



*A SPES ahead in  
particle analysis*



*CLASSIFICATION, ANALYSIS, and COUNTING  
of PARTICLE MIXTURES in biological,  
industrial, and environmental liquids*

*powered by patented  
SPES AND SPES<sup>2</sup>  
CUTTING-EDGE TECHNOLOGIES*

# CLASSIZER™ ONE

## MULTIPARAMETRIC SINGLE PARTICLE ANALYSER

- Formulation QbD & SbD
- Heterogeneous Samples
- Complex-But-Real Particles
- Classify particle mixtures
- Formulation behaviour
- In target complex liquids
- Continuous Flow Analysis
- Process QC/PCA
- Impurities Identification

# About EOS

*"If you cannot measure it,  
you cannot improve it"*  
Lord Kelvin 1824 – 1907

EOS S.r.l. (Effective Optical Systems) has been founded in 2014 in Milano (Italy). Since the beginning, EOS develops and offers **novel scientific devices and technological solutions for the analysis, design, and formulation of particles in biological, industrial, and environmental heterogeneous fluids.**

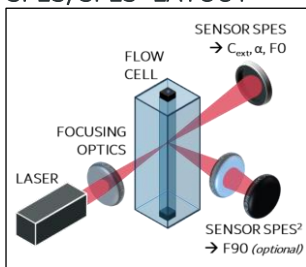
EOS proprietary solutions are unique game-changers for improving R&D, formulation, and process quality control of products based on particles and particle mixtures in markets as **delivery systems, cosmetics, pigments, inks, specialty chemicals, abrasives, beverages, and life and environmental sciences.**

The legal and business headquarters of EOS are located in Milano, Italy (EOS S.r.l. – Viale Ortles 22/4 – I-20139 Milano – Italy)

# SPES/SPES<sup>2</sup>

SPES (Single Particle Extinction and Scattering) and SPES<sup>2</sup> are patented light scattering technologies highly effective for the classification and characterisation of mixtures of particles in complex liquids. Exploiting the unique optical properties of each particle measured, SPES/SPES<sup>2</sup> classify, analyze, and count the particle populations in a heterogeneous fluids.

## SPES/SPES<sup>2</sup> LAYOUT



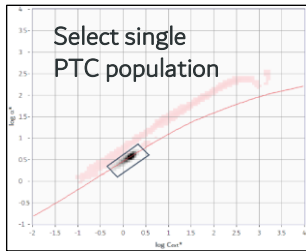
How CLASSIZER™ ONE BASED ON SPES/SPES<sup>2</sup> works. A sample is dispersed in a liquid, which is flowed through a scattering cell where a laser beam is properly shaped and focused. As a single particle crosses the laser beam, the interference pattern between the transmitted beam and the forward scattered light is recorded on a segmented sensor. The fringes in the interference pattern delivers unique SPES optical properties of the single particle illuminated. Side scattering signals are synchronously measured and synergistically analyzed accordingly to novel SPES<sup>2</sup> retrieving further unique value-added data for each single particle detected.

## SPES FRINGES



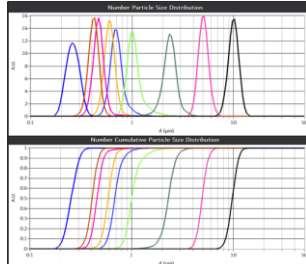
SPES retrieves the Extinction Cross Section  $C_{ext}^*$  and Polarizability  $\alpha^*$  for each single detected, validated, and counted particle from the forward interference pattern thanks to a robust Pulse Shape Analysis scheme and proprietary algorithms. Artifact signals are rejected increasing data quality and robustness. SPES<sup>2</sup> technology empower the analysis of complex particles by recovering additional independent parameters for each individual particle, such as F00 / F90. SPES<sup>2</sup> is supplied as an optional module of the CLASSIZER™ ONE platform.

## EOS CLOUDS



Tens of thousands of particles are measured and classified based on their unique optical properties in few minutes. Thus CLASSIZER™ ONE creates the unique multidimensional EOS CLOUDS histogram which is the optical fingerprint of the sample. Mixes of optically different particles produce simultaneously different clouds for each particle population, which can be individually selected, analysed, and compared. Particle size distribution, numerical concentration, and other insights are retrieved accordingly to whole sample, to selections of single populations detected, and/or for a time frame in continuous flow analysis.

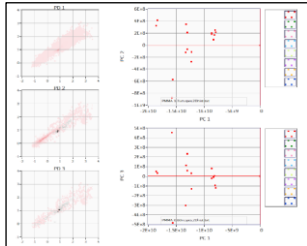
## PTC SIZE DISTRIBUTIONS



Added-value information is provided thanks to SPES/SPES<sup>2</sup> and EOS unique data libraries:

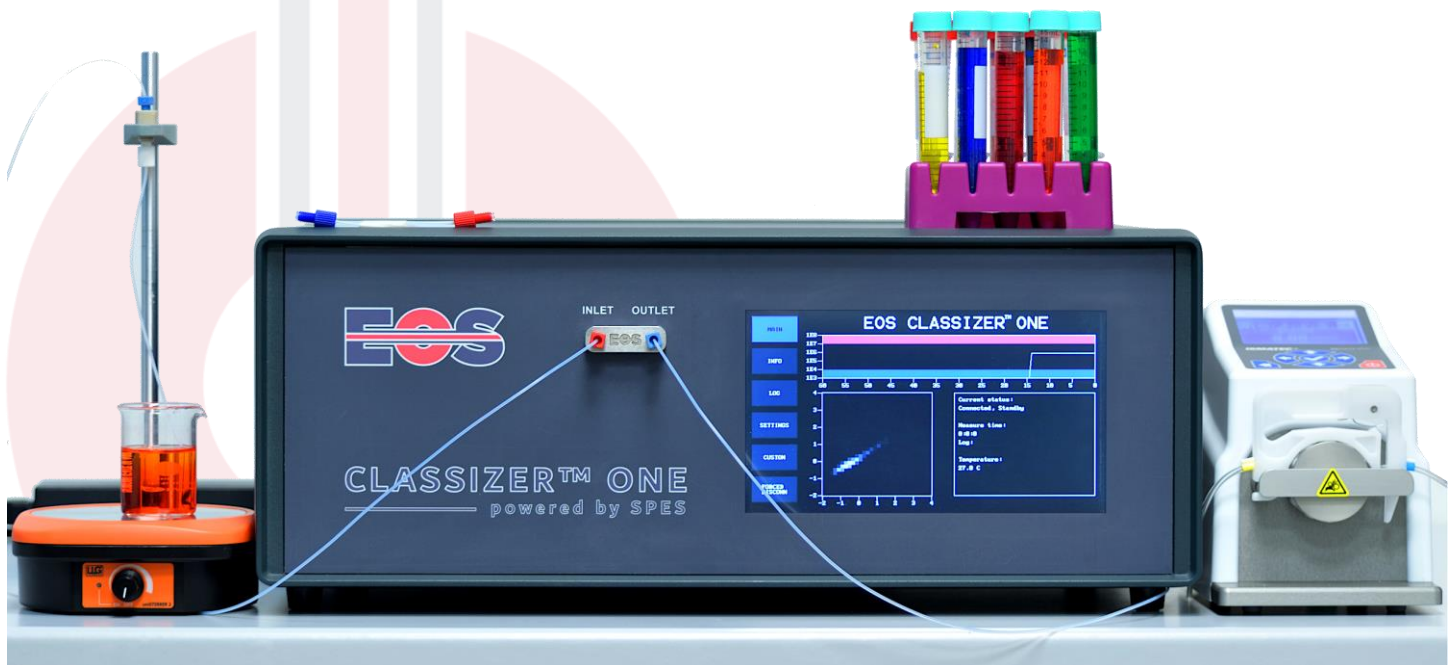
- Optical Classification, Absolute Particle Size Distribution, and Numerical Concentration of each single particle populations irrespectively of polydispersity and particle mixtures.
- Optical Quality Control of particle structures as porosity, aggregation, aspect ratio, payload, impurities, and shelf-life without intermediate steps (as purification/filtration).
- Measurement of the particle behavior and the particle formulation stability directly in heterogeneous non-filtered target biological, industrial, or environmental fluids.
- Hi-Resolution Continuous Flow Analysis of particles, ready to couple to other analytical devices and systems, as cFFF separators, small chemical reactors, and pilot lines.
- Statistical approaches as Oversize Measure and PCA for Hi-Quality Batch-2-Batch analysis and out-of-specifics/impurities identifications in formulation and production.

## STATISTICAL ANALYSES

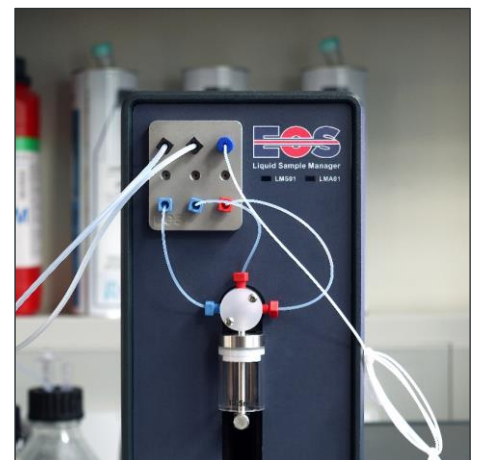


# CLASSIZER™ ONE

CLASSIZER™ ONE delivers accurate, robust, reliable data based on patented **Single Particle Extinction and Scattering SPES and novel SPES<sup>2</sup> methods** for the **analysis, classification, and counting** of simple and mixtures of particles in liquids. CLASSIZER™ ONE enables critical decision-making throughout research and development, particles formulation, and quality control in manufacturing processes driven decisions in delivery systems, cosmetics, cosmeceuticals, pigments, inks, specialty chemicals, food, beverage, microplastics, abrasives, process controls, life and environmental sciences.



