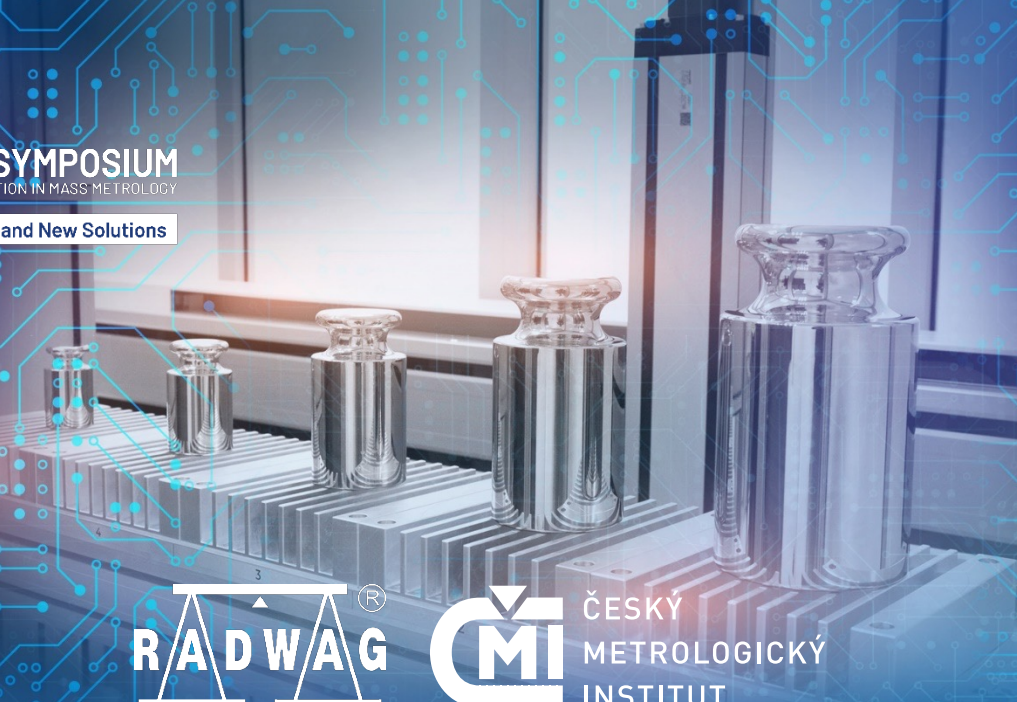




METROLOGY SYMPOSIUM
DIGITALIZATION AND AUTOMATION IN MASS METROLOGY

Third Edition: Future and New Solutions



ČESKÝ
METROLOGICKÝ
INSTITUT

The robotic measuring station for comparison of mass standards from 0.05 mg to 1 kg through dissemination



METROLOGY SYMPOSIUM

DIGITALIZATION AND AUTOMATION IN MASS METROLOGY

Third Edition: Future and New Solutions



Presenters

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A mass comparator manager,
A sales manager for Asian markets



RMCM

Robotic mass comparator

The **RMCM** robotic mass comparator guarantees the best repeatability in the range from **0.05 mg to 10 g** with a reading precision of **0.1 µg**.

The comparator is supplied with a **120-position** standard **magazine** and allows performing a fully automatic dissemination with a division of up to 3 mass standards.

Model	Maximum capacity	Readability [d]	Standard repeatability [Max]	E0	E1	E2	F1	F2
RMCM 5	5,1 g	0,1 µg	0,4 µg	0,05 mg - 5 g	0,05 mg - 5 g	0,05 mg - 5 g	0,05 mg - 5 g	0,05 mg - 5 g
RMCM 10	10,1 g	0,1 µg	0,6 µg	0,05 mg - 10 g	0,05 mg - 10 g	0,05 mg - 10 g	0,05 mg - 10 g	0,05 mg - 10 g



RMC

Robotic mass comparator

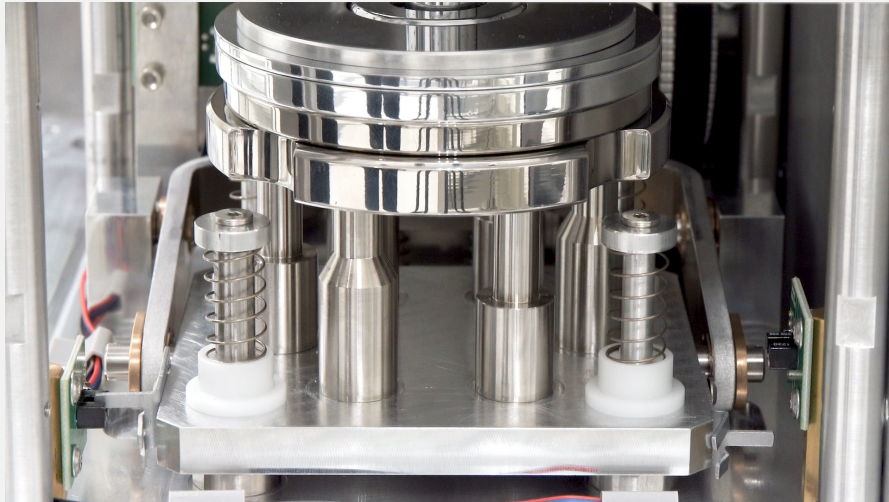
The **RMC** robotic mass comparator guarantees the best repeatability in the range from **1 g to 1000 g** with a reading precision of **0.1 μ g / 1 μ g**.

