SHIMADZU
Excellence in Science

Multitype ICP Emission Spectrometer

ICPE-9000

ICPE-9000

ICP-AES Multitype ICP Emission Spectrometer

Higher accuracy analysis and easier operation exemplify the thought we’ve put into the basics of our analytical devices

Used in a broad range of fields, ICP emission spectrometers feature ppb-level detection ability and 5-6 orders of linear dynamic range, which permits a wide concentration of samples to be measured. In addition, they enable batch analysis of multiple elements.
Recent wider usage has resulted in an increased demand for shorter analysis times and improved high-matrix sample detection. As a result, we have developed two models - a "multitype" using a semiconductor detector to shorten analysis times, and a high-resolution sequential type* for improved detection.
Shimadzu's ICPE-9000 multitype ICP emission spectrometer includes our new ICPEsolution software, a radical departure from conventional thinking.
Making full use of the ICPE-9000's multitype performance, problems with measurement samples can be evaluated in a number of ways. For example, the Method Development and Method Diagnosis Assistant Functions automatically perform wavelength selection for measured elements and interference correction for coexisting elements, tasks that typically relied on the skill of the analyst. Simple and accurate measurement is now possible-even with hard-to-measure high-matrix samples.

*The sequential type is not available in the United States.

Multi-fanctional assistant software simplifies plasma emission spectroscopy

MULTI TYPE ICPEsolution

Non-interfering wavelengths are automatically distinguished from multiple wavelengths for each measurement sample

Multifaceted diagnosis of coexistent element interference quantities
Methods are automatically corrected, based on determining the necessity of each type of correction

Simple and Accurate

Simply
and accurately measure
all types of samples

Ultra-Trace Element Detection and Component Analysis for Highly Precise Analytical Results

ICP Emission Spectrometry

Inductively coupled plasma emission spectrometers generate a high-temperature plasma by ionizing argon using a high frequency (27.12 MHz). Liquid samples are aspirated and atomized by a nebulizer and then supplied to the plasma to excite the elements in the sample, thus causing them to emit light.

Key Features

1. Measures a variety of elements with high sensitivity and saves energy by analyzing multiple elements simultaneously.

Many elements (71 elements) can be detected with high sensitivity, at µg/L (ppb). The instrument also allows saving energy by simultaneously analyzing multiple components using the same analytical conditions.

2. Simultaneously analyzes elements ranging from ultra-trace to high-concentration elements.

A 5-6 order of linear dynamic range permits a wide concentration of samples to be measured at once.

3. Enables qualitative analysis.

Samples with unknown components can be analyzed qualitatively.
Semi-quantitative values can be obtained without using standard samples.

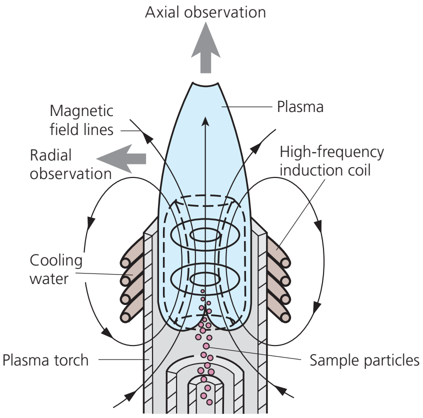
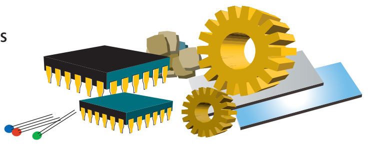


Diagram of Plasma Torch Components

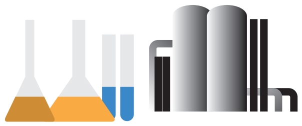
Metals / Electrical Materials / Ceramics

Metals
Semiconductors
Minerals
Glass
Ceramics



Petroleum / Chemistry / Macro-molecules

Petroleum
Oil
Catalysts
Chemical products

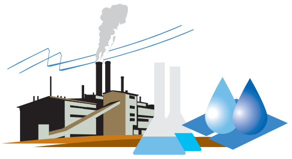


Medicine / Biology / Food Products

Blood
Organisms
Plants
Medicines
Food products

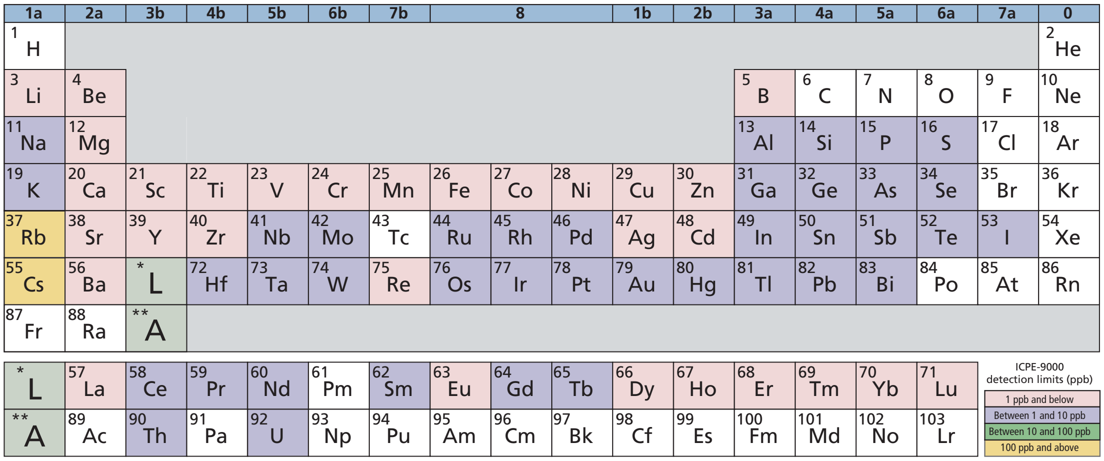
Environment

Drinking water
Seawater
River water
Wastewater
Soil
Sludge
Atmospheric dust



ICPE-9000 element analysis

🟥 1 ppb and below
🟪 Between 1 and 10 ppb
🟩 Between 10 and 100 ppb
🟨 100 ppb and above



1a	2a	3b	4b	5b	6b	7b	8			1b	2b	3a	4a	5a	6a	7a	0
1 H																	2 He
3 Li 🟥	4 Be 🟥											5 B 🟥	6 C	7 N	8 O	9 F	10 Ne
11 Na 🟪	12 Mg 🟥											13 Al 🟪	14 Si 🟪	15 P 🟪	16 S 🟪	17 Cl	18 Ar
19 K 🟪	20 Ca 🟥	21 Sc 🟥	22 Ti 🟥	23 V 🟥	24 Cr 🟥	25 Mn 🟥	26 Fe 🟥	27 Co 🟥	28 Ni 🟥	29 Cu 🟥	30 Zn 🟥	31 Ga 🟪	32 Ge 🟪	33 As 🟪	34 Se 🟪	35 Br	36 Kr
37 Rb 🟨	38 Sr 🟥	39 Y 🟥	40 Zr 🟥	41 Nb 🟪	42 Mo 🟪	43 Tc	44 Ru 🟪	45 Rh 🟪	46 Pd 🟪	47 Ag 🟥	48 Cd 🟥	49 In 🟪	50 Sn 🟪	51 Sb 🟪	52 Te 🟪	53 I 🟪	54 Xe
55 Cs 🟨	56 Ba 🟥	* L	72 Hf 🟪	73 Ta 🟪	74 W 🟪	75 Re 🟥	76 Os 🟪	77 Ir 🟪	78 Pt 🟪	79 Au 🟪	80 Hg 🟪	81 Tl 🟪	82 Pb 🟪	83 Bi 🟪	84 Po	85 At	86 Rn
87 Fr	88 Ra	** A															

