

ICP-MS



Thermo Scientific iCAP RQplus ICP-MS with XS product specifications

Key benefits

- Enhanced matrix tolerance and improved robustness
- Simplified method development for user-friendly operation in applied testing and scientific research laboratories
- Automated notification of important maintenance activities and simplified consumables management that reduces instrument downtime and supports a more consistent instrument performance
- Enhanced productivity with automated hardware and software solutions for the entire analysis workflow, from instrument set up and performance validation to results reporting

Introduction

The Thermo Scientific™ iCAP™ RQplus ICP-MS has been developed to meet the key requirements of analytical testing and scientific research laboratories. Designed to provide maximized uptime and productivity, the iCAP RQplus ICP-MS takes laboratory productivity to the next level, while providing an excellent user experience.

The iCAP RQplus ICP-MS is the best-in-class solution for the analysis of samples with diverse matrix content. The in-built hardware capability to perform automatic dilution of samples using argon gas enables accurate, robust, and reliable analysis of samples containing a dissolved solids content of up to 25% (m/v). The newly introduced Thermo Scientific™ Hawk™ Consumables and Maintenance Assistant and Instrument Performance Monitoring integrated into the Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) Software enables seamless monitoring of instrument performance, maintenance logging, and consumables utilization.

Perform your day-to-day analytical work with enhanced simplicity, productivity, and robustness for high throughput demanding laboratories.

Keywords

User friendly operation, matrix tolerance, instrument performance and consumables management, high throughput, effective interference removal



Hardware details

Sample introduction system

All sample introduction components are positioned for easy access for the user, simplifying removal and re-fitting of each component during routine maintenance.

Spray chamber

- Peltier cooled, high purity quartz, low volume, baffled cyclonic spray chamber efficiently filters out larger aerosol droplets for improved plasma stability
- Software controls temperature in the range of $-10\text{ }^{\circ}\text{C}$ to $+20\text{ }^{\circ}\text{C}$
- Low internal volume and reduced surface area improve sample washout and decrease carryover
- Optional PFA version available for HF and other aggressive sample matrices

Nebulizers

- Glass concentric nebulizer with $\sim 400\text{ }\mu\text{L}\cdot\text{min}^{-1}$ sample flow rate
- Optional nebulizers with different sample flow rates and different types are available for enhanced dissolved solids tolerance, organic solvents, and samples containing HF

Torch

- Easy to install with push-fit, demountable, single-piece quartz torch as standard
- Option to use the ceramic Thermo Scientific™ PLUS torch, offering improved lifetime and backgrounds for critical analytes such as silicon
- All gas connections are self-aligned, quick connect unions, located inside the torch holder. This reduces design complexity and eliminates the need for maintenance of these connections.
- Horizontal and vertical position: $\pm 2\text{ mm}$ with 0.02 mm increment steps
- Sampling depth: $0\text{--}15\text{ mm}$ with 0.025 mm increment steps

Injectors

- Proprietary, screw-in, self-aligning O-ring free injector, for ease of use and reliability
- Quartz injector with 2.5 mm i.d. as standard
- Optional injectors with 1.0 mm and 2.0 mm i.d., sapphire and platinum injectors available for organic solvent and high purity sample analysis

Peristaltic pump

- Innovative, automatically tensioning, easy access design, which requires no manual adjustment, eliminates sample introduction variables for simple operation and longer pump tubing lifetime
- Software controlled compact, low pulsation, 12 roller, four channel minipump with removable inert rollers for improved reliability
- Computer controlled pump speed: $0\text{--}100\text{ rpm}$ with 1 rpm increment steps

Additional gas kit

- One in-built and factory fitted additional mass flow controller for Argon Gas Dilution (AGD) with variable flow rates in the range of $0\text{--}1,000\text{ mL/min}$ available on most configurations
- Another additional mass flow controller with variable flow rates in the range of $0\text{--}250\text{ mL/min}$ is available. Fully software-controlled operation allows introduction of different gases, depending on the application requirement (e.g., O_2 for the analysis of organic solvents, He and Ar for analysis using accessories such as laser ablation).
- Easy coupling with the sample introduction system via quick-fit connection

Inductively coupled plasma

The plasma ion source of the iCAP RQplus ICP-MS rapidly adapts to changing sample matrix load, enabling handling of the most challenging matrices, such as highly volatile organic solvents and high dissolved solids containing samples, effectively with proven robustness and sensitivity.