The **comparator is supplied with a 100-position mass standard magazine** and allows performing a fully automatic dissemination with a division of up to 3 mass standards.

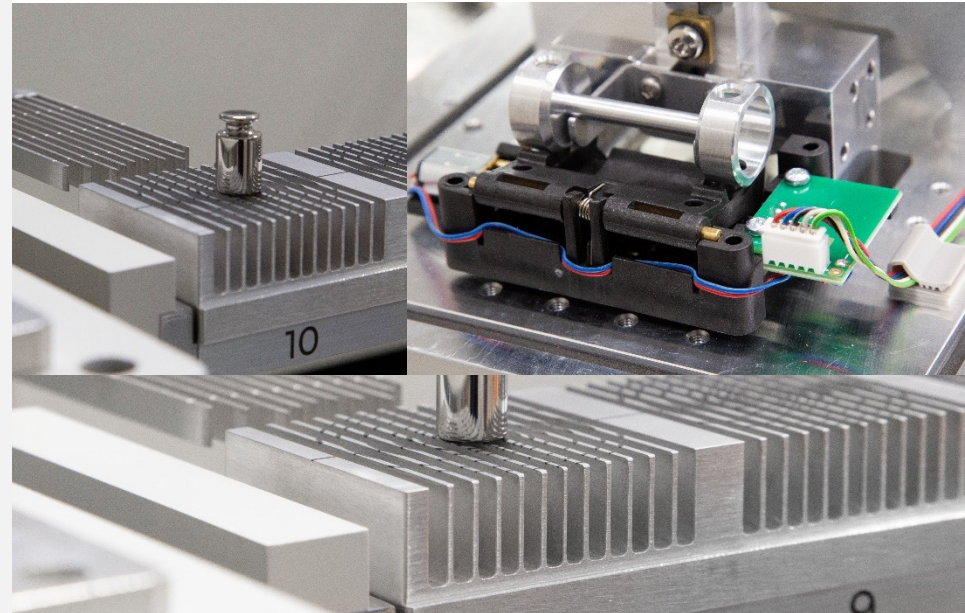
Model	Maximum capacity	Readability [d]	Standard repeatability [Max]	E0	E1	E2	F1	F2
RMC 100	110 g	0,1 μ g	0,8 μ g	1 g - 100 g	1 g - 100 g	1 g - 100 g	1 g - 100 g	1 g - 100 g
RMC 1000	1020 g	1 μ g	2 μ g	10 g - 1000 g	10 g - 1000 g	10 g - 1000 g	10 g - 1000 g	10 g - 1000 g

Main advantages of RMC- and RMCM-series robotic comparators

Fully automated change of the comparison range
in comparators equipped with inner ballasts



Internal adjustment and robotic adjustment with
the mass standard collected from the magazine



Main advantages of RMC- and RMCM-series robotic comparators

Robot in the robot

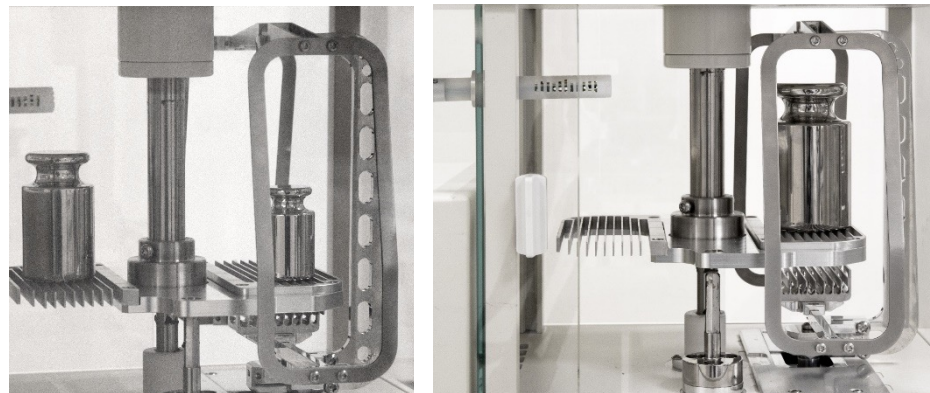
Combination of advantages of the robotic system and automatic system

A few-time better repeatability in view of stable ambient conditions during comparison due to the fact that the weighing chamber does not open throughout the cycle.

