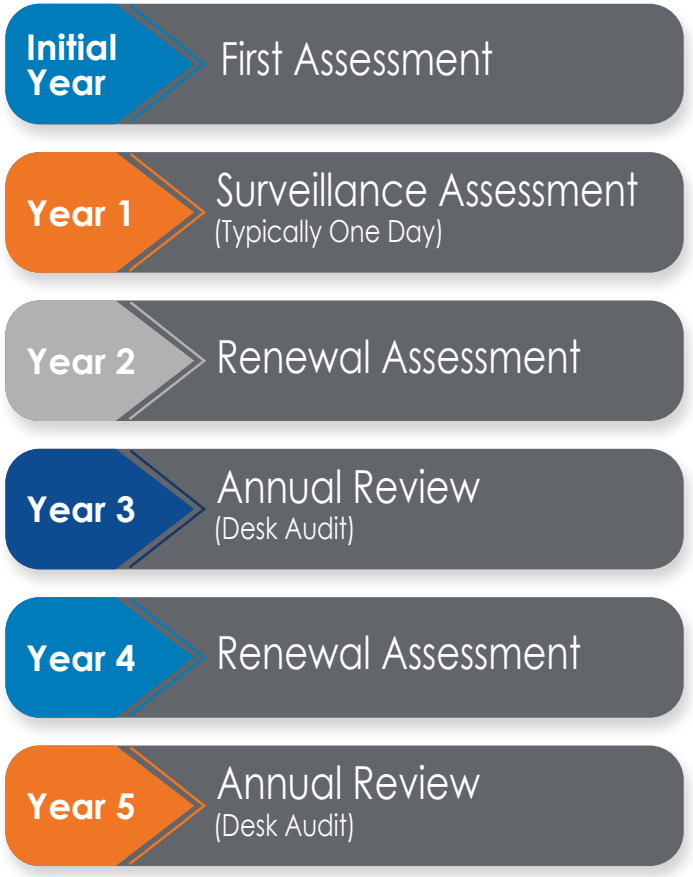
Umbrella Accreditation: A form of field service accreditation whereby an accredited laboratory contracts with another party, usually their authorized dealers or representatives, to provide accredited testing or calibration service on their behalf and who serves as a De facto field service employee of the accredited laboratory.

[6] Per JCGM 200:2012 International vocabulary of metrology – Basic and general concepts and associated terms (VIM) 3rd edition.

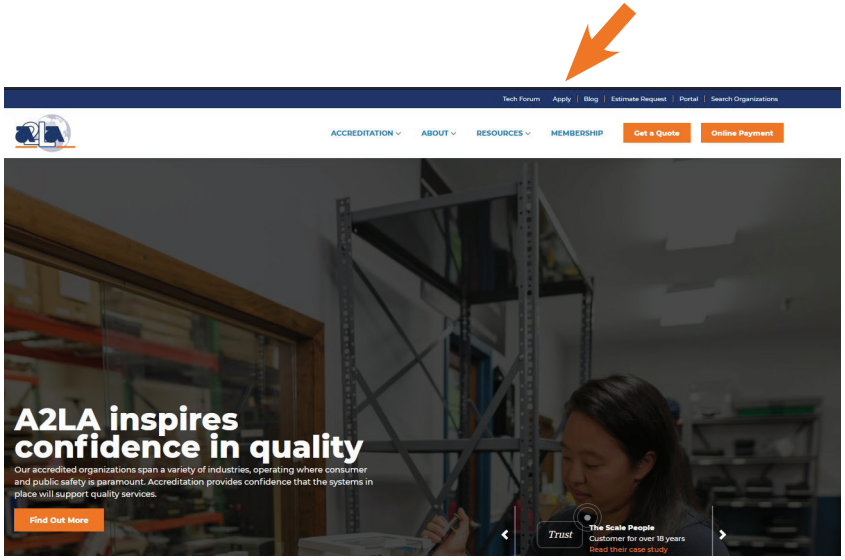
A2LA Accreditation Process

Accreditation at A2LA requires a yearly activity beginning with an initial assessment. When an organization becomes accredited, they are referred to as a Conformity Assessment Body (CAB). After the initial assessment, a two (2) year anniversary (expiration) date is established. Renewal assessments are to be completed every two (2) years with Annual Reviews to be completed in the off years.

