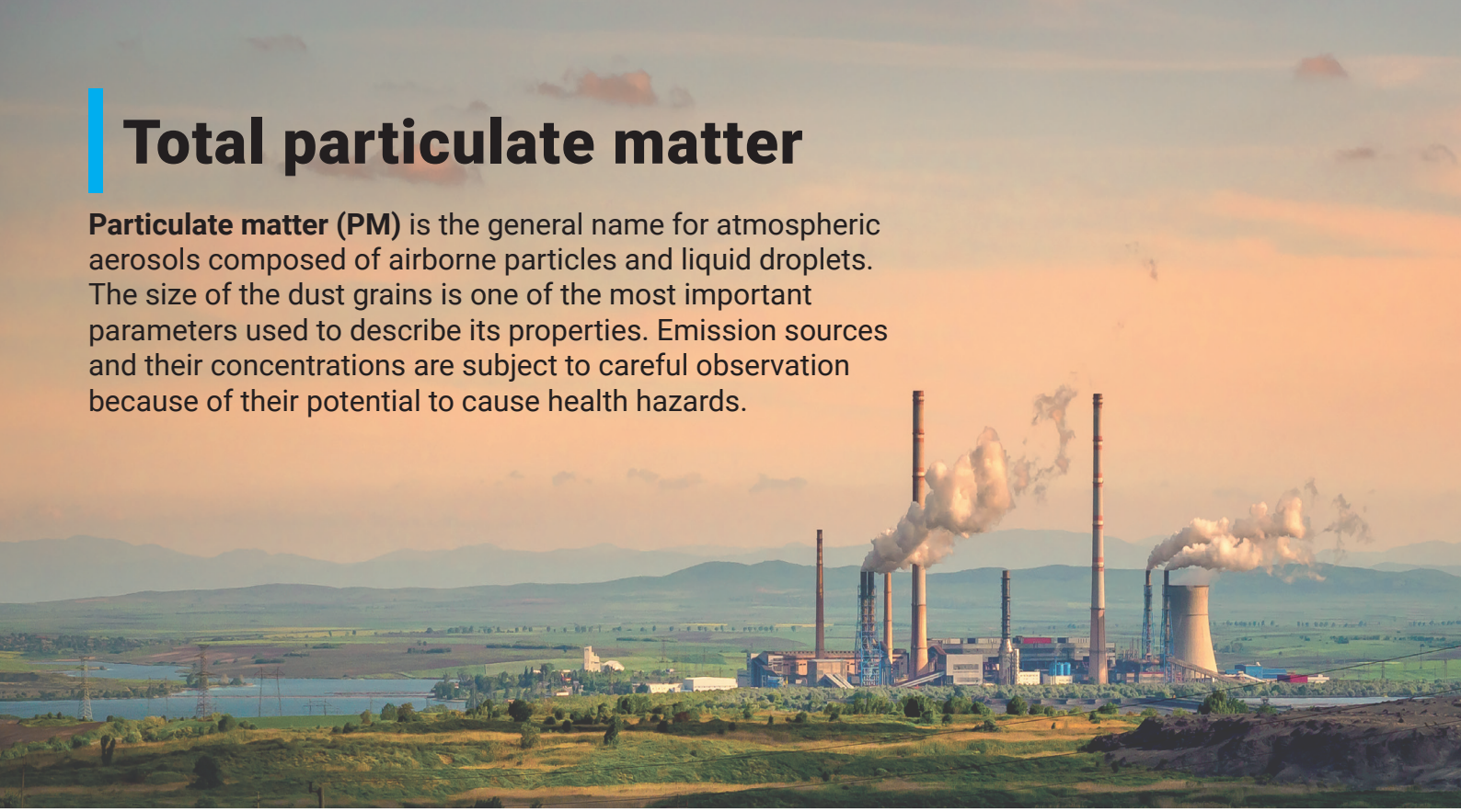
Gravimetric methods

Air quality testing at workplaces in atmospheric air quality studies and particulate emissions monitoring.

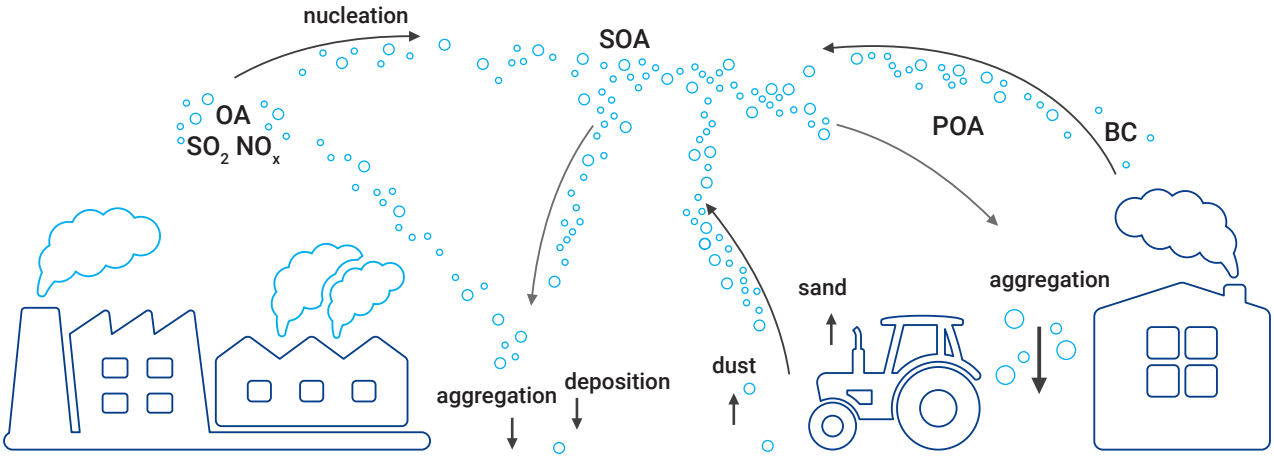
Compliance: UE regulations 2017/1151, EN 12341:2024,
US EPA 40CFR 1065, 40CFR part 50

