

**Spectrum**  
Instruments

**SP-AA 2000**  
**SP-AA 3000**  
**SP-AA 4000**  
Atomic Absorption Spectrometer



**Excellence in Measurement**

**Reliable · Accurate · Reasonable Price**

## Innovative Technology

**SP-AA 2000, 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.



▲ Auto Sampler

SP-AA 2000  
Double Beam

SP-AA 3000  
Single Beam

SP-AA 4000  
Single&Double Beam

**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.

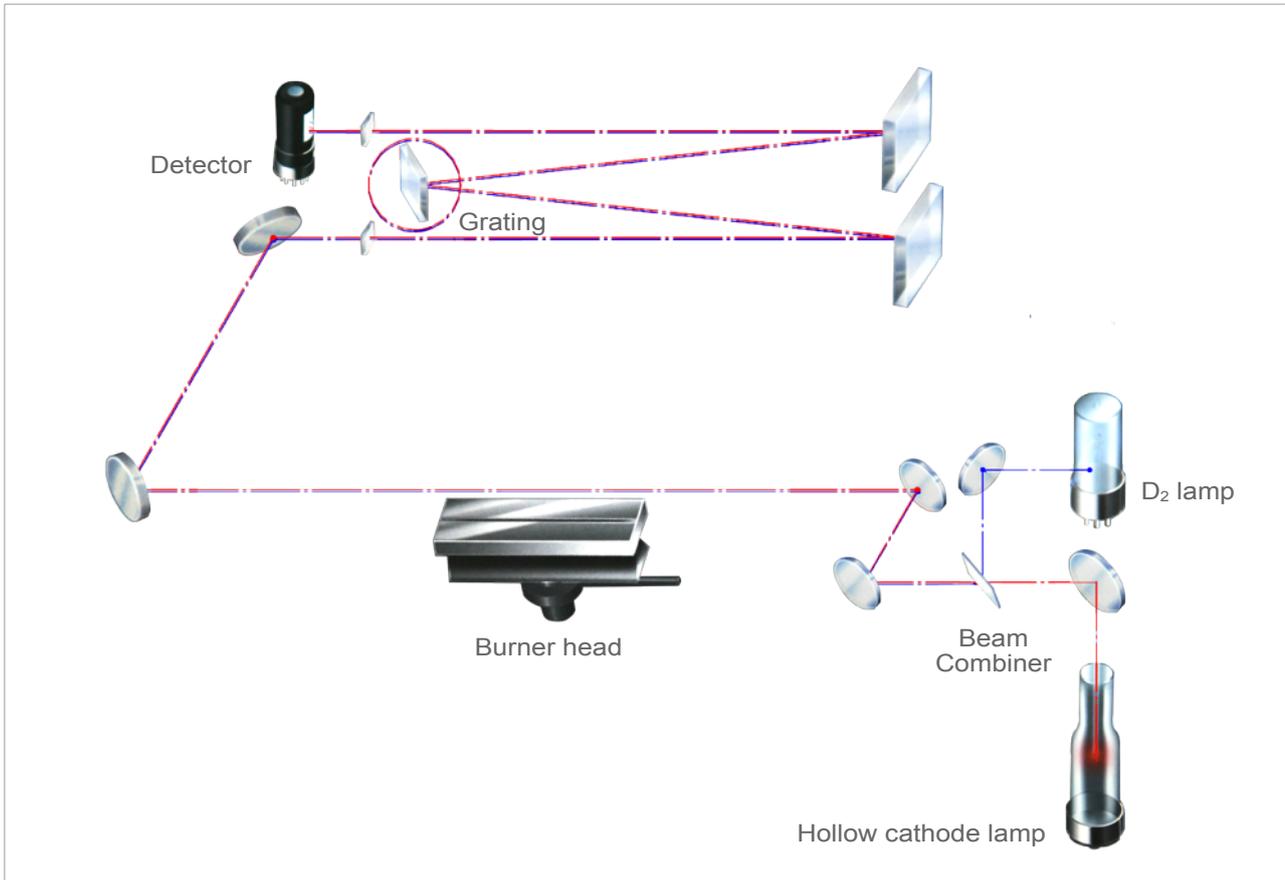
## Spectrum Instruments AA-Spectrometers

