

NexION® 1100 ICP-MS Comprehensive Specifications

SPECIFICATIONS

ICP - Mass Spectrometry



PerkinElmer, a renowned leader in ICP-MS technology for over four decades, has continually driven advancements in the field, delivering exceptional analytical performance and operational efficiency, while bringing an enhanced user experience to laboratories worldwide performing trace-elemental analyses. Among the latest innovations, the NexION® 1100 ICP-MS system utilizes a single gas channel on the Universal Cell for exceptionally simple yet powerful interference removal, to meet all your routine analysis requirements.

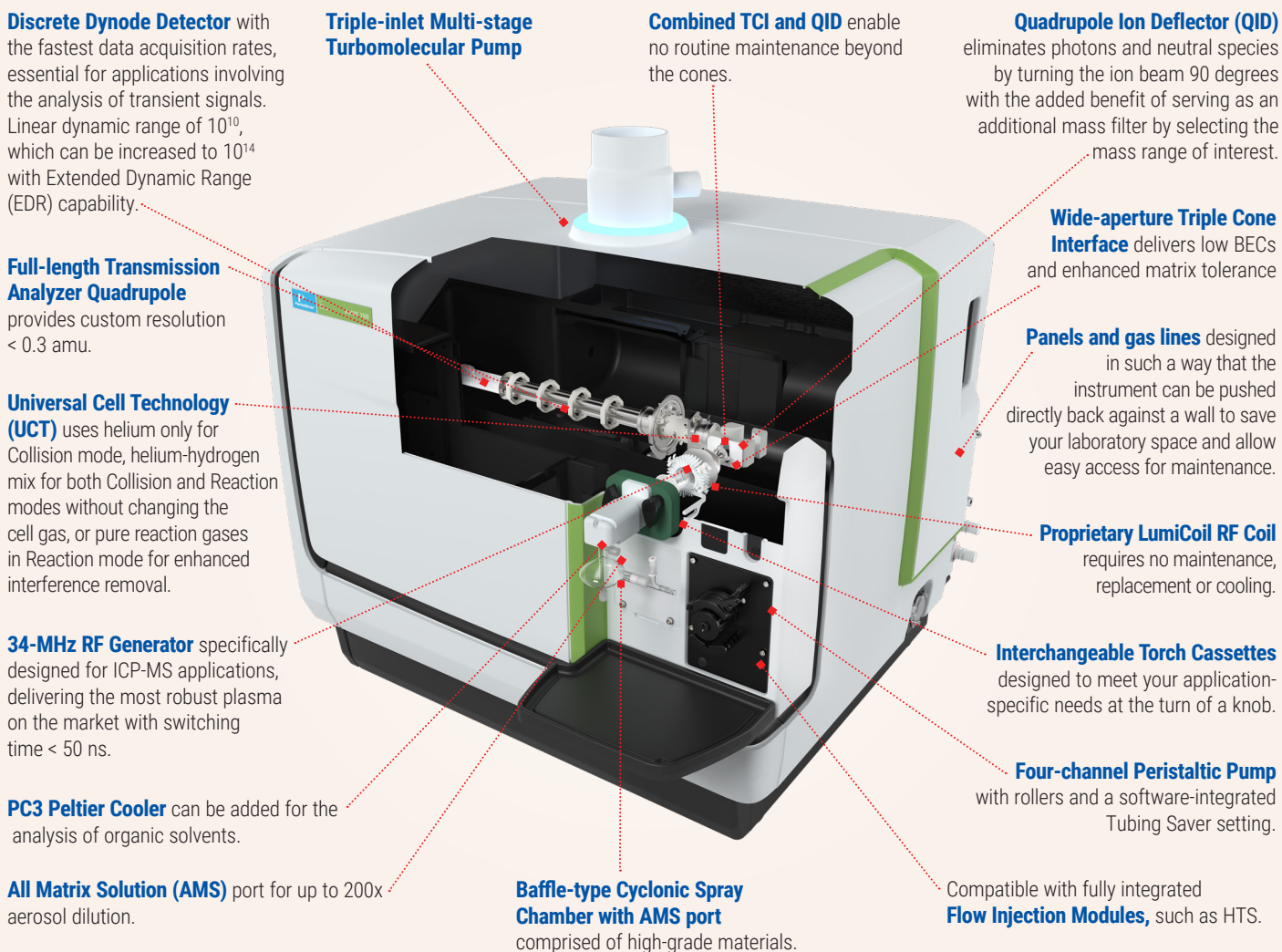
In addition to helium, which is used as collision gas in Collision mode with kinetic energy discrimination (KED), the single gas channel is also capable of utilizing PerkinElmer's patented helium and hydrogen gas mixture as a collision gas in KED mode. The NexION 1100's daily operation is made even more efficient by using the same helium and hydrogen gas mixture as reaction gas in the Reaction mode using dynamic reaction cell (DRC) technology, extending the interference removal power of the single gas channel, without the need to change gases. The NexION 1100 is also designed to be flexible and future-proof. If ultimate interference removal capability with other types of pure reaction gases is needed, the system can be upgraded with one or two additional gas channels.

Alongside the innovations of the NexION 1100 instrument is Syngistix™ for ICP-MS software. Starting with version 4.0, the software brings a new user-friendly and modern FastQuant™ Data Viewer module that is plug-and-play and requires minimal training. The FastQuant Data Viewer is user-centric and interactive and provides a completely new experience to review, process and export data. Together with the modern LCD touchscreen and LED lighting on the instrument, users can reap the rewards of the contemporary era.

These unique capabilities of the NexION 1100 ICP-MS are complemented by additional proprietary features, which you will learn more about further in this document.

KEY BENEFITS:

- Superior operational efficiencies
- Easy and effective interference removal
- Modernized user experience
- Low cost of operation and sustainability
- High matrix tolerance



Syngistix for ICP-MS Software (v. 4.0 and higher) provides database backend for easier LIMS and external system integration, plus modern and interactive FastQuant Data Viewer for easier review, processing and exporting data.

LCD Touchscreen and LED Lighting optimize user experience and interaction

Figure 1. Key components of the NexION 1100 ICP-MS system.

Overview: NexION 1100 Single Analyzer Quadrupole ICP-MS

Among the most recent technological advancements in ICP-MS, in 2024 PerkinElmer introduced its NexION 1100 ICP-MS, which employs a single gas channel (with upgrade options) for simple, yet powerful interference removal capability for routine applications, using both kinetic energy discrimination (KED) and dynamic reaction cell (DRC) technology without changing the gas (when using helium and hydrogen gas mixture).

The system inherited the low-maintenance requirements from the NexION family and provides superior sample throughput with proprietary technologies such as the Extended Dynamic Range (EDR) electronic dilution, the All Matrix Solution (AMS) on-the-fly gas dilution and the High Throughput System (HTS) flow injection sample introduction.

Syngistix for ICP-MS software version 4.0 and higher now includes the FastQuant Data Viewer that is built based on the database

backend, providing a modern look and feel, while allowing users to interact with the data in a simpler and more straightforward fashion with minimal training required.

Together with other proprietary technologies, the NexION 1100 delivers analytical performance and exceptional robustness, while upleveling user interaction.