* L	57 La 🟥	58 Ce 🟪	59 Pr 🟪	60 Nd 🟪	61 Pm	62 Sm 🟪	63 Eu 🟥	64 Gd 🟪	65 Tb 🟪	66 Dy 🟥	67 Ho 🟥	68 Er 🟥	69 Tm 🟥	70 Yb 🟥	71 Lu 🟥
** A	89 Ac	90 Th 🟪	91 Pa	92 U 🟪	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

ICPE-9000 detection limits (ppb)

🟥 1 ppb and below
🟪 Between 1 and 10 ppb
🟩 Between 10 and 100 ppb
🟨 100 ppb and above

Key Features of the ICPE-9000

ICPEsolution Software Makes ICP Analysis Easy

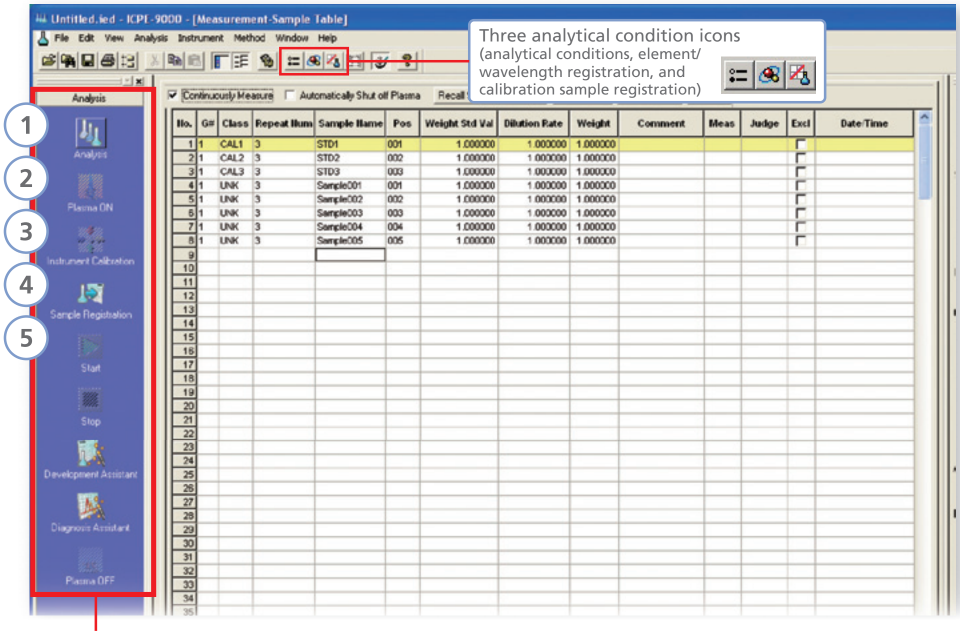
A Wealth of Analytical Technology Makes ICP Emission Spectrometry Easy

Simple to Operate Using Five Icons

ICPEsolution software is very easy to operate, allowing even inexperienced operators to start measurements in only five steps after startup.

Because measurements are recorded continuously for all elements and all wavelengths, data can be recalled for each element or wavelength without re-measuring. Measurement results can be evaluated automatically as well.

Process Flow of Analysis Using ICPEsolution (analytical procedure settable from one main window)



☑ Continuously Measure ☐ Automatically Shut off Plasma

No.	G#	Class	Repeat Num	Sample Name	Pos	Weight Std Val	Dilution Rate	Weight	Comment	Meas	Judge	Excl	Date/Time
1	1	CAL1	3	STD1	001	1.000000	1.000000	1.000000				☐	
2	1	CAL2	3	STD2	002	1.000000	1.000000	1.000000				☐	
3	1	CAL3	3	STD3	003	1.000000	1.000000	1.000000				☐	
4	1	UNK	3	Sample001	001	1.000000	1.000000	1.000000				☐	
5	1	UNK	3	Sample002	002	1.000000	1.000000	1.000000				☐	
6	1	UNK	3	Sample003	003	1.000000	1.000000	1.000000				☐	
7	1	UNK	3	Sample004	004	1.000000	1.000000	1.000000				☐	
8	1	UNK	3	Sample005	005	1.000000	1.000000	1.000000				☐	
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Three analytical condition icons
(analytical conditions, element/ wavelength registration, and calibration sample registration)

Analytical procedure icons

1 Analysis

Select an analytical method.

Various methods are available for different sample supply systems. Select the method best suited to the given conditions.

2 Plasma ON

Ignite the plasma.

The plasma is ignited automatically.

3 Instrument Calibration

Calibrate the instrument (wavelength calibration).

Wavelength calibration and database calibration (for qualitative analysis) are available. Standard samples are not necessary for wavelength calibration.

4 Sample Registration

Register the sample.

5 Start

Start the measurement.

Development Assista

Method Development Assistant

When measuring a new sample, the Method Development Assistant helps set analytical conditions, such as selecting the wavelength, setting calibration curve concentrations, and correcting for the background signal.

Diagnosis Assistant

Method Diagnosis Assistant

After measuring samples, the Method Diagnosis Assistant automatically reviews spectral interference and other factors to diagnose the causes of inaccurate results for each measurement sample.

Continuously Records All Elements and All Wavelengths

1. Measurements can be recorded for all elements and all wavelengths.

The state-of-the-art CCD used in the ICPE-9000 continuously records measurements for all elements and wavelengths.

2. Wavelengths can be added after measuring.

Since measurements are recorded for all wavelengths, it is easy to consider additional wavelengths even after measuring. Therefore, it is not necessary to determine optimal wavelengths before measuring.

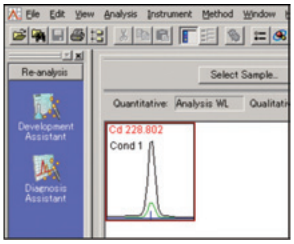
3. Elements can be added after measuring.

Once a standard sample containing a mixture of elements has been measured, even if the operator forgets to specify an element, quantitative values can be obtained for that element by simply adding it after measurement.

4. Qualitative data can be obtained after measuring.

Since information is recorded for all elements and all wavelengths, qualitative data can be obtained for all elements, even from data obtained only for quantitative analysis.

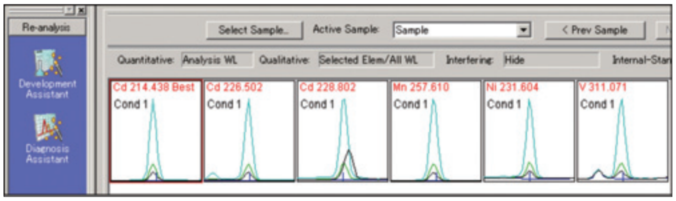
Quantitative Analysis Data



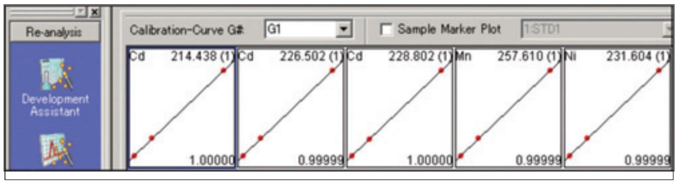
Adding qualitative information

Adding elements and wavelengths

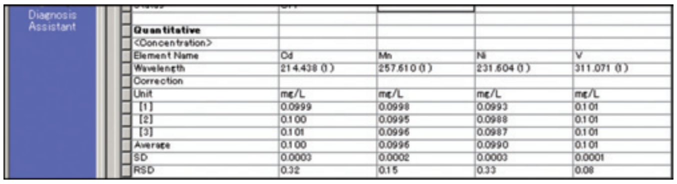
Peak Profiles



Calibration Curves



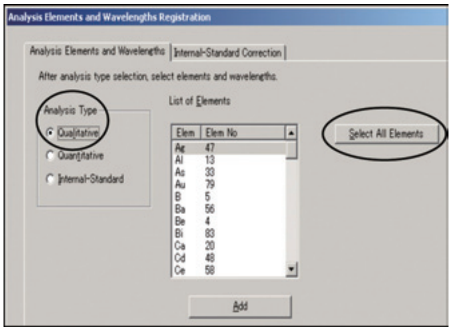
Quantitation Results (displayed for optimal wavelengths)



