

INCONSISTENCY OF CALIBRATION RESULTS OF INDUSTRIAL PLATINUM RESISTANCE THERMOMETERS CALIBRATED ACCORDING TO THE ITS-90 IN THE H₂O TO Zn RANGE

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According to their sensitivity, there are two types of industrial platinum resistance thermometers (IPRT). One of those (of higher sensitivity; $\alpha 392$) regularly fulfil with the W -criteria required for an interpolating instrument of the ITS-90 [1]. Consequently, the calibration of these instruments through the ITS-90 procedure is an option.

Those IPRTs of low sensitivity ($\alpha 385$) are no suitable to be used as interpolating instruments of the ITS-90 but they are used as approximating instruments [2].

The improving of the calibration results of IPRTs obtained by using the ITS-90 procedure were compared with the Callendar Van Dusen model and presented at Tempmeko-2001 [3]. In this document we present an evaluation of the inconsistency of calibration results of a set of IPRTs.

Experimental

We calibrated a set IPRTs in the H₂O, Ga, In Sn and Zn points. The parameters a and b of the ITS-90 deviation function,

$$W(T_{90}) - W_r(T_{90}) = a[W(T_{90}) - 1] + b[W(T_{90}) - 1]^2, \quad (1)$$

were calculated using the W corresponding values for Sn and Zn fixed-points.

At Ga and In points we calculated the temperature error (e) of each IPRT by comparing the calculated W value at the fixed point (W_c) and the experimental one (W_e) thus e is defined as

$$e/K = T(W_c) - T(W_e) \quad (2)$$

Results

In table I we present the results obtained with those IPRTs that have $W(29.7646\text{ }^\circ\text{C}) > 1.11807$.

Table I. Error values of a set of IPRTs with $W(\text{Ga}) > 1.11807$, calibrated in the H_2O to Zn fixed-points range. The first column is the identification number; the second is the experimental W value at Ga point; third and fourth columns are the temperature error (e) of the calculated value related to the experimental one.

IPRT Id.	$W(\text{Ga})$	$e(\text{Ga})/\text{mK}$	$e(\text{In})/\text{mK}$
74	1.118 165	-2.5	3.2
115	1.118 104	0.4	-1.8
143	1.118 085	-5.3	0.6
141	1.118 071	4.7	7.0
144	1.118 097	2.7	4.4
148	1.118 095	3.5	6.1
154	1.118 108	0.3	0.3
155	1.118 113	-0.7	0.2
156	1.118 103	2.0	3.7
157	1.118 092	1.1	5.0
158	1.118 122	1.2	3.5
183	1.118 081	2.1	-1.5
217	1.118 111	0.6	0.5
233	1.118 111	-3.2	1.4
234	1.118 098	0.9	-2.2
250	1.118 097	1.6	0.2

Another set of IPRTs with $W(29.7646) < 1.11807$ is shown in table II.

Table II. Error values of a set of IPRTs with $W(\text{Ga}) < 1.11807$, calibrated in the H_2O to Zn fixed points range. The first column is the identification number; the second is the experimental W value at Ga point; third and fourth columns are the temperature error (e) of the calculated value related to the experimental one.

IPRT Id	$W(\text{Ga})$	$e(\text{Ga})/\text{mK}$	$e(\text{In})/\text{mK}$
139	1.117 871	-8.6	-11.2
142	1.118 059	4.3	4.9
148a	1.115 989	-0.7	-5.6
170	1.118 040	2.2	-3.4
160	1.117 771	-13.5	-14.6
171	1.115 965	11.2	-14.4
180	1.115 826	7.2	2.5

Discussion

The standard deviation (2σ) of the errors of IPRTs of table I is 5 mK; while for IPRTs of table II is 14 mK. These values provide an order of magnitude of the expected performance of IPRTs when calibrated by fixed points in the H_2O to Zn range.

References

- [1] Preston-Thomas, H. (1990). The International Temperature Scale of 1990 (ITS-90). *Metrologia* **27**, 3-10, 27.
- [2] BIPM 1990. Techniques for Approximating the International Temperature Scale of 1990.
- [3] Méndez-Lango, E., Ramirez-Bazán, R. (2001). Calibration of Industrial type Platinum Resistance Thermometers by ITS-90 Fixed Points. Proceedings of Tempmeko 2001, in press.