Multimeter 2025:1

Content

Intercomparison ILC multimeter 2025:1

The calibration objects will be transported between participating laboratories.

The participants can select the objects they want to calibrate. The above concept of intercomparison was decided by an advisory group (TIC engineer Ove Gunnarsson, technical director Håkan Källgren, electrical engineer Wilmer Manfredsson) related to electrical calibration. No subcontractors are involved in the intercomparison.

Participants welcome to this intercomparison.

Participation is open for three categories of laboratories:

- Accredited laboratories
- Laboratories that will apply for accreditation.
- Laboratories that want to evaluate their Calibration and Measurement Capability (CMC).

Due to practical reasons the number of participants is limited to minimum 8 and maximum 20.

Description of the values included in the intercomparison.

The intercomparison will start and end with all objects calibrated at a reference laboratory after the all participants which also will define the reference values. The CMC levels for uncertainty on the reference laboratory are given in the tables below as well as the possibly reference uncertainty when calibrating the objects.

Measurements for DC voltage (V DC)

Range	Calibration point	Reference laboratory CMC values *	Possible expanded reference uncertainty **
V	V		
1 000	+1 000 -1 000	[0.8 , 1.3] µV/V	4 mV 4 mV
100	+100 -100	[0.8 , 1.3] µV/V	0.4 mV 0.4 mV
10	+10 +6 +1 -10	0.8 µV/V	0.02 mV 0.02 mV 0.02 mV 0.02 mV
1	+1 -1	0.8 µV/V	2 µV 2 µV
0.1	+0.1 -0.1	2.0 µV/V	0.6 µV 0.6 µV

*CMC values from the KCDB database at bimp.org

**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.

Measurements for AC voltage (V AC)

Range	Calibration point	Frequency	Reference laboratory CMC values *	Possible expanded reference uncertainty **
V	V	kHz		
750	700	1 50	[8.0 , 1000.0] µV/V	86 mV 450 mV
100	100	1 50	[8.0 , 1000.0] µV/V	5.5 mV 12 mV
10	10	1 50	[8.0 , 1000.0] µV/V	0.5 mV 0.9 mV
1	1	1 50	[8.0 , 1000.0] µV/V	0.50 µV 0.90 µV
0.1	0.1 0.1	1 50	[8.0 , 1000.0] µV/V	13.0 µV 23.0 µV
*CMC values from the KCDB database at bimp.org				
**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.				

Measurements for Frequency

Range	Calibration point	Frequency	Reference laboratory CMC values *	Possible expanded reference uncertainty **
V	V	Hz		
1	1	20 000 15 000	[2.0E-7 , 2.0E-14] Hz/Hz	0.3 Hz 0.3 Hz
1	1	10 000 1 000	[2.0E-7 , 2.0E-14] Hz/Hz	0.08 Hz 7 mHz
1	1	100 10	[2.0E-7 , 2.0E-14] Hz/Hz	0.7 mHz 0.09 mHz
*CMC values from the KCDB database at bimp.org				
**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.				

Measurements for DC current

Range	Calibration point	Reference laboratory CMC values *	Possible expanded reference uncertainty **
mA	mA		
3 000	+3 000 -3 000	16.0 µA/A	0.09 mA 0.09 mA
1 000	+1 000 -1 000	9.0 µA/A	20 µA 20 µA
100	+100 +20 +15	7.0 µA/A	1.6 µA 1.0 µA 1.0 µA
100	-100	7.0 µA/A	1.6 µA
10	+10 +8 +4 +2 +1	7.0 µA/A	0.16 µA 0.15 µA 0.12 µA 0.10 µA 0.10 µA
10	+0.5 +0.35 +0.2 +0.1	7.0 µA/A 7.0 µA/A 10.0 µA/A 10.0 µA/A	0.06 µA 0.06 µA 0.05 µA 0.05 µA
10	-10	7.0 µA/A	0.16 µA

*CMC values from the KCDB database at bimp.org

**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.

Measurements for AC current

Range	Calibration point	Frequency	Reference laboratory CMC values *	Possible expanded reference uncertainty **
A	A	kHz		
3	3	1	[0.06 , 2.8] mA/A	1.50 mA
1	1	1	[0.06 , 2.8] mA/A	290 µA