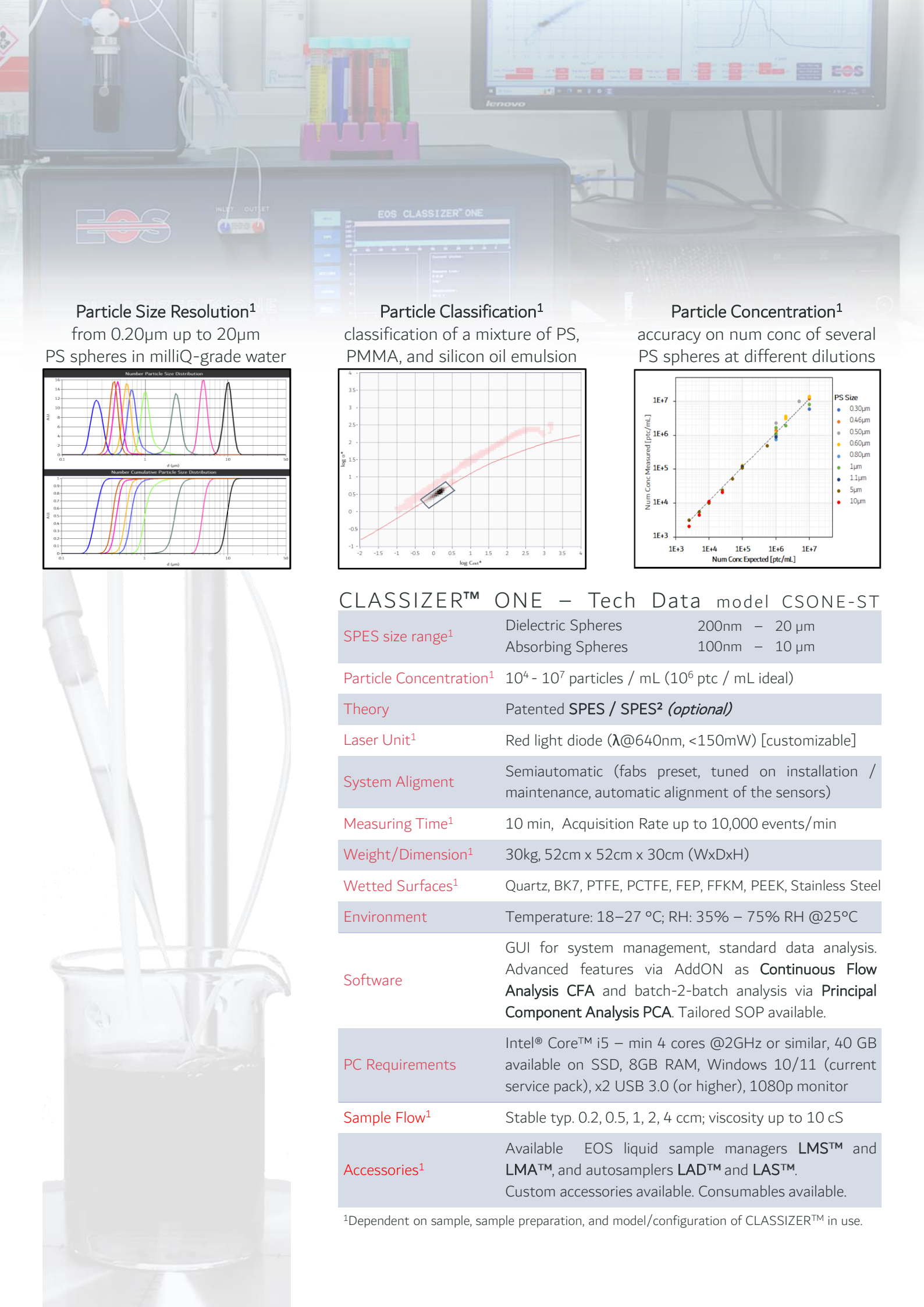
Unique Patented Optical Layout – Industrial-grade – Touchscreen – Accessories



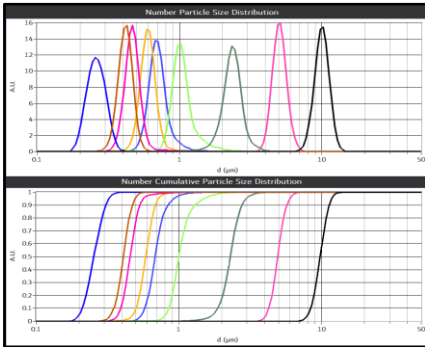
Quartz, BK7, PTFE, PCTFE, FEP, FFKM, PEEK, and Stainless Steel wetted surfaces ensure high chemical compatibility. CLASSIZER™ ONE measures samples at laminar constant flows of 0.2, 0.5, 1.0, 2.0, 4.0 mL/min and viscosity up to 10cS.

CLASSIZER™ ONE works with standard syringe pumps for standard manual usage. EOS offers liquid sample managers and autosampler to deliver highest measurement throughput and reliability in particle analysis and batch-2-batch QC.

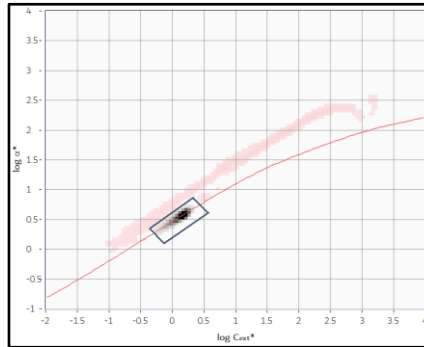
Tailored hardware and software solutions are available and can be developed on the basis on the single user needs.



