EMPIR Call 2018 – Health, SI Broader Scope, Normative and Research Potential

Selected Research Topic number: **SRT-r04**
Version: 1.0

Title: Traceable measurement capabilities for monitoring thermocouple performance

Abstract

Thermocouples are amongst the most commonly used temperature measuring instrumentation. While new thermocouples have well-known properties, with use their behaviour can vary due to a change of chemical composition of the thermo-elements, causing inhomogeneity and drift. A comprehensive study of the parameters that cause changes to thermocouples, and the development of measurement techniques and appropriate measurement facilities are needed in order to quantitatively assess inhomogeneity and drift in thermocouples and their effect on temperature measurements.

Keywords

Thermocouples, ITS-90, homogeneity and drift of thermocouples, thermo-elements

Background to the Metrological Challenges

The measurement of temperature is crucial for many industrial processes, both to ensure the quality of the products and also for process efficiency and energy management. Thermocouples are commonly used for temperature measurement in these processes.

Knowledge of the lifetime and drift of thermocouples in these types of applications is of critical importance. At all levels of the traceability chain, from final user to the primary laboratory there is a lack of knowledge adapted to the needs, methods and devices for thermocouple performance metrics. These quantities are not very well known and usually thermocouples are replaced when necessary to ensure continued optimum process control. However, it can often be difficult for the user to decide when is optimal to replace the thermocouple. There are no standardised traceable measurement capabilities for the verification of performance of thermocouples during temperature measurement in industrial process. Furthermore, secondary calibration laboratories are required to determine the inhomogeneity of thermocouples while performing their calibrations. But standardised, easy-to-use methods and devices are not currently available.

At the level of primary laboratories, new and extended traceable measurement methods and devices are required that will provide confidence in the verification of thermocouple performance. These capabilities should enable the drift of the thermocouples to be identified and quantified and provide the ability to measure their physical changes and behaviour under conditions of typical use, including capabilities to check performance with varying temperature conditions in terms of temperature profile and heating and cooling cycling. This performance mapping would provide important input into the development of standardised test methods and performance metrics.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the development of metrological capacity for traceable measurements using thermocouples.

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The specific objectives are

1. To develop and test novel methods and devices for the monitoring of thermocouple drift in-situ. These methods should be suitable for implementing in critical industrial processes in order to assist the users in maintenance and replacement decisions.
2. To develop and test easy-to-operate methods and instruments for the assessment of inhomogeneities of thermocouples for secondary calibration laboratories.
3. To design and construct novel measurement facilities that can provide confidence in the verification of thermocouple performance and to identify and quantify the range of drift of the thermocouples. The new facilities, targeting the primary calibration laboratories, should have the ability to measure the physical changes and behaviour of thermocouples under typical conditions of the production and distribution processes.
4. For each participant, to develop an individual strategy for the long-term operation of the capacity developed, including regulatory support, research collaborations, quality schemes and accreditation. They should also develop a strategy for offering calibration services from the established facilities to their own country and neighbouring countries. The individual strategies should be discussed within the consortium and with other EURAMET NMIs/DIs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole.

Joint Research Proposals submitted against this SRT should identify

- the particular metrology needs of stakeholders in the region,
- the research capabilities that should be developed (as clear technical objectives),
- the impact this will have on the industrial competiveness and societal needs of the region,
- how the research capability will be sustained and further developed after the project ends.

The development of the research potential should be to a level that would enable participation in other TPs.

Proposers should note that the programme funds the activity of researchers to develop the capability, not the required infrastructure and capital equipment, which must be provided from other sources.

EURAMET has defined an upper limit of 500 k€ for the EU Contribution to any project in this TP, and a minimum of 100 k€.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 10 % of the total EU Contribution across all selected projects in this TP.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Provide a lasting improvement in the European metrological capability and infrastructure beyond the lifetime of the project,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health or protection of the environment,
- Transfer knowledge to the thermocouple sector and the metrology community.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.