Automatic weighing system (AWS) for gravimetric evaluation of dust-loaded filters with a diameter of 150 mm

Type AWS-2

Automatic weighing system without protection hood

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Automatic weighing system (AWS) used to weigh dust-laden filters with a diameter of 150mm for registration and documentation of particulate matter (Pat. pend.)

The automatic weight determination system (AWS) registers and documents the amount of particulate matter in outdoor air in compliance with the EN 12341:2014 (PM_{10} and $PM_{2,5}$) standards. The particulate matter is collected on filter media with a filter diameter of 150 mm mounted in volume samplers in combination with specimen sampling systems.

- Very exact, automatic weight determination system for filters with a diameter of 150 mm
- Automatic registration and documentation of particulate matter concentration
- Tremendous reduction of measurement deficiencies
- Great reduction of stress and strain for personnel
- Air-tight housing to isolate the weighing system from the outside world. This is to keep the system from being contaminated by airborne particles and to maintain the specified climatic conditions (temperature and humidity).
- When the AWS is set up in an appropriately conditioned atmosphere (e.g. 20 °C and 50 % relative humidity) one may, of course, operate the system without the integrated climate control feature. In this case the filtered outside air is used to ensure the temperature and humidity of the work space.
- Wind protection device with a soft-closing mechanism for the weighing cell unit

Options:

- Integrated temperature and humidity regulation
- Integrated marking station
- Ionization blower for Teflon filters
- Microbalance:
  Mettler-Toledo weighing cell WXS26S/15 or
  Sartorius weighing cell WZA-26-NC
  (other weighing cells can be used on request)

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Introduction of the automatic weighing system

Several European Union directives require that the particulate matter present in outside air be measured. In most cases reference units (low-volume samplers) are used for this purpose. A vacuum pump is used to draw particulate-laden air into the device, the particulates are sorted by size in separation stages (impactors) and the dust particles thus recovered are deposited on a filter. In the past, the amount of dust thus collected was ascertained by manual weighing at an outside laboratory. Where non-continuous registration and ongoing monitoring of the dust concentration are required, the usual technique is to employ filter changers that automatically remove individual filters after a defined exposure period and place them in a magazine. The collector unit is then fitted with a fresh filter. In this way dust can be collected for subsequent evaluation over a relatively lengthy period of time.

The type AWS-2 automatic weight determination system was developed to register and document the amount of particulate matter in outdoor air. Automatic weighing of filters eliminates the need to weigh the filters manually. This simplifies the staff's work considerably. Errors in determining and recording the measured values, resulting from human subjectivity, are virtually excluded. Both the clean filters and the dust-laden filters have to be weighed several times to arrive at a mean value. This results in a very large number of weighing operations, representing considerable strain for personnel due to the concentrated but monotonous nature of this work.

The filters are stored – both prior to the collection cycle and then for a certain period of time after exposure – at a specified temperature and defined relative humidity level. This makes it necessary for the automatic weight determination system to be capable of maintaining these defined atmospheric conditions.

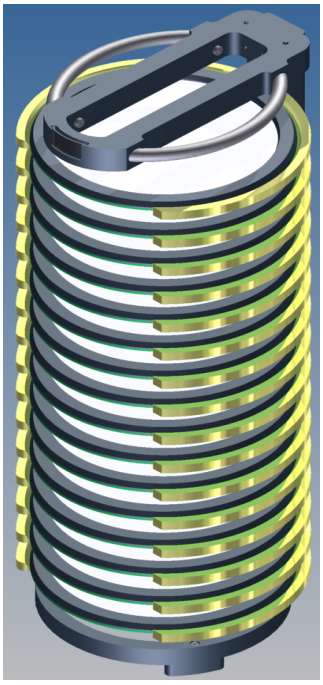
The particulate concentration, expressed in micrograms per cubic meter (µg/m³), is calculated on the basis of the difference in the weights of the laden and clean filters, taking account of the total volume of air processed during the collection period.

One prerequisite for running the entire process automatically is marking the individual filters, thus making them identifiable. A separate filter marking system (optional) is used for this purpose. The corresponding reader is installed at the AWS-2 to identify the filters.

