

Particle size



Spraytec

Spraytec

Accurate particle sizing of aerosols and sprays

General Introduction

Particle size of sprays and aerosols is central to defining product performance in a range of applications, from the delivery of drugs to the human respiratory system through to the application of coatings and agrochemicals. Sprays present unique challenges both in terms of the environment in which measurements have to be made or the speed at the event that must be characterized. The Malvern Spraytec has been designed specifically to meet these challenges in order to deliver routine, accurate and precise spray particle size analysis.

The Malvern Spraytec provides automated, *in-situ* analysis of high concentration aerosols and sprays from a robust, ease-to-use platform. Real-time, high-speed measurements ensure the complete characterization of both pulsed and continuous spray events. Extensive size distribution data are generated rapidly and are presented in a form that allows instant understanding of the evolution of the spray over time. Detection of particles over a wide size range provides unparalleled sensitivity to changes in the spray size distribution. The system's flexible design, completely sealed against moisture ingress, ensures reliable operation even when characterizing wide, high-volume spray plumes.



High Performance delivered

In designing the Spraytec system, Malvern has drawn upon the company's extensive experience in the field of spray characterization. The resulting system enables users to gather precise measurement data from all types of sprays.

You asked for Spraytec delivers...

<i>Rapid measurements</i>	A 10kHz data acquisition rate yields size distributions with 100 microsecond time resolution, enabling accurate analysis of the dynamics of spray atomization and dispersion. The rapid changes in particle size observed during pulsed spray events can also be followed, in contrast with slower systems.
<i>Wide size range</i>	The Spraytec system covers a size range from 0.1 - 2000 microns using only two lens systems. Broad size distributions can therefore be characterized routinely, with a dynamic range of greater than 1000:1 being covered by each lens.
<i>High concentration analysis</i>	A patented multiple scattering analysis ensures accurate measurements can be made at high spray concentrations. This allows the Spraytec to continue to operate where traditional laser diffraction systems would fail.
<i>Wide spray plume measurements</i>	The Spraytec's optical design enables measurements to be made over large working ranges. This, coupled with an efficient optics air purge and the ability to use a range of optical bench sizes, ensures continuous operation even when measuring dense, widely distributed sprays.
<i>Robust, simple measurements</i>	From the design of the optical bench, through to its software implementation, the Spraytec is robust and simple to operate. Automatic alignment ensures that the system setup is always optimized. The built-in Standard Operating Procedure (SOP) system allows single-click operation.
<i>Meaningful data analysis</i>	The Spraytec's unique size history chart allows the changes in particle size during atomization to be assessed easily, with real-time update of results when characterizing long-term events. Averaging, data export and result analysis is achieved via a simple drag-and-drop interface.
<i>Regulatory compliance</i>	Full lifecycle documentation, following GAMP guidelines, provides complete design traceability. IQ/OQ documentation is provided as the basic building block of any validation plan. In addition, the software provides technical compliance to the requirements of 21 CFR Part 11. The recommendations of ISO13320, the international standard for laser diffraction measurements, are also met in full.

Advanced Spray Characterisation

The Spraytec system measures droplet size distributions using the technique of laser diffraction. This requires the angular intensity of light scattered from a spray to be measured as it passes through a laser beam. The recorded scattering pattern is then analysed using an appropriate optical model to yield a size distribution.

The angular range over which scattering measurements are made has been optimised within the Spraytec to ensure polydisperse size distributions are fully resolved. Particle size calculations are then carried out using a patented multiple scattering algorithm. This ensures accurate particle size distributions can be measured at up to 98% obscuration, far beyond the range of operation of traditional laser diffraction systems.

Key for image:

- 1 HeNe laser
- 2 Collimating optics
- 3 Measurement zone
- 4 Fourier lens
- 5 Silicon diode detector array
- 6 Rapid data acquisition system

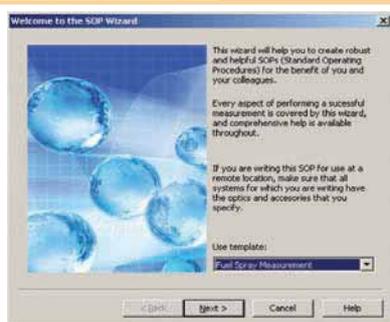


Spraytec Delivers:

- 10KHz maximum acquisition rate
- Unique lens configuration, imaging scattering over a large working range.
- 300mm and 750mm lens systems, covering a 0.1 – 2000 micron dynamic range.
- Rapid auto-align
- Robust construction and design
- Customisable optical bench arrangement
- Patented high-concentration analysis
- Measurement synchronisation via flexible triggering options

Simple Operation

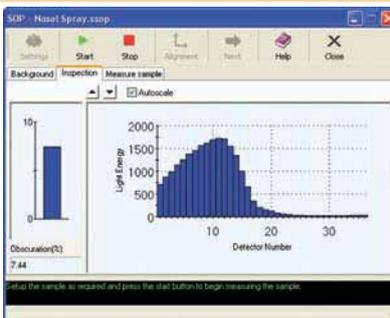
Access to the Spraytec's powerful measurement capabilities is controlled via an equally impressive software interface that makes precise spray measurements entirely straightforward.



1 Set up your Standard Operating Procedure (SOP) using the system's integrated method definition wizard. SOPs lock-down all aspects of the measurement process including the hardware configuration, analysis settings, triggering options, result parameter reporting and data averaging. Online help supports method specification for different spray types.



2 Run the measurement by selecting the desired SOP from the menu system. This automatically configures the system and ensures everything is optimally set to deliver accurate results, including auto-alignment of the optical system. Synchronisation of external systems such as extractors, actuators and positioning systems is also supported.



3 Observe each stage of the measurement via the software's measurement manager. This allows the user to monitor all aspects of the measurement and analysis process. Prompts ensure that the correct sample preparation, handling and disposal procedures are followed.

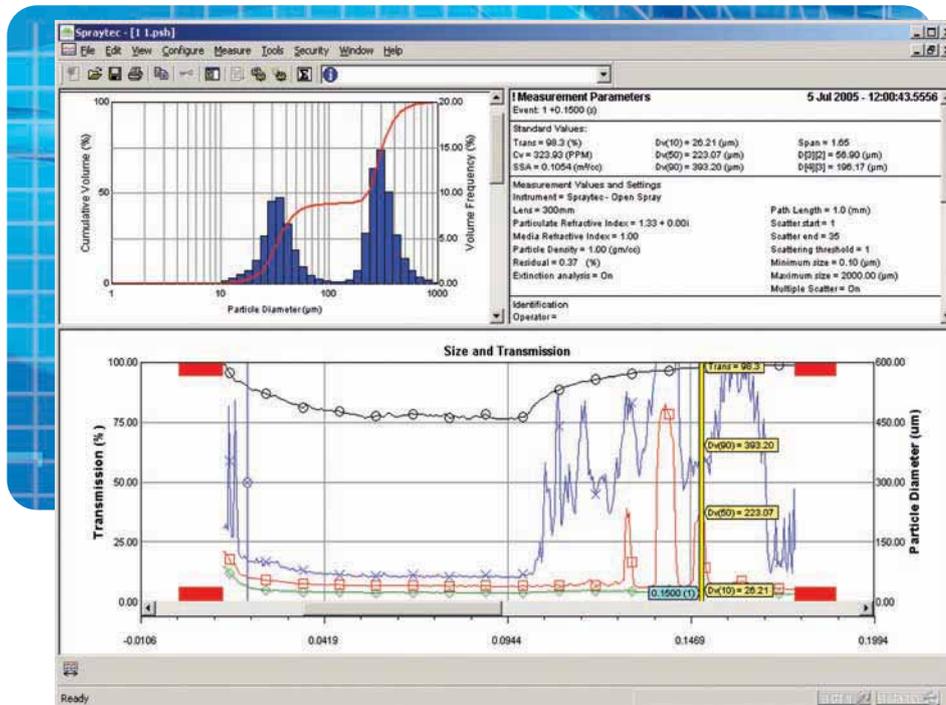


4 View the results using the size history window. This displays the recorded particle size distributions along with a size history chart showing how the spray developed over time. Users can play back the spray event and select records for further analysis.

Once analysis is completed, the system is automatically ready to carry out further measurements.

Spray Dynamics Revealed

Understanding the dynamics of spray formation requires users to quickly assess how the particle size changes with time. The Spraytec's unique size history display enables a frame-by-frame inspection of the particle size distributions recorded during a given spray event. Instantaneous playback of the spray event is possible, showing exactly how the spray particle size evolves over time. At each time point the entire size distribution can be viewed together with all relevant sample details. Users can define which variables can be viewed on the size history chart and can select records from the chart for averaging, export and reanalysis.



