



Environmental Protection

In ambient air quality and particulate matter emission testing.

Air quality test at the workstation.

MEASUREMENT



robotic



automatic



manual

MEASUREMENT RESOLUTION



10 µg



1 µg



0.1 µg

Total Suspended Particulate Matter

Particulates size, ranging between few nanometres to up to even 100 micrometres, is the most crucial parameter used to describe particulate matter characteristics.



Particulate matter classification by size

Name	PM 10	PM 2,5 - 10	PM 2,5	PM1	PM 0,1
PM diameter	< 10 µm	2.5 µm - 10 µm	< 2.5 µm	< 1.0 µm	< 0.1 µm

Natural and anthropogenic sources of particulate matter



Agriculture and land reclamation



Combustion processes in industry



Production processes in waste management



Combustion processes in energy sector

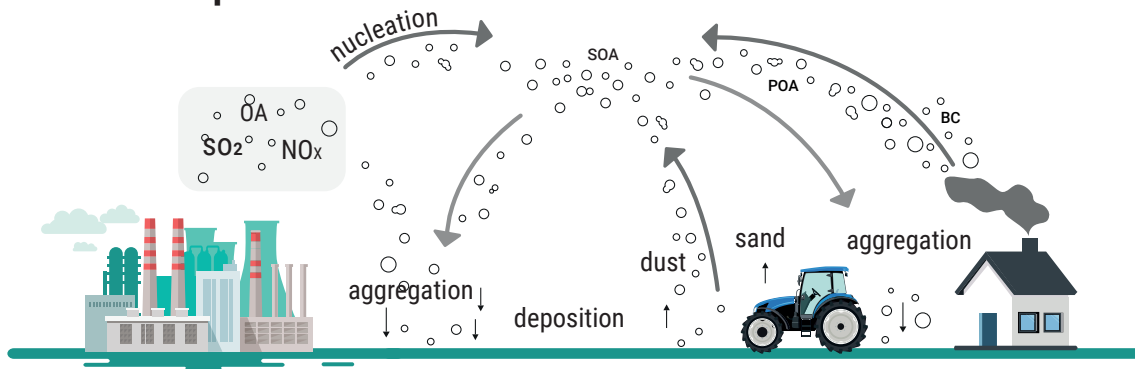


Shipping services



Combustion processes of non-industrial origin

Diagram of the formation and transformation of particulate matter in the atmosphere.









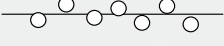
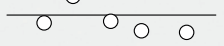