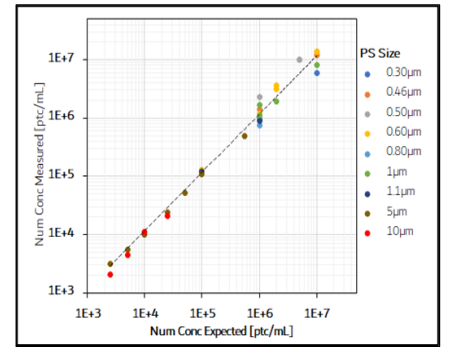
**Particle Size Resolution<sup>1</sup>**  
from 0.20µm up to 20µm  
PS spheres in milliQ-grade water



**Particle Classification<sup>1</sup>**  
classification of a mixture of PS,  
PMMA, and silicon oil emulsion



**Particle Concentration<sup>1</sup>**  
accuracy on num conc of several  
PS spheres at different dilutions

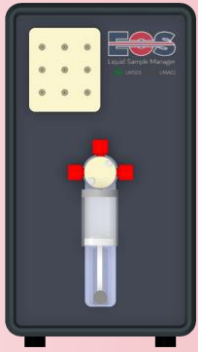


## CLASSIZER™ ONE – Tech Data model CSONE-ST

<b>SPES size range<sup>1</sup></b>	Dielectric Spheres	200nm – 20 µm
	Absorbing Spheres	100nm – 10 µm
<b>Particle Concentration<sup>1</sup></b>	10 <sup>4</sup> - 10 <sup>7</sup> particles / mL (10 <sup>6</sup> ptc / mL ideal)	
<b>Theory</b>	Patented <b>SPES / SPES<sup>2</sup> (optional)</b>	
<b>Laser Unit<sup>1</sup></b>	Red light diode (λ@640nm, <150mW) [customizable]	
<b>System Alignment</b>	Semiautomatic (fabs preset, tuned on installation / maintenance, automatic alignment of the sensors)	
<b>Measuring Time<sup>1</sup></b>	10 min, Acquisition Rate up to 10,000 events/min	
<b>Weight/Dimension<sup>1</sup></b>	30kg, 52cm x 52cm x 30cm (WxDxH)	
<b>Wetted Surfaces<sup>1</sup></b>	Quartz, BK7, PTFE, PCTFE, FEP, FFKM, PEEK, Stainless Steel	
<b>Environment</b>	Temperature: 18–27 °C; RH: 35% – 75% RH @25°C	
<b>Software</b>	GUI for system management, standard data analysis. Advanced features via AddON as <b>Continuous Flow Analysis CFA</b> and batch-2-batch analysis via <b>Principal Component Analysis PCA</b> . Tailored SOP available.	
<b>PC Requirements</b>	Intel® Core™ i5 – min 4 cores @2GHz or similar, 40 GB available on SSD, 8GB RAM, Windows 10/11 (current service pack), x2 USB 3.0 (or higher), 1080p monitor	
<b>Sample Flow<sup>1</sup></b>	Stable typ. 0.2, 0.5, 1, 2, 4 ccm; viscosity up to 10 cS	
<b>Accessories<sup>1</sup></b>	Available EOS liquid sample managers <b>LMS™</b> and <b>LMA™</b> , and autosamplers <b>LAD™</b> and <b>LAS™</b> . Custom accessories available. Consumables available.	

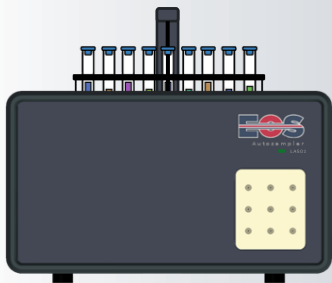
<sup>1</sup>Dependent on sample, sample preparation, and model/configuration of CLASSIZER™ in use.

# ACCESSORIES



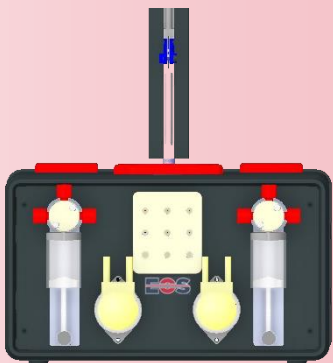
## LMS™ Standard Liquid Sample Manager

EOS LMS™ standard sample manager enables Classizer™ ONE to operate in stable and repeatable conditions. It drastically reduces operator-dependent issues respect using a standard external pump; it occupies only a small space on the table. LMS™ relies on a robust syringe pump, PTFE and borosilicate syringe, plus a PCTFE/PTFE four-way valve for sample, PEEK/FFKM automatic valves to use up to two solvents to flush/rinse the Classizer™ ONE, and waste management. LMS™ is designed to speed-up and standardize operations, to measure samples which are mostly already diluted, and for customers that do not want to lose time and energy in a search for compatible external pump.



## LAS™ Liquid Autosampler

LAS™ is an autosampler compatible with Classizer™ ONE and liquid sample managers LMS™/LMA™. Compatible with up to 20 test tubes and vials of 20mL. Settings, operative procedures, and the washing can be started and operated through the Classizer™ ONE software. Each sample may be stirred via a magnetic stirrer to prevent particle settling before the sampling. Via LMS™ / LMA™ internal washing is performed in order to prevent the cross contaminations between samples. Tested sample can be recovered for new analyses.