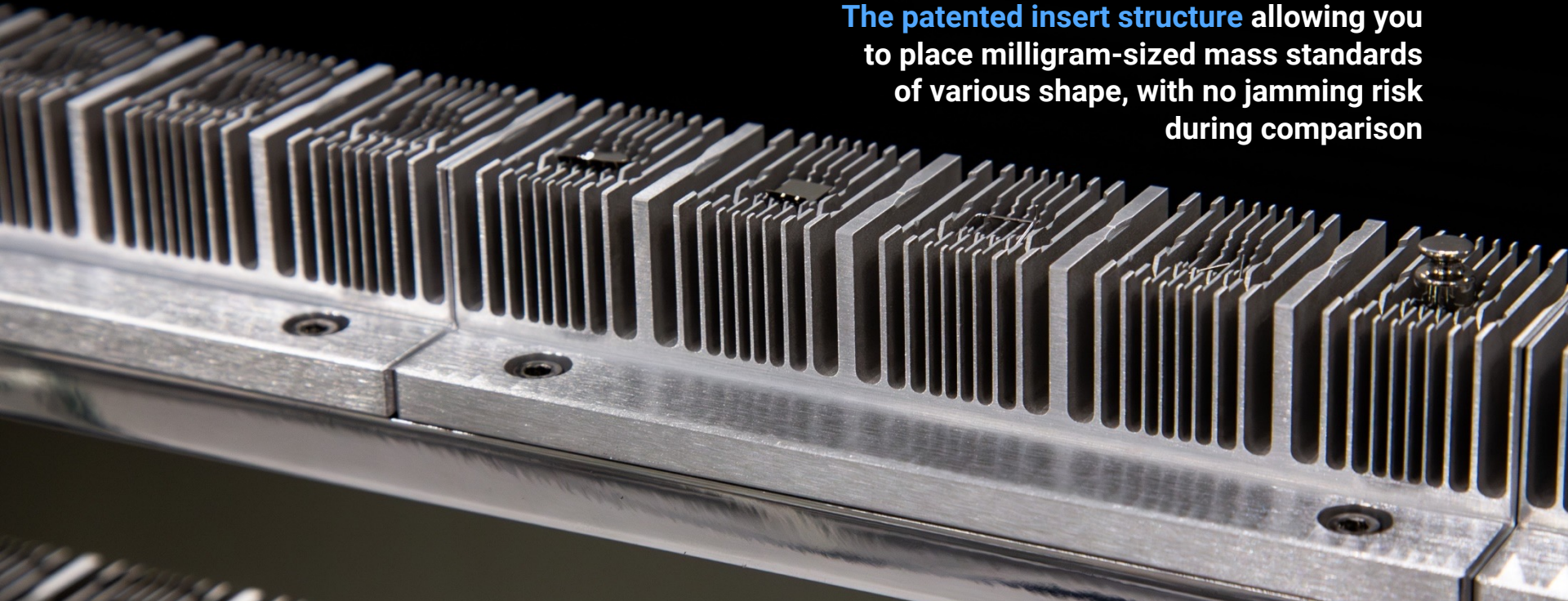


Self-centring suspended weighing pan

Elimination of a eccentricity error thanks to the use of a special suspended weighing pan.



Main advantages of RMC- and RMCM-series robotic comparators



The patented insert structure allowing you to place milligram-sized mass standards of various shape, with no jamming risk during comparison

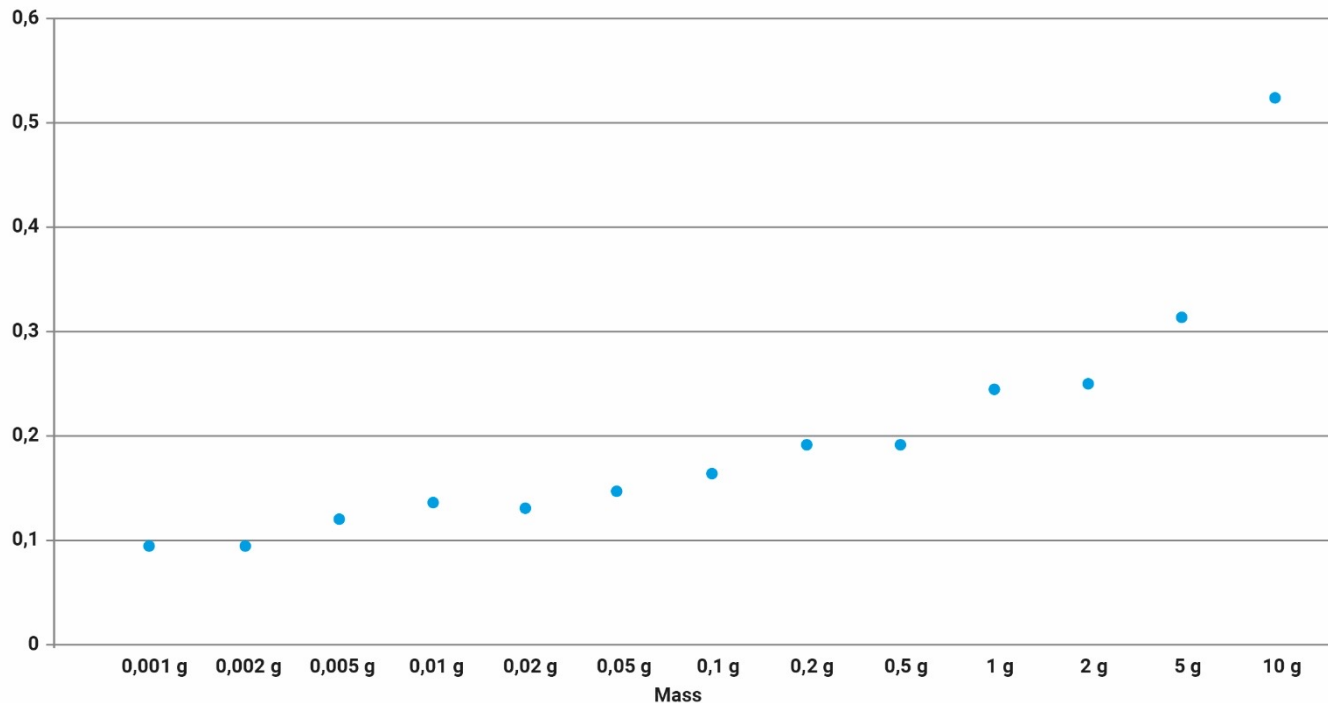
Main advantages of RMC- and RMCM-series robotic comparators

