

Model 3091 Fast Mobility Particle Sizer™ Spectrometer

Measures size distribution and number concentration of submicrometer aerosol particles in real time

The Model 3091 Fast Mobility Particle Sizer (FMPS™) spectrometer measures submicrometer aerosol particles in the range from 5.6 to 560 nanometers in diameter. Due to its unique design, the FMPS spectrometer is capable of making particle size distribution measurements with one-second resolution, enabling you to visualize particle size distributions and events in real time. The FMPS spectrometer is ideally suited for measuring the dynamic behavior of submicrometer particles over a wide range of applications, including particle formation and growth studies, indoor air quality, environmental research, inhalation toxicology, urban canyon

studies, and transient emission studies from stacks, boilers, wood burners, and much more.

FMPS Features and Benefits

The Model 3091 FMPS spectrometer offers features and benefits that are important to industrial and environmental researchers working with rapidly changing aerosols:

Real-time measurements. Visualize submicrometer particle size distributions and events with one-second resolution.

Wide size range. Measure submicrometer aerosols between 5.6 to 560 nanometers, reporting a total of 32 channels (16 channels of size per decade).

Wide dynamic concentration range. Very sensitive electrometers provide the ability to measure particle concentrations across a very broad range—greater than 4 orders of magnitude, as shown in the figure on the next page—making the FMPS well-suited for a wide range of applications.

Ease of use. Simply connect the sample line, connect the power, switch the instrument ON, and let it warm up. Once warm (approximately 10 minutes), status changes to "Normal" and the instrument is ready to make measurements. It's really that easy!

The front panel includes a large, color VGA display and a built-in control knob so you can select parameter settings and interrogate instrument operating status very quickly. The display is updated in real time, with complete size distributions to show dynamic processes. The display shows the size distribution histogram



in a variety of ranges, including auto-range, linear or log scale, and total concentration ($dN/d\log D_p$) for comparison to other instruments.

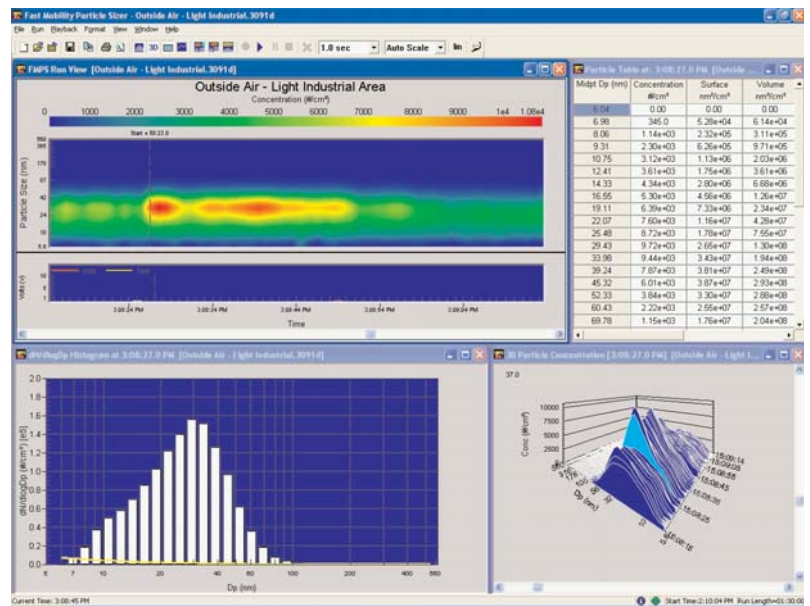
Flexible data management. A full-featured software program combines data collection and analysis for convenience. View up to 90 minutes of data in a file at a time, and then "zoom in" on the time scale to view interesting episodes. Data may be displayed, replayed, and exported in many different ways.

One FMPS software highlight is the ability to display and playback 3-dimensional plots of size distribution and particle concentration vs. time, so you can visualize particle events as soon as they occur. In addition, the FMPS software allows input of individual effective densities per size class to calculate a continuous output of total particulate mass.

High sample flow rate. The FMPS spectrometer operates at a high sample flow rate of 10 L/min, which greatly reduces particle sampling losses due to diffusion. All flows are controlled using microprocessor-controlled, internal pumps that are corrected for temperature and barometric pressure.

No radioactive neutralizer. This spectrometer operates using a unipolar diffusion charger to place a predictable charge on the particles. As a result, there are no special licensing concerns regarding radioactive materials.