Quantitative				
<Concentration>				
Element Name	Cd	Mn	Ni	V
Wavelength	214.438 (1)	257.610 (1)	231.604 (1)	311.071 (1)
Correction				
Unit	mg/L	mg/L	mg/L	mg/L
[1]	0.0999	0.0998	0.0993	0.101
[2]	0.100	0.0995	0.0988	0.101
[3]	0.101	0.0996	0.0987	0.101
Average	0.100	0.0996	0.0990	0.101
SD	0.0003	0.0002	0.0003	0.0001
RSD	0.32	0.15	0.33	0.08

Cd was measured at multiple wavelengths, but the optimal wavelength is selected automatically.
(Results can also be displayed for each wavelength.)

Qualitative information can be confirmed for all elements, even after measuring.
(Add qualitative information after measuring.)



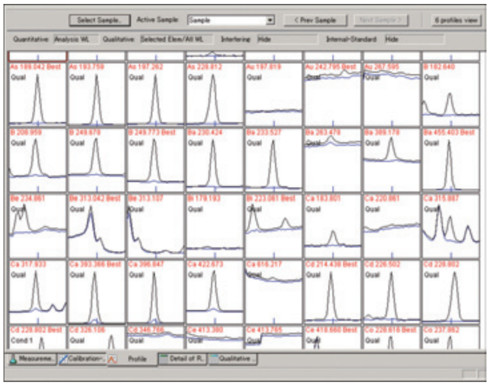
After analysis type selection, select elements and wavelengths.

Analysis Type
● Qualitative
○ Quantitative
○ Internal-Standard

List of Elements

Elem	Elem No
Ag	47
Al	13
As	33
Au	79
B	5
Ba	56
Be	4
Bi	83
Ca	20
Cd	48
Ce	58

Peak Profiles for All Elements (qualitative)



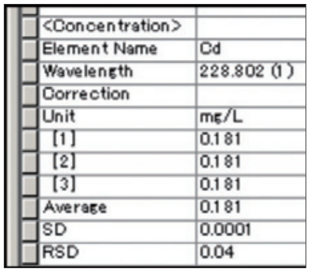
Data processing functions that utilize measurements of all elements and wavelengths

Automatically Evaluates Measurement Data

Method Diagnosis Assistant

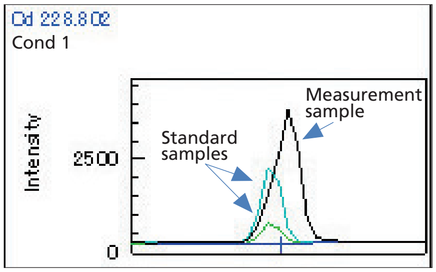
In ICP emission spectrometry, measurement errors can have a number of causes, including physical interference, ionization interference, and spectral interference. For this reason, it is sometimes necessary to determine whether or not values in the measurement results are truly correct. The ICPE-9000's Method Diagnosis Assistant evaluates the causes of errors for each measurement sample. It then allows modifying methods easily by displaying a way to resolve the causes of errors based on the diagnosis results so that the method can be optimized.

Spectral Interference from Coexisting Elements in Measurement Samples

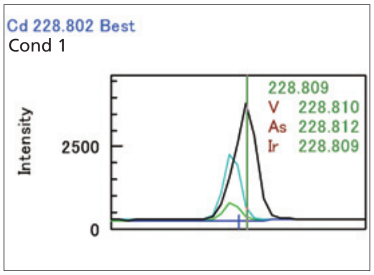


<Concentration>	
Element Name	Cd
Wavelength	228.802 (1)
Correction	
Unit	mg/L
[1]	0.181
[2]	0.181
[3]	0.181
Average	0.181
SD	0.0001
RSD	0.04

Spectral interference causes analysis values to increase.

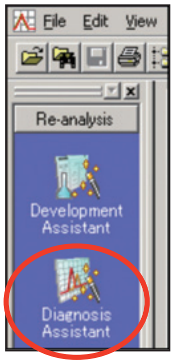


Peak Profiles

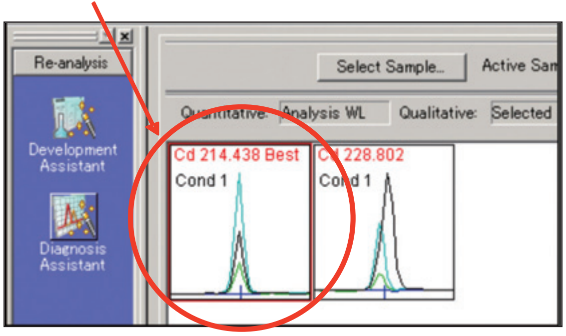


Note: To search for interfering elements after measurements, single-click on the enlarged peak view window.

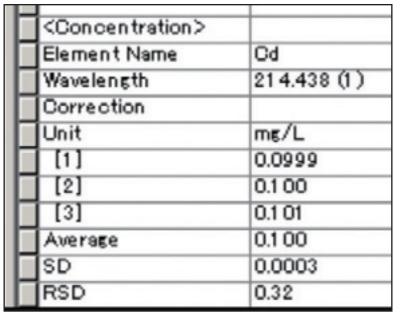
Click [Diagnosis Assistant]



Automatically detects the optimal wavelength.



Automatically selects the optimal wavelength.



<Concentration>	
Element Name	Cd
Wavelength	214.438 (1)
Correction	
Unit	mg/L
[1]	0.0999
[2]	0.100
[3]	0.101
Average	0.100
SD	0.0003
RSD	0.32

Quantitation results for the optimal wavelength

Example of Postrun Analysis Using the Diagnosis Assistant

Method Development Assistant

The Method Development Assistant generates measurement conditions based on the qualitative analysis results for all elements.

If elements are selected from the qualitative results listed, the Method Development Assistant automatically generates information regarding the optimal interference-free measurement wavelength and the calibration curve sample.

If interference cannot be avoided, correction information is also automatically generated, including BG correction and interelement correction (IEC).

ICPEsolution

Method Development Assistant automatically creates measurement conditions.

Method Development Assistant

Also automatically creates Measurement Wavelength and Calibration Curve information.
If interference is unavoidable,
it also automatically creates Correction information.

Simple and accurate setting of conditions

Automatic Wavelength Selection

In ICP emission spectrometry, the optimal wavelength can differ for different samples, due to the effects of spectral interference from coexisting elements. As a result, determining the optimal wavelength is required.

ICPEsolution simplifies this process by including a function for automatically selecting wavelengths. With previous multitype ICP instruments, if a single element was measured at different wavelengths, the instrument generated measurement results for each selected wavelength, which required determining the optimal wavelength. With ICPEsolution, only the optimal measurement results are shown, regardless of the number of wavelengths registered. ICPEsolution continuously monitors all elements included in the measurement sample and automatically evaluates the amount of interference at each wavelength where elements are measured. Based on that information, it automatically selects the optimal measurement wavelengths for each sample and displays accurate analytical values.

ICPEsolution

Element/wavelength	Sample A	Sample B
Cd 1	8ppb	–
Cd 2	–	5ppb

ICPEsolution automatically selects the optimal wavelength for each sample.

