www.grimm-aerosol.com

COUNTS

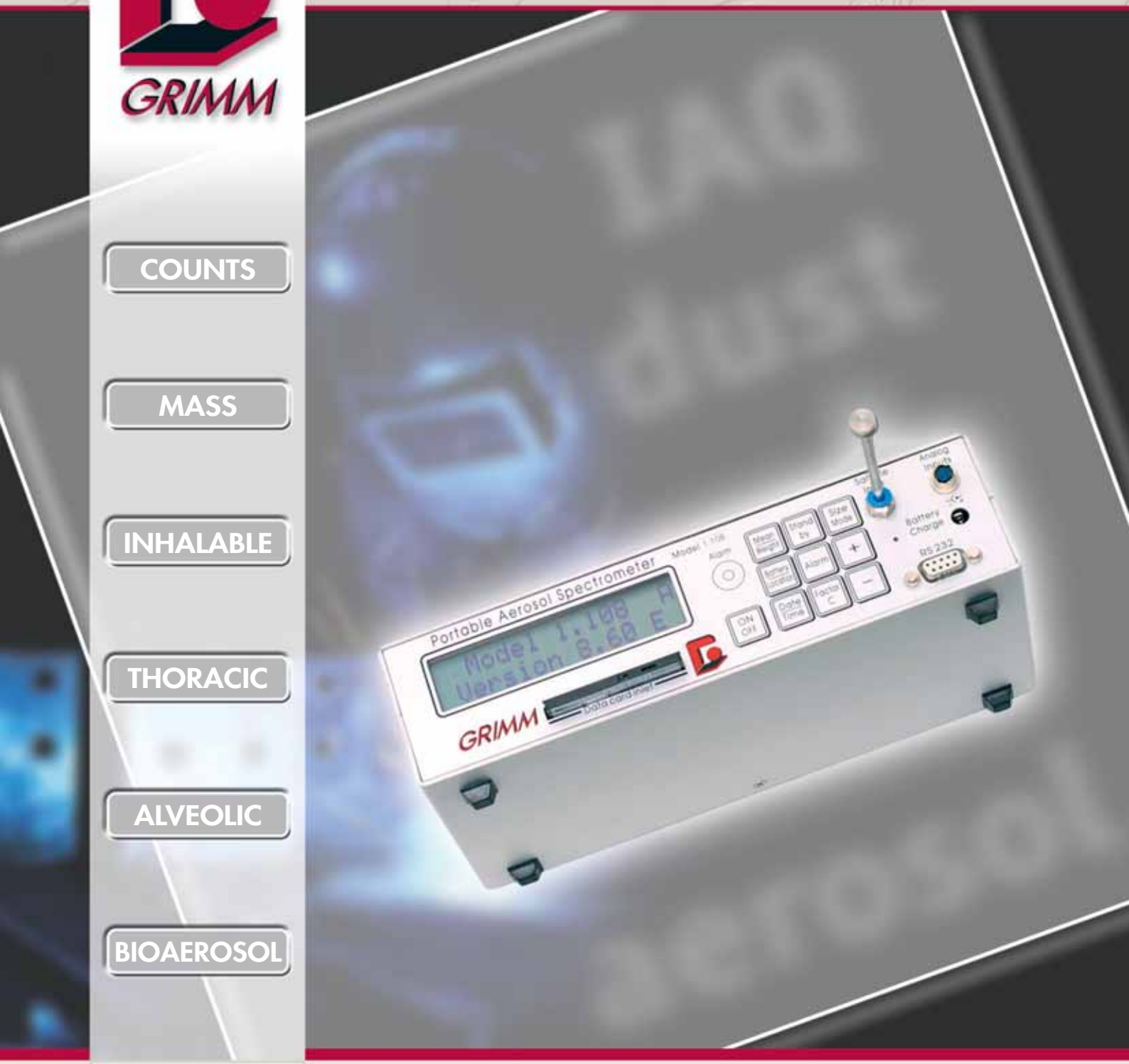
MASS

INHALABLE

THORACIC

ALVEOLIC

BIOAEROSOL



2008

Indoor Air Monitoring Instruments

(IAM)

Spectrometry vs. Gravimetric vs. Nephelometry

Equivalent methods

Past:

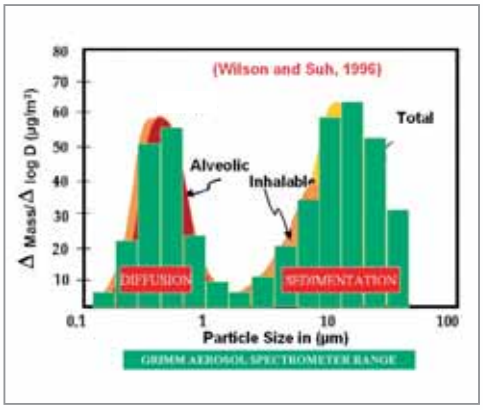
Over 20 years ago the first optical **Nephelometer** was introduced for dust monitoring using light scattering of many aerosol particles at the same time, so called opacity. Since then several companies now offer such low cost solutions. All those systems depend on the aerosol composition, the size distribution and the colour *(refractive index)* of the sampled dust. Consequently, Nephelometer only shows an acceptable mass correlation to the material selected for calibration. This means this method is good for dust trend INDICATION only.

Over 10 years ago GRIMM developed and patented their first **8 size channel laser Aerosol Spectrometer** (IAM 1.101 to 1.105) for mass measurements based on light scattering of individual particles to calculate the mass distribution in relation to the particle size distribution. Since then hundreds of such systems have been sold and provide continuous real-time indoor dust mass and mass distribution values as well as the particle size distribution. Results are much better than from Nephelometer.

Present:

To further improve the above 8 size channel performance GRIMM designed a new kind of **multi size channel Aerosol Spectrometer.** Today instruments with 15 and 31 size channels are in use, such as the IAM 1.108 and 1.109.

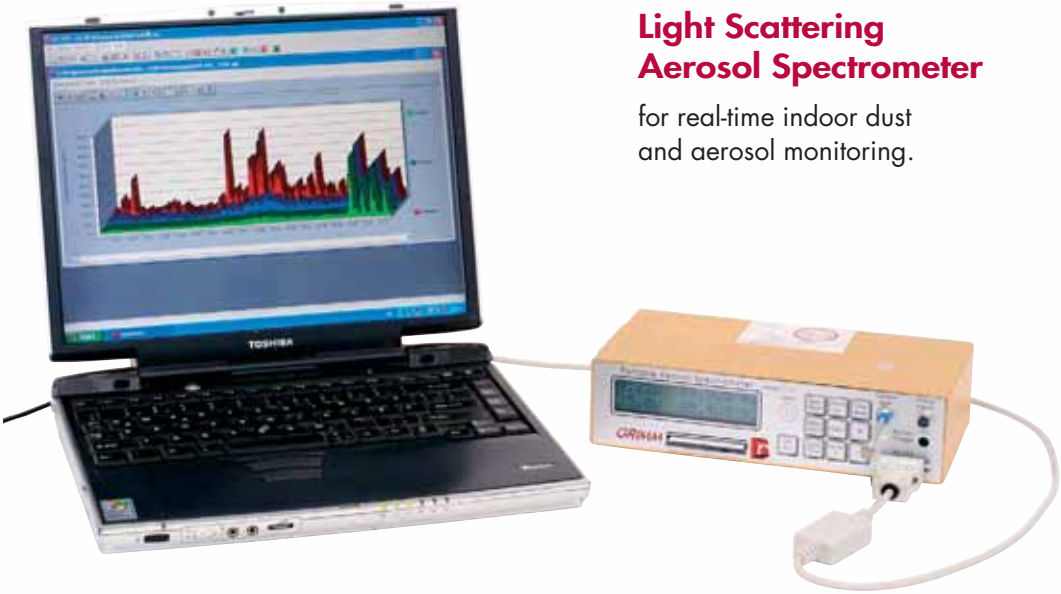
With this step the precision of mass determination increased, since the particle mass strongly depends on the particle size. Since this technology cannot identify the sample density, **a flat 47 mm Teflon filter** was integrated in the Aerosol Spectrometer collecting the total aerosol sample after the optical measurement. This patented technique allows a gravimetric correlation and/or chemical analysis after the measurement.



The above picture shows the particle size distribution covered by the IAM 1.108.