Total particulate matter

Particulate matter (PM) is the general name for atmospheric aerosols composed of airborne particles and liquid droplets. The size of the dust grains is one of the most important parameters used to describe its properties. Emission sources and their concentrations are subject to careful observation because of their potential to cause health hazards.

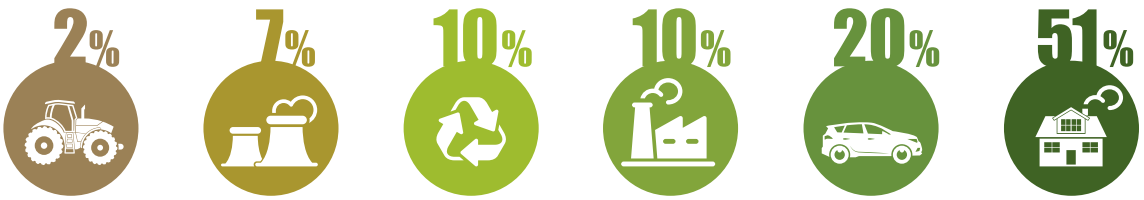


Scheme of the formation and transformation of particulate matter in the atmosphere



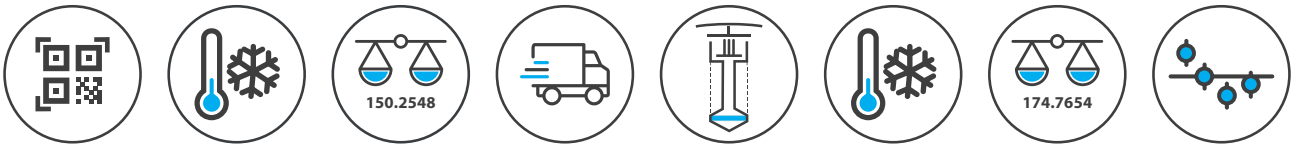
SO_2 - sulfur compounds
NO_x - nitrogen compounds
OA - organic aerosol
BC - black carbon
POA - primary organic aerosols
SOA - secondary organic aerosols

Natural and anthropogenic sources of particulate matter



Measuring Method

Before measurements, filters must be conditioned under stable environmental conditions in terms of temperature and relative humidity. The mass of particulate matter is calculated based on the differential measurement of the filter's mass before and after exposure. The particulate concentration is determined considering the airflow rate and exposure time. The required balance resolution is d= 1 µg or 0.1 µg.



METHOD	MANUAL	AUTOMATIC	ROBOTIC
Measurement precision	0.8 µg ÷ 3 µg depending on the balance resolution and filter diameter	0.3 µg steel – closed system	0.3 µg steel – closed system 2 µg POM – opened system
Balance model	UYA 2.5Y Max 2 g / d=0.1 µg MYA 5Y Max 2 g ÷ 51 g d=1 µg ÷ 10 µg	UYA 2.5Y Max 2 g / d=1 µg AK-6.510.5Y.F Max 0.51 d=0.1 µg	RWF 5Y Max 2 g ÷ 6.1 g d=0.1 µg ÷ 1 µg RB 2.5Y.F / RMC 5Y.F Max 2.1 g / d=1 µg

Compliance with the requirements

EN 12341:2024	Ambient air - Standard gravimetric measurement method for the determination of the PM10 or PM2,5 mass concentration of suspended particulate matter
40 CFR Part 50	National Primary And Secondary Ambient Air Quality Standards
EN 13284:2017	Stationary source emissions - Determination of low range mass concentration of dust Part 1: Manual gravimetric method
40 CFR Part 1065	Protection of Environment - Engine-Testing Procedures
EU 2017/1151	Regulation on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6)

