

Specifications

Concentration measurement range (auto-ranging):¹
0.0001 to 400 mg/m³

Precision/repeatability (2-sigma):^{2,3}
± 1% of reading or ± 0.001 mg/m³, whichever is greater (1-second averaging)
± 0.3% of reading or ± 0.0003 mg/m³, whichever is greater (10-second averaging)

Accuracy:¹
± 2% of reading ± precision

Resolution:
0.1% of reading or 0.0001 mg/m³, whichever is greater

Scattering coefficient range:
10⁻⁷ to 0.4 m⁻¹ (resolution: 3 significant digits, maximum)

Visual range (@λ=550 nm):
0001 to 337 km (resolution: 3 significant digits, maximum)

Ångström coefficient measurement range:
0.0 to 4.0

Particle sizing range (log-normal, $\sigma_g = 2.0$, $m = 1.50$):
0.05 to 10 μm

Particle size range of maximum response (concentration measurements):
0.08 to 10 μm

Temperature measurement range:
-15° to 60°C (accuracy: 0.05°C)

Relative humidity measurement range (@ 25°C):
0 to 100% (accuracy: 2%, noncondensing)

Sampling flow rate range:⁴
1.0 to 3.0 liters/minute
(accuracy: 0.05 liters/minute, adjustability: 0.1 liters/minute)

Measurement/display integration time range:⁴
1 to 60 seconds (selectable in 1-second steps)

Measurement/display update frequency:
1 per second

HEPA filter cartridge replacement frequency (typical):
Less than 1 per 5 years (@ < 1 mg/m³)

Alarm level range:⁴
Selectable over entire measurement range

Data logging averaging periods:⁴
1 second to 24 hours (selectable in 1-second increments)

Data logging memory capacity:
50,000 data points in up to 99 tags (data groups)

Programmable zeroing periods:⁴
1 to 168 hours (selectable in 1-hour increments;
if enabled, logging period must be more than 10 minutes)

Elapsed time readout range:
1 second to 100,000 hours (over 11 years),
in seconds, minutes, and hours

DR4 2.5M/5M/75M/10M 9/00 Printed in USA

Digital communications:
RS232/RS485: full duplex, 4800 baud, software-controlled,
device-filtered

Computer requirements:
IBM-compatible PC, 486 or higher; Windows™ 95 or higher;
8 MB memory or more

Analog outputs:⁴
0 to 5 V and 4 to 20 mA, with selectable full scale ranges between
0.1 and 400 mg/m³

Power:

- Internal battery: rechargeable, sealed lead-acid, 6.5 Ahr, 6 V, 20-hour run time between charges (typical)
- AC line: universal voltage charger/power supply (included), 100-250 V, 50-60 Hz (CE marked)
- Optional solar power system (Model DR-SOL)

Alarm outputs:

- Alarm switch: 30 V (off, open), 2.5 A (on, closed)
- Alarm signal: 0 V (off), 5 V (on) (1 mA maximum load current)
- Audio alarm (back panel): More than 65 dB @ 1 m

Operating environment:
-10° to 50°C (14° to 122°F); 10 to 95% RH, noncondensing

Storage environment:
-20° to 70°C (-4° to 158°F)

Dimensions:
134 mm (5.28 in) H x 184 mm (7.25 in) W x 346 mm (13.63 in) D

Weight:
5.3 kg (11.7 lbs)

Safety approvals and certifications:
The DataRAM 4 complies with US FCC rules (Part 15)
and has received CE certification.

