

Weighing Systems



Automatic Weighing System
AWS-1RE
with RFID Technology
for Gravimetric Assessment of
47 mm Sampling Filters



Automatic Weighing System AWS-1RE

Page 2/8

Automatic Weighing System with RFID technology for gravimetric evaluation of sampling filters with a diameter of 47 mm

- Precise, fully automated weighing system for Ø 47 mm filters
- Automatic data capture and documentation, prevents incorrect readings
- Dust-protected weighing chamber with FFU and reliable climatization
- Ideal and time-saving filter conditioning by open filter storage
- Reduces workload for lab technicians
- RFID filter encoding and identification
- Ionization system

The automatic weighing system **AWS-1RE** weighs up to 750 suspended particulate matter (SPM) filters (diameter 47 mm) in an automated process according to EN 12341:2014. The weighing results are recorded in a database along with relevant environmental data, such as temperature and relative humidity. Automation contributes to the very high reliability and precision of both weighing and documentation. A weighing chamber with fan filter unit (FFU) and climate control unit maintains controlled, dust-protected conditions throughout the weighing process. Its modular design allows the system to be adapted easily to the customer's specific requirements.

Design

- Dust-protected weighing chamber with:
 - Magazines for holding filters before and after weighing (up to 2 magazine towers, with 25 or 14 magazine discs, with 15 filter positions, total capacity from 210 up to 750 filters)
 - RFID filter trays (patented) for holding the individual filters
 - Carrier fork for transporting the filters within the system
 - Microbalance with draft shield
 - Reference magazine for holding reference filters and reference weights
 - Fan filter unit (FFU) for contamination protection
 - Climate control unit (without climatization on request)
 - Control panel for manual control of system components
 - RFID system for filter encoding and identification
 - Ionization system
- PC with system software *AWS Control* (featuring custom encoding function)
- Power supply cabinet underneath the weighing chamber

The AWS-1RE, being a modular system, is assembled with optional components according to the customer's individual requirements. Optional components can be integrated into the main system and are fully compatible with the system's

hardware and software. All components operate fully automatically within the system.

Operating Principle and Weighing Process

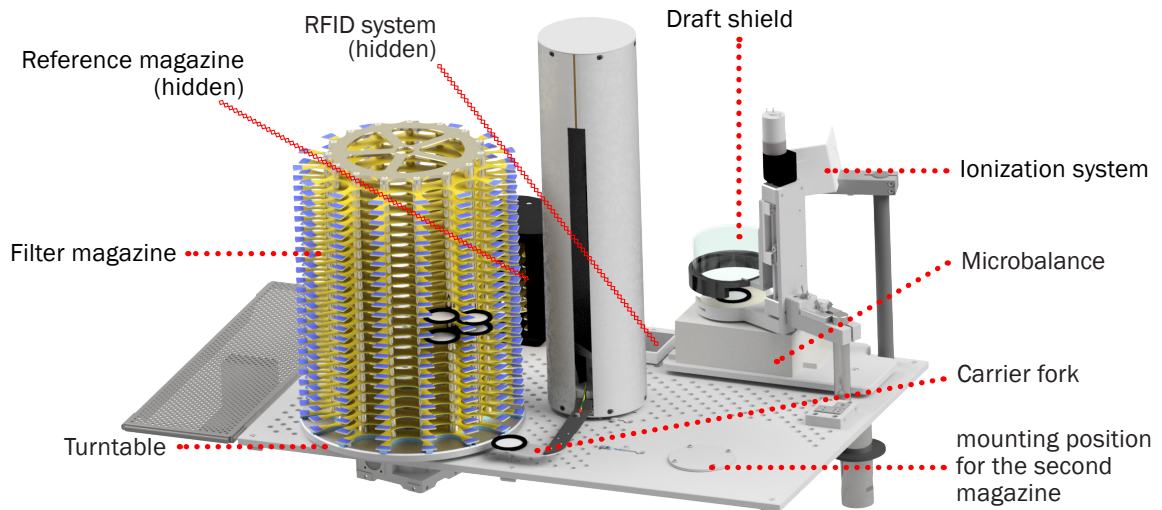
Before weighing takes place, the system settings and all parameters for the planned weighing job are entered in the PC, using the software *AWS Control*. Next, the unsampled filters are manually placed in RFID filter trays and inserted into the magazine of the AWS-1RE. Each filter remains in the same tray during the whole process to ensure identifiability at all times.