## LAD™ Liquid Autosampler

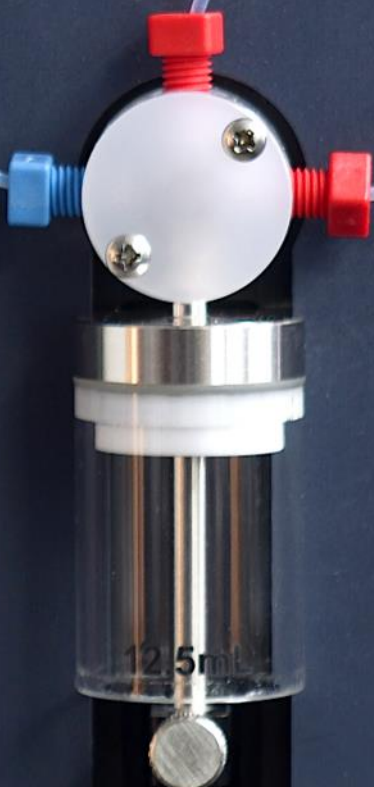
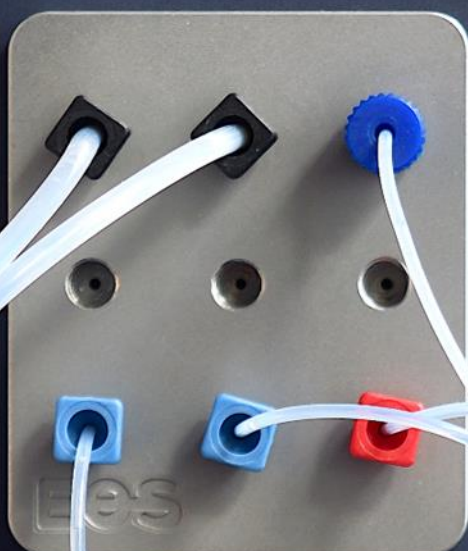
LAD™ is a single point autosampler compatible with Classizer™ ONE and liquid sample managers LMS™/LMA™. LAD™ samples small aliquots at fixed times from a selected point in a vial or a bottle containing a solution in order to study the particle stability, aging, and settling over time. LAD™ integrates a dilution system to manage and dilute concentrated aliquots and a cleaning system.



Liquid Sample Manager

■ LMS

■ LMA



12.5ml

# EOS SOFTWARE

## USER FRIENDLY CONTROL & EVALUATION PLATFORM

All-in-one software platform with dedicated tabs for acquisition and analysis offers intuitive solutions for easy-to-use and reliable measurements. Standard operations and add-ons for advanced data acquisition and analysis are available and ready to use. Tailored Operative Procedures can be developed in the software to fit user needs.

Internal checks are performed continuously. Warnings and expert advices are provided to the user in real time to guarantee the highest data quality, accuracy, and repeatability.

Acquisition and analysis tabs provide a continuously increasing number of tailored customizations of acquiring, classifying, and interpreting the multiparametric SPES data.

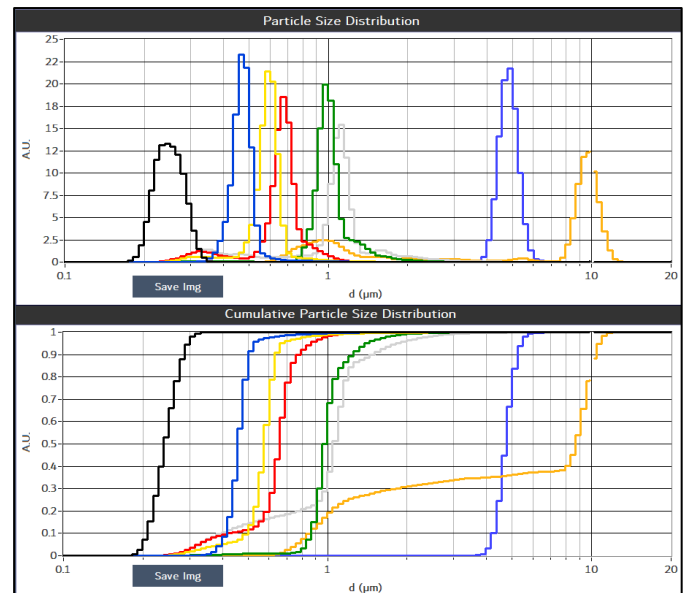
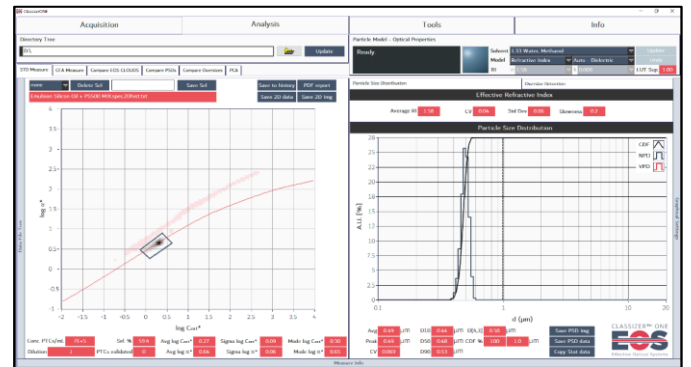
Comments and operator observations can be added to data during acquisition and analysis. Data are saved continuously limiting the risk of data loss and unintentional file overwriting.