SP-AA 2000 double beam atomic absorption spectrometer

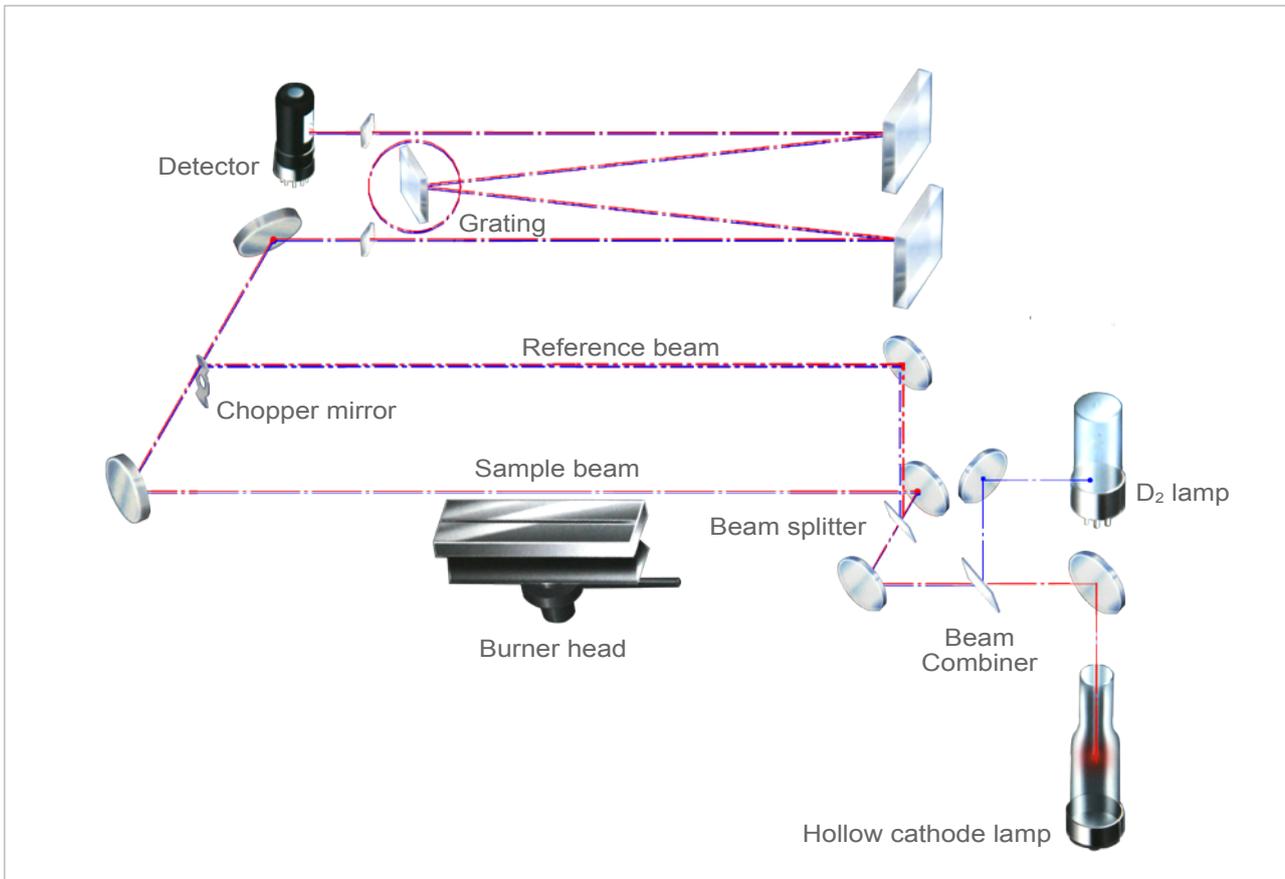
SP-AA 3000 single beam atomic absorption spectrometer