SO₂ - sulphur compounds
NO_x - nitrogen compounds

OA - organic aerosol
BC - black carbon

POA - primary organic aerosol
SOA - secondary organic aerosol

Standard gravimetric measurement method according to EN 12341:2014

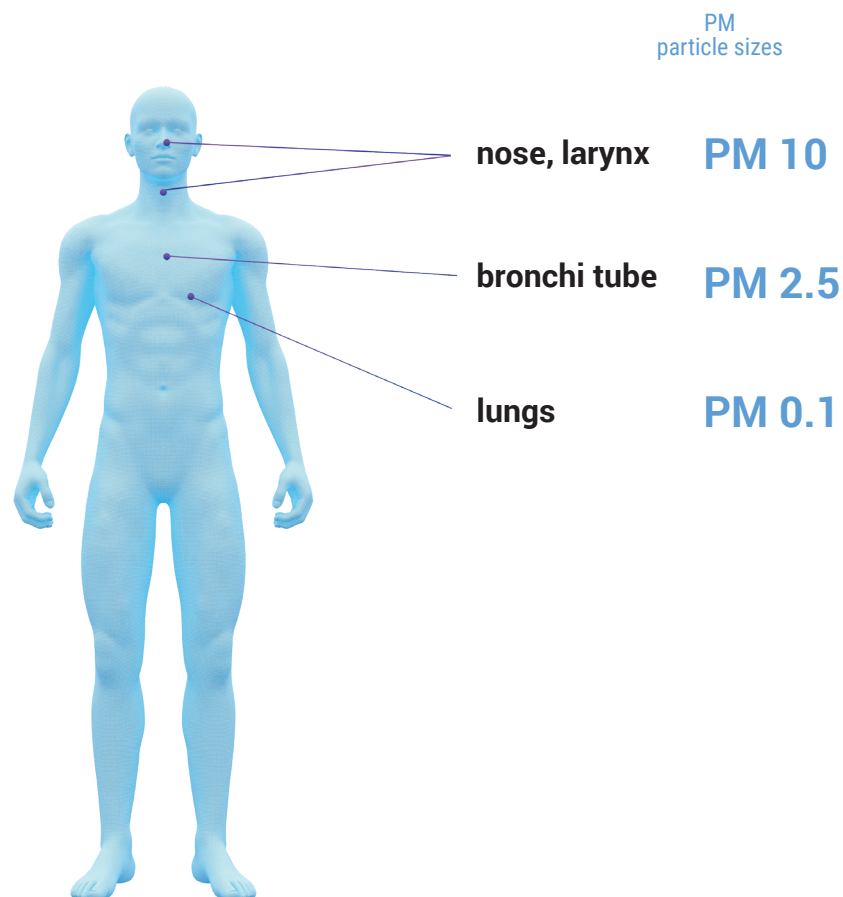
The particulate matter concentration is calculated from the difference in filter masses before and after exposure and the air flow rate over a given period of time. The precision and accuracy of the mass measurement, the conditioning of the filters under fixed conditions (temperature at 19-21 °C, relative air humidity at 45-50%), the exposure of the filter over a fixed period of time and under fixed exposure conditions (temperature, humidity, air flow), the safe transport of the filter to and from the exposure point are important for the accuracy of the particulate matter concentration determination.

filter marking	 QR code (filter)	 RFID (filter case)	 QR code (container)	 EAN code (container)
filter weighing method	 robotic / automatic		 manual	
measurement accuracy and precision				
filter conditioning	inside the device UMA 2.5Y.FC; RB 2.5Y.FC; RMC 2.5Y.FC		based on the lab ambient conditions MYA 2.5Y.F; AK-6/510.5Y.F; UMA 2.5Y.F; RB 2.5Y.F; RMC 2.5Y.F	
operator	 automatic procedures		 knowledge on methodology required who?, when?, why?, how?	
daily cycle performance	Q > 300		Q = ~ 50	

Mass Emission of Particulate Matter

Particulates emitted from internal combustion engines are polydisperse systems containing particles of different shapes and sizes. Toxic components of exhaust fumes have a negative impact on the human body, contributing to disease states and mutagenic changes.

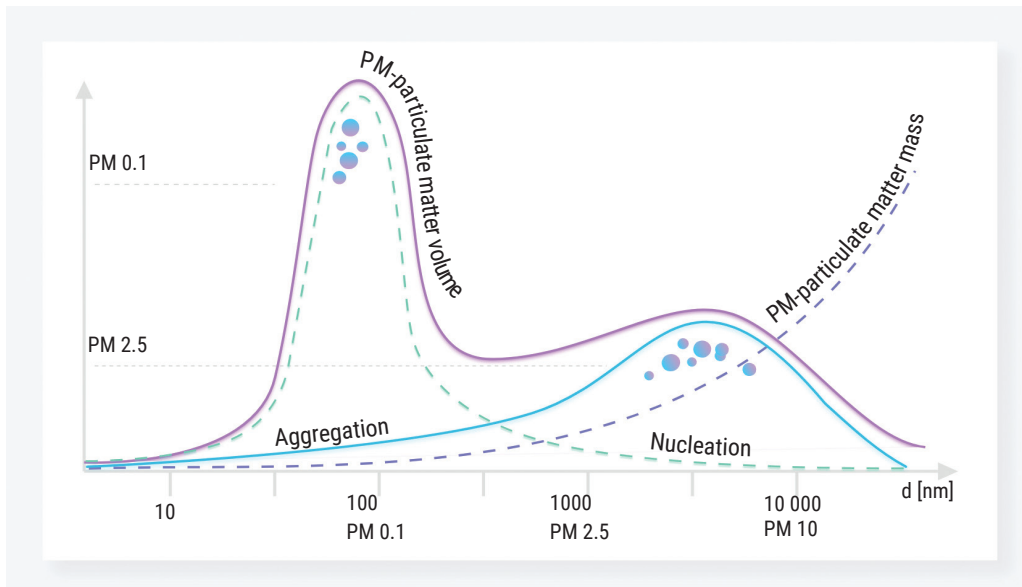
Effects of particulate matter on the human body



Formation and transformation of particulate matter during emission from the internal combustion engine

The term particle is not explicit, particles are not identical in size and shape, they are an irregular mixture of chemical components. The particles are formed under oxygen deficiency conditions with increased fuel dosage due to incomplete combustion of fuel. The form, size, and composition of the particle depend on the temperature and location in the cylinder-exhaust system.