Proven technology. The technology was developed originally at the University of Tartu in Estonia. It com-



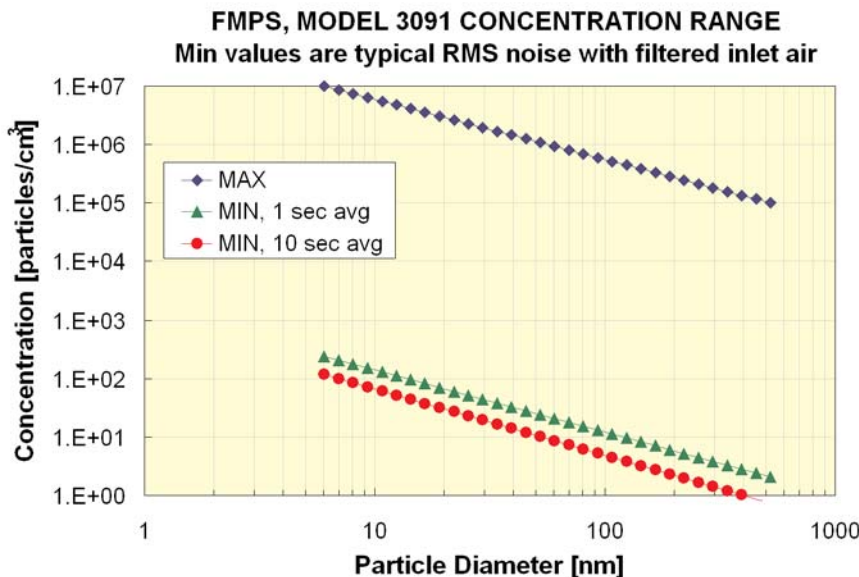
FMPS software offers advanced options for data display, such as run view, concentration histogram, and three-dimensional particle concentration graphs.

bins detection from an array of electrometers with electrical mobility classification. TSI engineers built on this extensive knowledge, combining it with their own experience developing the Scanning Mobility Particle Sizer (SMPS™) spectrometer.

Electrical Mobility Diameter

What is Unique About the FMPS Spectrometer?

Building on nearly 40 years of expertise with electrical mobility measurement techniques, TSI continues its tradition of developing cutting-edge instrumentation with a spectrometer designed specifically for real time, submicrometer particle sizing. Earlier methods of submicrometer sizing required a stable aerosol and about 30 to 120 seconds to get a single measurement. As a result, they do not lend themselves to measuring rapidly changing aerosols. The FMPS uses a unique charging system and multiple electrometers to get signals from all particle sizes simultaneously. The electrometer-current data is processed in real time using a high-performance DSP inside the instrument. The data algorithm corrects for multiple charges, image charge, and the time delay between electrometers. Data is then processed further to give results in 32 equally spaced (log-scale) size channels. Measurements are displayed on the instrument in real time and sent to a computer for long-term storage, display, and playback capability.

