Report on the

EURAMET bilateral comparison 1319

100 Ω DC Resistance

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Report of the EURAMET bilateral comparison 1319
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1 INTRODUCTION

A bilateral interlaboratory comparison of DC resistance was proposed by the LNE, the French national metrology institute, in the frame of a EU funded project: Development of Quality Infrastructure and Metrology (DQIM) – Montenegro.

The comparison was approved by LNE and EURAMET in May 2014. The second participant is the beneficiary of the project.

2 DESCRIPTION OF THE INTERLABORATORY COMPARISON AND ORGANIZATION

2.1 Objective of the interlaboratory comparison

The objective of the project was to perform a comparison of 100 Ω DC resistance at rated current.

The measurements were carried out at the uncertainty level which is as close as possible to the best measurement capabilities of the two laboratories. The results are used to verify the competence of the laboratories to measure accurately DC resistance within their KCDB and/or accredited uncertainty.

2.2 Travelling standards

One 100 Ω DC resistance standard was used as traveling standard:

GUILDLINE type 9330, serial number 57778

2.3 Measurement instructions

A copy of the complete measurement instructions sent to the participating laboratories is given in Appendix A.

The measurements were performed under the following conditions:

- DC current: 5 mA ;
- Temperature of the environment (air) 23°C ± 0.1°C (or the best which can be achieved)
- Relative humidity of air: between 30 % and 70 %.

2.4 Participants

The two participants were:
Pilot laboratory: Laboratoire national de métrologie et d'essais, LNE, France
Isabelle Blanc, Pierre-Jean Janin
Participant: Bureau of Metrology, BoM/MBM, Montenegro
Rabina Sabotic

3 INTERLABORATORY COMPARISON

3.1 Schedule of the circulation

The circulation was scheduled in June 2014.
The original measurements were taken from calibrations performed in September 2013. The resistance was hand carried to BoM, Montenegro, on June 1st.
The resistance was carried back to LNE on June 6th.

4 RESULTS OF THE MEASUREMENTS

4.1 Measurements

The original measurement instructions were complied in every case.
The uncertainties had to be calculated and expressed in accordance with the GUM.

The measurements at BoM were performed from June 2rd to June 5th then hand carried back to LNE on June 6th. The measurements were performed again at LNE on June 18th.
The preliminary report from BoM was received by LNE on June 17th, the final report was sent on July

4.2 Reference values

The comparison reference value, R_{ref}, has been determined as the linear interpolated value between the first and final measurement performed at LNE. For the result of the comparison, the resistance values were calculated at 23°C using the temperature coefficient measured by LNE.
The comparison is linked to the corresponding CCEM comparison CCEM-K10

4.3 Presentation of the results

The values given in the calibration certificates are given in table 1.

Laboratory	Date of calibration	Temperature (°C)	Resistance value (Ω)	Uncertainty (Ω)
LNE-1	27-29/11/2013	22.99	100.00820	0.00005
BoM	2-6/06/2014	23.1	100.00819	0.00086
LNE-2	18/06/2014	23.03	100.00869	0.00005

Table 1

The result of the comparison is given in the table 2.

Laboratory	Resistance value at 23 °C (Ω)	Calibration uncertainty (Ω)	En
Reference value LNE	100.00866	0.00005	
BoM	100.00819	0.00086	0.55

Table 2

The results of the Laboratories are displayed in graphical representation : see figure 1