Volume, particulate matter emission



Measurement method (EU) 2017/1151 - 40 CFR Part 1065

The effect of external conditions on the stability of the test filters is verified for each test cycle by observation of the mass changes of at least two reference filters. the weighing accuracy of all filters (test and reference) is controlled by periodical weighing of a certified mass standard of a weight value close to that of the test filters. the maximum permissible variation in filter mass between tests is 5 μg .

Particulate matter emission limits

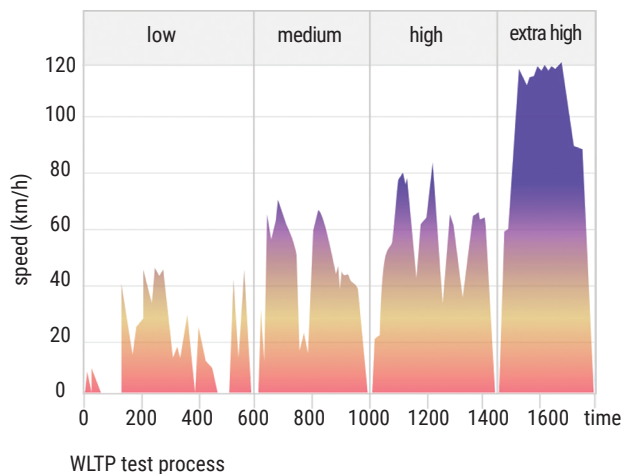
Region	Standard	PM
UE	Euro 6	4.5 mg/km
China	China 6	4.5 mg/km
EPA USA	Tier 3	10 mg/mile



Engine test stand - BOSMAL Automotive Research and Development Institute

Weighing system requirements:

reading unit	$d \leq 1 \mu\text{g}$
measurement precision	st. dev. $\leq 2 \mu\text{g}$
air buoyancy correction	



Manual Method

Ultra-microbalances UYA 5Y.F / 0.1 µg Microbalances MYA 5Y.F / 1 µg

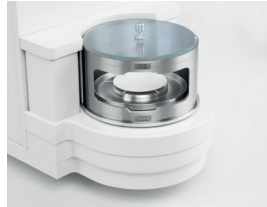
- The UYA 5Y.F ultra-microbalances and MYA 5Y.F microbalances are designed for accurate weighing of filters with a diameter of max 70 mm.
- Automatically open weighing chamber
- Ambient conditions monitoring
- Monitoring of weighing quality, online correction of air buoyancy
- Statistics, reports, data sheets
- Programmable infrared sensors





Air buoyancy compensation

Allows for automatic correction of the weighing result in real time, which is particularly important in the case of samples with density significantly different from the density of the mass standard.



Ambient conditions module (temperature, humidity, pressure, vibrations, and air density)



Facilitates real-time measurement, record and visualisation of the above values.



Weighing correctness monitoring

Allows avoiding weighing errors resulting from incorrect placement of the sample on the weighing pan.

Vibrations in the weighing process



The 5Y series balances are equipped with a vibration sensor, which is a unique solution enabling monitoring of the workplace for vibrations caused by people, devices and machines.



Remote control of the balance

Enables transfer of data from the balance (measurement result, statistical data, etc.) directly to a tablet or a smartphone.



Databases of measurement series and reports



Full control and the possibility of filtering of always available measurement data.



Automatic Method

AK 5Y.F Automatic Balances

The AK-6 5Y.F weighing system is designed to facilitate a professional mass measurement of filters. Dynamic control and correction of mass indications both ensure fast and stable weighing, regardless of the weighed filter type. The automated filter weighing process is a guarantee for excellent accuracy and repeatability. The device features a 6-position magazine.



