

Spectrum
Instruments
A PerkinElmer Company

SP-AA 4500 SP-AA 5000

Atomic Absorption Spectrometer



Excellence in Measurement


PerkinElmer
For the Better

Reliable · Accurate · Reasonable Price



Atomic Spectrometer



SP-AA 4500 GRAPHITE FURNACE SYSTEM



SP-AA 5000 FLAME & GRAPHITE FURNACE SYSTEM

Innovative Technologies

Spectrum Instruments is now your partner for atomic spectroscopy. Our AAS is productive, reliable and user-friendly. It improved the optical precision, linear range and background correction effectively. The SP-AA 4500 & 5000 are the external computer controlled AAS fitted with 8-lamp positions and automatic gas control.

SP-AA 4500 is an Atomic Absorption Spectrometer for Graphite Furnace technique.

SP-AA 5000 is an Atomic Absorption Spectrometer with international advance technologies for Flame & Graphite Furnace technique.

Both models have two background correction technologies in one unit.

Spectrum Instruments developed PC information processing technology. Automatic measurement and straylight dynamic detected without any reference materials and any cost increment.

Original Optical Noise Reduction

Spectrum Instruments develops optical noise reduction technology, which combines optical component UV enhancement technology. It improves instrument's optical performance, linear range and enhanced background correction.

Lamp Control (Patent)

Spectrum Instruments develops interval lamp control technology. It makes normal hollow cathode lamps self-absorption background correction possible without the influence to instrument's stability. Meanwhile, it will prolong working time of the lamp. The cost of normal hollow cathode lamp is only about one-tenth of special lamp.

Original "Hg lamp-reagent" gradient measurement

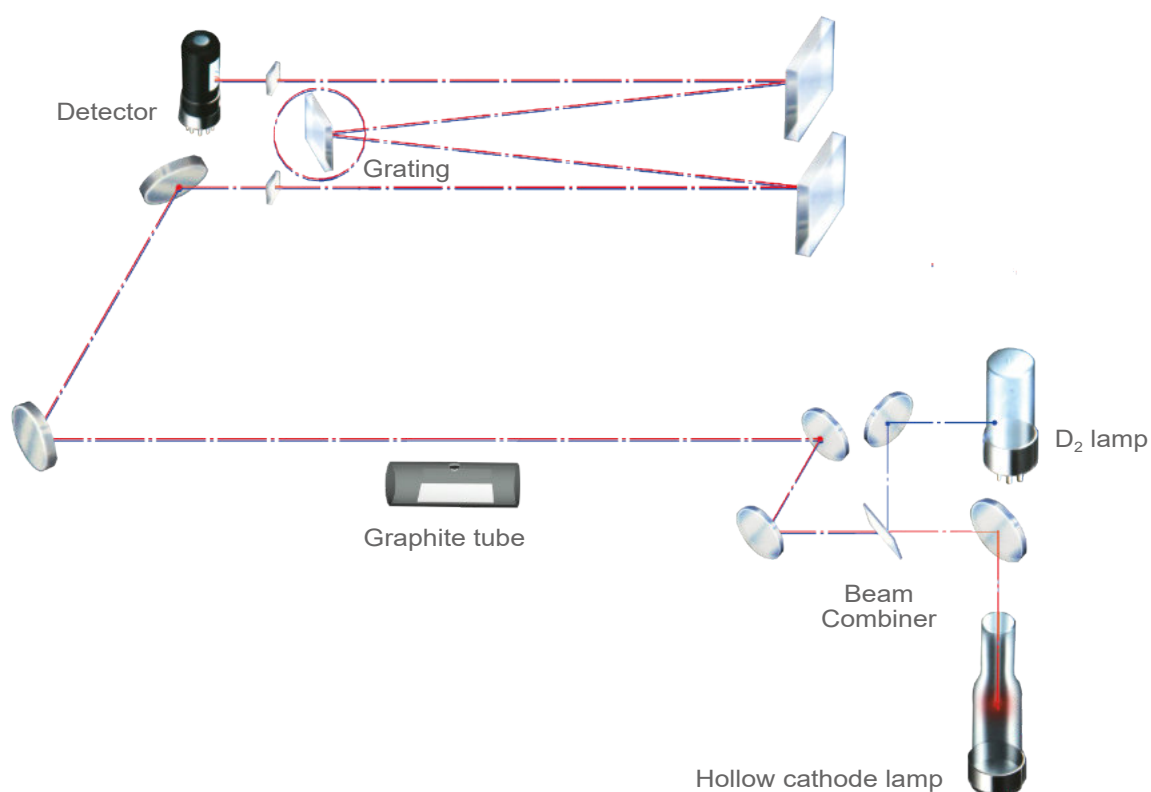
Spectrum Instruments develops "Hg lamp-reagent" gradient measurement technology. We establish an exact mathematical model to estimate "double beam linear and balance" specification. This technology provides a fast and economic method for instrument self testing system. It also establishes a brand new method to improve instrument's detection performance. Numerous technological innovation and renewal such as fashion design, element lamp multi-dimensional automatic adjustment system, gas path electronics functional and modular design, No-adjustment D₂ lamp holder and so on.



