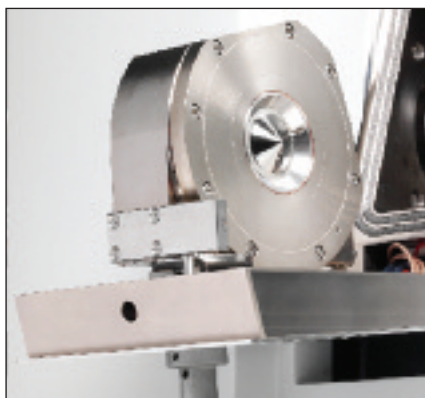


The Thermo Scientific iCAP Q ICP-MS has been developed with groundbreaking technology to enable advanced high-performance analysis combined with total reliability and ultra-flexibility. The radical design simplifies the user experience and dramatically improves laboratory efficiency.

Thermo Scientific iCAP Q ICP-MS

Dramatically Different ICP-MS



The Thermo Scientific iCAP Q ICP-MS offers dramatically improved levels of performance, reliability, ease of use and flexibility compared to its predecessor, the Thermo Scientific XSERIES 2. The iCAP Q is the result of a series of technological and useability improvements derived from Thermo Scientific's wide range of analytical instruments.

With three models available, the iCAP Q ICP-MS is the ideal tool for a wide range of applications and market sectors, from routine 24/7 analysis to demanding high quality research.



Which iCAP Q ICP-MS?

iCAP Qa: Routine 24/7 workhorse

For laboratories upgrading from AA or ICP-OES. The entry level iCAP Qa ICP-MS provides multi-elemental analytical capabilities without the need to invest in collision cell technology. With a footprint of 0.5 m², existing equipment can be simply replaced with an iCAP Qa ICP-MS – without requiring any rearrangement of the existing laboratory bench. A robust sample introduction system suited for routine environmental applications and an advanced matrix tolerant interface minimise routine maintenance, providing a reliable, multi-elemental laboratory workhorse.

While classed as an entry level system, the iCAP Qa retains all of the advanced reliability and ease of use features common to the iCAP Q range, i.e. peltier cooled spray chamber, self-aligning injector, bayonet fitting torch, lightning fast RF generator, bench height access for routine maintenance and high ion transmission with the QCell ion guide. With One-Click setup and pre-installed protocol compliant analysis templates within the Qtegra elemental analysis software suite, any analyst will soon feel like an ICP-MS expert.

When analytical requirements require added flexibility or expanded elemental ranges, an on-site upgrade pathway is available to the next level of performance: the iCAP Qc.

iCAP Qc: High sensitivity cell mode performance

The iCAP Qc ICP-MS is configured for high quality analyses in routine, high throughput laboratories such as those specializing in environmental analysis, food quality control and geochemical exploration. With proprietary QCell technology, single mode analysis is possible across the entire mass range using pure He as a collision gas. The benefits of a single analysis mode are clear: reduced instrument set-up and no mode switching delays leading to increased sample throughput and reproducibility. Unlike instruments that require the use of multiple analysis modes for the analysis of routine environmental, clinical and food samples, sensitivity in He QCell KED mode for the low mass elements on the iCAP Qc is more than sufficient while higher sensitivity is there where it's needed at high masses. He QCell mode provides predictable, reproducible interference reduction in all sample types. Through the use of intelligent sample introduction, analysis times are radically reduced thereby driving sample throughput and providing a rapid return on investment.

With the optional high performance interface, the class leading iCAP Qc ICP-MS is the analytical solution to high end applications. For example, the high elemental sensitivity and low backgrounds make the iCAP Qc the ideal instrument for coupled applications, for example in speciation and laser ablation studies. Control of He (for laser) and O₂ (for organic mobile phases in LC applications) are possible from optional mass flow controllers located within the iCAP Q casing. With plug-in software control of commonly used ICP-MS accessories direct from within the Qtegra software platform, there is no need for additional software packages to control accessories or to perform specialised data handling – a complete software workflow within a single software package!

iCAP Qs: Demanding applications made simple

Equipped with an acid resistant sample introduction system and platinum tipped cones, the iCAP Qs is configured for high purity applications. With the high performance interface as standard the iCAP Qs is ideally suited to the analysis of trace and ultra-trace concentrations in high purity process chemicals in the semiconductor industry.