These unique technologies will future-proof your ICP-MS purchase, delivering:

- Operational efficiency
- Simple yet powerful interference removal
- Excellent stability and robustness
- Lowest maintenance
- Modernized user experience
- Sustainability and low cost of operation
- Unmatched matrix tolerance

Operational Efficiency

The NexION 1100 ICP-MS is engineered to effectively improve laboratory efficiencies, mitigating the rigorous turnaround requirements of today's labs conducting elemental testing.

The NexION 1100 leverages a single gas channel, providing a universal solution for most elements without the need to switch gases or develop complex multi-gas methods. With the single gas channel, helium, helium-hydrogen gas mixture or other inert gases can be used as collision gas in Collision mode. The helium-hydrogen (HeH) gas mixture, or other pure reaction gas – for instance ammonia, oxygen and methane – can be used in Reaction mode. The advantage of PerkinElmer's single-gas-channel ICP-MS is that when the helium-hydrogen gas mix is used, the user can easily switch between Collision and Reaction modes without the need to change gases, providing ultimate convenience for a wide range of routine applications.

In addition to the convenience of a single gas channel, the NexION 1100 is also a future-proof ICP-MS solution. In case more gas channels are needed for other pure reaction gases, upgrade kits and installation are available, so the NexION 1100 can become even more powerful.

To further enhance day-to-day lab efficiency, the NexION 1100 gas manifold and electronics are optimized, reducing time to pressurize and depressurize to three seconds for faster switching between Standard and Collision modes. The NexION 1100 is also compatible with the High Throughput System (HTS) flow injection module, reducing the sample uptake, stabilization and washout times. This improves sample throughput to as low as 55 seconds per sample for 56 elements, while maintaining stability by lowering carryover contamination.

The NexION 1100 inherits the quadrupole Universal Cell Technology (UCT) from the NexION family, therefore Extended Dynamic Range (EDR) comes standard, utilizing RPa to selectively attenuate sensitivity by masses, therefore extending the dynamic range up to 14 orders of magnitude, so low and high concentrations of analytes can be analyzed in a single run.

To overcome the matrix suppression and deposition on the cones from high-matrix samples, especially those with high total dissolved solids, the NexION 1100 offers the All Matrix Solution (AMS) system to minimize manual dilution. By introducing a flow of argon into the spray chamber neck, the aerosol stream is diluted. The flows of the dilution and nebulizer argon gases can be adjusted while maintaining a constant flow to the torch, where the ratio of the flows determines the dilution factor. By varying the flows, a universal dilution up to 200 times across the mass range can be achieved.

Simple Yet Powerful Interference Removal

The heart of the NexION 1100 is its Universal Cell Technology (UCT), enabling both Collision (KED) and Reaction (DRC) modes in a single collision/reaction cell.

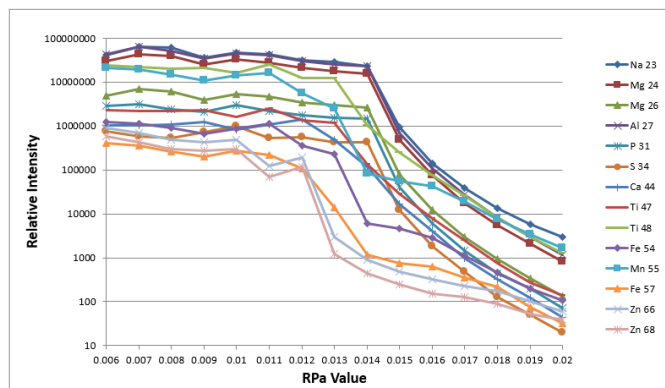


Figure 2. Graphical display of EDR impact on signal intensity – approximately 4 orders of magnitude signal attenuation can be achieved.

With helium-only or helium-hydrogen gas mixture, Collision mode uses cross-sectional collisions and energy barrier to effectively discriminate molecular ions from the target analytes, therefore reducing the polyatomic interferences. It is a simple, versatile, yet effective solution for most of the routine applications, with simply one set of operating conditions, a single gas channel, and no need for extensive optimization.

The NexION 1100 ICP-MS is also capable of the powerful Reaction mode using helium-hydrogen mixed gas, or other pure reaction gases such as ammonia, oxygen, hydrogen and methane. The reaction gas can remove the most challenging spectral interferences in a controlled environment by adjusting the dynamic bandpass tuning parameters (RPq), a feature proprietary to quadrupole-based cells, so unwanted reaction byproducts are eliminated, thus lowering the background equivalent concentrations (BECs) and instrument detection limits (DLs). With the innovation on the cell gas manifold and associated electronics, the helium-hydrogen mix gas flow is further enhanced, resulting in even better interference removal on Ar^2 species and lower detection limits for a number of masses, for example Se^{80} , as shown in Figures 3 and 4.

Unlike traditional single-quad systems, the NexION 1100 ICP-MS delivers three stages of mass resolution. A clean, focused ion beam is introduced into the ion optics, enabling you to control interferences as early as the Quadrupole Ion Deflector (QID – Q0). In the NexION 1100 ICP-MS, the ion beam is shaped and directed within Q0 with the additional benefit of being able to reduce ions outside the mass range of interest, thereby preventing additional interferences from forming in the cell. Thereafter, the ion beam is passed into the quadrupole Universal Cell (Q1) for either a controlled reaction, collision or no reaction, and the mass of interest is separated by its mass-to-charge ratio in the Transmission Analyzer Quadrupole (Q2). This combination allows the system to deliver outstanding background equivalent concentrations (BECs) and detection limits (DLs) for most elements and delivers repeatable and reliable cluster formation, reducing the risk of interferences at the cluster mass due to the mass cut-off which occurs in the QID.

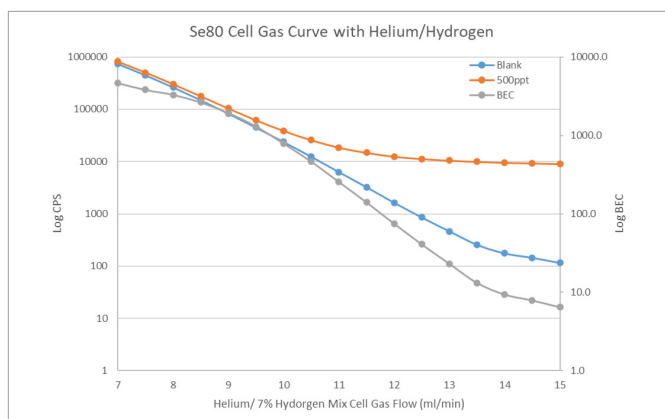


Figure 3. Cell Gas optimization of ⁸⁰Se using helium-hydrogen mix showing calculated BECs from the 500 ppt and blank.