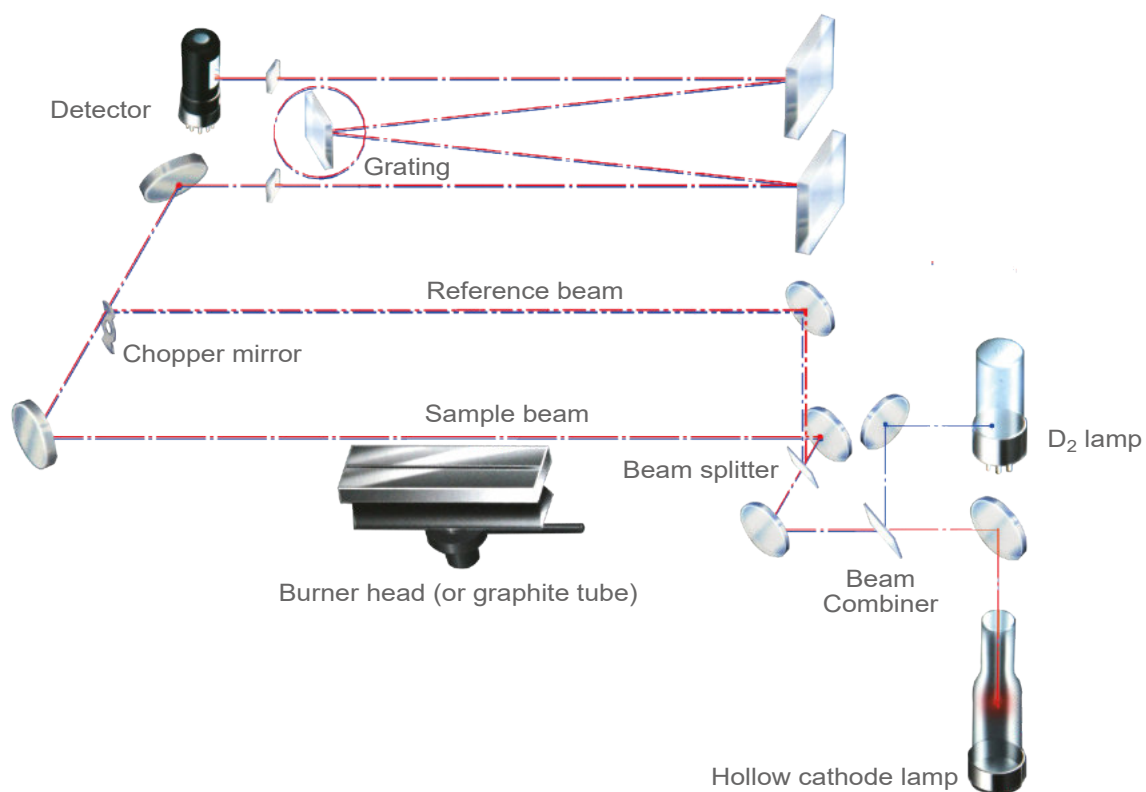
Product Model

SP-AA 4500 Graphite Furnace Atomic Absorption Spectrometer
SP-AA 5000 Flame & Graphite Furnace Atomic Absorption Spectrometer

Optical Diagram of SP-AA 4500 : total reflection optical systems



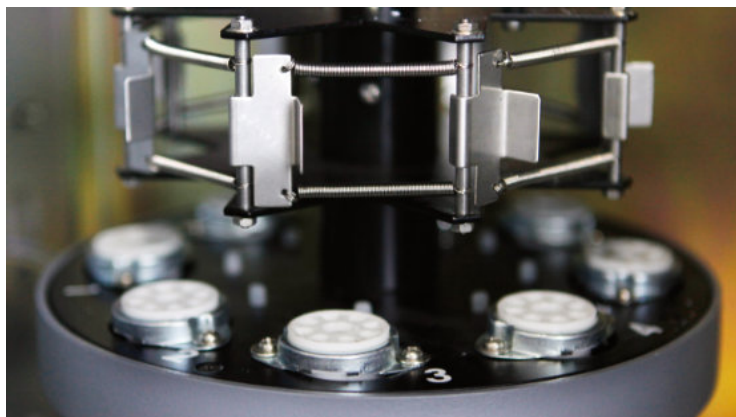
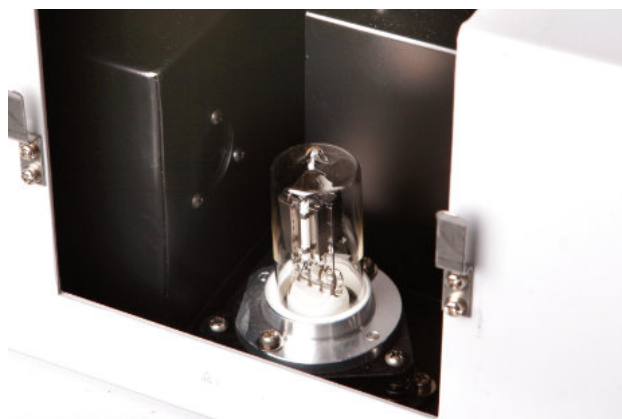
Optical Diagram of SP-AA 5000 : total reflection optical systems



Atomic

Spectrometer

The Main Features



Reflection Achromatic Optical System :

SP-AA series Atomic Absorption Spectrometer using a large aperture of 355.8 and 345.6 mm focal length monochromator and 1800 lines/mm diffraction grating monochromator, total reflection optical systems, as well as aberration aspheric mirrors, the instrument has a high luminous flux, no color, excellent optical performance without chromatic aberration. Keep the measurement is accurate and reliable. Make the analysis is effective.

Pioneering Lamp Turret Position Vertical Structure :

8 lamps turret position vertical structure for maximum automatic changer.

Automatic Ignition For Flame Mode (For SP-AA 5000) :

The ignition of flame on the burner head is controlled from the software.

Good Ability To Resist Atomizer Optical Radiation Reasonable Design.

