

PERFORMANCE TEST RESULTS OF THE UME “M ONE” MASS COMPARATOR IN AIR AND UNDER VACUUM ENVIRONMENTS

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ABSTRACT

The UME “M One” mass comparator system was installed at the UME to be used research activities in describing an optimum transfer standard as buoyancy artifacts and comparing buoyancy artifacts between in air and vacuum environments and also 1 kg mass standards. The system were designed and manufactured by Mettler Toledo. The reproducibility of the mass comparator is 0,4 µg under vacuum.

1. INTRODUCTION

The comparison of mass standards of the highest accuracy is carried out using high-resolution balance. The measurement has always been become in air. Thus to ensure continuity it is necessary to continue to operate balances at atmospheric pressure. This presents difficulty in comparing weights made from different materials, and hence having different density, since the effects of both buoyancy in air, and the adsorption of air molecules onto the surface of weight need to be taken into account. For these reason major masses as prototypes are manufactured from the same alloy.

It is well known that apparent mass variation of weights depends on adsorption and desorption of water vapor on surfaces of weights as a results of relatively large variations in air composition. Much research has been done to improve the characterization of the long-term stability of mass standards, adsorption layers on surfaces of weights and determining air density by experimentally [1-4].

The UME “M One” mass comparator system will be used to characterize adsorption layers on Cu-Be and Zirconium buoyancy artifacts, investigate contamination effects and besides determine air density by experimentally. Also the aim of these work can be determined an optimum transfer standard and gotten the adsorption layer information. Because adsorption layer information is used to correct the mass value in air measurement.

This paper describes performance of the balance in air and under vacuum

2. MEASUREMENTS

2.1. THE UME “M ONE “ MASS COMPARATOR SYSTEM

The UME “M One” mass comparator is single pan electromagnetic compensation beam balance. The maximum load is 1001,5 g and readability is 0,1 µg. The comparator is equipped with an automatic mass exchange mechanism, which has four weight positions that can be used for cylindrical and buoyancy artifacts. The vacuum mass comparator system as “M One” is designed to produce optimum results from controlled ambient conditions to moderate vacuum which is worked in specified pressure range as 10^{-3} mbar-1000 mbar.

The system includes a load lock with a weight transporter allowing the mass comparator to be loaded under vacuum as well as vacuum pumping system for both the vacuum enclosure and load lock and hence the system shows in Figure 1. The load lock allows the mass comparator to be loaded under vacuum without breaking the vacuum enclosure, which is designed to evacuate the load lock from ambient to 10^{-3} mbar in about 20-30 minutes. Finally, the system is provided long-term investigations under vacuum and eliminated time consume. The time consume is app. 1 hour per weight using load lock system and is app. 48 hour per weight without load lock system.