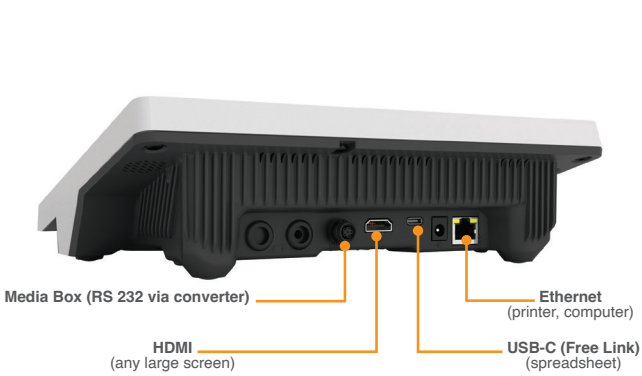
Manual Method

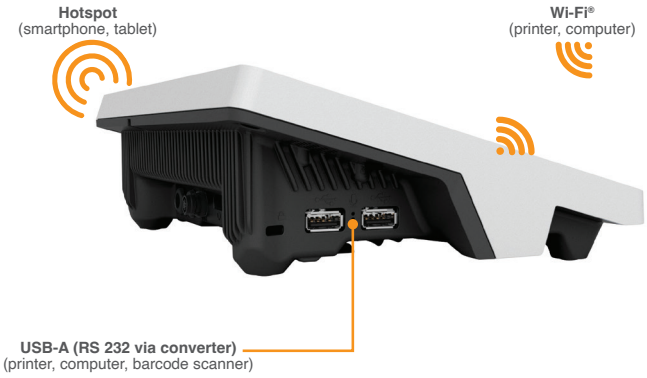
Microbalances MYA 5Y.F / Ultra-microbalances UYA 5Y.F / Microbalance MYA 5.5Y.F1

Microbalances and ultra-microbalances are modern and ergonomic high-resolution measurement systems that enable the detection of even the smallest changes in filter mass. Automatic adjustment, integrated with the environmental conditions module, ensures measurement accuracy under all conditions.

Measuring the mass of large filters is a challenge for most measurement systems.
The 5Y.F1 microbalance series is the ideal solution, providing both speed and accuracy of analysis, regardless of the size or type of filter being weighed.

- Defined access levels for multiple operators / safety, ergonomics / environmental condition monitoring / temperature, humidity, pressure, ground vibrations
- Differential filter mass measurement application
- Real-time air buoyancy correction
- Digital Weighing Auditor – comprehensive supervision of the weighing process quality
- GLP, GMP reports, summaries, statistics, Alibi memory, Audit Trail





-------- Adjustment: Internal --------

Date	2025.02.13
Time	13:15:07
Balance type	MYA 5Y
Balance S/N	765432
Operator	John Smitch
Level status	Yes
Nominal mass	4.800065 g
Current mass	4.800066 g
Difference	0.000001 g
Temperature	23.77 °C

Signature

Manual Method

Microbalances MYA 5Y.F / Ultra-microbalances UYA 5Y.F / Microbalance MYA 5.5Y.F1

Areas of application: pharmaceutical, environmental, automotive, R&D.
Manual opening weighing chamber.
Readability **d=0.001 mg**.
Max filter diameter 160 mm

Auto Level System
Ambient Light
Live Note
Hand Library
Smart Min Weight
RFID - quick access to the balance menu

Areas of application: pharmaceutical, environmental, automotive, R&D.
Automatic opening weighing chamber.
Readability **0.001 mg** / **0.0001 mg**.

Max filter diameter 70 mm
Auto Level System
Ambient Light
Live Note
Hand Library
Smart Min Weight
RFID - quick access to the balance menu

Manual Method
Analytical Balances XA 52.5Y.F - XA 110.5Y.F

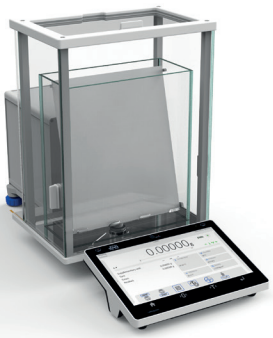
The XA 5Y series of analytical balances is an excellent example of using precision weight measurement in unusual applications. Now you can weigh filters with large surfaces quickly and accurately. Information about the weighing process will be automatically stored in the scale's database.

Areas of application: pharmaceutical, environmental, automotive, R&D.
Manual opening weighing chamber.
Readability **0.01 mg**.

The weighing chamber is further protected by a glass cover so that the evaluation of the filter weight variation is always accurate.

Max filter diameter 210x254 mm
Ambient Light
Live Note
Hand Library
Smart Min Weight
RFID - quick access to the balance menu

- Defined access levels for multiple operators / safety, ergonomics / environmental condition monitoring / temperature, humidity, pressure, ground vibrations
- Differential filter mass measurement application
- Real-time air buoyancy correction
- Digital Weighing Auditor – comprehensive supervision of the weighing process quality
- GLP, GMP reports, summaries, statistics, Alibi memory, Audit Trail



Méthode manuelle
MYA / XA

Vibrations in the Weighing Process

The 5Y series balances are equipped with a vibration detector, a unique solution that enables workplace monitoring of vibrations caused by people, devices, and machines.

Air Buoyancy Compensation

Allows for automatic real-time correction of weighing results, which is particularly important for samples with a density significantly different from mass standards.

Mobile Operation and Weighing Reports

Allows data transfer from the balance (measurement results, statistical data, etc.) directly to the user's tablet or smartphone.

Correct Weighing Monitoring

This feature helps prevent weighing errors caused by incorrect sample placement on the weighing pan.

Environmental Conditions Module (Temperature, Humidity, Pressure, Vibrations, and Air Density)

Enables real-time measurement, recording, and visualization of these parameters.

