Calibration of a weight of nominal value 10 kg

The calibration of a weight of nominal value 10 kg of OIML class M1 is carried out by comparision to a reference standard (OIML class F2) of same nominal value using a mass comparator whose performance characteristics have previously been determined.

Model Equation:

$$m_X = m_S + \delta m_D + \delta_m + \delta m_C + \delta_B$$

List of Quantities:

Quantity	Unit	Definition
m_X	g	conventional mass of the unknown
m_S	g	conventional mass of the standard
δm_D	g	change of value of the standard since its last calibration due to drift
δ_m	g	observed difference in mass between the unknown mass and the standard
δm_C	g	correction for eccentricity and magnetic effects
δ_B	g	correction for air buoyancy

m_S: Type B normal distribution
Value: 10000.005 g
Expanded Uncertainty: $45 \cdot 10^{-3}$ g
Coverage Factor: 2

REFERENCE STANDARD: The calibration certificate for the reference standard gives a value of 10 000,005 g with an associated expanded uncertainty of 45 mg (coverage factor k=2)

δm_D: Type B rectangular distribution
Value: 0 g
Halfwidth of Limits: $15 \cdot 10^{-3}$ g

DRIFT OF THE VALUE OF THE STANDARD: The drift of conventional mass of the reference standard is estimated from previous calibrations to be zero within limits ±15 mg

δ_m: Type A
Method of observation: Indirect SUUS
Number of observations: 3

No.	Hint	Reading	Observation
1	Standard	0.010 g	
	Unknown	0.020 g	
	Unknown	0.025 g	
	Standard	0.015 g	0.0100 g
2	Standard	0.025 g	
	Unknown	0.050 g	
	Unknown	0.055 g	
	Standard	0.020 g	0.0300 g
3	Standard	0.025 g	
	Unknown	0.045 g	
	Unknown	0.040 g	
	Standard	0.020 g	0.0200 g

Arithmetic Mean: 0.02000 g
Pooled Standard Deviation: $25 \cdot 10^{-3}$ g
Pooled Degrees of Freedom: 50
Standard Uncertainty: 0.01420 g

COMPARATOR / OBSERVATION: A previous evaluation of the repeatability of the mass difference between two weights of same nominal value gives a pooled estimate of standard deviation of 25 mg.

δm_C: Type B rectangular distribution
Value: 0 g
Halfwidth of Limits: $10 \cdot 10^{-3}$ g

COMPARATOR: No correction are applied for the comparator whereas the uncertainty due to eccentricity and magnetic effects is estimated to have rectangular limits of ±10 mg

δ_B: Type B rectangular distribution
Value: 0 g
Halfwidth of Limits: $10 \cdot 10^{-3}$ g

AIR BUOYANCY: No correction is made for the effects of air boyancy, the limits of deviation are estimated to be $\pm 1.0 \cdot 10^{-6}$ of the nominal value

Uncertainty Budgets:

m_X: conventional mass of the unknown

Quantity	Value	Standard Uncertainty	Distribution	Sensitivity Coefficient	Uncertainty Contribution	Index
m_S	10000.00500 g	0.02250 g	normal	1.0	0.022 g	59.6 %
δm_D	0.0 g	$8.660 \cdot 10^{-3}$ g	rectangular	1.0	$8.7 \cdot 10^{-3}$ g	8.8 %
δ_m	0.02000 g	0.01420 g	normal	1.0	0.014 g	23.7 %
δm_C	0.0 g	$5.774 \cdot 10^{-3}$ g	rectangular	1.0	$5.8 \cdot 10^{-3}$ g	3.9 %
δ_B	0.0 g	$5.774 \cdot 10^{-3}$ g	rectangular	1.0	$5.8 \cdot 10^{-3}$ g	3.9 %
m_X	10000.02500 g	0.02915 g				

Results:

Quantity	Value	Expanded Uncertainty	Coverage factor	Coverage
m_X	10000.025 g	0.058 g	2.00	95% (t-table 95.45%)