Future:

The latest accessory for GRIMM Aerosol Spectrometer is a **NANO attachment,** model 1.300 permitting the continuous particle counting below the measurement range of the optical system. This new **Sensor** is able to measure in real-time the particle concentration from 30 nm to 400 nm. Now it is possible to monitor the full aerosol size range with one battery operated portable Spectrometer.



Light Scattering Aerosol Spectrometer

for real-time indoor dust and aerosol monitoring.

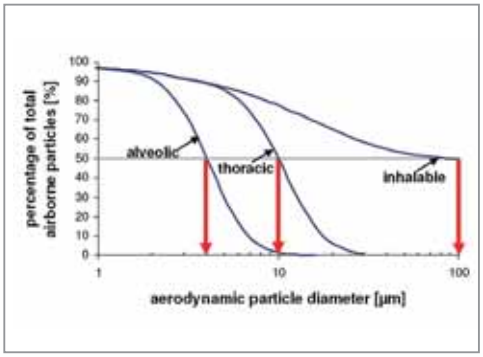
The Grimm IAM 1.109 light scattering aerosol spectrometer is the ideal unit for a fast and accurate determination of particle **number** concentration, particle **size** distribution, **total dust** and various dust **mass fractions** of aerosols. All three mass fractions shown in the diagram at the right are displayed simultaneously or particle number/mass distribution. So this system displaying online the ration between coarse and fine particles can be applied in **source apportionment** to identify particle sources and to estimate the variations in particle release e.g. at a production site or an industrial area.

High accuracy with over 30 size channels and high time resolution down to 1 second are combined with easy handling and user-friendly data presentation software for a low total cost of ownership. Grimm technology is now used world wide for fine dust monitoring and aerosol research.

Reference method

In Europe and United States the traditional **method for inhalable dust monitoring** is based on a weight-to-volume measurement, whereby the dust is collected on a filter and subsequently weighed. This method is still the reference method, low cost, but requires an adherence to time-consuming procedures, as well as a skilled technician.

The finer dust mass fractions introduced, as the **thoracic and alveolic** fraction require a larger sampling air volume and a longer sampling period to collect sufficient mass that can be measured gravimetrically on a high quality microbalance.



In any case the results derived from filter samples and gravimetric are delayed, so any potential exposure problem is realized after the exposure has occurred.

INHALABLE

THORACIC

ALVEOLIC

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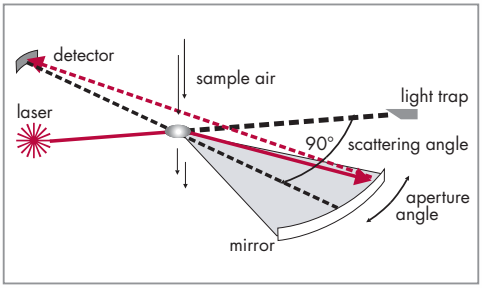
MASS

IAQ

Functional Principle of Grimm Laser Aerosol Spectrometer

The Grimm Aerosol Spectrometer IAM 1.108 and 1.109 use a radial symmetric sampling head to draw the aerosol sample at a flow rate of 1.2 l/min independent from wind direction with a built-in flow-controlled pump. The air inlet speed is in accordance to human inhalation *(Johannesburg convention)* so the sampling is as recommended for many industrial hygiene applications.



The sample air goes into the **patented GRIMM high resolution optical cell** in such a way, that one particle after the other can cross the laser illuminated optical volume. Each single particle passing the laser generates a scatter signal, which is collected at 90° scattering angle on a mirror and a photodiode. This signal is classified by a pulse height analyzer and stored in the appropriate data registers. The signal is then sent to a micro-processor for display and updated every 6 seconds as particle size distribution for all channels.

From this data set the particle mass concentration is calculated as **Inhalable, Thoracic** and **Alveolic mass fraction,** or mass distribution in real-time. After the optical particle counting and sizing the aerosol sample is collected by the **patented GRIMM dual technology** on a **47 mm PTFE-filter** for subsequent gravimetrical, chemical or microscopy analysis.

Highlights of IAM 1.108 and 1.109

- Real-time measurements
- 15 or 31 size channels
- Particle concentration and dust mass fractions
- Particle sampling on integrated PTFE-filter
- Work place monitoring according to EN 481
- PM_{10}, $PM_{2.5}$ and PM_1 simultaneously
- For dust, smoke and droplets
- Portable and easy to use
- Isokinetic sampling probe
- Sensors for temperature, rel. humidity and velocity
- Accessories for Nanoparticles and PAH

The availability of real-time, direct-reading, portable dust monitors that display even low concentrations of mass values and counts are an important development in the Indoor Air Quality **(IAQ)** monitoring and will have a significant impact on future regulations for finer particle sizes and lower concentration measurements.