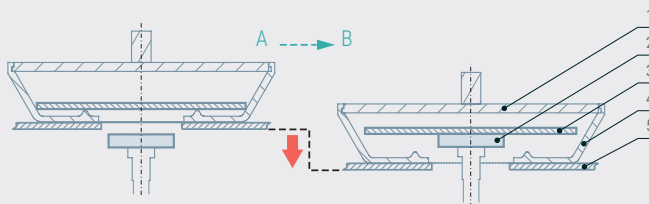
Weighing analysis efficiency

Elimination of the human factor guarantees repeatability of measurements, which is unachievable for manual weighing cycles. This is especially crucial when assessing emission of particulate pollutants, emitted by combustion engines (Euro 6 standard). Additionally, it allows carrying out tests and research while maintaining measurement repeatability of $sd < 0.5 \mu\text{g}$.



Filter case

A specially designed case allows the filters to be safely stored and guarantees stable filter mass.



Key:

1 - filter case cover

2 - weighing pan

3 - test filter

4 - filter case housing

5 - filter and mass standard magazine



Measurement of ambient conditions inside the chamber

The automatic weighing system, AK-6 5Y.F, is equipped with a high-class thermo-hygro-barometer allowing to register ambient conditions in real time with the readability of ± 1 hPa (pressure) / $\pm 1.8\%$ (humidity) / ± 0.1 °C (temperature).



Filter identification

The filters are identified by a number being a combination of a digit code of a magazine position and EAN/QR code of the weighing container (option).

Metrological control

Control, aiming to specify whether the system operates correctly or not, can be carried out by means of an external adjustment mass, a certified external mass standard of a weight value close to that of the test filter or a reference filter.

