

## **Title: Expansion of European research capabilities in humidity measurement**

### **Abstract**

The measurement of humidity and its control within certain limits is important for applications such as the manufacture and storage of food, textiles, wood, paper, electronics, photovoltaics, pharmaceuticals, industrial and medical gases, and many other products. The maintenance of electrical equipment, indoor climate and ventilation control and monitoring, and environmental and climate monitoring also requires reliable and accurate humidity measurement and calibration. Humidity sensors can drift significantly over time and therefore require regular calibration.

This topic is focussed on improving the research capability and availability of associated services in the field of humidity measurements, within countries or regions in Europe where access to this capability is currently limited. The developed capabilities will aim to support local industry and societal needs and those humidity needs of stakeholders in the region.

### **Keywords**

Humidity, traceability, dew-point temperature, relative humidity, uncertainty analysis, interlaboratory comparison

### **Background to the Metrological Challenges**

Humidity is a key parameter in controlling ambient conditions in many industrial processes as low humidity can promote electrical discharges, and high humidity can cause undesired chemical and physical changes in the actual process, the raw materials or the products produced or can unduly influence the lifetime of products. This can lead to poor or variable quality or performance of the manufactured products. The quality of humidity measurements also directly affects the productivity through energy and material efficiency. The printing industry needs to control humidity tightly because changes in humidity affect the handling properties of paper in high speed presses. In the energy sector, the humidity of high power switches must be monitored in order to prevent insulator breakdown and arcing, which poses a significant risk to health and safety as well as equipment damage. In the pharmaceutical sector, stability and accelerated age testing, as per ICH protocols (CPMP/ICH/2736/99) are required to ensure the intrinsic safety and quality of active substances and this requires humidity to be controlled and monitored. Humidity and moisture control is critical to the efficient functioning of hydrogen fuel cells, and therefore requires close monitoring at its operating temperature (60 °C to 90 °C). Photovoltaic modules must be thoroughly tested in order to guarantee their efficient operation. IEC61215, IEC61646, IEC61730-2 and IEC62108 provide testing regimes for the certification of photovoltaic modules, which involve subjecting the panels to a regime of different temperature and humidity in order to minimise the risk of failure in the field. Wood drying is a complicated process which requires that content of moisture left inside wood is optimal for post-production. Water activity is often used as a proxy for moisture content, where higher humidity can change active substances and decrease effectiveness of the product.

Air-conditioning systems in buildings often control humidity and significant energy may go into cooling the air to remove water vapour. Humidity measurements contribute both to achieving correct environmental

conditions and to minimising the energy cost of this. Water vapour is key agent in both weather and climate, and it is a key atmospheric greenhouse gas. Air humidity is a crucial parameter due to the enormous heat capacity of gaseous water and its key role in atmospheric processes. Traceable measurements of air humidity from the ground level up to the stratosphere are required.

During recent years, the development of humidity sensors and equipment has matured to a level where traceable calibration is beneficial to all industries in which humidity and moisture measurement and control are important. Humidity measurement techniques are diverse and each presents different challenges for use and calibration in a range of pressures and gases. The most common humidity sensors, based on capacitance measurement, can drift significantly over time and therefore require regular calibration. NMIs need to maintain standards in this field which allow them to provide fast, cost effective calibration services for the various instrument types. This might be achieved through primary standards for dew point and humidity or alternatively via secondary devices or transfer standard hygrometers. At present the humidity measurement and calibration capability in some European NMIs is limited; consequently the costs to industry in accessing reliable and accurate humidity calibration can be significant.

## 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 in humidity measurement.

The specific objectives are

1. For the participating countries wishing to develop research capabilities in humidity metrology to develop the relevant facilities and operating procedures. The parameters to be addressed eg relative humidity, dew point, moisture, gas species, and the measurement ranges to be covered must address existing documented industrial and stakeholder needs. The research to be undertaken in the project to address these needs and build capability must be clearly described in the proposal.
2. To develop and implement appropriate methods for measurement uncertainty evaluation for humidity, suitable for CMC submission or updates.
3. 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 new and/or improved 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 competitiveness 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 to the project. Any deviation from this must be justified.

## 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 calibration, testing and manufacturing sectors and the metrology community.

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

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.