

Spectrum
Instruments

SP-AA 3000 SP-AA 4000

Atomic Absorption Spectrometer



Excellence in Measurement

Reliable · Accurate · Reasonable Price

Innovative Technology

SP-AA 3000 & 4000 are Atomic Absorption Spectrometers with state of the art performance. The instruments are equipped with two background correction techniques.

Deuterium Source background correction and Smith-Hieftje Background correction are providing advantages and limitations. Combined in one instrument even complex background can be handled accurately.

High energy throughput optics with sophisticated coating

High light throughput results in outstanding signal to noise. Spectrum Instruments makes use of large scale optical components with high performance UV optimized coating. It assures high optical performance, extended linear range and enhanced background correction capability. A unique gradient beam combiner allows for optimal light throughput for line specific and deuterium lamp offering unmatched signal to noise in D2 background correction mode.

Lamp operation with reduced duty cycle

Smith-Hieftje Background Correction requires high puls operation of the line source. Spectrum Instruments uses a patented lamp control which limits the application of the high pulse to the read cycle. In graphite furnace operation the stress to the lamp is reduced by a factor of ten. Cost efficient standard hollow cathode lamps can thus be used for operating the instrument in Smith-Hieftje Background correction mode.



Individual fine tuning of wavelength drive

The wavelength accuracy of each instrument is calibrated with the help of spectral reference lines, processed with a mathematical algorithm, and stored in the instrument memory. The benefit is a fast and accurate peak picking. Fine tuning of the instrument is possible by service or by experienced users.



