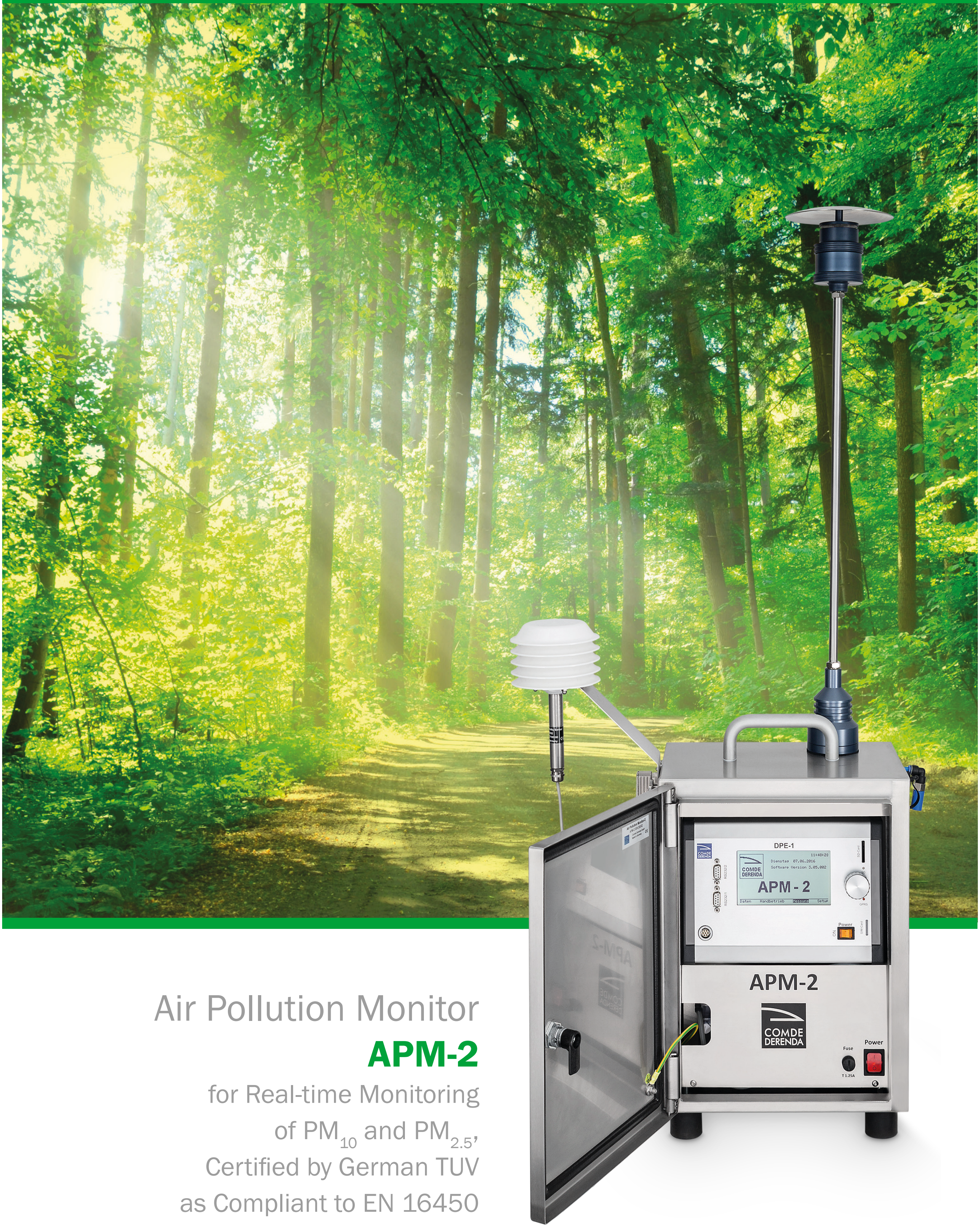
Environmental Monitoring Systems

SPM and Gas Monitoring



Air Pollution Monitor
APM-2

for Real-time Monitoring
of PM_{10} and $PM_{2.5}$,
Certified by German TUV
as Compliant to EN 16450

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Particulate matter monitor certified by German TUV for continuous real-time monitoring of $PM_{2.5}$ and PM_{10} concentrations

- **Real-time monitoring of particulate matter**
- **Measurement of $PM_{2.5}$ and PM_{10}, alternating in short intervals**
- **Control Panel with large monitor displays all measurement parameters**
- **Software update function**
- **Tri-band GPRS modem**
- **Measurement of environmental values**

