TRANSCOM 2025: 16th International Scientific Conference on Sustainable, Modern and Safe Transport

- Visegrad Fund

Problems in Assessing the Accuracy of Mass Comparators AVK1000: Analysis of the Impact of External Factors

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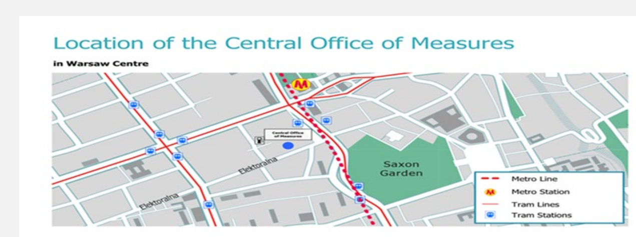
INTRODUCTION

Background Information & Market Context

The transition from the International Prototype of the Kilogram (IPK) to a definition based on the Planck constant, effective from 20 May 2019, required NMIs worldwide to implement new methods for realizing and disseminating the unit of mass.This shift increased the importance of precise mass transfer and vacuum weighing to reduce air buoyancy effects and ensure traceability with minimal uncertainty.

Problem Statement & Stakeholders

Maintaining measurement stability is challenged by vibrations and ambient fluctuations. The issue concerns NMIs, metrology labs, and industries relying on precise weighing.



Research Objectives & Expected Impact

The study compares AVK1000 and AT1006 comparators at GUM, focusing on repeatability under external disturbances. Results are relevant for transport and other critical applications.

MATERIALS, METHODS & IMPLEMENTATION

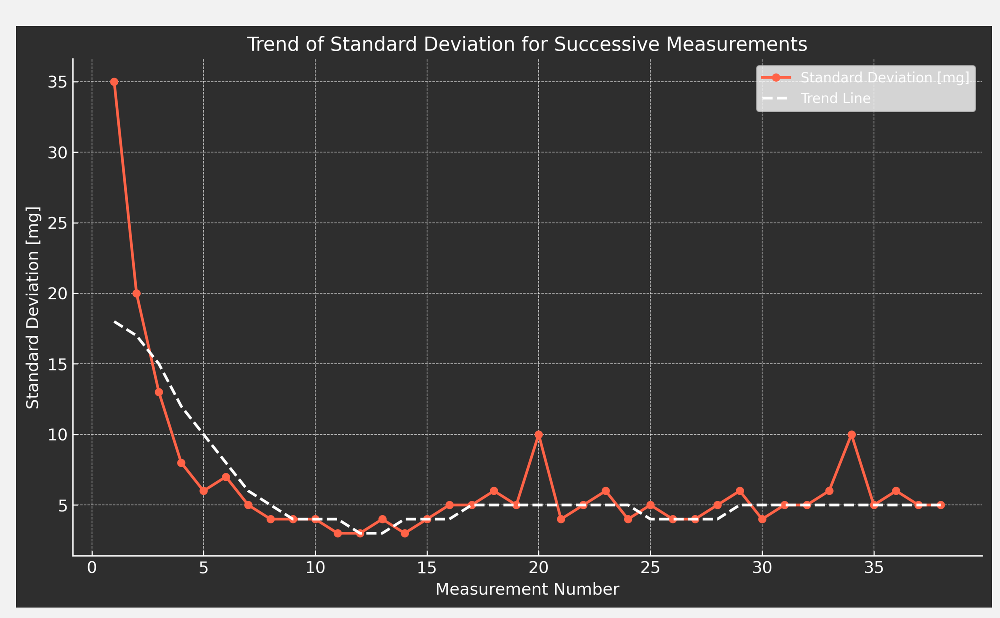
The influence of external factors on the repeatability parameter of mass comparators for measurements related to the transfer of the mass unit from the national standard to copy standards. Compared two comparators: AVK 1000 and AT 1006. Two 1 kg mass standards, weights of classes E2.
Measurement Technique: ABBA/ABA method with 6 cycles or 10 cycles.

