Exposure Monitoring

AeroTrak™ 9000 Nanoparticle Aerosol Monitor

The **AeroTrak 9000** *Nanoparticle Aerosol Monitor indicates the surface area of particles deposited in the lung.*

TSI®

There is increasing commercial development of nano-scale materials, structures, and devices that takes full advantage of the unique properties affecting the physical, chemical, and biological behaviors of these nano-scale materials. At this time, the occupational health risks associated with the manufacturing and use of nanoparticles are not clearly understood. Workers may be exposed to nanoparticles through inhalation, at levels that greatly exceed ambient concentrations.

The Instrument and the Measurement

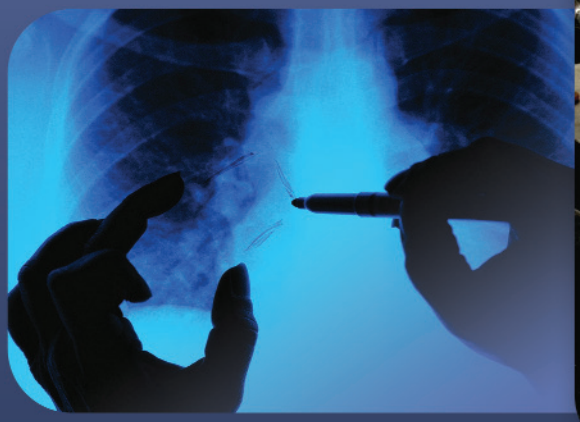
The Instrument

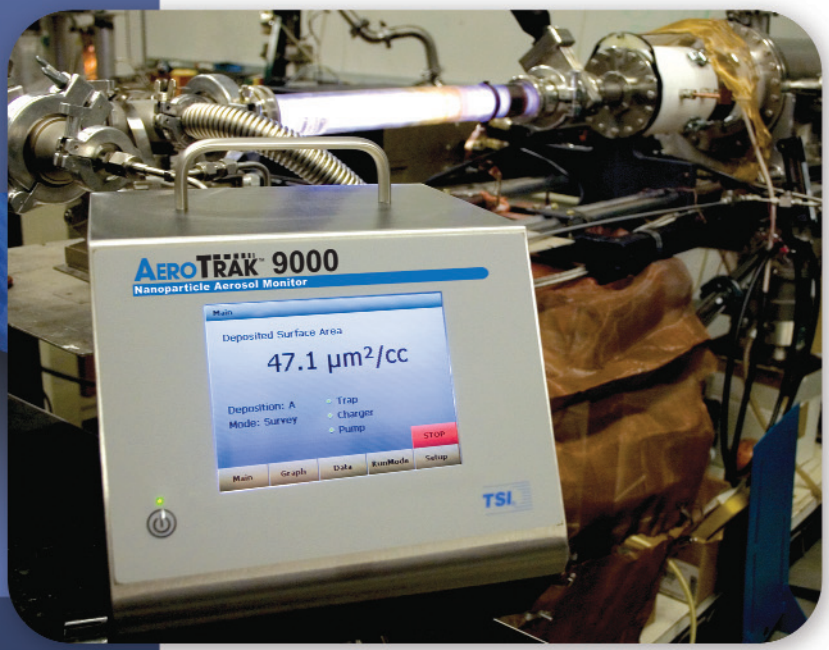
The AEROTRAK™ 9000 Nanoparticle Aerosol Monitor is an industrial hygiene tool for measuring a new metric for nanoparticle aerosol exposure–lung deposited surface area. Unlike, mass or number-based measurements, nanoparticle surface area is a key factor for the toxicity of nanoparticles. Surface area is the measurement metric that research has shown to be highly correlated with exposure and dosing of nanoparticle aerosols.

The AEROTRAK 9000 monitor indicates the human lung-deposited surface area of particles in units of micrometers squared per cubic centimeter ($\mu m^2/cc$), corresponding to tracheobronchial (TB) and alveolar (A) regions of the lung. It is based on diffusion charging of sampled particles, followed by detection of the charged aerosol using an electrometer.

