



## Overview of mass calibration work and maintenance of BIPM working standards

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**B**ureau  
International des  
Poids et  
Mesures

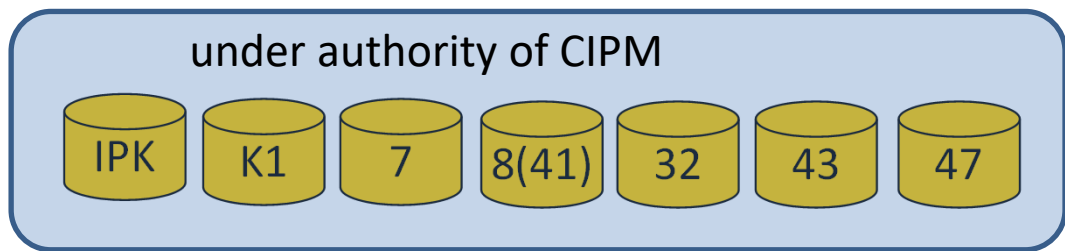


## Guiding principles to ensure a stable BIPM mass unit

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- BIPM working standards calibrated against IPK in 2014
- significant mass changes since 3<sup>rd</sup> PV in 1992, attributed to wear
- new hierarchical system of mass standards with 3 significantly different levels of usage introduced in 2015
- significant reduction of the total number of weighings
- regular reports of status to CCM and CIPM

## Hierarchy of BIPM Pt-Ir working standards, introduced in 2015



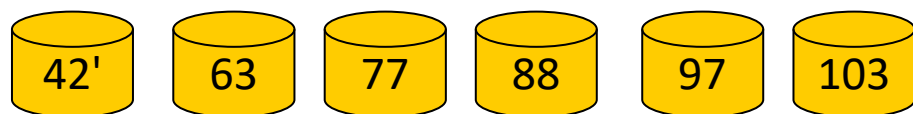
IPK & official copies:  $\frac{\text{1 use of 2 copies}}{10 \text{ years}}$



3 prototypes for exceptional use:  
(to be cleaned and washed before use)  $\frac{\text{1 use}}{5 \text{ years}}$