Measurement Series and Report Databases

Provides full control and filtering options for always-available measurement data.

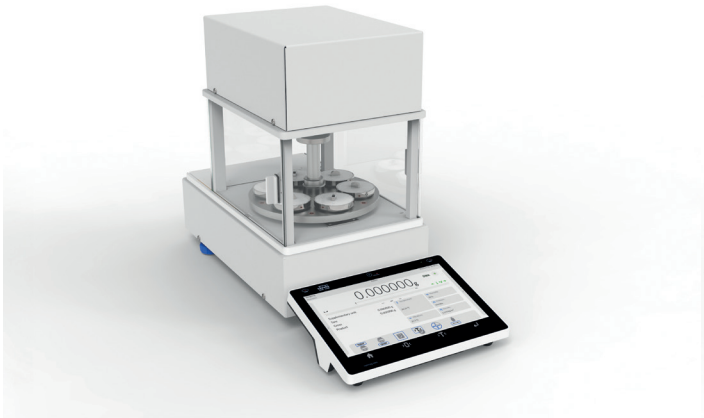
Automatic method
AK 4-6.510.F

The automatic weighing system of the AK series is dedicated to R&D studies in which the variation of filter weight as a result of different physical processes is monitored. The weighing method in steel containers guarantees high analysis accuracy, which is a necessary element in the process of improving research methods.

Areas of application:
environmental, automotive, R&D.
Manual opening weighing chamber.
Readability **0.1 µg**.
Number of filters: 6 units

MEASURING METHOD

The filters are conditioned in steel containers, which are placed in a rotating 6-position magazine. During weighing, the plane of the magazine lowers towards the balance pan. The target lower position of the magazine gently places the filter on the weighing pan. The small internal space of the container ensures stable conditions and thus achieves a weight precision of approx. 0.3 µg for the filter.



Filter conditioning

The conditioning period is the time after which the filter mass is considered stable. Due to the value of the random error, a stable mass is usually the average value of several measurements, with a difference between weighing results of no more than 40 µg - EN 12341:2024. Repeatability is strongly dependent on the weighing conditions and, for objects with a large surface area, air movement is decisive.

Filter Identification

Uniquely marking each filter is crucial for accurately assessing mass changes over time, reducing the risk of identification errors at different stages of research. A QR or EAN code can be applied to the filter structure or the container lid.

Measurement and Monitoring of Environmental Conditions

Conditioning and weighing of filters should be conducted under stable environmental conditions (19±21°C, 45±50% EN 12341:2024). The stability of the working environment can be assessed using a certified thermo-hygro-barometer. Measurement accuracy: temperature ±0.1°C, humidity ±0.1%, pressure ±0.1 hPa.

Metrological Control / Adjustment

External adjustment and balance indication verification are performed using a certified mass standard similar to the mass of the tested filters. This complies with the requirements of EN 12341:2024 and 40 CFR Part 50 / 1065. The evaluation results serve as a measure of the balance's indication accuracy and the permissible sensitivity drift Δm < 25 µg.

Automatic weighing systems
UMA 5Y.F d=0.1µg, 1 µg / UMA 5Y.FC d=0.1µg, 1 µg

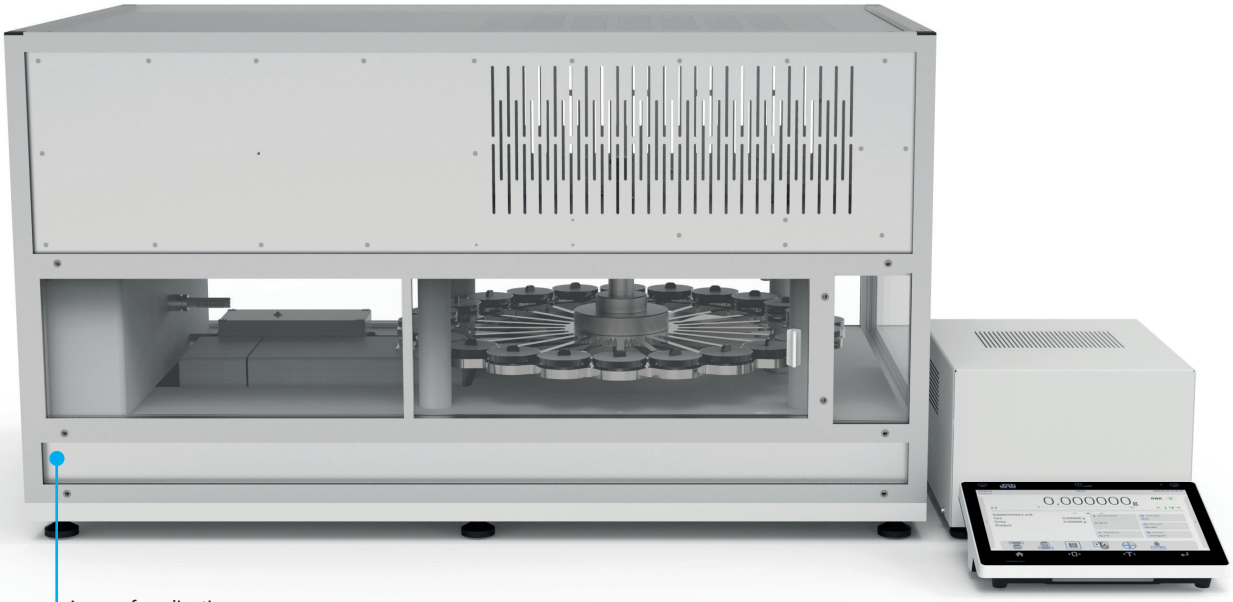
The weighing systems of the UMA series are the perfect solution for all processes where the maximum number of filters in a test does not exceed 24. Optimum operation of the filter store and weighing in steel containers guarantee accuracy and precision of measurements regardless of the type of filter to be weighed.

