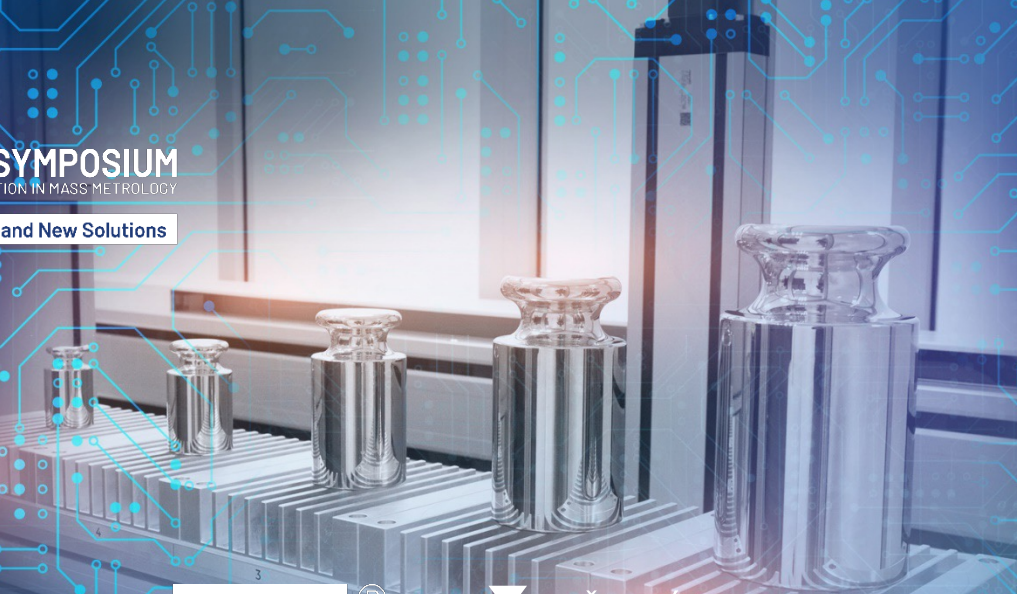




METROLOGY SYMPOSIUM
DIGITALIZATION AND AUTOMATION IN MASS METROLOGY

Third Edition: Future and New Solutions



ČESKÝ
METROLOGICKÝ
INSTITUT

**Robotic measuring station for comparison
of heavy mass standards from 2 kg to 50 kg**



METROLOGY SYMPOSIUM

DIGITALIZATION AND AUTOMATION IN MASS METROLOGY

Third Edition: Future and New Solutions



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Analytical Balances Specialist



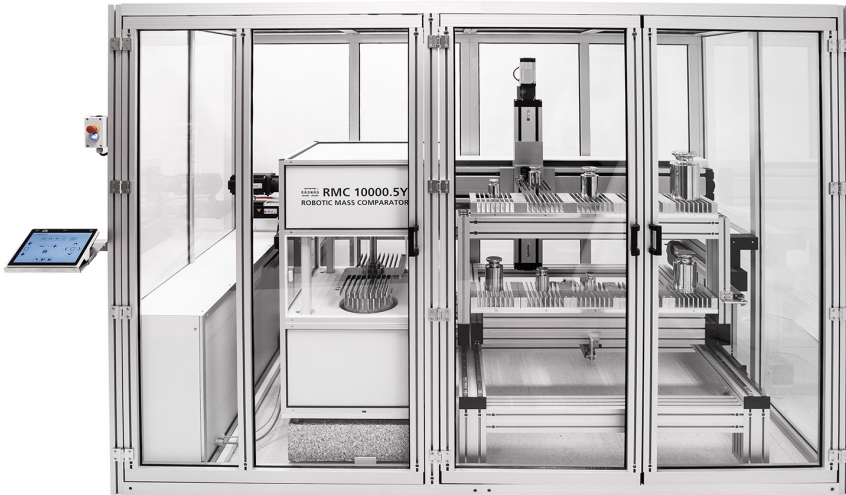
Krzysztof Schabowski

Support Service Technical

Presenters

RMC 10000/20000.5Y

Robotic mass comparator



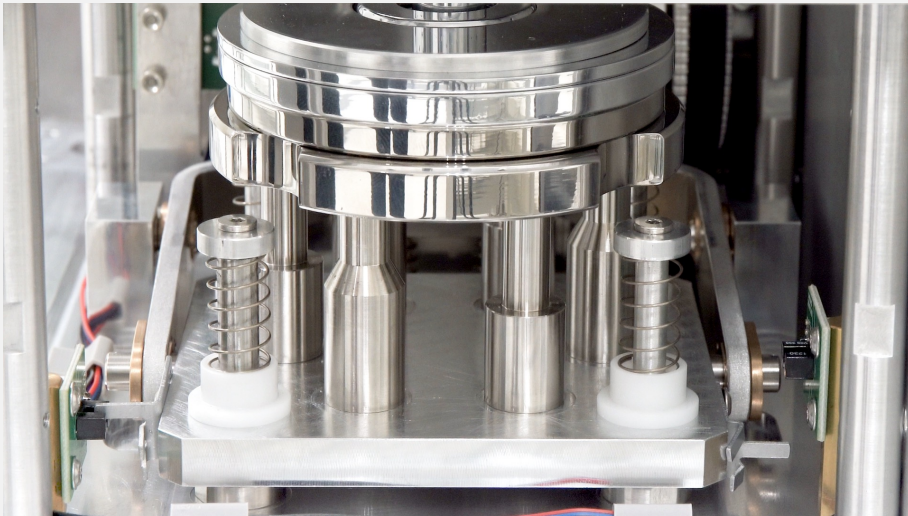
The **RMC 10000/20000.5Y** robotic mass comparator guarantees the best repeatability in the range from **1 kg to 20 kg** with a reading accuracy of 10/100 µg. **Full automation of the robotic mass standard comparison.**

The comparator is supplied with a **10-position mass standard magazine** and allows performing a fully automatic „dissemination” with a division into up to 3 mass standards.