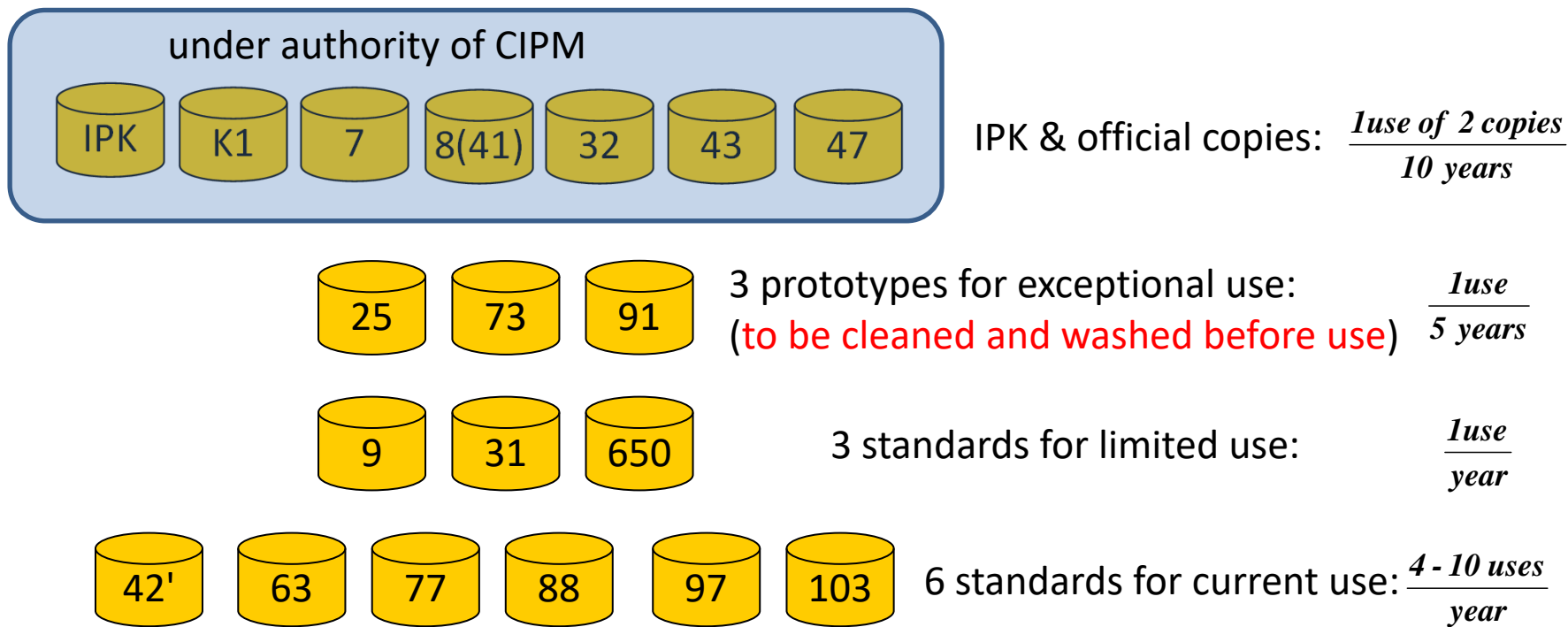


3 standards for limited use:  $\frac{\text{1 use}}{\text{year}}$



6 standards for current use:  $\frac{4 - 10 \text{ uses}}{\text{year}}$

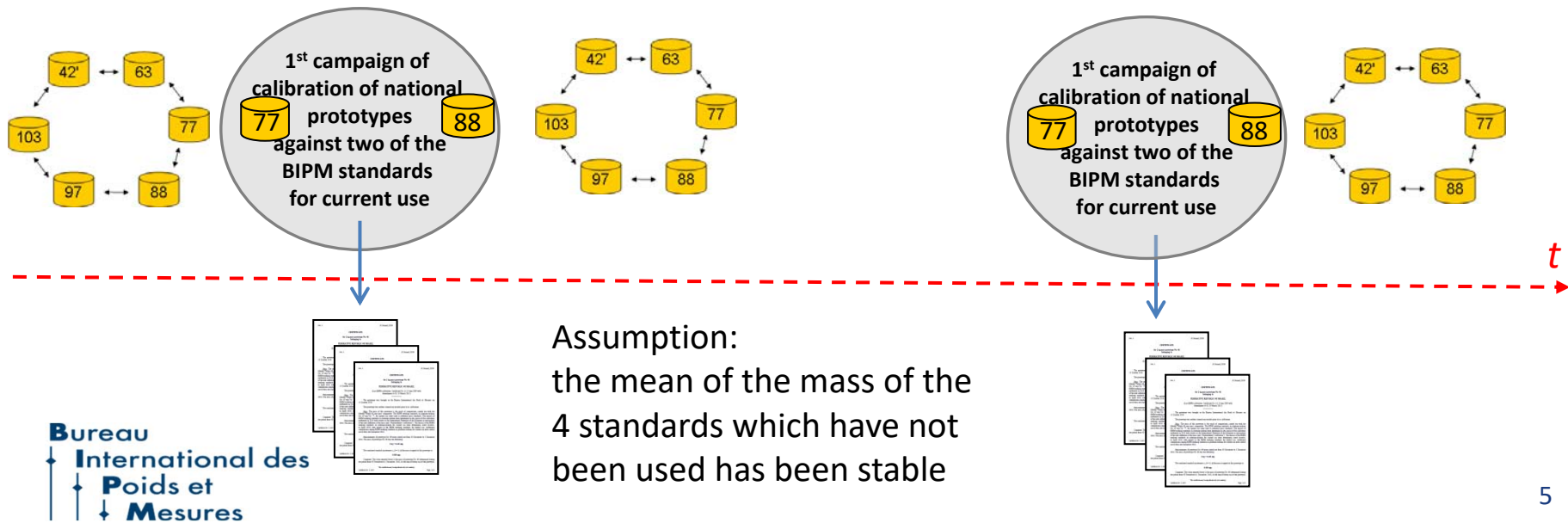
## Hierarchy of BIPM Pt-Ir working standards, introduced in 2015



