C113-E018

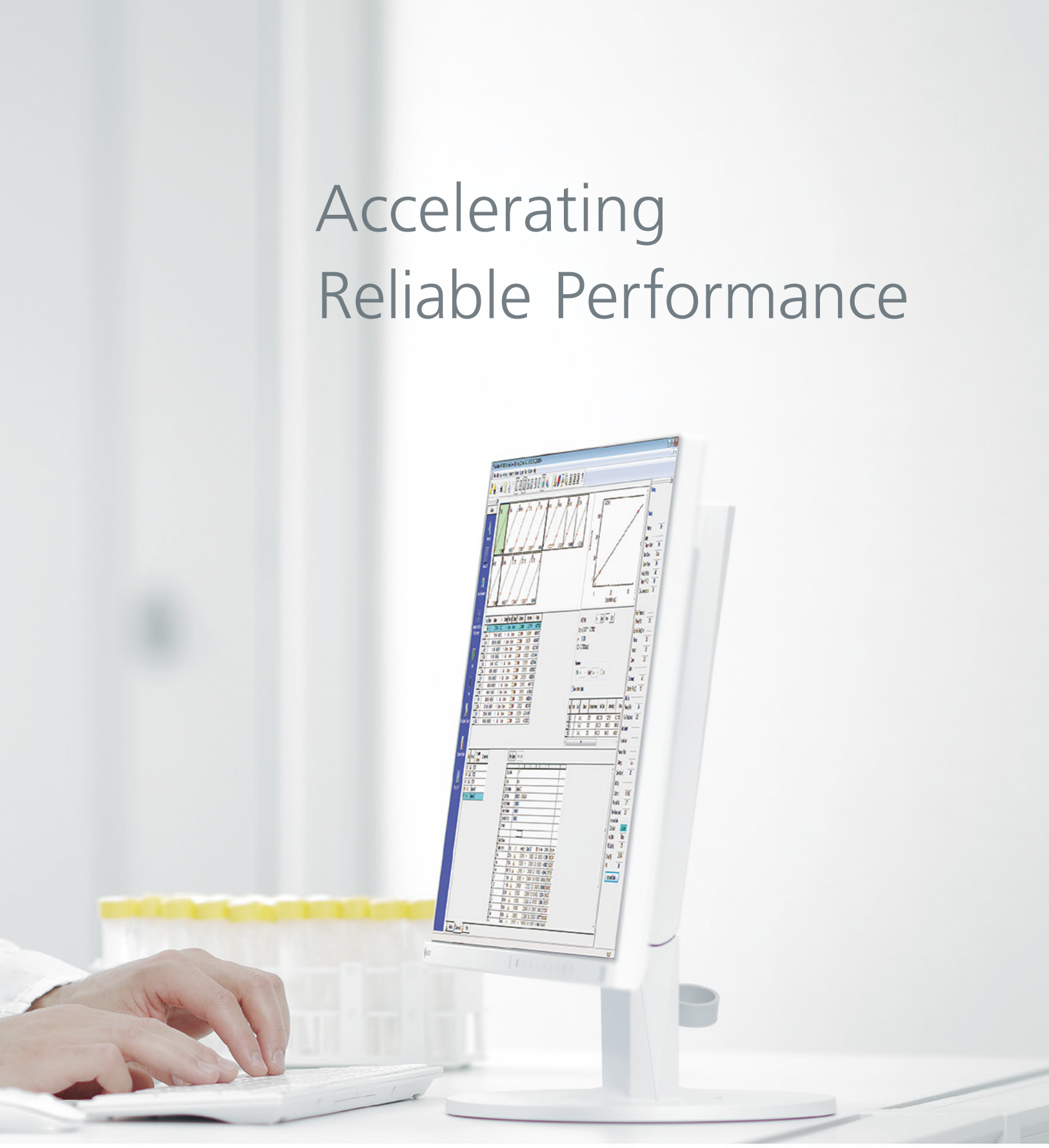
SHIMADZU
Excellence in Science

Inductively Coupled Plasma Mass Spectrometer

ICPMS-2030


SHIMADZU

Accelerating Reliable Performance



- The first system in the industry to include functions for assisting with analytical method development and diagnostics.
- Newly developed collision cell provides high sensitivity and low interference.
- Unique system developed by Shimadzu results in the industry's lowest running costs.

* As of February 2016, based on data obtained by Shimadzu

Two Assistant Functions Simplify Analysis

The Development Assistant simplifies the process of developing analytical methods. The Diagnosis Assistant automatically diagnoses spectral interference. Together, they provide analytical results with exceptionally high reliability.

Conventional Method Development Process (when analyzing a sample for the first time)

Prepare sample (pretreat sample)

Qualitatively analyze all elements

Create analytical method

- Select target elements and mass numbers for measurement (optimal mass numbers).
- Select internal standard elements and mass numbers for measurement (optimal mass numbers).
- Set concentration range for calibration curve.

Prepare calibration standards

Perform analysis

- Calibration curve samples
- Unknown samples

Check measurement results

ICPMS-2030 Analysis Process Flow

Development Assistant creates the analytical method.

Automatically selects the optimal mass number for the target elements and internal standard based on qualitative data for all elements.

Diagnosis Assistant checks measurement results for errors.

Automatically checks all samples for interference based on qualitative data for all elements.

Development Assistant Function Ensures Analytical Methods Can Be Developed with Confidence by Anyone.