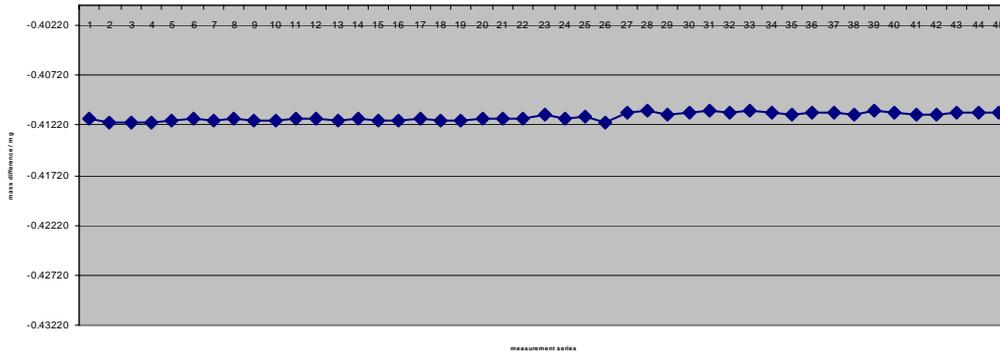


Figure1. General view of UME “M One” mass comparator system

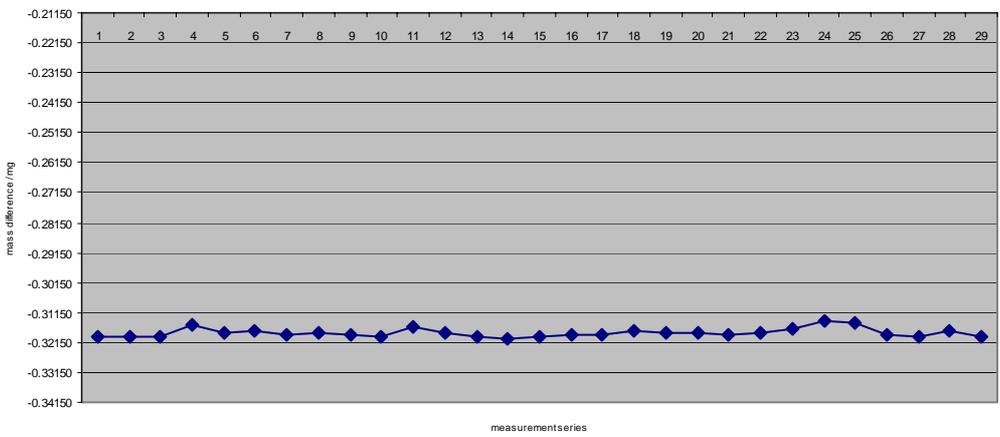
2.2. LONG -TERM STABILITY AND SENSITIVITY TESTS ON THE MASS COMPARATOR IN AIR AND UNDER VACUUM

These test were carried out by comparison between stainless steel mass standards in air and under vacuum as a typical data set obtained to check long-term stability and reproducibility of mass comparator.

Figure 2. a and b show long term stability of mass comparator in air and under vacuum. 1 kg stainless steel mass standards were used for measurements. A-B-A comparisons were performed ever one hour. Measurements were kept on during three months. According to measurement results, reproducibility of mass comparator was determined 1 μg for twenty nine measurement series in air as the air buoyancy correction was no done in air measurements and 0,4 μg . under vacuum for fourth five measurements series.



a



b

Figure 2. (a) Mass difference under vacuum; (b) mass difference in air

And also the sensitivity of balance was checked with built-in 1 g weight after each group measurement in air and under vacuum as sensitivity curve for 1 g weight is showed only in air measurements in Figure 3.

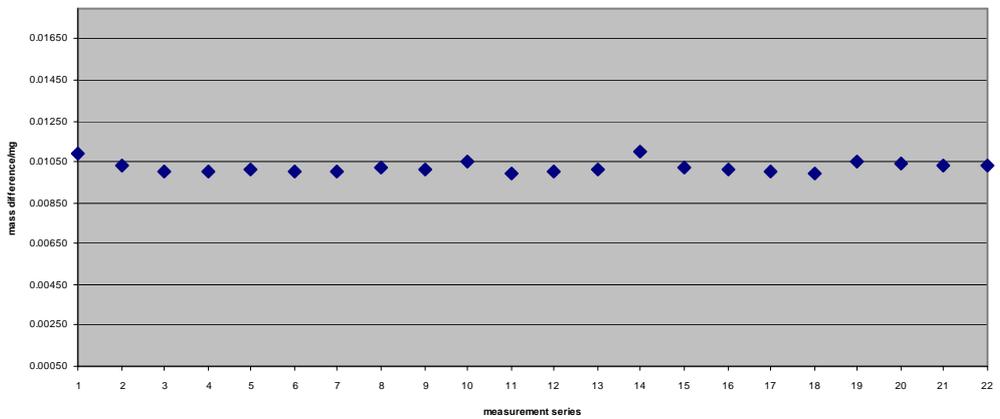


Figure 3. Sensitivity of mass comparator obtained in air measurements

3. CONCLUSIONS

The system were designed and manufactured and installed by Mettler Toledo. Long-term stability and sensitivity test with built-in 1 g weight after each group measurement in air and under vacuum were done during three months. The reproducibility of the mass comparator was determined 0,4 μg under vacuum and 1 μg in air {not included air buoyancy correction).

The UME “M One” mass comparator system will be used to characterize adsorption layers on Cu-Be and Zirconium buoyancy artifacts, investigate contamination effects and besides determine air density by experimentally. Finally, the aim of these work can be determined an optimum transfer standard and taken the adsorption layer information.

4. REFERENCES

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