



Fully automatic system for weighing filters with \varnothing 47 mm
Conditioning of up to 1020 filters
Air conditioning system with HEPA filtering



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RB 2.5Y.F Robotic Weighing System

GRAVIMETRIC EVALUATION OF FILTERS WITH 47 mm DIAMETER

RB 2.5Y.F

Readability: 0.001 mg
Compliance with EN 12341:2014 standard

The RB 2.5Y.F filter robot assembly enables automatic weighing of up to 510 filters with 47 mm diameter. The air conditioning and humidification system ensures stable and fixed ambient conditions inside the chamber, which guarantees correct filters conditioning. Ambient conditions monitoring allows control of current chamber status and report of data.

Hermetic housing protecting against dust and contamination

2 magazines for storing filters
(each magazine consists of 34 discs with 15 filter positions)

Turntable warehouse

Conditioning warehouse

An in-built HEPA filter

Robot chamber

Sensors for ambient conditions monitoring

Microbalance

An in-built air-conditioning system

Weighing terminal for control of the device

Control unit

PC with the RMCS Filter software

An external air conditioning unit

QR code printer

Ionizer

Robot arm – filter carrying fork
(3-axis movement: X,Y,Z)

6-position reference magazine for mass standards

QR code reader



Advantages

- Fully automatic system for weighing filters with \varnothing 47 mm
 - Compliance with EN 12341:2014 standard
 - Conditioning of up to 1020 filters
 - Additional reference magazine
 - Less time consumed when compared to manual filter weighing
 - Elimination of human factor as the reason of measurement errors
 - Process management using RMCS Filter software
 - Automatic data recording, creating reports and statistics
 - Coding and identification of filters using QR code system
 - Elimination of the influence of electrostatics onto the measurement
 - Hermetic robot chamber and the chamber for filter weighing
 - Air conditioning system, HEPA filter (version without air conditioning on request)
 - Increased pressure in the chamber prevents contamination
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Means of Operation

Prior to weighing it is necessary to configure system parameters and the procedure using the RMCS Filter software. Next, preparation of all filters proceeds, the filters are assigned with QR codes and placed in the device magazine.

Thus prepared filters are conditioned in previously set ambient conditions, i.e. determined temperature and humidity. According to EN 12341:2014 standard, conditioning should take 48 hours.

After the conditioning, microbalance adjustment is carried out using an integrated or an external mass standard taken from the reference magazine. Next, a series of measurements can be carried out and the reference filter weighed.

All prepared and unsampled filters are weighed twice in 12-hour cycle. If there are too great discrepancies between the two measurements (the tolerance is determined with parameters of the whole process), then respective filters are weighed for the third time.

Each filter before weighing is subjected to neutralization of uncompensated electric charge using ionizing system located in front of the microbalance chamber.

This procedure guarantees obtaining filter mass after the conditioning process completion.

Weighed unsampled filters are transferred for sampling in accordance with EN 12341:2014 standard. All the filters are exposed to SPM in air for 24 hours.

The filters after sampling return to the magazine and are conditioned again.

A series of sampled filters weighing starts. The series consists of two weighings carried out in 12-hour cycle, this is to verify correctness of filter conditioning. In case of those filters for which mass dispersions are too great, the third weighing is realised.

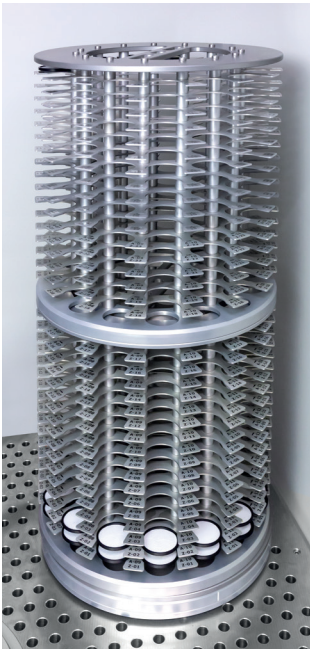
Each filter is marked with a QR code and automatically identified by the system. The final result of filter weighing is real mass of dust on the filter.

During the series of filter weighing, verification weighings are carried out using reference filters or mass standards. This enables monitoring of ambient conditions inside the device chamber, e.g. dustiness, air conditioning operation.

The concentration of suspended particles is calculated on the basis of the difference in filter mass before and after sampling, the air flow through the filter during sampling is taken into account.

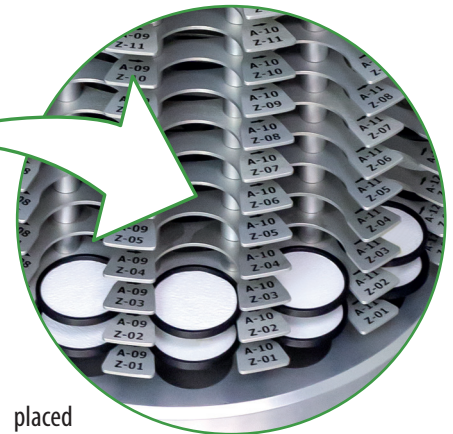
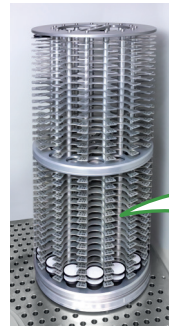
Throughout the whole operation all read data (mass values, differences before and after sampling, results of filters contamination concentration, temperature and humidity measurements) is sent to and recorded in the RMCS Filter database. The data can be exported for further analysis.