Conventional Multitype Instruments

Element/wavelength	Sample A	Sample B
Cd 1	8ppb	100ppb
Cd 2	18ppb	5ppb

Conventional multitype ICP instruments do not determine the presence of interference.

Interelement Correction Makes High-Accuracy Measurement Simple

For samples with multiple matrix components, accurate analysis may not be possible due to spectral interference at all wavelengths. However, ICPEsolution enables accurate measurements by using interelement correction (IEC).

Previously, IEC required specialized knowledge for creating calibration curve samples and for calculating correction factors. ICPEsolution, however, enables IEC to be performed by simply adding a calibration sample to the calibration curve sample. Furthermore, the Method Diagnosis Assistant allows both correction information and calibration sample data to be created automatically, which makes performing IEC simple.

Automatic Accuracy Control Analysis Using QAQC Software (optional)

The QAQC software complies with the accuracy control parameters specified for Japanese public water supply analysis and by the U.S. EPA.

By using this functionality, accuracy can be automatically controlled.

Switchable Between Axial and Radial Observation Directions

Axial / Radial Directions

The ICP instrument allows observation from two directions, either axial or radial.

Axial Observation

- High sensitivity (ppb level)

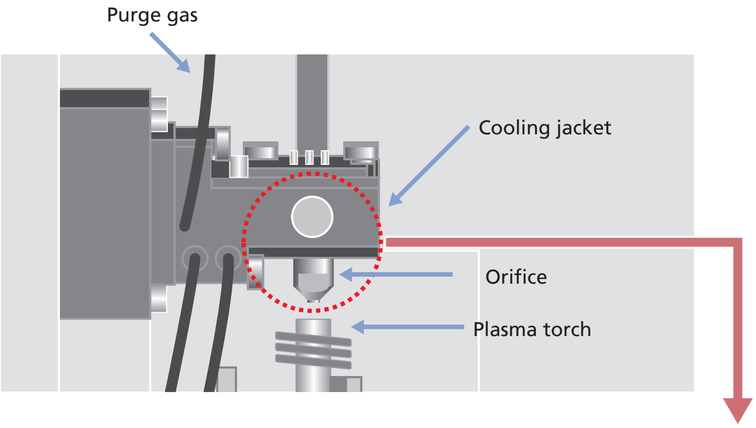
Radial Observation

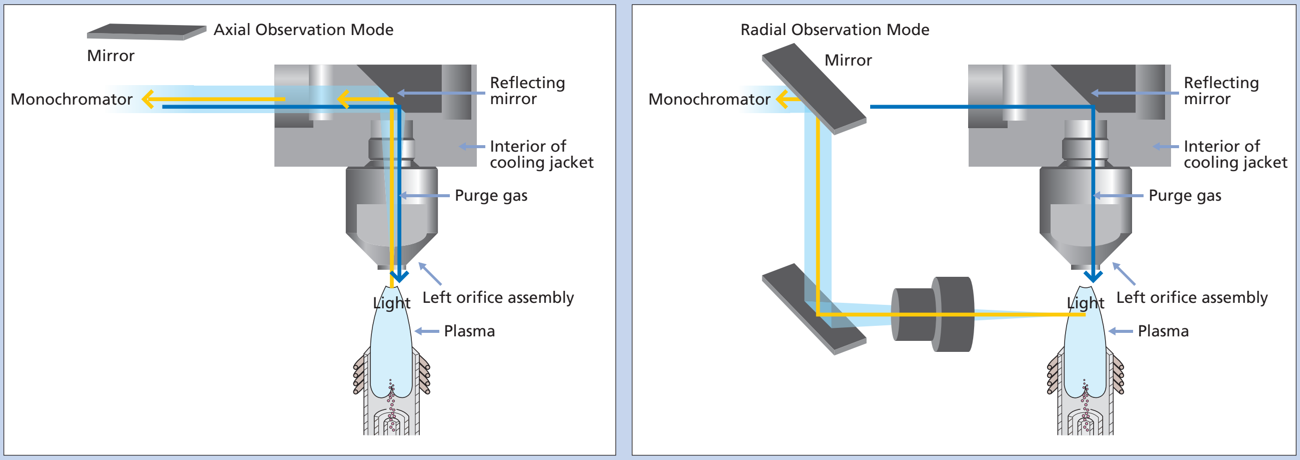
- Enables measuring high-concentration samples.
- Minimizes ionic interference from matrix.

Axial Observation System

An orifice for capturing light is located above the torch. This area is cooled using a cooling jacket to minimize thermal effects from the plasma.

In addition, purge gas flows toward the plasma from inside the cooling jacket to prevent the optics from being contaminated by particulates from the sample.





Axial Observation

Radial Observation

Select from Two Types, Depending on Objectives

ICPE-9000 (axial observation)

ICPE-9000 (dual-view observation —both axial and radial)

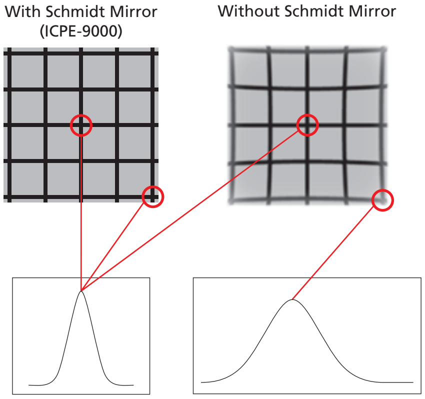
Note: The observation direction can be switched automatically using the ICPEsolution software.

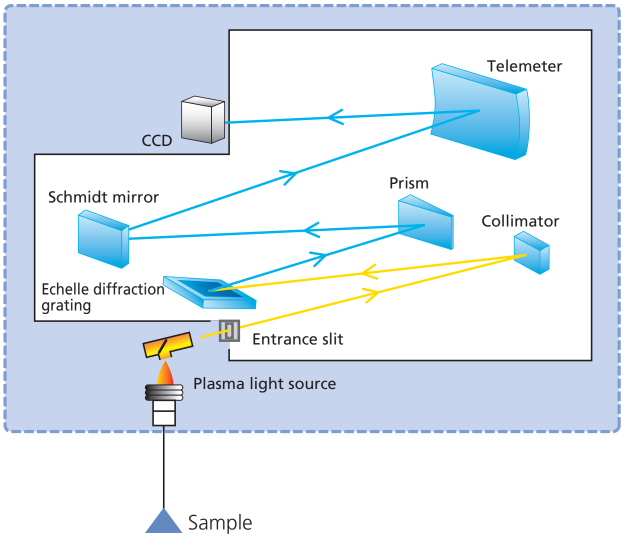
High Sensitivity and High Resolution

Equipped with Schmidt Mirror (aberration correcting mirror)

Spectrometers without an astigmatism correction function cause the photoelectric surface of the detector to be blurry along its perimeter, which results in poor resolution and sensitivity.

The ICPE-9000 optical sysytem includes a Schmidt mirror for correcting astigmatism. Consequently, it allows obtaining data with high sensitivity and high resolution.

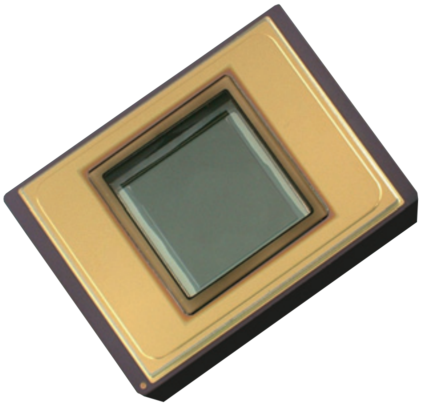




Low noise, high sensitivity

Large-scale 1-inch CCD

The ICPE-9000 is equipped with a large-scale 1-inch CCD. In multitype devices, semiconductor detectors with a large number of elements are indispensable for increasing resolution.
However, with small-sized detectors, pixel size is reduced, which, in turn, reduces the amount of light captured by each pixel. With the ICPE-9000, a large-scale 1-inch CCD is used, eliminating this problem.
In addition, in comparison with conventional semiconductor detectors, the ICPE-9000 runs at a relatively high cooling temperature (-15 degrees Celsius), which shortens the initial stabilization period and provides long-term stability.