Development Assistant

Creating analytical methods for ICPMS-2030 analysis involves only selecting the measured and target elements, even for samples being analyzed for the first time. Then, based on the qualitative analysis data (for all mass numbers) from a representative sample, the Development Assistant automatically selects the optimal mass numbers and internal standard elements for the target measurement elements and automatically specifies the concentration range for calibration curve samples.

Conventional Method Development Process (when analyzing a sample for the first time)

Prepare sample (pretreat sample)

Qualitatively analyze all elements

Determine optimal mass numbers for target measurement elements

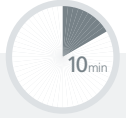
(1) Isobaric ions
(2) Oxide ions (Check mass numbers 16 less than target mass numbers.)
(3) Divalent ions (Check mass numbers twice the target mass numbers.)

Example: Determining optimal mass number for Cd
(1) Select mass number from mass number list.
=> Select 111 Cd with no isobaric ions.
(2) Check spectra for oxide ions (111-16 = 95) that might interfere with 111 Cd.
(3) Check spectra for divalent ions (111×2) = 222).

Select internal standards (Select optimal elements and mass numbers)

Criteria for selecting internal standard elements
1. Quantity in sample is less than 1/100 of quantity added.
2. Mass number is near target measurement element.
3. Ionization energy is close to ionization energy of measurement element.
4. Not easily affected by spectral interference
5. Does not cause interference with spectra of target measurement elements.
6. Elements and mass numbers are detectable with sufficient sensitivity.

Specify calibration curve sample



Method completed in **10 minutes**

Creating Analytical Method Using Development Assistant

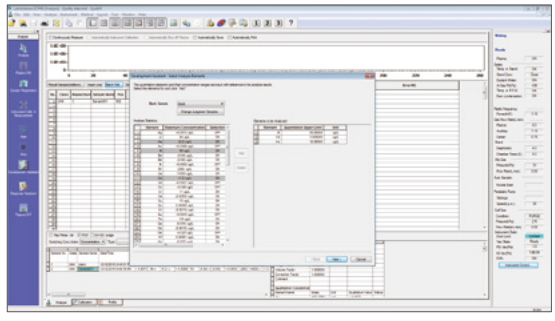
Prepare sample (pretreat sample)

Qualitatively analyze all elements

Select target measurement elements

The Development Assistant function automatically sets the optimal mass numbers and internal standard elements for the target measurement elements, and suggests a calibration scheme.

Method completed in **2 minutes**



Obtain Reliable Results Quickly with the Diagnosis Assistant Function.

Diagnosis Assistant

The Diagnosis Assistant automatically diagnoses spectral interference, based on data measured from all mass numbers. Even when using an already established method for routine analysis, the software analyzes data for any spectral interference to determine if a problem occurred.

Checking Data Conventionally

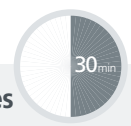
Check measurement results (all samples)

- If only target elements are measured, then information about other elements is not obtained, which means the presence of interference cannot be determined.
- When spectra are measured for both target elements and other elements, then interference with target measurement elements is confirmed just like it is for method development.

Check all samples for the above.

Determine methods for correcting any problems.

Checking process completed in **30 minutes**

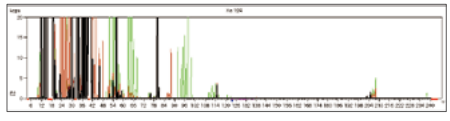


Checking Data Using Diagnosis Assistant

Check measurement results (all samples)

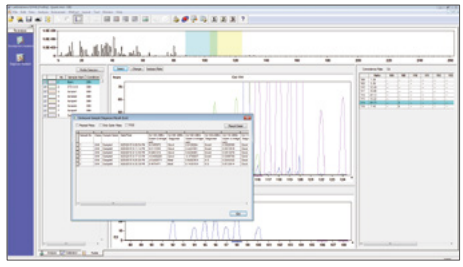
Diagnosis Assistant automatically checks for any spectral interference based on data for all elements and all mass numbers measured from all samples.

All Element and Mass Data



If a problem occurs, it indicates the type of problem and the sample where the problem occurred.

Checking process completed in **3 minutes**



Unique Combination Eco Mode/Mini-Torch Reduces Running Cost by Dramatically Reducing Gas Consumption

In addition to lower running costs, the environmentally-friendly mini-torch plasma unit, developed by Shimadzu, minimizes the energy (electricity) consumed in producing and maintaining an argon plasma.

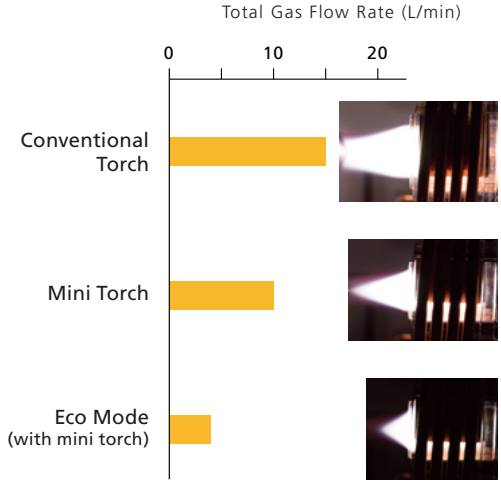
Three Factors That Reduce Running Costs

Mini-Torch Plasma Unit

One of the highest costs associated with ICP-MS systems is the large quantity of argon gas they consume. However, Shimadzu's proprietary mini-torch plasma system consumes two-thirds the argon gas (10 L/min) as conventional plasma torches. Consequently, one gas cylinder of argon (~7,800 liters) allows for approximately ten hours of continuous operation.