The filters are then preconditioned, at preselected temperature and humidity values, in the closed weighing chamber for a user-specified period of time, e.g. according to EN 12341 for 48 hours. The next step is the first weighing series, which consists of weighing the unsampled filters, usually in two weighing passes. All selected filters are consecutively weighed once, and then for a second time. Before the first weighing pass, the RFID system transmits an individual code to each filter tray in a contact-free process. The ionization system neutralizes static electricity and thus enhances weighing accuracy.

If discrepancies lying outside the specified tolerances are recorded between the first and second weighing passes, the relevant filters are weighed again in a third pass.

Once the unsampled filters have been weighed, they are

Automatic Weighing System AWS-1RE



System components (without panels of the weighing chamber, example figure)

placed in filter cartridges, together with their trays, and installed in a dust sampler or other sampling system. Sampling then takes place according to EN 12341 – as a general rule, each filter is exposed to airborne SPM for 24 hours. During the SPM sampling process, sampling systems are often loaded with an additional blank filter (reference filter), which is not sampled, to detect a possible passive dust ingress into the system.

After sampling, the filters with trays are returned to the filter magazine and conditioned again. The second weighing series (weighing the sampled filters) follows, once again with two or possibly three weighing passes. Previously coded filters are identified by the RFID station, which allows the sampled reading to be compared directly with the preceding unsampled reading. Both before and during the weighing series, verification weighing operations are performed with reference filters or weights in order to monitor the conditions (regarding climatization and particle intrusion) inside the weighing chamber.

During the weighing operation, all data (weight values, mean values, weight difference between unsampled and sampled filters, and ancillary data, such as temperature and relative humidity) are saved in the database on the system PC.

The concentration of suspended particulate matter is calculated from the weight difference between the sampled and unsampled filters, taking into account the air flow rate during the sampling period. The saved data can subsequently be exported for analysis and processing.

Benefits

The gravimetric assessment of particulate samples pre-

scribed by European regulations is mostly performed in laboratories by way of manual weighing procedures. Given that both unsampled and sampled filters have to be weighed several times in order to obtain a mean value, a large number of weighing operations is required. This monotonous, repetitive task places a considerable burden on laboratory technicians, and entails a relatively high risk of incorrect values being recorded during weighing and when results are transferred. The automated weighing operation performed by the AWS-1RE in dust-protected, controlled conditions substantially alleviates manual strain, prevents weighing errors and delivers reliable, precise results.

System Components

Filter magazine

The filter magazines for holding sampling filters consist of 14 or 25 magazine discs with 15 filter positions each (diameter of the filters: 47 mm). The capacity of one magazine is 210 or 375 filters. Up to two magazines can be installed in the weighing chamber. The total capacity of the system therefore amounts maximum 750 filters.

The magazines are installed on turntables and are driven gradually by a brushless servomotor and a coupled incremental encoder. The system's carrier fork automatically serves each of the up to 750 filter positions.

The 1.6 mm thick magazine discs are made of fiberglass reinforced epoxy resin (FR4). Similar discs are used in the manufacturing of printed circuit boards. The upper surfaces of the magazine discs are gold-plated. The gold-plated plac-