The Measurement

The AEROTRAK 9000 monitor does not measure the total active surface area (i.e., Fuch's surface area) of particles suspended in air. It indicates the surface area of the fraction of these particles that deposit in either the tracheobronchial or alveolar regions of the human respiratory tract.





Nanoparticle Exposure

Recent research (Oberdörster, 2001) has shown that surface area plays an important role in the toxicity of nanoparticles and is the measurement metric that best correlates with particle-induced adverse health effects. The potential for adverse health effects is directly proportional to particle surface area (Driscoll 1996; Oberdörster 2001).

Lung Deposition

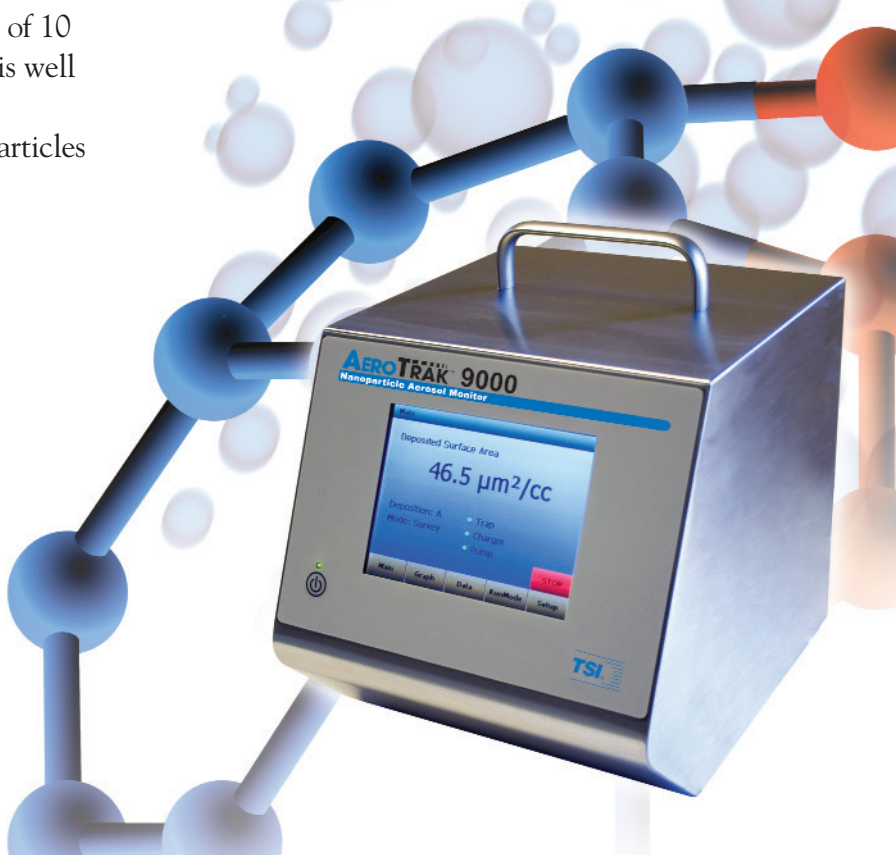
Inhalation is the most common route of exposure for aerosols. In industrial hygiene sampling, it is common to sample aerosols according to where they deposit in the lung. Inhalable, thoracic, and respirable size fractions are common examples of size-selective sampling currently done for mass-based exposure sampling.

For nanoparticle aerosols it is important to understand how and where they deposit in the lung. Comprehensive lung deposition models are well developed for a reference worker for use in industrial hygiene exposure assessment applications. Model results show that deposition rates differ for varying particle sizes in different areas of the lung. Exposure to inhaled particles by our body is determined by where they deposit in the respiratory tract.

