LABORATOIRE NATIONAL DE MÉTROLOGIE ET D'ESSAIS
LABORATOIRE DE TRAPPES
29, avenue Roger Hennequin - 78197 Trappes Cedex
Tél : 01 30 69 10 00 - Fax : 01 30 69 12 34

CALIBRATION CERTIFICATE

N° P234518/3

Issued for : **HEMMER - GV PRUFGERATE OG**
KUGELBERGSTRASSE 30
8112 GRATWEIN-STRASSENGEL
AUSTRIA

Order : **29/08/2023 – Order n° 757/2023**

CALIBRATED INSTRUMENT

Designation : **Calorimeter Langavant**

Manufacturer : /

Type : / Serial N° : **AE06 N°14**

This certificate includes **4** pages Date : **December 13th, 2023**

THE MANAGER
ACCREDITED LABORATORY

Jacques HAMEURY

cofrac
ETALONNAGE
Accréditation
N° 2-56
Portée disponible
sur www.cofrac.fr

1. IDENTIFICATION OF THE EQUIPMENT

The identification of the Langavant calorimeter to be calibrated is : **AE06 N°14**.

2. METHOD OF CALIBRATION

Calibration of the calorimeter is carried out according to standard NF EN196-9 (December 2010).

The scope of the calibration procedure is to determine its thermal transmission coefficient $\alpha=a\cdot\theta+b$ in function of the temperature rise θ and the thermal capacity μ of the calorimeter.

An aluminum calibration cylinder with a heater of resistance R is placed into the calorimeter to be calibrated. This cylinder, externally equal in size to the mortar box, has a thermal capacity of 1855 $J°C^{-1}$ and a resistance of 2012,5 Ω.

An identical calorimeter containing an inert mixture of cement, water and sand is placed close to the calorimeter to be calibrated. This calorimeter is used as a temperature reference.

The heater is connected to an external power supply set at a constant DC voltage. When the thermal steady state is obtained, the thermal transmission coefficient α is determined through the measurement of :

- the electrical power supplied to the calibration cylinder by Joule effect,
- the temperature difference θ, between the temperature of the calibration cylinder and the temperature reference.

The thermal capacity μ of the calorimeter is calculated from the cooling rate of the calorimeter when the DC power supply is switched off.

3. CONDITIONS OF CALIBRATION

The calibration is performed in an air conditionned room maintained at 20°C ± 1°C. The air velocity around the calorimeters is less than 0.5 $m.s^{-1}$.

All temperatures, voltages and electrical resistance are measured with calibrated apparatuses.

Calibration certicate to be followed on next page

4. RESULTS OF CALIBRATION

4.1. MEASUREMENT OF THE THERMAL TRANSMISSION COEFFICIENT α

Temperature of the calibration cylinder (°C)	28.77	32.39	37.39	43.60	52.73
Reference temperature (°C)	19.96	19.98	19.92	20.01	19.98
Overheating θ (°C)	8.81	12.41	17.47	23.59	32.74
Voltage (V)	20.297	24.260	28.989	34.021	40.518
Power (W)	0.205	0.292	0.418	0.575	0.816
α ($J \cdot h^{-1} \cdot °C^{-1}$)	83.63	84.83	86.06	87.77	89.69

In steady state, the equation of power as a function of heating is:

$$P = \alpha * \theta$$

The coefficient α being practically a linear function of θ :

The equation of the line is: **$\alpha = 81.92 + 0.239 \cdot \theta$ ($J \cdot h^{-1} \cdot °C^{-1}$)**

The linear correlation coefficient is equal to 0,99.

4.2. MEASUREMENT OF THERMAL CAPACITY CALORIMETER μ

Time (h)	0	22	24	26	28
Temperature of the calibration cylinder (°C)	52.72	35.21	34.21	33.28	32.41
Reference temperature (°C)	19.98	20.00	20.00	20.00	20.00
Overheating θ (°C)	32.74	15.21	14.21	13.28	12.41
Heat capacity of the calorimeter μ ($J \cdot °C^{-1}$)	/	652	653	653	654

The average thermal capacity: **$\mu = 653\ J \cdot °C^{-1}$**

Calibration certicate to be followed on next page

5. SUMMARY OF RESULTS

Equipment reference	:	CALORIMETER Langavant No. **AE06 N°14**
Calibration date	:	28/09/2023 to 01/12/2023
Calibration performed by:		Marc Grélard

Thermal transmission coefficient α	$\alpha = 81.92 + 0.239 \cdot \theta$ $(J \cdot h^{-1} \cdot °C^{-1})$
Average thermal capacity	$\mu = 653\ J \cdot °C^{-1}$

Uncertainty of the thermal transmission coefficient α : $\pm$ 1 $J \cdot h^{-1} \cdot °C^{-1}$
Uncertainty of the average thermal capacity μ : $\pm$ 70 $J \cdot °C^{-1}$

The expanded uncertainties mentioned are those corresponding to twice the combined standard measurement uncertainty.
The expanded intervals correspond to a 95% coverage probability

This calibration certificate guarantees the connection of the calibration results in International System of Units (SI).

Results only relate the instrument received from the client and submitted for evaluation and as defined in this document.

End of calibration certificate