Calculation of the Consensus Value for the Kilogram 2023

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CCM Task Group on the Phases for the Dissemination of the kilogram following redefinition
(CCM-TGPfD-kg)

Summary

The 2023 consensus value for the SI unit of mass, the kilogram, has been determined to be:

1 kg - 7 µg with a standard uncertainty of 20 µg

with respect to the mass value of the International Prototype Kilogram (IPK), which is equal to the BIPM as-maintained mass unit. That means that the mass of the IPK, based on the consensus value is 1 kg – 7 µg. (The 2023 consensus value is 5 µg lower than the consensus value of 2021).

Traceability for the SI unit of mass will be taken from the 2023 consensus value of the kilogram commencing 1st March 2023.

Action required

To achieve consistency with the 2023 consensus value, **all NMIs would need to reduce the mass value of their national as-maintained mass unit by 7 µg with respect to the mass value based on the IPK or by 5 µg with respect to the consensus value of 2021**. It is recommended to all NMIs to state clearly on their certificates the traceability to the Consensus Value 2023, for example, using the following sentence "The calibration results stated in this certificate are based on the Consensus Value of the kilogram commencing 1st March 2023." **The adoption of the consensus value of 2023 requires no further adjustment to the published CMCs of NMIs**.

1. Background

The Consultative Committee for Mass and Related Quantities (CCM) decided in 2017 that the use of a consensus value for the dissemination of the kilogram is necessary due to the discrepancy in the values produced by the realisation experiments (Kibble balance and X-ray crystal density experiments). The determination and implementation of the kilogram consensus value has been agreed by the CCM TGPfD-kg. Details of the calculation and use of the consensus value and the dissemination process can be found in [1] and [2].

2. Calculation

This is the second consensus value for the kilogram and has been calculated based on an arithmetic (non-weighted) mean of three sets of data:

- Extant data from the CCM Pilot Study of realization experiments (corrected for the shift of 17 parts in 10^9 in *h* introduced by the CODATA 2017 adjustment and considering the temporal stability of the BIPM working standards) [3]
- The Key Comparison Reference Value (KCRV) of the first CCM Key Comparison (CCM.M-K8.2019) [4]
- The Key Comparison Reference Value (KCRV) of the second CCM Key Comparison (CCM.M-K8.2021) [5]

The consensus value will be reviewed after each Key Comparison of realisations, currently scheduled to take place every 2 years.

	Value (1 kg +) / µg	Standard Uncertainty / µg
Pilot Study Reference Value (2016)	12.4	*11.4*†
KCRV of the first CCM.M-K8 (2019)	-18.8	*8.1*†
KCRV of the second CCM.M-K8 (2021)	-15.2	*7.4*†
Calculated Consensus Value (arithmetic mean)	**-7.2**	**20**‡

† These uncertainties are given for information only and are not used in the calculation of the consensus value, the uncertainty in the value of the IPK includes a contribution from the stability of the BIPM working standards on which the mass of the IPK is maintained.

‡ The uncertainty in the consensus value was agreed by the CCM-TGPfD-kg.

REFERENCES

[1] CCM detailed note on the dissemination process after the redefinition of the kilogram, available on the BIPM web site: www.bipm.org

[2] Report on the Calculation of the CCM Consensus Value for the Kilogram 2023, M Stock, S Davidson, available on the BIPM web site: www.bipm.org

[3] M. Stock *et al*., "Final report on CCM Pilot Study CCM.R-kg-P1 - Comparison of future realizations of the kilogram", CCM working document CCM/17-03-7B2, available on the BIPM web site: www.bipm.org

[4] M. Stock, *et al*., "Report on the CCM key comparison of kilogram realizations CCM.M-K8.2019", *Metrologia* **57** (2020) Tech. Suppl., 07030

[5] M. Stock *et al*., "Final report on the CCM key comparison of kilogram realizations CCM.M-K8.2021", *Metrologia* **60** (2023) 07003