



NATIONAL INSTITUTE OF METROLOGY

Thermometry laboratory

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INM

Historical background

- ★ The Thermometry Laboratory in INM was set up in 1951:
 - various cell models for the thermometric fixed points have been used
 - studies on TPW led to the construction of cells with good qualities
 - **the BIPM comparison of TPW cells (Rapport BIPM-96/8, Document CCT/96-1, 1996)**
 - in 1981, a set of crucibles and furnaces was put in place for the freezing points of Sn, Zn, Sb, Ag, and Au
 - the obtained values satisfied the needs of the time.

Basic activities

- ★ The Thermometry Laboratory:
 - has developed and maintained the national temperature references in the most usual range, between $-200\text{ }^{\circ}\text{C}$ and $2\ 200\text{ }^{\circ}\text{C}$,
 - ensures the traceability of their values to the ITS-90,
 - disseminates the unit of temperature to the user community.

Contact thermometry

- ★ The laboratory has designed and built all the fixed points of ITS-90 from $-189\text{ }^{\circ}\text{C}$ to $1\ 085\text{ }^{\circ}\text{C}$: Ar, Hg, Ga, In, Sn, Zn, Al, Ag, Au, Cu.
- ★ Between $-189\text{ }^{\circ}\text{C}$ and $660\text{ }^{\circ}\text{C}$, the laboratory realizes the ITS-90 according to its definition
- ★ The national standard consists of:
 - ★ apparatus for the realization of the fixed points,
 - ★ a group of SPRTs and HTSPRTs.

Contact thermometry

- ✦ **From 660 °C to 1 085 °C**, the national standard consists of:
 - apparatus for the realization of the fixed points,
 - a group of reference S-type thermocouples, made in the laboratory.
- ✦ The provided level of accuracy meets the requirements that exist in Romania.

Radiation thermometry

- ★ The national temperature scale is realized with a linear monochromatic photoelectric pyrometer, traceable to PTB Germany. It is the reference standard of Romania from 800 °C to 2 200 °C.