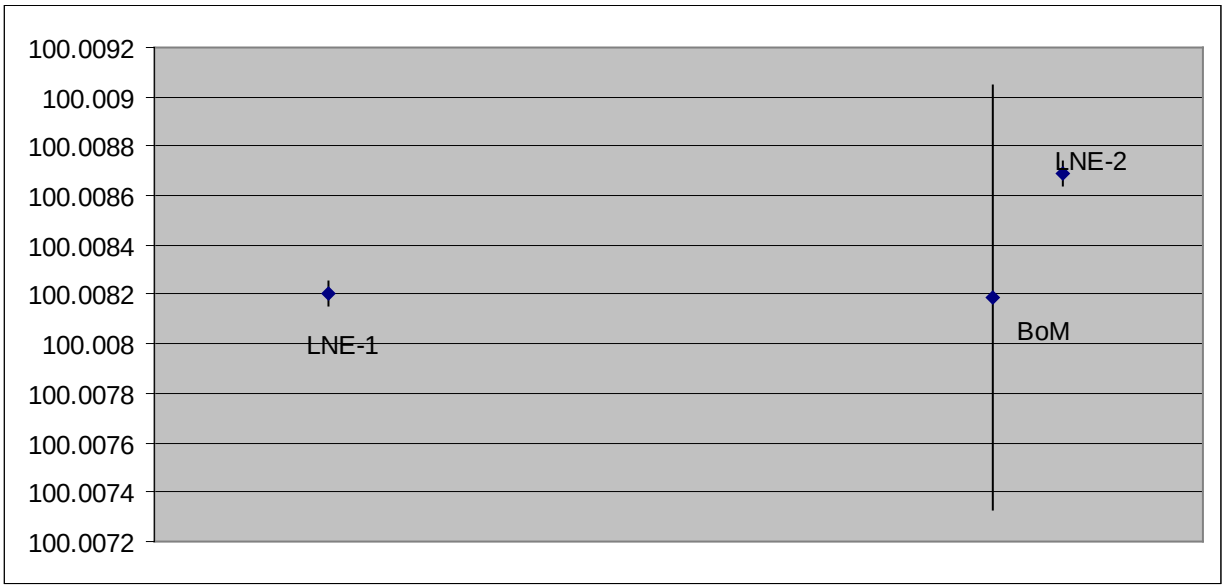

Figure 1

The En value was calculated according to the following formula:

$$E_n = \frac{R_{lab} - R_{ref}}{\sqrt{\varepsilon_{lab}^2 + \varepsilon_{ref}^2}}$$

where ε_{lab} et ε_{ref} are the uncertainties associated with the resistance value R_{lab} measured by the participant laboratory, BoM, and the resistance value R_{ref} measured by the Reference Laboratory, LNE.

4.4 Discussion of the results

The En value of BoM is lower than 1, so it is acceptable as such. Nevertheless one comment can be made:
The value of the resistance changed between the first measurement and the final measurement at LNE but there no impact on the final results taken into account the large value of the uncertainty of BoM.

5 CONCLUSION

The comparison is conclusive and the measurements of BoM are acceptable.

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Appendix A

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5.1 TECHNICAL PROTOCOL

6 INTRODUCTION

The comparison is organised within the EU-project: **"Development of quality infrastructure and metrology (DQIM) –Montenegro"**, EuropeAid/132571/C/SER/ME.
The comparison is linked to the corresponding CCEM comparison CCEM-K10
Two National Metrology Institutes take part in this comparison: LNE (France) and BoM (Montenegro).
LNE is acting as the pilot laboratory and in this function is responsible for providing the travelling standard, the evaluation of the measurement results and the final report.
The comparison will be accomplished in accordance with the EURAMET Guidelines on Conducting Comparisons and CCEM Guidelines for Planning, Organising, Conducting and Reporting Key, Supplementary and Pilot Comparisons.

7 TRAVELLING STANDARDS

2.1. The travelling standard is a resistance, Guildline 100 ohms S/N 57778, having the nominal value of 100 Ω.

2.2. Specifications

Nominal value of the resistance	100 Ω

3. Quantities to be measured

- ***R:*** resistance of the standard (four terminals);
- ***I:*** DC current through the resistor;
- T_{ext}**:** the temperature (°C) of the environment where the standard is measured (air).

4. Measurement instructions

The measurements should be performed under the following conditions:

- DC current: 5 mA ;
- Temperature of the environment (air) 23°C ± 0.1°C (or the best which can be achieved)
- Relative humidity of air: between 30 % and 70 %.

5. Reporting of results

A report should be sent to the pilot laboratory within one month after the measurements are completed. The report should include:
– Description of the measurement method;
– The reference standard;
– The traceability to the SI;
– The results of the quantities to be measured (list of section 3);
– The associated standard uncertainties, the effective degrees of freedom and the expanded uncertainties;
The measurement of the DC current and the temperature of the oil bath must also be recorded and reported.

6. Uncertainty of measurement

The uncertainty must be calculated following the ISO "Guide to the expression of uncertainty in measurement" (GUM) and the complete uncertainty budget must be reported.

7. Transportation

The travelling standard must be transported in the original case and protected from mechanical loads, vibration etc. for transport by plane.
The travel box contains the following items:
– Resistance standard,
– Operating instructions of the travelling standard (this document).

8. Contact

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