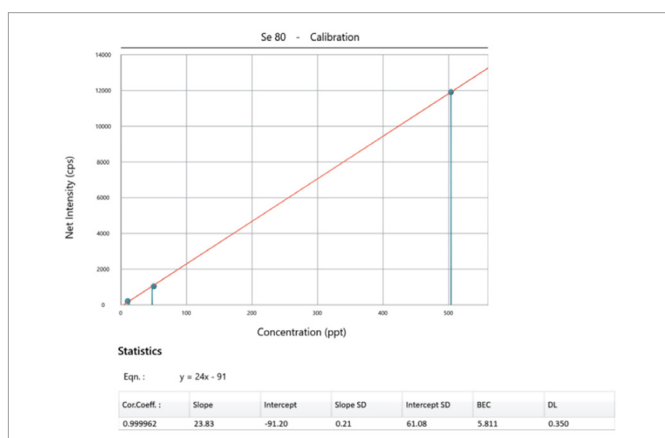


Figure 4. Sub-ppt DL for Se⁸⁰ with helium-hydrogen mixed gas in Reaction (DRC) modes.

Excellent Stability and Robustness

Everything about the NexION 1100 ICP-MS says stability and robustness – for your instrument and your results (Figure 5). For example, its free-running 34-MHz RF generator delivers the fastest impedance matching on the market. Plus, its Triple Cone Interface with wide-aperture cones offers unparalleled resistance to clogging even for tough matrices. And finally, the ability to use helium, helium-hydrogen mixed gas, or pure reaction gases in its Universal Cell, a true quadrupole, ensures that the collision and reaction are stable and reproducible.

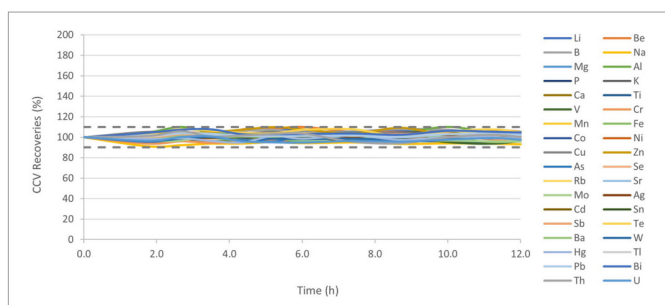


Figure 5. Example of continuing calibration verification (CCV) recoveries throughout a 12-hour drinking water samples sequence.

Lowest Maintenance

Regardless of your industry, uptime is key to keeping your lab running at peak productivity. That’s why the NexION 1100 system eliminates virtually all non-routine maintenance requirements, ensuring unsurpassed instrument uptime. First, our LumiCoil™ technology is guaranteed for the life of your instrument and requires no water or gas cooling. Also, the system’s Triple Cone Interface reduces the spread of the ion beam through a three-step drop in pressure between the atmosphere and the high-vacuum regions of the ICP-MS and produces a tightly focused ion beam – plus, the cones are located outside the vacuum for quick, easy access. The wide-aperture cones maximize signal stability and minimize cone clogging during extended high-TDS sample runs. What’s more, the patented combination of the Triple Cone Interface and Quadrupole Ion Deflector controls and focuses the beam in the downstream ion optics, ensuring that there is no routine cleaning beyond the cones. Furthermore, in contrast to many collision cells on the market, the Universal Cell does not require frequent replacement over the instrument’s lifetime, ensuring you can rely on the robustness of the system for years to come.

In addition to all its low-maintenance features, the NexION 1100 ICP-MS is also designed for better serviceability to further optimize your uptime. And PerkinElmer factory-trained service engineers will be at your disposal for all your maintenance and repair requirements.

Modernized User Experience

The NexION ICP-MS series has consistently aimed to deliver a streamlined user experience, providing a quick and smooth hands-on.

Syngistix for ICP-MS software is designed to mirror the actual user workflow with an icon-based, left-to-right navigation pane that walks users through day-to-day operation from startup, optimization, method development, and sample analysis to data review and reporting. Further optimizing the user experience is the PostgreSQL-based database backend, available in Syngistix for ICP-MS software version 4.0 and higher.

Utilizing the database backend, an out-of-the-box framework is provided so API can be configured to interface different LIMS/ELN with quick and easy setup to save costly implementation.

- From the sample/batch in the software, users can open batches/jobs provided directly from LIMS
- Datasets associated with the batches/jobs generated by NexION can be sent directly from Syngistix software to the LIMS system

Another benefit of the new database backend is the brand new, interactive FastQuant Data Viewer that is designed to aid labs with high-throughput requirements and high staff turnover. The Data

Viewer provides an easier-than-ever experience when performing data review, data reprocessing and data output.

- Modern looking four-quadrant FastQuant Data Viewer, that is plug-and-play with minimal training needed.
- Independent browser-based (no internet connection needed) application that enables independent data review and processing from anywhere, at any time and at any point of your analysis
- It is designed to be interactive so users can configure their own workspace and view relevant data by clicking Analyte, Sample or Replicates.
- And even perform data reprocessing on the fly in the FastQuant Data Viewer by changing calibration, reassigning internal standards and removing replicates etc.
- The FastQuant Data Viewer and data processing functions on the Enhanced Security™ software are fully compliant with 21 CFR Part 11 thanks to:
 - The ability to apply user-permission control in FastQuant Data Viewer
 - A full audit trail
 - Version histories with easy revert-back
 - Saving changes with electronic signatures
 - Full review/approval workflows

What's more, the NexION 1100 uplevels user experience for its operators. The instrument comes with a powerful, yet simple, built-in LCD touchscreen. The touchscreen houses complimentary information while the graphical user interface is designed to be so simple that users can perform critical day-to-day missions, including hardware control, real-time data review, instrument parameter diagnostics, analytics and even access to embedded training videos. Plus, with the LED lighting on the instrument, users can monitor the instrument and check its status without going into the control software.



Figure 6. Example of LCD touchscreen, displaying Analytics window.

Sustainability and Low Cost of Operation

Among the highest running costs for laboratories using ICP-MS are plasma gases and power consumption from both the instrument and the cooling device.

The NexION 1100 ICP-MS boasts a host of features that help laboratories reduce running costs, improving their bottom line – while at the same time be much more sustainable.

Thanks to its efficient plasma generation and LumiCoil RF coil design, the NexION 1100 consumes as low as 12 L/min argon gas at 1300W RF power and doesn't require a special torch or hardware. At the same time, the unique quadrupole collision/reaction Universal Cell with dynamic bandpass tuning can optimize the collision and reaction in the cell, while using low flows of gas to remove interferences. In Collision mode, typical helium gas flow can be less than 4 mL/min, generating less gas waste than traditional collision cells. And in Reaction mode, typical reaction gas consumption is less than 1 mL/min.

Accompanying the NexION 1100 is the optional innovative GreenCT™ cooling system. Unlike conventional chillers, GreenCT uses a cleaner, greener and more affordable coolant, while consuming much less power and generating less waste.

And last but certainly not least, All Matrix Solution (AMS), Extended Dynamic Range (EDR) and High Throughput System (HTS) capabilities all reduce sample and washout runtime and reduce the chance for sample reruns, in turn minimizing the consumption of instrument power as well as chemical waste.



Figure 7. GreenCT cooling system.