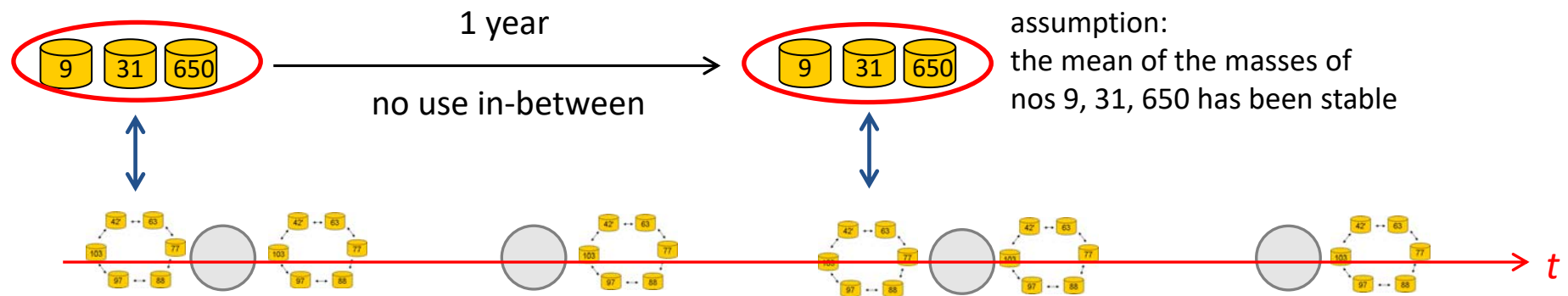
## Use of BIPM standards for **current use**

Calibrations for NMIs grouped into two batches per year

- less weighings (-> better stability)
- more efficient
- but: service not permanently available