In semiconductor cleanrooms where lab space is at a premium, the iCAP Qs – at only 66 cm wide, the smallest bench-top ICP-MS available – is the ideal partner. The iCAP Q RF generator achieves cool plasma without requiring a grounded shield – improving reliability and lowering running costs. Cool plasma, like any other analysis mode in the Qtegra software, can be combined in multimode labbooks for complete flexibility in analysis and improved sample throughput. The iCAP Qs is equipped with the full range of mass flow controllers – both for gas delivery to the ion source and sample introduction system and to the collision and reaction capable QCell – ready for the most challenging analytical tasks in complicated industrial sample matrices. The ultimate performance with the ultimate flexibility.

Sample Introduction

The sample introduction system on the iCAP Q ICP-MS is positioned directly in front of the seated user: all parts are within arm's reach. With bench height, open access to the iCAP Q ICP-MS sample introduction system, specialized sample introduction systems (e.g. desolvating nebulizers etc) can be easily placed directly next to the ICP source.

The standard sample introduction system consists of high quality, robust components. Low flow nebulizers, cyclonic spray chambers and wide bore injectors ensure the highest plasma robustness in samples containing up to 0.2 % total dissolved solids. All sample pathways are minimized for rapid sample uptake / washout and reduced memory effects. A water cooled peltier is supplied as standard on all models to ensure the highest sample introduction stability.

Designed for all user skill levels, rebuild of the sample introduction system after routine maintenance is simple and straightforward.

Peristaltic Pump

Compact, low pulsation, 12 roller, 4 channel mini-pump with metal free rollers for improved reliability. Three stop flared pump tubing is standard for reduced cost of ownership. Integrated bubble sensors on the spray chamber waste line for improved reliability.

Nebulizer

High performance, concentric nebulizers, glass (iCAP Qa) or PFA (iCAP Qc and iCAP Qs) with ~0.4mL/min sample consumption. Operated in combination with the mini-pump for routine applications and in self-aspiration mode for research applications.

Spraychamber

High purity quartz (iCAP Qa or iCAP Qc models) or PFA (iCAP Qs) low-volume, baffled cyclonic spray chamber, efficiently filters out larger aerosol droplets for improved plasma stability. Reduced surface areas when compared to larger Scott style spraychambers improve sample washout. Compatible with all 6 mm OD nebulizers.

Peltier Cooler

Water cooled peltier cooling of the spray chamber (-10° to +20°C, assuming coolant water at 18 °C) for optimum stability during the analysis of aqueous and organic sample types. Software control for ease of use and flexibility.

Plasma

RF Generator

Argon ICP ion source with new digital, solid state RF generator with dynamic frequency impedance matching to the plasma at ~27 MHz. Unparalleled plasma robustness, enabling high plasma stability even for highly volatile organic solvents.

The power range is PC controlled and continuously variable from 500 W to 1600 W. Low ion energy spread for optimum ion focusing and transmission is obtained without the need of a grounded shield between torch and load coil. Standard operation at 1550 W for a robust plasma and optimum sample decomposition.

Load Coil

Silver coated copper load coil (water cooled) for improved lifetime and reliable plasma ignition. Accessible at bench height for ease of maintenance.

Torch and Torch Holder

Push-in, demountable single piece quartz torch with connection free gas supply. 'Tulip' design for improved plasma stability. All connectivity (argon gas supplies and plasma ignition) designed into the holder, reducing torch complexity and improving usability.

Injector

Proprietary screw-in, self-aligning injector for ease of use and reliability. 2.5 mm ID (internal diameter) quartz as standard to eliminate blocking and to provide robust sample decomposition in the plasma. Easily removable without effecting torch position for improved robustness and reduced maintenance. Optional internal diameters and injector materials are available for all sample requirements.

Plasma TV

Remote monitoring of plasma status via camera.

Gas Control

Coolant, auxiliary and nebulizer gas are controlled by mass flow controllers as standard. Two additional mass flow controllers are available as options.

Interface

Unique front opening interface provides rapid, simultaneous access to cones and extraction lens. Bench height access facilitates routine maintenance of cone exchange, reducing complexity and minimizing downtime. Cones are rapidly removed by a single (magnetic) tool while the extraction lens is bayonet mounted for easy handling.

Sample Cone

Field proven 1.1 mm diameter orifice for minimal deposition when analyzing high matrix samples. Solid Ni construction as standard, Pt tipped as option (standard on iCAP Qs) for increased durability.