Unmatched Matrix Tolerance

The NexION 1100 ICP-MS is ideal for laboratories requiring reliable, stable and reproducible data in a variety of different matrices, from aqueous to organic, from ultrapure water (UPW) to high total dissolved solids (TDS). Its powerful All Matrix Solution (AMS) sample introduction system is able to deliver up to 200x dilution and support samples even with 35% total dissolved solids (TDS) without the need for off-line dilution. Moreover, alternative gases, such as oxygen, can be introduced into the spray chamber to burn-off excess carbon in organic samples, thereby reducing cone clogging in these matrices. Plus, the innovative solid-state, free-running RF generator with unique LumiCoil technology provides accurate impedance matching to easily handle even the most difficult matrices. Furthermore, the patented design of its wide-aperture Triple Cone Interface dramatically reduces clogging of cones, allowing for outstanding matrix tolerance.

Specifications

The three quadrupoles of the NexION 1100 ICP-MS can be outlined as follows:

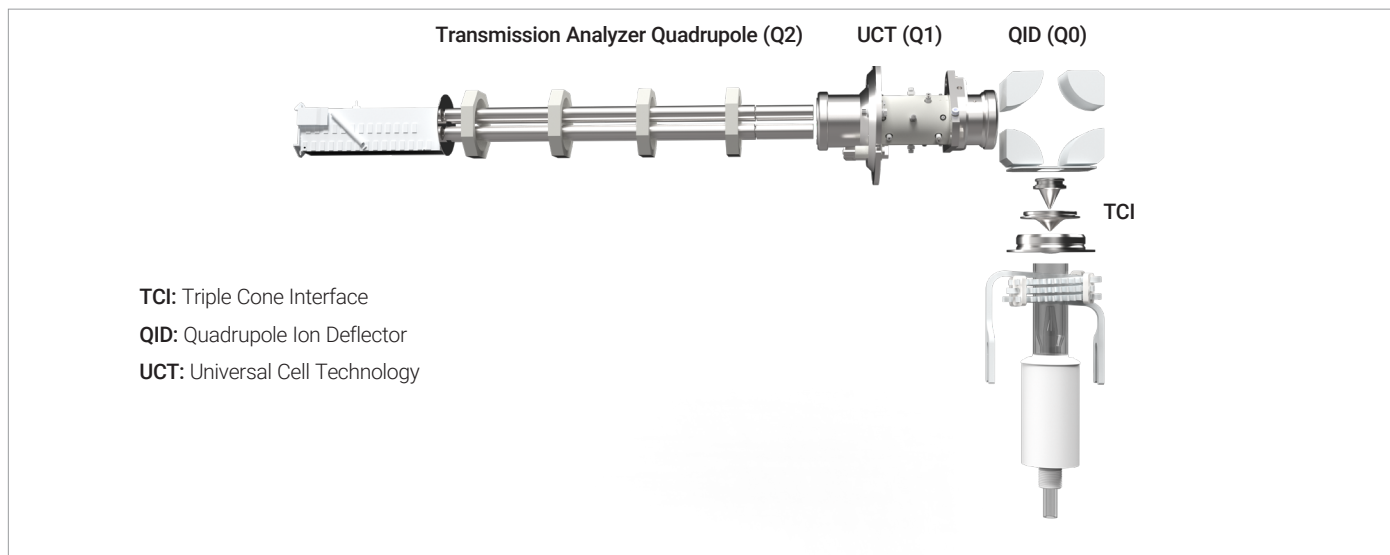


Figure 8. NexION 1100 ICP-MS ion optics with three quadrupoles designated by Q0, Q1 and Q2 respectively.

- **First:** Quadrupole Ion Deflector (Q0) directs ions to the Universal Cell (Q1) and Transmission Analyzer Quadrupole (Q2).
- **Second:** Quadrupole Universal Cell (Q1), empowered by dynamic bandpass tuning, creates a controlled environment for effective interference removal through dynamic reactions with reactive gases or collisions using non-reactive gases.
- **Third:** Transmission Analyzer Quadrupole (Q2, full-sized with < 0.7 amu mass resolution for normal operation and custom resolution to < 0.3 amu), with the highest duty cycle on the market, is ideal for applications requiring short dwell times.

Q0: Quadrupole Ion Deflector

The Quadrupole Ion Deflector (QID) is an electrostatic analyzer that turns the analyte ion beam 90 degrees. The QID can operate with either a non-fixed or fixed voltage. With a non-fixed voltage, the transmission of ions across the low-, mid- and high-mass ranges is optimized. In the case of a fixed voltage, a software-controlled fixed voltage is applied to the QID to maximize the transmission of target ions within a specific mass range into the Universal Cell, thereby improving sensitivity for the analyte of interest, while reducing ions outside the mass range of interest and eliminating the transmission of photons and neutral species to the mass spectrometer via the vacuum.

Since the ion beam is focused through the use of the Triple Cone Interface (TCI), analyte ions and neutral species don't touch surfaces in the QID, ensuring cleanliness and no routine maintenance beyond the cones as well as superior stability and robustness. Moreover, the kinetic energies of the ions exiting the QID are similar (< 10 eV), ensuring that the ions entering the cell all have a similar kinetic energy to ensure more reproducible collisions and reactions.

Q1: Quadrupole Universal Cell

The Universal Cell, standard in all NexION ICP-MS systems, is a true quadrupole-based cell driven by frequency modulation.

Unlike higher-order multipoles which have less-characterized and less-stable quadrupole fields, the Universal Cell is aptly named due to its universal ability to effectively remove interferences via reaction with dynamic bandpass tuning (DBT) or collision with KED. The Universal Cell is designed to provide: effective collision for simple polyatomic interference removal for most analytes in most matrices; or the best out of reaction chemistry to deliver the lowest BECs and DLs for the most demanding applications. The cell is further empowered by Axial Field Technology (AFT), which ensures that ions undergoing reaction do not lose kinetic energy, leading to improved sensitivity, reduced residence times for ions in the cell and keeping the formation of higher-order product ions in check.

The modes of operation of the cell are summarized as follows:

Reaction (DRC) mode with the capability to run the helium-hydrogen gas mixture, or 100% highly corrosive gases in a single gas channel (with upgrade options to two or three channels) at typical flows < 1 mL/min. If upgraded to multiple gas channels, reaction gases may be combined in the cell to provide enhanced interference removal and detection capabilities. Reaction mode is ideal for applications demanding the best performance, with minimal loss of analyte sensitivity, and an unprecedented level of interference removal. Reactive gases – such as ammonia, oxygen, hydrogen, carbon dioxide, methane etc. – are introduced into the cell to create predictable chemical reactions with either the analyte or interferent ions, as well as predictable and reproducible cluster formation for cluster-forming ions, such as Ti, Zn, Ge etc. Reaction by-products are prevented through dynamic bandpass tuning, controlling side reactions from taking place by rapidly destabilizing

reaction by-products before they have a chance to form new interferences, a unique feature only available in quadrupole reaction cells. In the quadrupole Universal Cell, low and high mass cut-off windows can be applied as needed per analyte, allowing custom settings and providing full flexibility during the analysis, all of which contribute to more accurate results and lower BECs.

Collision (KED) mode is compatible with a variety of collision gases. For the removal of unknown spectral polyatomic interferences, Collision mode is especially useful. In this mode, non-reactive gases, such as helium, or slightly reactive gas mixtures can be introduced into the cell to collide with the ions that are travelling through it. Since many interfering polyatomic ions tend to have larger diameters (collisional cross section) than the analyte ion, they will be subjected to more collisions than the analyte. These extra collisions mean that the interfering ions lose more kinetic energy and, as such, are removed through kinetic energy discrimination (KED). This mode delivers much better detection limits than Standard mode for some elements, while keeping the convenience of less complex method development, and no corrosive gases used. Collision mode should meet the requirements for most of the routine applications.