MEASUREMENT METHOD

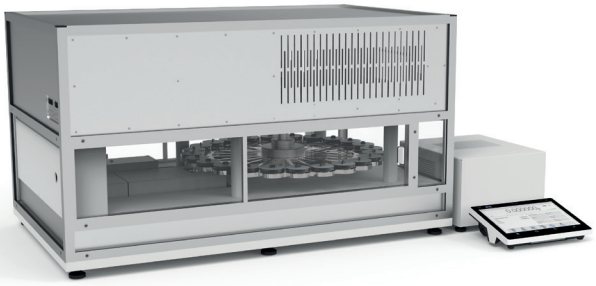
The filters are conditioned in steel containers, which are placed in a rotating magazine. During weighing, the plane of the magazine lowers towards the balance pan. The target bottom position of the magazine gently places the filter on the weighing pan. The small internal space of the container ensures stable conditions and thus achieves a weighing precision of approx. 0.3 µg. Temperature/humidity stability should be maintained in the laboratory in accordance with standard requirements.

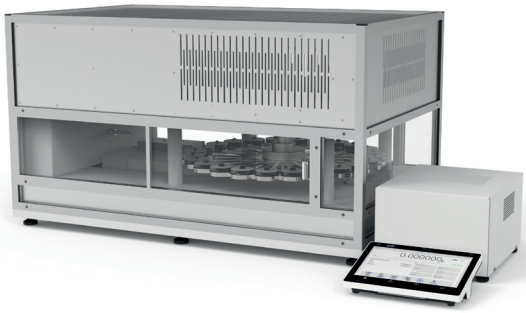
DEDICATED SOFTWARE

The ergonomic RMCS software allows you to manage the time and test schedules of each filter or filter series. Summary statements and report elements are defined by the system administrator.



Areas of application:
environmental protection, automotive, R&D.
Automatic operation.

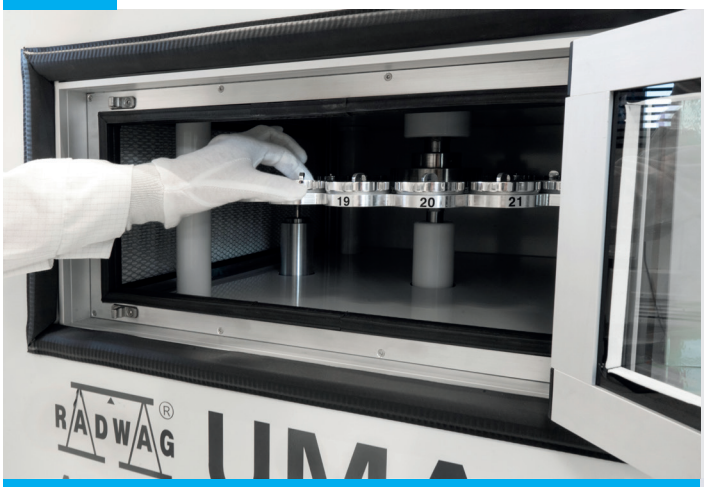




Automatic weighing systems
UMA 5Y.F d=0.1µg, 1 µg / UMA 5Y.FC d=0.1µg, 1 µg

Areas of application:
environmental protection, automotive, R&D.
Automatic operation.

Automatic method
UMA 2.5Y.FC



Safety

Access to the weighing system is limited by authorisation levels, which are assigned by the system administrator. All measurements are permanently stored in the Alibi memory with the possibility to review them.

Filter conditioning

The conditioning period is the time after which the filter mass is considered stable. Due to the value of random error, a stable mass is typically the average of multiple measurements, with the difference between weighing results not exceeding 40 µg (EN 12341:2024). Repeatability is highly dependent on weighing conditions, and for large surface objects, air movement plays a crucial role.

Filter Identification

Uniquely marking each filter is essential for accurately assessing mass changes over time, minimizing the risk of identification errors at different research stages. A QR or EAN code can be applied to the filter structure or the container lid. The container design is dedicated to filters ranging from 25 to 47 mm in size, regardless of the filtration material type.

Metrological Control

The accuracy of filter mass measurement is ensured through a two-stage procedure. Automatic balance adjustment corrects sensitivity across the entire weighing range. Measurement accuracy in the filter weighing area is monitored using a reference standard with a mass similar to the tested filters. The results of metrological control can be presented as an adjustment report and as a drift-tracking graph of mass changes (weighing results of the reference standard).