▲ Auto Sampler

SP-AA 3000
Single Beam

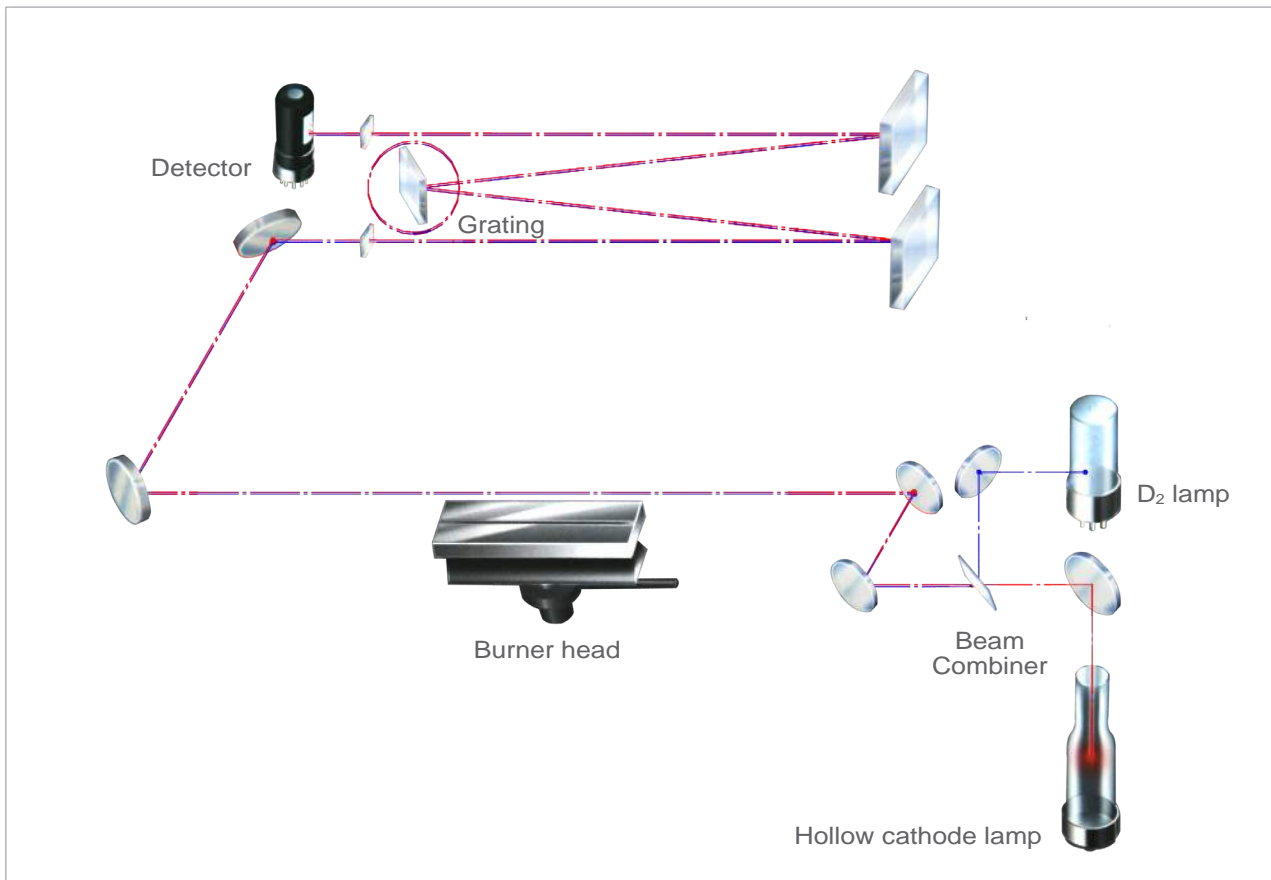
▲
SP-AA 4000
Single&Double Beam

Spectrum Instruments AA-Spectrometers

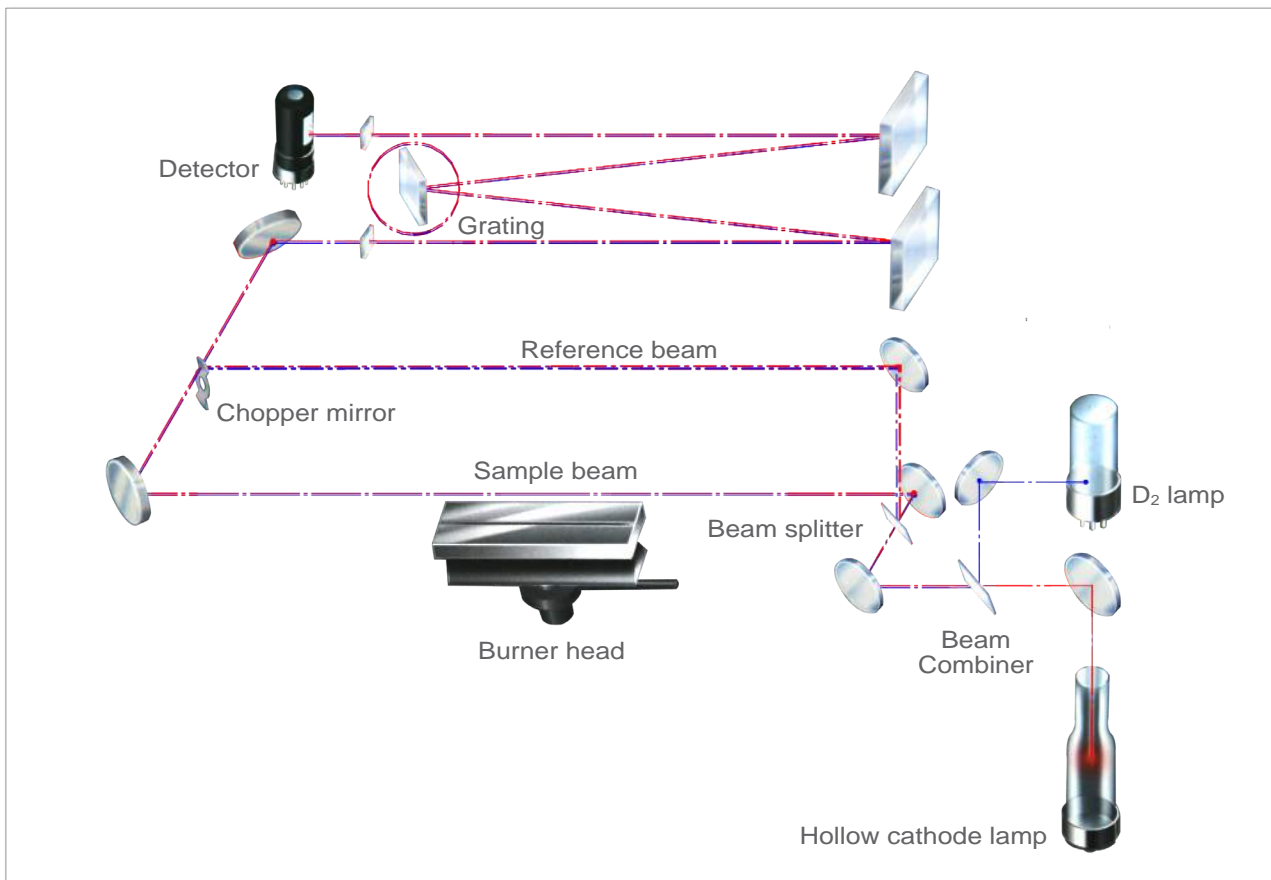
SP-AA 3000 single beam atomic absorption spectrometer