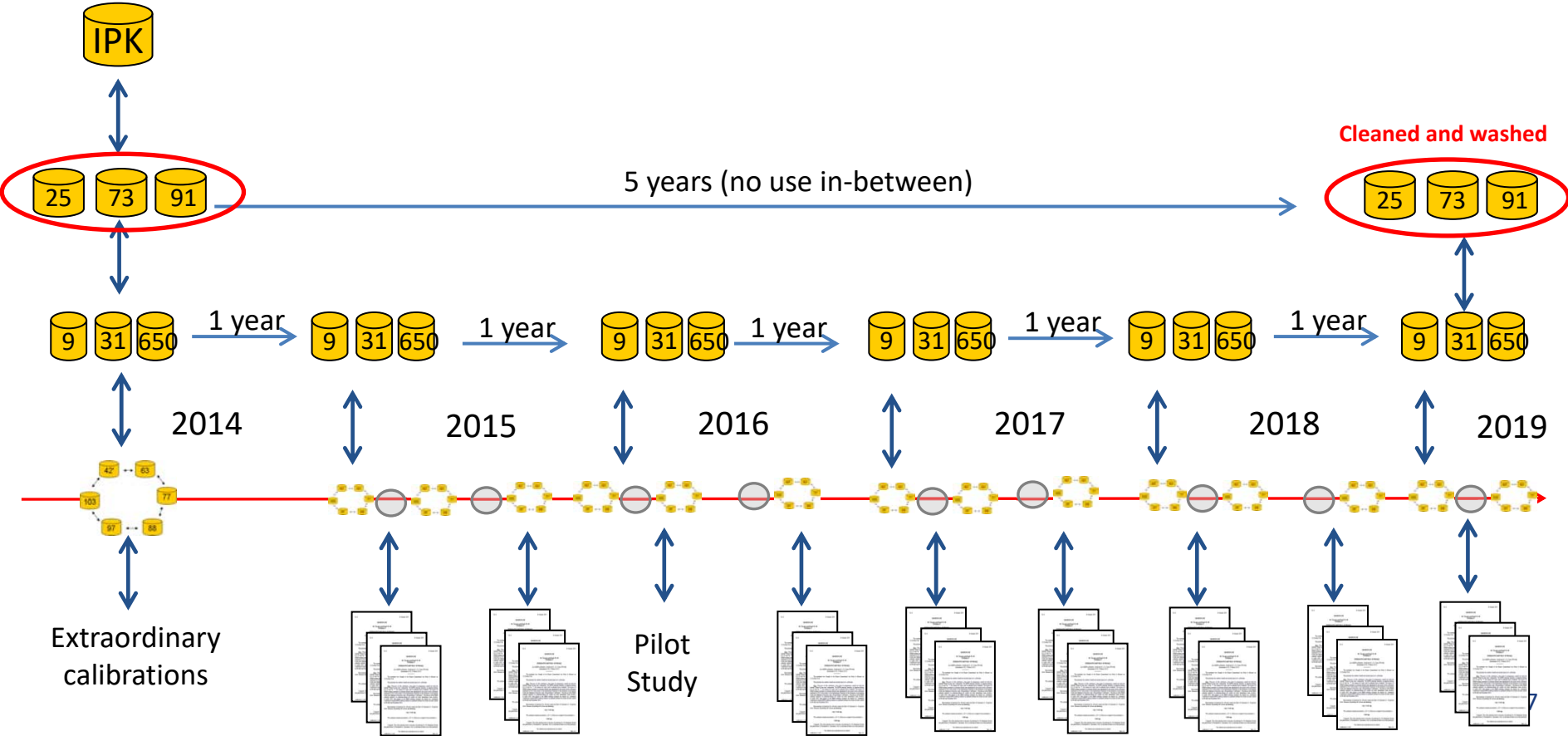


## Use of BIPM standards for **limited use**



during 1 year, mass evolution of standards for current use derived from least-squares adjustment based on assumption that standards not used are stable