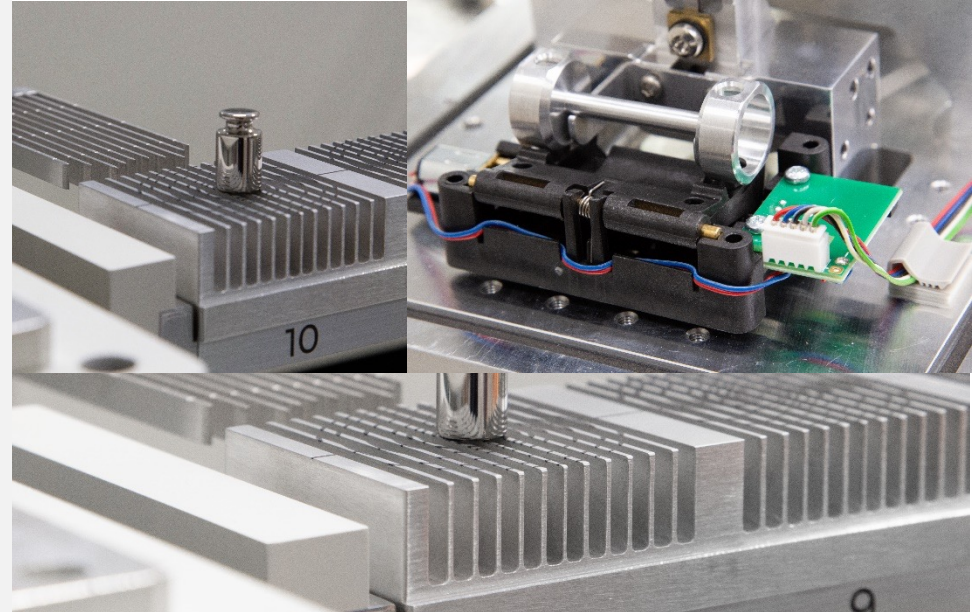
| Model | Maximum capacity | Readability | Standard repeatability [5% max] | Standard repeatability [max] | E0 | E1 | E2 | F1 | F2 |
|-------------------|------------------|-------------|---------------------------------|------------------------------|--------------|--------------|--------------|--------------|--------------|
| RMCM 10000 | 10,2 kg | 0,01 mg | 0,05 mg | 0,05 mg | 1 kg - 10 kg | 1 kg - 10 kg | 1 kg - 10 kg | 1 kg - 10 kg | 1 kg - 10 kg |
| RMCM 20000 | 20,5 kg | 0,1 mg | 0,15 mg | 0,2 mg | 5 kg - 20 kg | 2 kg - 20 kg | 1 kg - 20 kg | 1 kg - 20 kg | 1 kg - 20 kg |

Main advantages of RMC 10000/20000 robotic comparators

**Fully automatic change
of comparison range**



**Internal adjustment and automatic adjustment
with a mass standard collected from the magazine**

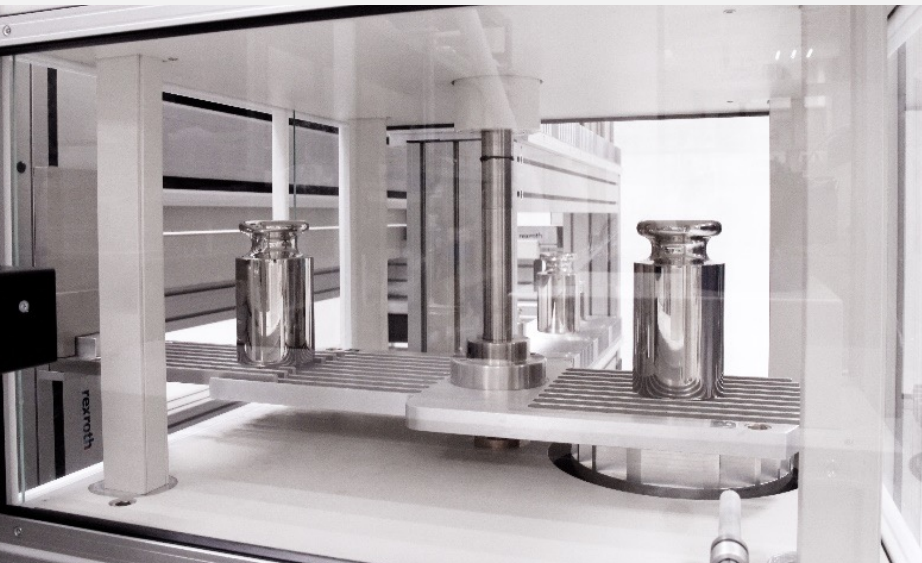


Main advantages of RMC 10000/20000 robotic comparators

Robot in the robot

The 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.



Main advantages of RMC 10000/20000 robotic comparators

Self-centring suspended weighing pan

Elimination of the non-centricity error thanks to the use of a special self-centring weighing pan.



Main advantages of RMC 10000/20000 robotic comparators

Retractable mass standard magazines

help the operator to load and unload heavy mass standards.



Main advantages of RMC 10000/20000 robotic comparators

It is possible to perform the dissemination with a division into up to 3 mass standards, as well as a reversed dissemination, e.g. A/10x1 kg to B.10 kg





AKM-2.5Y

Automatic mass comparator

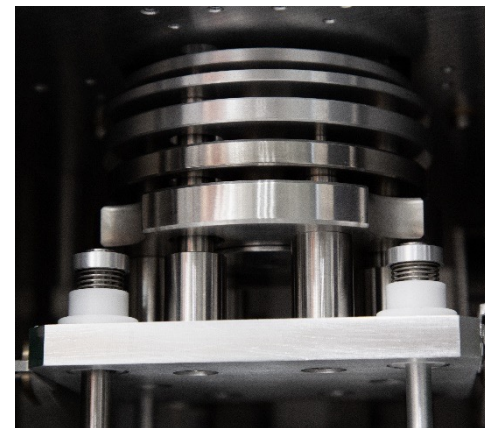
As it is equipped with automatic mass feeders, the **AKM.5Y** mass comparator is used for automatic determination of mass deviations for an individual test weight in one cycle.

The automatic comparator is widely used in the mass measuring laboratories, in particular in E- and F-class weight certifying units.