Robotic system
RMC 2.5Y.F

Filters in the RMC robotic system are conditioned and weighed in special stainless steel containers. This solution significantly increases the measurement accuracy of each filter while ensuring fast analysis. Temperature and humidity are automatically maintained within the required limits inside the device.

Areas of application:
environmental protection, automotive, R&D.

HEPA FILTER
air cleanliness
analysis safety

ROBOT CHAMBER
temperature 19-21°C
humidity 40-50%

CAMERA
Remote supervision
of the robotic system operation

MICROBALANCE
weight measurement d=1 µg
measurement precision ~ 0. 3 µg

FILTER STORAGE
ergonomic design
capacity: 156 units
quick disassembly

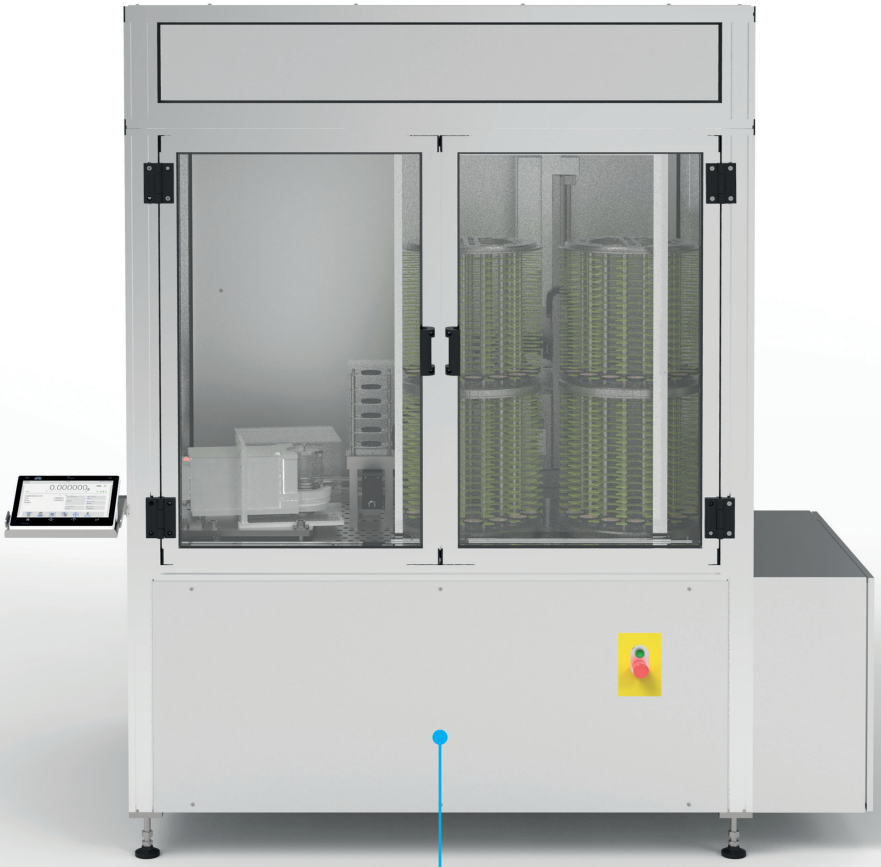
DISPLAY
adjustment, logging,
databases, reports,
printouts

ENVIRONMENTAL CONDITIONS

Temperature and humidity measurements are performed in real-time, with hourly average values calculated according to EN 12341 requirements. Measurement data is presented in tabular form and as a graph in the computer application.

Robotic system
RB 2.5Y.F

The analysis of a very large number of filters requires a robotic system in which the filters are cyclically retrieved from storage and weighed according to the requirements of the standard. The storage capacity is max. 1020 units. The internal robot chamber can be equipped with an environmental module to condition the filters under stable temperature and humidity conditions.



Areas of application:
environmental protection, automotive, R&D.
Storage capacity 1020 pcs.