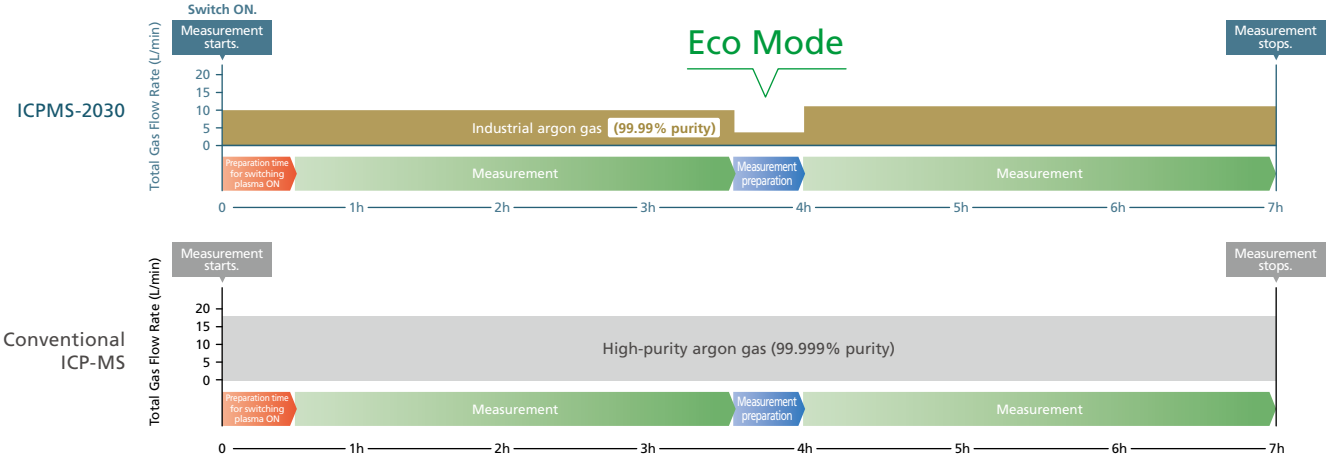
Eco Mode (5 L/min of Plasma)

During standby when Eco mode is active, the plasma gas flow and power are reduced to 5 L/min and 0.5 kW to minimize the required gas and electricity; however, analysis can be started immediately with no loss of productivity.



Low-Purity Argon Compatible

High-purity argon gas required by conventional systems is no longer necessary. Using less expensive argon gas (99.95%) over a three-year period can reduce costs by several tens-of-thousands of dollars.



Designed for High Stability and Low Running Costs

More Compact Vacuum System!

The smaller three-stage split-flow turbomolecular pump is especially easy to maintain, maximizing up-time of the instrument.

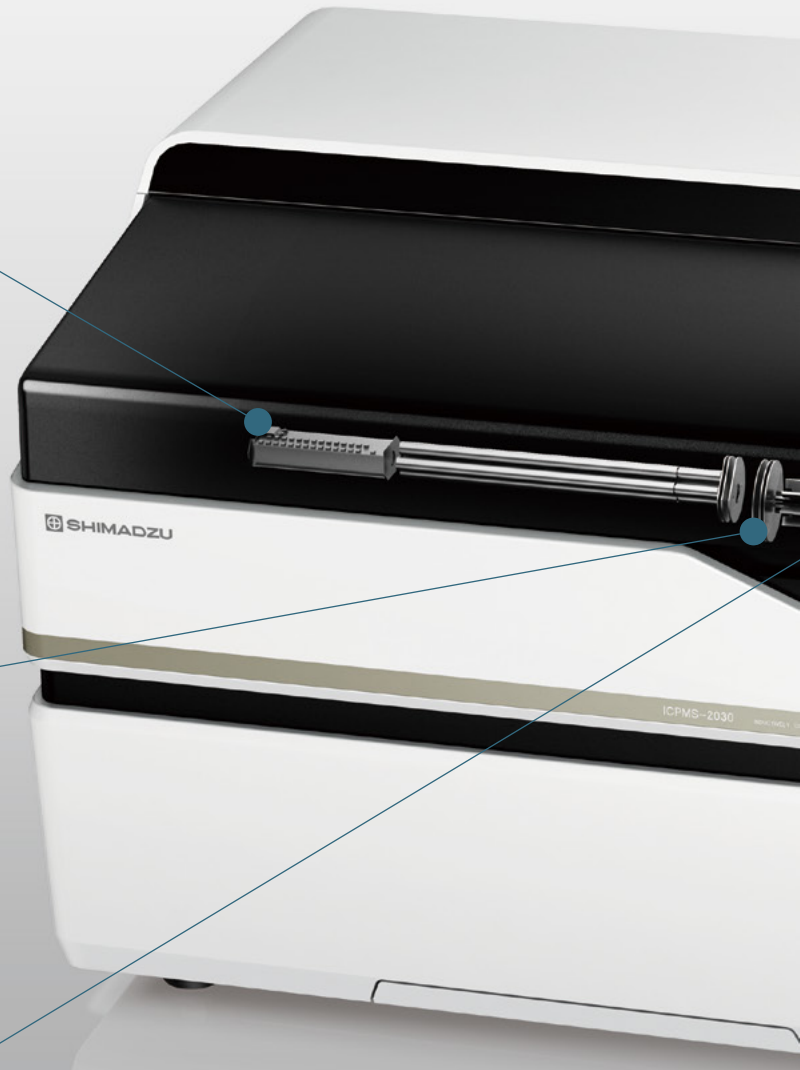
Secondary Electron Multiplier Tube Detector!

The 9-digit dynamic range detector allows for measuring major components and trace components simultaneously with high sensitivity.