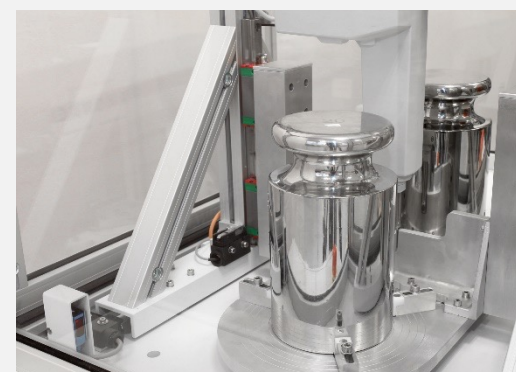
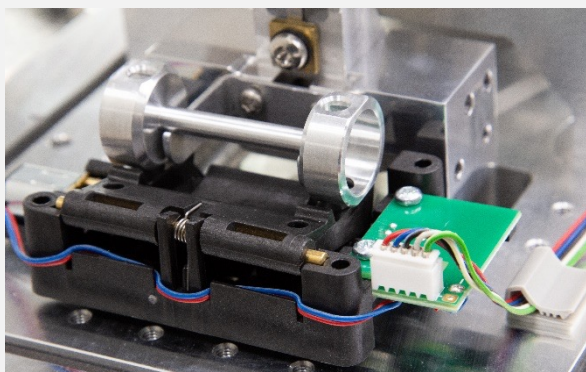
| Model | Maximum capacity | Readability | Standard repeatability [max] | E0 | E1 | E2 | F1 | F2 |
|------------|------------------|-------------|------------------------------|---------------|---------------|--------------|--------------|--------------|
| AKM-2/20 | 20,2 kg | 0,1 mg | 0,2 mg | 5 kg - 20 kg | 2 kg - 20 kg | 1 kg - 20 kg | 1 kg - 20 kg | 1 kg - 20 kg |
| AKM-2/50 | 50,5 kg | 1 mg | 2 mg | 50 kg | 20 kg - 50 kg | 5 kg - 50 kg | 1 kg - 50 kg | 1 kg - 50 kg |
| AKM-2/50.1 | 50,2 kg | 0,1 mg | 0,6 mg | 10 kg - 50 kg | 5 kg - 50 kg | 5 kg - 50 kg | 5 kg - 50 kg | 5 kg - 50 kg |

Main advantages of AKM-2-series automatic comparators

Fully automatic change
of comparison range



Internal
adjustment

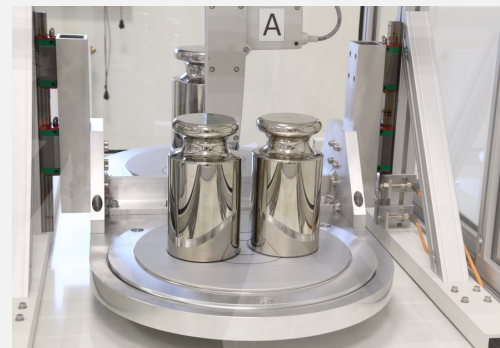
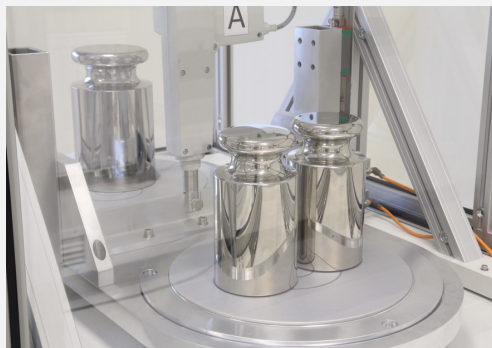


Main advantages of AKM-2-series automatic comparators

Self-centering pan

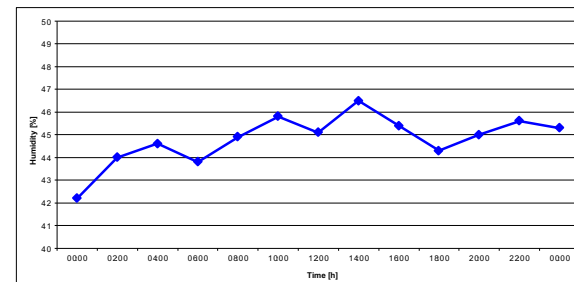
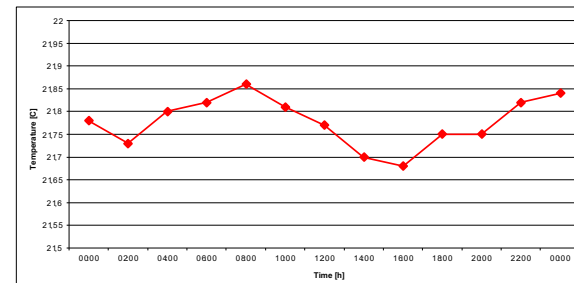


Possibility to carry out the dissemination process



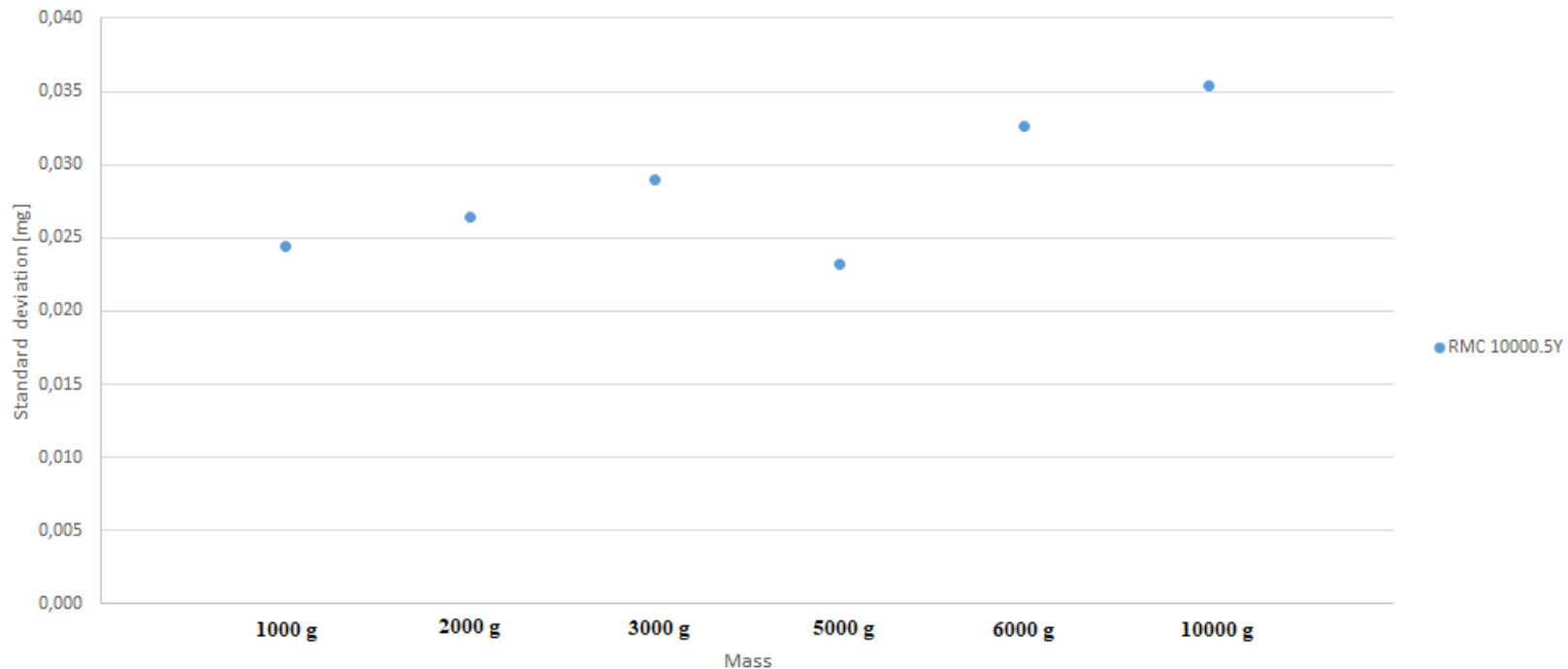
RMC 10000 comparator repeatability results