Skimmer Cone

Extensive computer modeling and experience in advanced materials technology has been utilized to define the skimmer tip operating temperature, minimizing matrix deposition and prolonging periods between maintenance. Narrow 0.5 mm orifice for protection of the subsequent lens stack. Gas dynamics modelling and experience in ICP-MS interface technology led to a proprietary skimmer insert design to control the plasma boundary and reduce memory effects from previously analyzed samples. A range of inserts are available allowing the user to balance the needs of matrix resistance against absolute sensitivity.

Interface Pump

External, high performance pump to provide backing to the turbo pumps and evacuation of the expansion region for improved sampling from the plasma. Supplied with synthetic, chemically stable, temperature resistant rotary pump oil as standard for improved sample matrix resistance and reduced maintenance. Rotary pump can be positioned away from the instrument for convenience and supplied with an optional acoustic cover.

Extraction Lens

Single extraction lens operated at low voltages for optimum ion extraction and focusing before entry into the RAPID lens. Situated before the slide valve on the same hinged interface door as sample and skimmer cones for easy access without breaking vacuum.

Slide valve

PC controlled. Defaults to closed position when plasma is off or in the event of a power failure, maintaining vacuum in the analyzer housing.

Ion Optics

The iCAP Q ICP-MS transfer lens system includes a unique 90° ion optics system providing high ion transmission across the entire mass range – the RAPID lens: Right Angular Positive Ion Deflection. High ion transmission efficiency is enabled by a low ion energy spread resulting from the new, shield-free ICP source and precise alignment of the individual lens components. The open lens stack eliminates lens cleaning maintenance and a completely off-axis design together with QCell technology delivers a class leading background noise of < 1 cps in all modes. Mass response is optimized for increased low mass sensitivity.

RAPID Lens

90° cylindrical ion lens operating at a single fixed voltage. High ion transmission efficiency by focusing ions of divergent angles, leading to high sensitivity in all modes. Neutrals pass directly out of the 90° lens without interacting with an active lens surface for improved reliability and reduced maintenance.

QCell

Non-consumable due to completely off-axis (interface - collision cell) to ion beam. Smallest cell volume in any ICP-MS for fast gas exchange, with switching and stabilization times of <10s. Proprietary flatapole rod system acts as an ion guide in non-gas mode while in He KED mode it provides powerful interference reduction for a clearer mass spectrum in all sample types. Unique design allows low mass ions to pass through the cell in He KED mode, enabling detection of Li, Be and B.

Quadrupole

Virtual hyperbolic field rods, driven by a solid state, 2 MHz supply ensures low abundance sensitivity (< 0.5 ppm at m-1 (m= ²³⁸U)). All new electronics provide class leading mass stability (< ± 0.025 u / 8 hours). Scan speed: >90000 u/s (Li-U-Li in < 5 ms, 100 µs at each mass). Mass range: 4 - 290 u. In scan, user definable resolution for improved dynamic range and abundance sensitivity. Mass calibration assessed and automatically updated when necessary through One Click Setup.

Detector

New long lifetime detector designed for ICP-MS requirements. Simultaneous analog/pulse counting over 4 orders of magnitude for improved reliability. Dwell times of 100 µs in both detection modes.

Linear dynamic detection range: > 9 orders of magnitude (< 1 - > 1 · 10⁹ cps) accurately measures traces to major matrix ions in a single scan. Intelligent over range protection with One Click Setup for automated assessment and optimization of operating voltages and cross-calibration.

Cradle design for ease of detector exchange without requiring cable connections inside the high vacuum analyzer housing.

Vacuum System

Three stage pumping with split-flow turbo pump for extremely fast gas displacement. In the event of a power failure, high vacuum is maintained and the turbo pump automatically restarts as soon as power is restored. Stable vacuum (< 1 · 10⁻⁶ mbar) is usually obtained in less than 15 minutes pump time for fast return to service after routine maintenance.

Electrical connection of ion optical lenses

All electrical connections to lenses inside the analyzer chamber are achieved via field proven, gold spring contacts mounted into the chamber lid, eliminating wiring and minimizing EMC issues and RF leakage.

Instrument Control

The iCAP Q ICP-MS communicates with the control PC via an optimized data acquisition system with a dedicated onboard processor for high data transfer rates over a high speed USB connection. 'Online' display of fast transient signals (e.g. in chromatographic and laser ablation applications) is achieved without any gaps in data acquisition.