Size History Display Provides:

- Frame-by-frame event analysis
- Instantaneous result playback
- Drag-and-drop result selection
- Zoom facility to examine changes over different time periods
- Statistical analysis via advanced averaging capabilities
- Size distribution and scattering data views for each time point
- Searching facilities to locate results
- Over plotting of results at different time points
- Display of measurement triggers and data groups

Applications

The flexibility of the Spraytec system makes it ideally suited to applications across a wide range of industries, from fundamental research and development through to product quality control and batch release testing. It delivers accurate, reproducible spray size analysis in an easy-to-understand format, improving product understanding and control.



Pharmaceuticals

Particle size is a key parameter in defining the deposition pattern and bioavailability of drug materials delivered using pump sprays and inhalers to the nasal mucosa and respiratory system. The Spraytec system can chart the changes in size produced during single device actuations, allowing the dynamics of particle dispersion to be identified along with the device reproducibility. Formulations can therefore be rapidly screened for the correct spray properties, reducing over development times and improving drug delivery efficacy.



Routine Atomiser Characterisation

Measurement of the droplet size produced by atomiser systems is key in promoting process understanding and a knowledge of the environmental impact of spraying, for instance in coatings or agrochemical applications. The Spraytec's rugged design, efficient air purge and multiple scattering analysis ensures measurements can be made at high concentrations directly within a spray plume, providing the real-time data required to track changes in particle size during atomiser operation.



Automotive Applications

The Spraytec instrument's ability to measure at 10kHz enables resolution of the fluctuations in droplet size observed during the rapid firing of automotive fuel injector systems. Provision of flexible triggering options ensures each injection event is fully captured. The repeatability of atomisation can then be assessed and related to combustion efficiency.



Specifications

Spraytec

Optical unit	Laser diffraction	
<i>Measurement principle</i>	Laser diffraction	
<i>Size range</i>	0.1µm - 2000µm	
<i>Optical models</i>	Mie Theory and Fraunhofer Approximation including Patented Multiple Scattering correction	
<i>Lens ranges</i>	300mm lens: 0.1 - 900 microns (Dv50: 0.5 - 600 microns) 750mm lens: 2.0 - 2000 microns (Dv50: 5 - 1600 microns)	
<i>Working range</i>	100 mm at 0.5 microns, >1m at 10 microns	
<i>Concentration range</i>	Minimum acceptable transmission: 5% (dependent on particle size range)	
<i>Detection system</i>	35 element log-spaced silicon diode detector array	
<i>Light source</i>	632.8 nm, 5 mW helium-neon laser	
<i>Laser Safety</i>	Class 3R laser product	
<i>Optical alignment system</i>	Automatic rapid align system	
<i>Maximum acquisition rate</i>	Continuous Mode: 1Hz Rapid Mode: 2.5kHz as standard, 10kHz with additional software feature key	
<i>Accuracy</i>	Better than +/- 1% on the Dv50 for NIST-traceable latex standards	
<i>Precision / Repeatability</i>	Better than +/- 1% COV on the Dv50 for NIST-traceable latex standards	
<i>Reproducibility between instruments</i>	Better than +/- 1% COV on the Dv50 for NIST-traceable latex standards	
Measurement Triggering	Internal: Based on transmission or light scattering levels External: Based on TTL input or simple switch trigger	
<i>External device synchronization</i>	Via two TTL trigger outputs	
Software		
<i>Minimum computer specification (supplied with system)</i>	DELL Mini Tower PC, 2.8GHz Intel Pentium IV Processor, 512Gb RAM, 160Gb-HDD, CD-RW, complete with mouse, keyboard and 1x17 inch Flat Panel Monitor. One free PCI slot and one free COM port required for nasal spray actuators	
<i>Operating platforms</i>	Windows XP Professional (Service Pack 2 or higher)	
<i>21CFR11 Compliance</i>	Technical compliance provided through layered access security system, audit trails and links to Adobe Acrobat for electronic signatures.	
Operating environment		
<i>Enclosure ratings</i>	IP65 rating for the main transmitter and receiver modules in normal use	
<i>Temperature</i>	15°C - 40°C	
<i>Humidity</i>	35% - 80%, non-condensing	
Weights and dimensions		
<i>Model</i>	Unpacked weight (kg)	Dimensions (length; depth; height in mm)
Optical Bench (300mm)	36kg	950x550x610 (LxWxH)
Optical Bench (500mm)	37kg	1400x550x610 (LxWxH)

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