Autosampler For Flame And Graphite Furnace :

One unit of autosampler can operate with flame and graphite furnace mode. The number of sample is 85 positions for flame mode and 87 positions for graphite furnace mode.

Auto Flame Ignition And Gas Flow Automatic Setup (For SP-AA 5000) :

It is important to determine the optimal gas flow rate for the flame when using an organic solvent or after changing the burner height.

Automatic Burner Height (For SP-AA 5000) :

The absorption sensitivity for flame analysis depends on the atomization position at the proper burner height .
Automatic burner cleaner for 50 mm. burner head (Option)

Automatic Slit Selection :

The system can select the six slits for SP-AA 4500 and six slits for SP-AA 5000.

Powerful Software And Data Process Ability, Humanistic Operation Interface And Beautiful Graphic Output :

Fashion design, element lamp multi-dimensional automatic adjustment system, gas path, electronics functional and modular design, No-adjustment D₂ lamp holder numerous technological innovation and renewal.

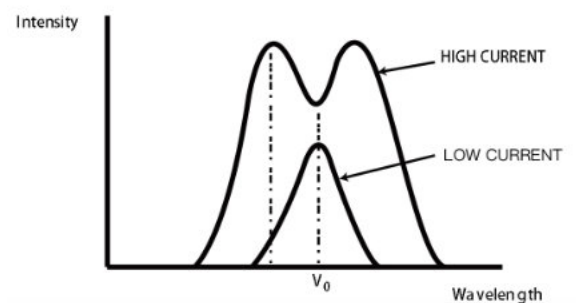
Other Automatic Function :

- Full wavelength scan and peak seeking.
- Negative voltage and energy balance.
- Auto optical balance in D₂ lamp balance correction.
- Lamp current setting.
- Alarm and safety protection.

Self-Absorption Background Correction Function

1.

Self-absorption background Correction (Smith-Hieftje).



2.

Comparison sheet of common background correction methods.

Compare items	D ₂ lamp	Zeeman			Self-absorption
		Constant magnetic (Horizontal)	Alternate (Horizontal)	Alternate (Vertical)	
Device	Beam consistency	Bad	Good	Good	Good
	Optics energy balance	Balance	Almost Balance	Almost Balance	Imbalance
Property	Energy calculation	Loss	Big Loss	Big Loss	Small Loss
	Wavelength correction range	UV Area (traditional)	Full-Wavelength	Full-Wavelength	Full-Wavelength
	Sensitive Loss	No	Big Loss	Loss	Loss
	Baseline Stability	Not so good	Good	Good	Better
	Background Correction 1A	Good	Good	Good	Good
	Background Correction 2A	Bad	Good	Good	Good
	Background Correction Structure	Not Allowed	Allowed	Allowed	Allowed
	Spectrum Overlapping interference	Not Allowed	Partially	Partially	Same as Zeeman
	Curve flip	No	High	High	High

3.

Advantage of High performance self-absorption background correction.

Competing with Zeeman effect background correction, it is low cost, no loss of light due to polarizers, accurate correction for spectral interference and easy to use for various application.

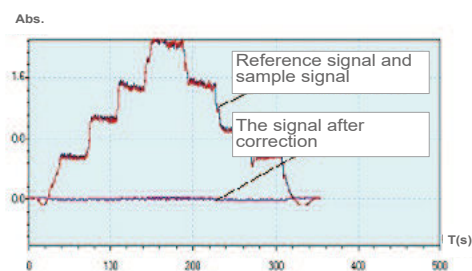
such as: Measurement of trace levels of zinc in iron solution.

Interested Element	Analytical Line (nm)	Matrix Element	Absorption Line (nm)
Al	309.28	Mg	309.30
As	193.76	Fe	193.73
Ca	422.67	Fe	422.64
Cd	228.80	Ni	228.84
Cu	324.75	Fe	324.73
Mg	285.21	Fe	285.18
Ni	232.00	Fe	232.04
Pb	217.00	Fe	216.95
Sb	217.58	Fe	217.55
Se	196.03	Fe	196.05
Si	251.61	Fe	251.69
Zn	213.856	Fe	213.8589

4.

Spectrum Instruments SP-AA 4500 & 5000 break many technologies bottleneck:

- Creating "multiple linearity and balance technique" adopted hardware and software combined method.
- Solving many problems by using self-absorption background correction.
- Dual signal (sample beam wide pulse and reference beam narrow pulse).
- Transmission/Absorption in wide linear range and dynamic balance.



Self-absorption background correction (Cd 228.80 nm)
Flame background correction performance at 2.0A

Self-absorption background correction is more accurate than deuterium lamp (D₂) background correction. This is ideal for the quantitation of trace elements in matrix complex solution, such as bio-samples and metals.

Self-absorption background correction over the entire wavelength range from 185 nm to 900 nm.

No polarizer is used, measurements are possible with no light loss and high S/N ratio.

Due to the excellent self-absorption and D₂ lamp background correction ability, the molecular absorption and particle scattering are corrected and produce the accurate correction for spectral interference and some spectral overlap.

These technologies are appropriate to test trace elements in food, traditional Chinese medicine, seawater, blood, biologicals, high-salt solution, especially in the analysis of Cd, Pb, Cu, Zn.