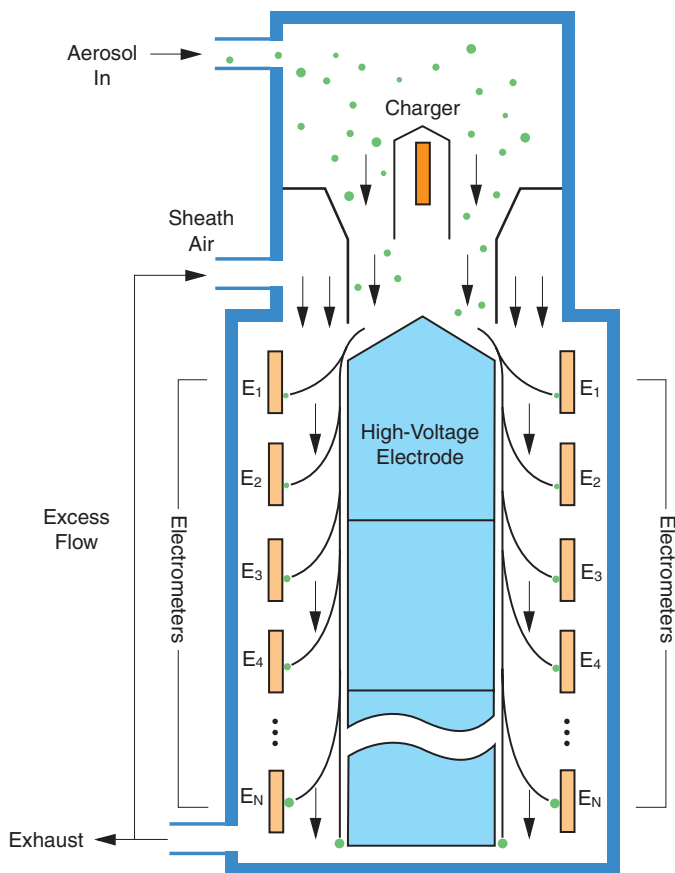


Applications

Real-time measurements and exceptional accuracy make the Model 3091 an effective measurement tool for a wide variety of industrial and environmental applications. It is especially good at measuring rapidly changing aerosols to help you visualize size distributions and particle events as they happen. Although SMPS spectrometers provide significantly higher size resolution, they are best-suited for measuring relatively stable aerosols. The FMPS spectrometer gives you with the ability to visualize particle distributions with one-second resolution.

Operation

The instrument draws an aerosol sample into the inlet continuously. Particles are positively charged to a predictable level using a corona charger. The charged particles are then introduced to the measurement region near the center of a high voltage electrode column and transported down the column via HEPA-filtered sheath air. A positive voltage is applied to the electrode and creates an electric field that repels the particles outward according to their electrical mobility. Charged particles strike the respective electrometers and transfer their charge. A particle with high electrical mobility strikes an electrometer near the top, whereas a particle with lower electrical mobility strikes an electrometer lower in



the stack. Effectively, this "inside-out DMA"* arrangement, using highly sensitive electrometers, allows for concentration measurements of multiple particle sizes simultaneously.

The Model 3091 uses a sophisticated, real-time data inversion to deconvolute the data. This inversion accounts for variability in particle charge, image charge, and detection time to present a size distribution that corresponds to a specific time. Using the same electrical-mobility principle as our SMPS systems, the FMPS technique dramatically increases the speed of the particle-size and concentration measurements.

When the aerosol is stable, data from the FMPS spectrometer corresponds well to our Model 3936-series SMPS systems. However, the FMPS gives you the ability to look at the size distribution in real time, which is extremely useful for studying rapidly changing aerosols.

*Differential mobility analyzer

Specifications

3091 Fast Mobility Particle Sizer™ Spectrometer

Particle Size Range	5.6 to 560 nm
Particle Size Resolution	16 channels per decade (32 total)
Electrometer Channels	22
Charger Mode of Operation	Unipolar diffusion charger
Inlet Cyclone 50% Cutpoint	1 µm
Time Resolution	1 size distribution/sec
Flow Rates	
Aerosol	10 L/min
Sheath Air	40 L/min
Inlet Aerosol Temperature	10 to 52°C
Operating Temperature	0 to 40°C
Storage Temperature	-20 to 50°C
Atmospheric Pressure Correction Range	70 to 103 kPa (700 to 1034 mbar)
Humidity	0 to 90% RH (noncondensing)
User Interface	Rotary knob and display
Front Panel Display	6.4-inch color VGA LCD
Data Averaging	2 to 60 sec (selectable)
Computer Requirements	Pentium® 4 processor, 2 GHz speed or better, at least 512 MB RAM
Operating System Required	Windows® XP or better
Communications	9-pin RS-232
Electrical Inputs	
Analog	Two analog input channels, 0 to 10 V
Trigger	Two trigger input channels, potential-free contact closure or 3.3 V pulled to GND
Electrical Outputs	Trigger output channel, potential-free contact closure
Dimensions (LWH)	70.4 × 34.3 × 43.9 cm (27.7 × 13.5 × 17.3 in.)
Weight	32 kg (70 lb)
Aerosol Inlet	3/8-in. OD (without inlet cyclone)
Cyclone Inlet	3/8-in. OD
Exhaust/Outlet	3/8-in. OD
Power Requirements	100 to 240 VAC, 50/60 Hz, 250 W

To Order

Fast Mobility Particle Sizer™ Spectrometer

<i>Specify</i>	<i>Description</i>
3091	FMPS™ spectrometer and software

Computer must be purchased separately.

Specifications are subject to change without notice. TSI, the TSI logo, SMPS, Fast Mobility Particle Sizer, and FMPS are trademarks of TSI Incorporated. Windows is a trademark of Microsoft Corporation. Pentium is a trademark of Intel Corporation.

Acknowledgment

The Model 3091 Fast Mobility Particle Sizer (FMPS) spectrometer was developed by TSI under license from Airel, Ltd. of Tartu, Estonia. We gratefully acknowledge the contributions from the dedicated scientists at Airel during the development of this instrument.



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