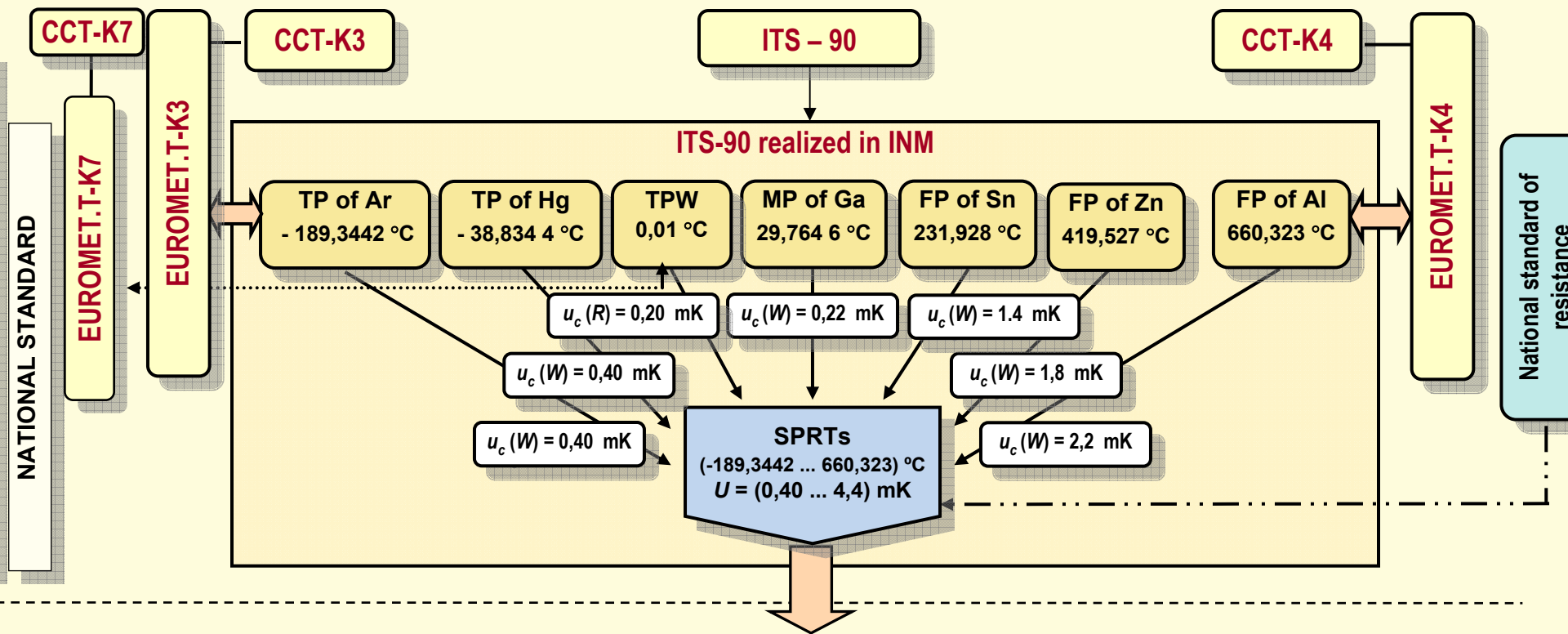
Recent achievements

- **Extending the national temperature standard to the triple point of Ar (-189,344 2 °C):** The laboratory has built in 2001 an apparatus for the realization of the triple point of argon, on the model of BNM-INM/CNAM France.
- **Automating the processes for measurement, data acquisition and processing** in SPRTs and reference thermocouples calibration at the defining fixed points.
- **Realization of the national standard at primary level, between 420 °C and 660 °C,** using SPRTs and the freezing point of Al cell.

Quality System

- ★ The laboratory performs calibrations and issues calibration certificates which fulfill the requirements of standard EN ISO/CEI 17025/2001.
- ★ Quality documents:
 - ★ Laboratory *Quality Manual*,
 - ★ 7 specific procedures,
 - ★ 20 working instructions.
- ★ Uncertainty budgets are contained within Quality Documents and are calculated according to the requirements of ISO GUM.

TEMPERATURE: SPRTs CALIBRATION FROM -189,344 2 °C TO 660,323 °C



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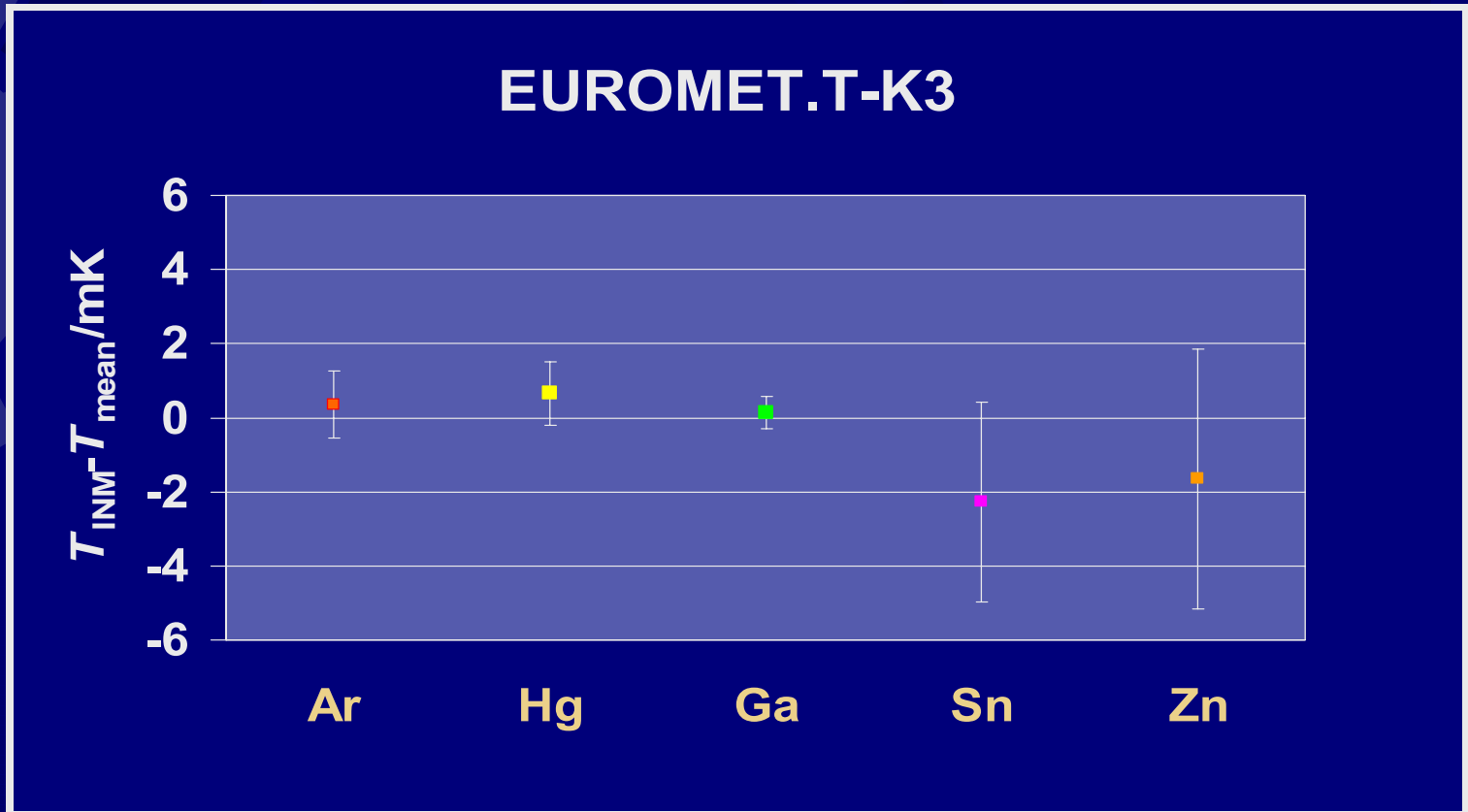
EUROMET.T-K3 (Project 552)