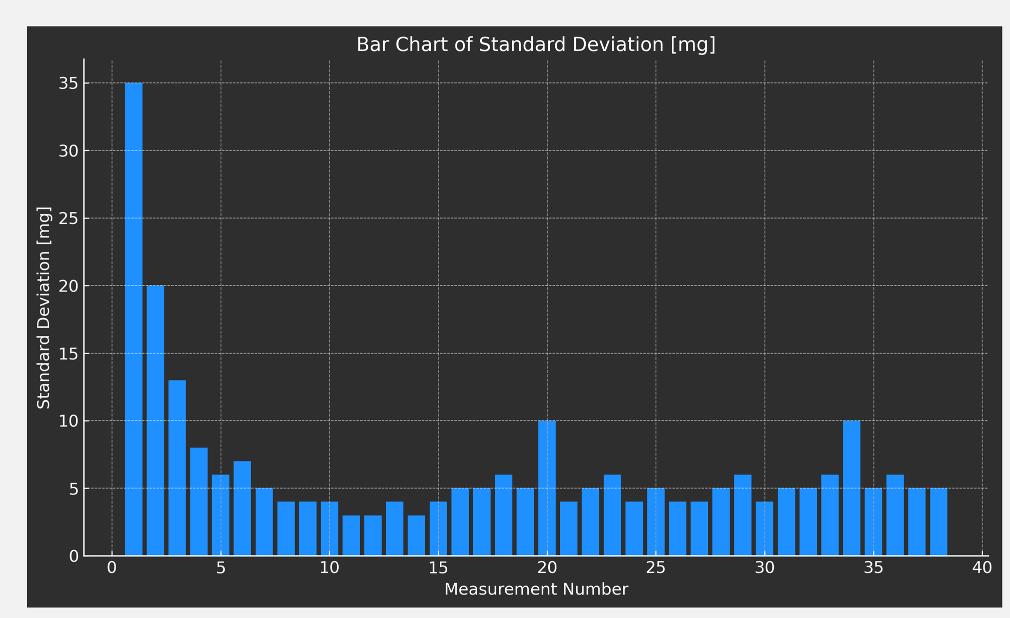
RESULTS

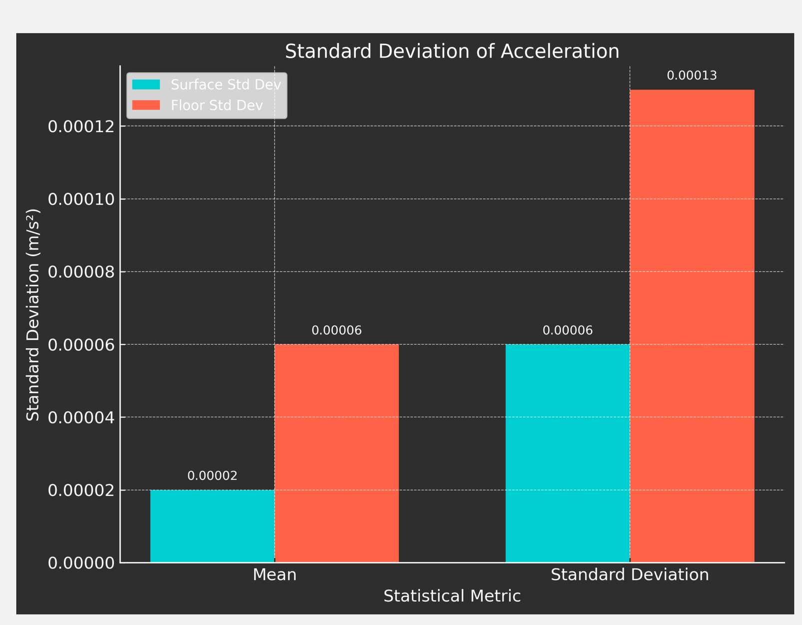
Academic Findings & Innovation
Practical Applications

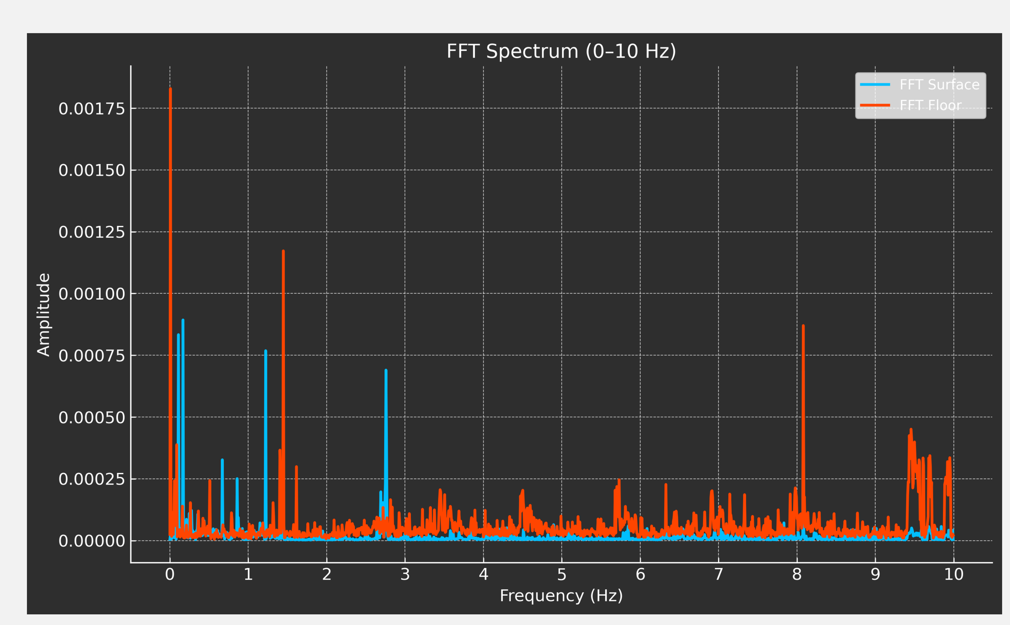
Mass Comparator AVK1000
Metrological parameters:
Maximum capacity [Max] 1002 g
Readability [d] 0.1 µg
Standard repeatability [5% Max] 0.4 µg
Standard repeatability [Max] 0.5 µg
Permissible repeatability 1 µg

Mass Comparator AT1006
Metrological parameters:
Maximum capacity [Max] 1002 g
Readability [d] 0.1 µg
Standard repeatability [5% Max] 0.4 µg
Standard repeatability [Max] 0.5 µg
Permissible repeatability 1 µg









CONCLUSION & IMPLEMENTATION PATH

The AVK1000 vacuum mass comparator demonstrated superior repeatability and low uncertainty in vacuum conditions, confirming the benefits of buoyancy-free measurement environments. Initial mechanical adjustments, made in cooperation with the manufacturer, improved performance and system stability. Vibrations were found to have negligible impact on measurement results, staying well below the comparator's sensitivity threshold. With a standard deviation of 2.13 µg (1 kg in vacuum), AVK1000 meets the requirements for international key comparisons and can be confidently implemented in high-accuracy mass dissemination systems.

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ACKNOWLEDGEMENTS

This research was conducted as part of the doctoral dissertation titled: Analysis of the Impact of External Factors, Particularly Vibrations, on the Repeatability Parameter of a Mass Comparator in Measurements Related to the Transfer and Reproduction of the Mass Unit from the National Standard to Secondary Standards, funded by the Ministry of Science and Higher Education of Poland, grant number DWD/6/0578/2022.