HEPA FILTER
air cleanliness
analysis safety

ROBOT CHAMBER
temperature 19-21°C
humidity 40-50%

CAMERA
Remote supervision
of the robotic system operation

MICROBALANCE
weight measurement d=1 µg
measurement precision ~ 3 µg

FILTER STORAGE
ergonomic design
capacity: 1020 units
quick disassembly

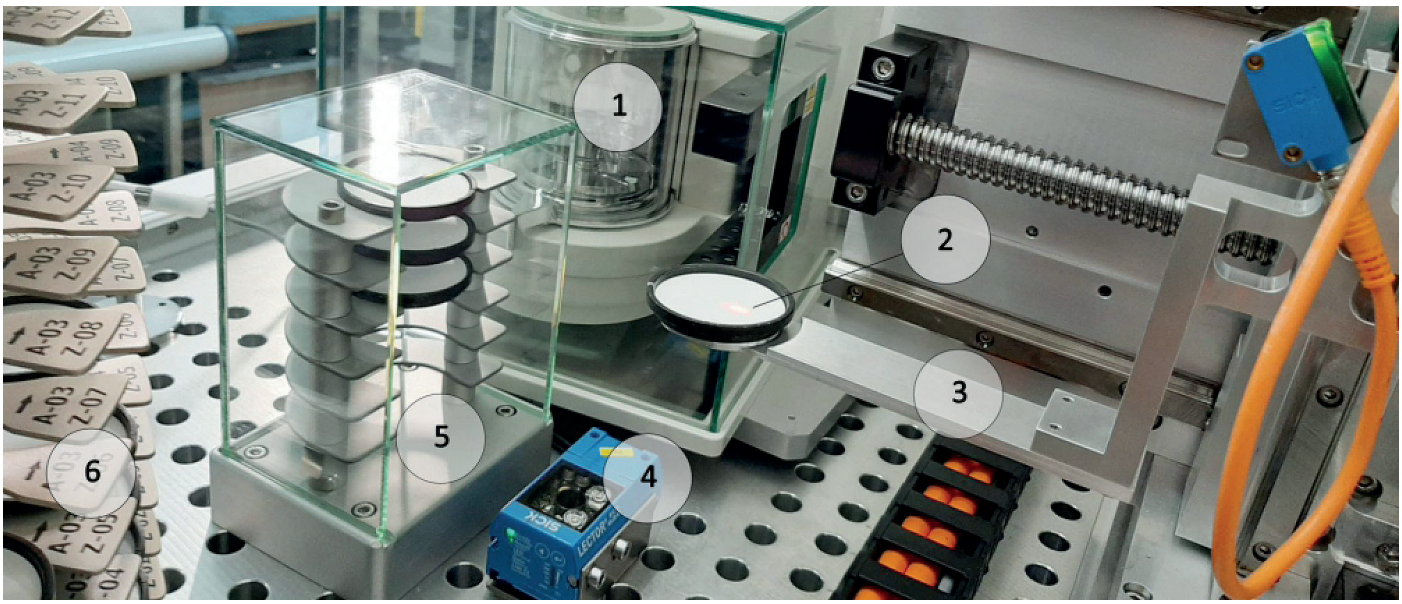
DISPLAY
adjustment, logging,
databases, reports,
printouts

ENVIRONMENTAL CONDITIONS

Temperature and humidity are measured on-line, hourly averages are calculated in accordance with the requirements of EN 12341 and the measurement data are presented in tabular form and as a graph in the computer application.

MEASUREMENT METHOD

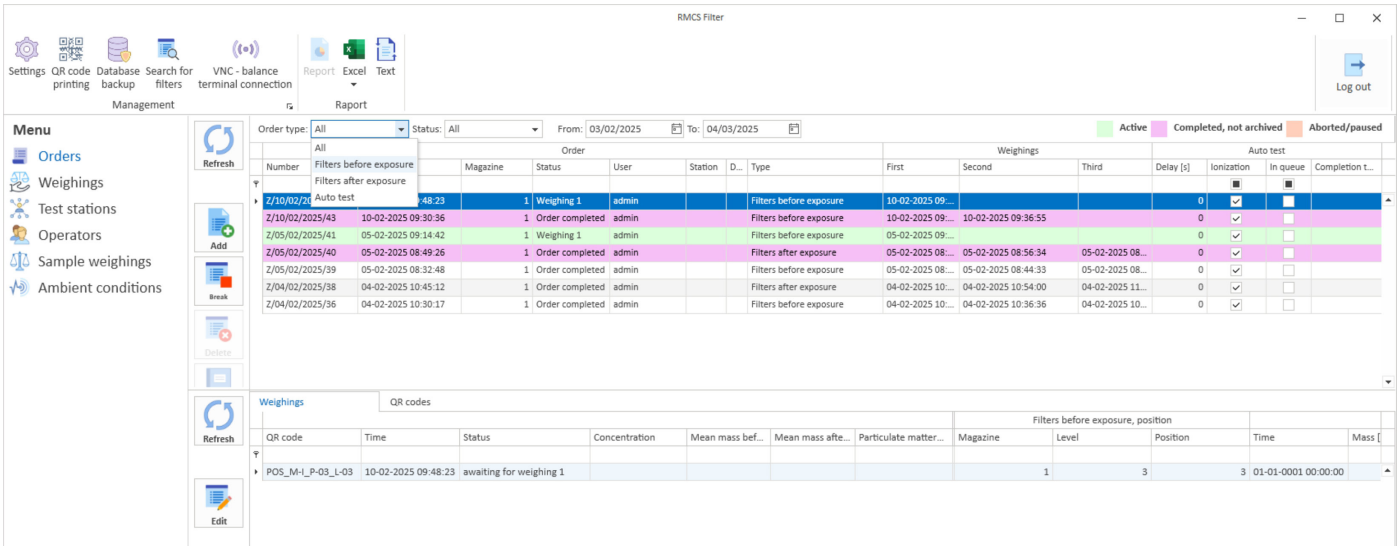
The robotic arm (3) picks up a filter (2) and transports it to the weighing chamber of the microbalance (1). As the filter moves over the QR code reader (4), it is registered in the system as the sample currently being weighed. The microbalance weighing chamber (1) opens automatically and the robotic arm places the filter on the microbalance pan. When weighing is complete, the microbalance chamber opens and the robotic arm takes the filter back to the storage.The reference filter and mass standards storage (5) is used to control the sensitivity drift of the robotic system and the effect of environmental conditions on the variation of the reference filter mass.