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

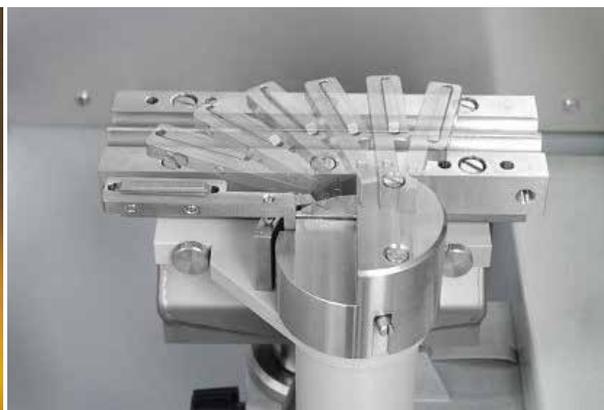
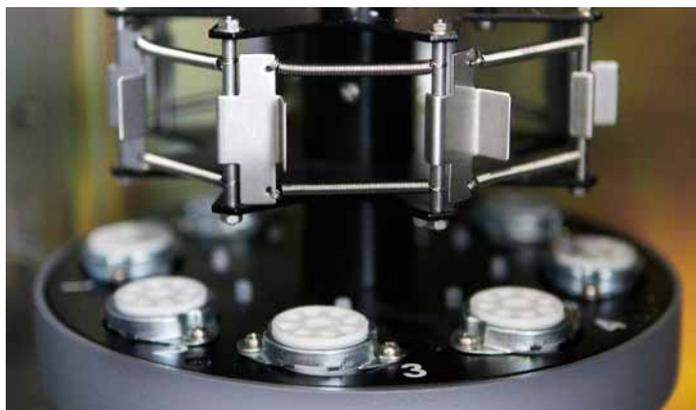
Optical Diagram of SP-AA 3000/4000 : total reflection optical systems



Optical Diagram of SP-AA 2000/4000 : 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. Uncompromized optical performance pays out in excellent analytical quality.

### **Vertical automatic 8-lamp turret (SP-AA 3000/4000) and 6-lamp turret (SP-AA 2000):**

The lamp holder combines minimal laboratory space with 8 lamp positions for SP-AA 3000/4000 and 6 lamp positions for SP-AA 2000.

### **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 & 6 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
- Automatic six slits selection

### **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 variety of accessories

## Coded and non-coded Lamp

### Multi - Element Lamps :

Spectrum, we have manufactured an extensive range of single and multielement lamps for Atomic Absorption. We concerned the result to be high performance and superior cost- effective performance.



## Scraper

### Accessory for easier cleaner :

The Scraper is an intelligent, automatic, software-controlled cleaning device for the nitrous oxide burner head for trouble-free work over a long period. Once activated in the software the Scraper guarantees a continuous and reproducible measuring cycle in the routine analysis. Before each sample measurement and calibration the slot is cleaned.



## Autosampler

### Easy to inject sample :

The Autosampler can be help you to prepare the sample or standard. Integral peristaltic pump with speed control provides on - demand rinsing of the probe, eliminating carry over and has the automatic dilution function.



## Flame Micro Injection Device - FMID

### Accessory for micro Volume :

The FMID is an application for smallest sample volume and high salt solution. It is connected to the nebulizer. The valve is controlled by the operating software for time-controlled flow injection.

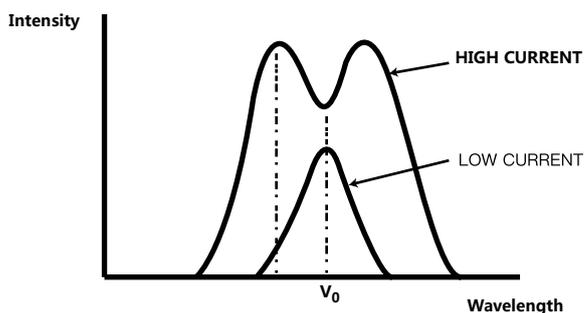




# Dual Background Correction for entire wavelength

# Self-absorption background correction function

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



## 2. Comparison sheet of common background correction methods.

Compare items	D <sub>2</sub> lamp	Zeeman			Self-absorption	
		Constant magnetic (Horizontal)	Alternate (Horizontal)	Alternate (Vertical)		
<b>Device</b>	Beam consistency	Bad	Good	Good	Good	
	Optics energy balance	Balance	Almost Balance	Almost Balance	Imbalance	
<b>Property</b>	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.

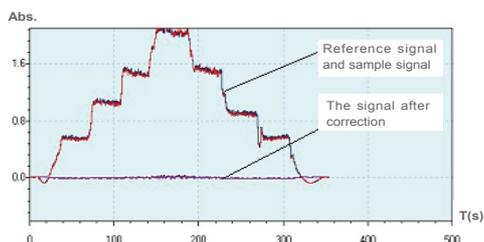
Competing with Zeeman effect background correction, it is low cost, no loss of light due to polarizers, accurate correction for spectral interference and easy to use for various application.