Possibility of carrying out
the dissemination proces
for a maximum of 3 patterns



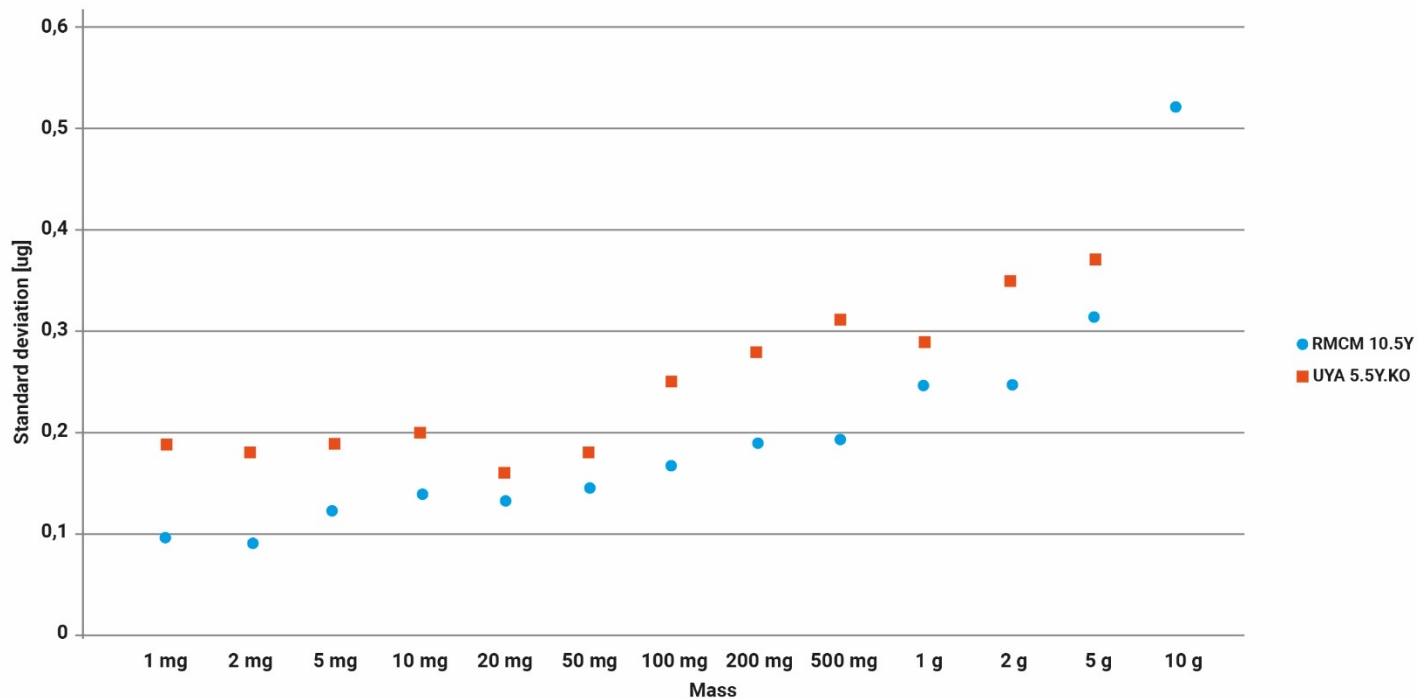
RMCM 10 comparator repeatability results

Standard deviation for robotic mass comparator RMCM 10



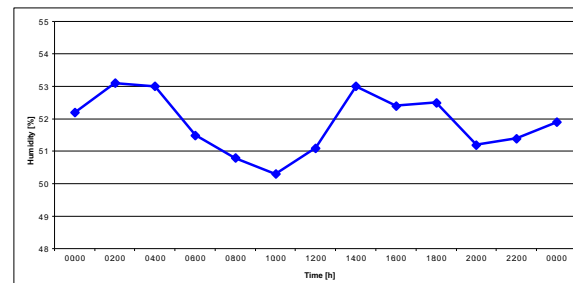
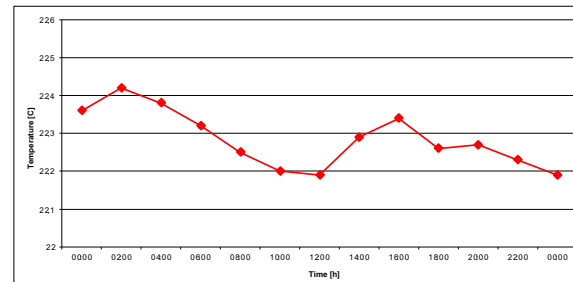
RMCM 10 comparator repeatability results