TÜVRheinland® CERTIFIED
Suitability Tested
Complying with
2008/50/EC
EN 15267
Regular
Surveillance
www.tuv.com
ID 0000040336

The method applied by the APM-2 uses light scattered by tiny particles (nephelometry) to determine the PM_{10} or $PM_{2.5}$ concentration in the ambient air directly and continuously. After performing qualification tests, TUV Rheinland certified the procedure as equivalent to the customary gravimetric method and compliant to EN16450:2017 (TUV Rheinland Energie und Umwelt GmbH, Cologne, Report No. 936/21219977/A in conjunction with No. 36/21253723/A). The system features an impactor inlet for fractionating the particulate matter, and a virtual impactor for dividing the air stream into two streams for the alternating, quasi-simultaneous determination of the SPM fractions $PM_{2.5}$ and PM_{10}.

Design

The APM-2 consists of the following principal components:

- Stainless steel cabinet
- Control unit with monitor and SD card reader
- Vacuum pump
- Intake tube
- Impactor inlet
- Virtual impactor
- Photometer
- Temperature, humidity and pressure sensors
- GPRS modem

In order to protect the photometer signal against the effects of changing temperatures, the photometer is installed in a thermally insulated, temperature-controlled housing.

Operating Principle

Before measuring begins, the desired parameters (e.g. the particulate matter fraction that is to be measured) are entered in the control unit. During operation, the device draws in ambient air through a PM_{10} impactor inlet at a volumetric flow rate of 3.3 l/min.
The design of the impactor inlet follows the same technical principles as standard inlets for gravimetric measurement methods which are specified in EN 12341:2014; its separation characteristics have been verified by the Institute of Energy and Environmental Technology (IUTA) and surpasses the requirements of DIN 481.
In the downstream virtual impactor, the aspirated air is separated into an auxiliary (enrichment) stream and a primary (normal) stream. A switching device (peristaltic valve) then diverts one of these two streams to the scattered light photometer. In the photometer, the aerosol is illuminated by a laser. The light scattered by the particles is captured by a photodetector and converted into an amplified output signal. This output signal is a direct measure of the airborne particulate matter concentration.
The photometer measures the PM_{10} concentration in the enrichment mode and the $PM_{2.5}$ concentration in the normal mode. For zero point adjustment purposes, the photometer is periodically supplied with filtered air by way of the switching device.

The captured data is saved in the internal memory and on an SD card. It can also be periodically transferred to a network computer by way of the GPRS modem.

TÜV Qualification Test

Our APM-2, basing on the photometric measurement method using scattered light, has undergone qualification testing by

TUV Rheinland. The procedure has consequently been certified as fully equivalent to the customary gravimetric method for all sites, according to the requirements of the EU guideline for „Demonstration of Equivalence of Ambient Air Monitoring Methods", in application of previously determined correction factors/terms. In addition, TUV Rheinland attested the compliance of the APM-2 to EN16450.

MCERTS Certification

Our APM-2 is also certified to comply with the MCERTS Performance Standards for Continuous Ambient Air Quality Monitoring Systems (CAMS).

