



Hybrid comparison protocol

INSTRUCTION FOR THE PARTICIPANTS IN THE HYBRID COMPARISON

Title: Hybrid comparison with resistance thermometer MIRS/UL-FE/LMK and IMBiH 2023

Date:

1.11.2023

Items:

- i. 1 x platinum resistance thermometers

Issuing NMI:

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Laboratory of Metrology and Quality (MIRS/UL-FE/LMK)
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Measuring instructions for participants of Hybrid comparison with indication and resistance thermometer MIRS/UL-FE/LMK and IMBiH 2023

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1 Introduction

The purpose of the hybrid comparison is to compare the results of the participating laboratories during calibration of a thermometer by comparison:

- i. platinum resistance thermometer

The circulating items are:

- i. Elpro Lepenik, type 2280 3870, serial number 651620922, range -200 °C to 500 °C

The instrument will be provided by the Issuing NMI. It is recommended that the participants use their standard procedure during the temperature calibration and if possible avoid making extra time-consuming measurements.

1.1 Issuing NMI

University of Ljubljana, Faculty of Electrical Engineering
Laboratory of Metrology and Quality (UL/FE-LMK),
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1.2 Applicant NMI

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1.3 Time schedule and deadlines

The deadline for the calibrations are determined on a basis of email agreement between the Issuing NMI and the Applicant NMI. The Applicant NMI takes care about the transport between both laboratories.

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If the Applicant NMI anticipates difficulties in keeping the deadlines, the Issuing NMI must be contacted immediately.

Deadline for reporting the results is 2 weeks after the equipment has left the laboratory. It is important that the deadline is met since the results are being analyzed continuously by the Issuing NMI. If there are any problems or doubt regarding the results of the Applicant NMI, the laboratory will be contacted immediately. Any suspicion that the equipment is defect or drifted, will lead to return of the equipment to the Issuing NMI, which then will make an extra check and take an appropriate action.

If deadlines are respected, the participants will receive the report of the Hybrid comparison by the end of March 2024.

1.4 Transportation of the equipment

As soon as the Applicant NMI receives the equipment the Issuing NMI shall be informed (e.g. by e-mail). The equipment is then unpacked, and an inspection carried out. If the equipment has any visible damage due to transportation, this must be reported to the Issuing NMI before the calibration begins.

For transportation of the equipment in the hybrid comparison, there are two possibilities:

- **The recommended solution:** The equipment is hand carried (personal transport). In this case it is important that this is agreed between the contact persons.
- Courier or carrier to the next laboratory sends the equipment. The equipment is delivered in strong shock-absorbing transportation boxes. In this case it is extremely important to ensure that the equipment is packed properly and that the boxes are marked sufficiently (up, down, fragile). The package is sent as a registered-plus parcel. Choose a courier/carrier that you have good experience with.

The Applicant NMI covers expenses of all transportations. The Applicant NMI is responsible to ensure that equipment is covered by insurance, if necessary. In this exceptional case, the Issuing NMI will hand-carry the thermometer to the Applicant NMI.

As soon as the equipment is delivered/sent, the Issuing NMI shall be informed (e.g. by e-mail).

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2 Description of the equipment

2.1 General

The laboratory receives the following equipment:

- i. Elpro Lepenik, type 2280 3870, serial number 651620922, range -200 °C to 500 °C

In a case any of the above-mentioned equipment is missing at any receipt, the Issuing NMI or the participant must be contacted.

2.2 Environmental conditions

Calibration is carried out at an ambient temperature of nominal 23 °C. The ambient temperature and relative humidity shall be reported.

2.3 Handling

2.3.1 Packing and unpacking

Procedure for unpacking is as follows:

1. Inspect the transportation boxes for damage. If the boxes are damaged, the Issuing NMI shall be contacted before continuing.
2. Unpack the equipment and check that all equipment mentioned in the section "Description of equipment" is present.
3. If any equipment is missing, the Issuing NMI or the participant shall be contacted.
4. Inspect the equipment. If any of the equipment shows visible signs of damage, the Issuing NMI or the participant shall be contacted.

The packing procedure is as follows:

1. Before packing, slowly heat up thermometers to room temperature.
2. Place the thermometer in the transportation box.
3. Check that all equipment mentioned in the section "Description of equipment" is packed before the equipment is transported.