Components of the RB 2.5Y.F Filter Robot Assembly



Filter Magazine

The device is equipped with two magazines for up to 1020 filters. Each magazine features 510 positions (34 discs with 15 positions each). The conditioning magazine is fixed, the other one has been installed on a turntable and is powered by servomotors with an encoder. Magazine discs are made of 2.0 mm thick aluminium.



Filter Trays

The filters are placed on specially-designed trays made of polyoxymethylene (POM) which compensates electric charges. The trays, being self-centring devices, facilitate loading of the weighing pan with the filter, and precise filter positioning in the magazine.

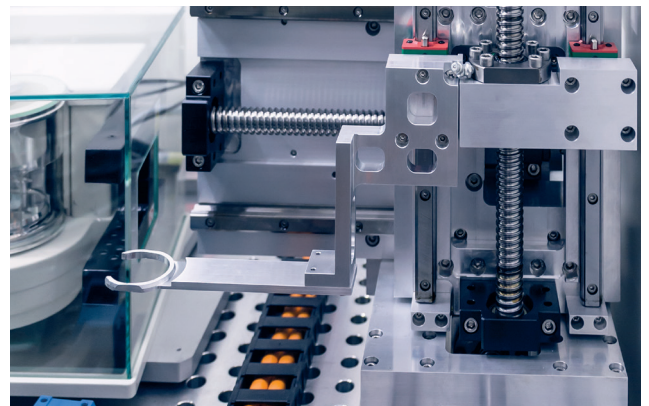


Reference Magazine

The RB 2.5Y.F is equipped with 6-position reference magazine for storing mass standards and reference filters.

Reference filters enable detection of dust or ambient conditions changes inside the chamber that may negatively influence weighing results of both sampled and unsampled filters.

The reference filter material has to correspond to the material of filters used in the test.



Robot

Filters are transported between device elements (filter magazine, reference filter magazine, ionizer, QR code reader, weighing instrument) using robot moving in three dimensions (X, Y, Z). Movement of the transport unit is carried out in accordance with the set procedure.

Microbalance

The microbalance integrated with the RB 2.5Y.F is a professional-class measuring device. It is characteristic for excellent precision and readability of $d= 0.001$ mg plus it is compliant with 21 CFR part 11 requirements. The weighing chamber has been adapted to cooperate with the robot. Prior to weighing, the filter is placed near the operating ionizer and then it is loaded onto the weighing pan. Although the tray remains inside the microbalance it is not weighed.

The microbalance features an integrated mass standard for carrying out the internal adjustment before filter weighing however the adjustment can be performed using external mass standards located in the reference magazine.

The microbalance is located on the granite anti-vibration table separated from the construction of the whole device. This eliminates the influence of vibrations on the mass measurement.



Software

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

Values saved by the system:

- QR filter code
- Air temperature, humidity and pressure
- Conditioning time
- Date and time
- Mean values before and after sampling
- The result of sample concentration as a difference in mass before and after sampling
- Operator

Filters

Filters used for tests carried out on RB 2.5Y.F device must be made of glass fibre, quartz fibre, cellulose nitrate, Teflon.