Standard mode (no gases added) is typically used for elements which do not have interferences or have isobaric and minor polyatomic interferences. There is no loss of sensitivity using this mode of operation, and interferences are dealt with using correction equations, however this may result in the over- or under-estimation of results.

Q2: Transmission Analyzer Quadrupole

This full-length Transmission Analyzer Quadrupole (Q2) only allows ions of a specific mass to be passed through to the detector, while all other ions not at the desired mass are removed. It has been engineered to deliver < 0.7 amu mass resolution (preferred for normal operation) with custom resolution to < 0.3 amu and is driven by a high-frequency 2.5-MHz power supply. Its carefully designed rods produce a perfect hyperbolic field, delivering optimal resolving power and ion-transmission efficiency. This quadrupole is designed using state-of-the-art alloy materials, exhibiting negligible thermal expansion. This guarantees rigid structural integrity along the entire length of the rod, ensuring exceptional mass calibration stability. All rods are carefully inspected prior to assembly and aligned to ensure maximum ion transmission for greater sensitivity.

Abundance Sensitivity

For the NexION 1100 ICP-MS, abundance sensitivity is measured at the highest naturally occurring isotope, ²³⁸U.

Owing to the unique design of the NexION 1100, the system delivers better than 5.0×10^{-7} at the low mass side of the peak.

Cell Gas Channels

The NexION 1100 ICP-MS is equipped with a single-channel cell gas control manifold that allows the introduction of pure reaction or collision gases or gas mixtures. In addition, additional flexibility is provided with options to upgrade the cell gas manifold to two channels or three channels for more reaction capabilities. With the upgrade, the NexION 1100 gains the ability to mix reaction gases inside the cell.

Vacuum System

Operating pressure is maintained in the event of an argon gas supply failure. In the event of a power failure, the ion optics backfill with argon to prevent contaminants from entering them.

Operating pressure is obtained in less than 15 minutes pumping time.

Turbo Pump: The triple-inlet multi-stage turbomolecular pump maintains vacuum $\leq 1e^{-6}$ Torr (with no cell gases) during operation. This system is purged by an inert gas during operation to prevent damage by reactive gases and/or corrosive vapors, such as those generated by the analysis of phosphoric acid.

Interface Pump: The system is backed by a single high-performance external roughing pump that is easy to support and maintain. It uses ultra-long-life PFPE fluid. This pump is fully computer-controlled and automatically shifts into power-saving mode when the plasma is off.

NOTE: A pump filter is highly recommended for applications involving high concentrations and the routine analysis of sulfur compounds. Please contact your PerkinElmer sales representative about available options.

Detector

The system uses a highly sensitive and stable dual-stage discrete-dynode electron multiplier, which covers a full 10 orders of magnitude of dynamic range in a single scan. The dual detector system operates from < 0.1 cps to > 10^9 cps. When used in combination with the NexION's unique Extended Dynamic Range (EDR) capability, the system offers up to 10^{14} orders of linear dynamic range. This allows for the accurate analysis of both low- and high-concentration analytes within a single analytical run, resulting in fewer re-runs and less chemical consumption, while ensuring longer detector lifetimes. Being applied selectively per analyte, the EDR functionality does not affect the signal response of other elements and does not call for the addition of gases into the cell.

The system delivers dwell times as short as 10 μ s in both analog and pulse-counting detection modes, essential to ensuring well-defined and resolved transient signals.

The system includes software-automated control of all operating voltages as well as continuous and automatic detector cross-calibration and has easy service access for detector exchange.

Sample Introduction System

SMARTintro Sample Introduction Modules

The SMARTintro™ sample introduction modules of the NexION family are compatible with the NexION 1100 ICP-MS and color-coded to ensure that parts do not get mixed up in the laboratory.

SMARTintro kits for specialized applications include options for HF resistance, organics and geological sample matrices.

4-Channel Peristaltic Pump

The NexION 1100 ICP-MS comes equipped with a fully software-controlled, high-precision peristaltic pump with four channels to draw sample through a capillary into the nebulizer for subsequent aspiration, droplet-filtration and ionization. The 36 mm peristaltic pump head has 12 inert rollers, improving flow consistency and reducing pulsations while also supporting a variety of different speeds from 0-100 rpm.

NOTE: The NexION 1100 ICP-MS is compatible with optional high throughput sampling systems. Please contact your PerkinElmer sales representative about available options.

Nebulizer

The sample is introduced into the plasma at a constant rate using a glass concentric nebulizer, greatly improving measurement precision and long-term stability.

NOTE: Optional compatible nebulizers are available, accommodating a variety of different flow rates, total-dissolved-solids concentrations and demonstrating resistance to organics or aggressive mineral acids. Please contact your PerkinElmer sales representative about available options.

Spray Chamber

The system comes standard with a baffle-type glass cyclonic high-sensitivity spray chamber with the All Matrix Solution (AMS) gas port. These spray chambers are designed to deliver superior aerosol droplet filtration, outstanding sensitivity and low RSDs. The AMS port allows in-situ aerosol dilution of the sample > 200x or the introduction of oxygen while analyzing organics to prevent carbon deposits on the cones (described in detail below).

NOTE: Other compatible spray chambers are available on request. All spray chambers are compatible with the industry standard of 6 mm o.d. nebulizers. Please contact your PerkinElmer sales representative about available options.

High Matrix Samples and Organic Solvents with All Matrix Solution (AMS)

The NexION's All Matrix Solution allows users to run samples with high TDS (such as seawater: > 3.5%; brine: > 25%) without the need for off-line dilution. Also, AMS allows the user to run organic solvents (IPA, NMP etc.) with the addition of oxygen.

The AMS gas flow setup is optimized via Syngistix for ICP-MS software to either use argon as a dilution gas or introduce oxygen gas to burn off excess carbon from the cones in organic solvents.

Peltier Cooler-Heaters

The Peltier cooler-heater (-10°C to 80°C) can be purchased as an option for the NexION 1100 to facilitate the analysis of organic solvents or if lower oxide levels are needed for certain applications.

NOTE: Peltier coolers/heaters that are compatible with either cyclonic or PFA spray chambers are available upon request. Please contact your PerkinElmer sales representative about available options.

Torch

The NexION 1100 ICP-MS sample introduction system comes standard with a quartz one-piece torch and a fixed 2 mm injector, ensuring excellent performance in different matrices. This torch is easily interchangeable with demountable torches, where the injector can be chosen to fit the application. The torch position is fully controlled via software which provides automated X, Y, Z positioning (± 3 mm with 0.05 mm reproducibility), ensuring that maximum ion transmission is achieved, thereby enhancing sensitivity.

NOTE: A variety of different torch designs (fixed and demountable), which accommodate injectors with varying diameters (including 1.0, 1.5, 2.0, and 2.5 mm i.d.) and material compositions, are available on request. Please contact your PerkinElmer sales representative about options.