Overall Accreditation Cycle



The first step in applying toward accreditation is to submit the application through the A2LA.org website by clicking 'apply'.



After the submission of supplemental documentation through the customer portal, we will then propose the technical assessor(s) to your organization. If accepted, the assessor will then be assigned to your organization and will contact you directly to schedule the assessment.

During the assessment, your organization will be assessed to the following requirements:

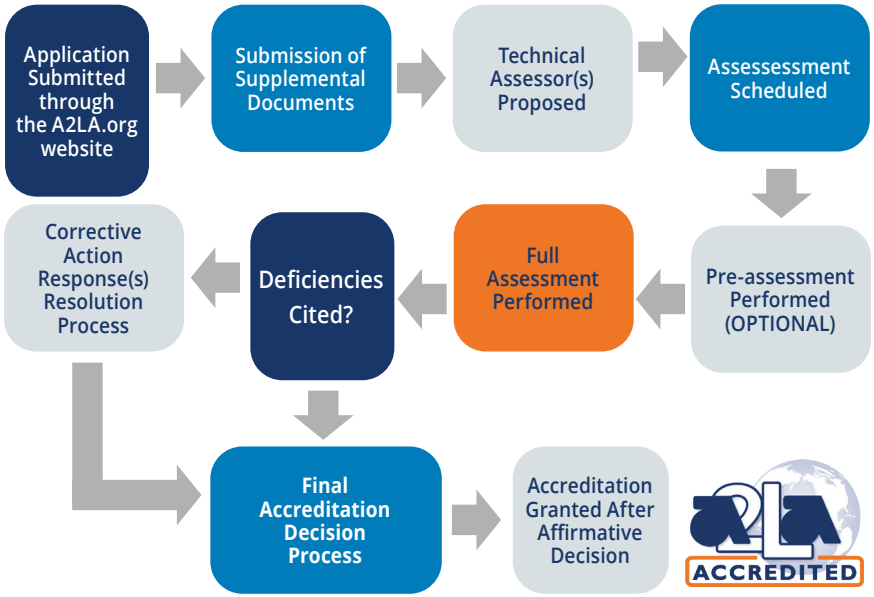
- *ISO/IEC 17025:2017*
- *R205 – Specific Requirements – Calibration Laboratory Accreditation Program*
- *R103 – General Requirements – Proficiency Testing for ISO/IEC 17025 Laboratories*
- *R105 – Requirements When Making Reference to A2LA Accredited Status*
- *P102 – Policy on Metrological Traceability*

Once the onsite assessment is performed, there are two different paths that your organization may follow:

If there are no deficiencies, the assessment package provided to A2LA by the technical assessor will be sent directly to the Accreditation Council for vote. The Accreditation Council are members who are primarily responsible for reviewing assessment reports and recommending accreditation decisions on A2LA applicants.

If there are deficiencies, your organization will enter the corrective action process. Here you will begin to address the deficiencies. We ask that you resolve the findings before sending to the Accreditation Council.

Once accreditation votes and payments are received, you will receive your accreditation.



**For more information and a more detailed breakdown of the different types of assessments, please refer to I105 – Typical Steps in Preparing for the Accreditation Process.*

R205 –

Specific Requirements – Calibration Laboratory Accreditation Program

INTRODUCTION

These accreditation requirements are applicable to laboratories applying within the general A2LA Field of Calibration. The Calibration field includes measurements typically conducted by standards and calibration laboratories for a variety of measurement quantities. This program is applicable to all types of calibration laboratories, including those that calibrate reference measurement standards as well as measuring and test equipment (M&TE).