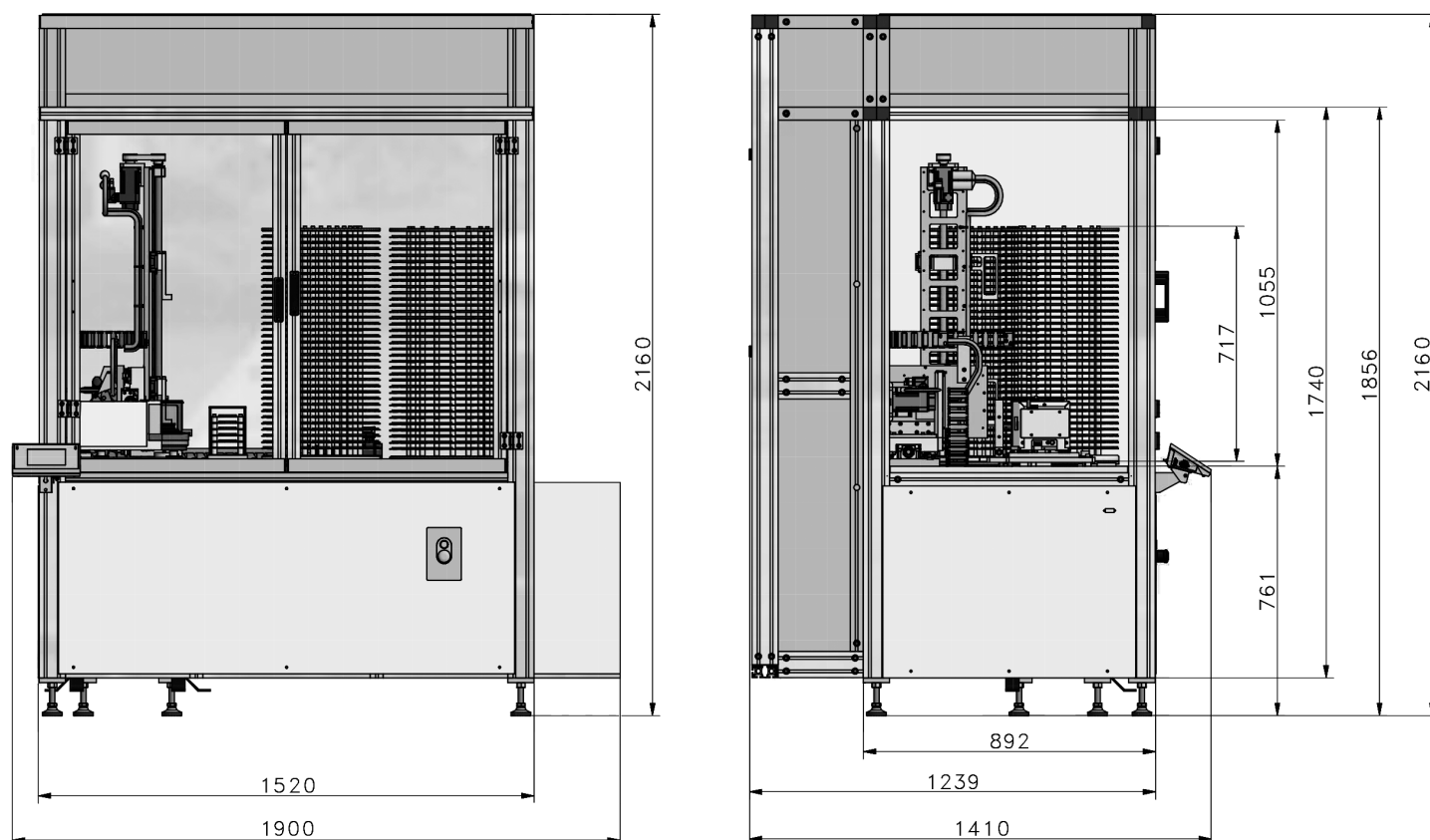
Ambient Conditions

The RB 2.5Y.F filter robot assembly must ensure certain climate conditions. Monitoring of ambient conditions such as temperature and humidity inside the weighing chamber is possible due to installed THB sensors.

To avoid the ingress of dust to the weighing chamber, the RB 2.5Y.F is equipped with HEPA filter that filters the air outside the weighing chamber.

Air conditioning system controls the air flow inside the chamber. With this, stable operating conditions are ensured along with automatic control and adjustment of temperature by heating and cooling. The convection unit controls required relative humidity. An air conditioning system is not necessary if the device is used in suitable ambient conditions.

Overall Dimensions



All the dimensions are given in millimetre [mm].

Technical Specifications

Filter Magazines

Maximum filter capacity of the weighing chamber	1020 (2 magazines with 34 discs with 15 filter positions)
Potential equalization	Consistent conductive design
Magazine drive system	Servomotors with encoder
Positioning of magazine	Via incremental encoder

Filter and Filter Trays

Filter material	Glass fiber, quartz fiber, cellulose nitrate, Teflon
Filter diameter	47 mm
Filter encoding	QR code
Filter identification	QR code

Microbalance

Integrable models	MYA 2.5Y
Reading precision (resolution)	0.001 mg
Maximum load	2.1 g
Location of the balance	Platform of a large mass (approx. 155 kg), decoupled from system
Calibration weights for weighing system	Integrated in the balance

Electronics

Data output	LAN (RJ-45)
Data export as CSV file (others on customer's request)	Weight of unsampled filter (average), weight of sampled filter (average), difference of weight between unsampled and sampled filter (average), temperature, rel. humidity, barometric pressure, filter number, sampler number, date / time, amount of weighings per filter

Dimensions and Weight

Width	1591 mm
Height	2139 mm
Depth	1409 mm
Weight RB 2.5Y.F (incl. balance platform)	700 kg
Weight external chiller for climate control unit	75 kg

Power Supply

Power supply	230 V \pm 10 %, 50 Hz
Power consumption (total)	approx. 1800 VA
Power consumption chiller	approx. 1300 VA

Climate Control

Temperature regulation	Climate control unit (heating, cooling, humidification, dehumidification) with external water connection and external chiller
Humidifier unit	Evaporator as air cooler unit
Accuracy of temperature regulation	\pm 0.5 K (with set value 20 ... 22 °C)
Accuracy of humidity regulation	\pm 2.5 % RH (with set value 45 ... 50 % RH)
Accuracy of dew point regulation	\pm 1 K (with set value 7.7 ... 11.1 °C)
Permissible operating conditions	16 ... 28 °C, 30 ... 60 % rel. humidity