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 2000 & 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

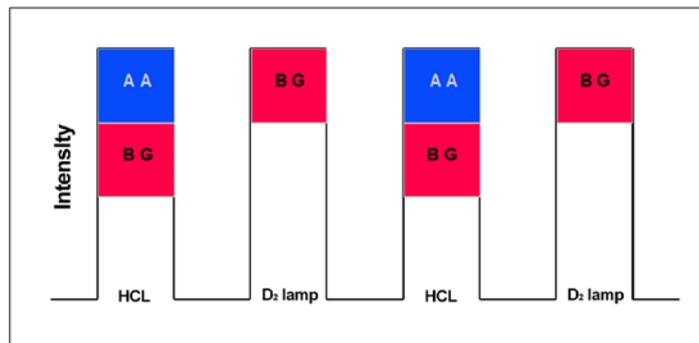
### Excellent D2 lamp Background Correction Technology. Unique reflection optical system.

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.

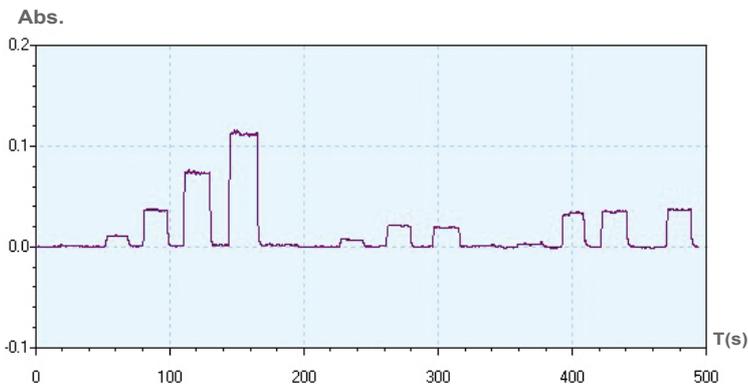
#### Principle

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.

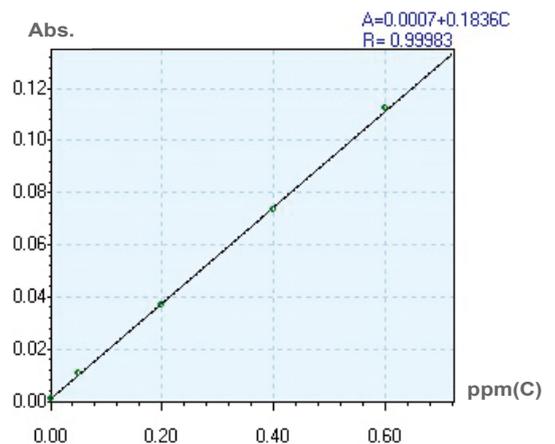


#### Advantages:

- High-sensitive detection.
- Wavelength range of background correction could be extended from 185 to 430 nm.
- Simple and inexpensive.
- No sensitivity loss.
- Does not require a special primary light source.
- Powerful enough for most flame and graphite furnace application.



Cu signal Curve



Cu Standard Curve



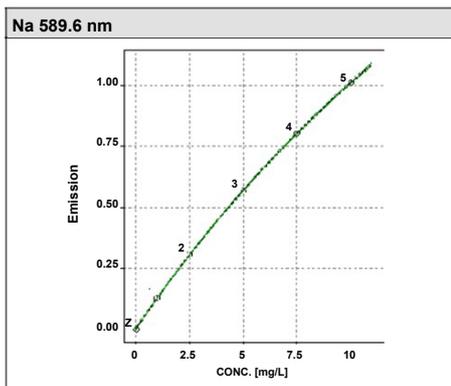
## Fields of Application/Industry:

- 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



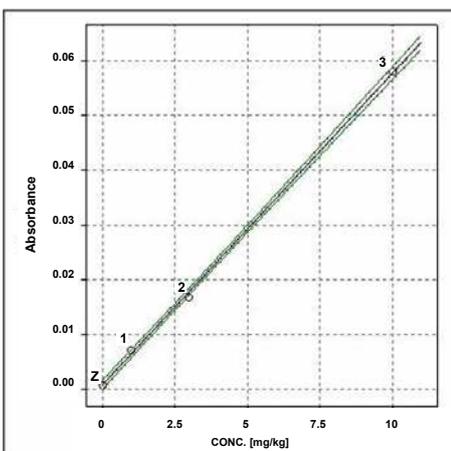
### Sample preparation

Approximately 0.2g of the samples were digested with HNO<sub>3</sub> 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/min]	Burner width [mm]
Na	589.6	0.2	C <sub>2</sub> H <sub>2</sub> /air	1.4	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 20g oil and 35g 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/min]	Burner width [mm]
Al	309.3	0.7	C <sub>2</sub> H <sub>2</sub> /N <sub>2</sub> O	5.8	50

## The Main Features

### Full operation SPWin-AAS software and QA/QC function

#### Neat and comprehensive information interface

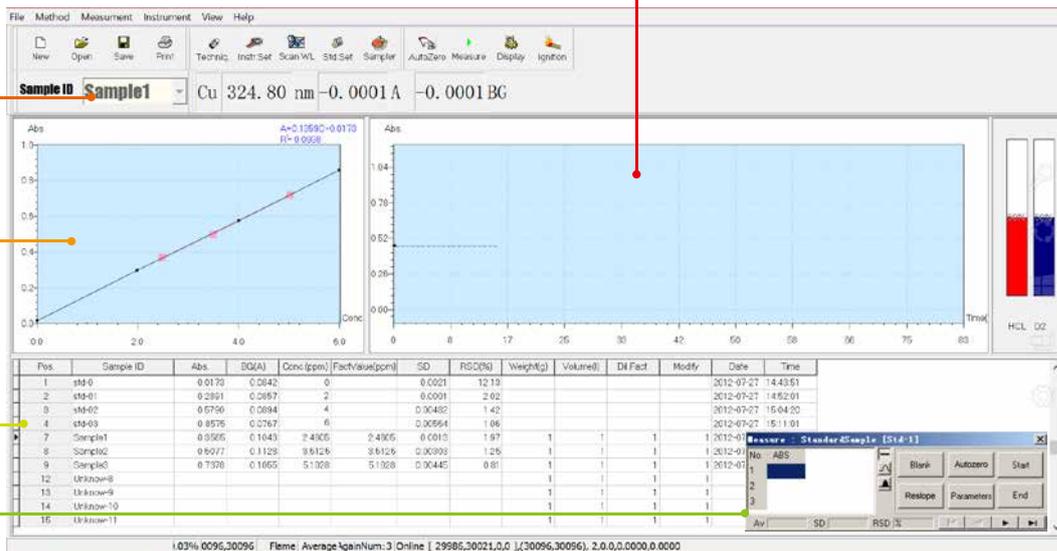
Flame real time status  
Test process display

Sample No./Element name/  
Wavelength and absorbance

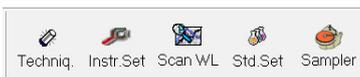
Standard Curve  
Display curve equation  
Related coefficient

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

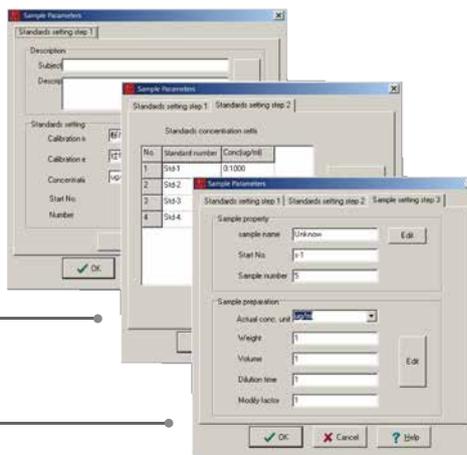
Test command  
Press "Start" button, automatic  
"Blank" & "correction" function