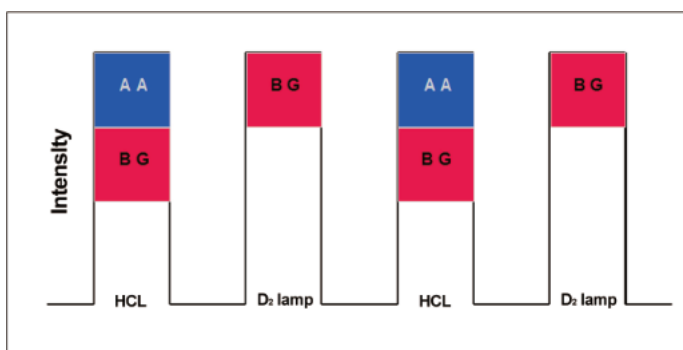
Excellent D₂ Lamp Background Correction Function

Unique reflection optical system keeps the light transmission unique. It makes hollow cathode lamp beam and D₂ lamp beam through different wavelength in the best condition.

Hollow cathode lamp and D₂ lamp Beam optical balance technology extended application range of D₂ lamp background correction. It also realizes high ability of background correction.

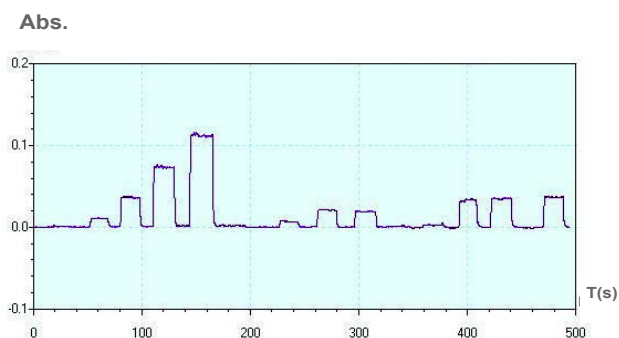
Principle

The deuterium lamp method involves lighting the hollow cathode lamp and the deuterium lamp alternately at high speed. The light from D₂ lamp almost observes to wide-bandwidth molecular absorption as background absorption. While the light from the hollow cathode lamp can absorb the same bandwidth of the atomic absorption band and molecular absorption band, the total of the atomic absorption and the background absorption can be observed. With the deuterium lamp background correction method, light from both sources passes through the burner. The difference of absorbance is determined to conduct background correction.

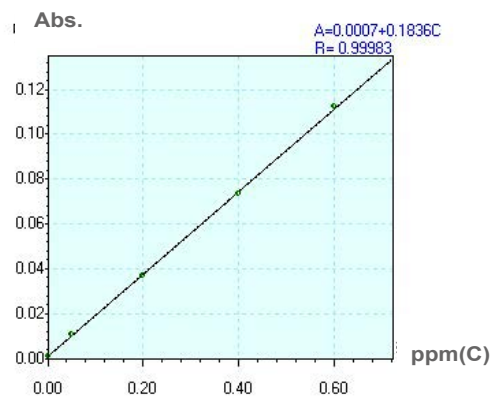


Advantages:

- High-sensitive detection.
- Wavelength range of background correction could be extended to 500 nm.
- Simple and inexpensive.
- No sensitivity loss.
- Does not require a special primary light source.
- Powerful enough for most and graphite furnace application.



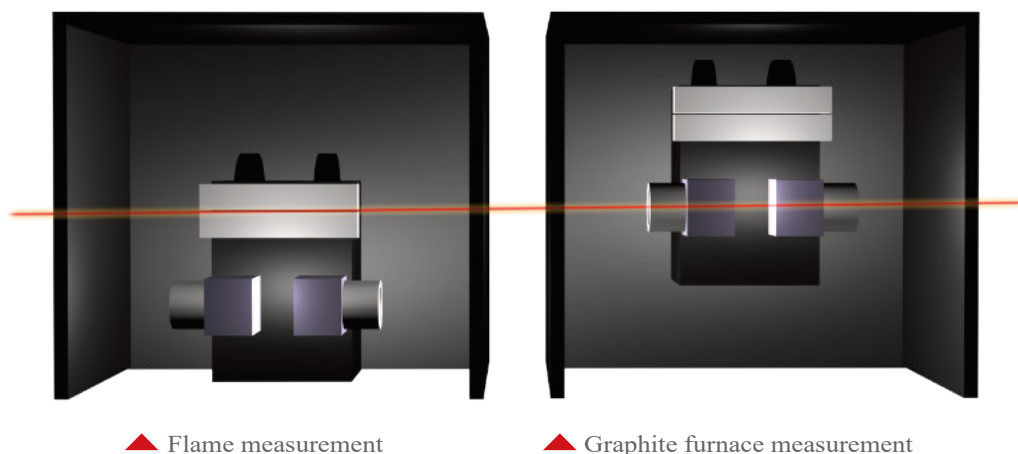
Cu Test Curve



Cu Standard Curve

New Atomizer Smart Design For Easy Swicthing Between Flame and Graphite Furnace (for SP-AA 5000)

- The atomizer units (burner head and graphite furnace head) can be switched both manual operation and automatically by software operation. No need to disconnect pipes or wires.
- One autosampler can be used for both flame and graphite furnace measurements.



Longitudinal-Heated Graphite Furnace :

Longitudinal-heated graphite furnace makes the improvement in accuracy. It minimizes many chemical interferences and matrix effects. It can programmable temperature up to 3000 °C and the heating is 2000 °C /s by software controlled.

Two independently controlled gas flows are used : external gas flow for protection of the graphite tube from the oxidation while heating and internal gas flow is used analytically to remove pretreatment step by-products and to control the sensitivity of an analysis. The internal gas flow can also be changed to an alternate gas, such as air or oxygen, to aid in sample decomposition.

Minimize Cost Per Analysis :

The cost of Longitudinal-heated graphite tube is cheaper when compare with the other techniques. You can choose between two types of tubes : platform type and wall type.