Due to the unique design and performance the Grimm portable Aerosol Spectrometer and Dust monitor enables many applications like IAQ-monitoring, occupational studies, filter testing, and aerosol science in general.

Nano particle and PAH Attachment
and Bioaerosol Spectrometer

NANO-CHECK

PAH

BIOAEROSOL

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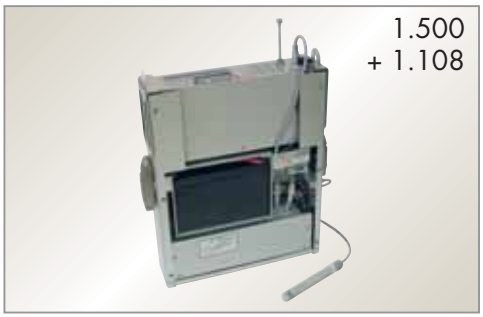
Portable Nano Counter Attachment

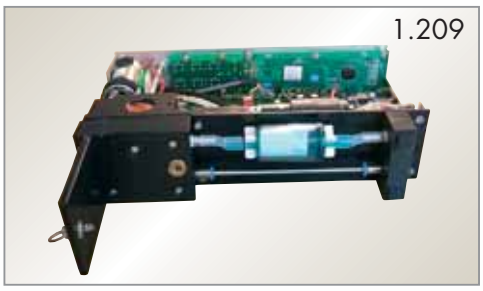
Since the scatter intensity decreases with the sixth power of the particle size, optical light scattering systems cannot detect particles below about 0.1 µm.
The mobile Nano counter attachment model 1.300 is a Grimm patented technique combining an electrical charger with a conductivity measurement and a faraday cup electrometer for **continuous nano particle counting** below the optical range down to 30 nm. In addition, the mean **particle diameter** of the nano particle size distribution is determined. The Nano counter attachment without pump and data logger can be added to any Grimm Spectrometer. The sample comes directly from the Spectrometer, which also displays and logs the data. With this setup it is possible to monitor the full aerosol size range including the **Ultra Fine Particles** with one battery operated portable system. This will help to understand the influence of nano aerosols on the inhalable aerosol concentration.

Portable PAH Sensor Attachment



Formation of **Polyaromatic Hydrocarbons (PAH)** occurs during incomplete combustion of oil, wood, diesel, tobacco and general garbage. Grimm developed a compact ambient **PAH Analyzer,** model 1.500 to measure the particle bound PAH in real-time. The PAH sensor uses an excimer lamp to ionize selective particle bound PAH-molecule structures by photoelectrical charge. Then the particulate matter containing the particle bound ionized PAH is collected on a filter and the charge of the collected particles on the filter is measured by an electrometer, while the volatile PAH in the gas phase pass the filter, without causing a signal. The Aerosol spectrometer supplies the attached sensor with the sample air and both displays and stores the concentration of particle bound PAH values.

Portable Bioaerosol Spectrometer



In addition to the physical aerosol number and size distribution, clients also want to know, if the aerosol contains spores, bacteria or other biological material with allergenic potential. Therefore based on the 31 channel spectrometer a special **bioaerosol spectrometer,** IAM 1.209, was designed to collect the particles after the optical counting and sizing on a prepared glass slide for a subsequent microbiological analysis. The spectrometer can be upgraded to a complete compact **bio station** with a portable **microscope.**

Stationary Aerosol Spectrometer
and Ambient Dust Indicator

The need for a real-time fine dust IAQ monitoring or process control was obvious. Therefore GRIMM designed several stationary systems.

Stationary Protection Housing

The Grimm Aerosol Spectrometer can be combined with a protection-housing model 1.165 with permanent power supply, automated data recording and various options depending on the application.