RF generator

- Digital, solid state RF generator operating with dynamic frequency impedance matching the plasma at $\sim 27\text{ MHz}$
- Low ion energy spread for optimum ion focusing and transmission, without the need of a grounded shield between the torch and load coil
- Highly stable and robust cold plasma operation
- RF Power range $380\text{--}1600\text{ W}$

Load coil

- Water cooled load coil for improved lifetime and reliable plasma ignition
- Accessible at bench height for ease of maintenance

Plasma TV

- Remote monitoring of plasma status via an integrated HD camera

Interface

- Unique front opening interface provides rapid, simultaneous access to cones and extraction lens to facilitate routine maintenance and minimize downtime

Cones

- Optimized sample (1.1 mm diameter orifice) and skimmer (0.5 mm diameter orifice) cone geometries for reduced matrix deposition and maintenance
- Ni cones as standard; optional Pt tipped cones for specialized applications
- Rapidly remove and replace both cones using a single piece (magnetic) tool
- Proprietary skimmer cone insert design reduces memory effects and provides users with full flexibility when developing methods for specific applications

Extraction lens

- Single piece extraction lens, bayonet mounted for easy handling, operated at low voltages for optimum ion extraction and focusing into the ion optics
- Dedicated lenses for cold plasma operation available as optional accessories

Slide valve

- Software controlled: defaults to closed position when plasma is off or in the event of a power failure, maintaining vacuum in the analyzer housing and allowing interface cone maintenance without venting the vacuum, reducing system downtime

Ion optics

- Unique 90° cylindrical ion lens – the Right Angular Positive Ion Deflection (RAPID) lens, providing high ion transmission across the entire mass range
- Large, open architecture RAPID lens geometry minimizes sample deposition and eliminates lens cleaning maintenance
- Off-axis lens system design delivers significantly reduced background noise
- Electrical connections with gold spring contacts from the analyzer housing to ions optics improve reliability

QCell collision/reaction cell (CRC)

- Zero maintenance, small volume collision/reaction cell with proprietary flatapole rods
- High transmission, even in He KED mode, enabling complete single measurement mode analysis of all analytes including Li and Be, greatly improving throughput by analyzing across the entire mass range without changing instrument conditions
- Two-stage interference removal using kinetic energy discrimination (KED) with helium cell gas combined with an automatically configured low mass cut off provides superior interference removal for lowest detection limits
- Choice of 1 or 2 cell gas mass flow controllers for He and other reactive gases, such as pure H₂ or O₂, or mixtures of different reactive gases such as H₂/He and NH₃/He

Quadrupole

- Quadrupole mass analyzer driven by a solid state, 2 MHz supply ensures low abundance sensitivity and class leading mass stability

- User definable mass resolution in the mass range 2–225 u
- Fixed mass resolution and Extended Sensitivity (XS) in the mass range 225–290 u
- Mass calibration assessed and updated if required when using the automated Get Ready sequence
- Mass stability < ± 0.025 u per day
- Abundance sensitivity <0.5 ppm at m-1 (m = ¹³³Cs) in the mass range 2–225 u

Vacuum system

- Three stage, differential vacuum
- High vacuum is maintained in the event of a power failure: the rotary and turbo pumps automatically restart as soon as power is restored
- A stable vacuum, obtained in less than 15 minutes pumping time, enables fast return to service after routine maintenance, reducing instrument downtime

Turbo pump

- Single, split flow turbo molecular pump

Interface pump

- External, high-performance pump to provide backing to the turbo pump and evacuation of the expansion region between the sample and skimmer cone for efficient ion sampling from the plasma
- Supplied with synthetic, chemically stable, temperature-resistant rotary pump oil as standard
- Optional dry pump for high purity analysis applications

Detector

- Dual mode, long life, discrete dynode electron multiplier
- Minimum dwell times of 100 μs in both analog (high signal) and pulse counting (high sensitivity) detection modes
- Linear dynamic detection range: >10 orders of magnitude (<1 to >5·10⁹ cps)
- Automated optimization of operating voltages and cross-calibration between pulse counting and analog modes
- Manual connection-free cradle design for ease of detector exchange

iCAP RQplus ICP-MS with XS instrument configuration and performance specification

Instrument configuration		
Nebulizer	Glass concentric (400 $\mu\text{L}\cdot\text{min}^{-1}$)	
Spray chamber	Quartz, cyclonic	
Torch	Quartz, demountable	
Injector	Quartz, 2.5 mm i.d.	
Cones/Interface	Ni-tipped sample and skimmer, 3.5 mm high matrix insert	
STD mode		
Sensitivity (kcps/ppb) ^b	⁷ Li	65
	⁵⁹ Co	110
	¹¹⁵ In	270
	²³⁸ U ^c	400
Detection limits (ppt) ^a	⁹ Be	<0.5
	¹¹⁵ In	<0.1
	²⁰⁹ Bi	<0.1
Oxides (%) ^b	CeO/Ce	<2
Doubly charged (%) ^b	Ba ⁺⁺ /Ba ⁺	<3
Background (cps) ^b	<i>m/z</i> 4.5	<1
Stability (%RSD)	Short term ^b	<2 (10 min)
	Long term	<3 (2 h)
Isotope ratio precision (%RSD)	¹⁰⁷ Ag/ ¹⁰⁹ Ag	<0.1
He KED mode		
Sensitivity (kcps/ppb) ^b	⁵⁹ Co	35
Interference removal	⁵⁹ Co/ ³⁵ Cl ¹⁶ O	18
Background (cps) ^b	<i>m/z</i> 4.5	<0.5

^a Typical values, dependent on cleanliness of chemicals.

^b Demonstrated on installation; Uranium sensitivity of 330 kcps/ppb is demonstrated on installation.