Standard deviation for robotic mass comparator RMCM 10 & UYA.5.5.KO



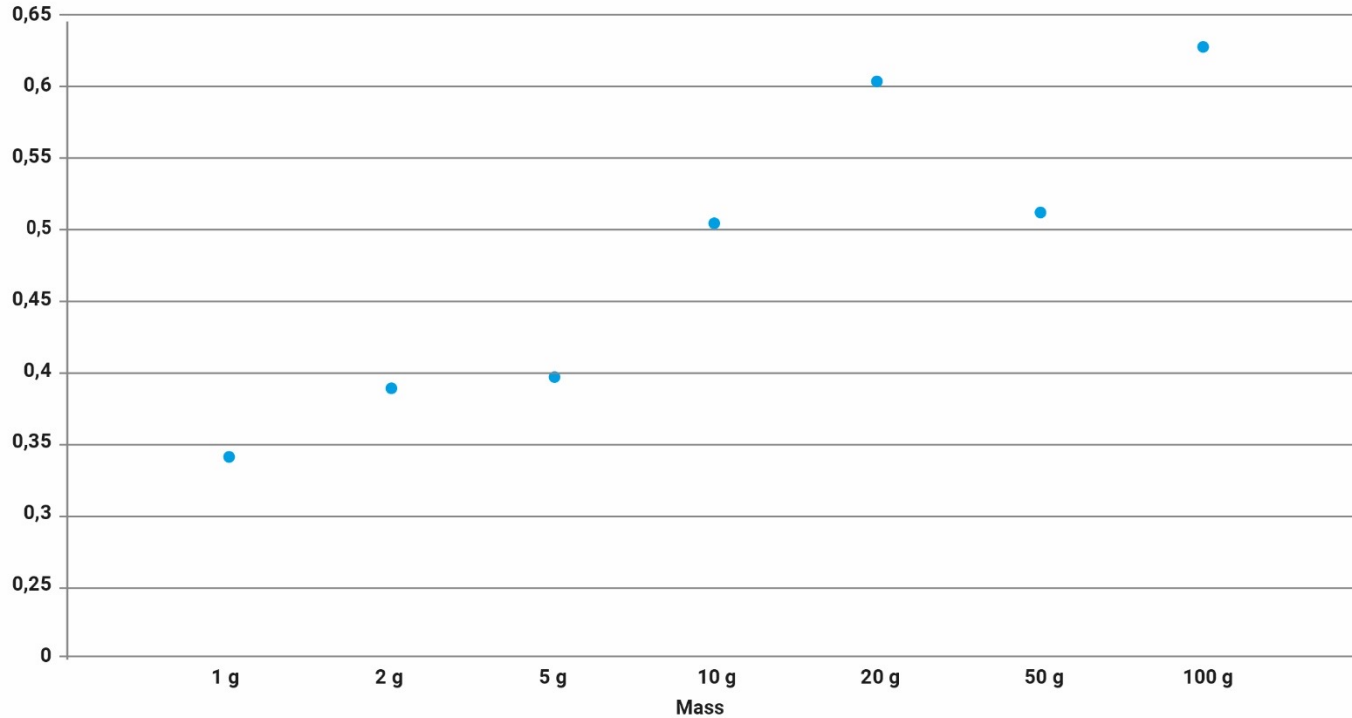
RMC 100 comparator repeatability results

Mass	MEASUREMENTS					Average
	1 SD [μg]	2 SD [μg]	3 SD [μg]	4 SD [μg]	5 SD [μg]	SD [μg]
1 g	0,34	0,27	0,3	0,41	0,38	0,34
2 g	0,49	0,32	0,37	0,36	0,4	0,388
5 g	0,5	0,33	0,26	0,45	0,44	0,396
10 g	0,46	0,39	0,55	0,61	0,51	0,504
20 g	0,66	0,54	0,5	0,62	0,69	0,602
50 g	0,28	0,53	0,58	0,7	0,47	0,512
100 g	0,47	0,48	0,75	0,78	0,65	0,626