- Easy to use / Easy to clean
- Dedicated SOPs available
- No calibrations needed
- Robust Internal checks
- Real-time / In-Line / On-Line

Thanks to the unique **EOS CLOUDS** and **SPES/SPES<sup>2</sup>**, the user can **easily select any single particle population** detected in the fluid and represented. Numerical particle size distribution, statistical parameters, and concentration are retrieved accordingly to the selection and/or to the whole sample. Advanced feature as aggregation state, estimate payload, and aspect ratio are provided via tailored add-on.

Advanced algorithms as **Principal Component Analysis PCA** and **Continuous Flow Analysis CFA** are available as add-on module to compare and correlate the behaviour of the single components in heterogeneous products and for batch-to-batch Quality Controls of raw material and processes.

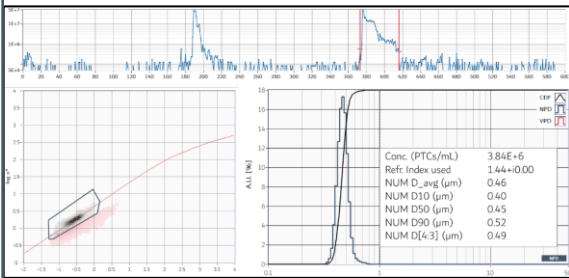
Traditional methods assumes particles as standard dielectric spherical particles. **Benefits from CLASSIZER™ ONE** for the unprecedented analysis and interpretation of particles and particle mixes in heterogeneous liquids.





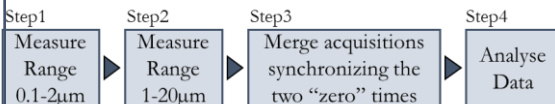
# EOS add-on

CFA-SPES Add-On is the perfect solution for **Continuous Flow Analysis CFA** and real-time monitor of particles in for continuous flow applications. **SPES/SPES<sup>2</sup> data** are retrieved with a time resolution of one second. Precise time laps can be selected for in detailed offline classification and analysis of particles and concentration transitions of single population.



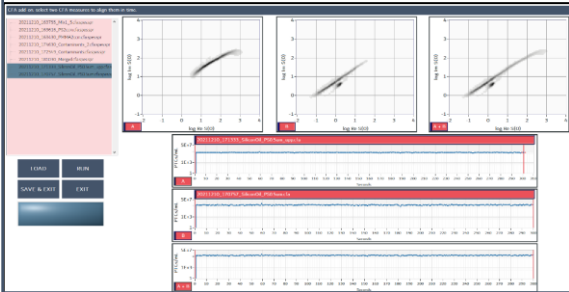
Online/InLine monitoring of particles during continuous flow processes lasting hours or for measuring samples injected using an external commercial autosampler. **CLASSIZER™ ONE** may start/stop acquisitions via an external communication protocols as RS485, square volt, or tailored com protocols developed to fit user needs.

**CLASSIZER™ ONE** measures particles either in the size range 0.1-2µm or 1-20µm, depending on settings. Two ergodic runs on the two ranges can be synchronised, merged, and analysed as a single acquisition.



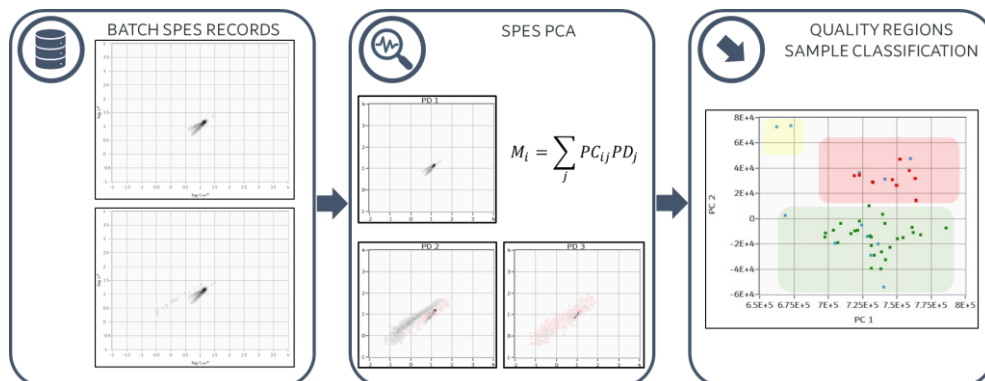
**CLASSIZER™ ONE** allows a high value and unique analysis of each single particle population classifying and extracting temporal resolved data of the single particle population in heterogeneous mix of particles in function of the single particle optical properties. The particle populations are detected and thus may be analysed separately by making a further selection in the EOS CLOUDS.

**CLASSIZER™ ONE** classifies the single populations in a particle mixture monitoring particle time transient and behaviour.



PCA-SPES Add-On provides an easy to use and effective **Principal Component Analysis PCA** tool for the statistical classification and batch-to-batch Quality Control of samples based on multiparametric **EOS CLOUDS** data.

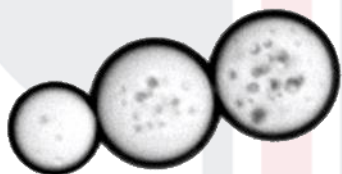
PCA-SPES classifies the EOS CLOUDS. Samples are clustered on the basis of secondary populations, difference in the shape of the main population, or changes in the absolute or relative numerical particle concentrations.



