

Developing a practical means of dissemination the new kilogram

SIB05

NewKILO



Mass and Related
Quantities

Overview



SCOPE: In the new definition the kilogram will have an uncertainty, the traceability chain has to be improved to avoid affecting uncertainties provided to the user.

GOAL: Ensuring the continuity of the practical realisation of the mass unit between existing and new realisations of the kilogram.

Dissemination at the level of the NMIs must be achievable with relative uncertainty $< 2 \times 10^{-8}$.

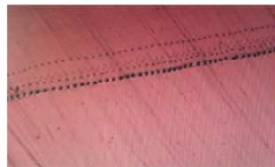
Aim - Develop a Practical Means of Disseminating the Redefined Kilogram

- WP1 New materials for mass standards
- WP2 Air/Vacuum transfer
- WP3 Surface analysis
- WP4 Cleaning and storage
- WP5 Uncertainties
- WP6 Impact



New materials for mass standards

Material	Advantages	Disadvantages
Platinum-iridium	Well characterised material Easy to machine	Expensive Relatively high magnetic permeability
Stainless steel	Well characterised material Used for the majority of current weights	High magnetic permeability Complex alloys - Surfaces difficult to analyse
Silicon	Excellent surface finish achievable Natural silicon readily available Very low magnetic permeability	Low density so must be weighed in vacuum Potential static issues
Gold alloy	Good magnetic properties Easy to machine Dense	Low relative hardness Samples analysed showed anomalous sorption characteristics
Iridium	Hard Good magnetic properties Dense	Difficult to machine Expensive
Nickel super alloy	Similar density to stainless steel Hard Good magnetic properties	Relatively expensive and difficult to obtain
Single crystal tungsten	Excellent magnetic properties Density similar to that of Pt-Ir	Difficult to manufacture artefacts High quality crystals of suitable size expensive and difficult to obtain
Plated copper	Excellent magnetic properties Easy to manufacture Similar density to stainless steel	Quality of artefacts relies on good coating process and material Au – soft, Rh – show inclusions form polishing



PTFE



PEEK

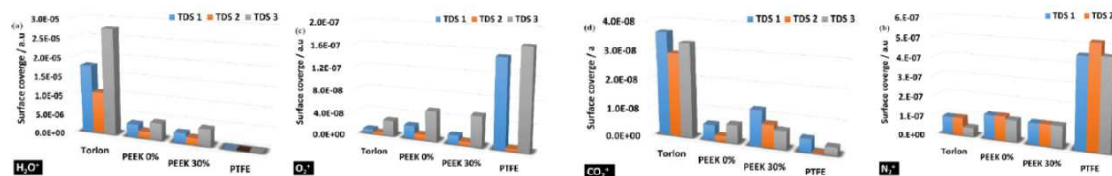


Aluminium

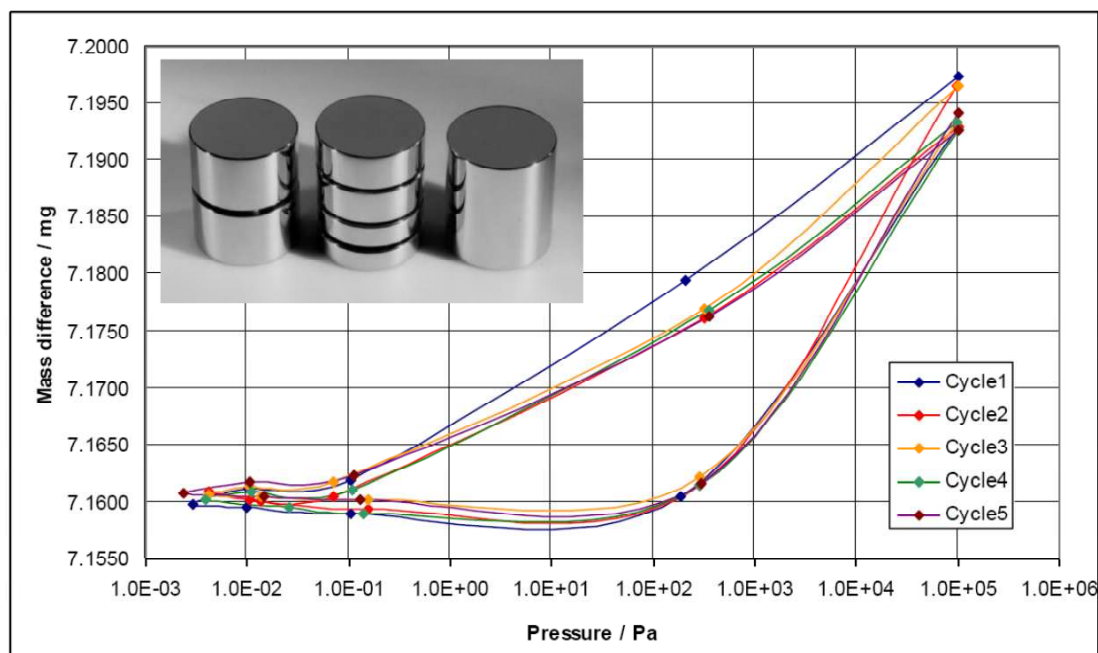


Titanium

- Titanium good multiple weight application (e.g. weighing pan)