#### Sample setup guide is easy to operate



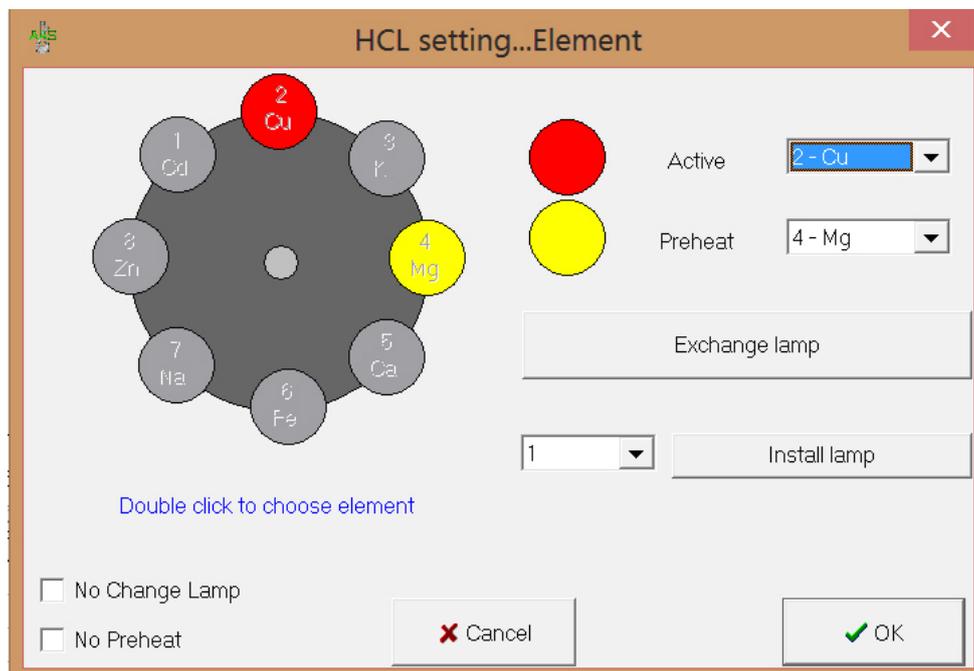
1. Element: Sample setup
2. Standard sample information  
Correction method, Correction equation,  
Concentration unit, Standard sample start No.,  
Quantity, Method description
3. Standard sample concentration setup
4. Sample property and configuration information
5. New form establish automatically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



Pos	Sample ID	Abs	BQ(A)	Conc(ppm)	Tech/Use(ppm)	SD	RSD(%)	Weight(g)	Volume(L)	Dil Fact	Modify	Date	Time
1	std-0	0.0178	0.0142	0		0.0021	12.13					2012-07-27	14:43:53
2	std-01	0.2801	0.0157	2		0.0091	2.02					2012-07-27	14:52:01
3	std-02	0.5796	0.0184	4		0.00482	1.42					2012-07-27	15:04:20
4	std-03	0.8576	0.0267	6		0.00564	1.06					2012-07-27	15:11:01
7	Sample1	0.9565	0.1043	2.4005	2.4005	0.0013	1.97	1	1	1		2012-07-27	15:11:01
8	Sample2	0.6077	0.1128	3.6126	3.6126	0.00303	1.26	1	1	1		2012-07-27	15:11:01
9	Sample3	0.7528	0.1665	5.1328	5.1328	0.00445	0.87	1	1	1		2012-07-27	15:11:01
12	Unknown-8							1	1	1			
13	Unknown-9							1	1	1			
14	Unknown-10							1	1	1			
15	Unknown-11							1	1	1			

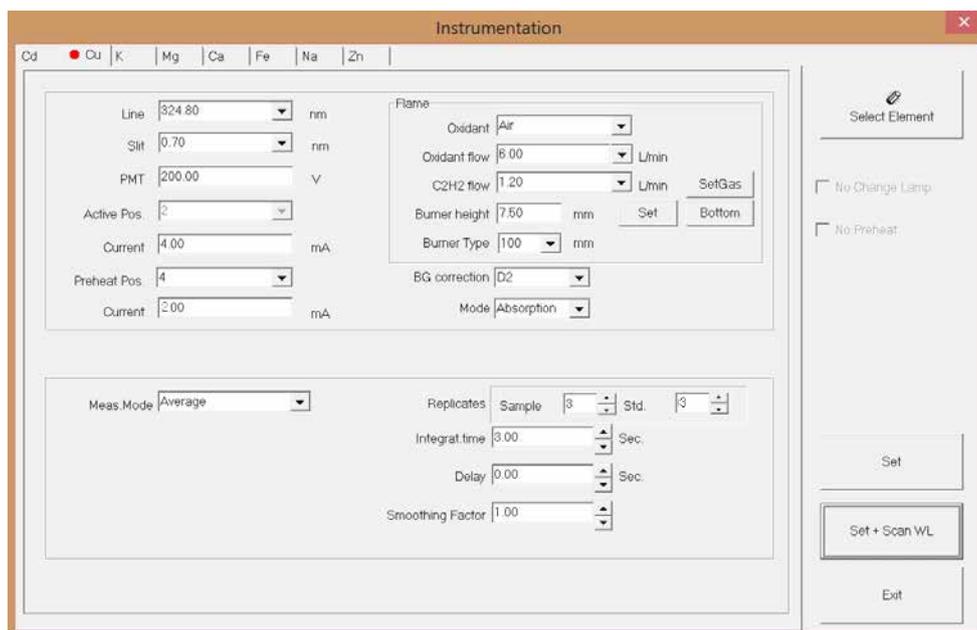
## ■ Test condition and calculation setup.