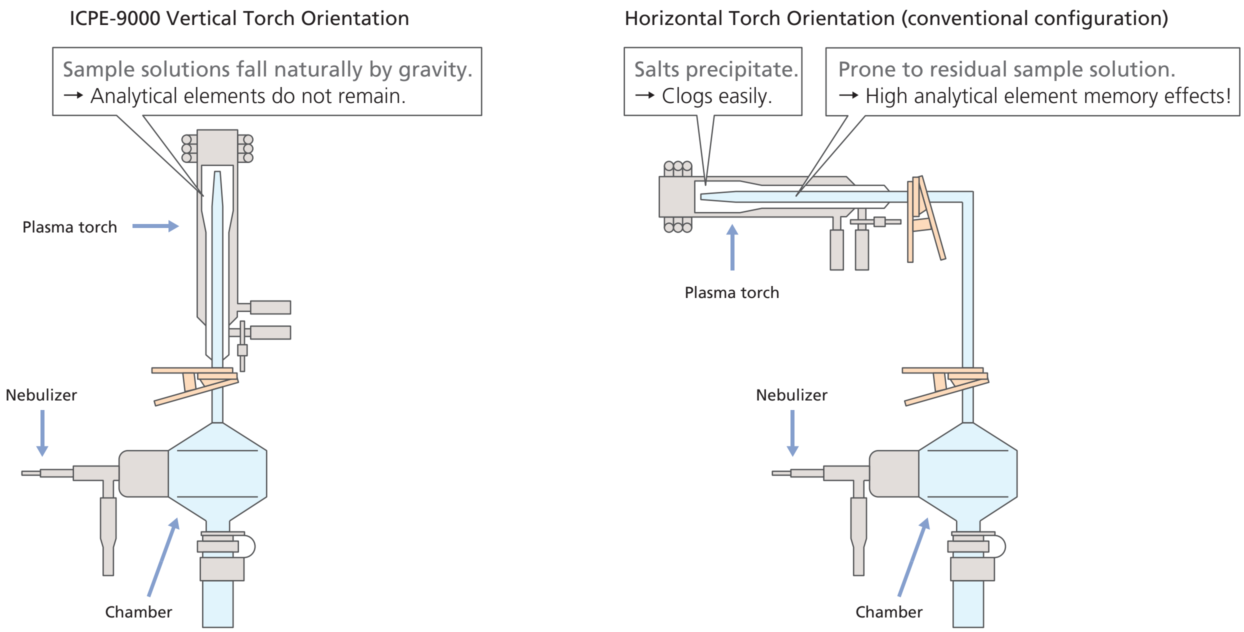
Large-scale 1-inch CCD

Vertical Torch Orientation

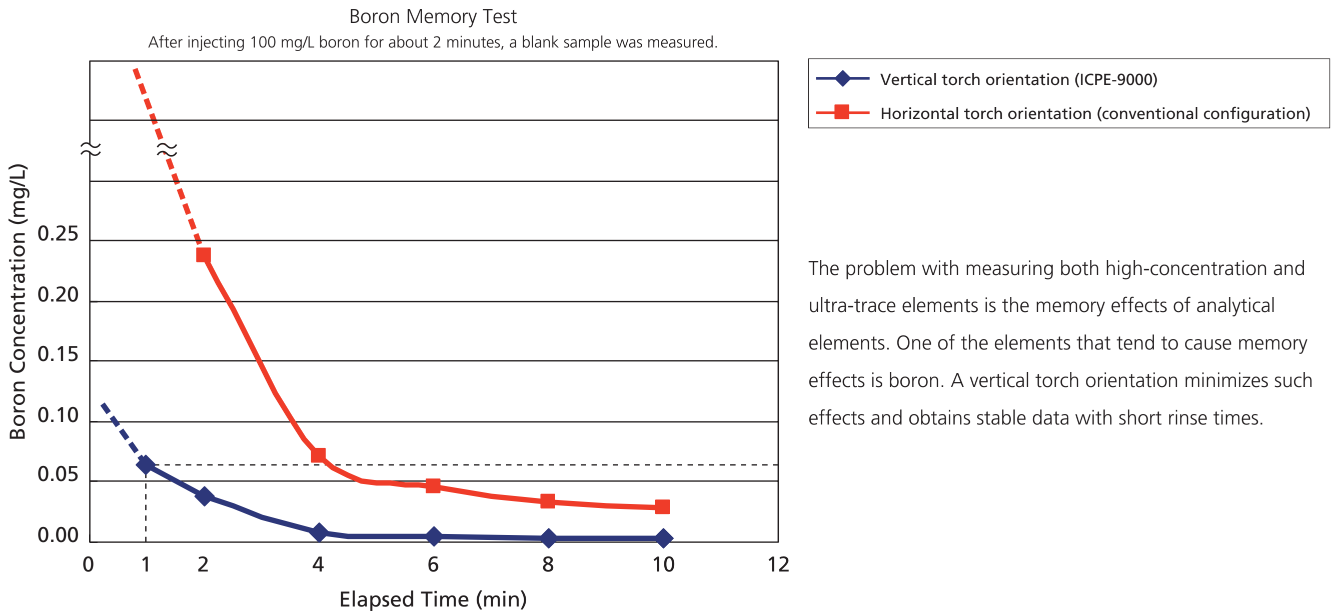
Contamination-Free

ICP emission spectrometers that only offer high-sensitivity axial observation are not ideal for high-matrix samples. This unsuitability is mainly due to sample adhesion to the torch caused by torch orientation.
With a horizontal torch layout, the sample gradually falls due to gravity while it moves through the torch, leading to adhesion to the walls, which causes contamination and torch blockage.

To resolve such problems, the ICPE-9000 uses a vertical torch orientation that has proven successful for high-matrix samples. As a result, analytical element memory effects and torch blockage are minimized, even for high-matrix samples, ensuring stable measurement.



The ICPE-9000 torch is oriented vertically to minimize analytical element memory effects.



The problem with measuring both high-concentration and ultra-trace elements is the memory effects of analytical elements. One of the elements that tend to cause memory effects is boron. A vertical torch orientation minimizes such effects and obtains stable data with short rinse times.