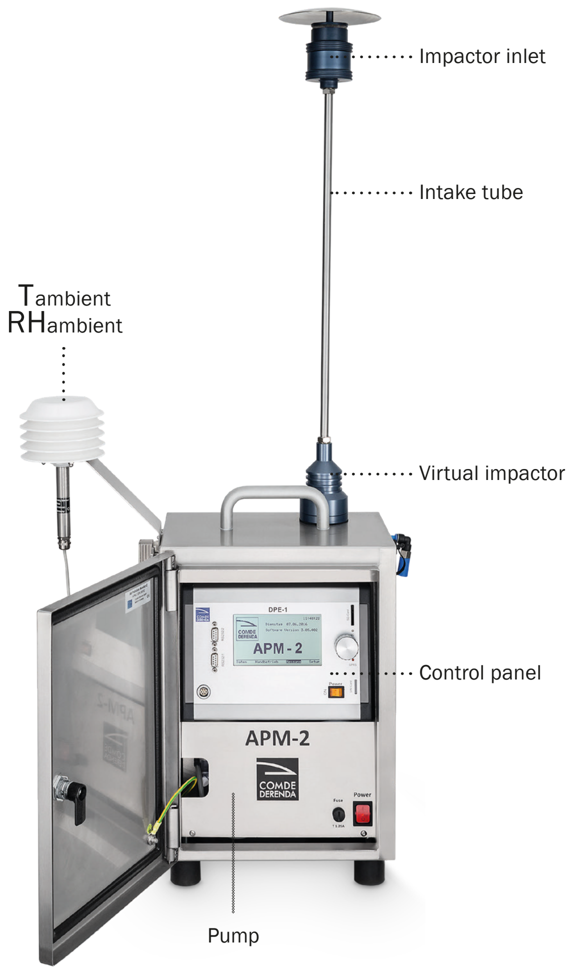
Details of the Measurement Method

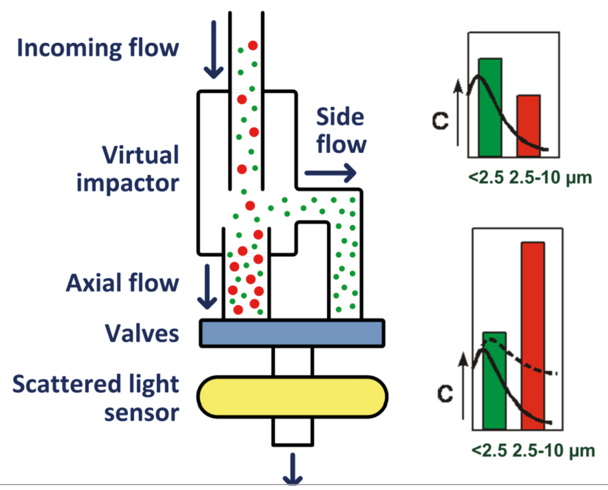
A highly sensitive scattered light sensor lies at the heart of the applied method. The light emitted by an intensity-stabilized laser diode illuminates a measuring space defined by the optical path. The light scattered by all the aerosol particles inside this measuring space is captured by a semiconductor photodetector, positioned at an angle of 90°. After amplification, the outcome of this measurement is made available as a voltage signal (0 ... 5 V). The signal is directly proportional to the mass concentration of the aerosol in the measuring space (measuring range 0 ... 1000 µg/m³).

The physical principles governing light scattering determine that aerosol particles whose diameter approximately corresponds to the applied wavelength scatter the light most efficiently in relation to mass. They are the prevailing contributor to the photometer output signal. The wavelength of 650 nm applied by the system is most sensitive to particles in the size range from 0.5 to 1 µm. For this reason, the output signal of a dispersion photodetector deployed outdoors is dominated by the $PM_{2.5}$ fraction. Simple dispersion photometry is thus subject to limitations for the measurement of the PM_{10} concentration, because the complementary coarse fraction $PM_{2.5}$ to PM_{10} contributes substantially less to the output signal in relation to mass, and is therefore under-represented in the measurement.

The measuring instrument has to compensate for this sensitivity deficit relating to the coarse fraction $PM_{2.5}$ to PM_{10}. The APM-2 compensates by way of the virtual impactor, situated upstream of the photometer, which selectively enriches the concentration of the coarse fraction. This enrichment effectively increases the sensitivity of the photometric equipment for the particle size range $PM_{2.5}$ to PM_{10}.

Design / Operating Principle of the Virtual Impactor





Air Pollution Monitor APM-2

Scope of Delivery:
Basic device APM-2,
intake tube Ø 12 mm,
sampling inlet PM_{10} for 3.3 l/min,
2 × SD card for data storage,
1 × transfer cable,
1 × USB SD card drive,
GPRS modem,
calibration protocol,
key and instruction manual

Ordering information:
D120006 Air Pollution Monitor APM-2

Consumables:
D100101 Zero air filter
D100058 Pump outlet filter
D101247 Bypass filter

Technical Data APM-2

Volumetric flow rate	3.3 l/min
Measurement duration	Continuous*
Power supply	230 V, 50/60 Hz, 110 V or others on request
Power consumption, typical	approx. 27 W / 46 VA
Power consumption, max.	48 W / 85 VA
Measuring range	0 ... 1000 µg/m³
Resolution	1 µg/m³
Interfaces	RS-232, SD card drive
Data output formats	Bavaria-Hesse, .csv file
Internal memory (for measurement data)	4 MB

Dimensions (without impactor inlet and antenna)	
Width	320 mm
Height	560 mm
Depth	270 mm

Weight	approx. 16 kg
IP classification	IP 65
Sound pressure level acc. EN 3744:2010 in 8 m distance	< 19 dB(A)
Operating temperature range (in compliance to EN16450)	–15 ... +40 °C
Permissible ambient temperature for device operation	–20 ... +50 °C
Operating humidity range	5 ... 95 % RH

*Alternating measurement of the two fractions $PM_{2.5}$ and PM_{10} in intervals of at least 2 minutes. Longer intervals can be parameterized. A limitation on one fraction possible. A zero point calibration (duration 2 minutes) automatically takes place after 60 minutes of measurement.

Ed. 2022-08

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