1.

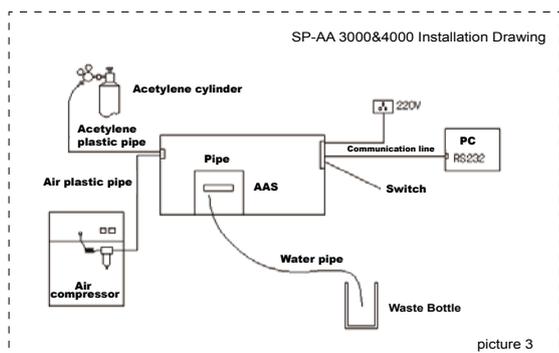
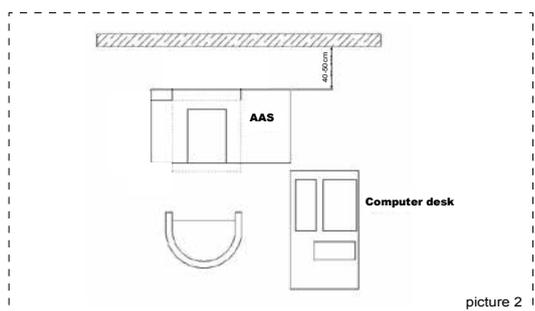
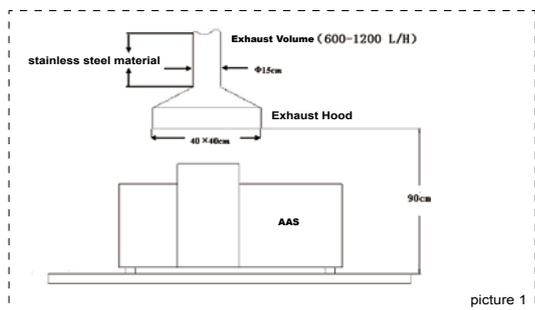
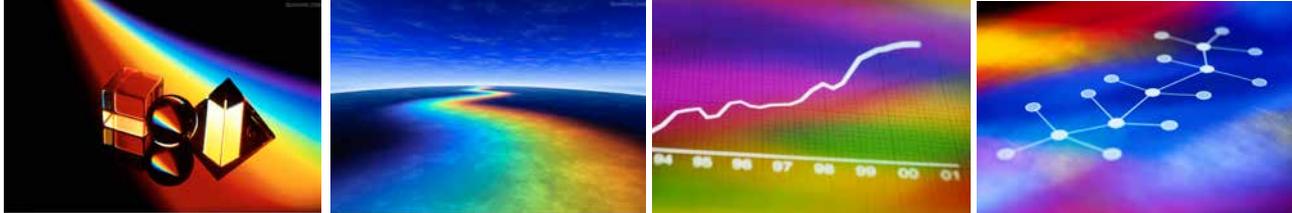


Element lamp setup  
 Element lamp property  
 Element lamp position  
 Element lamp preheat

2.



Default value of every element from cookbook in the software (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 2000, 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/cm<sup>2</sup> (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/cm<sup>2</sup> (0.4-0.6 MPa or 56-85 psi).

Compressed air, oil free, output pressure gauge: approximately 4-6 kgf/cm<sup>2</sup> (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/cm<sup>2</sup> (0.25 MPa or 35 psi).

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

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**Spectrum**  
Instruments

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