2.3.2 Mounting

1. The PRT is connected to the resistance measuring device (automatic resistance bridge or multimeter).
2. The thermometer is cleaned and carefully placed in the calibration media (bath, dry block, fixed point or cryostat).

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2.3.3 Precautions

- Pt100 are very sensitive device to vibration and mechanical shock.
- Check that the thermometer is completely clean and dry before placing them in the calibration media.
- Ensure that the thermometer is heated up to the room temperature and cleaned with alcohol, if necessary before placing it in the transportation box.

Refer to the manual or contact the Issuing NMI in a case of doubt about the above-mentioned precautions.

3 Calibration/Hybrid comparison method

After checking visually and cleaning the PRT, the actual temperature calibration is carried out.

For the purpose of checking the performance of the equipment (e.g. operation) during the progress of measurements, first the measurements as described in section Inspection/Start-up are carried out. Hereafter the actual temperature calibration is carried out.

It is recommended that the participants use their standard procedure during temperature calibration and avoid making extra time-consuming measurements, if possible. For NMI laboratories seeking the CMC acceptance, it will be advantageous to apply the standard procedures in preparation for later use of the report in relation with documentation to the EURAMET and RMOs review.

The participants will not perform any heat treatment to the PRT.

Details about the applied procedure can be stated in the report form and calibration certificate.

3.1 Inspection/Start-up

1. For the PRT the first measurement must be the triple point of water check.
2. Place the PRT in the triple point of water.
3. Wait long enough to get stable results (approximately 30 minutes).
4. Write the resistance of the SPRT for 1 mA and calculated for 0 mA, in the table in the report form.
5. If the difference with previous measurement at the triple point of water is larger than 2 mK, further steps are agreed between participants.

3.2 Measuring points

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The PRT Elpro Lepenik, type 2280 3870, serial number 651620922, range -200 °C to 500 °C is calibrated by comparison and at fixed point at increasing temperatures in the following points:

0,01 °C, -90 °C, -50 °C, -40 °C and -20 °C

At the end repeat the measurement at 0,01 °C.

3.3 Reporting of results

The results are reported electronically in the forwarded Excel spreadsheet as well as in the shape of the calibration certificate. The green fields of the spreadsheet should be filled in, if possible.

For the PRT the participant can calculate the calibration coefficients of the PRT.

In the report form, the participants are also asked to fill in details about the applied method, equipment and traceability, if this information does not appear on the issued calibration certificate.

The results shall be sent to the Issuing NMI no later than **2 weeks** after the equipment has left the laboratory. Electronic reporting by e-mail is preferred.

Final report

The participants will receive summary of all measurements, reference values and uncertainties of reference values, and evaluation of the degree of equivalence.

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4 Appendix A: Report form

Standard form for reporting of results and uncertainties for thermometer type (PRT) is shown below.

Results of hybrid comparison between IMBiH and and MIRS-UL/FE-LMK					
Name of Laboratory:					
Equipment calibrated (date, period):					
Initial check in the triple point of water					
thermometer resistance		ohm			
reference temperature	0,01	°C			
uncertainty of the reference temperature		°C			
Measurement results					
Based on measured resistance the participant should calculate coefficients of the calibrated PRT					
Set ¹⁾ °C	measured resistance ¹⁾ Ω	reference temperature ²⁾ °C	<i>U RT (95%)</i> ³⁾ °C	CMC ⁴⁾ °C	Measurement current mA
0,01					
-90,0					
-50,0					
-40,0					
-20,0					
0,01					
Ambient temperature			°C		
Ambient relative humidity			% r.h.		
Notes					
1)		Average value of measured resistance			
2)		Reference temperature of calibration bath or furnace measured by the participant			
3)		Expanded uncertainty of calibration			
4)		Calibration and measurement capability (CMC)			

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Description of equipment used					
State, if required, details concerning the used calibration procedure					
Used reference standards and traceability					
Reference standards (range)				Traceability*	
* by comparison or fixed points, institute/laboratory					
Used auxiliary measurement equipment and traceability					
Auxiliary measurement equipment (range)				Traceability*	
* by comparison or primary calibration, institute/laboratory					