Supervised Machine Learning and K-nearest neighbour method available to classify batches using discrete labels as True/False, Yes/No, OK/Not OK, or Good/Bad to evaluate new data against library of previously measured batches.

# APPLICATIONS

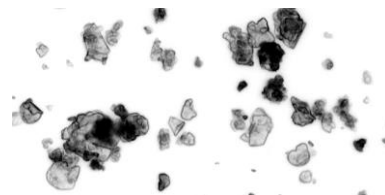
## POLYMERIC / EMULSIONS



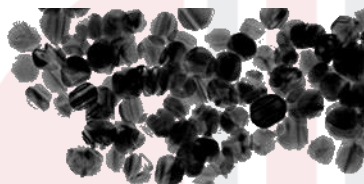
## BIOFLUIDS / DELIVERY SYSTEMS



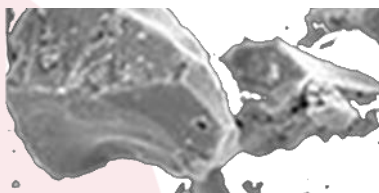
## PIGMENTS / INKS



## METALLICS / CARBONACEOUS



## ABRASIVES / OXIDES



## ENVIRONMENT / MINERALS



**Presentation of Single Particle Extinction and Scattering (SPES) - Mixtures of polymeric particles and powders**  
AN001-2021 Analysis of Polymeric Particle Mixes via SPES Technology – an introduction to SPES method  
AN006-2021 Multiparametric Classification of Particles as a Pathway to Oversize Analysis in Complex Fluids via SPES  
Potenza MAC et al., «Measuring the complex field scattered by single submicron particles », AIP Advances 5 (2015)

**Example of CFA application of SPES technology**  
AN002-2022 Continuous SPES Flow Analysis CFA-SPES

**Example of PCA application of SPES technology**  
AN005-2022 Batch-To-Batch Consistency via Multiparametric SPES Principal Component Analysis PCA

**Classizer™ ONE + Sample Managers & Autosampler**  
AN008-2022 Automatic Liquid Sample Management and System Cleaning with EOS LMS01™ and LMA01™  
AN009-2022 Standardize SPES Operative Procedure and improve throughput of Liquid Samples via EOS LAS01™  
Potenza MAC et al., «Single-Particle Extinction and Scattering Method ...», ACS Earth Space Chem 15 (2017)

**Example of SPES application to aggregates**  
AN003-2021 Addressing the Issue of Wetting and Clustering by Means of SPES Technology  
Potenza MAC *et al.*, «Single-Particle Extinction and Scattering Method ...», ACS Earth Space Chem 15 (2017)

**SPES application to non-spherical particles**  
AN004-2021 Addressing the Classification of Non-Spherical Particles by Mean of the SPES Technology  
Simonsen MF et al., «Particle shape accounts for instrumental discrepancy in ...», Clim. Past 14 (2018)

**SPES application to emulsions, emulsion mixtures, blends**  
AN015-2022 Classification of Oil and Oil Mixes Emulsions

**Examples of SPES application to particle analysis and behaviour characterization in biotech applications**  
AN011-2021 Quantitative Classification of Particles in Biological Liquids via SPES Technology  
AN016-2021 Multiparametric Determination of Yeast Cell Viability via SPES Technology

AN017-2022\_SPES Classification of Probiotic Formulations  
Sanvito T et al., «Single particle extinction and scattering optical method unveils in real...», Nanomedicine 13 (2017)

**Examples of SPES application to inks, pigments, coatings**  
AN018-2022 Classification of Inks and Pigments via SPES Technology  
AN019-2022 SPES Classification of Vinyl Glues

**Example of SPES application to oxide particles, abrasives, and industrial slurries w/o impurities and w/o emulsions**  
AN013-2022 Analysis of Abrasives via SPES Technology  
Potenza MAC et al., «Optical characterization of particles for industries», KONA Powder and Particle 33 (2016)

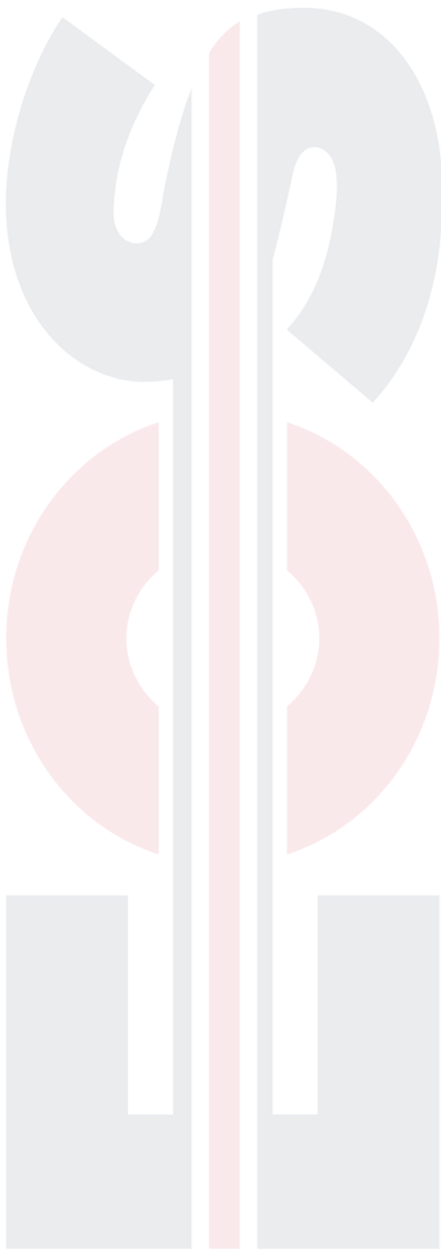
**Example of SPES application to particle degradation in target food environmental liquids and ecotoxicity analysis**  
AN012-2021 Monitoring the Fate of a Lipid/ZnO Emulsion in Environmental Waters  
AN020-2023 Quantify Particle Release from Food Packaging  
Maiorana S et al., «Phytotoxicity of wear debris from traditional and innovative brake pads», Env Int., 123 (2019)

