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BILATERAL SUPPLEMENTARY COMPARISON EURAMET.M.M-S6 BETWEEN DMDM (Serbia) AND BoM (Macedonia)

(EURAMET 1228)

Comparison of 20 kg mass standard provided by DMDM

Final Report

by

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Abstract:

The intention of this bilateral comparison between DMDM (Serbia) and BoM (Macedonia) is to provide evidence of metrological equivalence of BoM in the field of mass standard calibration. It will be used as supplement support for submission of CMC entries by BoM for 20 kg mass standard. This comparison was coordinated by DMDM.

This bilateral comparison is registered as supplementary comparison «EURAMET.M.M-S6» (EURAMET project No. 1228) in a KCDB BIPM.

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Aim of the comparison

The aim of this bilateral comparison between Mass laboratory of Directorate of Measures and Precious Metals (DMDM) - Serbia and Mass laboratory of Bureau of Metrology (BoM) - Macedonia is to provide evidence of metrological equivalence of BoM in the field of mass standard calibration, to give confidence of the technical capacity and to support the capabilities of BoM for submission of CMC entries at 20 kg. This comparison gives objective evidence about the technical competence of the BoM mass laboratory, and it assist in identifying opportunities to improve the metrological assurance system.

Organization

For this bilateral comparison Directorate of Measures and Precious Metals (DMDM), Serbia, undertook the role of the pilot laboratory with the following responsibilities:

- planning, execution of the technical protocol and assuring the integrity of the interlaboratory comparison,
- selection, provision and monitoring stability of the transfer standard,
- formulation of reference values for the comparison,
- collation of results and evaluation of the participant's performance.

Participants

Laboratory	Address	Contact person
Directorate of Measures and Precious Metals (DMDM), Serbia (pilot)	Mike Alasa 14 11000 Belgrade R. Serbia	Predrag Djuric/Boris Ramac +381 11 20 24 417 djuric@dmdm.rs/ramac@dmdm.rs
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Transfer standard

For this bilateral comparison 20 kg mass standard was used. Transfer standard complies with the requirements of E2 accuracy class of the International Recommendation OIML R111. Serial number of transfer standard is 16929345. The transfer standard was provided by the Bureau of Metrology (BOM) - Macedonia. As pilot laboratory, Directorate for Measures and Precious Metals (DMDM), determined the conventional mass of the transfer standard at the beginning and the end of the comparison. The assumed density of the transfer standard was 7950 kg/m³ as given by the manufacturer. Stability of the standards was monitored by the pilot laboratory.

Transportation

The transportation of the transfer standard between laboratories was done by hand-carrying in order to avoid any contamination or damage. The 20 kg mass standard was placed in the original wooden box. The transfer standard was circulated between laboratories without any incident.

Time schedule

The measurements in this bilateral comparison were carried out from July 2012 to September 2012. The participant had approximately 2 weeks to carry out measurements.

Laboratory	Period of measurements	Comment
DMDM	July	first measurement by pilot
BoM	September	
DMDM	September	second measurement by pilot

Measurements

Each participating laboratory determined the conventional mass of the transfer standard, and their associated uncertainty. All weighing were performed in air. Measurements were carried out after adequate acclimatization at the mass laboratory, as described in the International Recommendation OIML R111 for weights of accuracy class E2. Measurements were carried out in accordance with International Recommendation for weights OIML R111.

Reporting by participant

The measurement results were sent to the pilot laboratory in a final report where a list of the equipment used for comparison, laboratory environmental conditions, condition of the transfer standard surface and uncertainty budget were included, besides the reference standard used in order to show traceability of laboratory's measurement results.

Reference value

The reference value for this comparison was determined by the pilot laboratory (DMDM). The instability of the transfer standard was taken into account in the calculation of the reference value and was included in the E_n value as an additional uncertainty component. Mean value is used as reference value. (table 1).

	First measurement	Second measurement	Reference value
Nominal mass	20 kg	20 kg	20 kg
Conventional mass	20 kg + 4,3 mg	20 kg + 1,9 mg	20 kg + 3,1 mg
$u_{c(k=1)}$	5 mg	5 mg	5 mg
$u_{d(k=1)}$	0,7 mg		

Table 1. Results of measurements (pilot)

where:

u_c - combined standard measurement uncertainty,

u_d - drift standard measurement uncertainty for the mass instability of transfer standard.

Results of bilateral comparison

The results of the measurements from each participating laboratory are shown in a technical protocol which has been prepared for this bilateral comparison.

