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Position of the EUROMET TC-M on the paper:

Redefinition of the kilogram: A decision whose time has come[1]

The EUROMET TC-M recognizes that the current definition of the kilogram in terms of the international prototype is not satisfactory, as the mass of the prototype is believed to change as a function of time.

In recent years, members of EUROMET, as well as the BIPM and NIST, have initiated new or improved Watt-balance experiments in order to determine the Planck constant h with a relative standard uncertainty of a few parts in 10^8 that is necessary for monitoring the foreseen change in mass of the prototype over a period of several years. These experiments are expected to deliver results within the next 5-10 years that might change the current value of h in terms of the kilogram at its present definition based on the international prototype.

In parallel, a significant effort is being put into the Avogadro project in order to measure the Avogadro constant N_A with the required relative standard uncertainty of a few parts in 10^8. As a result, an improved value of N_A is expected to be available within the next 5-10 years as well.

Currently, there is a relative discrepancy of 10^{-6} between the prototype-based values of h and N_A. If the kilogram would be defined by fixing the value of h or N_A today, the mass of the prototype, $m(\mathcal{K})$ could therefore be expected to change by 1 mg or more within the next 5-10 years, as the results of the new experiments become available. In other words, the relative difference between the SI unit kg and the temporary conventional unit kg_{07}, being defined in the paper as the mass of the kilogram prototype, could well amount up to 10^{-6}. For comparison, the relative expanded uncertainty ($k = 2$) claimed by a typical NMI is $5 \cdot 10^{-8}$ at the 1 kg level, whereas the relative maximum permissible error for commercial OIML class E_1 weights larger than 50 g is $5 \cdot 10^{-7}$.

A relative difference of 10^{-6} between the SI unit kg and the conventional unit kg_{07} would create a number of problems at NMIs, at industrial calibration laboratories and at verification offices the day the conventional unit kg_{07} were abolished:

- All values assigned to high accuracy weights, weighing instruments and density standards would have to be updated from one day to the next.
- Most of the classified OIML class E_1 weights would have to be replaced.
- Density tables used in volume and density measurements would have to be updated.
- The impact on all instruments measuring quantities derived from the kilogram, such as force, torque and pressure, would have to be evaluated.

[1] Ian M Mills, Peter J Mohr, Terry J Quinn, Barry N Taylor and Edwin R Williams, Redefinition of the kilogram: a decision whose time has come, *Metrologia* **42** (2005) 71–80

In order to avoid such problems, the relative difference between the new SI unit kg and the mass of the international prototype of the kilogram should not be larger than $2 \cdot 10^{-8}$. Therefore, the EUROMET TC-M recommends that a new definition of the kilogram based on fixed values of h or N_A should be postponed until at least three independent experiments (Watt-balance experiments or the Avogadro project) have provided consistent results with relative standard uncertainties of a few parts in 10^8.

Agreed by EUROMET TC-M at its meeting 2005-03-03 in Thessalonica