In addition, with the publication of the American National Standard ANSI/NCSL Z540, A2LA offers the option of including **ANSI/NCSL Z540-1** in a calibration laboratory's accreditation, particularly in cases where a laboratory's customers require it. A2LA also offers the option of including **ANSI/NCSL Z540.3** in a calibration laboratory's accreditation, particularly for those seeking to meet the requirements of the United States Navy and NASA. See APPENDIX A and B of R205 for more information.

POLICIES

A2LA has developed policies for all of its accredited laboratories related to measurement traceability, measurement uncertainty, proficiency testing, and references to accredited status. The following policies apply to the field of Calibration:

- **Measurement Traceability:**

  P102 - Policy on Metrological Traceability

- **References to Accredited Status:**
  R105 - Requirements When Making Reference to A2LA Accredited Status

- **Proficiency Testing Policy:**
  R103 - General Requirements – Proficiency Testing for ISO/IEC 17025 Laboratories

- **Measurement Uncertainty:**
  See R205 Calibration Program Requirements section for both the measurement uncertainty that supports the scope of accreditation and for the uncertainty reported to the customer.

- **Flexible Scopes of Accreditation (when applicable):**

  P112 - Policy on Flexible Scopes

GENERAL CRITERIA

The general criteria for accreditation within the field of Calibration are contained in ISO/IEC 17025:2017, "General requirements for the competence of calibration and testing laboratories". All provisions of these general criteria and the requirements outlined in R101 - General Requirements for Accreditation of ISO/IEC 17025 Laboratories apply under this field.

CALIBRATION PROGRAM CRITERIA

The additional criteria for accreditation of calibration laboratories are:

Technical Decisions

The final decision on technical matters is made by A2LA. See R101 – General Requirements: Accreditation of ISO/IEC 17025 Laboratories for information on appeals.

Calibration Intervals

Calibration intervals for each measuring instrument or standard shall be established to control the probability of calibrations being out-of-tolerance at the end of the calibration interval. The method[7] used to establish and adjust intervals shall be documented and based upon a determination of the standard's performance. Equipment records shall include the measured value for each parameter found to be out of tolerance during calibration or verification.

Accredited Calibration Certificates

1) The laboratory shall meet the requirements of ILAC P14:09/2020 Policy for Uncertainty in Calibration section 5.1 to 5.6.
2) An indiscriminate use of the CMC listed on the A2LA scope of accreditation as the uncertainty of an actual calibration is not justified.

Statements of Compliance

Laboratories are permitted to issue certificates with a statement of compliance (e.g. conformance to a specification) relating to the metrological aspects of specifications. In such cases the laboratory shall ensure that:

1) The specification is a national or international standard or one that has been agreed to or defined by the customer;
2) The measurements needed to determine conformance are within the accredited scope of the laboratory;
3) When parameters are verified to be within specified tolerance, the associated uncertainty of the measurement result is properly taken into account with respect to the tolerance by a documented procedure or policy implemented by the laboratory that defines the decision rules used by the laboratory for declaring in or out-of-tolerance conditions;
4) The laboratory shall ensure the decision rule used meets the needs of the customer[8];
5) The calibration laboratory shall retain documentary evidence of the measured quantity value and the uncertainty of measurement, as specified in ISO/IEC 17025:2017 clause 7.8.4 and shall provide such evidence upon request;
6) The certificate relates only to metrological quantities and states which clauses of the specification are verified to have been met.

Method or Parameter Observation During an Assessment

At a minimum, all of the parameters or all of the method(s) on the draft scope of accreditation must be observed by the assigned assessor during the assessment at least once in a four-year period.

[7] See NCSL International *RP-1: Establishment and Adjustment of Calibration Intervals (2010)* and ILAC G24:2007 Guidelines for the determination of calibration intervals of measuring instruments for more information.

[8] See ILAC G8:09/2019 Guidelines on Decision Rules and Statements of Conformity. JCGM 106:2012, *The role of measurement uncertainty in conformity assessment,* ISO/TR 14253-6:2012, *Generalized decision rules for the acceptance and rejection of instruments and workpieces,* ISO 14253-1:1998, *Decision rules for proving conformance or non-conformance with specifications,* ASME B89.7.3.1-2001, *Guidelines for decision rules: considering measurement uncertainty in determining conformance to specifications* for guidance.