Automatic Weighing System AWS-1RE

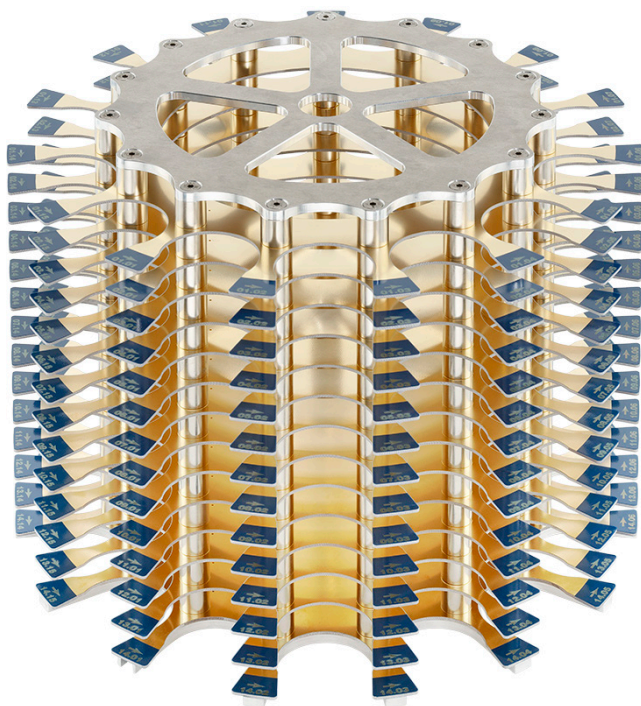
ing positions prevent static charging. At the same time, the gold plating is used to equalize the electrical potential for all 25 magazine discs.

The magazines are placed on the turntables without screw connections and can be easily removed and returned, as a whole, to load and remove the filters.

Filter Trays

Special patented filter trays are used in the AWS-1RE to transport and store the 47 mm sampling filters. The filter trays are made of potential-balancing polyoxymethylene (POM). In addition, a gold-plated lower surface supports the potential equalization. The trays are self-centering, which simplifies inserting the filter and exact positioning in the filter magazines. Each tray is equipped with an RFID transponder, which allows the system to recognize the encoding and identifying of filter trays and their filters. Additionally, the filter trays are equipped with internal data storage, which can also be accessed by Comde-Derenda sampling systems. Each tray is also provided with an alphanumeric code, readable from the outside and etched by laser marking.

Microbalance



Removable filter magazine, small version with 210 filter slots



Filter tray with RFID transponder (cutaway)

The system balance is a microbalance with a readability of 0.001 mg. The balance is equipped with a mechanical fixture which enables access by the carrier fork.

Before weighing, the filter is placed on the balance plate, while the tray remains on a separator ring. It is not weighed together with the filter. After weighing, the carrier fork lifts filter tray and filter up together, whereby they are reassembled.

The integrable balance models mostly feature integrated weights for balance calibration. These are usually more accurate than external weights and preserve the calibration until the next annual calibration is performed by a service technician. Additionally, calibration supported by the system can also be realized, using external weights.

RFID System

An important requirement for ensuring an efficient and accurate automatic weighing process with data recording is the encoding and identification of the sampling filters. Both features are realized in the AWS-1RE by the integrated RFID system.

The RFID system transmits a code to the RFID trays via contact-free data exchange before the first weighing, and reads this code in the course of every future weighing. This ensures that sampling filters are always identifiable and that their data can be allocated at any time. The customization of the encodings is done using the filter encoding software installed on the connected PC, which is also used for control and data capture. Read-out codes are stored in the PC's memory.

FFU and Climate Control Unit

The AWS-1RE has to ensure defined ambient climatic conditions, such as temperature and humidity. The contamination with airborne particulate matter, which could lead to distur-

Automatic Weighing System AWS-1RE

Page 5/8



Microbalance with filter mounting

tion of the weighing results, needs to be avoided. Therefore, the system is equipped with a closed weighing chamber with a fan filter unit (FFU).

The AWS-1RE is additionally equipped with a climate control unit. It automatically controls the temperature by heating and cooling. A highly reliable convection unit accurately controls the required relative humidity.

The climate control unit is very quiet and economical and has an excellent control behavior. Safety features include an overheating thermostat and an overflow protection.

An integrated climate control unit is not necessary if the AWS-1RE is positioned in appropriate ambient conditions.