Torch Cassette

A variety of torch cassettes are available, whereby each torch cassette is color-coded according to the application, taking the guesswork out of the sample-introduction component selection. Optional torch and injector designs are available for:

- Organic solvents
- HF resistance
- Geological
- High TDS sample introduction/best BECs

The ambidextrous design of the torch cassette allows the sample introduction system to be changed with minimal downtime. The self-aligning torch cassette has fully integrated gas and plasma ignition connections and a one-piece torch providing exceptional ease of use for operators of all skill levels. The torch cassette has fully software-controlled and automated X, Y, Z torch positioning (± 3 mm with 0.05 mm reproducibility), ensuring that maximum ion transmission is achieved for optimal sensitivity.

Inductively Coupled Plasma

The NexION 1100 ICP-MS offers the most robust plasma on the market, allowing for the rapid transition between aqueous and organic matrices, cold and hot plasma, delivering unmatched performance and stability.

RF Generator

The NexION line of ICP-MS instruments offers the only RF generator to be specifically designed for ICP-MS. The state-of-the-art 34-MHz free-running solid-state RF generator with PlasmaLok™ delivers the best of both plasma power range and stability. This generator provides accurate impedance matching and adjustable power with 1 watt increments from 400 to 1600 watts and a response time of 50 nanoseconds, quickly adapting to changing plasma loading. With no moving parts aside from the cooling fans, it electrically decouples the plasma from the ion optics, allowing independent adjustment of the ion optic parameters and the plasma conditions.

The RF generator is able to run in Cold Plasma mode (400-800 W) and Hot Plasma mode (1400-1600 W) in a single sample acquisition and can rapidly change between these modes without the need to create multiple methods.

LumiCoil RF Load Coil

The innovative design of the LumiCoil RF coil is unique in that it is air-cooled by the system exhaust and requires no additional infrastructure for water or gas cooling. This eliminates the need for maintenance or replacement of plasma load coils as is often needed with copper RF coils. This novel design ensures that the torch does not require any additional and costly consumables to prevent the secondary discharge of the plasma, such as torch shields, bonnets and screens, and is overall more sustainable than copper coils.

PlasmaLok Interface

PlasmaLok stabilizes energy distribution, thus maintaining excellent spectral resolution and simplifying ion-optic tuning. This is achieved even when the sample matrix dramatically changes, such as going from a wet-sample aerosol (conventional nebulization) to a dry-sample aerosol (laser sampling), from hot plasma to cold plasma, and from aqueous solutions to organics.

Furthermore, PlasmaLok eliminates damage to the interface cones by preventing uncontrolled arcing between the plasma and cones without the need for a plasma shield.

And finally, PlasmaLok minimizes deposition on the cones and reduces double-charged signals, guaranteeing excellent signal precision and long-term stability. Due to the lower amount of deposition on the cones, this feature dramatically reduces the need for routine maintenance and cleaning of the cones.

Clear Plasma View

A true reflection, full-color plasma view window allows for careful, unobstructed and real-time visual inspection of the cones, torch, load coil, sampling depth, and plasma color without needing to extinguish the plasma.

This feature simplifies the optimization of gases when running organic matrices and troubleshooting, allowing early diagnosis and quick response to issues via plasma observations.

Inert Tubing

Cleaned, high-purity stainless steel, low-sulfur cell gas tubing is provided as the standard configuration for lower sulfur backgrounds.

Interface

As with all NexION ICP-MS instruments, the NexION 1100 system offers easy cone access at the touch of a button. The wide-aperture cones ensure less clogging and maintenance. The Quadrupole Ion Deflector (QID) replaces the traditional lens systems adopted in older ICP-MS designs and turns the ion beam 90 degrees to eliminate photons, unionized material and neutral species, cleaning the beam for excellent BECs. With no lenses to clean or maintain after the cones, uptime is dramatically increased as routine maintenance decreases.

Triple Cone Interface

The wide-aperture Triple Cone Interface produces the most tightly defined ion beam in the industry while minimizing space-charge effects, delivering low maintenance and long-term stability. The Triple Cone Interface is easy to remove and clean without opening the vacuum chamber. The details of the cones that come with the NexION 1100 ICP-MS are provided below:

Sampler: Nickel. 1.1 mm diameter orifice. Used to sample ions from the plasma.

Skimmer: Nickel. 0.88 mm diameter orifice. This large diameter offers a nearly 2x larger aperture than 0.4 mm cone orifices, delivering improved signal stability and less cone-maintenance due to clogging during extended high-TDS sample runs.

Hyper-Skimmer: Aluminum. 1.0 mm diameter orifice to produce a tightly focused ion beam that helps the Quadrupole Ion Deflector (QID) to filter out neutrals and photons and ensures no routine maintenance beyond the cones.

Cones are easily removed using a magnetic cone removal tool, which ensures that the cones do not drop and are protected as they are being removed.

NOTE: Other cone materials and cones recommended for sulfur analysis are available on request. Please contact your local PerkinElmer sales representative about available options.

Interface Gate Valve

The software-firmware-controlled interface gate valve defaults to the closed position when the plasma is off and when the instrument is not powered. The gate valve remains closed for a few seconds after plasma ignition, which maintains the high vacuum in the ion optics housing. There is no need to exchange the gate valve for the analysis of 10% H₂SO₄, saving on the cost of components and instrument downtime.

General

A streamlined user experience is achieved thanks to several product enhancements. The following features aim to create a simple and guided user experience as well as provide best-in-class detection limits:

Refined, Easy-to-use Software with Modernized User Experience

Syngistix for ICP-MS software enables users to quickly harness the robust analytical capabilities of the NexION 1100 ICP-MS. The contemporary user interface offers an easy-to-understand workflow. With just a few mouse clicks, the user can quickly access and complete a suite of automated optimizations which tune the instrument to reach optimal performance. Also included with the software are a number of tried and tested methods based on published application notes, allowing users to get up and running quickly.

Syngistix for ICP-MS software (v. 4.0 or higher) harnesses a PostgreSQL-based database back end. This allows the software to provide a ready-to-configure API for easier and faster LIMS integration to save costly customization. Thanks to the database backend, an all-new, fully interactive FastQuant Data Viewer module is provided. This plug-and-play Data Viewer allows users at any levels to configure their own workspace and view relevant data by clicking Analyte, Sample or Replicates. It also enables automatic reprocessing by changing parameters such as calibration, internal standards and replicates.

Moreover, the software includes a variety of features which provide a more streamlined user experience:

- Advanced QC options and intuitive graphs for improved QC tracking
- Interactive charting tools for advanced analytics
- Automated hands-free sample runs with Scheduler feature
- Customizable maintenance reminders
- Intuitive logbook for improved performance tracking of both default and laboratory specific parameters
- Method validation for regulated labs, delivering ease of method validation via Syngistix for ICP-MS Enhanced Security software

LCD Touchscreen

The NexION 1100 ICP-MS comes standard with a built-in LCD touchscreen with comprehensive operation data and control capabilities. Users can control the instrument hardware, including cones, plasma and vacuum, through the Control tab and view the intensity data results live in numeric and pre-defined dashboards. The touchscreen also displays common system diagnostic parameters and an Analytics dashboard to provide operator intelligence, including argon consumption. Moreover, training videos are stored and accessible directly through the LCD touchscreen.