Highlights of IAM 1.165

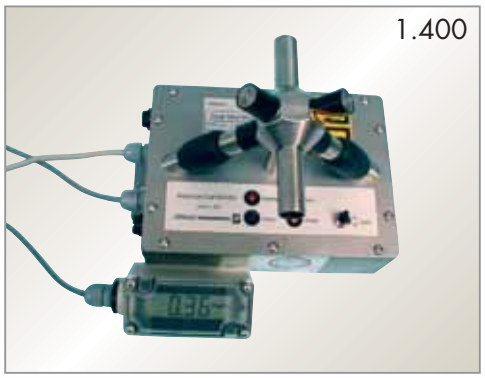
- Easy installation
- Sensors for temperature, rel. humidity
- Optional optical and acoustical alarm unit
- Simple to service and maintain
- Automated data recording, optional via network

Industry and Atmospheric Research

The model 1.129 Sky-OPC Spectrometer integrates a removable high performance laser aerosol spectrometer in a docking station with external power supply. The spectrometer with no moving parts is operated by a "local external air/vacuum" supply system while the airflows inside the spectrometer are controlled by so called critical orifices. This enables a precise particle counting and sizing independent of the ambient pressure.

Stationary Dust Indicator

An other group of industrial instruments are the Fine **Dust Indicators *(Nephelometer)*** IAM 1.4xx. This concept is based on a free floating optical cell with no moving parts. It is designed for continuous total dust indication. Different models for indoor, tunnels, roof mounting, high humidity or wet industrial applications are available.



Highlights of IAM 1.400

- Continuous unattended operation
- No moving parts in all systems (little maintenance)
- Quick check adapters for "ZERO" control in the field
- Optional protected housing

The total mass value can be calibrated to the respective application (using a 1.109 unit). Also an appropriate alarm value can be pre-set and a 4-20mA concentration signal can be displayed.

Grimm Spectrometer Software Model 1.177

The data can be transferred online via USB or RS-232 connection by the Grimm Windows® Software on a computer for data presentation or analysis. The following application settings are possible:

- Particle concentration in counts/litre, for all size channels
- Dust mass concentration in µg/m³, for all size channels
- Dust mass fractions PM_{10}, $PM_{2.5}$ and PM_1, according to US EPA guideline
- Dust mass fractions inhalable, thorathic and alveolic, according to EN 481

With this software graphs can be viewed easily and quickly and statistical numbers or data can be exported directly into Excel™.

Sensor data from connected accessories such as temperature, relative humidity wind speed, nano particle concentration, mean nano particle diameter and particle bound PAH concentration can also be displayed.

For applications or solutions to your needs not covered in this IAM catalog please check our other publications:

Environmental Instruments

- Current standards and equivalent methods for outdoor dust monitoring
- PM_{10}, $PM_{2.5}$, and PM_1
- Portable outdoor fine dust monitor EDM 107
- Stationary ambient dust monitor EDM 180
- Environmental wide range aerosol spectrometer model 565 (5 nm to > 30 µm)
- NanoCheck extension to count Nanoparticles and determine their active surface
- Polyaromatic Hydrocarbon Analyser (PAH) model 130
- Soot monitor model 140

Nano Particle Counter and Sizer

- Nano particle counting with Condensation Particle Counter CPC and Faraday Cup Electrometer FCE
- Nano Particle sizing with Differential Mobility Analyzer DMA for different size ranges
- SMPS+C, for precise Nano particle counting and sizing, portable and stationary for continuous operation
- SMPS+E, for high concentration aerosols
- Wide range aerosol spectrometer model, portable and stationary (5 nm to > 30 µm)
- FAPES, 25 channels with 200 milliseconds resolution
- Electrostatic Precipitator for Nano particle sampling
- Aerosol Generators, Tungsten Oxide 1.2-20 nm, Soot for automotive application and atomizer for DEHS or PSL

GRIMM Aerosol Technik GmbH

The European Leader in Particle Measurement Technology

GRIMM Aerosol Technik GmbH & Co. KG is the only European manufacturer of accurate and reliable instruments for measuring nanoparticles in aerosols. The company was founded 25 years ago and today offers a complete range of products for nanoparticle generation and monitoring in industry and research.
Continuous participation in EU projects and investments in research and quality manufacturing ensure high quality scientific instruments.
Specialists in house will advise about the correct instruments for particular applications, e.g. for automotive, emission, occupational health, filter efficiency and ambient air, for quality control and for pharmaceutical, atmospheric or epidemiological studies.

IAQ

Workplace

Atmospheric research

Industry

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