Carrier Fork (Filter transportation Unit)

The handling system with carrier fork moves through the weighing chamber in rotatory and vertical movements. Combining both movement directions, it transports filters from and to various positions in the system (filter magazine, RFID system, balance, reference magazine). All movements are executed automatically according to the preselected parameters.

Reference Magazine

For storage of reference filters and reference weights, the AWS-1RE features a reference magazine with eight placement positions. In the reference magazine, filters of different materials (e.g. Glass fiber, Quartz fiber or Teflon filters) can be stored after placement in a special mounting fixture for reference filters.

By weighing these reference filters, a possible ingress of dust into the weighing chamber can be detected according

to the standards. The material of the reference filters should correspond to the material of the filters used for sampling.

Sampling Filters

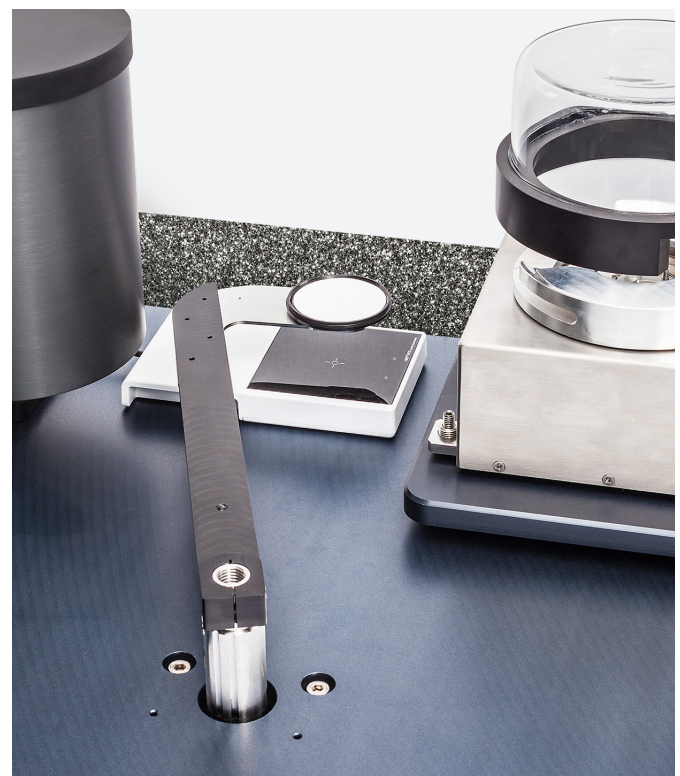
The following filter materials can be weighed with the AWS-1RE:

- Glass fiber filters
- Quartz fiber filters
- Cellulose nitrate filters
- Teflon filters

Evaluation and Documentation

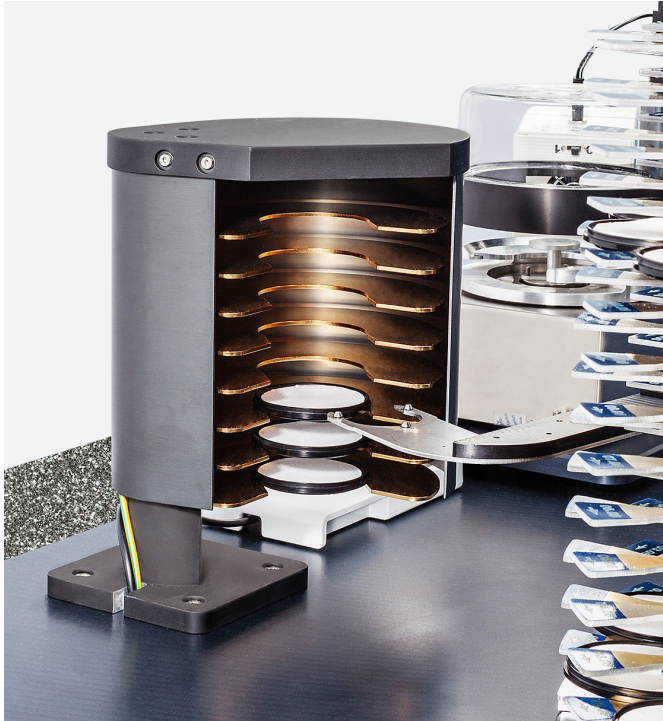
The following values are recorded automatically by the system during the weighing process:

- Filter code



Carrier fork with filter tray and RFID station

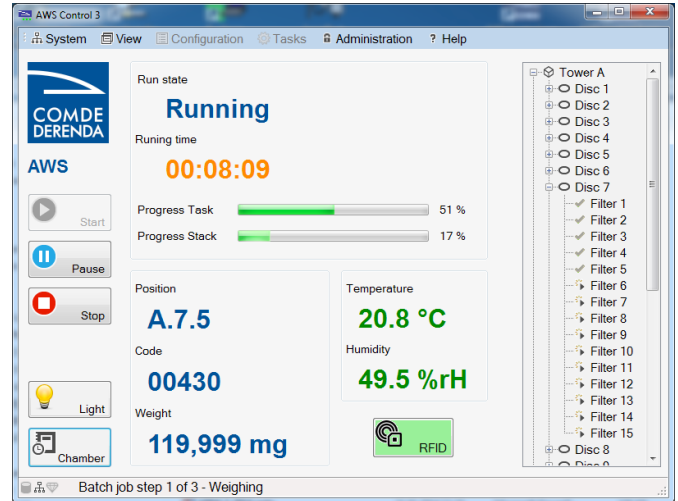
Automatic Weighing System AWS-1RE



Reference magazine

- Air temperature, rel. humidity and air pressure
- Period of conditioning
- Filter positions in the magazine
- Date and time
- Mean weighing values before and after the sampling process

