

## Fact sheet of the interlaboratory comparison:

### Multimeter Calibration - 2023\_v1

#### 1. Context and objectives:

As in 2018 and 2020, the CT2M organizes in 2023 an inter-laboratory comparison on a European scale on the calibration of multimeters. You are a calibration laboratory or a testing laboratory performing its own calibrations: this inter-laboratory comparison is organized for you.

The objectives of this proficiency testing are to:

- Evaluate the performance of the participants to achieve mass calibration,
- Improve client confidence of participants,
- Identify differences between participants.

#### 2. Proficiency testing item:

The comparison is based on the calibration of an Agilent 34461A multimeter (6 ½ digit resolution)

Resolution	6 ½ figures
Current range	100 µA – 10 A
Voltage range	DC : 100 mV – 1000 V / AC (True RMS) : 100 mV – 750 V
Environmental conditions of use	0 à 55 °C / 20 à 80 % Hygrometry
Acquisition rate	1 000 Hz
Internal memory	10 000 measurements
Interface	USB, LAN

The multimeter will be calibrated at the beginning and end of the circuit by a reference laboratory whose best uncertainties are:

DC and AC current	$0 \text{ A} \leq I \leq 1\,000 \text{ A}$ $\text{DC} \leq f \leq 1 \text{ MHz}$	$1,3 \cdot 10^{-6} \cdot I$ à $2 \cdot 10^{-4} \cdot I$
DC and AC voltage	$0 \text{ V} \leq U \leq 1\,000 \text{ V}$ $\text{DC} \leq f \leq 100 \text{ kHz}$	$80 \text{ nV}$ à $1,2 \cdot 10^{-4} \cdot U$
Resistance	$1 \text{ } \mu\text{W} \leq R \leq 1 \text{ PW}$ $\text{DC} \leq f \leq 1 \text{ MHz}$	$0,2 \text{ nW}$ à $1,1 \cdot 10^{-3} \cdot R$

The metrological traceability of the reference value is guaranteed by COFRAC accreditation according to ISO 17025 of the reference laboratory.

#### 3. Calibration Method(s):

The calibration method is left to the participant's choice. The routine procedure of the participating laboratory is preferred. The calibration points are described in the following table:

Direct current (DC)		
Object	Measured or desired characteristic	Calibration points
Multimeter	Potential difference	100 mV – 50 V – 800 V
Multimeter	Current intensity	100 $\mu$ A – 500 mA – 5 A
Multimeter	Electric resistance	100 $\Omega$ - 100 k $\Omega$ - 1 M $\Omega$ - 100 M $\Omega$

Alternating current (AC)			
Object	Measured or desired characteristic	Frequency	Calibration points
Multimeter	Potential difference	60 Hz	100 mV – 100 V – 750 V
Multimeter	Current intensity	60 Hz	10 mA – 1 A – 8 A

Participants may register for one or more sizes. It is not mandatory to perform the calibration for all the proposed points. Moreover, any laboratory can participate, whatever its level of uncertainty.

A detailed protocol will be provided to each participant at the beginning of the campaign.

#### 4. Organization of the proficiency testing:

Each laboratory must calibrate the multimeter within one or two weeks of receiving the equipment. The equipment will be passed from one participant to the next. It is particularly important to respect the schedule that will be provided.

The CT2M will provide the participants with an Excel form in which their results will have to be transcribed. For each calibration point, the participants will have to indicate the following results:

- Correction value,
- Associated expanded uncertainty (k=2).

#### 5. Assigned values and evaluation of performance:

The objectives of the performance evaluation of this inter-laboratory comparison are:

- The evaluation of the ability of each participant to obtain results in agreement with the results of all the participants (z-score or z'-score depending on the number of participants),
- The evaluation of the ability of each participant to obtain results close to an independent reference value considering the claimed expanded uncertainty (En score).

Two assigned values will therefore be established to meet each of these objectives:

- The robust average of the participants' results determined from the A algorithm defined in ISO 13528.

- The "reference value" determined from the reference laboratory results.

The standard deviation for proficiency assessment and the uncertainties of the assigned values will be determined to establish the performance scores of each participant for each entity.

## 6. Report(s):

At the end of the circuit, a statistical analysis will be performed and a final report will be sent to the participants. This report will contain the results of all the participants (rendered with a codification to respect anonymity), the detection of outliers, the assigned values and their associated uncertainties, the performance scores of the participants and all other elements useful for the interpretation.

Intermediate reports may be provided as the study progresses if many participants require a study period longer than 6 months.

The final report will be distributed only to the participants and will remain anonymous.

## 7. Important dates:

Key steps	Estimated deadline
End of registration	End of April 2023
Emailing of the protocol and the results form	May 2023
Launch of the circuit	Mai 2023
Publication of the final report	Date depending on the number of participants

## 8. Reciprocal commitments:

### CT2M commitments:

The CT2M undertakes to:

- guarantee the confidentiality of participants results and respect their anonymity (\*),
- carrying out the performance evaluation in complete impartiality,
- organize and process the results in accordance with the reference applicable documents (ISO 17043, ISO 13528).

(\*) The data obtained and generated during the inter-laboratory comparison may be consulted during internal or external audits. Auditors are systematically subject to a confidentiality agreement. For communication purposes (conferences, articles, etc.), the results may be used but in a totally anonymous manner. The transport of the test item from one participant to another necessarily entails the partial loss of anonymity concerning the identity of the previous participant and the following participant. Registration for this inter-laboratory comparison implies acceptance of this condition.

**Participant commitments:**

The participants in this inter-laboratory comparison undertake to:

- respect the protocol provided for carrying out calibrations,
- provide their results within the deadlines defined by the organizer,
- not to communicate with any other participant who may be known in order to avoid any risk of collusion,
- transmit all the necessary information of the successful completion of the inter-laboratory comparison to all the persons concerned within their laboratory,
- inform the CT2M of any malfunction.

**9. Registration and contacts:**

If you are interested in participating in this inter-laboratory comparison, please complete the associated registration form "Registration form - CIL 2023 - Calibration of a multimeter\_v1" and send it back to us by email at [cilmultimetre@ct2m.fr](mailto:cilmultimetre@ct2m.fr).

For more information, do not hesitate to contact us:

- Email: [cilmultimetre@ct2m.fr](mailto:cilmultimetre@ct2m.fr)
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