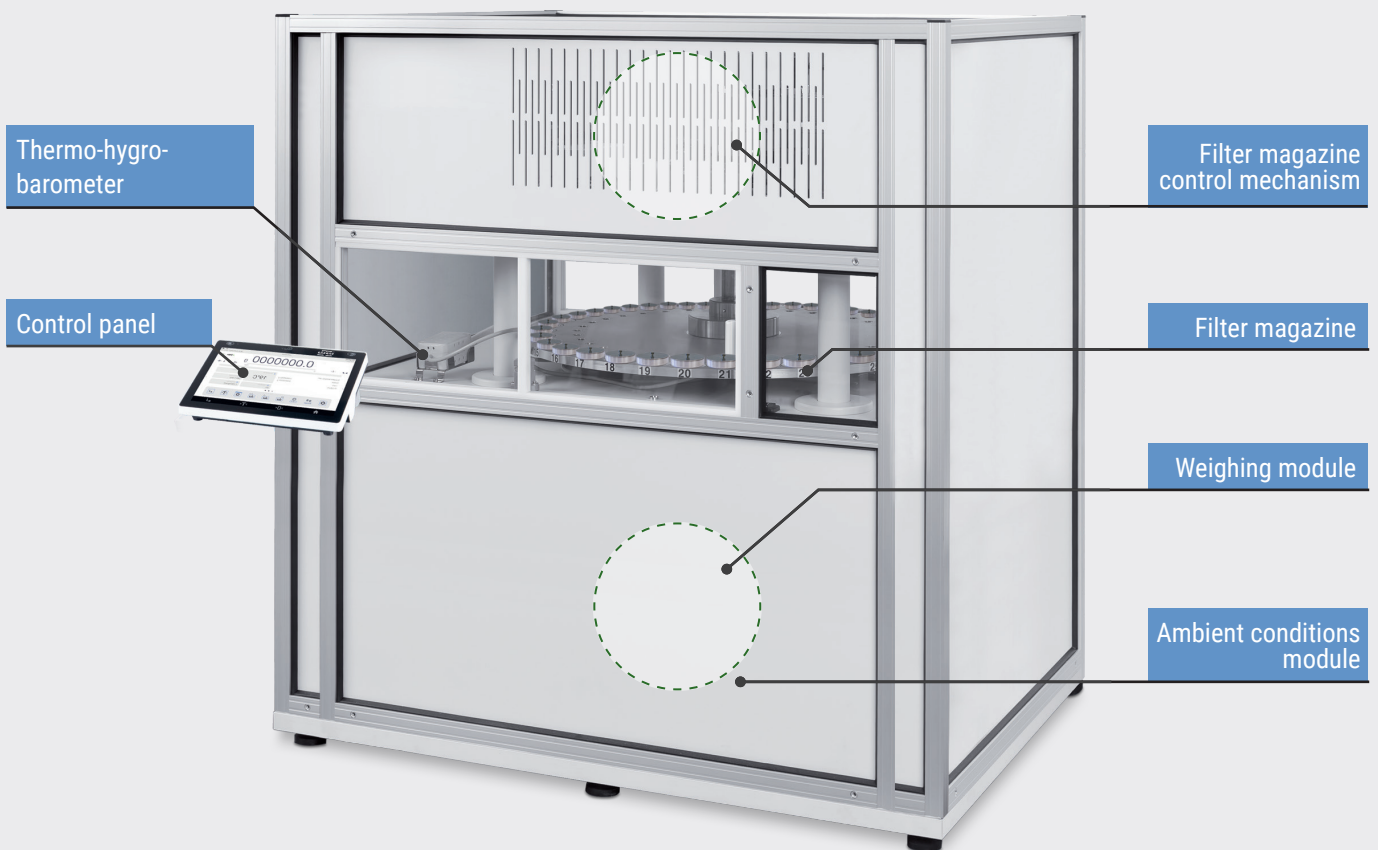
Dedicated software

Ergonomic software supported by an independent RMCS application allows managing time and test plans of each filter or filter series.

Automatic Method

UMA 5Y.FC Automatic Weighing Systems

The automatic weighing system has been designed to test changes in mass of filters made of quartz glass fibre, glass fibre, Teflon, and Teflon covered with glass fibre, that are used in various physical and chemical processes. It enables conditioning of the filters in accordance with the requirements of PN-EN 12341:2014 standard. The device features a 24-position magazine.



Efficient and safe measurements

The UMA weighing system is a first-class solution for professional mass measurement. Dynamic control and correction of mass indications both ensure fast and stable weighing regardless of the weighed filter type.

Effective weighing analysis

Full automation of the weighing cycle, thanks to the elimination of the 'human factor', is a guarantee of measurement repeatability impossible to be obtained in case of manual weighing. Remote designing of measurement processes significantly increases operation efficiency. Test cycle design - a computer application. Online and remote control, report, statistics.



Filter case

Each filter during conditioning is stored in a steel container.



Filter identification

The filters are identified by a number being a combination of a digit code of a magazine position and EAN code of the weighing container (option).



Metrological control

The accuracy of mass measurements is periodically checked using a certified mass standard of a weight value close to that of the analysed filters.

Ambient conditions measurement

The UMA weighing system is equipped with a high-class thermo-hygro-barometer allowing to register ambient conditions in real time. the characteristic feature of the device is high readability of pressure (± 1 hPa), humidity (± 1.8 %), and temperature (± 0.1 °C). the ambient conditions module of the weighing system is built into the lower part, so that a laminar air flow is possible without disturbing the filter mass measurement process. the range of temperature and humidity changes is forced automatically in accordance with the values programmed in the device terminal.