Standard accessories included:

- Universal voltage battery charger/power supply
- Standard HEPA filter cartridge
- Analytical filter holder
- PC communications software disk
- Digital output cable
- Carrying case and instruction manual

¹ Referred to gravimetric reference calibration (NIST traceable)
with SAE Fine test dust (mmd = 2 to 3 μm, $\sigma_g = 2.5$, as aerosolized)

² At 25°C

³ For single-wavelength concentration sensing

⁴ User selectable



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MODEL DR-4000 Dual Wavelength Nephelometer

Ambient Air Monitoring

PM_{2.5} Monitoring

*Remediation Site Perimeter
Monitoring/Alarming*

*Real-Time Fine Particle
Size Determination*

*Indoor Air Quality
Monitoring*

*Workplace and
Plant Monitoring*

Source Monitoring

*Atmospheric Scattering
and Visibility Monitoring*

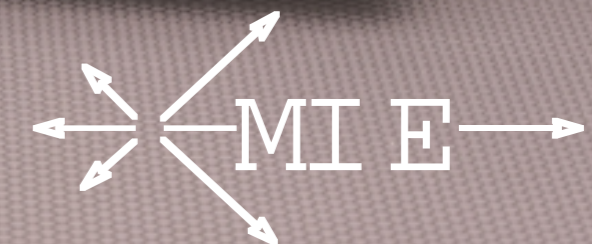
*Measurement of
Ångström Coefficient*

Mobile Monitoring

*Toxicology and
Aerosol Research*

DataRAM 4™

Portable Particle Sizing Aerosol Monitor/Data Logger



Real-Time Particulate Monitoring and Particle Size Selective Measurements

Measures Airborne Particulate Concentrations and Size in Real-Time

The DataRAM 4™ provides direct and continuously updated readouts of concentrations of airborne dust, smoke, mist, and fumes as well as the median particle size. In addition, both air temperature and humidity are displayed. All data can be logged in the integral, large-capacity, non-volatile memory. Up to 50,000 data blocks can be stored in up to 99 tagged groups.

An on-board audible alarm as well as switched and active alarm outputs are triggered whenever concentrations exceed a user-selected level.



With appropriate aerodynamic particle discriminators, the DataRAM 4 provides measurements correlated with PM₁₀, PM_{2.5}, PM_{1.0}, and respirable fractions.

Determines Particle Median Size Regardless of Concentration

DataRAM 4's patented two-wavelength particle detection system provides the volume median particle diameter of the sampled aerosol, over the remarkably wide concentration range of 1 microgram per cubic meter to 400 milligrams per cubic meter.

Unlike typical particle counting devices, the DataRAM 4 is totally immune to particle coincidence errors, even at the highest concentrations. Volume median particle sizes down to 0.05 µm can be measured by this unique spectral nephelometric technique.

Monitors Mass Concentrations of Fine Particulates (PM_{2.5})

The DataRAM 4 monitors in real-time the concentrations of fine particulates in ambient air by a combination of aerodynamic size

preselection, two-wavelength nephelometry, and concurrent sensing/correction for relative humidity. This patented technique provides a continuous measurement of PM_{2.5} independent of particle size and moisture, without altering the sample stream (i.e., without heating, diffusion drying, denuding, etc.)

Measures Scattering and Ångström Coefficients, and Visual Range

In addition to measuring the mass concentration of airborne particulates, the DataRAM 4 measures the scattering coefficient at two wavelengths (in units of inverse megameters) and computes the coefficient at the reference wavelength of 550 nanometers, as well as the Ångström exponent (a measure of atmospheric fine particle size). Based on the 550 nm scattering coefficient, the instrument then calculates the visual range (in kilometers).

Complete Digital Communications

The DataRAM 4 has both RS232 and RS485 data ports for two-way digital communications with personal computers.

Special software (Windows™ compatible) provided with the instrument allows data transfer either in real-time or from the DataRAM 4's logging memory for tabular and/or graphic computer presentation. All operational and programming functions of the DataRAM 4 can be controlled from a remote location through the RS485 communications port. Sampling start and stop as well as data transfer can be controlled via modem or other digital transmission paths.

Analog Signal and Alarm Outputs

For added versatility, the DataRAM 4 provides two separate analog signal outputs, updated every second: a voltage output (0-5 V) and a current output (4-20 mA), both programmable over the instrument's full measurement range. Two alarm outputs (and an audible horn) are also included: voltage step (0 to 30 VDC) and switching output (2.5 A maximum). The alarm level is also user programmable over the entire measurement range of the instrument.