REPORTS

The correctness of the operation of the robotic system is assessed by evaluating the drift of the weighing system readings using a certified mass standard.

The influence of the conditioning conditions on the variation of the weight of the test filters is monitored by periodically measuring the weight of the reference filters.



Indication drift chart
Graph of reference filter weight variation

Cobotic system
RW.5Y.F

MEASURING METHOD

The cobotics system of the RW RMC series has a linear storage area where the filters are conditioned in steel containers. The cobotics system takes a container from the storage area and moves it into the weighing chamber of the microbalance. Inside the microbalance chamber, the container is placed on a special bracket with the result that the weighing pan is centrally inserted into the centre of the container. The weighing system measures the weight of the filter. The cobotic arm moves the container back into storage and the weighing result is recorded in a database. Reference filters and reference weights are also placed in storage, which must be taken into account in the order schedule for the test filters.

*Compliance with requirements for cobotic systems.

Areas of application: environmental, automotive, R&D.
Storage capacity of max. 156 units, expandable.
Readability d=0.001 mg / 0.0001 mg.

ENVIRONMENTAL CONDITIONS

Temperature and humidity are measured on-line and hourly average values are calculated in accordance with the requirements of EN 12341. The stability of temperature and humidity should be maintained in the laboratory in accordance with the requirements of the standard. The measurement data are presented in tabular form and as a graph in a computer application.

Automatic method
Robotic system

- Defined access levels for multiple operators / safety, ergonomics / environmental condition monitoring / temperature, humidity, pressure, ground vibrations
- Differential filter mass measurement application
- Real-time air buoyancy correction
- Digital Weighing Auditor – comprehensive supervision of the weighing process quality
- GLP, GMP reports, summaries, statistics, Alibi memory, Audit Trail

Technical Specification

Model	Product code	Maximum capacity [Max]	Readability [d]	Standard Repeatability [5% Max]	Stabilization time	Weighing pan dimensions
ROBOTIC WEIGHING SYSTEM RW 5Y.F						
RW 5Y.F153	WL-506-0003	2 g	0.1 µg	0.5 µg	2 s	ø47 mm
RW 5Y.F42	WL-506-0002	6.2 g	1 µg	0.8 µg	~ 3.5 s	ø47 mm
ROBOTIC WEIGHING SYSTEM RB 5Y.F						
RB 2.1.5Y.F	WL-501-0004	2.1 g	1 µg	0.5 µg	10 – 20 s	ø47 mm
RB 2.5Y.F	WL-501-0003	2.1 g	1 µg	0.5 µg	10 – 20 s	ø47 mm
ROBOTIC WEIGHING SYSTEM RMC 5Y.F						
RMC 2.5Y.F	WL-504-0003	2.1 g	1 µg	0.5 µg	10 – 20 s	ø47 mm
RMC 2.5Y.FC	WL-504-0004	2.1 g	1 µg	0.5 µg	10 – 20 s	ø47 mm
AUTOMATIC WEIGHING SYSTEM UMA 5Y.F						
UMA 2.5Y.F	WL-502-0005	2.1 g	1 µg	0.5 µg	30 s	ø20 mm
UMA 2.5Y.FC	WL-502-0004	2.1 g	1 µg	0.5 µg	30 s	ø20 mm
AUTOMATIC BALANCE FOR FILTERS AK 5Y.F						
AK-6.510.5Y.F	WL-502-0005	2.1 g	1 µg	0.5 µg	30 s	ø47 mm
MICROBALANCES MYA 5Y						
MYA 0.8/3.5Y	WL-109-1000	0.8 / 3 g	1 / 10 µg	0.6 µg	3.5 s	ø16 mm, ø60 mm
MYA 11/52.5Y	WL-109-1001	11 / 52 g	1 / 10 µg	1.5 µg	3.5 s	ø16 mm, ø60 mm
MYA 21/52.5Y	WL-109-1002	21 / 52 g	1 / 10 µg	1.5 µg	3.5 s	ø16 mm, ø60 mm
MICROBALANCES FOR FILTERS MYA 5Y.F						
MYA 5.5Y.F.A	WL-109-0024	5.1 g	1 µg	0.6 µg	3.5 s	ø70 mm
MYA 5.5Y.F1	WL-109-0025	5.1 g	1 µg	0.6 µg	3.5 s	ø160 mm
MICROBALANCES FOR FILTERS XA 5Y.F						
XA 52.5Y.F	WL-110-0017	52 g	0.01 mg	0.007 mg	5 s (30 s for filters)	210mm × 254 mm, ø90 mm
XA 110.5Y.F	WL-110-0018	110 g	0.01 mg	0.007 mg	5 s (30 s for filters)	210mm × 254 mm, ø90 mm

Storage capacity	Adjustment	Display	Communication interfaces
153 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
42 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
510 pcs – working & conditioning storage, 510 pcs – conditioning storage	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
510 pcs – working & conditioning storage, 510 pcs – conditioning storage	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
156 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
156 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
24 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
24 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
6 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot
1 pcs	internal (automatic)	10" colour touchscreen	2×USB-A, USB-C, HDMI, Ethernet, RS232, Wi-Fi®, Hotspot

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