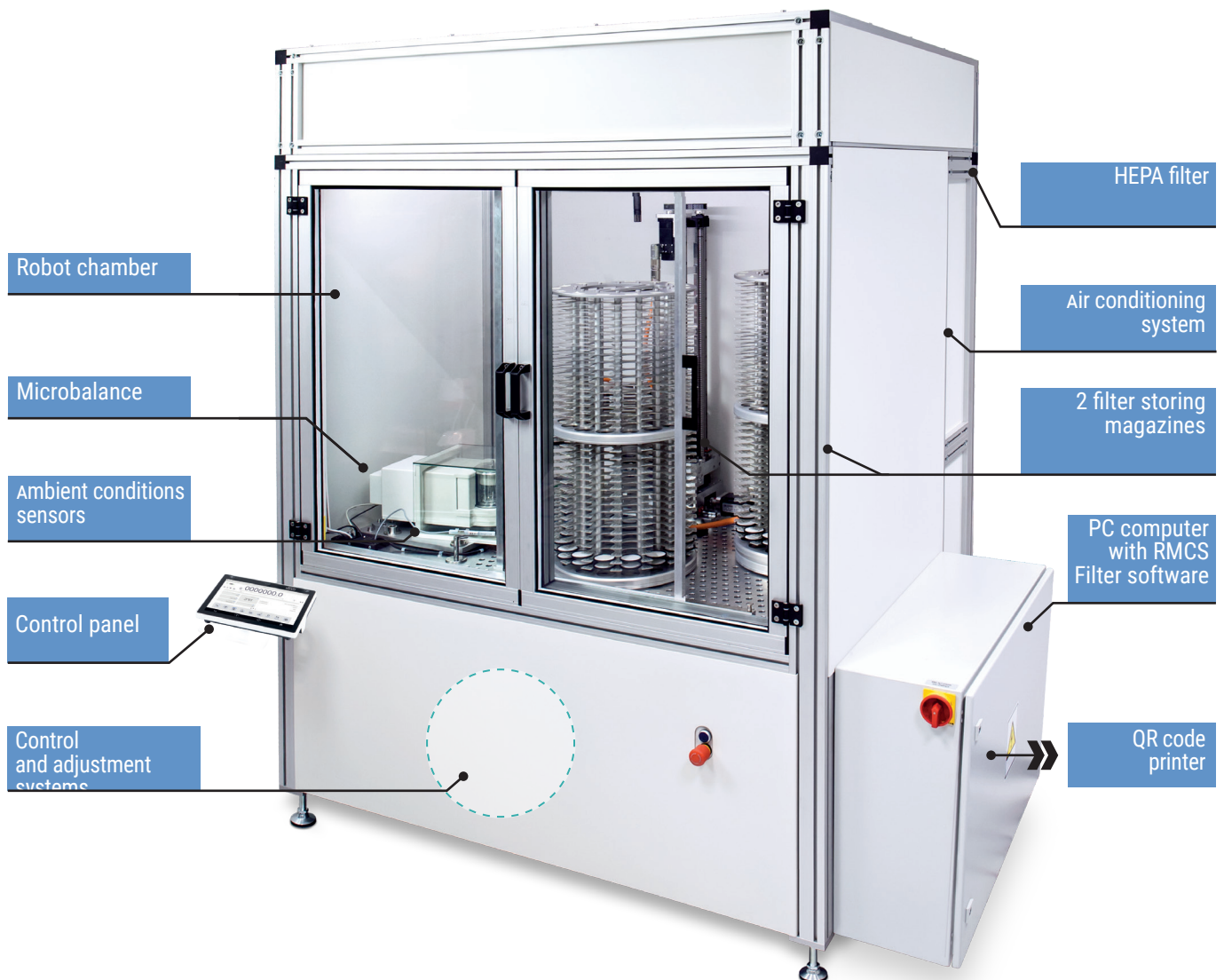
Dedicated software

Ergonomic software supported by an independent RMCS application allows managing time and comparison test plans of each filter or filter series. Summary reports and report components are defined by the system administrator.

Automatic Method RB/RMC Robotic System

RB 5Y.F Robotic Weighing System

It allows for an automatic conditioning procedure and weighing of filters with a maximum diameter of 47 mm. the air conditioning system ensures stable, invariant ambient conditions inside the chamber. the device is equipped with 2 magazines that can store up to 1020 filters.





Filter magazine

The devices feature integrated conditioning magazines. the filters are placed on specially designed trays made of metal or polyoxymethylene (POM). the trays can optionally feature RFID marking.



Air conditioning

Achieving appropriate, standard-compliant measurement results is possible thanks to the built-in air conditioning. Depending on the device model, we offer two systems to choose from: based on the use of chilled water or a Peltier cell.



Robot

Filters are transported between device elements (filter magazine, reference filter magazine, ionizer, QR code reader, weighing instrument) via a robot moving in three dimensions (X, Y, Z). the transport unit moves in accordance with a set procedure.



RMC 5Y.F robotic weighing system

The RMC 5Y.F robot, while maintaining the functionality of the RB 5Y.F robot, offers measurements of filters placed in specially designed metal cases. This solution allows the filters to be stored in perfect conditions.