1) If a parameter or method is not observed by the assigned assessor within a four-year period, that method or parameter will be removed from the scope of accreditation until such a time as it can be observed.

2) If a laboratory can demonstrate successful participation in a commercially available proficiency test or a well-organized inter-laboratory comparison that meets the requirements of ISO/IEC 17043, ***at the level of uncertainty being claimed on the draft scope of accreditation,*** the laboratory may rely on this demonstration in lieu of an observed parameter during the assessment.

NOTE 1: Equipment out for repair or calibration is not sufficient reason to grant an exception request.

NOTE 2: In cases where it is not possible to observe a parameter or method an exception request may be submitted to A2LA for consideration. Exception requests granted by A2LA are only granted until the next renewal assessment.

Review of Calibration Certificates

The laboratory shall implement a procedure for issuing accredited (endorsed) calibration certificates. The procedure shall ensure that these calibration certificates are evaluated for compliance with ISO/IEC 17025 and A2LA requirements before being issued to the customer including (but not limited to):

- Review of items required from the contract (e.g. method agreed on, indication of limited calibration when applicable, provision of data, accredited symbol etc.);
- Inclusion of before and after data when the instrument requires adjustment or repair;
- Identification of sub-contracted results and/or non-accredited results (e.g. those not included in the scope of accreditation);
- The measurement uncertainty is not smaller than the CMC claim on the scope of accreditation.

Requirements for CMC Uncertainty Calculations on the Scope of Accreditation

You can download a copy of our MU budget template at the link below.

G129 – Measurement uncertainty budget template

CMC Uncertainty Contributors

1) Every CMC uncertainty shall take into consideration the following standard contributors, even in cases where they are determined to be insignificant, and documentation of the consideration shall be made:

- Repeatability (Type A)
- Resolution
- Reproducibility
- Reference Measurement Standard Uncertainty
- Reference Measurement Standard Stability
- Environmental Factors

NOTE: It should be noted that scope components such as resolution, may also contribute to other components such as repeatability. Therefore, simply combining all components on an equal basis could result in an overstatement of the measurement uncertainty.

2) The CMC uncertainty shall also:

   - Include those significant contributors that apply to the measurement.
   - Include those significant contributors required by a method/procedure associated with the measurement.

General Considerations

1) The data from which the origin of the CMC uncertainty was determined shall be documented and the assumptions made for the determination of the uncertainty shall be specified and documented.

2) The statistical analysis shall be in accordance with the *Guide to the Expression of Uncertainty in Measurement* (GUM)[9].

[9] BIPM JCGM 100:2008, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement (GUM 1995 with minor corrections)*.

Scopes of Accreditation

1) The laboratory shall meet the requirements of ILAC P14:09/2020 ILAC Policy for Uncertainty in Calibration section 4.1 to 4.4.

2) Organizations are not permitted to claim a Calibration and Measurement Capability (CMC) on their scope of accreditation that is smaller than the CMC claimed by the National Metrology Institute (as stated in the key comparison database listed on the BIPM website) through which traceability is achieved unless allowance is made by A2LA. For those parameters approved, the laboratory shall use the following footnote on the scope of accreditation:

   > "The CMC claim is smaller than that of the expanded uncertainty claim for (*insert name of NMI*) as listed in the BIPM Key Comparison Database. A2LA has evaluated the laboratory's CMC claim and has verified this information to be correct and appropriate."

   NOTE: A2LA may also accept uncertainties smaller than the NMI's "commercial" uncertainty that is provided to its own customers on a case-by-case basis.

3) The numerical value of the CMC shall be expressed on the scope of accreditation in accordance with ILAC P14:01/2013 ILAC Policy for Uncertainty in Calibration section 6.3.