# Use of BIPM standards for exceptional use

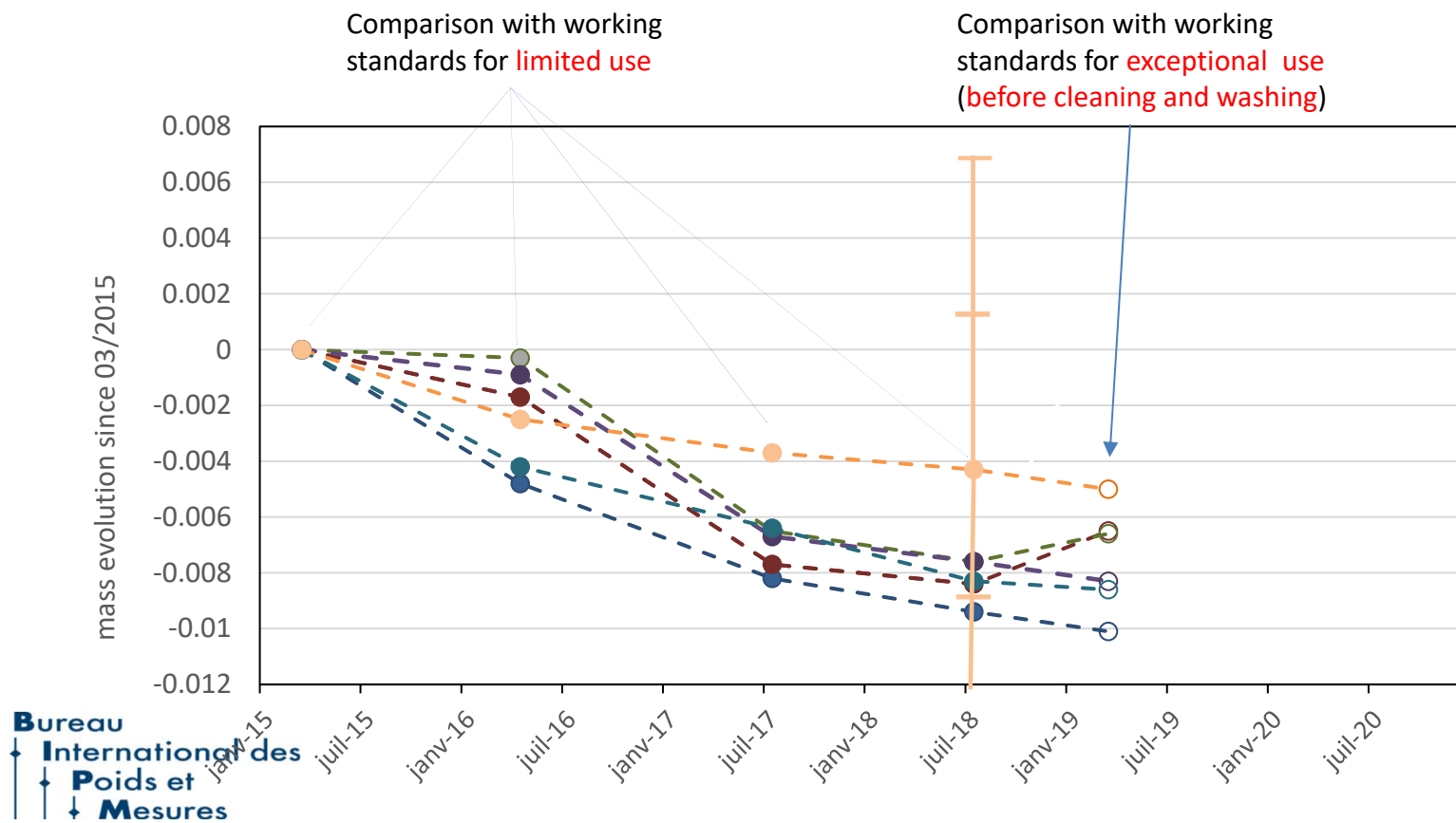


# Mass values attributed to the BIPM working standards for current use (I)

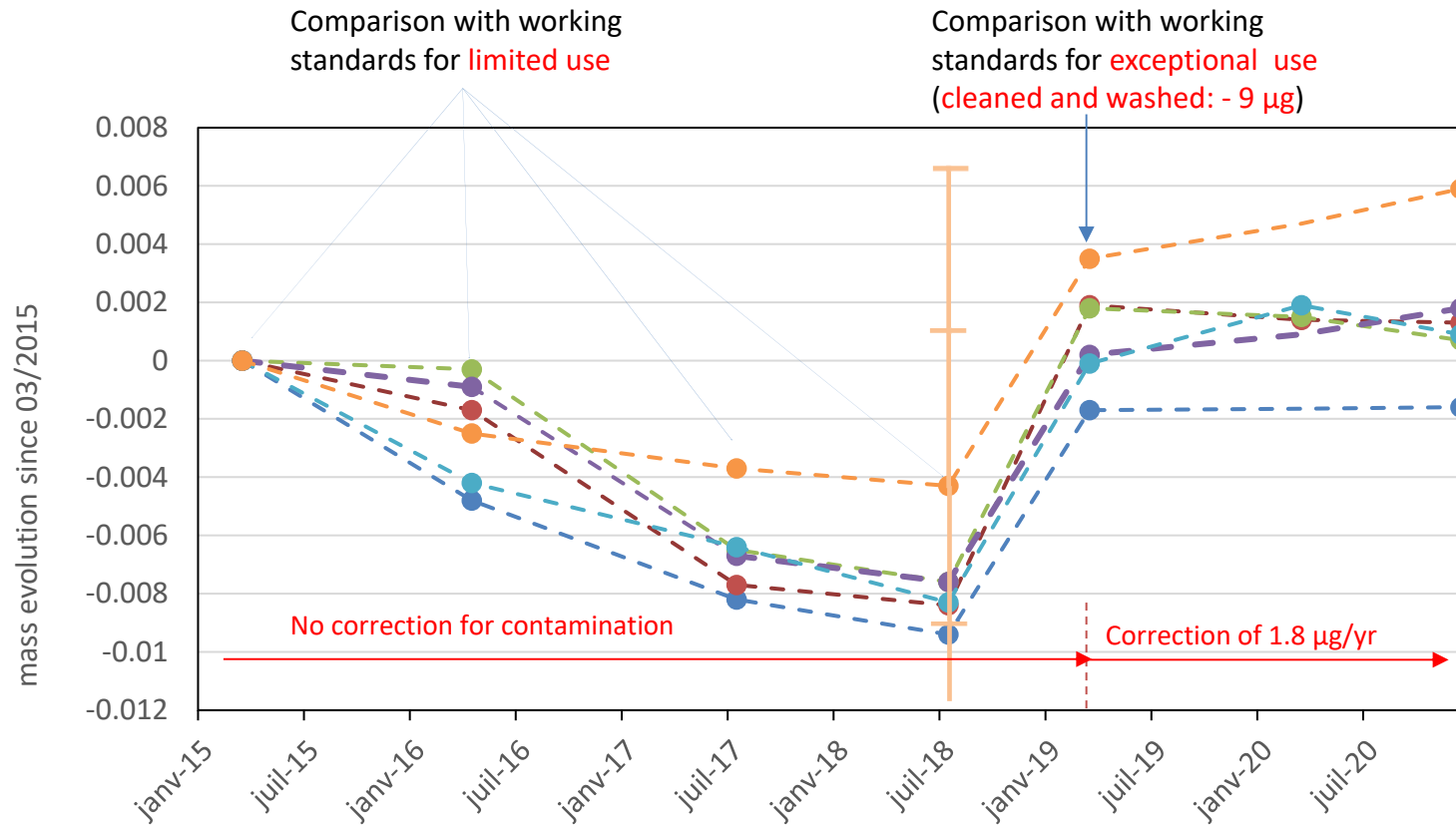




## Mass values attributed to the BIPM working standards for current use (I)



## Mass values attributed to the BIPM working standards for current use (II)



# BIPM information note for calibration customers

**BIPM**

**Note on the impact of the beginning of Phase 2 of the kilogram dissemination process on BIPM mass calibrations**

The Consultative Committee for Mass and Related Quantities (CCM) requested in its Recommendation G1 of 2017, that until the dispersion in values becomes compatible with the individual realization uncertainties, the dissemination of the kilogram should be based on the 'consensus value', which would be determined from key comparisons between realization experiments. The CCM has issued a *Detailed note on the dissemination process after the redefinition of the kilogram*<sup>1</sup>. The results of the first key comparison were published in October 2020. Following this, the first consensus value, determined in December 2020, was officially implemented on 1<sup>st</sup> February 2021. This marks the beginning of Phase 2 of the dissemination process. The CCM Task Group on the Phases for the Dissemination of the kilogram following redefinition, CCM-TGPPD-kg, has issued a note on the calculation of the consensus value<sup>2</sup>. The most relevant information is provided below.

