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## Acoustic thermodynamic calibration of capsule-type standard resistance thermometers between 10 K and 25 K

Roberto Gavioso<sup>1</sup>, Dario Imbraguglio<sup>1</sup>, Daniele Madonna Ripa<sup>1</sup>, Peter Steur<sup>1</sup>

<sup>1</sup>Istituto Nazionale di Ricerca Metrologica (INRIM), Torino, Italy

Corresponding Author: [r.gavioso@inrim.it](mailto:r.gavioso@inrim.it)

Gavioso ORCID: 0000-0002-1631-5133; Imbraguglio ORCID: 0000-0002-1289-772X

Madonna Ripa ORCID: 0000-0002-8760-8574; Steur ORCID: 0000-0001-5161-8554

In the context of the EMPIR research project “Realizing the Redefined Kelvin” (Real-K)<sup>1</sup> [1], we have implemented absolute acoustic gas thermometry [2] between 10 K and 25 K to evaluate the performance of this method for the direct thermodynamic calibration of capsule-type resistance thermometers on the thermodynamic temperature scale. Our implementation of acoustic thermometry is based on speed of sound measurements in He at a single pressure, chosen in the range between 65 kPa and 125 kPa, at each temperature calibration point, with non-ideality corrections relying on the accurate ab initio calculations of the thermophysical properties of He.

From the acoustic calibration of RhFe and Pt capsules, previously calibrated on ITS-90, we determine  $(T-T_{90})$  differences between the thermodynamic temperature  $T$  and its approximation  $T_{90}$  by the International Temperature Scale of 1990 (ITS-90), finding them in remarkable agreement with the 2022 consensus estimate [3] of these differences within the small combined uncertainties.

We discuss the advantages of acoustic thermodynamic calibration compared to ITS-90 calibration both in terms of achievable uncertainty and practicality of use.

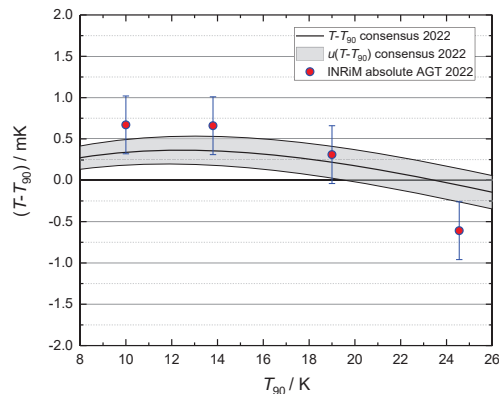


Fig. 1 Differences  $(T-T_{90})$  determined using absolute acoustic gas thermometry between 10 K and 25 K.

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