Status Lighting

The NexION 1100 system has incorporated status LED lighting which provides visibility to the state of the instrument from afar and facilitates the quick response to and diagnosis of issues.

Regulatory and Safety Compliance

The NexION 1100 ICP-MS carries the CE Mark and fully meets the safety and regulatory standards below:

- EN 61010-1:2010 and EN 61010-2-081 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use
- European EMC Directive 2014/30/EU and referenced standards EN 61326-1:2013
- WEEE Directive 2012/19/EU
- RoHS 2

Peripheral Equipment

The NexION family of instruments supports a wide range of PerkinElmer, ESI and CETAC autosamplers, autodilutors as well as laser ablation, field flow fractionation and speciation systems. PERSPEX® covers with extraction ports and easy-access doors are available for various autosampler models. A variety of bench options and pump-noise enclosures are also available on request. Please speak to your PerkinElmer sales representative about available options.

High Throughput Sampling Compatibility

The NexION 1100 also supports a wide range of PerkinElmer and ESI high throughput and flow injection systems.

SUMMARY TABLES

Standard Configuration

COMPONENT	STANDARD CONFIGURATION
Nebulizer	Glass Concentric Nebulizer
Spray Chamber	Baffle-type glass cyclonic high sensitivity spray chamber with All Matrix Solution (AMS) gas port
Torch	Quartz
Injector	Quartz 2.0 mm (fixed)
Sampler and Skimmer Cones	Nickel
Hyper-Skimmer Cone	Aluminium
Plasma Gas Flow Controllers	Three (Plasma, Auxiliary and Nebulizer)
Universal Cell Gas Channels	One Mass Flow Controller
Additional Gas Flow Controllers	One optional for All Matrix Solution (AMS)
Argon Supply Lines	Polyethylene
Interface Pump	Standard, Rotary
Cooling Water Supply Fittings	Push-fit



Figure 9. Standard NexION 1100 ICP-MS sample introduction system.

Hardware Specifications

SAMPLE INTRODUCTION	
Access	Eye-level height (based on unit being placed on an appropriate bench) Quick exchange torch access via SMARTintro sample introduction modules and torch cassette
Peristaltic Pump	Close-coupled, software-controlled 12-roller 4-channel peristaltic pump, which is fully integrated with the ICP-MS system. Inert rollers, low pulsation and noise. Speeds 0-100 rpm 2-stop flared tubing as standard
Spray Chamber	Baffle-type glass cyclonic high-sensitivity spray chamber with AMS gas port as standard option Optional quartz or Si/Q cyclonic, PFA Barrel type or Asperon™ spray chamber available
Injector	Fixed, 2 mm i.d.. Optional 1 mm, 1.5 mm, 2 mm and 2.5 mm fixed injector, and self-aligning demountable torch injectors with various internal diameters and material compositions available
Service	O-ring free sample introduction system
PLASMA ION SOURCE	
Torch	Screw-in, single piece, quartz Variety of fixed and demountable torch injector designs available Automatic gas coupling Horizontal, vertical and sampling depth position: 3 to -3 mm, ± 0.05 mm steps, ± 0.050 mm accuracy
Torch Mount	Ambidextrous cassette style torch mount, which supports single-hand removal of the torch and injector assembly
RF Generator	Free-running, specifically designed for ICP-MS, 34 MHz Accurate impedance matching RF power range: 400 - 1600 W PlasmaLok ensures plasma stability No plasma shield required Most robust plasma on the market for easy switching between cold and hot plasma, aqueous and organic samples
Load Coil	Novel LumiCoil design, passively air-cooled via the extraction Lifetime guarantee* Aluminum load coil
Ar Gas Flow Controllers	Three channels: plasma/coolant, auxiliary, nebulizer
Additional Gas Flow Controllers	Integrated AMS, argon is pressure flow controlled. Can be upgraded with a MFC for argon gas while oxygen gas is pressure flow controlled
Clear Plasma View	True reflection full-color plasma view window. No cameras and/or supporting infrastructure to maintain or replace.

* Assuming no misuse/damage caused by handling

Hardware Specifications *continued...*

VACUUM SYSTEM	
Configuration	Four-stage differential pumping
Vacuum Pumps	Triple-inlet turbomolecular pump External backing rotary pump
Pump-Down Time	< 15 min after maintenance, which involves the breaking of vacuum and opening the vacuum chamber from atmospheric pressure (< 10 ⁻⁶ mbar)
INTERFACE	
Access	Cone access from the front at the push of a button, instrument front panel drops down and slightly to the left for easy cone access
Sampler Cone	Nickel, 1.1 mm i.d.. Pt tipped sampler cone available
Skimmer Cone	Nickel, 0.88 mm i.d. Pt tipped skimmer cone available
Hyper-Skimmer Cone	Aluminum cone, 1 mm i.d.
Interface Gate Valve	Software-firmware controlled, power failure, argon-depletion interlock
OPTICS	
Quadrupole Ion Deflector (Q0)	Quadrupole which actively turns ions 90 degrees while ionized materials, photons and neutrals are not deflected and carry on straight to be removed via vacuum
	Replaces traditional lens system in older ICP-MS designs
	Optimizes the transmission for the mass of interest and broadly rejects other ions, therefore keeping the system cleaner than traditional linear lens systems
	No lenses to clean or maintain
Quadrupole Universal Cell (Q1)	Ions exiting the QID have similar (< 10 eV) kinetic energies to prevent sputtering of the quad material
	Not a consumable, no routine maintenance
	Single gas channel, which can be upgraded to two or three gas channels
	User-defined low- and high-mass cut-off window
	Can accommodate a wide variety of pure and mixed gases for extended periods of time
	Bandpass tuning of the cell is achieved by frequency modulation while keeping the RF amplitude constant to prevent unwanted chemical reactions occurring inside the cell
Transmission Analyzer Quadrupole (Q2)	Extended Dynamic Range (EDR) extends dynamic range up to 10 ¹⁴ by actively and selectively reducing ion signal on high-concentration elements
	EDR does not affect the signal response of other elements or require the pressurization of the cell with a gas
	Axial Field Technology (AFT) controls the speed of the ions through the cell
	Mass range: 1 - 285 amu
	2.5 MHz
	Resolution: Typical operating resolution 0.7 amu, custom resolution to < 0.3 amu
	Quadrupole peak hop (slew) speed: 1.6 M amu/sec
	Quadrupole scan speed: 5000 amu/sec
Peak hopping settling time: < 0.2 ms regardless of mass change	
Abundance Sensitivity	Mass stability for ⁷ Li, ²⁴ Mg, ¹¹⁵ In and ²³⁸ U: < 0.05 amu over eight hours of continuous operation
	Isotope ratio precision (¹⁰⁷ Ag/ ¹⁰⁹ Ag): < 0.08% RSD
Thermal coefficient of expansion < 1.3 x 10 ⁻⁶ .K ⁻¹ at 25 °C for the best stability	
Minimum Dwell Time	Better than 5.0 x 10 ⁻⁷ at low-mass side of peak. Better than 1.0 x 10 ⁻⁷ at high-mass side of peak. Measured at ²³⁸ U
	100 µs in conventional model. 10 µs in Nano and Single Cell modes.
ION DETECTION	
Detector	Dual-stage discrete dynode detector
	Simultaneous pulse/analog over two orders of magnitude
	Detector dead time of 35 ns
	< 0.2 ms switching between pulse and analog
	Both pulse and analog signals are captured simultaneously
	Cradle design for easy exchange
Dynamic Range	Transient data acquisition speed: > 3000 temporal data points/sec maximum
	14 orders of magnitude with EDR, > 10 orders of magnitude without EDR