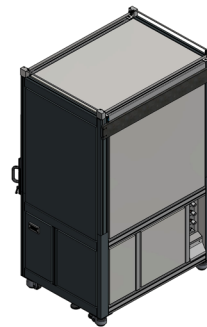
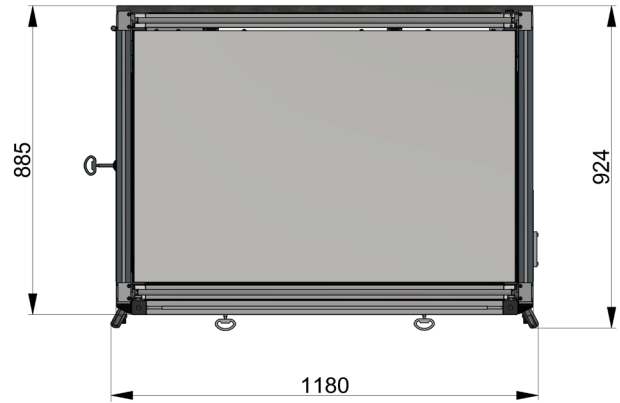
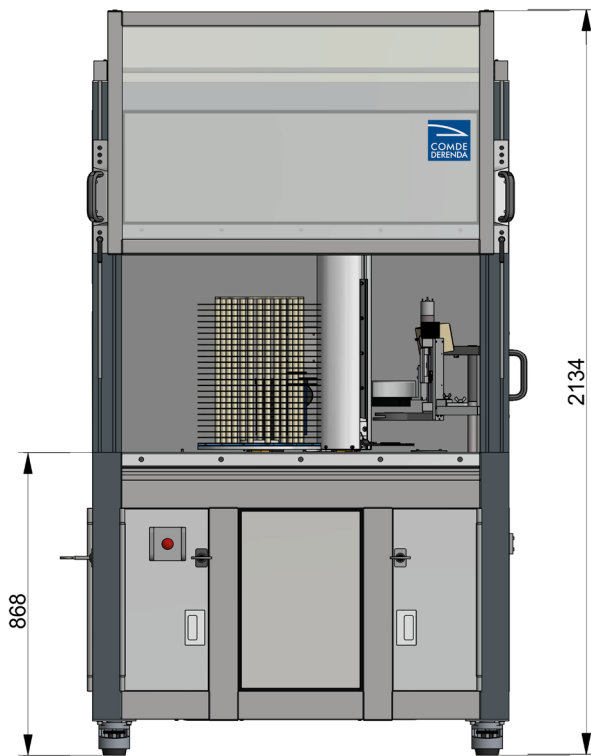
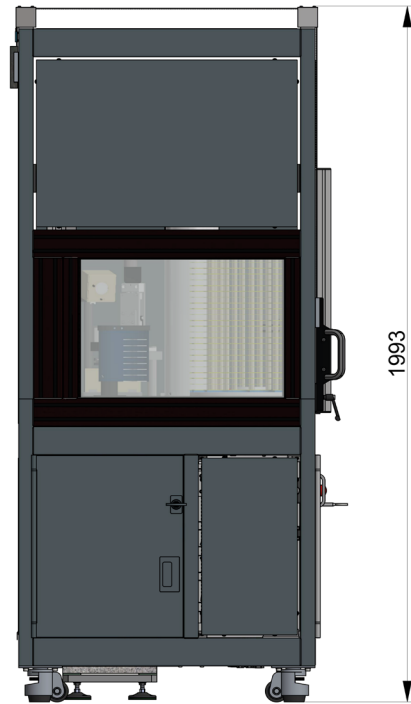
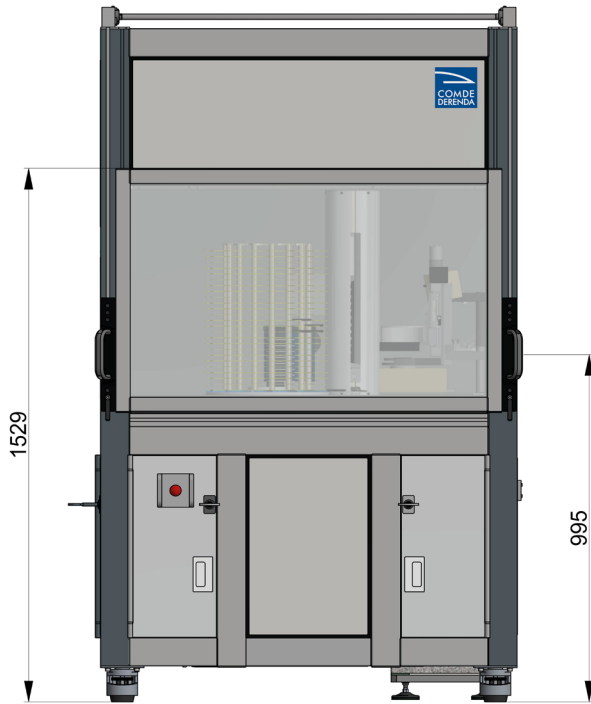
The stored data can be easily evaluated after weighing, e.g. using a spreadsheet application for postprocessing. Custom modifications regarding to the postprocessing can be provided as an option.



Main window of the AWS Control software

Automatic Weighing System AWS-1RE

Dimensions in mm



Technical Data AWS-1RE

Page 8/8

Filter Magazines	
Maximum filter capacity of the weighing chamber	750 (2 magazines with 25 discs with 15 filter positions)
Potential equalization	Consistent conductive design
Magazine drive system	Brushless, maintenance-free DC motor
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	Via RFID system and RFID transponder in the filter tray
Filter identification	Contactless RFID data transmission

Microbalance	
Integrable models	Sartorius WZA-26-HC, Mettler-Toledo WXS26S/15 (others on request)
Reading precision (resolution)	0.001 mg
Maximum load	20 / 22 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

Additional Specifications	
Cleanroom class (within the weighing chamber)	6

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	approx. 1180 mm
Height	approx. 2000 mm (working height approx. 870 mm)
Depth	approx. 930 mm
Weight AWS-1RE (incl. balance platform)	< 640 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

This information corresponds to the current state of knowledge. Comde-Derenda GmbH reserves the right to discontinue or change specifications. Liability for consequential damage resulting from the use of Comde-Derenda products is excluded. Ed. 2018-08