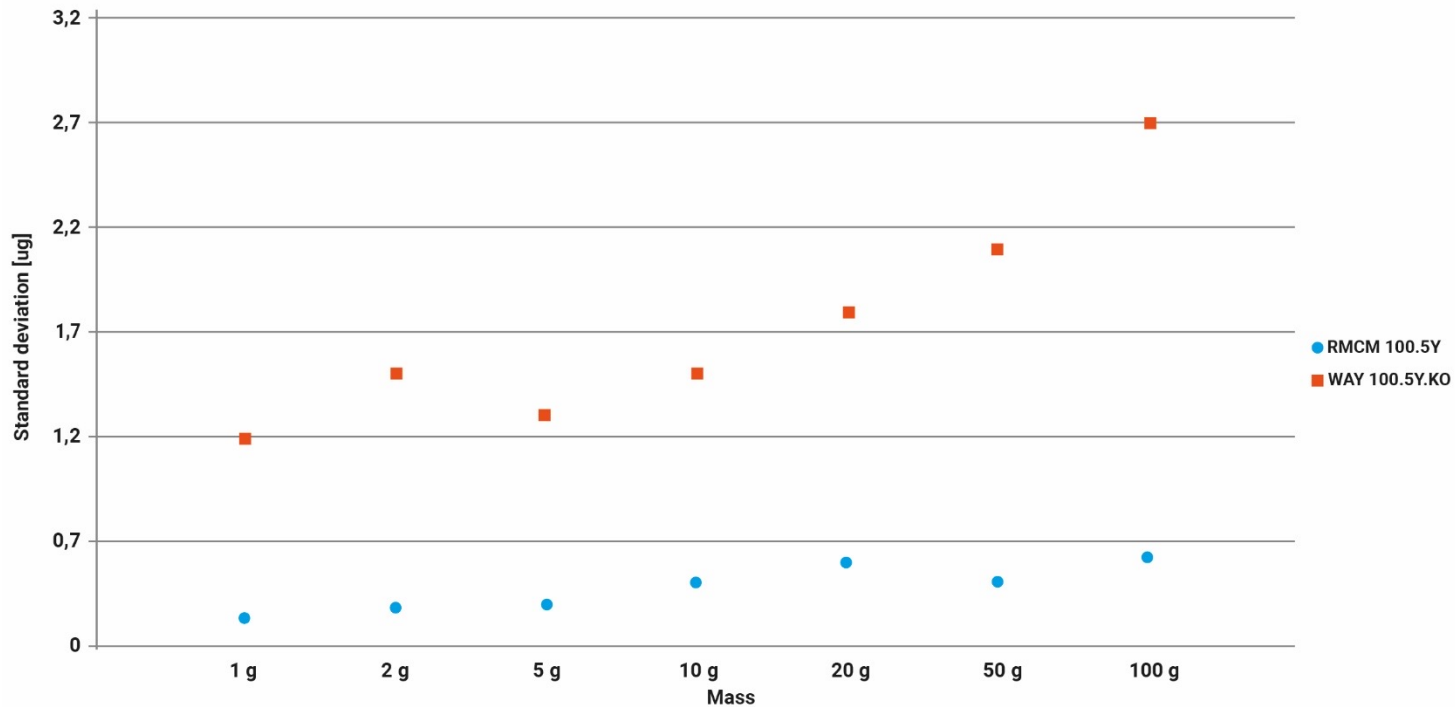
RMC 100 comparator repeatability results

Standard deviation for robotic mass comparator RMC 100



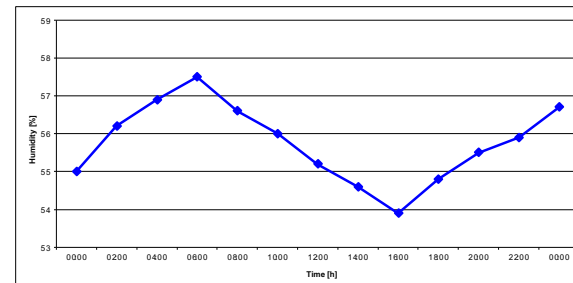
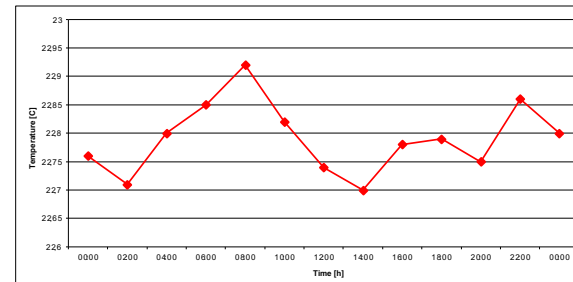
RMC 100 comparator repeatability results

Standard deviation for robotic mass comparator RMC 100 & WAY 100.5Y.KO



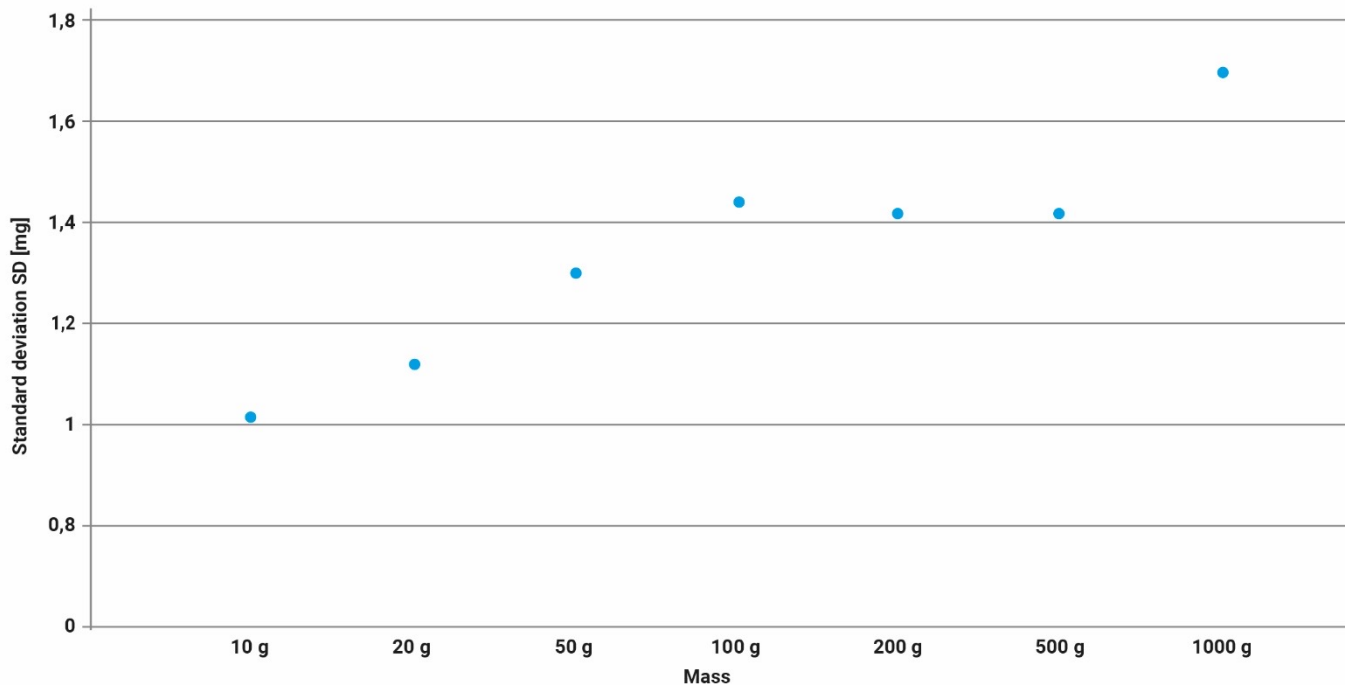
RMC 1000 comparator repeatability results