SP-AA 4000 single and true double beam atomic absorption spectrometer

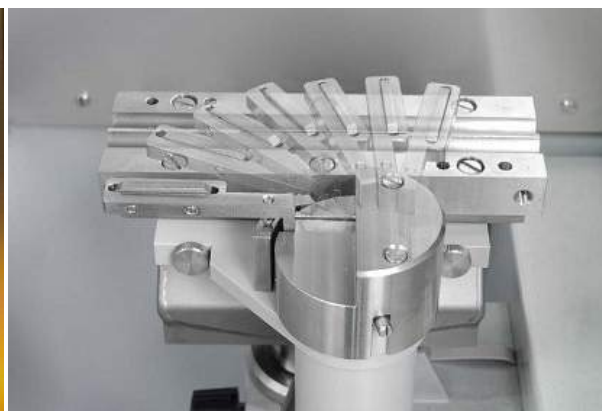
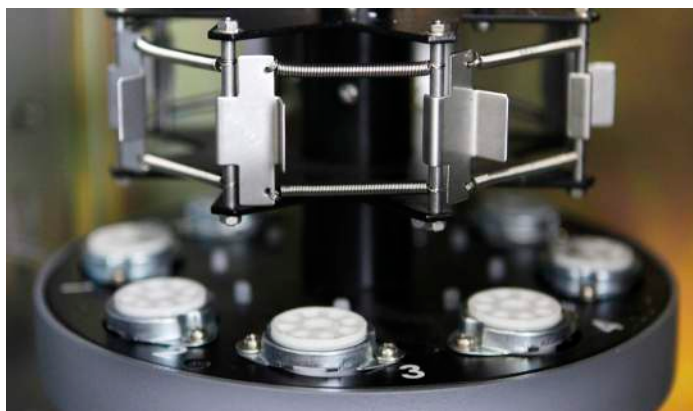
Optical Diagram of SP-AA 3000 : total reflection optical systems



Optical Diagram of SP-AA 4000 : total reflection optical systems



Main Features



Achromatic optical system with brilliant reflectivity:

The SP-AA series spectrometer is making use of large-scale surface optimized aspheric mirrors. The holographic grating holds 1800 lines/ mm. The monochromator is a large aperture, low stray light Czerny-Turner assembly with focal lengths of 355.8 and 345.6 mm. The instrument features an excellent light throughput without chromatic aberration. Uncompromised optical performance pays out in excellent analytical quality.

Vertical automatic 8-lamp turret:

The lamp holder combines minimal laboratory space with 8 lamp positions.

Pre-aligned D2 Lamp for background correction:

Replacement of the pre-aligned D2 Lamp is an easy routine. Service is not required.

Atomic Emission measurement mode for elements such as Na, K, Li

Excellent sensitivity and linearity for elements which can be easily thermally excited. Automatic setting of PMT for best operating conditions in manual and automatic sampling modes.

Automatic gas box, automatic burner control, automatic flame ignition and monitoring:

The gas and flame control unit provides fully automated, safe and interlock-controlled flame operation from the PC.

Optimized emission correction:

Accurate and precise absorbance readings depend on time optimized interpolated readings of emission generated in the atomizer. Outstanding care has been taken to minimize and correct for stray radiation.

Automatic flame sampler with flame injection technology:

The autosampler is easy to adjust and operate. It features intelligent dilution and holds a maximum of 85 positions.

State of the art windows based software:

Easy to use plain software package including state of the art functionality and easy to learn operation.