*CMC values from the KCDB database at bimp.org

**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.

Measurements for Resistance four-terminal

Range	Calibration point	Reference laboratory CMC values *	Possible expanded reference uncertainty **
100 MΩ	100 MΩ	30.0 μΩ/Ω	44 kΩ
10 MΩ	10 MΩ	7.0 μΩ/Ω	0.08 kΩ
1 MΩ	1 MΩ	4.9 μΩ/Ω	5 Ω
100 kΩ	100 kΩ	2.8 μΩ/Ω	0.3 Ω
10 kΩ	10 kΩ	2.8 μΩ/Ω	0.04 Ω
1 kΩ	1 kΩ	2.4 μΩ/Ω	3 mΩ
100 Ω	100 Ω	2.4 μΩ/Ω	0.3 mΩ
*CMC values from the KCDB database at bimp.org			
**The values are expressed as expanded uncertainty, *U* with 95 % confidence level and include possible drift during circulation of the objects among the participating laboratories.			

The reference values and respective uncertainties concerning these intercomparison objects will be based on the calibration in the reference laboratory before and after the distribution. Reference laboratory will be RISE Research Institutes of Sweden.

Detailed documented instructions

Detailed technical instructions will be sent to the participants who have registered to the intercomparison together with the reporting form as an excel document.

Time schedule and quality check

After registration of interested laboratories, a plan for the circulating of calibration objects and a time schedule will be worked out and sent to all of them.

The calibration objects will eventually be transported by different means in participating countries. Immediately at receiving and sending the objects each participant should inform the organizer (SMQ) by e-mail about the status of the objects. If there are any signs of impact (for example marks or scratches) a photograph shall be sent to the organizer to decide how to proceed and to inform the next participant.

Each participant will have access to the object for maximum 2 weeks, including shipping to the next participant, and should use its own method for calibration.

Laboratories freely decide which uncertainty they want to state in the protocol. Accredited laboratories can declare their CMC-values, or a value estimated for the actual measurement condition.

After finishing calibration, the objects shall be sent to the following participant on the transportation list using the same parcel they arrived in.

Original data from the calibration shall be sent to the organizer immediately after finishing the calibrations. This is preferably done by e-mailing the filled excel-reporting file. The organizer gets control of that everything is as expected including stability. It also helps to detect eventual problems in time.

Statistical analysis which will be used

The organizer will calculate reference values that will be used in the calculations as described in ISO/IEC 17043:2023 annex B presenting En-values (formula B6)

Reporting

Participants shall send their final calibration certificate by e-mail to the organizer within one week after the calibrations are finished in form of a pdf-file.

The excel-reporting document that will be sent to all laboratories shall indicate important environment conditions.

At the end of the intercomparison a draft report will be returned to the participants within 2 weeks of the time when the last participant has reported its results in a calibration certificate.

The participants are encouraged to comment on the draft report within two weeks after receiving it.

If a participant does not follow the reporting rules described without giving reasonable explanations the organizer tries to extract the relevant content for the comparison. If this is not possible the results will be excluded from the report.

A participant may decide to withdraw from the exercise. This might be caused by problems detected during or after having performed the measurements. However, the withdrawal in this case must be announced to the organizer before the draft report is distributed to all participants.

The participant may appeal to the full report if there should be major faults in the report.

The intercomparison report will list all participating laboratories. However, each will be treated anonymously, and its result will only be identified by a code that is sent to each participant in a separate e-mail.

Damaged apparatus

The participant shall immediately inform the organizer in case of any anomalies or other detected problem to allow for appropriate actions.

Price for participation

- Laboratories having maximum 3 calibration technicians –basic price 750 EUR.
- Laboratories having more than 3 calibration technicians –basic price 980 EUR.
- In addition, 320 EUR per calibration object (DC V, AC V, Frequency, DC A, AC A, Resistance)

The laboratories shall pay the transport costs to next laboratory.

If the laboratory decides not to fulfil part of the agreement after they have registered, they shall still pay the registration price.