



Hybrid comparison protocol

INSTRUCTION FOR THE PARTICIPANTS IN THE HYBRID COMPARISON

Title: Hybrid comparison with indication and resistance thermometer MIRS/UL-FE/LMK and NSAI 2019

Date:

1.9.2019

Items:

- i. standard platinum resistance thermometer

Issuing NMI:

University of Ljubljana, Faculty of Electrical Engineering
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 NSAI 2019

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1 Introduction

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

- i. standard platinum resistance thermometer

The circulating items is:

- i. Accumac, type AM1860-25, serial number 1620703, range -100 °C to 0 °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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E-mail: Dubhaltach.MacLochlainn@nsai.ie

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

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the transport between both laboratories. In this exceptional case, the Issuing NMI will hand-carry the thermometer to the Applicant NMI.

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.

The Issuing NMI will also act as the third party, responsible for the final check of the comparison report and will send the final report to the TC chair for approval.

If deadlines are respected, the participants will receive the report of the Hybrid comparison by the end of October 2019.

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.

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

2 Description of the equipment

2.1 General

The laboratory receives the following equipment:

- i. Accumac, type AM1860-25, serial number 1620703, range -100 °C to 0 °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

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1. The SPRT 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,...).

2.3.3 Precautions

- Pt25 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 cooled down 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 SPRT, 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 SPRT.

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

3.1 Inspection/ Initial stability check

1. For the SPRT the first measurement must be the triple point of water check.
2. Place the SPRT 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.

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3.2 Measuring points

The SPRT is calibrated by comparison at increasing temperatures in the following points:

0,01 °C, -98 °C, -85 °C, -75 °C, -50 °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 SPRT the participant can calculate the ITS-90 calibration coefficients of the SPRT.

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 from an issued calibration certificate.

The laboratories which normally issue calibration certificates (e.g. the accredited laboratories), should send a standard certificate to the Issuing NMI.

The results shall be sent to the Issuing NMI no later than **2 weeks** after having finalized the calibration. Electronic reporting by e-mail is preferred.

A stability check on the transfer standard will be carried out both at the beginning and upon return of the transfer standard to the Issuing NMI. The stability check consists of a triple point of water check of the transfer standard.

Final report

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

3.4 Measurement Uncertainty

The following are a list of the principal components of the uncertainty budget for the comparison:

Calibration Uncertainty of reference SPRT This is the uncertainty associated with the calibration of the reference SPRT used to compare to the measurements obtained with the transfer standard.

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SPRT drift This is the maximum expected drift of the reference SPRT between calibrations.

Resistance Bridge tolerance This is the maximum allowable deviation in resistance readings of the resistance bridge used to measure the reference SPRT transfer standard.

Standard Resistor Calibration Uncertainty The uncertainty associated with the calibration of the reference standard resistor, used in conjunction with the resistance bridge.

Standard Resistor drift The maximum expected drift of the standard resistor used in the calibration between calibrations.

Temperature Medium Stability The amount of variation in temperature over time associated with the ability of the calibration bath to maintain constant temperature conditions.

Temperature Medium Gradients The variation in temperature within the calibration volume of the calibration bath, due to temperature inhomogeneity within the liquid medium.

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4 Appendix A: Report form

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

Results of hybrid comparison between NSAI 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 ITS-90 coefficients of the calibrated SPRT					
Set ¹⁾ °C	measured resistance ¹⁾ Ω	reference temperature ²⁾ °C	<i>U</i> RT (95%) ³⁾ °C	CMC ⁴⁾ °C	Measurement current mA
0,01					
-100,0					
-98,0					
-85,0					
-75,0					
-50,0					
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					