STPF :

The "Stabilized Temperature Platform Furnace" (STPF) concept can reduce the spectral interferences. It improves the accruacy of the analytical data.

Hydride System :

The Hydride system is a continuous flow technique for the determination of As, Se, Sb, Sn, Te, Bi and Hg at low microgram per liter (ppb) concentrations with electrothermal heating unit to heat the quartz cell. With the continuous flow mode, it guarantees convenient handling and precision as well as efficiency during the analysis of hydride-forming elements and mercury with the cold vapour technique.



▲ Hydride System

The Main Features

Full Operation SPWin-AAS Software and QA/QC Function

Neat and comprehensive information interface

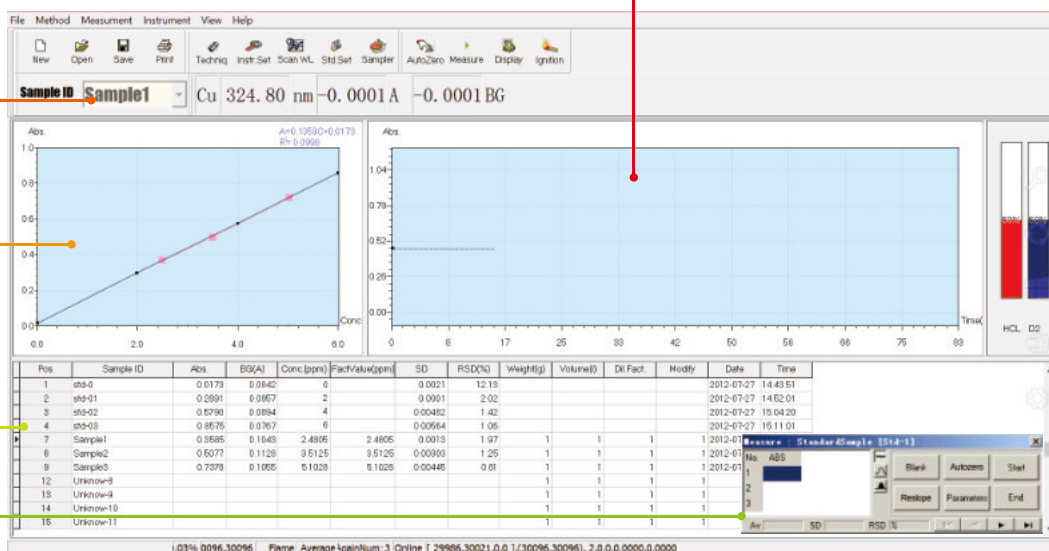
Flame real time status
Test process display

Sample No./Element name/
Wavelength and absorbance

Standard Curve
Display curve equation
Related coefficient

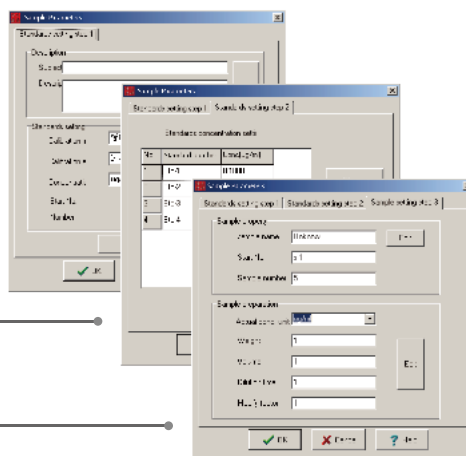
Analysis result of elements
Sample No./Absorbance/background
signal
Calculated concentration of curve/
Actual concentration.

Test command
Press "Start" button,automatic
"Blank" & "correction" function



■ Sample setup guide
is easy to operate

1. Element: Sample setup
2. Standard sample information
Correction method, Correction equation,
Concentration unit, Standard sample start No.,
Quantity, Method description
3. Standard sample concentration setup
4. Sample property and configuration information
5. New form establish automatically after completed



Pos	Sample ID	Abs	BG(AI)	Conc(ppm)	Factvalue(ppm)	SD	RSD(%)	Weight(g)	Volume(l)	DI Fact	Modify	Date	Time
1	std-0	0.0173	0.0842	0	0.0021	0.0021	12.13					2012-07-27	14:43:51
2	std-01	0.0891	0.0867	2	0.0001	0.0001	2.02					2012-07-27	14:43:51
3	std-02	0.0790	0.0894	4	0.00482	0.00482	1.42					2012-07-27	15:04:20
4	std-03	0.8675	0.0767	6	0.00564	0.00564	1.06					2012-07-27	15:11:01
7	Sample1	0.5585	0.1643	2.4806	2.4806	0.0013	1.97	1	1	1	1	2012-07-27	15:11:01
8	Sample2	0.6077	0.1126	9.5125	9.5125	0.0020	1.25	1	1	1	1	2012-07-27	15:11:01
9	Sample3	0.7378	0.1085	5.1028	5.1028	0.0046	0.91	1	1	1	1	2012-07-27	15:11:01
12	Unknown-8							1	1	1	1		
13	Unknown-9							1	1	1	1		
14	Unknown-10							1	1	1	1		
15	Unknown-11							1	1	1	1		

■ Test condition and calculation setup,
Instrument automatically



1.

HCL setting...Element

Double click to choose element

☐ No Change Lamp

☐ No Preheat

Cancel OK

Element lamp setup
Element lamp property
Element lamp position
Element lamp preheat

2.