Automatic functions:

- 8 lamp holder: automatic lamp adjustment.
- Automatic burner cleaner for 50 mm. burner head (Option).
- Automatic gas box
- Automatic flame ignition and control.
- Automatic wavelength selection and peaking.
- Automatic burner height setting.
- Automatic optical photon flux balance between hollow cathode lamp and D2 lamp.
- Extensive safety interlocks

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.

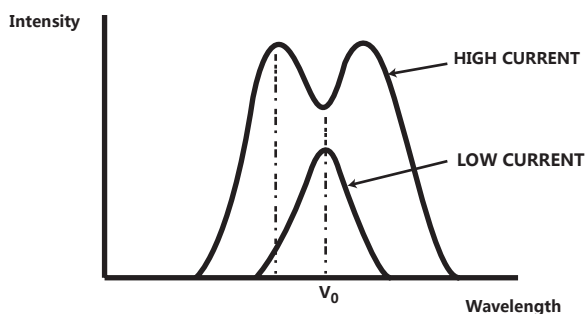


▲ Hydride System

Self-absorption background correction function

1.

1. Self-absorption background Correction (Smith-Hieftje).



2.

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	No Loss
	Wavelength correction range	UV Area (traditional)	Full-Wavelength	Full-Wavelength	Full-Wavelength	Full-Wavelength
	Sensitive Loss	No	Big Loss	Loss	Loss	Few
	Baseline Stability	Not so good	Good	Good	Good	Better
	Background Correction 1A	Good	Good	Good	Good	Good
	Background Correction 2A	Bad	Good	Good	Good	Good
	Background Correction Structure	Not Allowed	Allowed	Allowed	Allowed	Allowed
	Spectrum Overlapping interference	Not Allowed	Partially	Partially	Partially	Same as Zeeman
	Curve flip	No	High	High	High	Very Low

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.

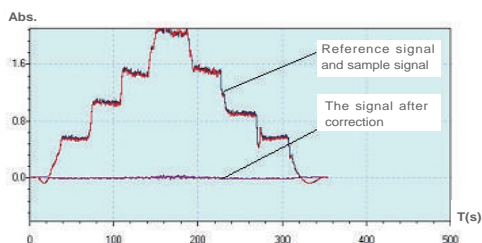
such as: Measurement of trace levels of zinc in iron solution.

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 3000 & 4000 break many technologies bottleneck :

- Solving many problems by using self-absorption background correction.
- Dual signal (sample beam wide pulse and reference beam narrow pulse).
- Wide dynamic range in absorption and emission mode.



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, sea water, blood, biologicals high-salt solution, especially in the analysis of Cd, Pb, Cu, Zn.

Excellent D2 lamp background correction function

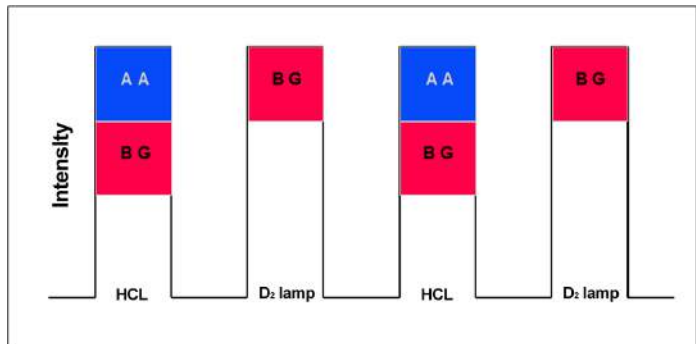
Excellent D2 lamp Background Correction Technology. Unique reflection optical system.

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.

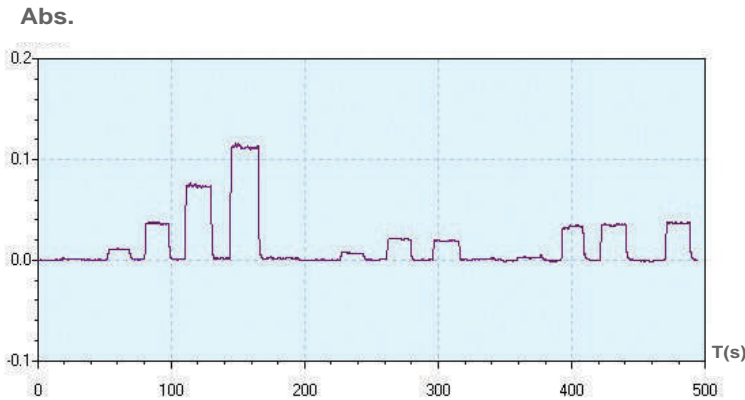
Principle

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.