Control electronics

State of the art control electronic boards are mounted directly next to the required analyzer component, minimizing cabling to provide a clean internal area for easier service access and minimum electrical interference.

Desktop PC

Supplied with all iCAP Q models, provides fully automated control of the iCAP Q system by Qtegra in an industry standard Windows® software environment.

Optional iCAP Q Components

Nebulizers

The standard cyclonic spray chamber accepts all types of nebulizers with a 6mm outside diameter. The PFA nebulizer used on the iCAP Q includes a user exchangeable reinforced sample probe.

PFA Spray chamber

While standard on the iCAP Qs, a PFA cyclonic spray chamber is an option on the iCAP Qa and iCAP Qc to provide increased resistance to high levels of mineral acids or when the very lowest detection limits are required.

Injectors

Injectors in a range of internal diameters (e.g. 1 mm for the analysis of organic solvents) as well as materials (e.g. Pt for ultra high purity analysis of semiconductor process chemicals) are available.

Additional gas MFC

Up to two additional mass flow controllers (MFCs) can be added to an iCAP Q system to allow the introduction of gases into the spray chamber (for example O₂ for the analysis of organic solvents) or to supply gases for coupled accessories (for example to add He during laser ablation analyses). Both MFCs are fully integrated into the iCAP Q control software and can be optimized as part of the

One Click Setup. Mass flow controllers of 0-250 and 0-1000 mL/min are available to provide optimum accuracy of gas delivery in different applications.

QCell

The QCell ion guide, as used in the iCAP Qa, can be field upgraded to provide He kinetic energy discrimination (KED) cell capabilities for clearer ICP-MS spectra and subsequent improvements in detection power for interfered isotopes in all samples.

Additional QCell gas MFC

For samples requiring the ultimate in flexibility, a second QCell mass flow controller can be installed in the iCAP Q to allow the use of e.g. reactive gas or reactive gas mixtures in the QCell.

Organics Kit

Organic solvents (e.g. as used in reverse phase LC applications) can be routinely analyzed by utilizing the organics kit comprising of a 1.0 mm quartz injector, a 250 mL/min additional gas MFC and organic solvent resistant waste pump tubing.

Acid Resistant Kit

For the analysis of aggressive sample matrices, for example HF or H₂SO₄, this kit contains a PFA cyclonic spray chamber, a 2.0 mm ID sapphire injector and Pt tipped sample and skimmer cones. Pt injectors are also available for the very lowest Al and Cr background equivalent concentrations (BECs).

Speciation Kits

The iCAP Q ICP-MS can be coupled to a range of IC, HPLC and GC systems to allow for speciation analysis of elements in a variety of sample matrices and applications. A dedicated I/O port is provided on the right hand side of the iCAP Q casing for the straightforward connection of accessories.

Kits for specific Thermo Scientific and Dionex chromatography systems are available. These kits consist of all the necessary parts and, uniquely in ICP-MS, dedicated software plug-ins within the Qtegra iCAP Q control software, which allow for complete bi-directional control of coupled systems and remove the need for an additional software package.

iCAP Q ICP-MS Accessories

Autosamplers

The complete range of CETAC and ESI autosamplers are compatible with the iCAP Q ICP-MS. The autosamplers supported range from small fully-enclosed autosamplers for use in semiconductor laboratories to large multi-rack systems used in high throughput environmental and exploration geology laboratories.

Autosampler housing

A dedicated autosampler (AS) housing is available for the iCAP Q ICP-MS. The AS housing is mounted directly onto the side of the iCAP Q ICP-MS and is compatible with all standard iCAP Q sample introduction systems. Four rack random access autosamplers from ESI and CETAC can be installed inside the AS housing. It is designed for use in laboratories where there is the risk of contamination from the laboratory environment that could lead to increased false positives and potentially expensive forced re-analysis. A positive air pressure of ULPA filtered air supplied to the AS housing provides a clean, safe environment for samples before and during analysis. The iCAP Q is the first ICP-MS system to take care of the sample before it's even analyzed!

Laser Ablation

Laser ablation systems from CETAC, NWR and Photon Machines are directly supported either via the I/O port or from a dedicated plug-in within the Qtegra control software. By working closely with these suppliers the iCAP Q provides a single operating platform for truly routine laser ablation analyses.

