Technical Data

PlasmaQuant 9100 Series
High-Resolution ARRAY ICP-OES

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General

- High-resolution ARRAY optical emission spectrometer with an inductively coupled plasma for multi-element analyses of highest accuracy and precision
- Compact bench-top instrument designed for high performance analytical tasks and ease of use
- Wide range of accessories maximize productivity, safety, ease of use and reduce wear

Torch and Sample Introduction

V Shuttle Torch

Plasma geometry	▪ Vertical
Torch mounting	▪ Shuttle design with compact sliding torch base made from thermally and chemically inert material
Gas connections	▪ Incorporated in torch base without separate gas tube connections
Torch models	▪ Fully demountable torch with separable inner, outer and injector tubes ▪ One-piece torch
Torch alignment	▪ Precision auto-alignment without necessity for routine re-alignment ▪ Automatic optimization of radial observation position ▪ Possibility for manual torch height optimization for special applications

Sample Introduction

Standard kit	▪ Borosilicate glass cyclonic spray chamber ▪ Demountable V Shuttle Torch with 2 mm injector and bonnet (quartz) ▪ Concentric borosilicate nebulizer 1 mL/min ▪ PVC pump tubing
Salt kit	▪ Borosilicate glass cyclonic spray chamber with dip tube ▪ Demountable V Shuttle Torch with 2 mm injector and bonnet (quartz) ▪ Concentric borosilicate nebulizer 2 mL/min ▪ PVC pump tubing
HF kit	▪ PTFE cyclonic spray chamber ▪ Demountable V Shuttle Torch with alumina inner tube, Syalon outer tube, 2 mm alumina injector and bonnet ▪ Concentric nebulizer PFA 1 mL/min ▪ PVC pump tubing
Organic kit	▪ Borosilicate glass cyclonic spray chamber with dip tube ▪ Demountable V Shuttle Torch with 1 mm injector and bonnet (quartz) ▪ Concentric borosilicate nebulizer 0.4 mL/min

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	▪ PU pump tubing
Additional sample introduction	▪ Wide range of concentric nebulizers (EasyFit®), parallel path nebulizers, ultrasonic nebulizer, pump tubing and torch components available
Sample transportation	▪ 12-roller peristaltic pump with four channels

Accessories for sample introduction

Autosamplers	▪ ASPQ 3300 (capacity up to 180 samples) ▪ Cetac ASX 560 (capacity up to 240 samples) ▪ Cetac Oils 7400 (capacity up to 384 samples)
Dilution autosamplers	▪ Cetac SimPrep offline dilution system ▪ Cetac SDX_{HPLD} online dilution system
Discrete sample introduction	▪ Cetac ASX_{PRESS} P_{LUS} 6 port rapid sample introduction system for aqueous samples ▪ Cetac ASX_{PRESS} P_{LUS} 6 port rapid sample introduction system for oil samples
Temperature controlled spray chamber	▪ Isomist XR with temperature range from -25 °C to 80 °C
Hydride systems	▪ Continuous flow hydride system HS PQ Pro with online reactant addition, micro spray chamber as gas/liquid separator and hydride pro injector for superior detection limits of hydride elements ▪ Continuous flow hydride system HS PQ with online reactant addition and dual inlet spray chamber for the simultaneous analysis of hydride and non-hydride elements
Argon humidifier	▪ Elegra Argon Humidifier

RF Generator

High Frequency RF Generator

Type	▪ Free-running RF-tube generator
Radio Frequency	▪ 40 MHz
Power range	▪ 700 to 1700 W (in 50 W increments)
Coil	▪ 4-winding copper
Power supply	▪ Solid-state
Plasma warm-up time	▪ < 5 min

Plasma Observation

Dual View Plus

Plasma observation	▪ Radial, axial
Attenuated plasma observation	▪ Radial plus, axial plus
Control	▪ Method parameter in software
Working range	▪ Sub µg/L to high percentage range
Viewing position	▪ Fully automated optimization of the plasma viewing position in all plasma observation modes

Optical Bench

High-resolution optics

	PlasmaQuant 9100 Elite	PlasmaQuant 9100
Type	▪ Echelle Double Monochromator	
Pre-monochromator	▪ Quartz prism	
Entrance slit	▪ 5 variable settings and fixed intermediate slit (dimensions entrance slit: 35 x 1800 µm)	
Optical bench	▪ Encapsulated and argon purged	
Grating	▪ Echelle grating with large blaze angle of 76°	
Focal length	▪ 400 mm	
Spectral resolution	▪ 0.002 nm at 200 nm	▪ 0.006 nm at 200 nm
FWHM values	▪ ≤ 3.5 pm for As 193.696, Tl 190.796	▪ ≤ 5.0 pm for As 193.696, Tl 190.796
Wavelength range	▪ 160 – 900 nm	
Number of accessible emission lines	▪ > 43,000	
Wavelength accuracy	▪ < 0.4 pm via internal Ne-correction	