A tool used to analyze the results of a bilateral comparison was normalized error E_n . The E_n value is obtained from the following expression:

$$E_n = \frac{x_{lab} - x_{ref}}{\sqrt{U_{lab}^2 + U_{ref}^2 + U_d^2}}$$

where:

x_{lab} - conventional mass value of the participating laboratory,

x_{ref} - conventional mass value of the pilot laboratory,

U_{lab} - expanded measurement uncertainty of the participating laboratory,

U_{ref} - expanded measurement uncertainty of the pilot laboratory,

U_d - expanded measurement uncertainty of the mass instability of transfer standard.

The pilot laboratory determined the conventional mass of the transfer standard at the beginning and the end of the comparison and included the instability of the transfer standard as an additional uncertainty component. A drift uncertainty U_d for the mass instability of the transfer standard is taken into account assuming rectangular distribution.

The results of the measurements (conventional mass value and its associated uncertainty) are shown in the tabular form (table 2) and as a graphical representation (figure 1).

The expanded uncertainty of the reference value was obtained, according to GUM-1995 [2], as the combined standard uncertainty multiplied by the coverage factor $k = 2$. The expanded uncertainty corresponds to a coverage probability of approximately 95 %.

Laboratory	Nominal mass	Mass correction	$U_{k=2}$	E_n
DMDM	20 kg	3,1 mg	10,0 mg	
BoM	20 kg	4,2 mg	15,6 mg	0,06

Table 2. Results of bilateral comparison

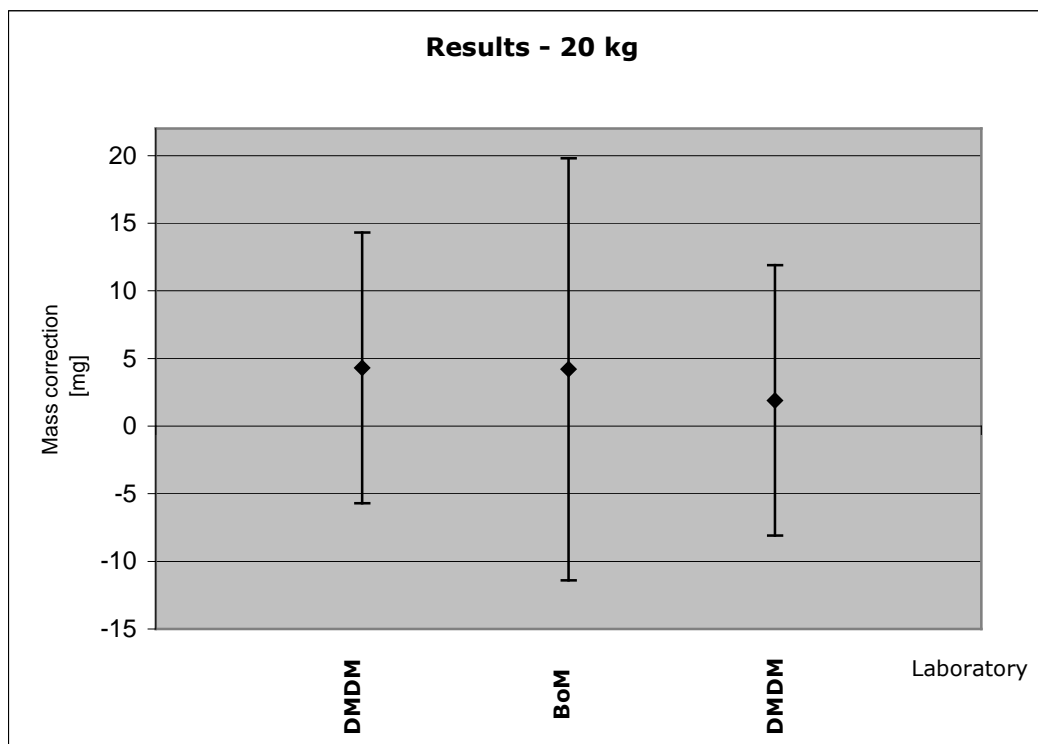


Figure 1. Results of bilateral comparison

Conclusion

A bilateral comparison in the field of Mass calibration between DMDM and BoM was conducted in the period from July to September 2012. For this purpose the conventional mass of 20 kg transfer standard was determined. DMDM acted as a pilot.

The results of measurement of 20 kg mass standard, obtained from participating laboratories were agreed within the measurement capabilities. Normalized error E_n between DMDM and BoM is 0,06, which is less than 1. From the evaluation of the results it is seen that the performance of the mass laboratory of BoM in this comparison is satisfactory based on the values of the normalized error E_n obtained, hence validating its technical competence in the specific field of application.

From this point of view, it can be concluded that bilateral comparison between the DMDM mass laboratory and BoM mass laboratory was successful.

References

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