Mass	MEASUREMENTS					Average
	1 SD [μg]	2 SD [μg]	3 SD [μg]	4 SD [μg]	5 SD [μg]	SD [μg]
10 g	0,8	1,1	0,9	1	1,3	1,02
20 g	1,2	1	0,8	1,4	1,2	1,12
50 g	1,5	0,9	1,1	1,6	1,4	1,3
100 g	1,7	1,9	1	1,1	1,5	1,44
200 g	1,4	1,5	1,5	0,9	1,8	1,42
500 g	1,9	1,1	1,6	1,3	1,2	1,42
1000 g	1,7	2	1,9	1,4	1,5	1,7



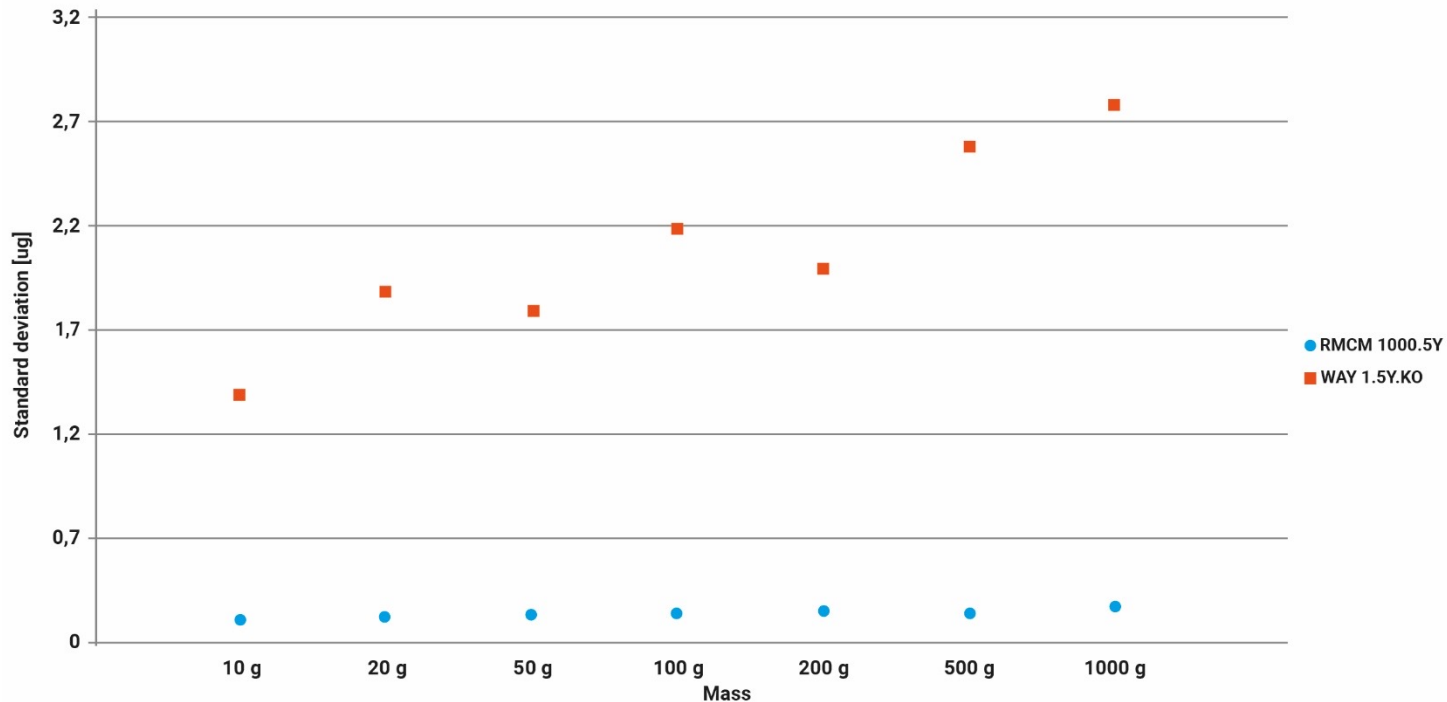
RMC 1000 comparator repeatability results

Standard deviation for robotic mass comparator RMC 1000



RMC 1000 comparator repeatability results

Standard deviation for robotic mass comparator RMC 1000 & WAY 1.5Y.KO



Robotic vs automatic comparators



- Mass standards magazine - **18-36 positions**
- Time for ABBA cycle - **~22 min**
- Readability unit max 100 g - **1 μ g**
- Readability unit max 1000 g - **5 μ g**