^c Uranium XS sensitivity specification is not qualified in the performance report criteria during installation.

Note that installation specifications are only conducted with the default sample introduction components listed in the table above.

Site requirements for installation

Lab environment		
Temperature	Range	15–35 °C
	Rate of change	<2 °C·h ⁻¹
Humidity	Range	20–80% (non-condensing)
Utilities		
Electrical	Supply	200–240 V AC, 50/60 Hz single phase
	Power	Apparent: 3,000 VA; Effective: 2,200 W
Cooling water	Supply temperature	20 to 30 °C, optimum at 21 °C
	Supply rate	>5.5 L·min ⁻¹
Argon gas supply	Pressure	0.25–0.6 MPa (2.5–6 bar; 36–86 psi)
	Purity	>99.996%
	Typical flow rate	16 L·min ⁻¹
Cell gas supply	Pressure	0.55–0.6 MPa (5.5–6.0 bar; 82.5–90 psi)
	Purity	>99.999%
	Flow rate	max. 10 mL·min ⁻¹
Ar gas flow controllers	Pressure	0.1–0.15 MPa (1–1.5 bar, 15–22.5 psi)
	Nebulizer	MFC tunable via software and adjustable between 0.0–1.5 L·min ⁻¹
	Auxiliary	MFC tunable via software and adjustable between 0.0–1.5 L·min ⁻¹
	Coolant	MFC tunable via software and adjustable between 0.0–20.0 L·min ⁻¹
Plasma exhaust	Argon gas dilution option	0–1000 mL·min ⁻¹
	Second additional gas (optional)	0–250 mL·min ⁻¹
	Port dimensions	60.3 mm (recommended 63 mm i.d. ducting)
Heat exhaust	Flow rate (63 mm i.d. ducting)	6–8 m·s ⁻¹ (67–90 m ³ ·h ⁻¹ 39.4–53.0 cfm)
	Port dimensions	60.3 mm (recommended 63 mm i.d. ducting)

Instrument dimensions

Length x width x height	772 mm x 665 mm x 1,102 mm
Weight	143 kg

Qtegra Intelligent Scientific Data Solution (ISDS) Software

Qtegra Intelligent Scientific Data Solution (ISDS) Software, with simplified and automated workflow for end-to-end analytical operation from instrument Get Ready to data reporting, is a user friendly and intuitive software solution. Qtegra ISDS Software also provides effective tools for enabling instrument performance monitoring, maintenance scheduling, and consumables management via the Hawk Consumables and Maintenance Assistant.

Supported languages

English is the default language. Support for additional languages including Simplified Chinese and Japanese, French, German, Polish, and Russian is available using specific Language Packs.

Integrated control of peripherals

The unique architecture of Qtegra ISDS Software allows for the integrated control of peripheral devices via plug-ins, ensuring full implementation of all features within a single window.

Regulatory compliance

Qtegra ISDS Software supports Title 21 CFR Part 11 compliance. Features such as system audit trails, access control, e-signatures, and secured data enable full confidence in FDA or GMP/GLP compliant environments.

Licensing

One instrument seat and three desktop seats are provided with each software license.

Supported accessories and sample introduction kits

Autosamplers: Thermo Scientific™ iSC-65 Autosampler delivers reliable unattended and automated sample analysis. In addition, a wide range of Teledyne CETAC™ Technologies and Elemental Scientific™ autosamplers are supported with the iCAP RQplus ICP-MS.

Auto and intelligent dilution accessories: Automated prescriptive and intelligent dilution for handling highly varied and complex sample matrices facilitate unattended sample analysis without any manual intervention.

Laser ablation: Laser ablation systems are directly supported via dedicated plug-ins within the Qtegra ISDS Software. With both powerful data evaluation (trQuant) and flexible data export, the iCAP RQplus ICP-MS provides a truly routine laser ablation analysis solution.

Speciation: The trace level analysis of various elemental species by seamless integration of separation techniques such as IC, LC, and GC with the iCAP RQplus ICP-MS powered by the Thermo Scientific™ ChromControl™ plug-in for Qtegra ISDS Software and tQuant plugin. The versatile structure of Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) Software provides access to all Thermo Scientific™ chromatography products.

Single cell characterization: Pre-set, self-optimizing online Argon Gas Dilution (AGD) modes provide automatic handling of sample matrix varieties—from drinking water to brine—without manual liquid dilution. Low, Medium, and High modes simplify challenging analyses by providing optimized settings for each sample matrix. Automatic parameter optimization for each AGD mode enables dependable, predictable performance and long-term analysis stability.

Organic kit: Specialized sample introduction kit for effective and trouble-free handling of organic samples, such as oil and petroleum products and organic solvents. Organic kit includes 1.0 mm i.d. quartz injector, 50 $\mu\text{L}\cdot\text{min}^{-1}$ PFA microflow nebulizer, and quartz torch for organics.

Acid resistant kit: For the analysis of aggressive sample matrices, for example HF or H_2SO_4 , this kit contains a PFA cyclonic spray chamber, a 2.0 mm i.d. sapphire injector, and Pt tipped cones.

Learn more at thermofisher.com/ICP-MS