Specification Table

Specification	iCAP Q Series		
	iCAP Qa	iCAP Qc	iCAP Qs
STD Mode			
Sensitivity (kcps/ppb)			
⁷ Li ^b	40	50	80
⁵⁹ Co ^b	60	100	200
¹¹⁵ In ^b	150	220	400
²³⁸ U ^b	200	300	500
Detection Limits (ppt)^a			
⁹ Be	< 0.5	< 0.5	< 0.5
¹¹⁵ In	< 0.1	< 0.1	< 0.1
²⁰⁹ Pb	< 0.1	< 0.1	< 0.1
Oxides (%)			
CeO/Ce ^b	<2	<2	<2
Double Charged (%)			
Ba ⁺⁺ /Ba ^{+b}	<3	<3	<3
Background (cps)			
m/z 4.5 ^b	<1	<1	<1
Stability (%RSD)			
Short Term ^b	<2 (10 min)	<2 (10 min)	<2 (10 min)
Long Term	<3 (2 h)	<3 (2 h)	<3 (2 h)
Isotope Ratio Precision (%RSD)			
¹⁰⁷ Ag/ ¹⁰⁹ Ag	<0.1	<0.1	<0.1
He Cell Mode			
Sensitivity (kcps/ppb)			
Co ^b		30	50
Background (cps)			
m/z 4.5 ^b		<0.5	<0.5

^a: Typical values, dependent on cleanliness of chemicals

^b: Demonstrated on installation

Site Requirements

Environmental

Temperature	Range	15-35 °C
	Rate of Change	<2°C/h
Humidity	Range	20-80% (non-condensing)