Filter magazine

The far greater size of the filters made it necessary to adopt an entirely new approach during development work. This made it possible to insert a large number of filters of these dimensions in the magazines and to move them by way of an appropriate filter conveyance unit.
In this new weighing system the filters are inserted in mounting rings which, in turn, are placed in a magazine tower with 16 slots. The weighing system is fitted with two turntables. Each of them can accept ten magazine towers so that a total of 320 filters can be installed in the unit, ready for fully automatic evaluation.

The magazine towers can be removed from the system individually so that the operator can then conveniently fill them with filters, separate from the system.



Filter magazine tower

Microbalance

The scale used here is a microbalance, readable to 0,001 mg. Other microbalances can be used on request. The balance was modified mechanically for this operation so that the filter conveyor fork can lay the filter to be weighed on the balance and then remove it again. The modifications to the balance have no influence on the technical data guaranteed by the manufacturer of the balance.

Microbalance

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The anodized aluminum mounting rings are fitted with support screens upon which the filters lie. These are gold-plated, glass fiber reinforced epoxy resin base panels (FR4). The gold plating serves primarily to equalize the electrical potential but also makes the contact surfaces easy to clean. What's more, the plating eliminates any interaction between the filter and the support, thus preventing contamination.

Before the sampling cycle starts, the clean filters are placed in support rings. This assembly is fitted in the magazine towers and provided with a code for later identification. Then the filters are conditioned and weighed. Thereafter they are positioned in filter cassettes in the sampling devices, ready for the sampling cycle.

At the end of the sampling cycle the dust-loaded filters are placed in the support rings, which are then put into the magazine towers (16 filters per magazine tower).

The weighing system is then fitted with as many as twenty magazine towers ready for the weighing process. The process starts with the conditioning again and the filters thus can be weighed after they are identified.

Filter marking unit

A prerequisite for automated operation of the entire process is marking the individual filters, making it possible to identify them individually. A separate filter marking unit is used for this purpose. It is integrated into the weighing system and applies an five-digit numerical code at the edge of the filter's rear surface. A specially designed, miniature inkjet printer is used for this purpose. In the first step all the clean filters are weighed and the appropriate identification codes are applied at the same time. The encoding scheme may be specified by the user as desired.

Filter identification (reader unit)

Prior to weighing, the filters are first identified using a reader unit built into the system. (This is an identification camera with OCR – optical character recognition technology.)

The following measured values are stored at the beginning of the weighing and conditioning process in conjunction with identifying the filter exposure conditions:

- Temperature
- Humidity
- Atmospheric pressure
- Conditioning period
- Number of the magazine disk
- Filter position on the magazine disk
- Filter code for identification purposes
- Date and time of day
- Collection period
- Mean value derived from the number of weighing cycles selected, before and after exposing the filter to particulate matter

Equipment to control the temperature and humidity of the air inside the enclosed handling and weighing system

The automatic weight determination system will have to maintain defined atmospheric conditions by controlling the temperature and humidity. Any ingress of foreign, airborne particles will have to be prevented. The system is thus closed with a protective hood.

The temperature is maintained with a climate control unit for heating and cooling.

The AWS is fitted with an evaporator as air cooler unit offering great operational reliability. It is able to maintain the specified relative humidity exactly. The system is very quiet and economical and features superior regulation properties. Included among the safety features are an overheating sensor, overflow sensor and protection against dry running.

When the AWS is set up in an appropriately condtioned atmosphere (e.g. 20 °C and 50 % relative humidity) one may, of course, operate the system without the integrated climate control feature.

Filter conveyance equipment

Located between the turntables is a filter conveyance unit comprising a rotating filter conveyor fork which can be raised and lowered, as well. Thus the desired filter can be removed from the magazine tower on either turntable. The filters thus removed are then forwarded to the printing and weighing unit and, once weighing and/or printing has been completed, the filters are returned to the magazine tower.

The magazine in a specimen sampling system is fitted with 16 filter cassettes containing filters; one of these filters is a so-called „blank filter" (reference filter). It is used to determine the passive accumulation of dust in the specimen sampling system's changing unit.

Once the magazine disks in the automatic weight determination system have been fitted with filters taken from the cassettes in the specimen sampling system, the reference filter will be weighed before the start of each weighing cycling to determine the potential need for corrective measures.