Lens System Minimizes Contamination!

Located behind the newly developed collision cell, the focusing lens improves ion transmission efficiency and elimination of light emission from the plasma.

* Light emission removal is especially important when combining with Laser Ablation systems.



Newly Developed Collision Cell!

The newly developed collision cell achieves superior sensitivity by providing highly efficient molecular ion removal and high elemental ion transmission using only helium gas.

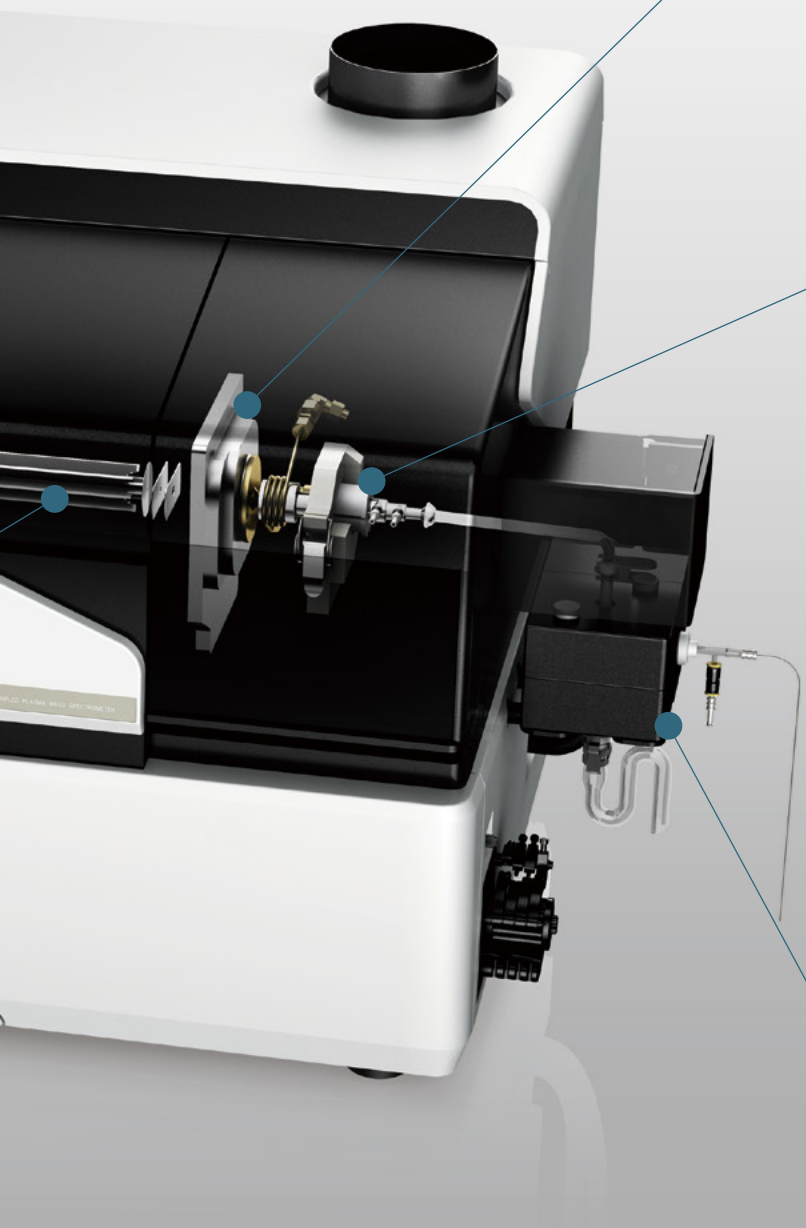
Newly Designed Interface!

The newly designed interface allows for easy maintainability. All parts can be removed and installed without the need for tools, which helps minimize downtime associated with cleaning and servicing.

High Stability and Flexibility! New High-Frequency Power Supply!

Shimadzu is the world's first ICP manufacturer to develop an all-solid-state high-frequency power supply. Due to Shimadzu's extensive experience, this free-running type high-frequency power supply unit offers the highest output stability.

* As of February 2016, based on data obtained by Shimadzu



High Stability and Low Running Costs

Shimadzu's Proprietary Mini-Torch Plasma System

Based on Shimadzu's extensive experience developing ICP emission spectrometers, Shimadzu's independently-developed mini-torch unit offers unrivaled performance and savings. One of the highest costs associated with ICP-MS systems is the large quantity of argon gas they consume. However, Shimadzu's proprietary mini-torch plasma system consumes two-thirds the argon gas (10 L/min) as conventional plasma torches. Furthermore, during standby when Eco mode is active, the plasma gas flow and power are reduced to 5 L/min and 0.5 kW to minimize the required gas and electricity; however, analysis can be started immediately with no loss of productivity.

Easy-to-Maintain Sample Injection System

Cyclone Chamber Cooled by a Peltier Element

The sample injection system features an electronically-cooled cyclone chamber utilizing a highly efficient coaxial nebulizer and unique overflow drain design. This design combines highly efficient aerosol production while reducing carryover to maximize sensitivity and throughput.

Trace Element Analysis Applications For Today's Demands

Environmental, Drinking Water, and Wastewater Analysis

Natural resources such as rivers, oceans, and soil are limited and we all share an obligation to preserve them for our future generations. In the world we live in today, we continue to place a burden on those resources through such practices as industrial manufacturing. It is essential that we preserve and protect our environment and our resources through reuse, recycling resources and reducing pollution. These can only be accomplished through monitoring by conducting massive amounts of measurements. To this end, Shimadzu provides a simple and accurate means of measuring samples so that recycling processes and manufacturing processes can be managed properly and responsibly.