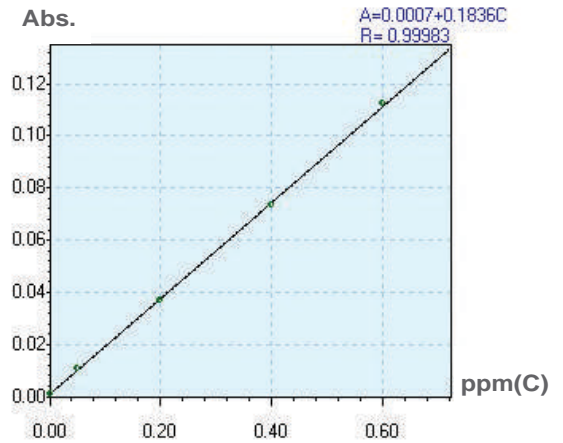


Advantages:

- 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



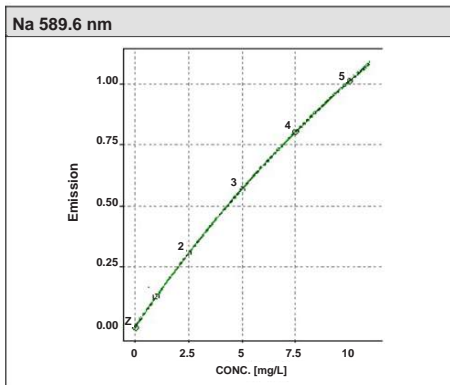
Fields of Application/Industry:

- 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

Determination of Na in cookies by emission mode



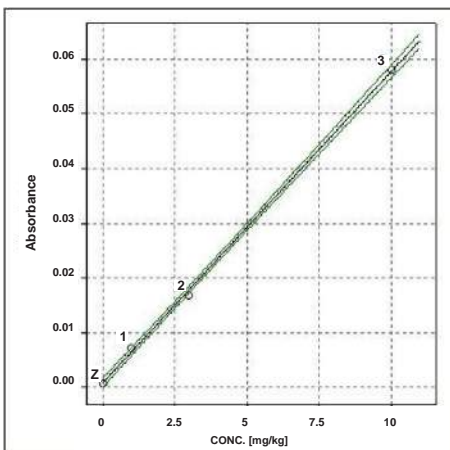
Sample preparation

Approximately 0.2 g of the samples were digested with HNO₃ using the microwave digestion system. After digestion all samples were transferred into a 50 mL volumetric flask. 0.5 mL of a 10% CsCl-solution was added and then filled up to 50 mL with deionized water.

Method parameters

Element	Wavelength [nm]	Slit [nm]	Flame type	Fuel flow [L/h]	Burner width [mm]
Na	589.6	0.2	C ₂ H ₂ /air	65	50

Determination of Al in motor oil



Sample preparation

The oil samples have been analyzed directly after dilution using IMBK (isobutylmethyl ketone). 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). Afterwards the calibration standards have been stocked using oil standard solutions.

Method parameters

Element	Wavelength [nm]	Slit [nm]	Flame type	Fuel flow [L/h]	Burner width [mm]
Al	309.3	0.7	C ₂ H ₂ /N ₂ O	260	50