In addition, the automatic weight determination system provides space for eight additional reference filters. These may be made from one of several different materials (e.g. fiberglass filter, quartz fiber filter).
These are kept in the reference filter tower, making it possible to detect – by weighing these filters – any accumulation of dust in the weighing chamber itself. The materials used for these filters are identical to those in the filters used to collect fine dust. These reference filters are changed out together with the filter disk magazine.

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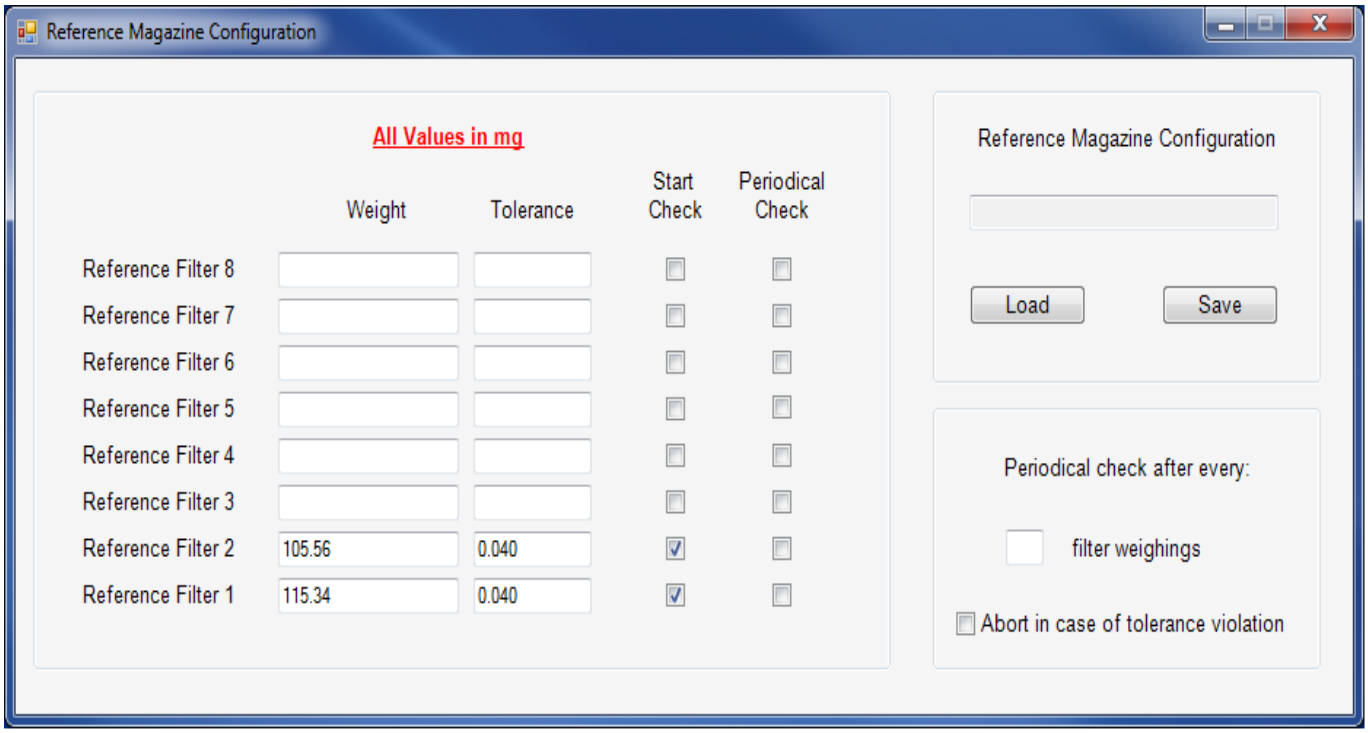
Evaluation and documentation

The supplied evaluation software can be used to post-process the data stored in databases or in an Excel spreadsheet. Custom modifications can be provided as extra-cost options.
In addition to the data mentioned above, the weights of the non-laden and laden filters will be stored after the weighing process is completed.