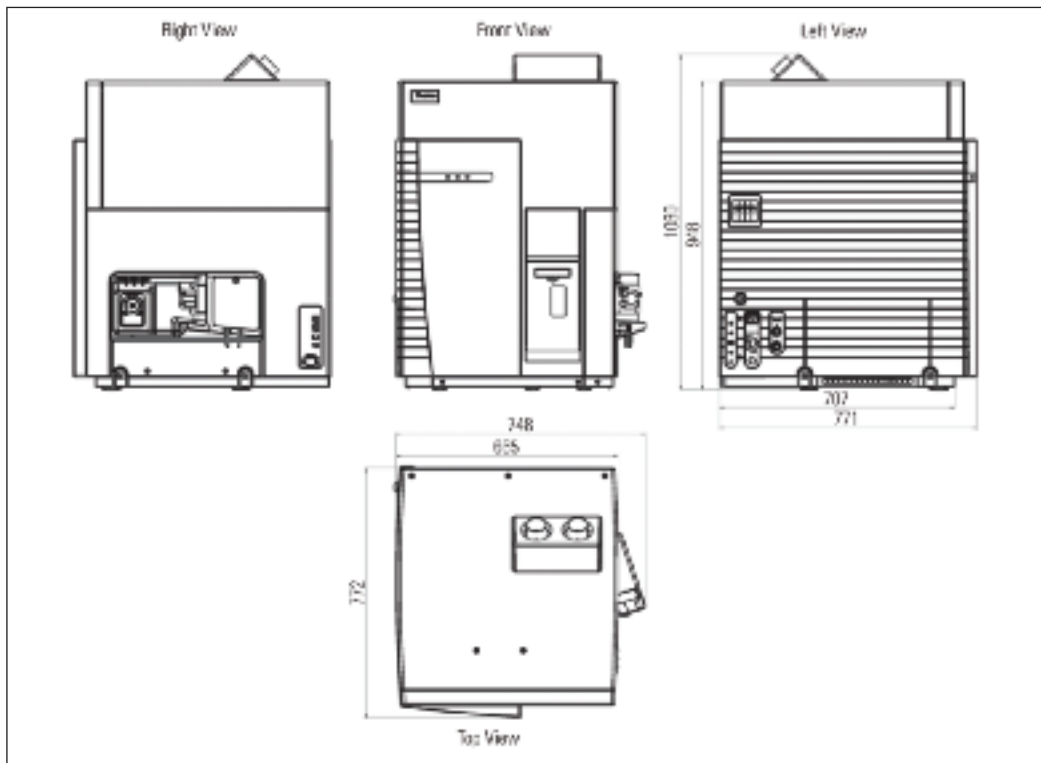
Utilities

Electrical	Supply	Three phase, 230 (± 10%), 50/60Hz, 6A per phase
Cooling water	Supply temperature	15-25 °C, opt. 21 °C
	Flow rate	>5.5 L/min
	Pressure	0.25 - 0.55 MPa (2.5 - 5.5 bar; 36 - 80 psi)
Argon gas supply	Purity	>99.996 %
	Flow rate	>20 L/min
	Pressure	0.6 MPa (6.0 bar; 90 psi)
Cell gas supply	Purity	>99.999 %
	Flow rate	>10 mL/min
	Pressure	1 bar (15 psi)
Plasma exhaust	Port Dimensions	60.3 mm (recommended 63 mm ID ducting)
	Flow rate (63 mm ID ducting)	6 - 8 m/s (67 - 90 m ³ /h; 39.4 - 53.0 cfm)
Heat exhaust	Port Dimensions	60.3 mm (recommended 63 mm ID ducting)
	Flow rate (63 mm ID ducting)	4 - 6 m/s (45 - 67 m ³ /h; 26.5 - 39.4 cfm)

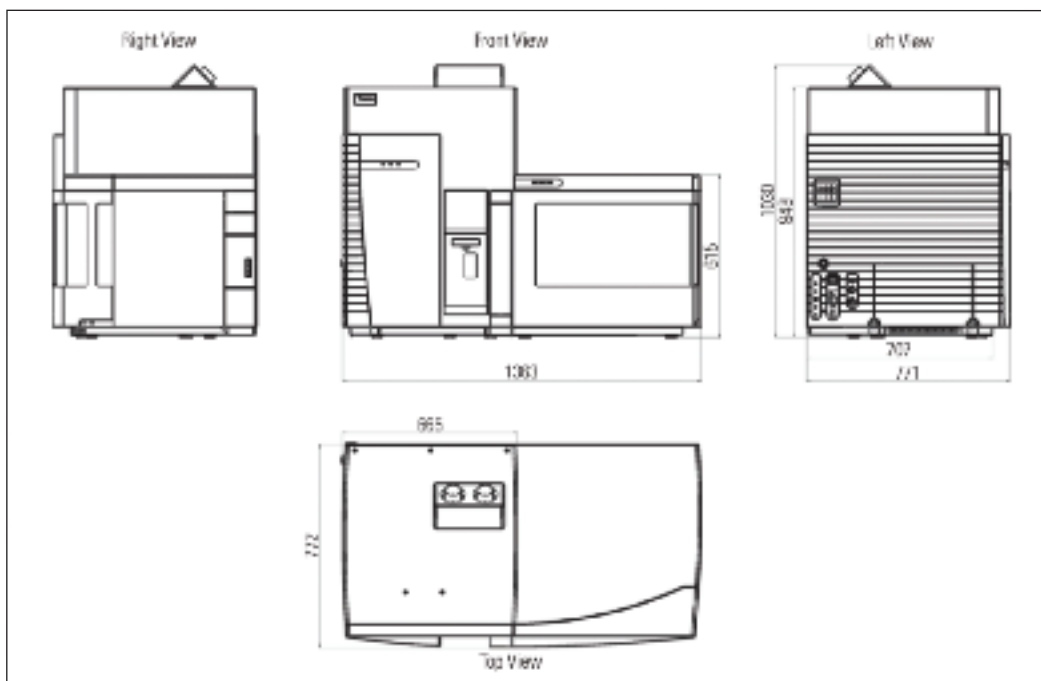
Model configurations

	iCAP Qa	iCAP Qc	iCAP Qs
Nebulizer	Borosilicate glass	PFA	PFA
Spray chamber	Quartz, cyclonic	Quartz, cyclonic	PFA, cyclonic
Torch	Quartz, demountable, no shield	Quartz, demountable, no shield	Quartz, demountable, no shield
Injector	Quartz, 2.5 mm ID Option: 1.0 and 2.0 mm ID	Quartz, 2.5 mm ID Option: 1.0 and 2.0 mm ID	Sapphire, 2.0 mm ID Option: 1.0 mm and 2.0 mm Pt
Interface	Ni, high matrix robustness Option: Pt, high matrix robustness	Ni, high matrix robustness Option: Ni, high performance	Pt, high performance
Ar Mass Flow Controllers (MFCs)	Three	Three	Four
Additional Mass Flow Controllers (e.g. O ₂ for organics, He for laser)	Option (Two)	Option (Two)	Option (One)
He Cell Gas MFC	Option	Yes	Yes
Additional Cell MFC (e.g. H ₂ /He, O ₂ etc)	Option	Option	Yes

Dimensions of iCAP Q system (mm)



Dimensions of iCAP Q system with optional autosampler housing (mm)



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