EMPIR Call 2014 – Industry and Research Potential

Selected Research Topic number: **SRT-r02**
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Title: Traceable calibration of dynamic weighing instruments

Abstract

With the development of weighing technology, automatic weighing instruments (AWIs), which carry out measurements in a dynamic mode, are increasingly replacing the more traditional non-automatic instruments (NAWIs). However, while non-automatic weighing instruments are routinely calibrated by accredited calibration laboratories, the calibration of automatic weighing instruments is not as well defined.

There is therefore a need to develop reproducible calibration methods and measurement uncertainty evaluation models for different groups of AWIs, which operate in a dynamic mode. Proposers should also aim to increase expertise among EURAMET members in the provision of reliable traceability of automatic weighing instruments and to extend the range of EURAMET Guidance documents into the area of automatic weighing instruments.

Keywords

Mass, dynamic weighing, automatic weighing instruments, dynamic system analysis, calibration, traceability, measurement uncertainty, capacity building

Background to the Metrological Challenges

With the development of weighing technology, automatic weighing instruments, which carry out measurements in a dynamic mode, are increasingly replacing the more traditional non-automatic instruments. Notwithstanding a generally higher purchase price, automatic instruments are more effective and efficient to their users in the long term. Automatic weighing instruments do not require the intervention of an operator and thus the weighing process is faster and labour costs are lower. Improvements in the accuracy of automatic weighing instruments mean that they are now used in an increasing number of applications from micro to macro weighing. Automatic catchweighers and automatic gravimetric filling instruments are used in the preparation of pre-packed products; automatic instruments are used for weighing road vehicles in motion, automatic rail-weighbridges replace non-automatic weighing bridges, belt weighers and totalising hopper weighers are used for transhipment of large quantities of bulk material.

While non-automatic weighing instruments are routinely calibrated by accredited calibration laboratories, the calibration of automatic weighing instruments is not as well defined. Due to the variety of AWIs and their dynamic operation, there is no standard approach on how to calibrate AWIs. Users of AWIs need information on the deviation in the AWI results and their uncertainty.

For the evaluation of the measurement uncertainty all relevant influences have to be taken into account. OIML Recommendations for AWIs are limited only to the required accuracy of the reference standards (weight, control weighing) and do not take into account factors which influence the indication of the instrument. Producers and users of weighing instruments find that the methods for validation and calibration of automatic weighing applications are vague and can be interpreted in a variety of ways.

At present automatic weighing systems are often only checked in a static way, not dynamically as they are used in practice. This is misleading for all parties concerned, since dynamic operation can introduce additional sources of errors and influences that may not be apparent when calibrated statically. For industries choosing between automatic and non-automatic instruments, it is vital that the measurement uncertainty, repeatability, etc be available and comparable for both types of weighing systems. The same applies to determining the weighing instrument performance at varying speed of the automatic instruments. There are currently only limited reliable and traceable data for the connection between speed and weighing performance.

The EURAMET Guidelines on the Calibration of Non-Automatic Weighing Instruments EURAMET/cg-18 is a well-established guide which is now commonly used by laboratories. It is recognised by accreditation bodies

as a standard method for calibration of NAWI. The development of calibration techniques and associated uncertainty formulation will drive the establishment of a new Guide on Automatic Weighers or the revision of EURAMET/cg-18 to integrate the methods devised for the calibration of dynamically operated automatic weighing instruments.

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 proposal.

The JRP shall focus on the development of reproducible calibration methods and measurement uncertainty evaluation models for different groups of Automatic Weighing Instruments (AWIs), which operate in a dynamic mode. The aim should also be to increase expertise among EURAMET members in the provision of reliable traceability of automatic weighing instruments.

The specific objectives are

1. To develop and validate appropriate measurement methods for the calibration of AWIs. The results from the developed dynamic calibration procedures should be compared with static measurement of weighed objects. The relevant specific content of a calibration certificate for calibration of an AWI should be defined. The reproducibility of methods developed should be confirmed by dynamic comparison measurements between EURAMET NMIs.
2. To develop error models for the dynamic weighing process for these groups of automatic weighing instruments and to determinate potential sources of contributions to the measurement uncertainty for these instruments.
3. To develop a measurement uncertainty budget for the determination of the uncertainty of measurement for the calibration of AWIs and for the determination the uncertainty of a weighing result. The measurement uncertainty budgets should be validated by comparisons, cross-checking with static methods and others.
4. To harmonise expertise related to establishment of suitable traceability of weighing instruments which operate in dynamic mode among EURAMET NMIs and to develop EURAMET Guide(s) for the calibration of AWIs.
5. For each participant to develop an individual strategy for the long-term development of their research capability in dynamic mass metrology including priorities for collaborations with the research community in their country, the establishment of appropriate quality schemes and accreditation (e.g. participation in key comparisons, the entry of CMCs into the BIPM database, accreditation to ISO/IEC 17025). 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.

Proposers shall give priority to work that meets documented metrological needs and activities that will lead to an improvement in European metrological capability and infrastructure beyond the lifetime of the project.

Proposers should establish the relevant current capability for research, and explain how their proposed project will develop capability beyond this.

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,
- Transfer knowledge to the weighing 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”.

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 to 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.