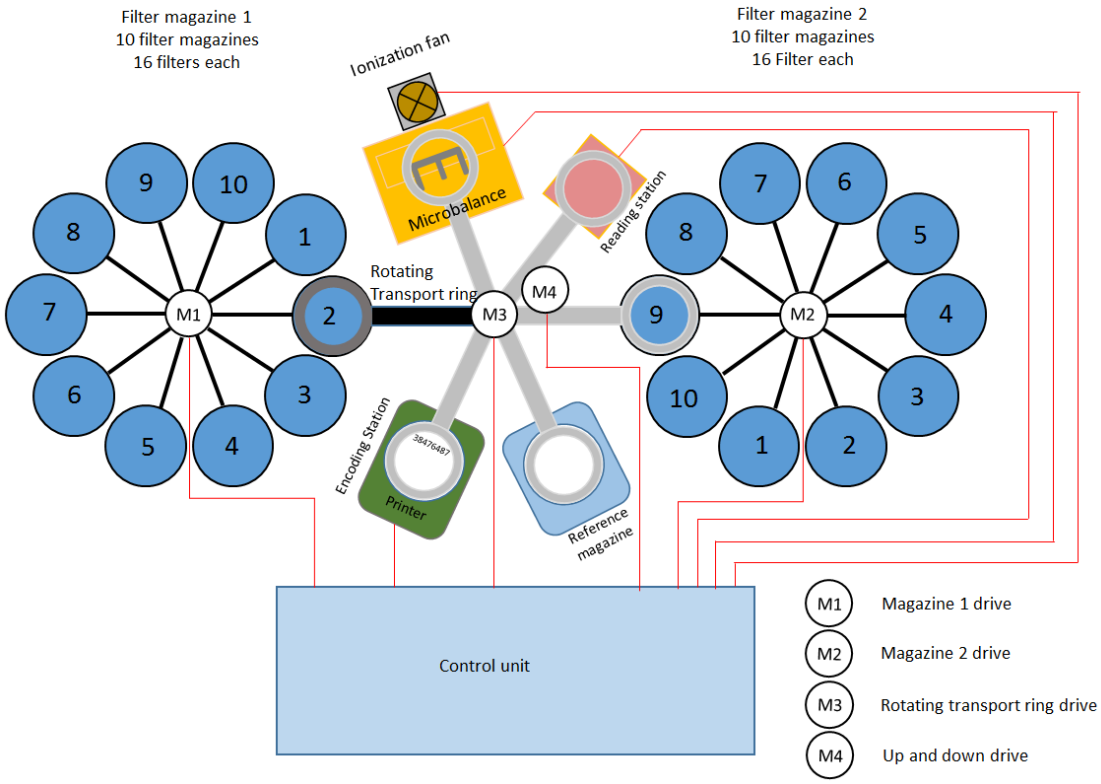
Information on the filter materials

The following filter materials can be weighed with the AWS-2:

- Glass fiber filter
- Quartz fiber filter



Reference magazine configuration menu



Block diagram AWS-2

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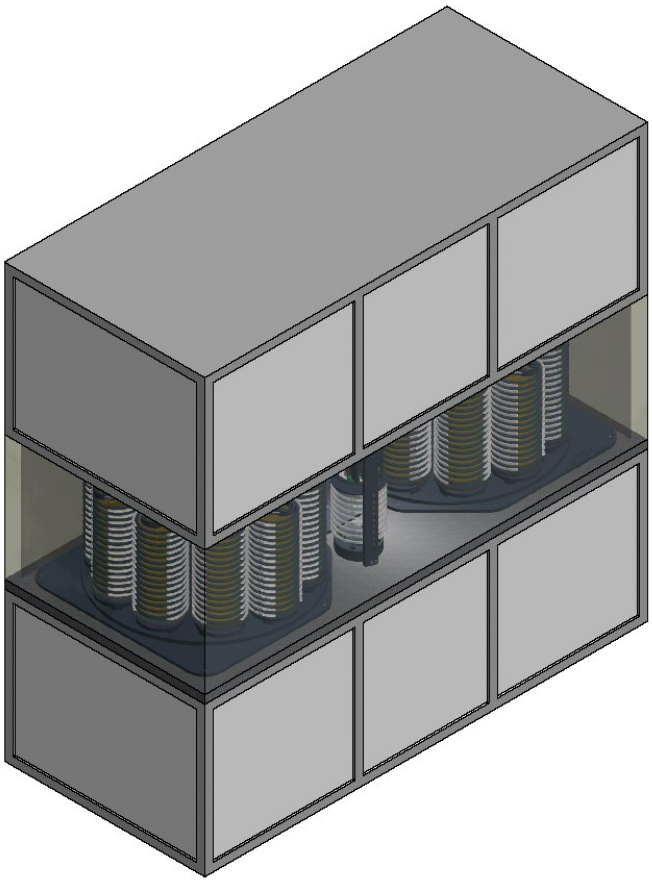
Dimensions