Vacuum Spectrometer

Eliminates the Need for Spectrometer Purge Gas

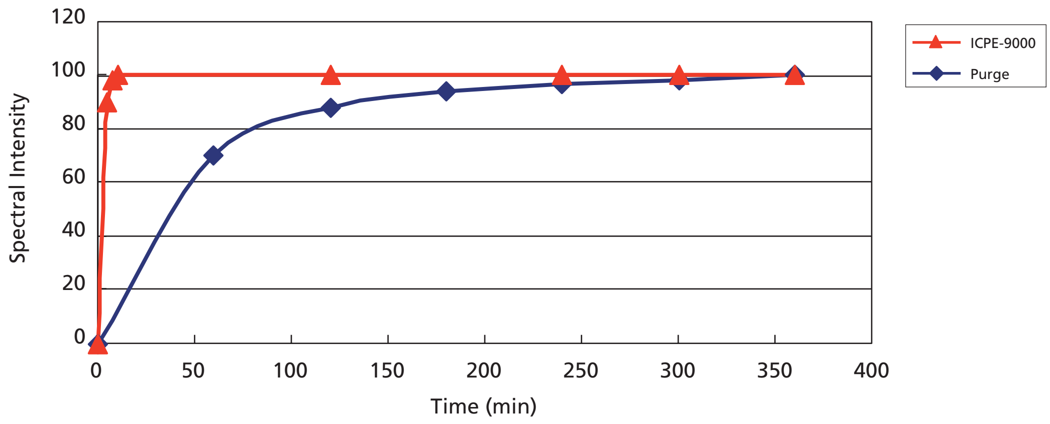
Measuring wavelengths in the vacuum UV region (below 190 nm) requires eliminating oxygen, which absorbs light of such wavelengths, from inside the spectrometer. One method for removing the oxygen involves using a vacuum pump (rotary pump) to take in the air (vacuum spectrometer). Another method involves purging the spectrometer with a high-purity gas (nitrogen or argon) to force out the oxygen (gas purging).

Advantages of Vacuum Spectrometers

- Spectrometer purge lines do not need to be installed, which reduces initial and running costs.
- The operator can freely select wavelengths without worrying about vacuum UV wavelengths versus atmospheric wavelengths.
- Since the temperature does not vary in the spectrometer, it provides stable data over long periods.
- Spectrometer interior is not contaminated by purge gas, even after long periods of use.
- Viewing the vacuum monitor allows confirming whether or not an element can be analyzed.
- Power interruptions do not cause contamination from the vacuum pump, because a solenoid valve closes between the vacuum pump and spectrometer.

Disadvantages of Gas Purge Spectrometers

- Requires obtaining and managing high-purity gases for purging the spectrometer.
- High-purity purge gas (N_2 or Ar) increases running costs.
- A long time is required for the spectrometer to stabilize.
- Purge status cannot be verified without performing an analysis.

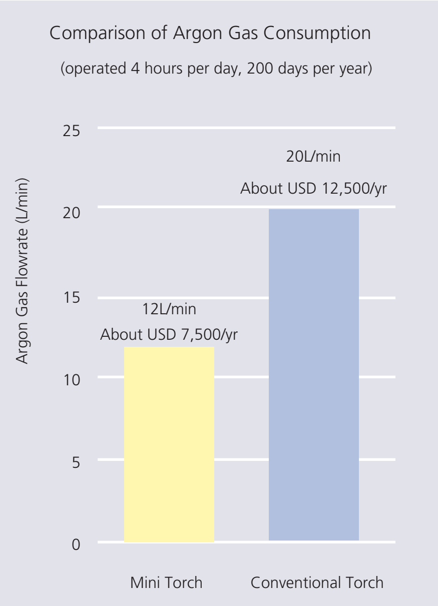


Change in Spectral Intensity

Lower Running Costs and Energy Consumption

Mini Torch

The ICPE-9000's mini torch reduces consumption of argon gas to half that of conventional torches. A high-frequency power supply is automatically tuned to the mini torch, which provides sensitivity equivalent to that obtained from a standard torch.



Argon Gas with 99.95 % Purity Is Sufficient

The purity of argon gas used in the ICPE-9000 only needs to be 99.95 % or higher. This reduces running costs by allowing the use of commercial analysis-grade argon gases (normally about 99.99 %).

In contrast, ICP instruments that use purge gas often use the same argon gas for both purging and plasma ignition, which requires using more expensive higher-purity gases (99.999 % or higher). Instruments that do not use the same argon gas require providing two grades of argon gas or both argon and nitrogen gases. In addition, in order to prevent condensation of purge gases on semiconductor detectors that are cooled to 0 °C or below, high-purity gas (99.999 % or higher) with low moisture content is required.

No Oxygen Gas (O_2) Is Necessary for Measuring Organic Solvents

To prevent carbon deposits on the plasma torch tip when measuring organic solvent samples, many ICP instruments require supplying oxygen to the plasma torch.

However, Shimadzu ICP emission spectrometers feature a high-performance high-frequency power supply and a carbon deposit resistant torch. Furthermore, the ICPE-9000 is designed with a vertical torch orientation that results in less sample remaining in the torch. Consequently, it does not require an oxygen supply for measuring organic solvents, such as dimethyl sulfoxide (DMSO), methanol, or ethanol.

Quick Instrument Startup and Shutdown

The ICPE-9000 allows a shorter stabilization time and faster shutdown time. Stable analysis is possible by supplying argon gas and cooling water and starting up the exhaust duct immediately before igniting the plasma torch. In addition, the use of a vacuum spectrometer allows immediately starting measurements in the vacuum UV region.

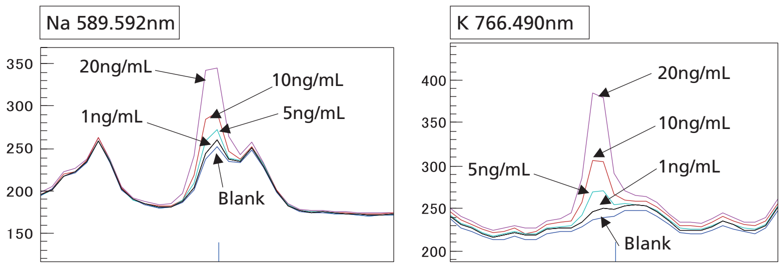
After measurements, the argon gas and cooling water supplies and the exhaust duct can be switched OFF immediately to avoid wasting expense and time.

Argon and Oxygen Gas Mixture Supply Unit (special order)

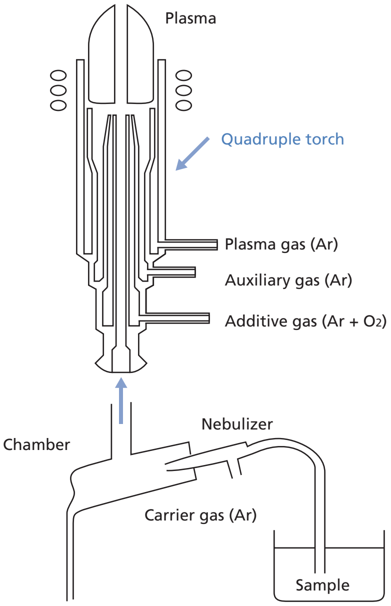
For High-Sensitivity Analysis of Na or K in Organic Solvent Samples

Normally, the ICPE-9000 does not require supplying oxygen gas (O_2) to the plasma when measuring organic solvent samples. However, measuring trace levels of elements such as Na and K in organic solvent can cause background noise from the organic solvent.

In such cases, oxygen can be safely mixed with the plasma by using a quadruple torch and an argon-oxygen gas mixture supply unit. This allows measuring trace levels of elements such as Na and Ka by reducing the background noise from the organic solvent.