4) The final decision on what constitutes "ambiguity" on expression of the CMC and on all content and editorial concerns of the scope of accreditation is made by A2LA. For more information on Calibration Scopes of Accreditation see A2LA G118 - Guidance for Defining the Scope of Accreditation for Calibration Laboratories.

5) Scopes of accreditation must contain the information required by ISO/IEC 17011:2017 section 7.8.3. However, A2LA's P112 - Policy on Flexible Scopes allows for the name/title of the method or procedure to be omitted from a calibration laboratory's scope of accreditation. The name/title of the method or procedure is recorded as part of the assessment and retained by A2LA for future reference. ISO/IEC 17011:2017 section 7.8.4 requires that any information not included on the scope of accreditation per section 7.8.3 be available upon request.

   As such, by participating in the A2LA Calibration Program organizations have consented to permit A2LA to provide the name/title of the method or procedure to requesting parties. If the name/title of the method or procedure is not included on the scope of accreditation A2LA will provide the name/title of the method or procedure used to support that measurement parameter to the requesting party. No confidential information is provided regarding the method or procedure, only the name/title which would have appeared on the scope of accreditation per ISO/IEC 17011:2017 section 7.8.3. Please note that this is a new requirement and all Accreditation Bodies compliant to the new standard will have to meet this requirement. A2LA will transition all Scopes of accreditation not containing a method or procedure to a flexible Scope in conjunction with the transition to ISO/IEC 17025:2017.

Durometer Requirements

For those laboratories that include durometers on their scope of accreditation:

For an endorsed (accredited) calibration requested to meet ASTM D2240 the calibration certificate must also include the following information in addition to the requirements of this document:

- Date of calibration;
- Date of last calibration;
- Calibration due date (as determined by the user);
- Manufacturer, type, model, and serial number of the instrument, and a notation when a maximum indicator or timing device is present;
- Values obtained for measurement parameters identified on the scope of accreditation (pre- and post-calibration results), including notation of the effect of a maximum indicator, if present. The method of reporting the calibrated value shall be attained by the arithmetic mean of the determinations: Ambient temperature; Relative humidity; Technician identification;
- Applicable standards to which the instrument is calibrated;
- Calibrating instrument information to include type, serial number, manufacture, date of last calibration, calibration due date (determined by calibration service provider), and a statement of traceability of standards to the SI through NIST or another acceptable national metrology institute (NMI)[10].

As indirect verification of durometers is not supported by ASTM D2240, therefore, it is not permitted on A2LA Scopes of Accreditation.

[10] See A2LA P102 - Policy on Metrological Traceability for information on acceptable NMIs.

Dimensional Testing Requirements

For those laboratories that have dimensional testing on their scope of accreditation where the unit under test is used to calibrate another device:

In addition to the requirements of this document:

- For all dimensional testing parameters for which the unit under test ***does*** serve as link in the traceability chain and where an endorsed (accredited) test report is issued, the organization shall identify on the test report that the test(s) conducted is performed in accordance with R205 – Specific Requirements: Calibration Laboratory Accreditation Program and is deemed equivalent with a calibration. Furthermore, they shall also identify this on the scope of accreditation.

- For dimensional testing parameters for which the unit under test ***does*** serve as link in the traceability chain for some parameters but ***does not*** serve as a link in the traceability chain for others, where an endorsed (accredited) calibration certificate or test report is issued the organization shall distinguish those results that performed in accordance with R205 and deemed equivalent to a calibration from those that **are not** deemed equivalent to a calibration. Use of an asterisk with language to this effect is acceptable.

Umbrella Accreditation

The authorized field representative(s) of the accredited laboratory shall:

- Not perform any key functions;
- Be trained on the accredited laboratory's quality management system, ISO/IEC 17025 and all A2LA Policies/Requirements by the accredited laboratory with records retained of the training;
- Be included on the accredited laboratory's organizational chart;
- Be included in the accredited laboratory's internal audit process with records retained of the audit of the authorized field representatives;
- Be included in the accredited laboratory's management review with records retained of any action items pertaining to authorized field representatives;
- Be available during A2LA assessments for observation and/or interview (sampling size determined by the A2LA assessor in accordance with A2LA internal policy);
- Be included in the accredited laboratory's four-year proficiency testing plan and participate in relevant and available proficiency testing. If there are four or more authorized field representatives, then at least 25% of them must participate each year with participation equally distributed in a four-year timeframe;
- Not use the "A2LA Accredited" symbol in any manner nor make statements implying A2LA accredited status for the authorized field representative. The accredited laboratory is responsible for ensuring that their authorized field representatives make no such claims or statements.