| Mass | MEASUREMENTS | | | | | Average |
|-------|--------------|-----------|-----------|-----------|-----------|---------|
| | 1 SD [mg] | 2 SD [mg] | 3 SD [mg] | 4 SD [mg] | 5 SD [mg] | SD [mg] |
| 1 kg | 0,023 | 0,019 | 0,034 | 0,026 | 0,02 | 0,024 |
| 2 kg | 0,029 | 0,038 | 0,016 | 0,018 | 0,031 | 0,026 |
| 3 kg | 0,04 | 0,025 | 0,025 | 0,019 | 0,036 | 0,029 |
| 5 kg | 0,017 | 0,015 | 0,026 | 0,024 | 0,034 | 0,023 |
| 6 kg | 0,045 | 0,033 | 0,02 | 0,027 | 0,038 | 0,033 |
| 10 kg | 0,041 | 0,04 | 0,032 | 0,036 | 0,028 | 0,035 |

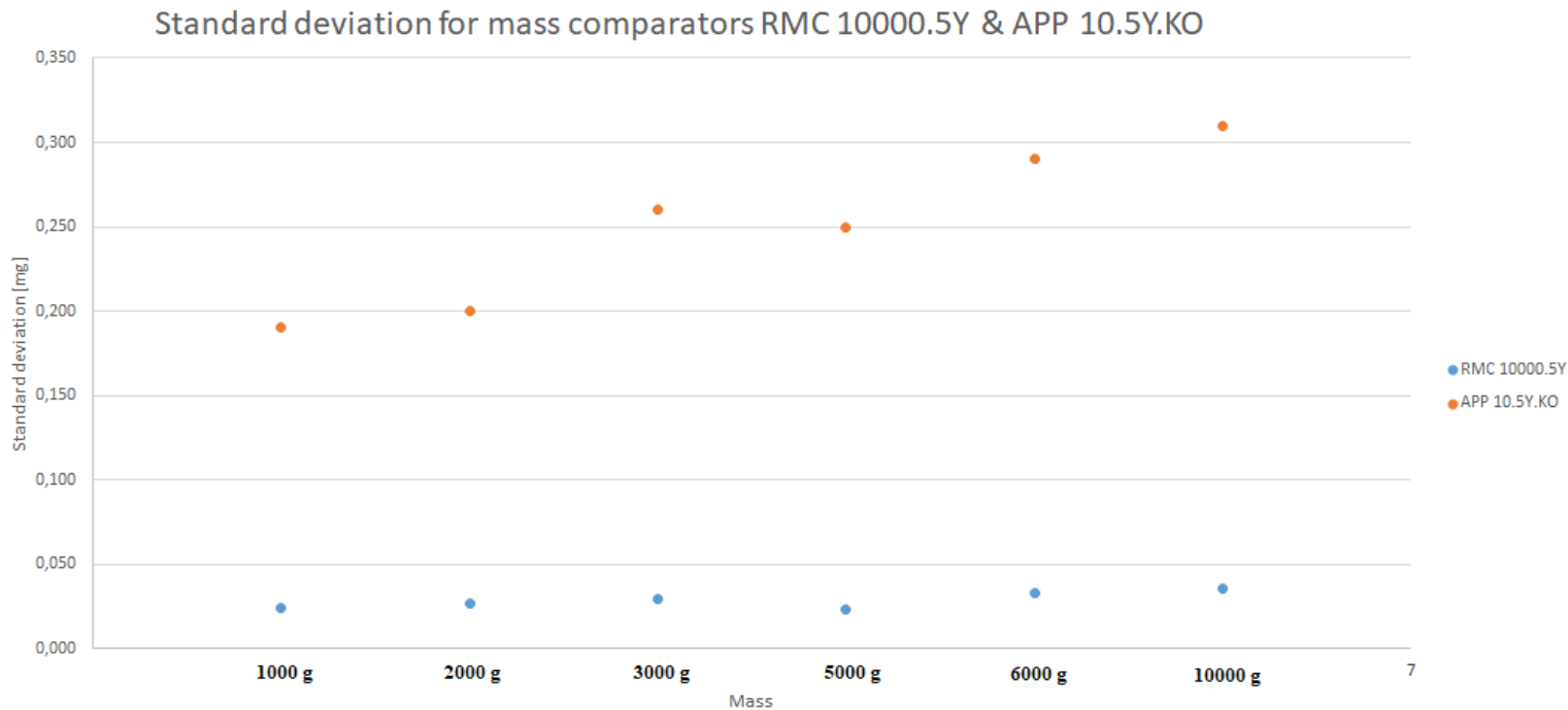


RMC 10000 comparator repeatability results

Standard deviation for robotic mass comparator RMC 10000.5Y

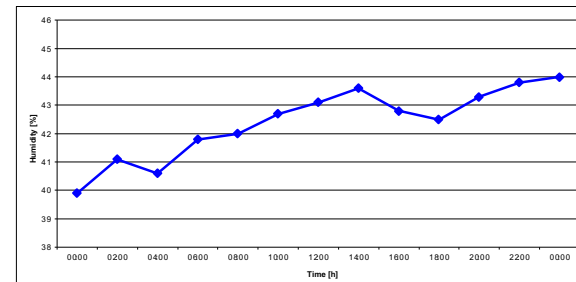
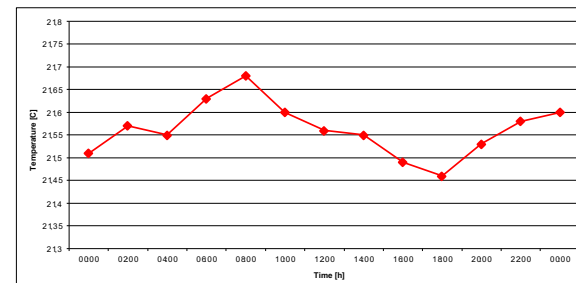


