

ORGANIZATION OF A PROFICIENCY TEST ON THE CHARACTERIZATION OF THERMOSTATIC CHAMBERS

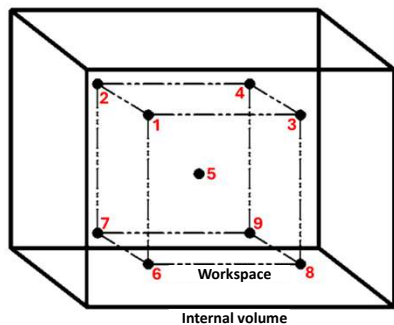
Boris GEYNET – CT2M – bgeynet@ct2m.fr

Context

➤ In 2024, the CT2M (Centre Technologique Méditerranéen de Métrologie), in partnership with the Côte d'Or departmental laboratory, organized an inter-laboratory comparison on the characterization of a thermostatic chamber. There were 26 participants from France and abroad. The comparison was based on the characterization at 37°C of a thermostatic chamber located in the Côte d'Or departmental laboratory in Dijon (France). The recommended characterization method to be used by participants is the one described in FD X15-140. Each participant carried out the characterization of the incubator using their own resources (temperature probes, data acquisition unit, etc.)

1- PT ITEM AND CHARACTERISATION METHOD

- ✓ **PT item:** Refrigerated incubator "FIRLABO Bioconcept BCR240" with an internal volume of 240L.
- ✓ **Recommended characterization method:** FD X15-140 or any other method provided that the results requested can be supplied.
- ✓ **Results provided by participants:**
 - the average temperatures at each of the 9 points in the volume (at the center and at each of the corners of the workspace) and their associated uncertainties,
 - the average temperature of the air in the workspace and its associated uncertainty.

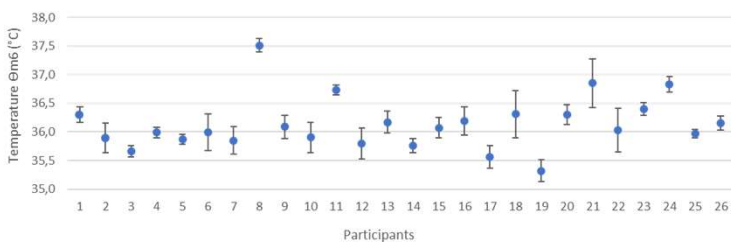


2- PARTICIPANTS' RESULTS

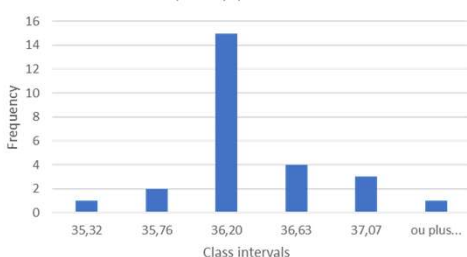
For each of the 9 points and the mean temperature, a frequency plots and a graph have been drawn:

- ✓ The distribution of results is symmetrical and follows a normal distribution
- ✓ Results are presented below for the point 6 :

Participants' results – Θm6



Frequency plot - Θm6



3- ASSIGNED VALUES AND PERFORMANCE EVALUATION

Two assigned values:

- ✓ **Robust mean x^*** determined from the participants' results (ISO 13528 - Algorithm A) after removing outliers.
- ✓ **Reference value x_{ref}** : weighted average of results traceable to the SI, i.e. the results of ISO 17025 accredited participants (weighting based on the uncertainties of the individual results).

Mesurand	Values number	Robust mean and standard deviation (°C)			Reference values (°C)		Score En
		x^*	S^*	$U(x^*)$ à $k=2$	x_{ref}	$U(x_{ref})$ à $k=2$	
Θ _{m1}	25	36,871	0,125	0,063	36,94	0,22	-0,3
Θ _{m2}	25	37,033	0,155	0,078	37,18	0,16	-0,8
Θ _{m3}	25	36,857	0,190	0,095	36,88	0,19	-0,1
Θ _{m4}	25	36,882	0,181	0,090	36,96	0,12	-0,5
Θ _{m5}	24	37,068	0,107	0,054	37,14	0,12	-0,5
Θ _{m6}	26	36,09	0,37	0,18	36,19	0,35	-0,3
Θ _{m7}	25	36,09	0,29	0,14	36,01	0,36	0,2
Θ _{m8}	25	36,64	0,28	0,14	36,72	0,35	-0,2
Θ _{m9}	26	36,43	0,47	0,23	36,10	0,52	0,6
Θ _{air}	26	36,667	0,115	0,056	36,68	0,22	-0,1

Two different performance scores:

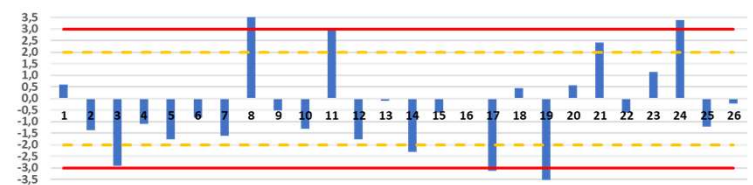
- ✓ **Score z**: comparison with robust mean x^* and interpretation using the PT standard deviation S^* .
- ✓ **Score zêta**: comparison with reference value x_{ref} and interpretation taking account uncertainties.

$$z = \frac{(x_{lab} - x^*)}{S^*} \quad \zeta = \frac{x_{lab} - x_{ref}}{\sqrt{u_{lab}^2 + u_{x_{ref}}^2}}$$

Z-scores (Point 6)



Scores zêta (Point 6)



Participants' performance		Interpretation
Score z	Score zêta	
Acceptable	Acceptable	Acceptable result.
Acceptable	Unacceptable	No significant bias compared with other participants. Bias in relation to the reference value and/or possible underestimation of uncertainty.
Unacceptable	Acceptable	Bias in relation to other participants. No bias in relation to the reference value or bias covered by the participant's uncertainty.
Unacceptable	Unacceptable	Significant bias.