Applications

The AEROTRAK 9000 monitor provides a simple and fast solution for indicating the surface area equivalent dose of particles in the size range of 10 to 1000 nanometers. The AEROTRAK 9000 is well suited for the following applications:

- Monitoring workplace exposure to nanoparticles
  - Industrial hygiene surveys
  - Ambient work area monitoring
  - Baseline screening and trending
  - Engineering studies
- Material science and production process monitoring
- Inhalation toxicology research studies
- Epidemiology research studies



Specifications

AeroTrak™ 9000 Nanoparticle Aerosol Monitor

Sensor Type	Diffusion charger plus electrometer
Particle Size Range	10 to 1000 nm (with 1µm cyclone on inlet)
Inlet Conditioner	Cyclone with 1µm cutpoint at 2.5 lpm
User-Selectable Response	Tracheobronchial (TB) and alveolar (A) response settings
Aerosol Concentration Range	
TB	1 to 2,500 $\mu m^2/cc$
A	1 to 10,000 $\mu m^2/cc$
Measurement Accuracy	
TB	±20% (20 to 200nm)
A	±20% (20 to 200nm)
Minimum Resolution	$0.1 \mu m^2/cc$ (displayed)
Flow Rate	2.5 slpm ± 5% total flow 1.5 slpm ± 5% measured flow (aerosol sample branch) 1.0 slpm ± 5% measured flow (filtered and ionized branch)
Temperature	
Operating Range	50 to 95°F (10 to 35°C)
Storage Range	32 to 140°F (0 to 60°C)
Instrument Humidity Range	0 to 90% Rh, non-condensing
Time Constant (display)	User-adjustable, 1 to 60 seconds
Data Logging	
Data Points	>1,000,000 (>694 days at a 1 minute log interval)
Logging Interval	User-adjustable, 1 second to 1 hour
Physical	
External Dimensions (L W H)	10.5 in. x 8.5 in. x 9.0 in. (26.7 cm x 21.6 cm x 9.0 cm), not including handle
Weight w/o batteries	15.8 lbs (7.2 kg)
Battery Weight	1.0 lb (0.45 kg) per battery (unit holds up to 3 batteries)
Tripod Mount	5/8"-11 UNC
Display	5.7" ½ VGA color touch screen
Power	100 to 240 VAC, 50 to 60 Hz
Communications Interface	
Type	Universal serial bus (USB) 1.1
Instrument Connector	USB Type-B (socket)
Computer Requirements for TrakPro™ Software	
Communication Port	USB 1.1 or higher
Operating System	Windows® 2000, XP
Analog Output	
Type	0 to 5v, or 4 to 20mA, user-selectable
Scaling Range	1 to 2,500 (TB), 1 to 10,000 (A), user-selectable
Maximum Output Impendence	250 ohms
Maximum Output Current	5mA
Connector	4-pin, mini-DIN connector
Alarm Output	
Type	Non-latching relay
Alarm Setpoint Range	1 to 2,500 (TB), 1 to 10,000 (A), user-selectable
Maximum Voltage	15 VDC
Maximum Current	1 Amp
Deadband	-5% of alarm setpoint
Connector	4-pin, mini-DIN connector
Maintenance	
User Zero Calibration	Before each use
Inlet Cyclone	Clean before each use
User Filter Replacement	Every 3 to 6 months (typical use)
Factory Clean/Calibrate	Recommended annually
CE Rating	
Immunity	EN 61326
Emissions	EN 61326
Safety	EN 61010-1

Battery Performance

Number of 6600 mAH Lilon Battery Packs, 11.6 v (P/N 1208057)	1 Battery	2 Batteries	3 Batteries
Battery Runtime (hours) at 2.5 lpm	6.25	12.5	18.75
Charge Time* (hours) in AeroTrak 9000	3.25	6.50	9.75
Charge Time* (hours) in external battery charger (P/N 2610114)	3.25	3.25	N/A

**Of a fully depleted battery*

U.S. Patents 6,544,484 and 7,812,306

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