Instrumentation

Line: 324.80 nm

Wt: 0.70 nm

PWT: 200.00 V

Active Pos: 2

Current: 4.00 mA

Preheat Pos: 4

Current: 4.00 mA

Flame: Oxidant: Air, Oxidant flow: 6.00 L/min, C2H2 flow: 1.20 L/min, Burner height: 750 mm, Burner Type: 100 mm, BG correction: D2, Mode: Absorption

Meas Mode: Average

Replicates: Sample: 5, Std: 0

Integrat time: 3.00 Sec

Delay: 0.00 Sec

Smoothering Factor: 1.00

Set

Set + Scan WL

Exit

Default value of every element
(recommended)

3.

Graphite Furnace Heating Parameters

Step	Begin (C)	End (C)	Ramp (s)	Hold (s)	Atomize	Stop Gas
1	50	100	5	20		
2	120	250	18	15		
3	250	250	0	5		
4	2000	2000	0	4		
5	2000	2500	0	4		
6	0	0	0	0		
7	0	0	0	0		
8	0	0	0	0		
9	0	0	0	0		

AZ temperature ramp mode

☒ Max Power

☐ Ramp to Atomize

Cooling time(S): 30

Gas(mL/min): 300

Graphite Tube

Reset Use Time: 0

Temp Calibration

Change Graphite Tube

Type of Graphite Tube

☒ Wall

☐ platform

Set

Cancel

OK

Temperature condition setup (recommended)

Fields of Application/Industry:

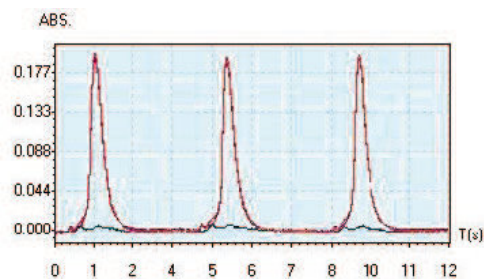
- Chemistry / Polymer Industry
- Clinical Chemistry / Medicine/
- Hygiene / Health Care
- Cosmetics
- Electronics
- Energy
- Environment / Water / Waste
- Food / Agriculture
- Geology / Mining
- Material Analysis
- Metallurgy / Galvanization
- Pharmacy
- Refineries / Petrochemistry
- Semi-Conductor Technology
- Others



Example of Application Case

1. Soil analysis

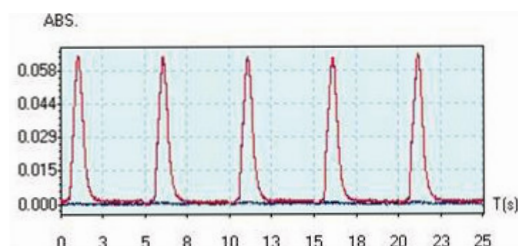
Test content of Pb in soil sample



Pb Atomization Graphic of soil sample

2. Food analysis

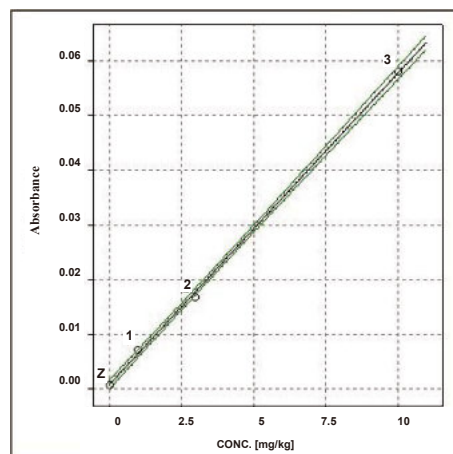
Graphite Furnace test content of Cd in tea leaf sample.



Cd Atomization Graphic of Tea leaf sample

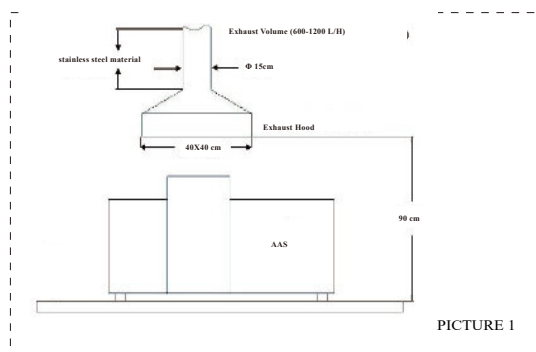
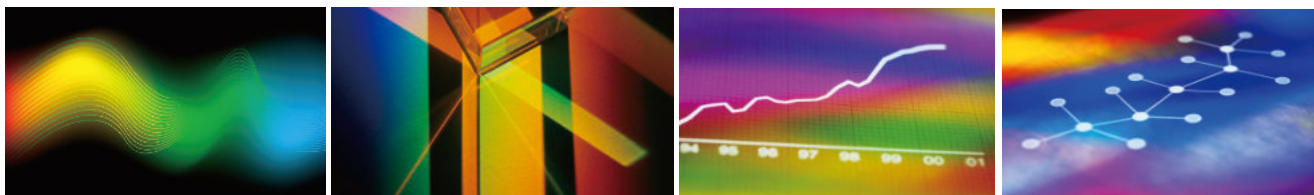
3. Petroleum analysis

Determination of Al in motor oil by flame mode. Al calibration standards have been prepared in a solution containing 20 g oil and 35 g IMBK. The calibration standards have been prepared using fresh motor oil (clean oil).