- ★ Comparison of the realisations of ITS-90 from 83,805 8 K to 692,677 K
 - **Pilot laboratory: BNM-INM/CNAM**
 - **Co-pilot laboratories: IMGCC, NMi/VSL, NPL, PTB, SMU**
 - **Participant laboratories: 25**
 - **Period: 2000-2004**
- ★ The laboratory has carried out the measurements in May-June 2003



EUROMET.T-K3 (Project 552)

RESULTS OF THE INM (RO)





EUROMET.T-K3 (Project 552)

- ★ Results obtained in the EUROMET.T-K3 allowed identification and fixing of weak points in realizing the ITS-90 over this range.
- ★ The laboratory has purchased in 2005 fixed point cells for Sn and Zn with metal with adequate purity.



EUROMET Project 713

- ★ “Traceability of the ITS-90 fixed points” - bilateral Project with BNM-INM/CNAM
- ★ The results:
 - confirmed the value obtained in the EUROMET.T-K3 at the freezing point of Zn
 - demonstrated a very good quality of the Ag freezing point cell
 - showed a serious problem with the Al freezing point cell.
- ★ The laboratory has purchased in 2005 a fixed point cell for Al with adequate purity, which has been used in EUROMET.T-K4.



EUROMET.T-K4 (Project 820)

- ★ “Comparison of the realisations of the ITS-90 at the freezing points of Al (660,323 °C) and Ag (961,78 °C)”
 - Pilot laboratory: PTB
 - Participant laboratories: 24
 - Period: 2004-2006
- ★ The laboratory has carried out the measurements in July-August 2005

Future Projects

- ★ EUROMET Project 844 “Comparison of Pt/Pd thermocouples calibrated at the freezing points of copper and silver”
 - ✿ The comparison will establish the calibration and measurement capabilities of the reference thermocouples at the fixed points.
 - ✿ The laboratory will carry out the measurements in March-April 2006.
- ★ EUROMET.T-K7 “Comparison of the triple point cells”

Dissemination of unit of temperature

☀ Calibrations by

- direct measurement at the defining fixed points, or
- comparison.

☀ Standards and equipments used:

- a set of secondary cells and apparatus for fixed points,
- SPRTs, reference S-type thermocouples, digital system thermometers, liquid-in-glass thermometers,
- liquid nitrogen cryostat (from $-160\text{ }^{\circ}\text{C}$ to $-30\text{ }^{\circ}\text{C}$),
- various temperature baths,
- furnaces of various types,
- variable temperature blackbodies,
- strip lamps.

Future developments

✦ From 660 °C to 962 °C:

- ✦ Realization of the national standard at primary level, using HTSPRTs and the existing freezing point of Ag.

✦ Above 962 °C:

- Realization of the primary standard, by developing blackbodies at the freezing points of silver and copper, to be used with the existing pyrometer.



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