Analytical Results of River Water

Element	Japanese Water Supply Act Standard (µg/L)	EPA Max. Limit Value for Drinking Water (µg/L)	Samples: JSAC0301-3		Samples: JSAC0302-3	
			Quantitation Value	Certified Value	Quantitation Value	Certified Value
Unit: µg/L						
Al	200	200	16	15±1	66.9	66±1
As	10		0.20	0.20±0.01	5.29	5.2±0.1
B	1000		8.52	8.2±0.3	58.0	59±1
Ba	700**	2000	0.55	0.53±0.01	0.55	0.52±0.01
Cd	3	5	0.0018	0.0018 (Reference value)	0.991	1.00±0.02
Cr^{6+}	50	100	0.17	0.16±0.01	10.0	10.0±0.2
Cu	1000	1300	0.4	0.37±0.03	10.0	9.9±0.1
Fe	300	300	6.5	6.4±0.2	58.5	58±1
Mn	50	50***	0.21	0.2±0.01	5.3	5.1±0.1
Mo	70**		0.30	0.290±0.004	0.30	0.290±0.004
Ni	10*				9.63	9.5±0.3
Pb	10	15	0.005	0.007 (Reference value)	9.68	9.9±0.2
Se			0.2	0.08 (Reference value)	4.95	5.0±0.2
Zn	1000	5000***	0.17	0.17±0.04	10.5	9.8±0.2
Unit: mg/L						
K			0.48	0.47±0.02	0.48	0.48±0.02
Na	200		4.53	4.34±0.07	4.47	4.32±0.07
Mg	Hardness: 300		3.37	3.34±0.07	3.34	3.32±0.06
Ca		250***	13.2	13.0±0.2	13.1	13.0±0.1

*: Target setting item, **: Required test item, ***: National Secondary Drinking Water Regulations

Pharmaceuticals/Pharmacopoeia

Many of the pharmaceuticals, food products, and other products we encounter can contain harmful elements, either introduced from natural sources or artificially through manufacturing processes. ICP-MS systems are able to quickly measure harmful elements with high sensitivity, making them ideal for monitoring such substances and ensuring the safety and security of pharmaceuticals, foods, and other products. Additionally, pharmaceuticals must satisfy the allowable limits specified by ICH Q3D guidelines, where the measurement methods used are specified in the pharmacopoeia of respective countries. The system must also be compliant with quality control standards specified by the FDA and Japanese Ministry of Health, Labor and Welfare.

Analytical Results of Tablet

Element	Oral Drug PDE µg/day	Max. Allowable Concentration µg/g	Measurement Value in Tablet µg/g	Equivalent Tablet Dose DL (3·) µg/g	Recovery Rate %
Cd	5	0.5	N.D.	0.0005	103
Pb	5	0.5	0.009	0.0002	103
As	15	1.5	N.D.	0.006	110
Hg	30	3	N.D.	0.0002	98
Co	50	5	0.004	0.00004	100
V	100	10	N.D.	0.01	110
Ni	200	20	0.66	0.003	110
Tl	8	0.8	N.D.	0.00002	98
Au	100	10	N.D.	0.0003	104
Pd	100	10	N.D.	0.0002	99

Max. Permitted Concentration Assuming a 10 g Max. Daily Intake of Formulation (Option 1:)

Food Products/Agriculture

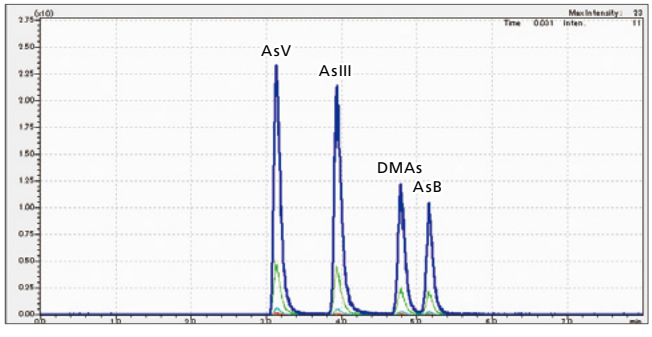
We rely on foods to provide necessary elements and minerals required for supporting life. However, if food contains hazardous elements, they can be harmful to our health. Therefore, analyzing food has become increasingly important in recent years for ensuring the safety of food. One example of this is powdered infant formula which is made with a healthy balance of minerals necessary for infant growth. Regulatory requirements specify the amounts of calcium (Ca), iron (Fe), copper (Cu), and other essential minerals and while limiting hazardous elements like arsenic (As), which has detrimental effects on child development. The ICP-MS is able to quickly measure a wide variety of elements in powdered milk products and other foods, including raw ingredient and finished products.