RMC 10000 comparator repeatability results



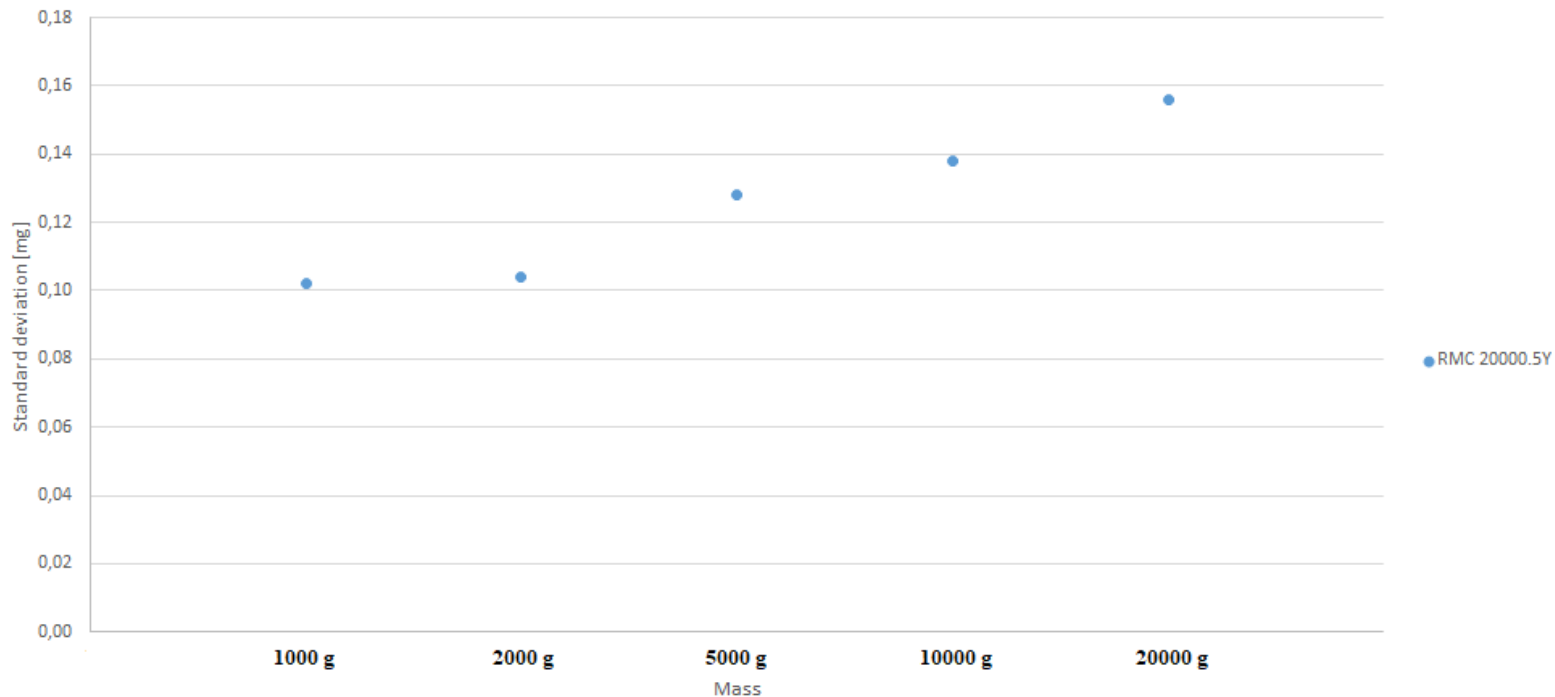
RMC 20000 comparator repeatability results

| Mass | MEASUREMENTS | | | | | Average |
|-------|--------------|-----------|-----------|-----------|-----------|---------|
| | 1 SD [mg] | 2 SD [mg] | 3 SD [mg] | 4 SD [mg] | 5 SD [mg] | SD [mg] |
| 1 kg | 0,07 | 0,1 | 0,09 | 0,11 | 0,14 | 0,102 |
| 2 kg | 0,12 | 0,08 | 0,06 | 0,13 | 0,13 | 0,104 |
| 5 kg | 0,16 | 0,14 | 0,15 | 0,1 | 0,09 | 0,128 |
| 10 kg | 0,13 | 0,18 | 0,11 | 0,17 | 0,1 | 0,138 |
| 20 kg | 0,19 | 0,19 | 0,12 | 0,11 | 0,17 | 0,156 |



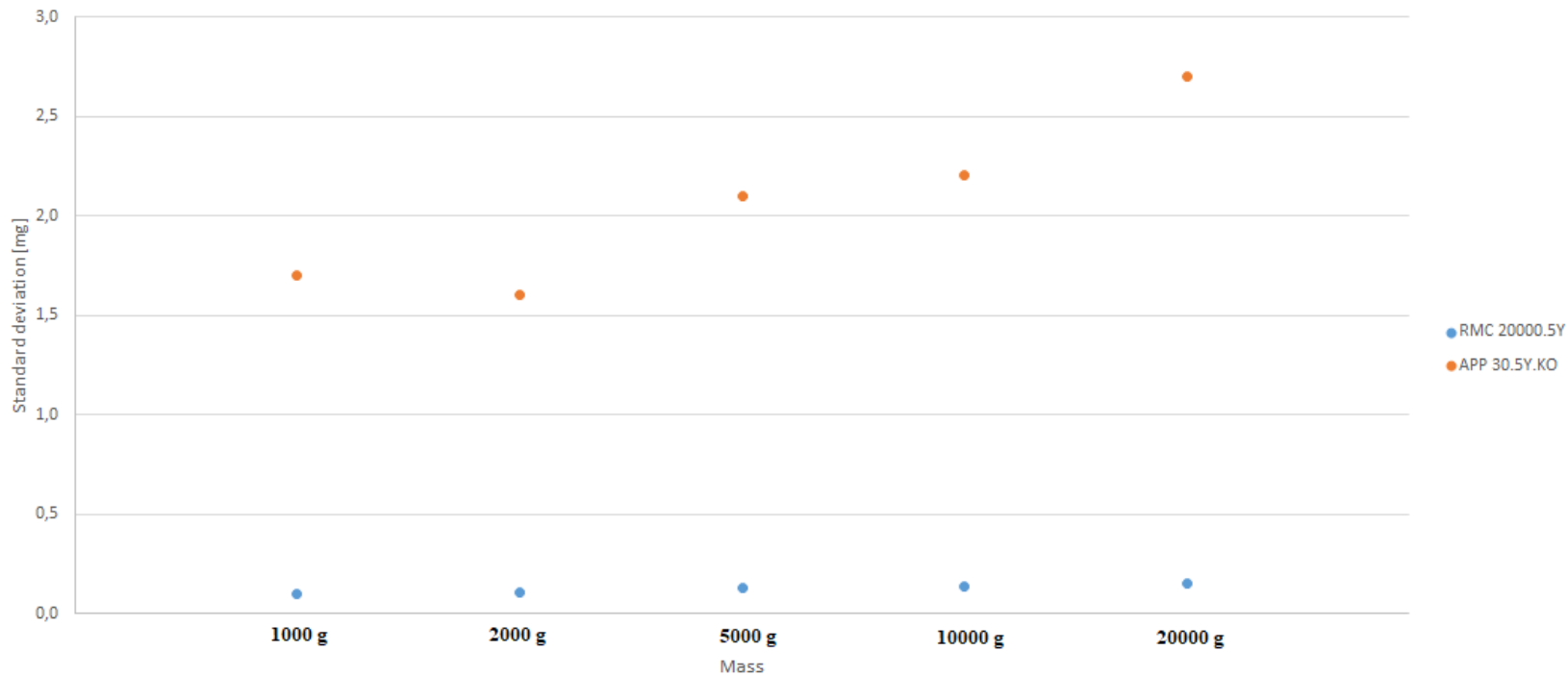
RMC 20000 comparator repeatability results