- Mass standards magazine - **40-120 positions**
- Time for ABBA cycle - **~45 min**
- Readability unit max 100 g - **0,1 μ g**
- Readability unit max 1000 g - **1 μ g**
- Full automated dissemination divided max to 3 patterns

ABBA

Tests results

RMCM 10.5Y			
Mass	A/B [μg]	B/A [μg]	Difference [μg]
0,001 g	0,1	-0,3	0,2
0,002 g	-0,4	0,8	0,4
0,005 g	0,3	-0,8	0,5
0,01 g	0,7	-0,2	0,5
0,02 g	-1,1	0,5	0,6
0,05 g	1,5	-2,1	0,6
0,1 g	1,3	-2	0,7
0,2 g	2,3	-1,5	0,8
0,5 g	-2,5	3,1	0,6
1 g	4,2	-3,3	0,9
2 g	4,5	-5,3	0,8
5 g	-3,9	2,9	1
10 g	4	-4,7	0,7

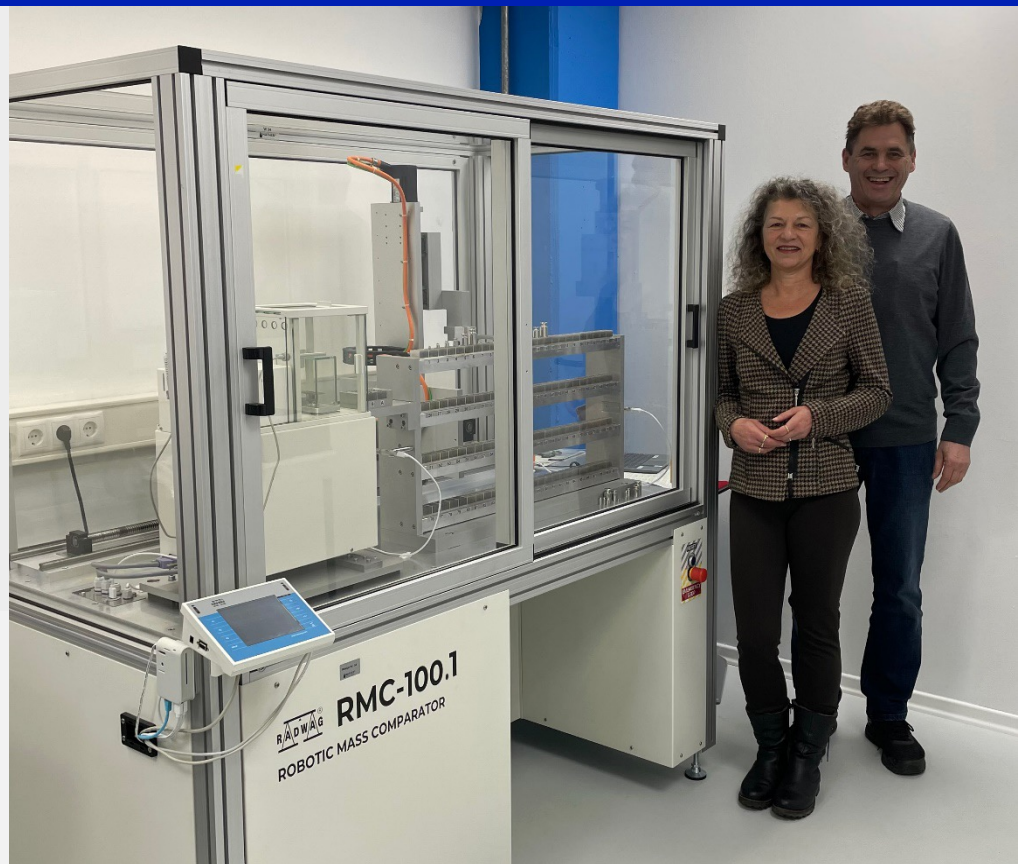
RMC 100.5Y			
Mass	A/B [μg]	B/A [μg]	Difference [μg]
1 g	4,1	-4,7	0,6
2 g	-10,6	11,8	1,2
5 g	11,9	-10,9	1
10 g	20,2	-21,1	0,9
20 g	34,5	-34,8	0,3
50 g	36,7	-37,4	0,7
100 g	-48,8	47,3	1,5

RMC 1000.5Y			
Mass	A/B [μg]	B/A [μg]	Difference [μg]
10 g	19,6	-20,1	0,5
20 g	33,3	-34,2	0,9
50 g	37,7	-36,4	1,3
100 g	-46,4	45	1,4
200 g	88,5	-86,9	1,6
500 g	-123,4	122,2	1,2
1000 g	200,7	-203,1	2,4

Installations and implementations

Robotic system
RMC 100, RMC 1000

Installation site:
Häfner
Oberrot, Germany



Installations and implementations

Robotic system
RMC 10, RMC 1000

Installation site:
NMI-VSL
The Hague, the Netherlands



Installations and implementations

Robotic system RMCM 10

Installation site:
Bilanciai
Modena, Italy



Special designs of RMC-and RMCM-series robotic systems



The robotic system based on the **RMCM**
robot for weighing gold samples

$d=0,1 \mu\text{g}$
Max 2,1 g

Mass standard magazine – **120 positions**



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**Thank you for
your attention**

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