**Summary**

The consensus value for the kilogram has been determined to be:

**1 kg – 2 µg with a standard uncertainty of 20 µg**

with respect to the mass value of the International Prototype Kilogram (IPK). This means that the mass of the IPK, based on the consensus value, is 1 kg – 2 µg.

Traceability for the SI unit of mass will be taken from the consensus value of the kilogram commencing 1<sup>st</sup> February 2021.

**Action required**

Since the change between mass values based on the past traceability to the Planck constant, *h*, through its known relationship with the IPK, and the new values, based on the consensus value and maintained by the BIPM platinum-iridium mass standards, is small in relation to the uncertainties, no adjustment to the international mass scale needs to be made. However, adjustments to the CMCs of National Metrology Institutes (NMIs) may be necessary to take into account the uncertainty in the consensus value. **Draft adjustments will be calculated by an ad-hoc Task Group of the CCM Working Group on Mass and circulated to the affected NMIs for approval.**

**Annex on the maintenance of the BIPM mass unit**

In 2019 the BIPM working standards for exceptional use were cleaned and washed for the first time since their last comparison with the International Prototype Kilogram in 2014. None of the working standards had been cleaned and washed since then. A contamination of 9 µg was observed on the working standards for exceptional use, since their last cleaning and washing in 2014.

