

AA

Varian
SpectrAA 220/880
Zeeman



VARIAN

Varian, Inc. is a world leader in instrumentation for atomic spectroscopy. From our development of the first components for atomic absorption spectrometers in the 1950s to the recent ground breaking Vista series of simultaneous ICP emission spectrometers, Varian, Inc. has over 40 years experience of innovation and development in all areas of atomic spectroscopy.



Varian researchers developed the Zeeman technique in the late 1960s and patented all possible configurations in 1971. Since then, three generations of Varian instrumentation have consolidated SpectrAA Zeeman's reputation for excellence, sensitivity and maximum performance with challenging samples. The new generation of SpectrAA Zeeman instruments continues this proud tradition by offering the highest sensitivity, performance, simplicity of operation and industry leading software expected of a worldwide leader in atomic spectroscopy.

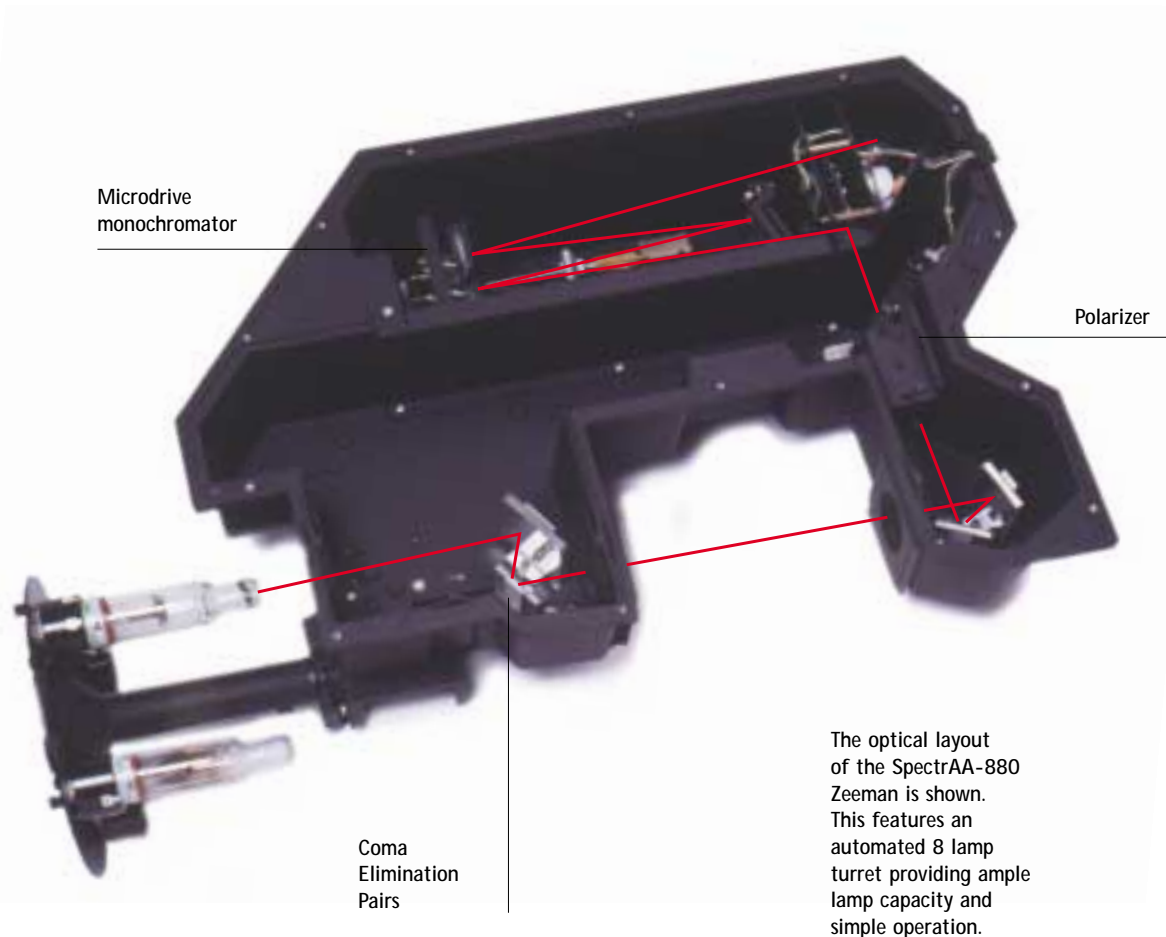
The combination of a Constant Temperature Zone graphite furnace, AC modulated Transverse Zeeman background correction and polynomial interpolation ensures superior spectral interference correction and maximum sample accuracy. In addition, Varian's low thermal mass graphite tubes with their long atom cell and fixed 0.8 Tesla AC magnetic field maximizes sensitivity without requiring complex optimization of the field strength.