The Main Features

Full operation SPWin-AAS software and QA/QC function

Neat and comprehensive information interface

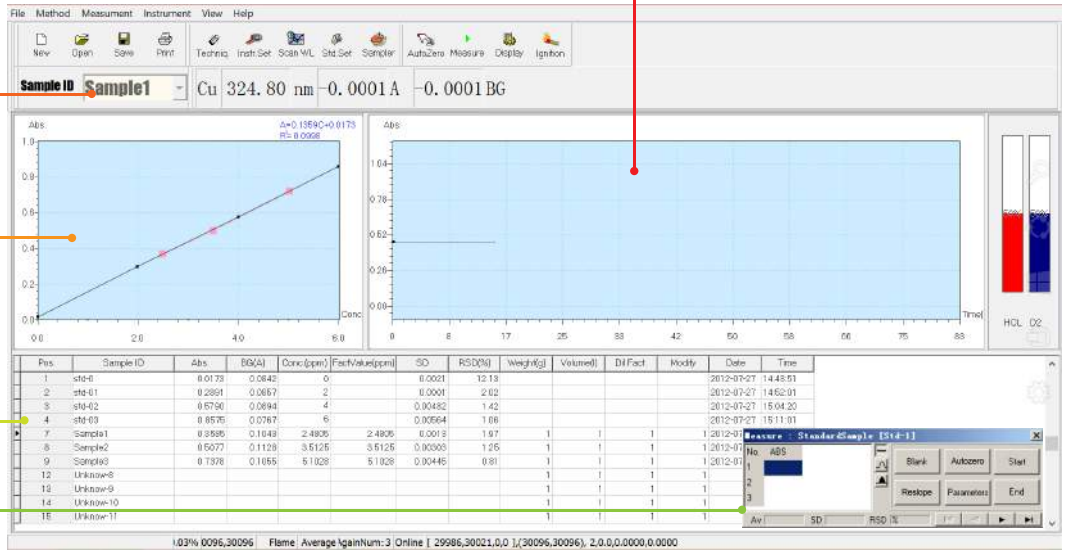
Flame real time status
Test process display

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.

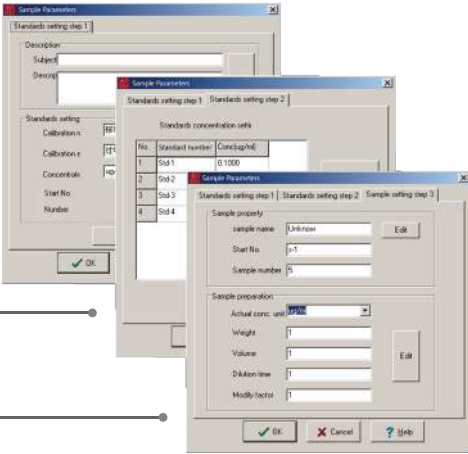
Test command
Press "Start" button, automatic
"Blank" & "correction" function



Sample setup guide is easy to operate



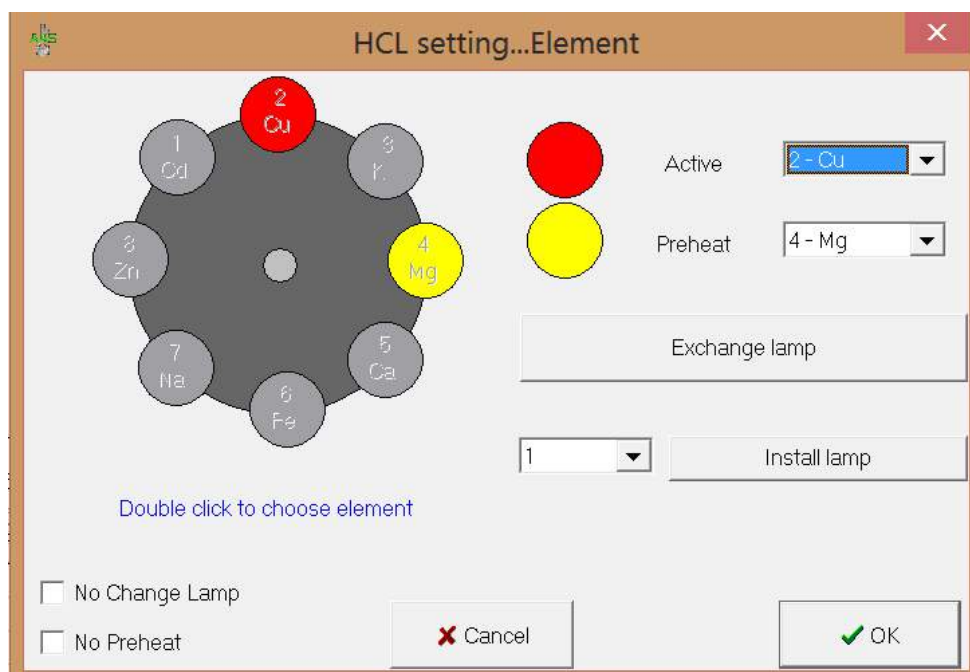
1. Element: Sample setup
2. Standard sample information
Correction method, Correction equation,
Concentration unit, Standard sample start No.,
Quantity, Method description
3. Standard sample concentration setup
4. Sample property and configuration information
5. New form establish automatically after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