Detector

Type	▪ Charge Coupled Device (CCD)
Cooling	▪ Peltier cooled to -10 °C
Integration times	▪ 1 ms to 10 s
Linear dynamic range	▪ 6 orders of magnitude
Integration modes	▪ Peak, spectrum
Type	▪ Charge Coupled Device (CCD)
Cooling	▪ Peltier cooled to -10 °C

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Limit of Detection*

Element/Line [nm]	*LOD axial [µg/L]*		*LOD axial [µg/kg]*
	0.5 % HNO_3	**15% NaCl***	**100% Kerosene***
P 177.436	< 2.0	< 5.0	< 3.0
As 193.698	< 2.0	< 5.0	< 4.0
Zn 213.856	< 0.1	< 0.4	< 0.6
Pb 220.353	< 1.0	< 3.0	< 10
Mn 257.610	< 0.05	< 0.3	< 0.1
V 292.401	< 0.1	< 0.3	< 1.0
Cu 324.754	< 0.2	< 0.7	< 0.6
Na 589.592	< 0.5	n.a.	< 4.0
K 766.491	< 1.0	n.a.	< 2.0

* LOD specification for PlasmaQuant 9100 Elite only

Gas Control

Automated gasbox for all gas flows	▪ Yes
Plasma gas	▪ 10 to 20 L/min with 0.1 L/min increments
Auxiliary gas	▪ 0.2 to 2.0 L/min with 0.05 L/min increments
Nebulizer gas	▪ 0.1 to 1.5 L/min with 0.01 L/min increments
Oxygen gas	▪ 0.0 to 0.05 L/min with 0.01 L/min increments
Gas purity	▪ > 4.6
Argon inlet pressure	▪ 4 to 6 bar

Self-Check System

▪ Sensors and interlocks	▪ Gas pressures
	▪ Gas flow rates
	▪ Extraction rate of exhaust system
	▪ Positioning of torch
	▪ Pressure of spectrometer gas
	▪ Nebulizer blockage
	▪ Generator power
	▪ Temperature of cooling agent
	▪ Flow rate of cooling agent
	▪ Plasma intensity and stability

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	▪ Status of door for torch compartment

Physical Data

Weight	Approx. 170 kg
Dimensions (W x H x L)	990 mm x 940 mm x 855 mm
Interface	PC connection: USB
Fuses	32 A
Power supply	230 V (± 10%)
Power consumption	4600 VA
Operation conditions	+ 15 to 35 °C, 20 to 90% relative humidity, non-condensing atmosphere, free from corrosive fumes
Exhaust requirements	3.5 to 5.5 m^3 / min
Technical Standards	Complies with standards for safety and electromagnetic compatibility for CE Marking (LVD 2014/35/EU; EMC 2014/30/EU; RoHS 2011/65/EU) and UL, CSA marking, ISO 9001 compliant
Gas consumption in standby	None
Warm-up from powered-down	< 15 min

Control and Data Evaluation

Control unit requirements	PC with Windows 8.1 or higher (32- or 64 bit), ≥ 2x USB 2.0 (or higher), graphics resolution of 1280x1024 (or higher), CD drive
Control unit requirements	ASpect PQ with: ▪ Method development tool (line library, pre-defined methods, free selection of instrument parameters, various calibration strategies) ▪ Spectral evaluation tools (Inter element correction (IEC), patented automatic baseline correction (ABC), static baseline fitting, correction of spectral interferences (CSI), identification of emission lines, free selection of number and position of evaluation pixels ▪ Quality control module with pre-defined QC tests and QC charts ▪ 21CFRPart11 compliance ▪ QC charts with pre-defined QC tests ▪ Advanced statistics module ▪ Optional online status updates on mobile devices

Chiller Requirements

Cooling capacity:	▪ 3 kW
Water temperature (at cooling water inlet ICP-OES)	▪ 17°C -24°C
Set temperature cooler	▪ 18°C
Temperature stability	▪ plus/minus 0.1 °C
Water flow in cooling water circuit	▪ min.1.5 ... 2,0 l/min , ideal 3,0 l/min
Cooling water pressure	▪ max. 6 bar
Water purity Conductivity	▪ 50 ... 200 uS/cm
Hose diameter cooler outlet	▪ 13 mm = ½ inch.
Water flow in cooling water circuit	▪ min. 1.5 ... 2,0 l/min , ideal 3,0 l/min
Cooling water pressure:	▪ max. 6 bar
Water purity Conductivity	▪ 50 -200 uS/cm

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