Analytical Results of Powdered Milk

	Unit	NMIJ Certification Value	Analytical Value (in the powder)	Detection Limit in Powder	Detection Limit in Measured Solution (DL: 3) µg/L
Cu	mg/kg	4.66	4.79	0.005	-
Mn		0.931	0.926	0.0002	-
Mo		0.223	0.211	0.0005	-
Sr		5.88	5.66	0.00004	-
Zn		41.3	41.5	0.003	-
Cd	µg/kg	-	N.D.	0.05	103
Cr		-	N.D.	0.3	103
Pb		-	N.D.	0.1	95
As		(2.1)	2.5	0.5	105

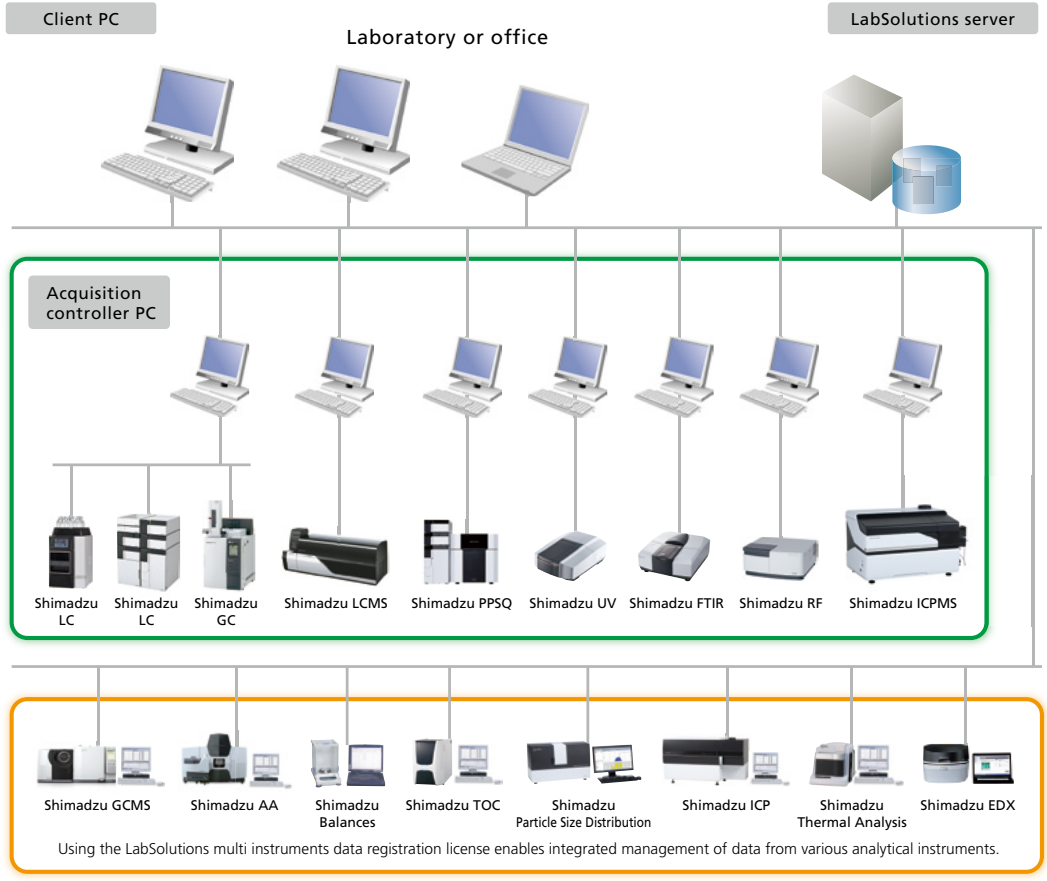
LC-ICP-MS

The environment, pharmaceuticals, food and other products can contain elements in different chemical form or oxidation states. Speciation of these is sometimes required. By combining different analytical techniques like LC-ICP-MS, speciation of chemical forms can be achieved with high sensitivity. This is accomplished by connecting the ICPMS-2030 in-line with an LC (Shimadzu Prominence Inert LC) system. LabSolutions ICPMS TRM (time-resolved measurement) software controls the LC (Shimadzu Prominence Inert LC System) from the ICPMS-2030, allowing for one smooth platform that automatically detects and measures analyte peaks.



Arsenic Chromatogram

LabSolutions CS/DB for ICPMS-2030 Supports Laboratory Networking and FDA 21 CFR Part 11 Compliance.



LabSolutions CS/DB ICPMS provides compliance for regulations concerning electronic record keeping and electronic signatures required by FDA 21 CFR Part 11 and other regulations stipulated by Japan's Ministry of Health, Labor and Welfare (ERES regulations). Additionally, since the software supports laboratory networking, analytical results from a broad variety of analytical instruments used in the laboratory, including LC, LCMS, GC, GCMS, UV, FTIR, RF, EDX, TOC, and PPSQ, can be managed centrally from a server.

Two Data Management Methods Available Depending on the System

■ Network System: LabSolutions CS (coming soon)

LabSolutions CS can freely access all instruments on the analytical network, so that all analytical data is managed on the network server and the data can be loaded to any computer connected to the network. This is especially recommended for customers that have many users and want to manage data on a server together with LC, GC, FTIR, UV, RF, EDX, TOC, PPSQ, and other data for ER/ES compliance.

■ Standalone Database System: LabSolutions DB ICPMS (option)

This configuration does not require a network connection and is ideal for customers that want to manage all data on one computer for ER/ES compliance only for a standalone system.

System Contents

Network system LabSolutions CS	LabSolutions ICPMS, LabSolution CS Connection Kit, LabSolutions CS
Standalone database system LabSolutions DB ICPMS	LabSolutions ICPMS, LabSolution DB Connection Kit

Peripheral Equipment

For automatic analysis of 60 samples

AS-10 Autosampler

(P/N S211-93680-58)

Multiple samples can be analyzed successively. The turntable results in a short path length for sample injection, which can reduce the rinse time.

Vials: 60 15- mL vials
8 50-mL vials
Size: W290 × D508 × H300 mm (excluding arm)
Power supply: Single-phase 100 V, 50/60 Hz, 100 VA

Note: Requires separate power cord (P/N S071-60821-08).
Note: An additional rinsing port is optional (There is no automatic solvent supply).
Rinsing Port Expansion Kit for AS-10 (P/N S211-94072-41).