Standard deviation for robotic mass comparator RMC 20000.5Y



RMC 20000 comparator repeatability results

Standard deviation for robotic mass comparator RMC 20000.5Y & APP 30.5Y.KO



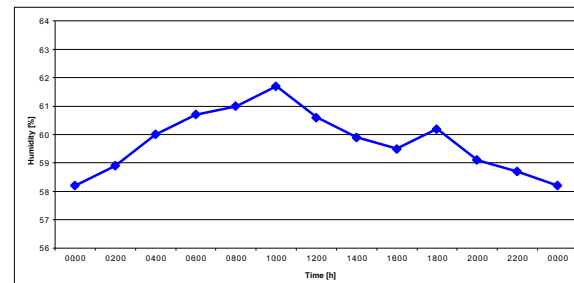
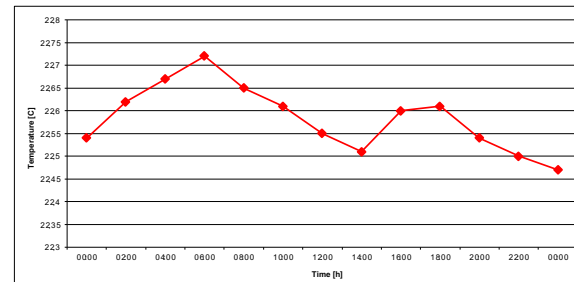
Exchange error tests results for the RMC 10000/20000 comparators

| RMC 10000.5Y | | | |
|--------------|----------|----------|-----------------|
| Mass | A/B [mg] | B/A [mg] | Difference [mg] |
| 1 kg | 0,199 | -0,187 | 0,012 |
| 2 kg | -0,414 | 0,41 | -0,004 |
| 3 kg | 0,296 | -0,311 | -0,015 |
| 5 kg | 0,365 | -0,358 | 0,007 |
| 6 kg | -0,233 | 0,21 | 0,023 |
| 10 kg | 0,544 | -0,597 | 0,053 |

| RMC 20000.5Y | | | |
|--------------|----------|----------|-----------------|
| Mass | A/B [mg] | B/A [mg] | Difference [mg] |
| 1 kg | 0,14 | 0,04 | 0,18 |
| 2 kg | 0,28 | -0,09 | 0,19 |
| 5 kg | 0,31 | -0,38 | 0,07 |
| 10 kg | 0,65 | -0,5 | 0,15 |
| 20 kg | 0,92 | -0,69 | 0,23 |

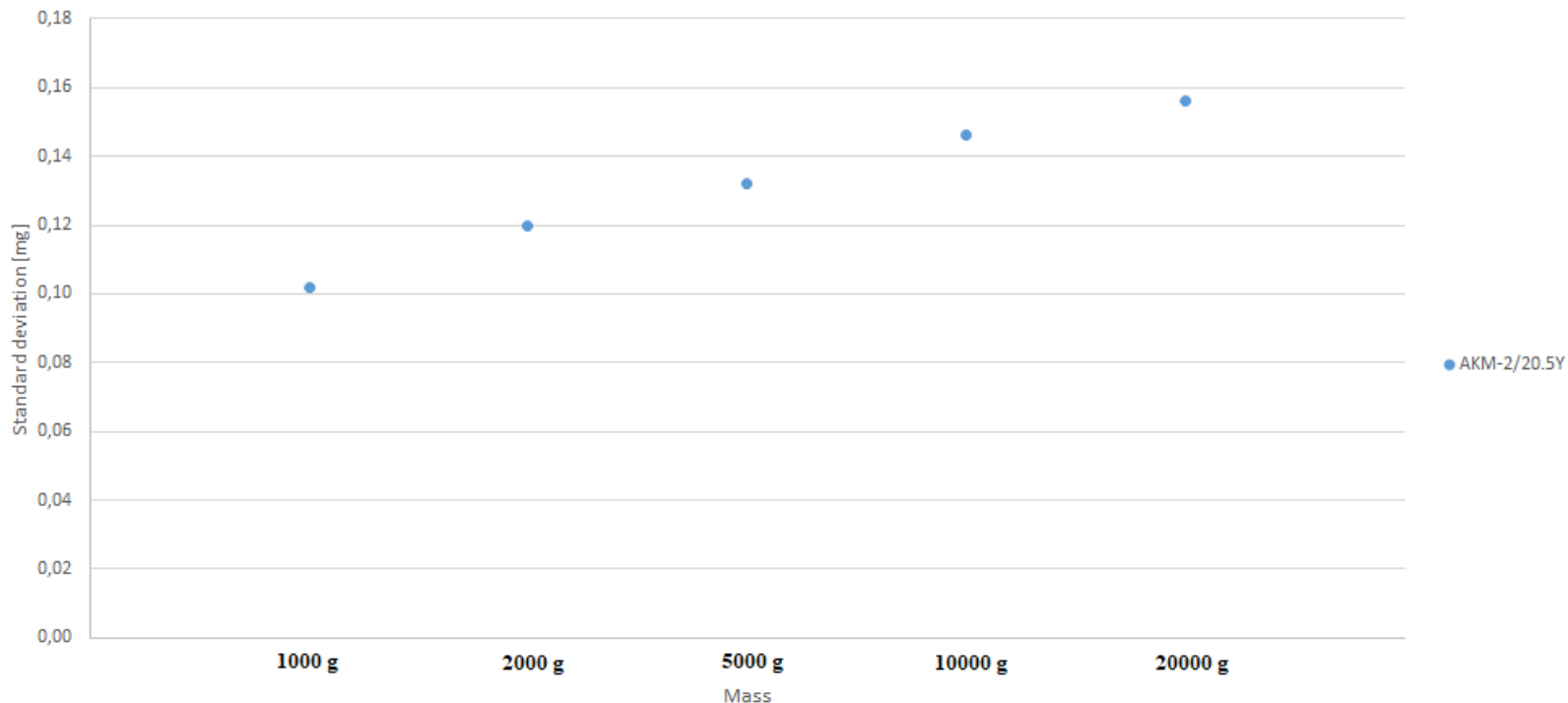
The repeatability results for the AKM-2/20 comparator