Productivity in the laboratory is also improved with the use of Varian's award winning multi-tasking Worksheet software. This advanced software combines the familiar spreadsheet concept with the full multi-tasking capabilities of the Windows® operating system.

When combined with flexible accessory options, the SpectrAA Zeeman series sets the industry benchmarks for performance without compromise.



The SpectrAA Zeeman Family: The economical SpectrAA-220 Zeeman and the high performance research grade SpectrAA-880 Zeeman.



Microdrive
monochromator

Polarizer

Coma
Elimination
Pairs

The optical layout
of the SpectraAA-880
Zeeman is shown.
This features an
automated 8 lamp
turret providing ample
lamp capacity and
simple operation.

The first requirement of the Zeeman optics is for a narrow, laser like optical image, which is provided by the high-energy hollow cathode lamps. This intense beam is matched to the narrow furnace tube profile and high efficiency surface protected mirrors which transmit the beam. This ensures maximum light throughput, producing excellent signal-to-noise ratios.

The use of Coma Elimination Pairs (comprising a matched set of a flat mirror and a focusing mirror) to turn the light beam eliminates coma (divergence of the light beam). This provides maximum light transmission for the best signal-to-noise performance at all wavelengths.

The selected Polarizer used in Varian Zeeman instruments is designed for minimum energy loss, unlike prism-based systems.

The 'microdrive' monochromator provides up to six times better wavelength definition for optimum line selection with unsurpassed repeatability of ± 0.02 nm. The outcome is smooth, quiet operation with the highest wavelength accuracy.

The result is the utmost accuracy with all your results and superb detection limits at all analytical wavelengths.

Having designed superior optics, we ensure superior lifetime performance by coating the optical components with quartz, and completely sealing the optical system against dust and vapor.

Achieving accurate Zeeman background correction

The Zeeman Effect

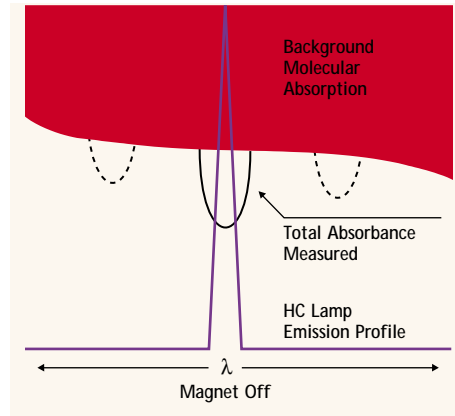
The Zeeman effect is the splitting and polarization of atomic spectral lines in the presence of a magnetic field. Molecular species and particulates that can cause background absorption remain relatively unaffected by the magnetic field. The Zeeman technique uses a magnetic field to achieve accurate background correction. With the magnet off, the total absorbance is measured. With the magnetic field applied, splitting of the spectral profile occurs, and only the background is measured. The atomic absorbance signal is determined by subtracting the background absorbance (magnet on) from the total absorbance (magnet off).

The Varian solution

Zeeman background correction is a powerful tool, but requires correct design to deliver accurate answers. The SpectrAA Zeeman features the sensitive transverse AC modulated Zeeman configuration, which has the field applied across the atomizer. This avoids the sensitivity losses observed with a DC (permanent) magnet and maximizes light throughput compared with longitudinal designs where end caps restrict the light passing through the pole pieces of the magnet. Varian's patented magnetic-field waveform provides a delay time of less than 5 ms between measurements and collects 100/120 data points (50/60 Hz) every second.

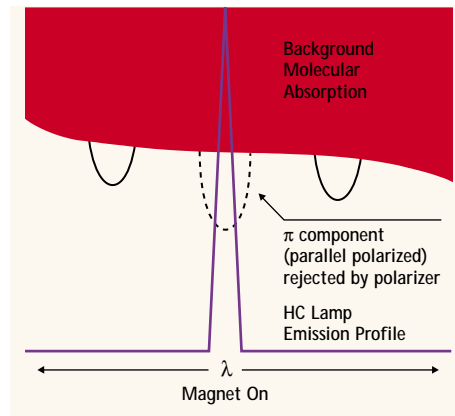
Polynomial interpolation

For accurate correction the instrument must determine the true background at the time the total signal was measured. Some instruments use simple linear interpolation of the background, which can result in erroneous calculations of the background signal if this signal is changing rapidly (a common occurrence with furnace analyses). SpectrAA Zeeman uses three-point polynomial interpolation to accurately track the actual shape of the peak and correctly calculate the background signal at the time the total signal was measured.