Detailed Diagnostic Information

The DataRAM 4 furnishes complete diagnostic data on the functional condition of all its critical elements. Examples include: condition of each of the two sensing sources, optical background level, scattering detector condition, sampling air flow control, internal battery charge status, charging current, etc. Any deviation from normal conditions is flagged on screen.

Self-Purging, Automatic Zeroing, and Clean Air Protection of Optics

The DataRAM 4's field-proven flow configuration includes a large-capacity HEPA filter cartridge directly downstream of the photometric sensing stage. Typically replaced every two years, this filter provides particle-free air that is partially recirculated over all critical optical surfaces to ensure their cleanliness.



For either manual or automatic zeroing, an electronically controlled solenoid valve diverts the entire filtered air stream through the optical sensing chamber to achieve "zero" air without the need for an external filter.

Self-Calibrating Internal Filter

A 37-mm membrane filter (for which a special holder/adaptor is provided) can be used in place of the zeroing HEPA filter cartridge for gravimetric calibration and/or chemical analysis of collected

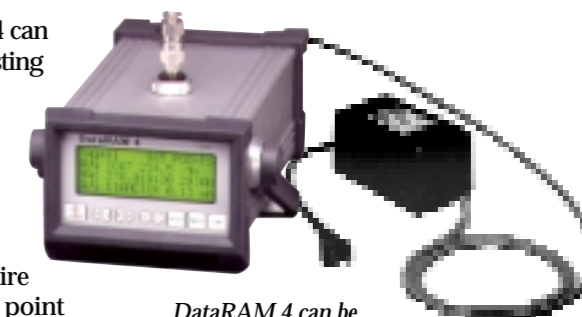
particulates. The DataRAM 4 can be easily calibrated by readjusting the calibration constant to agree with gravimetric measurements obtained from the on-board filter. Because the photometric response of the instrument is exactly linear over its entire operating range, only single point gravimetric calibration is needed. The second point of the straight response line is the zero concentration obtained by self-purging.

Large Character Screen, Menu-Driven Displays, and Scrolling of Logged Data

A large (48-cm² active area) LCD screen with 4 lines of alphanumeric text provides highly visible readouts. The screen has automatic backlighting whenever the DataRAM 4 is powered from the AC line current (through its power supply/charger). The instrument provides users with a variety of self-explanatory informational screens. The main measurement screen, for example, displays real-time and date, mass concentration, time-averaged concentration from the start of the run, and elapsed run time. Logged data can be displayed/scrolling during or after a measurement run, and transferred to a PC.

Several Power Options

The DataRAM 4's large-capacity rechargeable battery (long-lived, "memory"-free) provides noninterruptible power to the unit. A charger/power supply is provided for continuous long-term operation. For portable monitoring, the instrument is designed to run without external power for 20 hours. An optional solar power system is available for remote installations.



DataRAM 4 can be powered by a rechargeable internal battery or an external power source

Expandable To A Complete Particulates Characterization System

Available accessories extend the capabilities of the DataRAM 4 for a wide range of monitoring/particle sizing applications. Aerodynamic particle size separators (cyclones and jet-to-plate impactors) measure specific size groups such as the thoracic, respirable, PM₁₀, PM_{2.5}, and PM_{1.0} fractions. An omnidirectional sampling inlet and an in-line heater (for mist/fog elimination) are available for ambient air monitoring. An isokinetic sampling probe/nozzle kit enables duct/stack monitoring.

Additional accessories will be available for the DataRAM 4 in the near future, providing a complete systems capability with unparalleled performance flexibility. These accessories/capabilities will include: a patented turntable aerodynamic particle size separator for aerodynamic particle size distribution analysis, and a condensation/nucleation module for ultrafine particle monitoring.



DataRAM 4 with ambient monitoring accessories