

World Record in Weighing Performance with Nanotechnology

Mass Comparator Balance with Nanogram Accuracy

METTLER TOLEDO's M_One Mass Comparator Balance sets a new benchmark in the field of ultra-high precision weighing. The ingenious combination of the company's leading-edge nanotechnology know-how with vacuum technology results in world-leading measurement performance: masses up to 1kg can be determined with an accuracy of 100 nanograms, a proven typical repeatability of 300 nanograms and a result data comparison of 10 nanograms. This extraordinary performance makes the M_One the first choice for mass comparisons in National Metrology Institutes and University Research Centers worldwide.

Designing Comparator Balances with an accuracy of 100 nanograms (1 nanogram = 0.000000001 gram) presents a technological challenge at the limits of physics. Already smallest changes in temperature, humidity, air pressure and air buoyancy will falsify the weighing result. The same applies for electrostatic charges, which must be eliminated. Each interaction with the operator is another possible source of error, calling for an ergonomic design that minimizes these. Last but not least, special care must be taken that the masses compared (e.g. National Prototype) are not damaged during handling. The M_One's world-leading measurement performance is achieved through the ingenious combination of nano- and vacuum technology.

Nanotechnology Competence

The optimal interaction of leading-edge weighing technology and innovative mechanical design guarantees unparalleled accuracy and repeatability. With a theoretical resolution of 10 billion points, the M_One's weighing cell delivers peak weighing performance at all times. The ingenious mechanics of the automated turntable with the unique triple-beam weighing pan is second to none. Up to 6 masses can be placed on the turntable and the user indicates how they are to be compared with each other. The intelligent software then activates the automatic turntable and optimizes the comparison process in such a way, that each comparison cycle has the same minimal number of mechanical movements and duration. This guarantees that each weighing cycle is performed under equivalent conditions, resulting in minimal measurement uncertainty and shortest possible overall weighing times.



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Thanks to the triple-beam weighing pan, each mass rests only on three contact points, guaranteeing minimal abrasion, another potential source of measurement error. Moreover, the triple-beam weighing pan is very flexible regarding what can be placed on it – ideal for weighing masses of various shapes, for example OIML weights with recessed bottom or silicon spheres up to 100 mm in diameter (see figure 2).

Nano- and Vacuum Technology Working Hand in Hand

The influence of ambient conditions is reduced to a minimum using vacuum technology. A dedicated, round vacuum enclosure for the M_One was developed that ensures even pressure distribution within. After a short time a full vacuum environment is built up that completely eliminates the effects of barometric pressure, air buoyancy, and humidity. What's more, the M_One can even be loaded under full vacuum conditions without breaking this special environment, which significantly improves results and saves time (see figure 3).

Introducing new optional features

Latest requirements from National Institutes have shown, that lower ultimate pressure in the recipient is required for certain physical examinations of artefacts and that mass standards become less stable when they are transferred between air and vacuum gaining hydrocarbon contamination. METTLER TOLEDO has further developed the M_one Vacuum Mass Comparator to meet these requirements and now introduces:

- A new modified „Load Lock“ system which allows the transfer of artefacts from the vacuum chamber, where the artefacts are measured, to the „artefact transfer chamber“ (also known as glove box) where the artefacts can be placed and prepared for further handling under a more stable inert gas atmosphere. This new feature consists of a vertical linear lift which allows a secure and easy artefact transfer from the „Load Lock“ to the glove box.
- An ultra-high-vacuum turbo-molecular pump can be attached to a 160mm flange of the vacuum enclosure which allows reaching up to 10 times lower pressure.

(See figure 1 for more details.)

Convincing Benefits

The M_One is the benchmark in the field of ultra-precise mass comparison. Due to its extraordinary weighing performance, it is optimally suited to support National Metrology Institutes and University Research Centers worldwide to perform the following tasks:

- Guarantee the traceability of the 1 kg units in all countries back to the international prototype
- Compare the competence of different NMIs worldwide. The unique „Load Lock“ feature allows loading the M_One under full vacuum conditions, enabling the transfer of artefact samples between NMIs to perform the round robin test without interference of external influences.
- Support research to replace the present artefact definition of the kilogram by a definition based on physical constants. The dedicated triple-beam weighing pan allows weighing Silicon spheres up to 100mm in diameter

Another Step into the Future

The M_One's weighing performance is unmatched to date. The combination of nano- and vacuum technology with intelligent mechanical engineering delivers the most accurate results with the smallest possible measurement uncertainty in the shortest time. It is another stunning example of METTLER TOLEDO's relentless dedication to extend the limits of ultra-high precision weighing by another notable step.



Figure 1:
The M_One Mass Comparator Balance is the benchmark in the field of ultra-precise mass comparison. The ingenious combination of high precision mechanics with vacuum technology leads to measurement results of unprecedented accuracy. System shown includes the optional Load Lock and ultra-high-vacuum pump features.

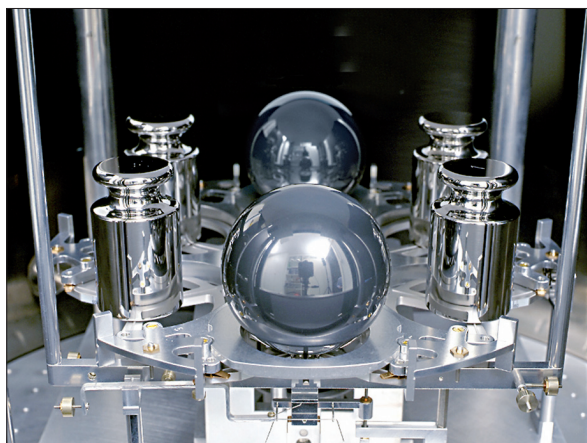


Figure 2:
The automated turntable with the unique triple-beam weighing pan guarantees minimal abrasion and allows weighing masses of various shapes, for example OIML weights with recessed bottom or silicon spheres up to 100 mm in diameter.

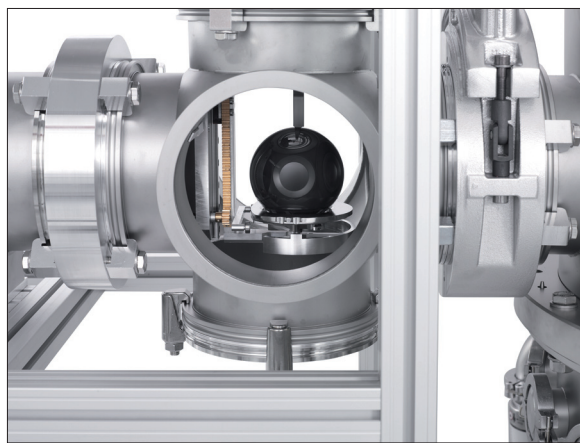


Figure 3:
The unique "Load Lock" feature allows loading the M_One under full vacuum conditions, enabling the transfer of artefact samples from the vacuum chamber to the glove box without interference of external influences in a very short time.

METTLER TOLEDO is a leading global supplier of precision instruments and services. The Company is the world's largest manufacturer and marketer of weighing instruments for use in laboratory, industrial and food retailing applications. The Company also holds top-three market positions in several related analytical instruments and is a leading provider of automated chemistry systems used in drug and chemical compound discovery and development. In addition, the Company is the world's largest manufacturer and marketer of metal detection and other end-of-line inspection systems used in production and packaging and holds a leading position in certain process analytics applications. Additional information about METTLER TOLEDO can be found on the World Wide Web at: ► www.mt.com



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