| Mass | MEASUREMENTS | | | | | Average |
|-------|--------------|-----------|-----------|-----------|-----------|---------|
| | 1 SD [mg] | 2 SD [mg] | 3 SD [mg] | 4 SD [mg] | 5 SD [mg] | SD [mg] |
| 1 kg | 0,14 | 0,12 | 0,06 | 0,09 | 0,1 | 0,102 |
| 2 kg | 0,11 | 0,15 | 0,08 | 0,14 | 0,12 | 0,120 |
| 5 kg | 0,13 | 0,16 | 0,09 | 0,11 | 0,17 | 0,132 |
| 10 kg | 0,19 | 0,13 | 0,15 | 0,1 | 0,16 | 0,146 |
| 20 kg | 0,2 | 0,12 | 0,15 | 0,14 | 0,17 | 0,156 |



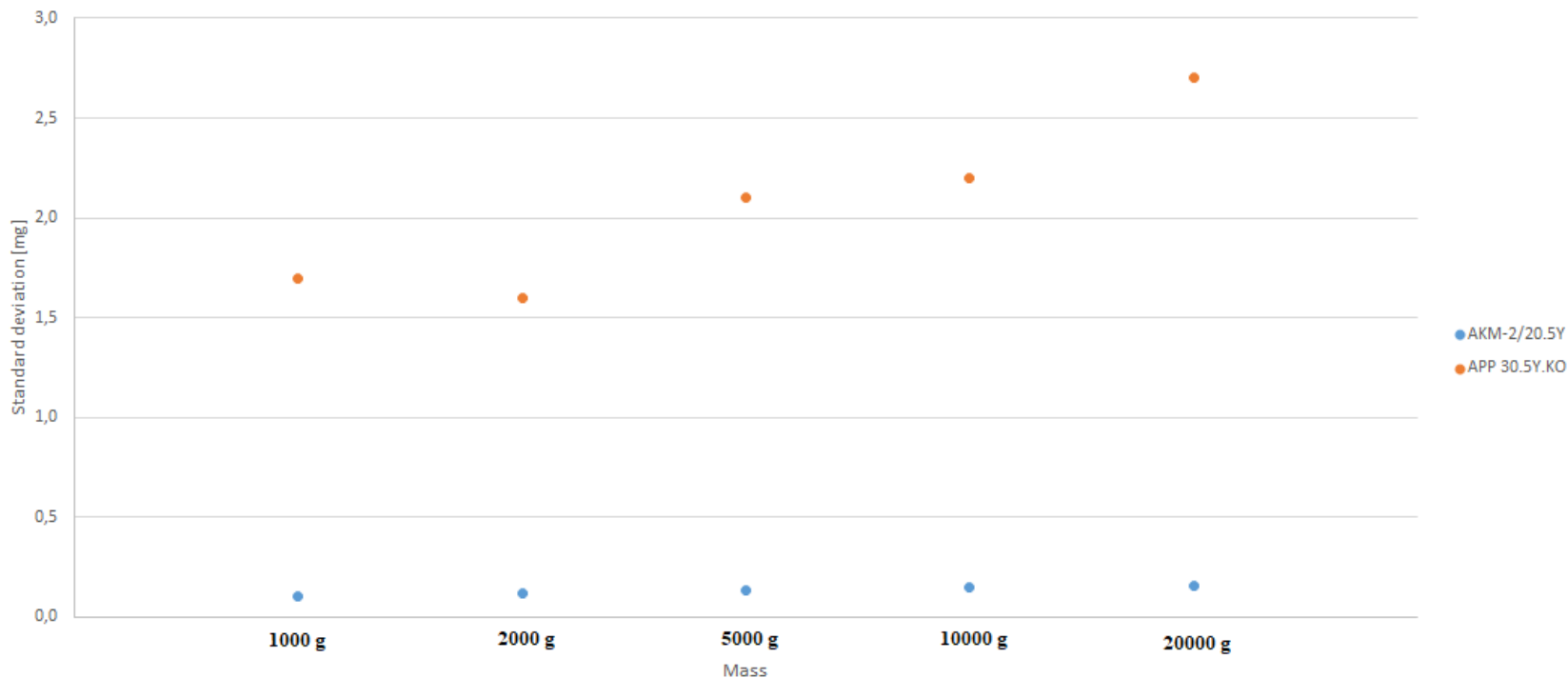
The repeatability results for the AKM-2/20 comparator

Standard deviation for robotic mass comparator AKM-2/20.5Y



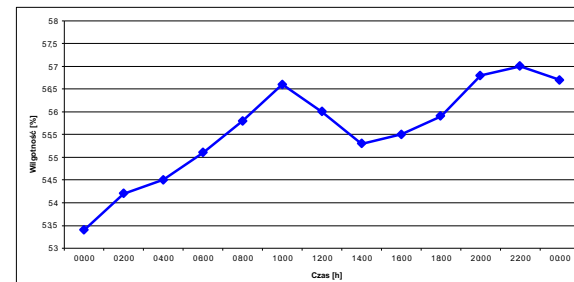
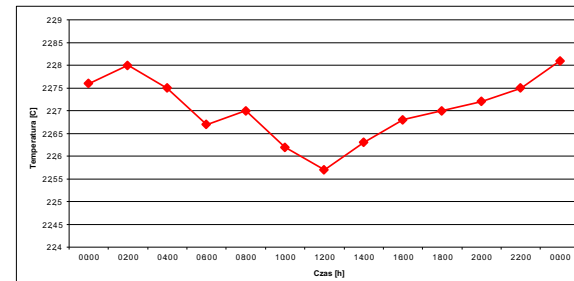
The repeatability results for the AKM-2/20 comparator