Dimensions in mm

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Technical Data Automatic Weighing System Type AWS-2

Filter magazine	
Number of magazine towers holding filters:	20
Number of filters / magazine tower:	16
Material of magazine discs:	2.4 mm fiberglass reinforced epoxy resin, gold plated
Potential equalization:	By means of cone contacts between the gold plated magazine discs
Drive system of the disc magazine:	Brushless DC motor
Positioning of the disc magazine:	By means of incremental encoder
Filter	
Filter material:	Glass fiber filter, Quartz fiber filter
Filter diameter:	150 mm
Filter marking:	By use of a miniature inkjet printer
Position of marking:	On the edge of the filter's rear surface
Dimension of marking:	30 x 4 mm
Type of marking:	Five digit numerical code
Reader station:	Identification camera with OCR - optical character recognition - technology
Microbalance	
Manufacturer:	Mettler-Toledo weighing cell WXS-26S/15 or Sartorius weighing cell WZA-26-NC (other weighing cells can be used on request)
Reading precision (resolution):	0.001 mg
Maximum load:	20 g / 22 g
Location of microbalance:	Granite block with a large mass (approx. 200 kg), decoupled from the main mounting rack
Data output	
Data output:	RS-232
Data export (CSV data file): (other data formats on customer request):	Weight of unloaded filter (average) Weight of loaded filter (average) Difference of weight of unloaded and loaded filter Temperature, humidity rel., barometric pressure Filter number Sampling number Date / time Amount of weighings per filter
Power	
Power supply:	230 V, 50 Hz
Power consumption:	250 VA
Dimensions and weight of mounting rack	
Length:	2120 mm
Width:	960 mm
Height of operation:	850 mm
Height with protective hood:	2070 mm
Overall weight (incl. granite block for balance):	Approx. 490 kg
Conditioning of climate (optional)	
Temperature regulation:	Climate control unit (heating and cooling) with water (external compressor)
Humidifier unit:	Evaporator as air cooler unit
Permissible operating and environmental conditions:	15 … 32 °C, 30 … 60 % rel. humidity
Power consumption:	2000 VA
Power consumption compressor:	1500 VA

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Environmental Monitoring Systems

Comde-Derenda GmbH in Stahnsdorf bei Berlin

Comde-Derenda GmbH was originally founded as an engineering office in Berlin, in the year 1972. The company's activities at that time included the development, production and sales of measurement and control systems and gas analysis systems.

Over the course of time the engineering office focused on the development and production of devices and systems for the collection of particulates in the ambient air, used in the field of environmental protection.

COMDE GmbH was founded in the year 1992. The company in particular concentrated on the development and production of equipment to measure and monitor pressure, gas density in high voltage circuit breakers (containing SF6 gas) and pressure at high temperatures. Moreover, the company developed and produced several white canes designed to increase the mobility of those who are visually impaired.

Our own building was erected in Stahnsdorf near Berlin, in 2007. All the activities of the three existing fields of operation gas density and pressure monitoring, environmental monitoring systems, and white canes are concentrated here.

The engineering office and COMDE GmbH were merged to form Comde-Derenda GmbH in the year 2012.

Comde-Derenda GmbH has been certified as per the DIN EN ISO 9001:2008 standards for quality assurance.

Comde-Derenda GmbH can supply far more than the products found in its product overview. A wide range of custom-engineered equipment can also be manufactured.

If you are interested in a product or accessory item and you do not see it in our line, then please be sure to ask.

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