For simultaneous analysis of 120 samples

ASX-260 Autosampler

(P/N S211-84476-19)

Vials:
10 50-mL vials (standard samples) or 120 14-mL vials
80 20-mL vials (rack sold separately)
42 50-mL vials (rack sold separately)
Size: W330 × D508 × H250 mm
(main unit/excluding sample probe unit)
W90 × D180 × H60 mm
(rough dimensions of power supply unit)
Power supply: 100 V AC ± 10 %, 200 VA, 50/60Hz
Weight: 8.4 kg (main unit)

Note: Requires a separate connection kit (P/N S211-94010-41).

HFS-5 Hydrofluoric Acid Sample Injection System

(P/N S211-93828-41)

This system includes a torch, chamber, extension tube, nebulizer, drain, and their corresponding accessory parts.
If purchasing a new system, order this kit and an S2 orifice assembly.
Used to directly inject samples that contain hydrofluoric acid. The nebulizer, chamber, and drain system are made using fluoropolymer materials and the injector unit on the torch is made using alumina.

Organic Solvent Injection System

(P/N S211-92618-41)

To introduce organic solvents, a mixture of argon and oxygen gases (70% Ar and 30% O2) is injected into the interface unit to prevent precipitation of carbon (C) by the organic solvent. This system includes a Quadruple Torch for Organic Solvents, ICPMS, drain, and their corresponding accessory parts.

Cooling Water Circulator Set

(P/N S211-92962-41)

Size: W377 × D500 × H615 mm
Power supply: Single-phase 200 V, 50/60 Hz, 2 kVA
Weight: 43 kg

Note: Used to cool the main unit.
Note: Requires a separate chiller connection kit (P/N S211-93827-41).
Note: Requires tetoron braided hoses (P/N S018-31509) for coolant water supply and drain.
Order in meter units for the overall length.

Exhaust Duct Connection Adapter

(P/N S211-93832-41)

For simultaneous analysis of 240 samples

ASX-520 Autosampler

(P/N S211-84476-01)

Vials:
10 50-mL vials (standard samples) or 240 14-mL vials
160 20-mL vials (rack sold separately)
84 50-mL vials (rack sold separately)
Size: W520 × D482 × H250 mm
(main unit/excluding sample probe unit)
W90 × D180 × H60 mm
(rough dimensions of power supply unit)
Power supply: 100 V AC ± 10 %, 200 VA, 50/60Hz
Weight: 10.5 kg (main unit)

Note: Requires a separate connection kit (P/N S211-94010-41).

LC Connection Kit

(P/N S228-62531-41)

This kit is used to connect ICPMS to an LC system (Prominence inert LC System).

Note: Requires LabSolutions ICPMS TRM (software) (P/N S211-49200-91) for LC Connection Kit

Automatic Internal Standard Addition Kit

(P/N S211-93150-41)

This kit is used for in-line mixing of measurement sample and internal standard solutions and introducing the mixtures into the ICP system.

For high-sensitivity analysis of As, Se, and Sb

HVG-1 Hydride Generator

(P/N S206-17143-41)

This unit uses nascent hydrogen generated from decomposition of sodium borohydride to vaporize elements in samples by reduction and then introduce only the gas phase into the plasma. This enables measurements with about 50 times higher sensitivity.

Note: Requires a separate HVG-ICPMS connection kit (P/N S211-93243-41) and liquid waste pump (P/N S042-00412-01)

Laser Ablation Connection Kit

(P/N S211-93829-41)

This connection kit is compatible with ESI NWR-213 laser ablation systems.

Tap Water Connection Kit

(P/N S211-90558-41)

This is required if using tap water to cool the main ICPMS-2030 unit.

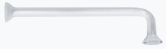
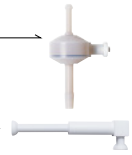
Note: Requires a separate coupler set (P/N S035-60942) for tap water connection.

Noise Reduction Box for Rotary Pumps

(P/N S225-27850-06)

Note: Requires Noise Reduction Box Connection Kit (P/N S211-93825-41) for Noise Reduction Box for Rotary Pumps.

Accessories

	Standard Set	For Organic Solvents	For Hydrofluoric Acid Resistance
Examples of Samples	Environmental water, effluent water, water with dissolved pharmaceutical or food substances, or other acid decomposition solutions	Organic solvents	Solutions with residual hydrofluoric acid
Torches	**Mini Torch, ICPMS** (P/N S211-94018) **Shield Screen** (P/N S211-93819) 	**Quadruple Torch for Organic Solvents, ICPMS** (P/N S211-94021-41) **Bonnet for Organic Solvents** (P/N S211-94047) **Torch Adapter for Organic Solvents** (P/N S211-93780-41) **Shield Screen for Organic Solvents** (P/N S211-93820) 	**Demountable Torch, ICPMS** (P/N S211-94095-41) 
Interfaces	**Sampling Nozzle, Copper** (P/N S211-90190-41) **Skimmer Cone, Copper** (P/N S211-90200-41) 		
Chambers	**Cyclone Chamber** (P/N S211-93578) **Torch Extension Pipe** (P/N S211-93728)   • Locking Screw, 0152 (P/N S046-00093-92) • Seal, 0237 (P/N S046-00092-93) Includes the above.		**PFA Cyclone Chamber** (P/N S211-93579) **Torch Extension Pipe, HFS** (P/N S211-94097) **Clamp** (P/N S037-60091-03) 
Nebulizers	**Nebulizer, 07UES** (P/N S046-00092-01)  • Suction tube assembly, NFTS-075 (P/N S046-00092-18) • Connector, QSM (P/N S046-00092-09) • Tube adapter, 0735 (P/N S046-00092-10) • Clamp, SNP-1 (P/N S037-6113-01) Includes the above. 		**Nebulizer, PFA1S** (P/N S046-00092-17) • Suction tube assembly, NFTS-075 (P/N S046-00092-18) • Connector, QSM (P/N S046-00092-09) • Tube adapter, 0735 (P/N S046-00092-10) • Clamp, SNP-1 (P/N S037-6113-01) Includes the above. 
Drains	**Drain Trap, 8214** (P/N S046-00093-01) 	**Drain Trap for Organic Solvents** (P/N S211-93814-01) 	**Hydrofluoric Acid Resistant Drain** (P/N S046-00093-06) 
Peristaltic Pump Tubes	**Peristaltic Pump Tube** (P/N S018-31558-44)	**Peristaltic Pump Tube for Organic Solvents** (P/N S018-31558-61)	**Peristaltic Pump Tube** (P/N S018-31558-44)