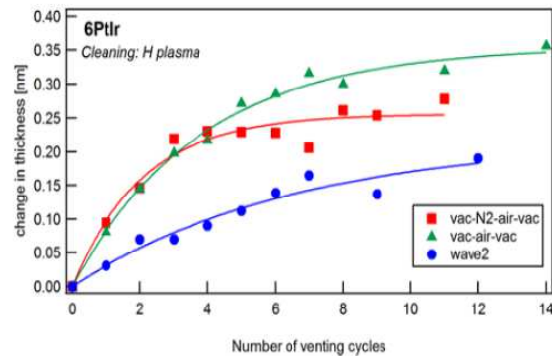
- PEEK most suitable for mass support in storage containers
- Surface finish (and cleanliness) more important than material



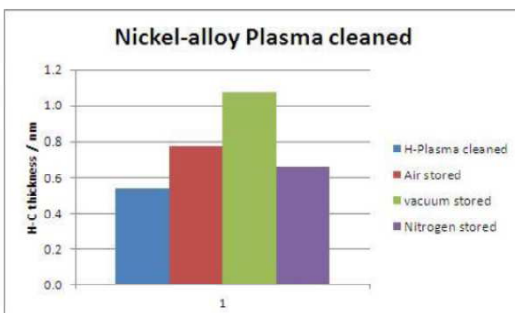
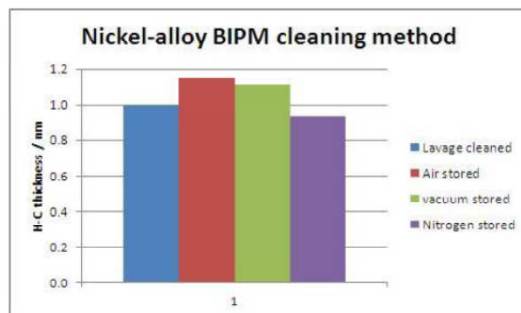
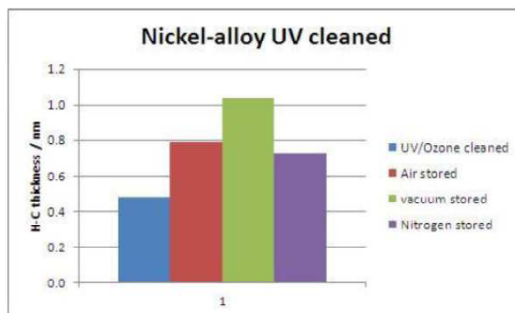
Venting cycles and contamination



- Mass gain after cleaning shows exponential gain model
- Nitrogen venting cycle shows reduced mass gain
- BUT mass will still reach steady state phase after 15-20 cycles
- AND standard needs to be weighed in nitrogen
- The introduction of an intermediate nitrogen stage on transfer to air has limited benefit and complicates transfer procedure



Cleaning and storage

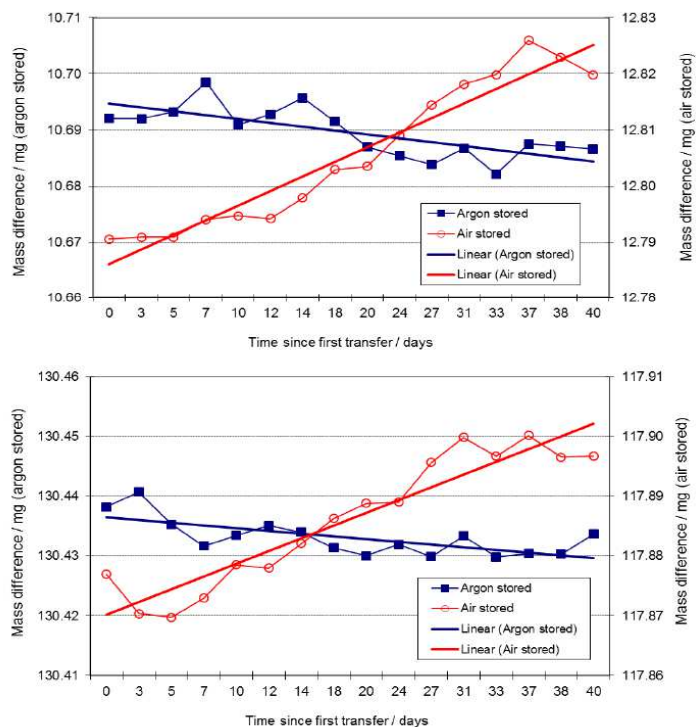


- Nettoyage-lavage method leaves more contamination on the surface (or contamination forms rapidly on the surface after cleaning)
- Vacuum stored samples gained most contamination after cleaning

Storage



- Silicon and SS weights stored in air or inert gas. Mass measurements made in vacuum.
- Artefacts stored in air show increase in mass due to surface contamination.
- Artefacts in argon show slight decrease in mass.
- Care with handling and transfer of artefacts (to balance) is critical in maintaining stability.



- NPL, CMI, CNAM, DFM, LNE, METAS, MIKES, MIRS, PTB, SMU, TUBITAK
- INRIM, NRC
- BIPM, KRISS, Häfner, Mettler-Toledo, Sartorius
- TU-Ilmenau, IPQ, IMBiH

www.newkilo.eu

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