Standard deviation for robotic mass comparator AKM-2/20.5Y & APP 30.5Y.KO



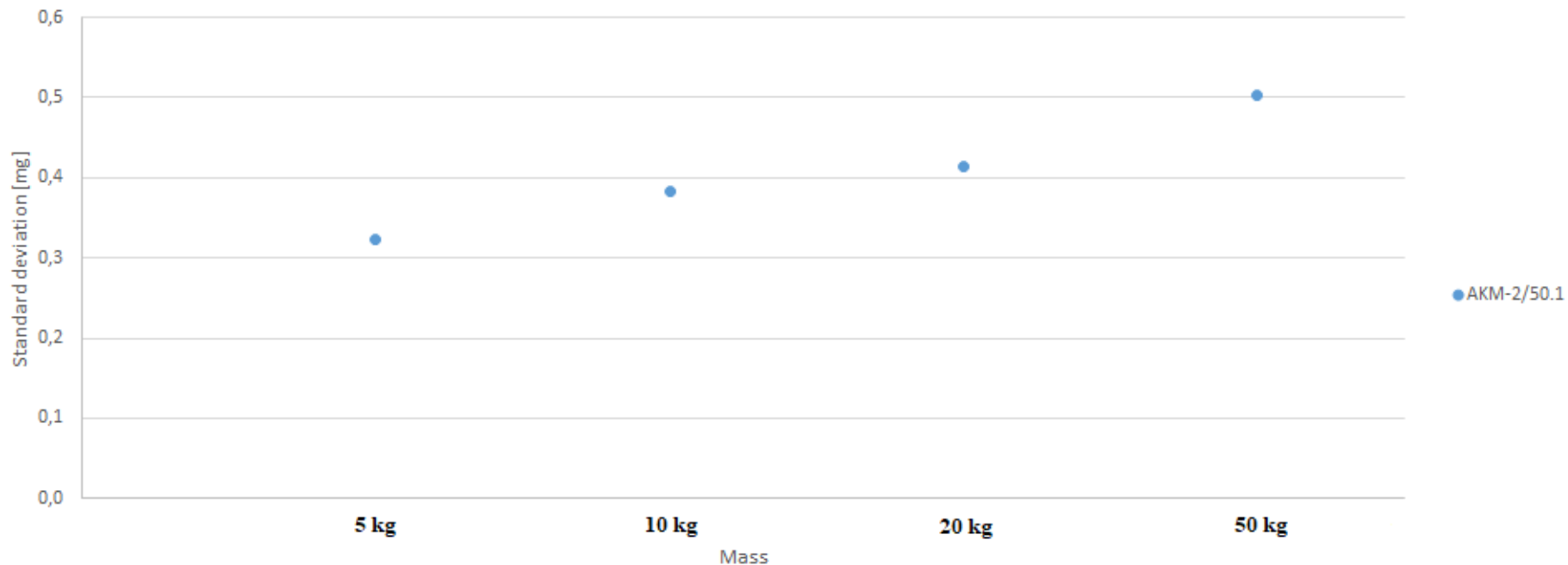
The repeatability results for the AKM-2/50.1 comparator

| Mass | MEASUREMENTS | | | | | Average |
|-------|--------------|-----------|-----------|-----------|-----------|---------|
| | 1 SD [mg] | 2 SD [mg] | 3 SD [mg] | 4 SD [mg] | 5 SD [mg] | SD [mg] |
| 5 kg | 0,34 | 0,27 | 0,38 | 0,23 | 0,4 | 0,324 |
| 10 kg | 0,34 | 0,42 | 0,29 | 0,45 | 0,41 | 0,382 |
| 20 kg | 0,52 | 0,31 | 0,39 | 0,45 | 0,4 | 0,414 |
| 50 kg | 0,58 | 0,43 | 0,45 | 0,5 | 0,55 | 0,502 |



The repeatability results for the AKM-2/50.1 comparator

Standard deviation for robotic mass comparator AKM-2/50.1



Installations and implementation

Robotic system RMC 10000

Installation site:
Polish NMI, GUM
Warsaw, Poland



Special projects

Automatic line for determination of the class M1 mass standards

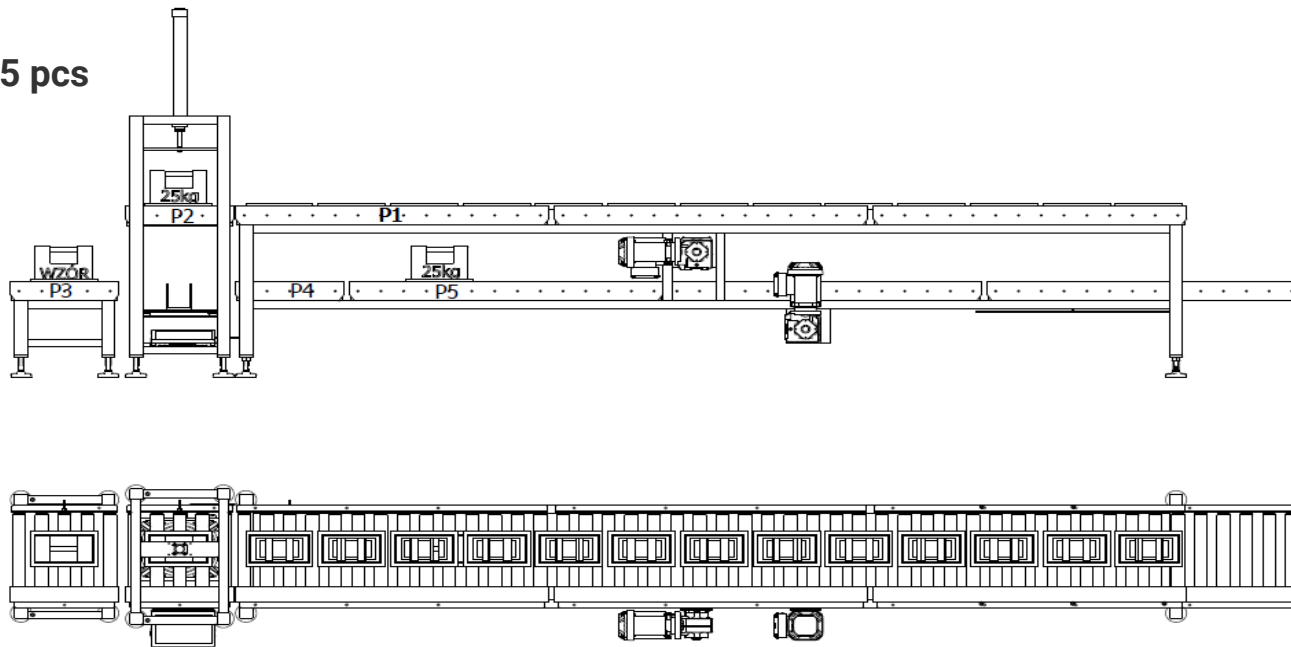
d=10 mg

Maximum capacity 25,5 kg

Mass standards magazine of 15 pcs

Special comparator with the weighing module of the **25.5 kg** maximum capacity for determination of the **class M1** mass standards in the shape of the line conveyer.

The line can accommodate **15 pcs** of mass standards at the conveyer length of **5 m**. The conveyer has the module structure, which enables the extension, each subsequent 1m enables to increase the mass standards magazine of **3 positions**.





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**Thank you for
your attention**

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