Others		**Organic Solvent System** (P/N S211-92618-41) This system includes a Quadruple Torch for Organic Solvents, ICPMS, drain, and their corresponding accessory parts.	**Hydrofluoric Acid Sample Injection System** (P/N S211-93828-41) This system includes a torch, chamber, extension tube, nebulizer, drain, and their corresponding accessory parts.

Specifications

	ICPMS-2030
Plasma Ion Source	
Sample Spray Chamber	Cyclone chamber (electronically cooled)
Peristaltic Pump	4 ch
Plasma Torch	Mini torch
Nebulizer	Coaxial
Torch Positioning	X, Y, and Z automatic 3-axis positioning
High-Frequency Power Supply Unit	
Frequency	27 MHz
High-Frequency Output	Max 1.4 kW ± 0.3%
Mass Spectrometer Unit	
Mass Spectrometer	Quadrupole mass spectrometer
Mass Number Range	5 to 260
Collision Cell	Octopole collision cell Gas used: Helium gas at 0 to 10 mL/min
Detector	Electron multiplier
Vacuum System	3-stage differential pumping

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Note: The ® symbol is omitted in this document.

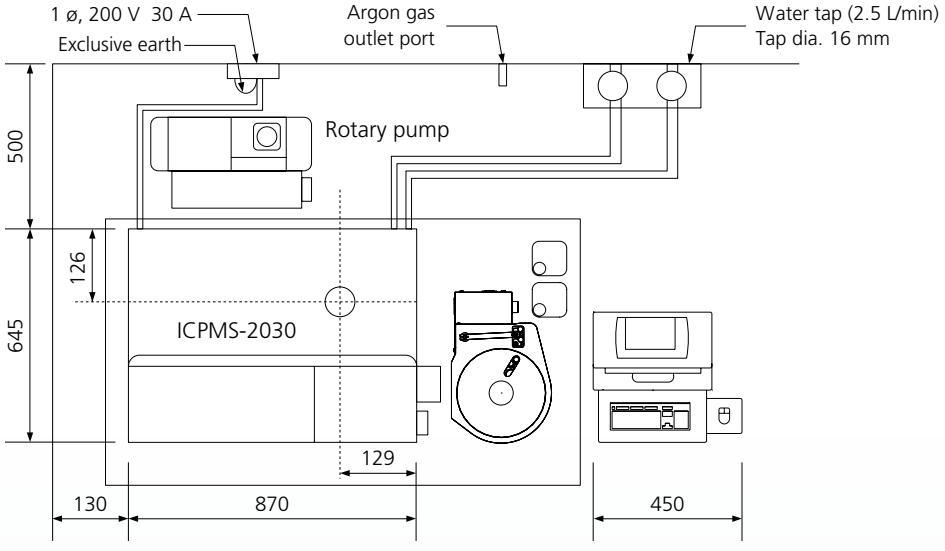
Installation Requirements

1. Installation Site Environment	Temperature within 18 to 28°C (max. 2°C/h temperature change)	
	Humidity within 20 to 70% RH	
	Avoid using the system in locations with significant vibration or dust.	
2. Power Supply	Main Unit	Single-phase 200 to 240 V ± 10 %, 50/60 Hz, 6 kVA
	Data Processing	Single-phase 100 V ± 10 %, 50/60 Hz, 200 VA
	Options	
	Laser Printer	Single-phase 100 V ± 10 %, 50/60 Hz, 900 VA
	Cooling Water Circulator	Single-phase 200 to 230 V, 50/60 Hz, 2 kVA
3. Grounding	Should be grounded independently with a maximum resistance of 30.	
4. Gas Supply	Type: Argon gas with 99.95% purity Helium gas with 99.999% purity Adjust the argon gas supply pressure to 450 ± 10 kPa. For 7 m^3 gas cylinders, one cylinder is required approximately every ten hours of operation. Adjust the helium gas supply pressure to 250 ± 10 kPa.	
5. Cooling Water	Main unit cooling water temperature 5 to 30 °C and minimum flow rate of 1 L/min	
6. Exhaust Duct	Exhaust gas from the plasma stand is mostly argon, but also includes some metal vapors and solvent. Therefore, install exhaust ducting.	
7. Application for Permit	In Japan, installing an ICPMS-2030 system requires applying for a permit for using high-frequency radio waves, based on the Radio Wave Control Law.	
8. Weight	140 kg	

Note: Refer to the installation guidelines for more details.

Installation Example

(Unit : mm)



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