Pos	Sample ID	Abs	Bkg(A)	Conc(ppm)	Fact/Value(ppm)	SD	RSD(%)	Weight(g)	Volume(l)	Dil Fact	Modif	Date	Time
1	std0	0.0173	0.0842	0	0.0001	12.13						2012-07-27	14:40:51
2	std01	0.2891	0.0857	2	0.0001	2.02						2012-07-27	14:45:01
3	std02	0.5790	0.0894	4	0.00482	1.42						2012-07-27	15:04:28
4	std03	0.8576	0.0767	6	0.00564	1.68						2012-07-27	16:11:00
7	Sample1	0.8586	0.1049	2.4905	2.4905	0.0019	1.97					2012-07-27	16:40:57
8	Sample2	0.5077	0.1128	3.5125	3.5125	0.00005	1.25					2012-07-27	16:40:29
9	Sample3	0.7378	0.1655	5.1028	5.1028	0.00446	0.81					2012-07-27	16:40:58
12	Unknown-8												
13	Unknown-9												
14	Unknown-10												
15	Unknown-11												

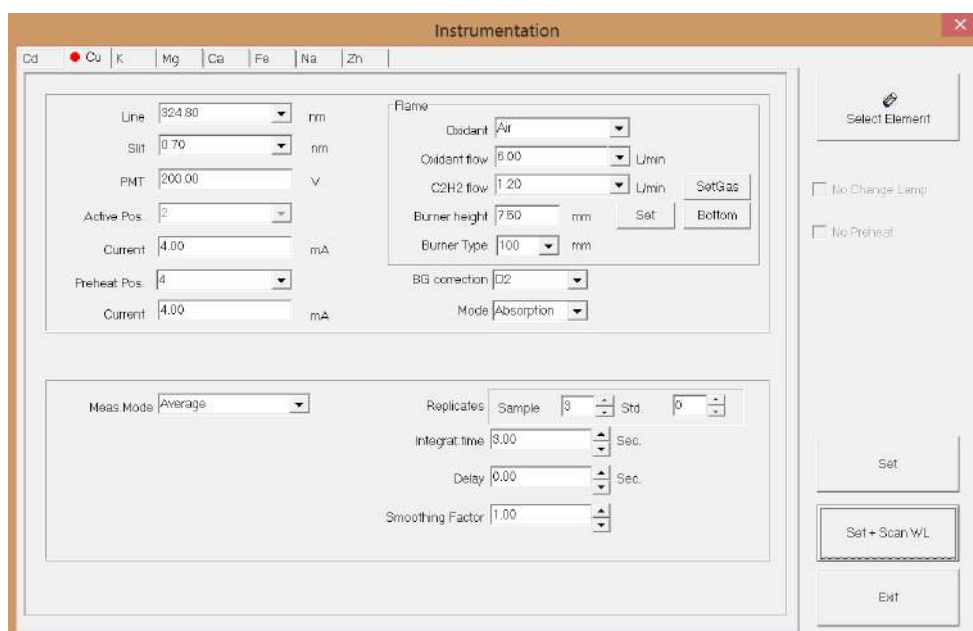
■ Test condition and calculation setup.

1.