Determination of Al in motor oil

Atomic Spectrometer



1. Exhaust Equipment

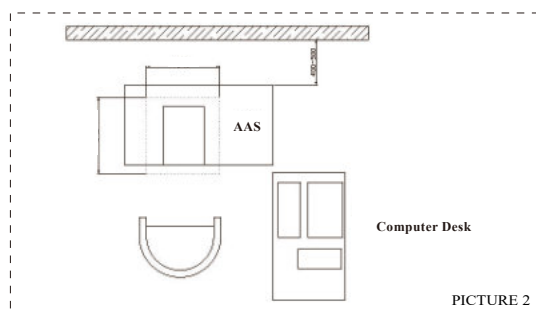
Exhaust equipment is required in the laboratory. The exhaust air rate should adsorb the big newspaper. If the exhaust air rate is too high, it will affect the stability of the flame. On the contrary, if the exhaust air rate is too low, the harmful gas will not be exhausted.

(Refer to picture 1)

2. Laboratory Cabinet

Laboratory cabinet is required to be consisted and stable. The table top should be smooth. The distance between the instrument and the wall is required about 40-50cm. It will be convenient for installation and maintenance.

(Refer to picture 2)



3. Power Requirement

3.1 SP-AA 5000 Flame:

Power requirement: 220 V ($\pm 10\%$), 50/60 Hz

Power $\geq 220 \text{ V} \times 10\text{A}$, 1 KVA exchange purification of electronic power supply is required.

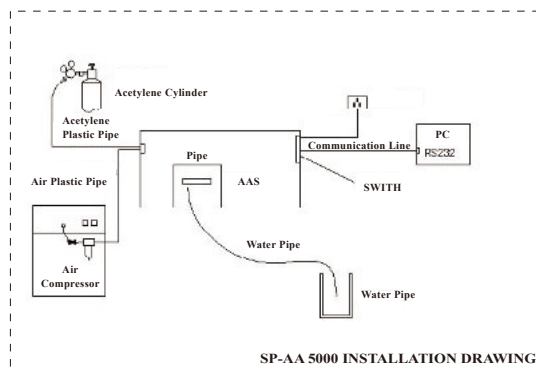
A separated earthing cable if possible.

3.2 SP-AA 4500 & 5000 Graphite Furnace:

Power requirement: 220 V ($\pm 10\%$), 50/60 Hz

Power $\geq 220\text{V} \times 30\text{A}$, 15 KVA exchange purification of electronic power supply is required.

A separated earthing cable is required and earth resistance $\leq 4\Omega$.



4. Gas Supply Configuration

4.1 Flame:

A bottle of high purity Acetylene $\geq 99.5\%$ (instrument grade) is required. Output pressure of Acetylene gauge: approximately 0.8-1.6 kgf/cm² (0.08-0.16 MPa or 12-22 psi). Technical grade Acetylene is not allowed.

A bottle of high purity Nitrous Oxide $\geq 99.5\%$ (instrument grade) if need. Output pressure of Nitrous Oxide gauge: approximately 4-6 kgf/cm² (0.4-0.6 MPa or 56-85 psi).

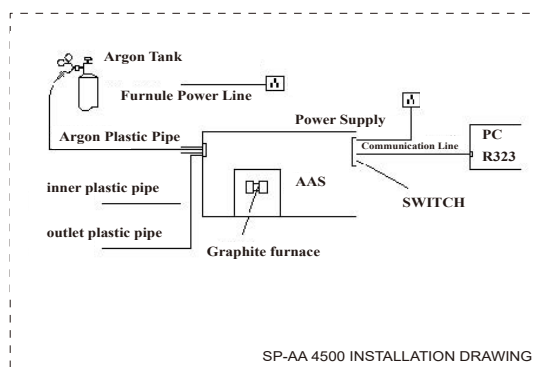
Compressed air, oil free, output pressure gauge: approximately 4-6 kgf/cm² (0.4-0.6 MPa or 56-85 psi).

4.2 Graphite furnace:

A bottle of ultra high purity Argon(99.998%) or high purity Argon(99.995%) is required. Output pressure of Argon relief valve: approximately 2.5 kgf/cm² (0.25 MPa or 35 psi). Cooling water is required.

4.3 Hydride:

A bottle of ultra high purity Argon(99.998%) or high purity Argon(99.995%) is required. Output pressure of Argon relief valve: approximately 2.5 kgf/cm² (0.25 MPa or 35 psi).



Innovation Technologies

Spectrum Instruments improve the optical precision, linear range and background correction effectively. SP-AA 4500 is an external computer controlled AAS equipped with 8-lamp positions and automatic gas control.

SP-AA4500 Performance Specification

System Design

Optical system	Developed optical noise reduction technology, which combined optical component UV enhancement technology. It improved instrument's optical performance, linear range and enhanced background correction.
Monochromator	Czerny-Turner type with 2 focal lengths at 355.8 and 345.6 mm, automated wavelength selection and slit selection.
Wavelength range	185-900 nm
Grating	Holographic grating with 1800 lines/mm
Wavelength repeatability	±0.1 nm
Wavelength accuracy	±0.3 nm
Detection limited	Cd ≤1.0 pg
Slits	Automated slit selection 0.1; 0.2; 0.4; 0.7; 1.4; 2.0 nm
Detector	Wide range UV sensitive photomultiplier tube
Lamp	Automated 8-lamp turret with independent lamp power supply for each lamp and two heating circuits for preheating lamp operation. Non-coded lamp and coded lamp can be used for analysis.
Background Correction	Deuterium (D2) Background Correction and Self-absorption Background Correction.