Dedicated software

The RMCS Filter software enables management of the filter weighing process, starting from QR code assigning, through weighing of both unsampled and sampled filters, to data analysis.

Technical specification



UYA 2.5Y.F.A

**MYA 5.5Y.F.A
MYA 5.5Y.F1**

MYA 21.5Y.MAG

Maximum capacity [Max]	2,1 g	5,1 g	21 g
Minimum capacity [Min]	10 µg	100 µg	100 µg
Readability [d]	0,1 µg	1 µg	1 µg
Verification unit [e]	1 mg	1 mg	1 mg
Tare range	-2,1 g	-5,1 g	-21 g
Repeatability (5% Max) - standard*	0,15 µg	0,6 µg	1 µg
Repeatability (Max) - standard*	0,35 µg	1,6 µg	3 µg
Repeatability (5% Max) - permissible*	0,35 µg	1,2 µg	1,6 µg
Repeatability (Max) - permissible*	0,6 µg	2,4 µg	4 µg
Linearity	±1,5 µg	±5 µg	±7 µg
Stabilization time	10 – 20 s	8 s	Max 10 s
Adjustment	Internal	Internal	Internal
Filter measurement method	Manual	Manual	Manual
Filter type	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE
Maximum filter size	Max. ø 100 mm	Max. ø 100 mm	Max. ø 100 mm
Maximum filter quantity in the test cycle	1	1	1
Filter marking system	–	–	–
Ionization	–	–	–
Air conditioning	–	–	–
Automatic leveling	Yes	Yes	–
Weighing pan dimensions	ø 50 mm (for filter)	ø 100 mm for filter (F), ø 160 mm for filter (F1), ø 26 mm	ø 26 mm
Display		10" touchscreen	
Communication interfaces	2 × USB-A, USB-C, HDMI, Ethernet, Hotspot, Wi-Fi®		

**XA 52.5Y.F****XA 110.5Y.F****AK-6/510.5Y.F****UMA 2.5Y.FC
UMA 2.5Y.F****RB 2.5Y.FC****RMC 2.5Y.FC
RMC 2.5Y.F**

52 g	110 g	0,51 g	2,1 g	2,1 g	2,1 g
1 mg	1 mg	10 µg	100 µg	100 µg	100 µg
10 µg	10 µg	0,1 µg	1 µg	1 µg	1 µg
1 mg	1 mg	–	–	1 mg	1 mg
-52 g	-110 g	-0,51 g	-2,1 g	-2,1 g	-2,1 g
5 µg	5 µg	0,2 µg	0,41 µg	0,41 µg	0,41 µg
10 µg	20 µg	0,2 µg	1 µg	1 µg	1 µg
12 µg	12 µg	0,4 µg	0,8 µg	0,8 µg	0,8 µg
20 µg	30 µg	0,4 µg	1,5 µg	1,5 µg	1,5 µg
±30 µg	±60 µg	≤1,5 µg	≤1,5 µg	≤1,5 µg	≤1,5 µg
~5 s, ~30 s for filter	~5 s, ~30 s for filter	10 s	30 s	10 – 20 s	10 – 20 s
Internal	Internal	External	Internal	Internal	Internal
Manual	Manual	Automatic	Automatic	Robotic	Robotic
GF, QA, MCE, PTFE	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE	GF, QA, MCE, PTFE
Max. 210 × 254 mm	Max. 210 × 254 mm	Max. ø 47 mm	Max. ø 47 mm	Max. ø 47 mm	Max. ø 47 mm
1	1	6	24	1020	156
–	–	EAN Numeric code	EAN Numeric code	–	–
–	–	–	–	Automatic	Automatic
–	–	–	Only FC	Yes	Only FC
–	–	–	–	–	–
210 × 254 mm for filter, ø 90 mm open-work	210 × 254 mm for filter, ø 90 mm open-work	ø 16 mm	ø 16 mm open-work	ø 30 mm	ø 16 mm open-work

10" touchscreen

2 × USB-A, USB-C, HDMI, Ethernet, Hotspot, Wi-Fi®

* Repeatability values are given for concentrated masses.
Wi-Fi® is a registered trademark of Wi-Fi Alliance.