In the years from 2015 to 2018 no corrections were applied for contamination of the working standards for current use (used for customer calibrations), but the related uncertainty component was increased every year.

Under the assumptions that

- the contamination of the working standards for current use is comparable to those of the working standards for exceptional use and
- the contamination of the working standards for current use is constant over time

the following corrections for the masses of the working standards for current use can be estimated:

2015	+ 1.8 µg
2016	+ 3.6 µg
2017	+ 5.4 µg
2018	+ 7.2 µg

These corrections apply in the same way to those national standards, which were calibrated using these working standards. The relevant dates are those of the weighings, which are indicated on the certificates. Since 2019 a correction for contamination of the working standards of +1.8 µg per year is applied to avoid similar step changes in the future.

Although these corrections are small in comparison with the uncertainty of the consensus value, 20 µg, and within the expanded uncertainties of the calibration certificates, this information will be useful for NMIs to be able to model the evolution of the mass values of their national standards which is important in maintaining the accuracy of the national mass scale between calibrations.

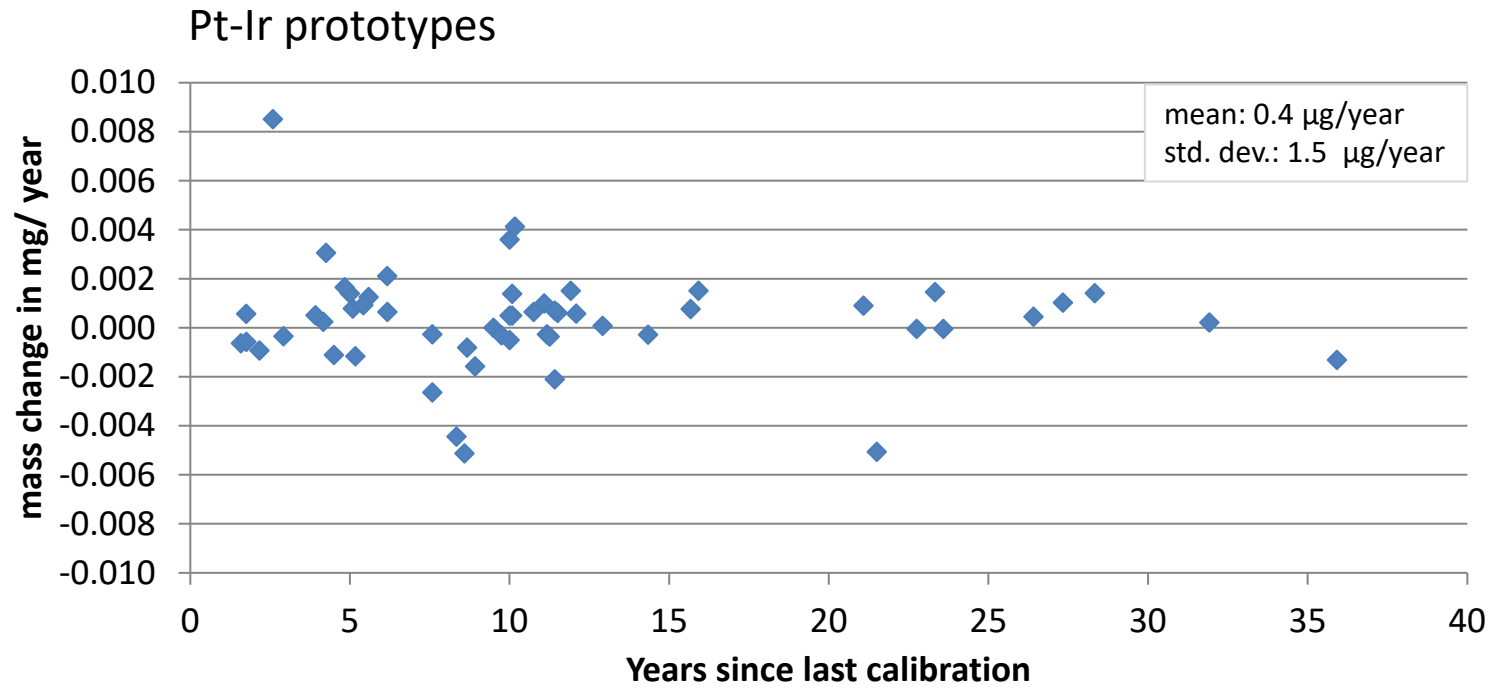
Under the assumptions that:

- Contamination of w.s. for current use is comparable to those of w.s. for exc. use
- Contamination of w.s. for current use is constant over time

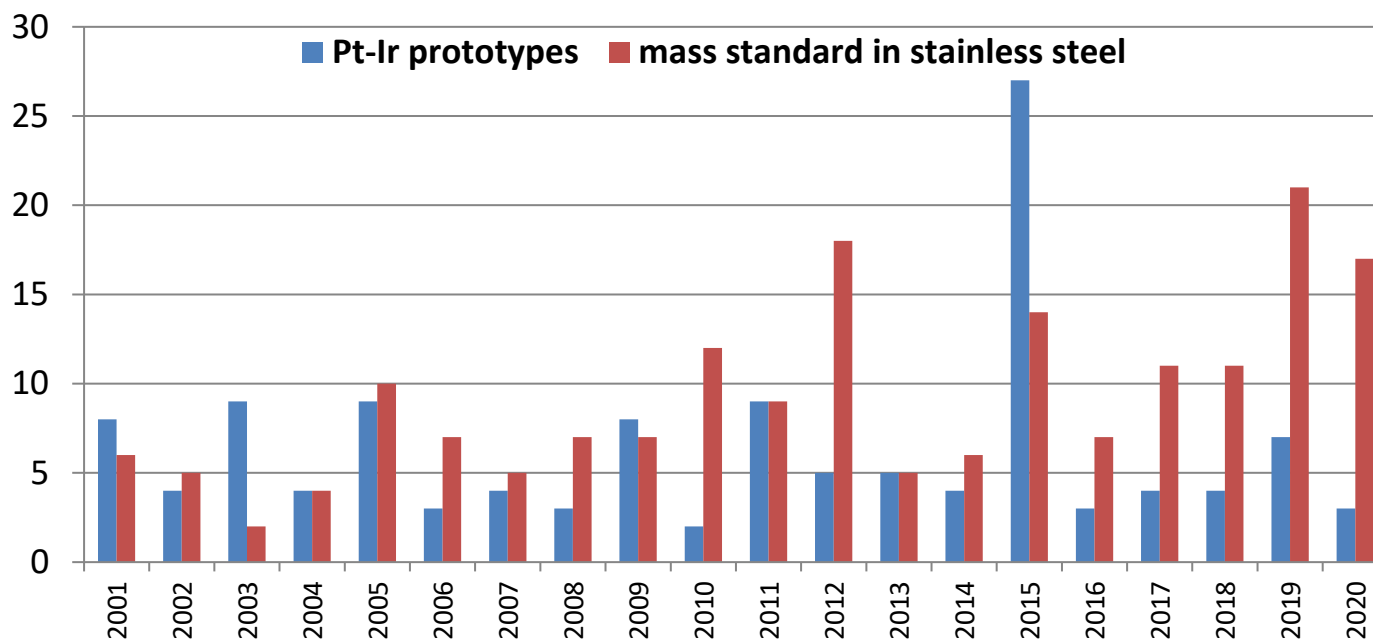
The following corrections for the masses of the w.s. can be estimated:

2015	+1.8 µg
2016	+3.6 µg
2017	+5.4 µg
2018	+7.2 µg

## Mass stability of national Pt-Ir prototypes



## Number of calibrations of mass standards per year



On average per year: 5 Pt-Ir prototypes  
12 stainless steel standards



Thank you for your attention !