Peak Profiles of Na and K in Xylene (0, 1, 5, 10, and 20 ng/mL)

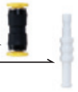
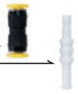
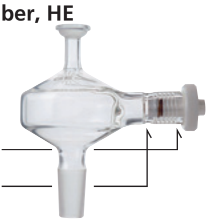
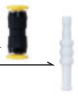
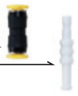
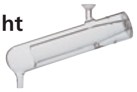
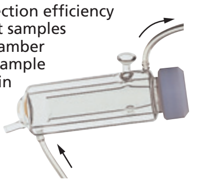
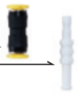


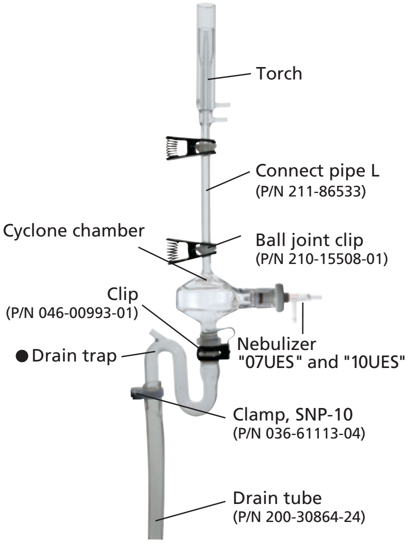
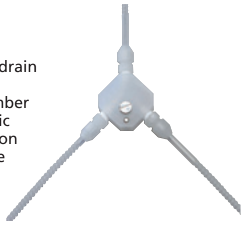
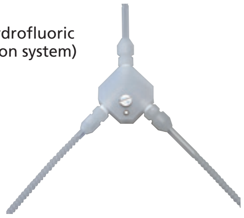
Automatic Internal Standard Element Supply Unit (special order)

This unit mixes the measurement sample solution and internal standard element solution through the flow lines and supplies it to the ICP instrument. Equipped with two flow lines, the supply unit is designed to drain waste liquids by a natural process, which eliminates any problems with drainage.

Accessories, Options

Note) Purchase items individually for sample types without a part number (P/N)

Item Sample Type	Nebulizers	Sample Take-up Tubing	Chambers
Standard Set ICPE-9000 Standard Accessories	**Nebulizer,10UES** (P/N 046-00092-20) Designed for high-concentration samples, with high-efficiency nebulization. (Sample take-up rate approx. 1 ml/min)  • Sample take-up tube ASSY, NFTS-075 • Connector, QSM(P/N 046-00092-09) • Tube adaptor, 0735(P/N 046-00092-10) • Clamp, SNP-1(P/N 036-61113-01) These are included. 	**Take-up tube ASSY, NFTS-075** (P/N 046-00092-18) For "10UES" and "07UES" nebulizers. 	**Cyclone chamber, HE** (P/N 046-00093-02)  Locking screw, 0152 (P/N 046-00093-92) Seal, 0237 (P/N 046-00093-93) These are included.
For Small Amounts of Samples	**Nebulizer, 07UES** (P/N 046-00092-21) A nebulizer with high-efficiency nebulization. (Sample take-up rate approx. 0.6 ml/min)  • Sample take-up tube ASSY, NFTS-075 • Connector, QSM(P/N 046-00092-09) • Tube adaptor, 0735(P/N 046-00092-10) • Clamp, SNP-1(P/N 036-61113-01) These are included. 	**Take-up tube ASSY, NFTS-075** (P/N 046-00092-18) For "10UES" and "07UES" nebulizers. 	**Cyclone chamber, HE** (P/N 046-00093-02)  Locking screw, 0152 (P/N 046-00093-92) Seal, 0237 (P/N 046-00093-93) These are included.
High Salt Samples (Used to inject high salt concentration samples)	**Nebulizer,10UES** (P/N 046-00092-20) (Sample take-up rate approx. 1 ml/min)  • Sample take-up tube ASSY, NFTS-075 • Connector, QSM(P/N 046-00092-09) • Tube adaptor, 0735(P/N 046-00092-10) • Clamp, SNP-1(P/N 036-61113-01) These are included. 	**Take-up tube ASSY, NFTS-075** (P/N 046-00092-18) For "10UES" and "07UES" nebulizers. 	**Cyclone chamber, HE** (P/N 046-00093-02)  Locking screw, 0152 (P/N 046-00093-92) Seal, 0237 (P/N 046-00093-93) These are included.
Organic Solvent Samples (Injection systems for organic solvents)	**Nebulizer,10UES** (P/N 046-00092-20) (Sample take-up rate approx. 1 ml/min)  • Sample take-up tube ASSY, NFTS-075 • Connector, QSM(P/N 046-00092-09) • Tube adaptor, 0735(P/N 046-00092-10) • Clamp, SNP-1(P/N 036-61113-01) These are included. 	**Take-up tube ASSY, NFTS-075** (P/N 046-00092-18) For "10UES" and "07UES" nebulizers. 	**Chamber drain straight** (P/N 211-80437-01)  **Nebulizer holder kit type 2** (P/N 211-48062) Includes organic solvent-resistant O-rings. They are attached to each chamber other than the cyclone chamber, and are used to support nebulizers. 
Organic Solvent Samples (Water-cooled chamber) (Controls evaporation of solvents)	—	—	**Water-cooled chamber kit** (P/N 211-43472) This increases injection efficiency of organic solvent samples by cooling the chamber and suppressing sample evaporation within the chamber.  *Cooling water circulator is necessary.
Hydrofluoric acid sample injection system (P/N211-42853-03) (Used for hydrofluoric acids)	**Nebulizer, PFA1S** (P/N 046-00092-14) Includes sample take-up tube.  • Sample take-up tube ASSY, NFTS-075 • Connector, QSM(P/N 046-00092-09) • Tube adaptor, 0735(P/N 046-00092-10) • Clamp, SNP-1(P/N 036-61113-01) • Tube adaptor, 0735 (P/N 046-00092-10) These are included. 	—	**Chamber ASSY** (P/N 205-07778-02) 

Torches	Drains	Other
Mini torch (P/N 211-81448) 	**Drain trap, 8214** (P/N 046-00093-01) Cyclone chamber Drain trap(Indicated by "●")  (Cyclone chamber assembly)	**Orifice ASSY L** (P/N 211-84352-91)
Mini torch (P/N 211-81448) 		**Water bubbler** (P/N 204-19281) Used to prevent blockages in the nebulizer when analyzing samples containing large amounts of sodium. Inserted in the carrier gas pathway. **Orifice ASSY** (P/N 211-43740) 
Torch for high-concentration salt solution samples (P/N 204-74323) Used when introducing an undiluted solution of a sample where the base element is of the % order of concentration. 		
Torch (P/N 204-70272) 	**Drain kit** (P/N 211-86140-91) Used for chamber drain (straight), water-cooled chamber kit and hydrofluoric acid sample injection system. Can also be used for organic solvents. 	**Arrange the ICPE-9000 with Radial View Unit** (P/N 211-86000-93) **Extension pipe L** (P/N 211-86533)
Organic solvent torch (P/N 204-77296) Used when analyzing organic solvent samples that are difficult to inject into the plasma. 	**Drain kit** (P/N 211-86140-91) 	**Low-temperature thermostatic chamber NCB-1200 (SP) for water-cooled chamber** (P/N 044-01910-01) **Arrange the ICPE-9000 with Radial View Unit** (P/N 211-86000-93) **Extension pipe L** (P/N 211-86533) 
Demountable torch (P/N 205-09627-01) 	**Drain kit** (Included in the hydrofluoric acid sample injection system) (P/N 211-86140-91) 	**Arrange the ICPE-9000 with Radial View Unit** (P/N 211-86000-93) **Connect pipe HFS** (P/N 211-84175) (Included in the hydrofluoric acid sample injection system.)

Peripheral Equipment (Options)

Autosampler ASC-6100F

(P/N 206-50100-30)
(P/N 206-50100-39)

After placing the samples in the autosampler, sample names and analysis conditions can be set via a PC, and multiple samples can be continuously analyzed.

Size: W330 x D280 x H285 mm
Power supply:
Single-phase 100 V 50/60 Hz 1 A (–30)
200 V 50/60 Hz 1 A (–39)

Turntable cover

(P/N 206-50295-01)

Ultrasonic Nebulizer UAG-1

(P/N205-09295)

This is a sample injection system developed for high-sensitivity ICP analysis. Unlike a standard nebulizer that uses negative carrier gas pressure, this nebulizer uses ultrasonic energy to nebulize a solution.
Ultrasonic energy produces a large amount of extremely fine particles. This enables the ICPE-9000 to perform analyses at a sensitivity 10 times higher than with conventional nebulizers.