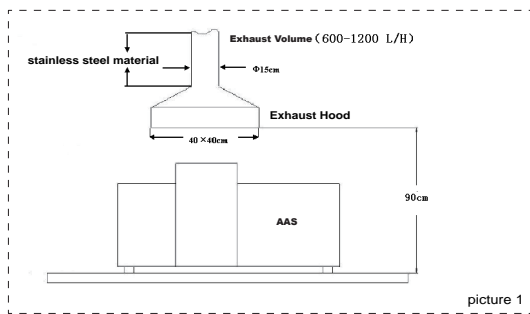
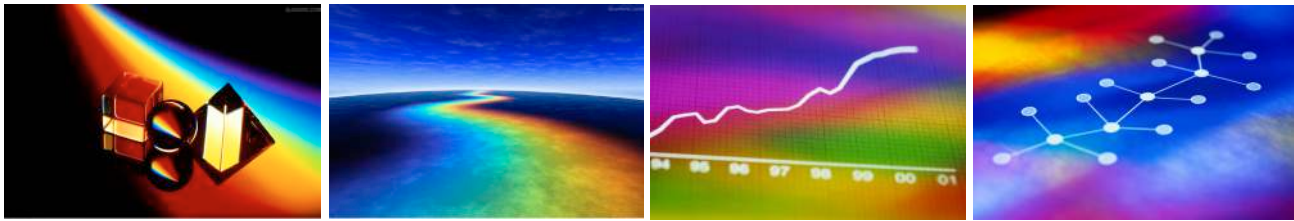


Element lamp setup
 Element lamp property
 Element lamp position
 Element lamp preheat

2.

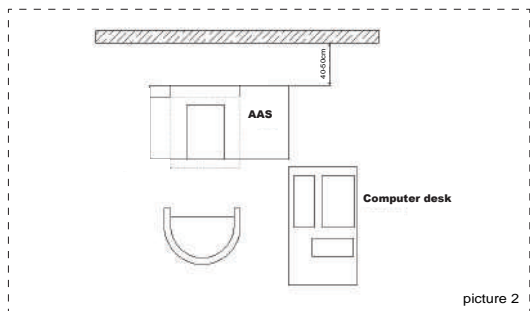


Default value of every element
 (recommended)



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

SP-AA 3000 & 4000 Flame :

Power requirement: 220 V (±10%), 50/60 Hz
 Power ≥ 220 V×10A, 1 KVA exchange purification of electronic power supply is required.
 A separated earthing cable if possible.

4. Gas Supply Configuration

4.1 Flame :

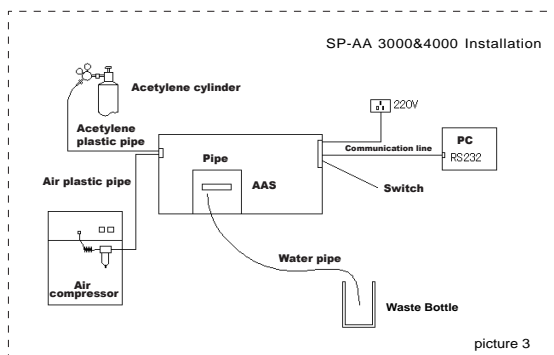
A bottle of high purity Acetylene ≥ 99.5% (instrument grade) is required. Output pressure of Acetylene gauge: approximately 0.8-1.6 kgf/cm² (0.08-0.16 MPa or 12-22 psi). Technical grade Acetylene is not allowed.

A bottle of high purity Nitrous Oxide ≥ 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 Hydride :

A bottle of ultra high purity Argon(99.998%) or high purity Argon (99.995%) is required. Output pressure of Argon relief value: 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 4000 is an external computer controlled AAS equipped with 8-lamp positions, extinguish button, autozero button, start button, automatic gas control and automatic burner height setting.

SP-AA 4000 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.
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	185-900 nm
Grating	Holographic grating with 1800 lines/mm
Wavelength repeatability	±0.1 nm
Wavelength accuracy	±0.2 nm
Sensitivity (Cu)	approx. 0.8A at 5 ppm
Slits	Automated slit selection 0.1; 0.2; 0.7 and 1.4 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.
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 as standard. SP-AA 4000 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 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 (option)

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.
Cooling System	A closed circuit optimised to save time, water and provide stable conditions. 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. There is a corrosion resistant 87-sample position tray.

Other information

Software	SPWinAA Software Package
Weight	90kg
Dimensions (W x D x H)	800 mm x 580 mm x 575 mm
Environmental Requirements	10 °C up to 35 °C Rel. humidity max. 85 %
Power Requirements	110 / 220V±10%, 50/60Hz



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