Software Specifications

SOFTWARE	
System Operations	All analytical system operations (component optimization, methods development, calibration, analysis and reports) controlled using Syngistix for ICP-MS software and the FastQuant Data Viewer module.
Automation	Syngistix software has automated system startup, shutdown, optimization and instrument tuning (including torch alignment).
Ease of Use	Scheduled user-defined alerts for routine maintenance
	Pre-set methods available
	Automated quality control checking
	Automatic data reprocessing in FastQuant Data Viewer module
Analysis Options	Quantitative analysis: <ul style="list-style-type: none"> ▪ External calibration ▪ Additions (matrix matched) calibrations ▪ Method of standard additions ▪ Isotope ratios ▪ Isotope dilutions
	Semi-quantitative analysis
Real-time Features	Real-time graphics with the ability to display transient and continuous signal profiles
	Real-time plotting of internal standard response in Results, plot exported with results
Graphing Feature	Ability to graphically overlay, add or subtract mass spectra and view composite signals
Method Setup	Computer-controlled automatic selection of cell gas when multiple gases or mixed mode are specified within a single method
	Computer-controlled cell gas flows and optimization
	Fast switching between Cold and Hot Plasma settings, allowing both modes to be run within a single analytical method
	Operation in a number of different modes and plasma conditions in a single method
	Pre-integrated correction equations with the option to delete and/or modify the equation being used
Auto-dilutors	Custom correction equations to accommodate for doubly-charged ions (half-mass correction) and other custom analytical needs
	Supports syringe-pump-based auto-dilution systems
	Supports pre-defined dilutions and auto-calibration
	Supports auto-dilutions by both a global dilution factor and serial dilutions for samples out of range
Calibration Curve Fitting	Supports auto-dilution of samples where internal standard out of range
	The following curve-fitting options are available: <ul style="list-style-type: none"> ▪ Linear least squares calibration fitting ▪ Weighted linear least squares ▪ Linear forced-through-zero least squares ▪ Method of standard additions (matrix matched calibration) ▪ Additions calibration
Quality Control	QC protocol limits on measured values: <ul style="list-style-type: none"> ▪ Analyst to define when and how an action is taken ▪ Ability to specify a second QC action
Data Reprocessing	Data reprocessing for: <ul style="list-style-type: none"> ▪ Changes of calibration points ▪ Internal standard points ▪ Curve fit mode
	Reprocessing options: pulse, analog or dual detector modes
	Data reprocessing function possible both in Syngistix for ICP-MS software or in FastQuant Data Viewer module
Data Export	Single-click to export analytical data as a Microsoft® Excel® file
Data Integrity	All analytical raw data is retained and stored on the hard disk and encrypted
	Time and date printed on each sheet of data
Support	Mass calibration on six elements (Be, Co, In, Mg, Pb, U)
	Online help with quick steps to reference entire instrument user manual
Operating System	Microsoft® Windows® 10 64-bit operating system
Software Package Add-Ons	TIBCO Spotfire® Data Visualization Software. Single Cell and Nano software modules. Clarity™ software for speciation analysis.

Peripheral Equipment

PERIPHERAL SYSTEM COMPATIBILITY

Autosampler Capacity	Available autosamplers are capable of holding 150 or more 15 mL sample vessels
Autosampler Compatibility	PerkinElmer S23/S25 autosamplers (fully integrated)
	CETAC ASX series autosamplers
	ESI SC and DX series autosamplers
	AIM autosamplers
High Throughput Sampling Compatibility	PerkinElmer HTS system
	ESI prepFAST systems
	ESI FAST system
	CETAC ASXpress system
	GE Niagara Plus CM system
Hyphenated Techniques	Compatible with a wide variety of hyphenated techniques. Please contact your local PerkinElmer sales representative for details

Site Description and Dimensions

ENVIRONMENTAL – LABORATORY

Temperature	Optimal performance range	15 and 30 °C (59 - 86 °F)
	Rate of change	3 °C (5 °F)
Humidity	Range	20 - 80% (non-condensing)

UTILITIES

Electrical	Current	16 A max continuous	
	Operating frequency	50/60 Hz	
Cooling Water	Supply temperature	18 °C	
	Supply rate	3.8 L/min (1.0 gpm) minimum 4.7 L/min (1.25 gpm) typical	
	Pressure	@ 413 ± 14 kPa (60 ± 2 psig)	
Argon Gas Supply	Purity requirements	≥ 99.996%	
	Typical flow rate	15 - 20 L/min (typical), can go as low as 12 L/min	
	Pressure	@ 586 - 690 kPa (85 - 100 psig) min-max	
Cell Gas Purity Requirements	Purity	Ammonia (with getter)	≥ 99.9995%
		Helium	≥ 99.999%
		Methane	≥ 99.999%
		Oxygen	≥ 99.999%
	Flow rate	Ammonia	0.6 mL/min (typical)
		Helium	5 mL/min (typical)
		Methane	0.5 mL/min (typical)
		Oxygen	0.5 mL/min (typical)
Pressure	@ 69-103 kPa (10- 15 psig)		
System Exhaust Requirements	Port dimensions	9.2 cm (3.6 in.) i.d.	
	Flow rate	110 to 150 CFM without instrument connected	

Dimensions and Weight

No rear access required. All gas, exhaust, filter and electrical connections are on the front/side/top of the NexION 1100 ICP-MS. The instrument is designed to fit through all standard international door frames.

PARAMETER	VALUE
Width	81 cm (32 in.)
Height	73 cm (29 in.)
Depth	72 cm (28 in.)
Weight	150 kg (330 lb.)



Specific Criteria Tested and Verified During Production

The summary below describes specifications verified during NexION 1100 manufacturing testing.

PARAMETER	ELEMENT/VALUE	FACTORY SPECIFICATION
Sensitivity	⁷ Li	> 20 Mcps/(mg/L)
	¹¹⁵ In	> 100 Mcps/(mg/L)
	²³⁸ U	> 80 Mcps/(mg/L)
Detection Limit (ng.L ⁻¹)	⁹ Be	≤ 0.4
	¹¹⁵ In	≤ 0.1
	²⁰⁹ Pb	≤ 0.1
Oxides (%)	CeO/Ce	< 0.025
Doubly Charged (%)	Ce ⁺⁺ /Ce ⁺	< 0.03
System Background (cps) ⁺	220.5	≤ 1 cps
Detector Background (cps)	220.5	≤ 0.1 cps
Short-term Precision	10 min	< 2%
Long-term Stability	2 hours (after 1 hour warm-up)	< 3 % (cycling between Standard and Reaction modes)

⁺ Background signals are obtained under identical operating conditions with no changes to voltages during blank and background signal acquisitions