**DISCOVER THE APPLICATION NOTES AVAILABLE ON [WWW.EOSINSTRUMENTS.COM](http://WWW.EOSINSTRUMENTS.COM)**



CLASSIZER™ ONE  
powered by SPES





## The EOS CLASSIZER™ family

<b>C S O N E - S T</b>	CLASSIZER ONE – benchtop unit based on SPES for multiparametric particle analysis in the size range 0.1-20µm @ 0.2-4mL/min
<b>C S O N E - S T - 90</b>	CLASSIZER ONE – benchtop unit based on SPES / SPES <sup>2</sup> for multiparametric particle analysis in the size range 0.1-20µm @ 0.2-4mL/min
<b>C S O N E - H F</b>	CLASSIZER ONE HF – benchtop unit based on SPES for multiparametric particle analysis in the size range 0.1-20µm @ high flow 20-200mL/min / high viscosity
<b>C S O N E - H F - 90</b>	CLASSIZER ONE HF – benchtop unit based on SPES / SPES <sup>2</sup> for multiparametric particle analysis in the size range 0.1-20µm @ 20-200mL/min / high viscosity
<b>C S P A T - S</b>	CLASSIZER PAT – online rack 19" unit based on SPES for particle analysis in the size range 0.1-2.0µm @ 20-200mL/min – computer integrated
<b>C S P A T - M</b>	CLASSIZER PAT – online rack 19" unit based on SPES for particle analysis in the size range 0.5-5.0µm @ 20-200mL/min – computer integrated
<b>C S P A T - L</b>	CLASSIZER PAT – online rack 19" unit based on SPES for particle analysis in the size range 1.0-20.0µm @ 20-200mL/min – computer integrated
<b>C S E N V - S</b>	CLASSIZER ENV – portable battery powered unit based on SPES for the analysis of particles in the size range 0.1-2.0µm – pump integrated
<b>C S E N V - M</b>	CLASSIZER ENV – portable battery powered unit based on SPES for the analysis of particles in the size range 0.5-5.0µm – pump integrated
<b>C S E N V - L</b>	CLASSIZER ENV – portable battery powered unit based on SPES for the analysis of particles in the size range 1.0-20.0µm – pump integrated
<b>C S A I R - S</b>	CLASSIZER AIR – rack 19" unit based on SPES/SPES <sup>2</sup> for the analysis of airborne particles in the size range 0.1-2.0µm @ 1-10L/min – computer integrated
<b>C S A I R - M</b>	CLASSIZER AIR – rack 19" unit based on SPES <sup>2</sup> for the analysis of airborne particles in the size range 0.5-5.0µm @ 1-10L/min – computer integrated
<b>C S A I R - L</b>	CLASSIZER AIR – rack 19" unit based on SPES <sup>2</sup> for the analysis of airborne particles in the size range 1.0-20.0µm @ 1-10L/min – computer integrated
<b>S W O N E</b>	Standard software platform for the management of EOS devices
<b>L M S</b>	Liquid Manager for standard sample management
<b>L M A</b>	Liquid Manager for advanced sample management
<b>L A S</b>	Liquid AutoSampler up to 24 vials of 20mL, coupling with LMS/LMA
<b>L A D</b>	Liquid AutoSampler for evaluation of particle aging and settling over time in a vial, coupling with LMS/LMA/LAS, dilution and cleaning
<b>A M S</b>	Aerosol Standard Manager – automatic aerosol management
<b>A D C</b>	Aerosol Dilution Chamber for the analysis of high concentrate aerosol with AMS

EOS, CLASSIZER™ ONE and other product names are trademarks of EOS S.r.l. All third-party product names and logos are trademarks or registered ones of their respective owners. Their use does not imply any affiliation, sponsorship, or endorsement by owner. Note: SPES results may depend on sample, sample preparation, or CLASSIZER™ configuration. This document is not contractually binding under any circumstances. 2014-2024 EOS S.r.l. | All rights reserved. | Printed in Italy

EOS Partner – Distributed by:

HeadQuarter - EOS S.r.l.  
 viale Ortles 22 | 20139 Milan | Italy  
 VAT IT08737210966  
 www.eosinstruments.com  
[info@eosinstruments.com](mailto:info@eosinstruments.com)  
 © 2024 EOS Srl. All Rights Reserved.

