

Thermo Scientific iCAP TQe ICP-MS

Discover a new level of triple quadrupole ICP-MS

The Thermo Scientific™ iCAP™ RQ ICP-MS and Thermo Scientific™ iCAP™ TQ ICP-MS allow for robust and reliable analysis of almost all elements in the Periodic Table in a wide variety of sample matrices. However, single quadrupole ICP-MS instruments are sometimes challenged by specific interferences on key analytes. Triple quadrupole ICP-MS is often perceived as complex to operate and not fit for purpose especially in high throughput analysis laboratories. Often, a single quadrupole instrument with the ability to add reactive gases, such as hydrogen or oxygen, is the preferred choice, although a triple quadrupole instrument offers a more powerful and flexible solution.

The ability to resolve interference is strongly correlated with achieving lower limits of detection and the certainty of consistent data quality. Ultimately, incorrect data leads to expensive re-runs of a sample biased by an interference. With the Thermo Scientific™ iCAP™ TQe ICP-MS, a new level of ICP-MS technology is available, specifically designed for the needs of laboratories focusing on robust and reliable analysis of environmental, industrial, food or pharmaceutical samples.

The iCAP TQe ICP-MS offers the ability to remove a wide variety of interferences (including doubly charged ions and interferences created by other elements present in high concentrations) and is perfectly tailored to the demands of laboratories working in analytical science. The system accomplishes full interference removal with only two gases connected to the collision/reaction cell (CRC), therefore reducing analysis time, complexity and ultimately, improving return on investment. The combination of helium and oxygen allows the combination of established methods based on KED with extended capabilities that leverage reactive chemistry for more effective interference removal. A technical and capabilities overview of the iCAP RQ ICP-MS, the iCAP TQe ICP-MS and the iCAP TQ ICP-MS is shown in Table 1.

Table 1. Technical overview on all Thermo Scientific™ iCAP™ Qnova Series ICP-MS systems

	iCAP RQ ICP-MS	iCAP TQe ICP-MS	iCAP TQ ICP-MS
System configuration	Single Quadrupole with QCell CRC – 1 or 2 Cell Gas MFC's	Triple Quadrupole with QCell CRC and 2 Cell Gas MFC's	Triple Quadrupole with QCell CRC and 4 Cell Gas MFC's
Interference removal	Generic using KED – common polyatomics are efficiently removed Option to use selected reactive gases (H ₂ or O ₂) – reduce intense polyatomics on key analytes	Triple quadrupole technology for full interference removal using just He and O ₂	Triple quadrupole technology with highest flexibility to resolve all interferences
Performance	Detection limits satisfactory for most applications	Optimized for best detection limits and full control over all typical interferences (including doubly charged and intense polyatomics)	All options to eliminate every interference – including isobaric overlaps
Lab installation requirements	Simple – Argon + Helium (other CRC gases optional)	Simple – Argon + Helium and oxygen (CRC gases)	More complex – Argon + a variety of CRC gases (e.g. He, O ₂ , NH ₃ etc.)
Software tools to streamline workflows	Straightforward using Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) Software Get Ready, plug-in control for common accessories, full feature set for 21 CFR Part 11 compliance, full feature set for embedded quality control	As for iCAP RQ ICP-MS Plus A new level of method set up using Reaction Finder Method Development Assistant	As for iCAP RQ ICP-MS Plus A new level of method set up using Reaction Finder Method Development Assistant Added flexibility for researchers and experienced users
Ideal for	Laboratories in applied analytical science	Laboratories in applied analytical science, that have problems with false positive results caused by interferences	Laboratories in strongly research orientated or tasked with complex challenges

Why is a triple quadrupole ICP-MS superior for interference removal?

The use of a reactive gas over helium sometimes leads to an improvement for certain analytes when using a single quadrupole ICP-MS instrument. Some reactive gases are occasionally used:

- Hydrogen is often applied to reduce intense polyatomic interferences, such as ⁴⁰Ar¹⁶O⁺ and ⁴⁰Ar₂⁺. Reducing these interferences enables detection of elements like Ca, Fe or Se using more abundant isotopes (e.g. ⁸⁰Se over ⁷⁸Se, ⁵⁶Fe over ⁵⁷Fe etc.) and ultimately, achieve better limits of detection. Outside of these examples, the use of hydrogen does not offer great improvement.
- Oxygen enables the elimination of a variety of interferences, mostly by oxidation of the analyte (e.g., conversion of ⁷⁵As into ⁷⁵As¹⁶O⁺ and subsequent detection on *m/z* 91). Another example is sulfur, where conversion of ³²S⁺ into ³²S¹⁶O⁺ is the only way to overcome the intense ¹⁶O₂⁺ interference.
- Ammonia (NH₃) is often used to neutralize polyatomic interferences (for example chlorine based) on elements such as vanadium or chromium.