Graphite Furnace System

Heating System	Integrated computer-controlled Longitudinal Heated Graphite Furnace.
Function	Analytical furnace program up to 9 steps can be set up.
Temperature	Programmable temperature up to 3000 °C in 1 °C increment.
Heating Rate	Maximum linear heating rate is 2000 °C/s under software control.
Ramp time & Holding time	1s~255s
Gas Flow	Choice of two inert gases with computer-controlled flows. Separate control of inert gas stream is Argon for internal and external gas flow. The external gas flow is 1 L/min and internal gas flow in the graphite tube can be adjusted to 250 mL/min.
Cooling System	A closed circuit optimized to save time, water and provide stable condition. Water temperature during operation is approx. 38 °C.
Autosampler for Graphite	Injection volumes from 1 to 50 µL in increments of 1 µL are user selectable. Automatic dilutions and additions of three different modifiers are available. Corrosion resistant sample tray holds 87 positions.
Safety Functions	Warning will function when cooling water flow failure, gas pressure over, Furnace temperature too high, Graphite tube broken.
Hydride System	The Hydride system is a continuous flow technique for the determination of As, Se, Sb, Sn, Te, Bi and Hg at low microgram per liter (ppb) concentration with electrothermal heating unit (600-950°C) to heat the quartz cell. The Hg will be determined with the cold vapour technique. The system has the gas flow control including two peristaltic pumps for supply the reagent, acid and samples solution.

Other Information

Software	SPWinAA Software Package
Weight	120kg
Dimensions (W x D x H)	800 mm x 800 mm x 575 mm
Environmental Requirements	10 °C up to 35 °C Rel. humidity max. 85 %
Power Requirements	110 / 220V±10%, 50/60Hz

Information, descriptions, and specifications in this publication are subject to change without notice.

SP-AA 5000 Performance Specification

System Design

Optical system	Dual Optics combined for single beam and double beam mode. True Double Beam developed optical noise reduction technology, which combined optical component UV enhancement technology. It improved instrument's optical performance, linear range and enhanced background correction. Measurement modes of atomic absorption and atomic emission are available.
Monochromator	Czerny-Turner type with 2 focal lengths at 355.8 and 345.6 mm, automated wavelength selection and slit selection. The monochromator provides a true double beam operation.
Wavelength range	180-900 nm
Grating	Holographic grating with 1800 lines/mm
Wavelength accuracy	±0.3 nm
Sensitivity (Cu)	approx. 0.8A at 5 ppm, RSD≤0.5%
Slits	Automated slit selection 0.1; 0.2; 0.4; 0.7; 1.4; 2.0 nm
Detector	Wide range UV sensitive photomultiplier tube
Lamp	Automated 8-lamp turret with independent lamp power supply for each lamp and two heating circuits for preheating lamp operation. Non-coded lamp and coded lamp can be used.
Background Correction	Deuterium (D2) Background Correction and Self-absorption Background Correction.

Flame System

Burner-Nebulizer-System	All-titanium 100mm and 50mm burners are available:-100mm burner for air / acetylene operation, 50mm burner for both air / acetylene and nitrous oxide /acetylene operation. Adjustable nebulizer with internal Platinum / Iridium capillary, PEEK Nozzle and fixed ceramic impact bead are supplied. SP-AA 5000 features automated setting of burner height for each elements.
Spray Chamber	The PPS (Polyphenylene Sulfide) spray chamber is used for both aqueous and organic solution.
Gas Controls	Programmable gas control features software-controlled gas flows with automatic setting of gas flows for each element.
Safety Functions	Interlocked safety system prevents selection of the nitrous oxide flame if the nitrous oxide burner is not fitted. Sensor controls for protection to use the incorrect burner head and check the siphon system. To ensure correct operating fuel gas and oxidant pressures are maintained also to check the flow rate. In case of the system power failure, safety interlocks will shut down the gases automatically.
Hydride System	The Hydride system is a continuous flow technique for the determination of As, Se, Sb, Sn, Te, Bi and Hg at low microgram per liter (ppb) concentration with electrothermal heating unit (600-950°C) to heat the quartz cell. The Hg will be determined with the cold vapour technique. The system has the gas flow control including two peristaltic pumps for supply the reagent, acid and samples solution.
Autosampler for Flame	Corrosion resistant sample tray is consist of 85 positions. Integral peristaltic pump with speed control provides on-demand rinsing of the probe, eliminating carryover.

Graphite furnace System

Heating System	Integrated computer-controlled Longitudinal Heated Graphite Furnace.
Function	Analytical furnace programs up to 9 steps can be set up.
Temperature	Programmable temperature up to 3000 °C in 1 °C increment. Maximum linear heating rate is 2000 °C/s under software control.
Gas Flow	Choice of two inert gases with computer-controlled flows. Separate control of inert gas stream is Argon for internal and external gas flow. The external gas flow is 1 L/min and internal gas flow in the graphite tube is 100ml/min and 200ml/min.
Cooling System	A closed circuit optimized to save time, water and provide stable condition. Water temperature during operation is approx. 38 °C.
Autosampler for Graphite	Injection volumes from 1 to 50 µL in increments of 1 µL are user selectable. Automatic dilutions and additions of three different modifiers are available. Corrosion resistant sample tray holds 87 positions.
Safety Functions	Warning will function when cooling water flow failure, gas pressure over, Furnace temperature too high, Graphite tube broken.
Camera for Graphite tube	This camera provides a full-color image monitoring for observation of the sample injection by autosampler or manual injection. It is also able to observe the sample drying in Graphite tube.

Other information

Software	SPWinAA Software Package
Weight	150kg
Dimensions (W x D x H)	800 mm x 800 mm x 575 mm
Environmental Requirements	10 °C up to 35 °C Rel. humidity max. 85 %
Power Requirements	110 / 220V±10%, 50/60Hz



CE CB ROHS

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