

# DataRAM 4™ - Model DR-4000

Portable particle sizing aerosol monitor/data logger  
Dual Wavelength Nephelometer



## Real-time airborne particulate concentration and size measurements

The DataRAM 4™ (Model DR-4000) continuously monitors the real-time concentration and median particle size of airborne dust, smoke, mist, and fumes. In addition, air temperature and humidity are displayed. With appropriate particle discriminators it provides measurements correlated with PM10, PM2.5, PM1.0, and respirable fractions. It's patented two-wavelength particle detection system provides the volume median particle diameter of the sampled aerosol, over a concentration range of up to 400 mg/m<sup>3</sup>. Unlike typical particle counting devices, the DR-4000 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.

### Expandable to a complete characterization system

A variety of accessories extend the capabilities of the DR-4000 to serve a wide range of monitoring and sizing applications. Aerodynamic particle size separators measure specific size groups such as the thoracic, respirable, PM10, PM2.5, and PM1.0 fractions. An omnidirectional sampling inlet and an in-line mist and fog elimination heater are available for ambient air monitoring. An isokinetic sampling probe/nozzle kit enables duct /stack monitoring.

### Monitors mass concentrations of fine particulate (PM 2.5)

The DR-4000 monitors 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 PM2.5, independent of particle size and moisture - *without heating, diffusion drying, or denuding the sample stream.*

### Measure scattering, angstrom coefficients, and visual range

DR-4000 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 angstrom 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 DR-4000 has both RS232 and RS485 data ports for two-way digital communications. Special, Windows™ compatible software (provided with the instrument) facilitates data transfer either in real-time or from the logged memory. All operational and programming functions 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.

### Self-calibrating internal filter

A 37 mm membrane filter (adapter provided) can be used in place of the zeroing HEPA filter cartridge for gravimetric calibration and/or chemical analysis of collected particulates. The DR-4000 is easily calibrated by adjusting the calibration constant to agree with gravimetric measurements obtained from the on-board filter. As 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.

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### Specifications

**Concentration measurement range (auto-ranging):**

Referred to gravimetric reference calibration (NIST traceable)  
with SAE Fine test dust (mmd = 2 to 3  $\mu\text{m}$ ,  $\sigma_g = 2.5$ , as aerosolized)  
0.0001 to 400  $\text{mg}/\text{m}^3$

**Precision/repeatability (2-sigma):**

At 25°C

For single-wavelength concentration sensing

$\pm 1\%$  of reading or  $\pm 0.001 \text{ mg}/\text{m}^3$ , whichever is greater  
(1-second averaging)  
 $\pm 0.3\%$  of reading or  $\pm 0.0003 \text{ mg}/\text{m}^3$ , whichever is greater  
(10-second averaging)

**Accuracy:**

Referred to gravimetric reference calibration (NIST traceable)  
with SAE Fine test dust (mmd = 2 to 3  $\mu\text{m}$ ,  $\sigma_g = 2.5$ , as aerosolized)  
 $\pm 2\%$  of reading  $\pm$  precision

**Resolution:**

0.1% of reading or 0.0001  $\text{mg}/\text{m}^3$ , whichever is greater

**Scattering coefficient range:**

$10^{-7}$  to  $0.4 \text{ m}^{-1}$  (resolution: 3 significant digits, maximum)

**Visual range (@ $\lambda = 550 \text{ nm}$ ):**

0.001 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 4  $\mu\text{m}$

**Particle size range of maximum response (concentration measurements):**

0.08 to 10  $\mu\text{m}$

**Temperature measurement range:**

5°F to 140°F (-15°C to 60°C); accuracy: 0.05°C

**Relative humidity measurement range (@ 25°F):**

0 to 100% (accuracy: 2%, noncondensing)

**Sampling flow rate range (user selectable):**

1.0 to 3.0 liters/min.  
(accuracy: 0.05 liters/min., adjustability: 0.1 liters/min.)

**Measurement/display integration time range (user selectable):**

1 to 60 sec. (selectable in 1-sec. steps)

**Measurement/display update frequency:**

1 per sec.

**HEPA filter cartridge replacement frequency (typical):**

Less than 1 per 5 yrs (@ < 1  $\text{mg}/\text{m}^3$ )

**Alarm level range (user selectable):**

Selectable over entire measurement range

**Data logging averaging periods (user selectable):**

1 sec. to 24 hrs (selectable in 1-sec. increments)

**Data logging memory capacity:**

50,000 data points in up to 99 tags (data groups)

**Programmable zeroing periods (user selectable):**

1 to 168 hrs (selectable in 1-hr increments; if enabled, logging period must be more than 10 min.)

**Elapsed time readout range:**

1 sec. to 100,000 hrs (over 11 yrs),  
in sec., min., and hrs

**Digital communications:**

RS232/RS485: full duplex, 9600 baud, software-controlled,  
device-filtered

**Computer requirements:**

IBM-compatible PC, Windows™ 95 or higher; 8 MB memory or more

**Analog outputs (user selectable):**

0 to 5 V and 4 to 20 mA, with selectable full scale ranges  
between 0.1 and 400  $\text{mg}/\text{m}^3$

**Power:**

- Internal battery: rechargeable, sealed lead-acid, 6.5 Ahr, 6 V, 20-hr 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:**

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

**Storage environment:**

-4°F to 158°F (-20°C to 70°C)

**Dimensions:**

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

**Weight:**

11.7 lbs (5.3 kg)

**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

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