As can be seen from the examples above, all of these gases address only a limited number of elements, so that multiple gas changes need to be included in a method providing best performance for all elements. In addition, when using a single quadrupole ICP-MS instrument, the use of reactive gases such as O₂ and NH₃ may lead to a variety of side reactions with other elements (or ion species) present in the ion beam, therefore, bearing the risk of new interferences causing a bias on other analytes.

Using oxygen in combination with triple quadrupole technology allows for a significantly streamlined workflow and full interference removal for all mentioned analytes (plus a variety of others) in a single run per sample. The combination of an added mass filtration before the CRC (only possible on a dedicated triple quadrupole system) enables complete removal of all other ions potentially reacting in a similar way, and hence eliminating the risk of unwanted side reactions.

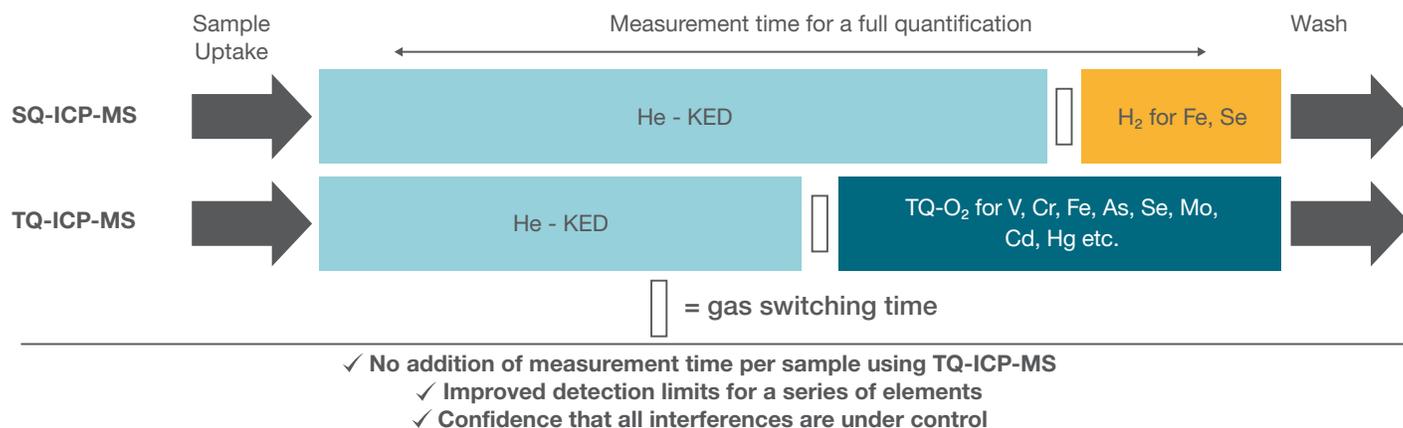


Figure 1. Comparison of sample turnover times between SQ and TQ-ICP-MS based methods (assuming identical timing for sample uptake and washout)

The potential impact on sample turnaround times can be minimal (compared to a method using a combination of two measurement modes on a single quadrupole instrument), whilst providing a great potential for improving detection limits and confidence in results. Figure 1 shows the sequence for a full quantitative analysis for a typical suite of elements on a single quadrupole ICP-MS instrument (using a combination of He KED and H₂ for reduction of argon based polyatomics on ⁵⁶Fe and ⁸⁰Se) and a triple quadrupole instrument, using a switch between He KED and TQ-O₂ mode. TQ-ICP-MS analysis delivers many improvements, not only for special analytes, with no prolongation of the measurement time per sample compared to SQ-ICP-MS.

- Use all your established methods and complement them with the power of triple quadrupole ICP-MS for superior interference removal
- Easy installation: Same space requirements as the single quadrupole iCAP RQ ICP-MS, only an additional oxygen line is required for provision of the CRC gas.
- Full compatibility of all existing accessories and consumables.
- User friendly Qtegra ISDS Software featuring the Reaction Finder Method Development Assistant for consistent, everyday operation and streamlined method development.

What is the benefit of the iCAP TQe ICP-MS?

The iCAP TQe ICP-MS allows a new level of interference removal and data quality to be achieved. With only minimal additional installation requirements, the iCAP TQe ICP-MS provides a significant step forward in reducing the number of samples failing because of false positive results, improves detection limits for a variety of analytes, and assures consistent results regardless of the sample matrix. At the same time, its unique user-friendly design allows different sample matrices to be flexibly analyzed, and reduces downtime for maintenance in a busy laboratory. With the new iCAP TQe ICP-MS, triple quadrupole interference removal combined with unique ease of use can be readily achieved in practice.

Find out more at thermofisher.com/TQ-ICP-MS