Authorized field representatives may:

- Include on their website and in promotional materials a statement that they are an authorized field representative for the accredited laboratory;
- Link to the accredited laboratory's website, but only the accredited laboratory itself may use the "A2LA Accredited" symbol and make any statements about the A2LA accredited status of the work they perform through their authorized field representatives.
- Under no circumstances may it be stated or implied that the accredited laboratory's accreditation extends to cover any other company.

Authorized field representatives are considered to be De facto employees of the accredited laboratory; therefore, it is the accredited laboratory's responsibility to generate and maintain records, and to provide training and ensure compliance by the authorized field representatives with ISO/IEC 17025 and A2LA policies and requirements.

All final reports must be issued by the accredited laboratory.

Any failure by a field representative providing services on behalf of the accredited laboratory to adhere to these requirements is the responsibility of the accredited organization that utilizes this field representative in the course of its work.

Excerpts from ILAC Policy for Uncertainty in Calibration ILAC–P14:09/2020

Below are excerpts from ILAC P14:09/2020 from section three through five for reference purposes only:

3. ILAC Policy on the Evaluation of Measurement Uncertainty

4. The Accreditation Body shall ensure that the accredited calibration laboratories evaluate measurement uncertainty in compliance with the GUM.

5. To ensure evaluation of the measurement uncertainty is aligned with the GUM, the Accreditation Body may use documents published by other organizations or publish its own document containing practical guidance and mandatory requirements.

Any mandatory requirements shall be in accordance with this policy and the reference documents.

4. ILAC Policy on Scopes of Accreditation of Calibration Laboratories

4.1 The scope of accreditation of an accredited calibration laboratory shall include the calibration and measurement capability (CMC) expressed in terms of:

a) measurand or reference material;

b) calibration or measurement method or procedure and type of instrument or material to be calibrated or measured;

c measurement range and additional parameters where applicable, (e.g. frequency of applied voltage);

d) measurement uncertainty.

4.2 There shall be no ambiguity in the expression of the CMC on the scopes of accreditation and, consequently, on the smallest measurement uncertainty that can be expressed to be achieved by a laboratory during a calibration or a measurement. Where the measurand covers a value, or a range or values, one or more of the following methods for expression of the measurement uncertainty shall be applied:

a) A single value, which is valid throughout the measurement range.

b) A measurement range. In this calibration laboratory shall ensure that linear interpolation is appropriate in order to find the uncertainty at intermediate values.

c) An explicit function of the measurand and/or a parameter.

d) A matrix where the values of the uncertainty depend on the values of the measurand and additional parameters.

e) A graphical form, providing there is sufficient resolution on each axis to obtain at least two significant digits for the uncertainty.

Open intervals ((example 1) "0<U<x", or (example 2) for a resistance interval of 1 to 100 ohms, the uncertainty stated as "less than 2 μΩ/Ω") are incorrect in the expressions of CMCs.

4.3 The uncertainty covered by the CMC shall be expressed as the expanded uncertainty having a coverage probability of approximately 95 %. The unit of the uncertainty shall always be the same as that of the measurand or in a term relative to the measurand, (e.g., percent, μV/V or part per 106). Because of the ambiguity of definitions, the use of terms "PPM" and "PPB" are not acceptable.

The CMC quoted shall include the contribution from a best existing device to be calibrated such that the CMC claimed is demonstrably realizable.

Note 1: The term "best existing device" is understood as a device to be calibrated that is commercially or otherwise available for customers, even if it has a special performance (stability) or has a long history of calibration.

