



Cell for realization of the Triple point of the water



Realization of the triple point of argon



Furnace with Freezing Point of copper

The Temperature Laboratory is responsible for the development of the national standards of temperature and relative humidity and has the following duties:

- The realization of the International Temperature Scale of 1990 (ITS-90) on the fixed points between the triple point of Argon (-189,3442 °C) and the freezing point of Silver (961,78 °C);
- The realization of the ITS90 based on Planck radiation, with the freezing point of Copper (1084,62 °C);
- To assure the traceability on Temperature measurements on the measuring interval from -190 °C to 2500 °C;
- Calibrate reference standards of secondary laboratories, accredited laboratories and industry;
- Participate and coordinate interlaboratorial comparisons;
- Technical support to the legal metrology.

International System Base Unit of Temperature (T)

kelvin (K) defined as:

the SI unit of thermodynamic temperature. It is defined by taking the fixed numerical value of the Boltzmann constant k to be $1,380\ 649 \times 10^{-23}$ when expressed in the unit J K^{-1} , which is equal to $\text{kg m}^2 \text{s}^{-2} \text{K}^{-1}$, where the kilogram, metre and second are defined in terms of h , c and $\Delta\nu_{\text{CS}}$.

Derived unit of the International System of the temperature quantity (t):

degree Celsius (°C) defined by the equation:

$t = T - T_0$, where $T_0 = 273,15$ K is the ice point. The unit of Celsius temperature unity is by definition equal in magnitude to the kelvin.

The unit of Relative Humidity quantity (U_w) with respect to water:

Symbol (%) defined as follows:

The ratio of the actual vapour pressure (e) to the saturation vapour pressure (e_w) over a plane liquid water surface at the same temperature t (°C), expressed as percentage. This is commonly understood when the term "X percent relative humidity" is used.

$$U_w = \frac{e}{e_w} \times 100$$

The traceability to SI units is achieved through the realization of the Fixed Points of ITS-90 and appropriate resistance standards.

Calibration

EQUIPMENT	RANGE	UNCERTAINTY
Contact Thermometry Thermometers	-75 °C to 0 °C	0,01 °C
Temperature Sensors	0°C to 20 °C	0,005 °C
Standard Platinum Resistance Thermometers	20 °C to 50 °C	0,007 °C
Comparison at stirred liquid bath	50 °C to 100 °C	0,010 °C
	100 °C to 200 °C	0,020 °C
	300 °C to 450 °C	0,035 °C
Contact Thermometry Thermometers	0 °C to 300 °C	0,4 °C
Temperature Sensors	300 °C to 600 °C	0,5 °C
Noble -metal thermocouples Type S and R Comparison at heat pipe	600 °C to 900 °C	0,7 °C
	900 °C to 1050 °C	1,0 °C
Contact Thermometry Liquid-in-glass thermometers Comparison at stirred liquid bath	-40 °C to 0 °C	0,01 °C
	0 °C to 50 °C	0,005 °C
	50 °C to 100 °C	0,01 °C
	100 °C to 200 °C	0,01 °C
	200 °C to 300 °C	0,1 °C
Non-contact Temperature Radiation thermometers Optical pyrometers	300 °C to 450 °C	0,2 °C
	Ice point	0,5 °C
	30 °C to 500 °C	0,5 °C
	500 °C to 1600 °C	0,1 %
Measuring instruments of relative humidity	1600 °C to 2500 °C	0,2 %
	10 % to 90 %	2 %
Platinum Resistance Thermometers	Liquid nitrogen boiling point \approx 77 K (-196 °C) (by comparison)	$5 \cdot 10^{-3}$ °C
	83,8058 K (argon triple point) to 273,16 K (water triple point)	$2 \cdot 10^{-3}$ °C
	-38,8344 °C (mercury triple point) to 29,7646 °C (gallium melt point)	$1 \cdot 10^{-3}$ °C
	0 °C to 29,7646 °C (gallium melt point)	$1 \cdot 10^{-3}$ °C
	0 °C to 156,5985 °C (indium freeze point)	$3 \cdot 10^{-3}$ °C
	0 °C to 231,929 °C (tin freeze point)	$3 \cdot 10^{-3}$ °C
	0 °C to 419,527 °C (zinc freeze point)	$5 \cdot 10^{-3}$ °C
	0 °C to 660,323 °C (aluminium freeze point)	$1 \cdot 10^{-2}$ °C
	0 °C to 961,78 °C (silver freeze point)	$5 \cdot 10^{-2}$ °C
	Noble metal thermocouples	231,929 °C (tin freeze point)
419,527 °C (zinc freeze point)		0,4 °C
660,323 °C (aluminium freeze point)		0,4 °C
961,78 °C (silver freeze point)		0,4 °C
Optical pyrometers	Copper freeze point (1084,62 °C)	0,5 °C



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Metrological Control

EQUIPMENT	TESTS	LEGISLATION
Measuring Instruments and Temperature recorders used for the control of ultra-frozen food in transport and store houses.	Pattern Approval	Law n.º 1129/2009, 1 st october

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