Size: Main unit W320 x D380 x H540 mm
Power supply: W382 x D360 x H159 mm
Power supply: Single-phase 100 V 50/60 Hz 10 A
* A cooling water system utility is required.

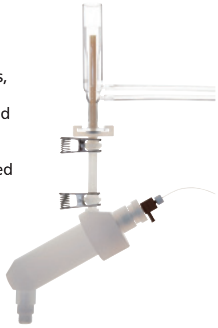
Table ND (with casters) (P/N 219-96005) (included)
Size: W600 x D480 x H750 mm

Hydrofluoric Acid Sample Injection System HFS-3

(P/N211-42853-04)

Samples composed primarily of silicates, such as rocks, soil, cement and ceramics, are insoluble or dissolve poorly even in strong acids. If hydrofluoric acid is used to dissolve these samples, normal glass injection systems cannot be used.
A sample dissolved in hydrofluoric acid can be injected into the plasma directly by using an injection system made of fluorinated ethylene resin.

*For system design information,
refer to pages 12 and 13.



Hydride Generator HVG-ICP

(P/N211-40981)

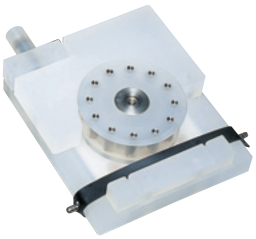
The elements within the sample are reduced and vaporized by the nascent hydrogen generated in the decomposition of sodium borohydride. Only the gas phase is injected into the plasma, providing high-sensitivity measurement.

Size: W333 x D210 x H195 mm
Power supply:
Single-phase 100 V 50/60 Hz 2 A

Peristaltic Pump

(P/N 211-88177-91)

Used in high-viscosity sample analysis.
Fixed sample injection is possible.



Low-temperature Thermostatic Chamber NCB-1200(SP)

(P/N 044-01910-01)

Used by water-cooled chamber.

Size: W210 x D430 x H639 mm 29 kg
Power supply: Single-phase 100 V 50/60 Hz 9.5 A

Autosampler ASX-520

Autosampler manufactured by CETAC (max. 240 samples) is also available. Please contact our sales representative.

Cooling Water Circulator CA-1115A-1

(P/N 044-01813-01)

Size: W354 x D384 x H851 mm 43 kg
Power supply: Single-phase 100 V 50/60 Hz 15 A
* When only the main ICPE-9000 unit is connected, the stand cooling-water valve kit (P/N 211-86152-91) is needed.
* When the ultrasonic nebulizer UAG-1 is also connected, the stand cooling-water valve kit (in combination with UAG-1)
(P/N 211-86152-92) is needed.

Software PKG ICPE-9000(E)

(P/N 211-44263-92)

Accuracy Control Software Package QAQC ICPE

(P/N 211-44280-91)

QAQC (for accuracy management) optional software.

Tap Water Connection Kit

(P/N 211-86153-91)

Required when tap water is used to cool the ICPE-9000.

Specifications

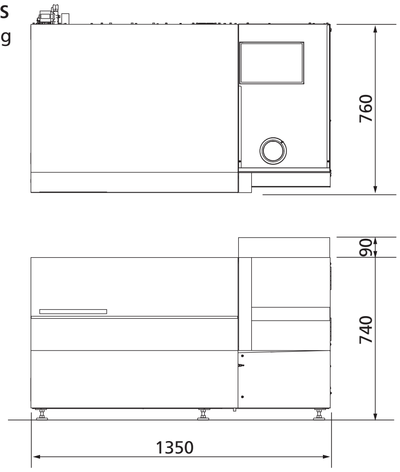
	ICPE-9000 (P/N211-86000-92)	ICPE-9000 with radial view unit (P/N211-86000-93)
Plasma Light Source		
Torch unit	Axiall observation	Axial/radial observation
Sample misting chamber	Cyclone chamber	
Plasma torch	Either mini torch (standard accessory) or conventional torch can be used.	
Nebulizer	Coaxial type	
Radio Frequency Generator		
OscillatorSample	Crystal oscillator	
Maximum frequency output	1.6 kW	
Output stability	Within ± 0.3%	
Radio frequency circuit element	Transistor element	
Ignition method	Fully automatic	
Load matching	Automatic matching	

Spectrometer Unit	
Optical system	Echelle spectrometer
Wavelength range	167 nm to 800 nm
Detector	CCD
Resolution	≤ 0.005 nm @200 nm
Vacuum ultraviolet range compatibility	Vacuum spectrometer
Spectrometer temperature	With thermal control

Software
Wavelength automatic selection
Automatic generation of coexistent element information
Qualitative analysis
Quantitative analysis Can also store data for entire wavelength range
Accuracy control (optional)

External Dimensions

Unit: mm Weight: 270 kg



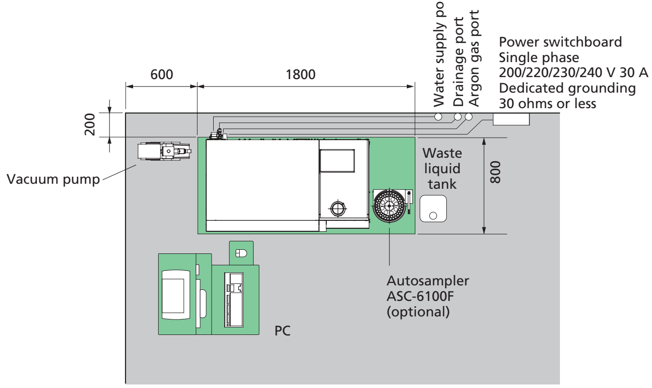
Installation

1. Installation room environment	Temperature: 18 to 28 (rate of temperature change: 2 degrees Celsius /h or lower)
	Humidity: 20 to 70%
	Avoid locations with high levels of vibration or dust.
2. Power source	Main unit: Single-phase 200/220/230/240 V ±10% (max 250 V) 50/60 Hz 30 A
	Data processor unit: Please refer to the manual
	Options
	Laser printer: Please refer to the manual
	Autosampler ASC-6100F: Single-phase 100-240 V ±10% 50/60 Hz 1 A
	Ultrasonic nebulizer UAG-1: Single-phase 100 V ±10% 50/60 Hz 10 A
	Hydride generator HVG-ICP: Single-phase 100 V ±10% 50/60 Hz 2 A
	All of the above are grounded and require 3-prong sockets.
	Check separately when using the cooling water circulator.
3. Grounding	Resistance: independent grounding below 30 ohms
4. Gas installation	Type: Argon gas of 99.95% or greater purity Advjust so that argon gas supply pressure is 450±10 kPa. Approximately one 7-cubic meter gas cylinder is required per 8 hours of operation. Consumption rate of argon gas used in analysis is 0.74 cubic meters/h with the standard specifications.
5. Cooling water	Plasma stand cooling water: Water temperature 5 to 30 flow rate 1L/min or more CCD detector cooling water: Use Shimadzu's recommended cooler Note) UAG-1 requires separate cooling water supply. Note) Cooling water circulator can also be used for plasma stand and UAG-1.
6. Exhaust duct	Plasma stand and radio frequency power source exhaust duct Exhaust gas from the plasma stand is primarily argon, however, be sure to install an exhaust duct, since this gas may also contain metallic vapors and solvents.

For details on other instruments,
refer to the ICPE-9000 Installation Requirements Manual.

Installation Example

(ICPE-9000 and autosampler placed on a 1800 x 800 table)
Unit: mm



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