Note 2: When it is possible that the best existing device can have a contribution to uncertainty from repeatability equal to zero, this value may be used in the evaluation of the CMC. However other fixed uncertainties associated with the best existing device shall be included.

Note 3: In exceptional instances, such as evidenced in very limited number of CMCs in the KCDB, it is recognized that a "best existing device" does not exist and/or contributions to the uncertainty attributed to the device may significantly affect the uncertainty. If such contributions from the device may be excluded from the CMC statement. For such a case, however, the scope of accreditation shall clearly identify that the contributions to the uncertainty from the device are not included.

4.4 Where laboratories offer services such as a reference value provision, the uncertainty covered by the CMC shall include factors related to the measurement procedure as it will be carried out on a sample, i.e., typical matrix effects, interferences, etc. shall be considered. The uncertainty covered by the CMC will not generally include contributions arising from the instability or inhomogeneity of the material. The CMC shall be based on an analysis of the inherent performance of the method for typical stable and homogeneous samples.

Note: The uncertainty described by the CMC for the reference value measurement is not identical with the uncertainty associated with a reference material provided by a reference materials producer. The expanded uncertainty of a certified reference material will in general be higher than the uncertainty described by the CMC of the reference measurement on the reference material.

5. ILAC Policy on Statement of Measurement Uncertainty on Calibration Certificates

5.1 The Accreditation Body shall ensure that an accredited calibration laboratory reports the measurement uncertainty in compliance with the GUM.

5.2 The measurement result shall include the measurand quantity value y and the associated expanded uncertainty U. In calibration certificates the measurement result should be reports as y ± U associated with the units of y and U. Tabular presentation of the measurement result may be used and the relative expanded uncertainty U / |y| may also be provided if appropriate. The coverage factor and the coverage probability shall be stated on the calibration certificate. To this an explanatory note shall be added, which may have the following content:

"The reported expanded measurement uncertainty is stated as the standard measurement uncertainty multiplied by the coverage factor K such that the coverage probability corresponds to the approximately 95%."

Note: For asymmetrical uncertainties other presentations than y ± U may be needed. This concerns also cases when uncertainty is determined by Monte Carlo simulations (propagation of distributions) or with logarithmic units.

5.3 The numerical value of the expanded uncertainty shall be given to, at most, two significant digits. Where the measurement result has been rounded, that rounding shall be applied when all calculations have been completed; resultant values may then be rounded for presentation. For the process of rounding, the usual rules for rounding of numbers shall be used, subject to the guidance on rounding provided i.e. in Section 7 of the GUM.

Note: For further details on rounding, see the GUM and ISO 80000-1:2009.

5.4 Contributions to the uncertainty stated on the calibration certificate shall include relevant short-tem contributions during calibration and contributions that can reasonably be attributed to the customer's device. Where applicable the uncertainty shall cover the same contributions to uncertainty that were included in evaluation of the CMC uncertainty component, except that uncertainty components evaluated for the best existing device shall be replaces with those of the customer's device. Therefore, reported uncertainties tend to be larger than the uncertainty covered by the CMC. Contributions that cannot be known by the laboratory, such as transport uncertainties, should normally be excluded in the uncertainty statement. If, however, a laboratory anticipates that such contributions will have significant impact on the uncertainties attributed by the laboratory, the customer should be notified according to the general clauses regarding tenders and reviews of contracts in ISO/IEC 17025.

5.5 As the definition of CMC implies, accredited calibration laboratories shall not report a smaller measurement uncertainty than the uncertainty described by the CMC for which the laboratory is accredited.

5.6 As required in ISO/IEC 17025, accredited calibration laboratories shall present the measurement uncertainty in the same unit as that of the measurand or in a term relative to the measurand (e.g. percent).

Guidance Section

The following section of the handbook will provide you with links to specific guidance documents that A2LA has created to assist our accredited laboratories and ensure consistency of the Calibration Accreditation Program. The guidance documents are grouped in the four following categories:

- General Guidance
- Dimensional Discipline Guidance
- Electrical Discipline Guidance
- Mechanical/Thermodynamics Discipline Guidance

General Guidance

LINKS FOR:

- G118 – *Guidance for defining the scope of accreditation of calibration labs*
- G129 – *Measurement uncertainty budget template*
- G132 – *Technical guidance from the Measurement Advisory Committee (MAC)*

Dimensional Discipline Guidance

LINKS FOR:

- G103 – A2LA guide for estimation of uncertainty of dimensional calibrationand testing results
- G111 – Guidance on pitch diameter and simple pitch diameter

Electrical Discipline Guidance

LINKS FOR:

- G110 – *guidance on uncertainty budgets for electrical parameters*
- G112 – *Guidance on 5700A-5720A-3458A artifact calibration*
- G128 – *Guidance for DC/AC power scope presentation*
- G130 – *Low frequency S parameter measurement of VNA calibration kits*

Mechanical/Thermodynamics Discipline Guidance

LINKS FOR:

- G126 – Guidance on uncertainty budgets for force measuring device
- G127 – Guidance for reporting uncertainty – Thunder Scientific

References

A2LA Documents:

G103 – *A2LA guide for estimation of uncertainty of dimensional calibration and testing results*

G110 – *guidance on uncertainty budgets for electrical parameters*

G111 – *Guidance on pitch diameter and simple pitch diameter*

G112 – *Guidance on 5700A-5720A-3458A artifact calibration*

G118 – *Guidance for defining the scope of accreditation of calibration labs*

G126 – *Guidance on uncertainty budgets for force measuring device*

G127 – *Guidance for reporting uncertainty – Thunder Scientific*

G128 – *Guidance for DC/AC power scope presentation*

G129 – *Measurement uncertainty budget template*

G130 – *Low frequency S parameter measurement of VNA calibration kits*

G132 – *Technical guidance from the Measurement Advisory Committee (MAC)*

P102 – *Policy on Metrological Traceability*

P112 – *Policy on Flexible Scopes*

R101 – *General Requirements for Accreditation of ISO-IEC 17025 Laboratories*

R103 – *General Requirements - Proficiency Testing for ISO-IEC 17025 Laboratories*

R105 – *Requirements When Making Reference to A2LA Accredited Status*

ANSI/ISO/ASQ Q9000:2000, *Quality management systems – Fundamentals and vocabulary.*

ANSI/NCSL Z540-1-1994, Part I, *Calibration Laboratories and Measuring and Test Equipment- General Requirements.*

ANSI/NCSL Z540-2-1997, *U.S. Guide to the Expression of Uncertainty in Measurement.*

ANSI/NCSL Z540.3-2006 *American National Standard for Calibration – Requirements for the Calibration of Measuring and Test Equipment.*

BIPM JCGM 100:2008, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement (GUM 1995 with minor corrections)*.

BIPM JCGM 200:2012, *International vocabulary of metrology - Basic and general concepts and associated (VIM) 3rd edition (2008 version with minor corrections).*

CIPM MRA-D-04, *Calibration and Measurement Capabilities in the context of the CIPM MRA* Version 4 October 2013

ILAC G8:09/2019, *Guidelines on Assessment and Reporting of Compliance with Specification.*

ILAC-P8:03/2019, *ILAC Mutual Recognition Arrangement (Arrangement): Supplementary Requirements and Guidelines for the Use of Accreditation Symbols and for Claims of Accreditation Status by Accredited Laboratories*

ILAC P10:07/2020, *ILAC Policy on Traceability of Measurement Results.*

ILAC P14:09/2020 ILAC Policy *for Uncertainty in Calibration*

ISO/IEC 17000:2020 *Conformity assessment – Vocabulary and general principles.*

ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories.*

ISO/IEC 17043:2010 - *Conformity assessment -- General requirements for proficiency testing.*

NIST Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, Taylor, Barry N., Kuyatt, Chris E., U.S. Government Printing Office, Washington, D.C., 1993.

UKAS, *The Expression of Uncertainty and Confidence in Measurement* (M3003), 2007.

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