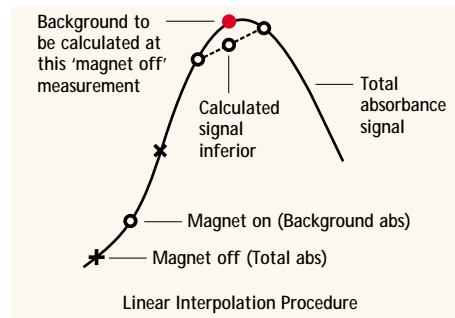


The principle of the Transverse (AC) Zeeman technique

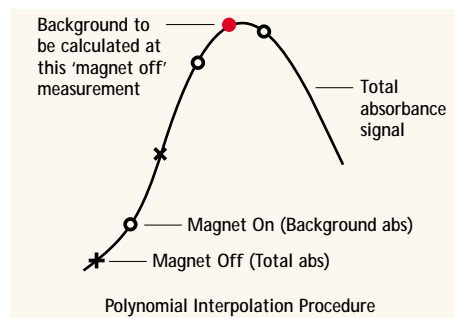
Magnet Off
The total absorbance is measured.



Magnet On
Zeeman splitting of the atomic absorption profile occurs and the polarizer excludes the central π component. This allows only background absorbance to be measured at the exact analytical wavelength.



Linear interpolation between consecutive background data points incorrectly calculates the background. Erroneous results with complex matrices are often observed.



The SpectrAA Zeeman three-point polynomial interpolation accurately tracks the background signal, resulting in 11 times improvement in correction accuracy.

Constant Temperature Zone design

Varian's furnace research has demonstrated that the best graphite furnace performance is achieved using a Constant Temperature Zone (CTZ) graphite furnace. The CTZ is created by carefully matching the design of the GTA-110 power supply to low thermal mass, end-heated graphite tubes. This ensures extremely fast atomization for the best signal-to-noise characteristics with difficult sample matrices.

The GTA-110 also features the most advanced furnace sampling systems. Analytical cycle times are reduced and performance is improved using hot injection and synchronized sampling.

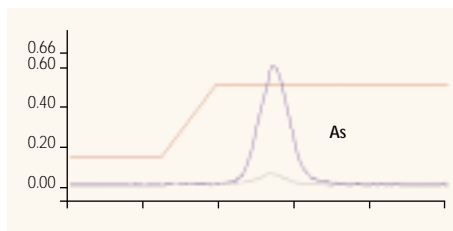
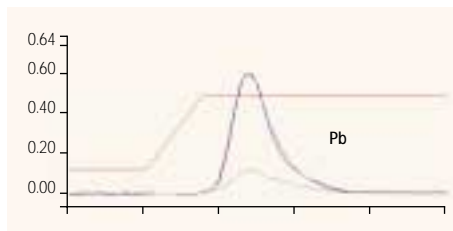
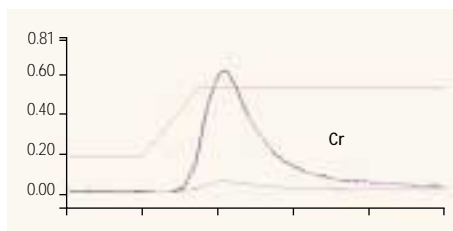
Varian's longitudinally heated GTA-110 CTZ graphite furnace with transverse Zeeman background correction provides outstanding performance at ppb levels with the flexibility to handle difficult samples speedily and effectively. This comes from the proven efficient furnace design, the patented dynamic feedback temperature control and flexibility in gas and temperature programming.

The Universal tube¹ with an integrated platform allows determination of difficult elements such as Cr and Cd.



Performance Table

Element	Wavelength (nm)	Detection Limit (µg/L)	Detection Limit (pg)	Characteristic Mass (pg)
Arsenic	193.7	0.0474	2.37	7.50
Cadmium	228.2	0.0010	0.05	0.29
Chromium	357.9	0.0103	0.52	1.72
Copper	324.8	0.0410	2.03	10.29
Manganese	279.5	0.0048	0.24	0.48
Molybdenum	313.2	0.0840	4.18	6.30
Lead	283.3	0.0150	0.74	5.17
Selenium	196.0	0.0230	1.59	8.50
Thallium	276.8	0.0640	3.20	5.05
Vanadium	318.4	0.1200	6.01	35.15



By combining research grade optics with improved graphite tube design and new state of the art peak algorithms, the SpectrAA Zeeman provides unparalleled detection limits even in complex sample matrices (top graph).

Signal graphics for lead and arsenic analysis of an environmental river water sample gave a result of 16.2 µg/L for lead and 30 µg/L for arsenic using an injection volume of 50 µL (middle and bottom graphs).

UltraAA lamps—lower detection limits

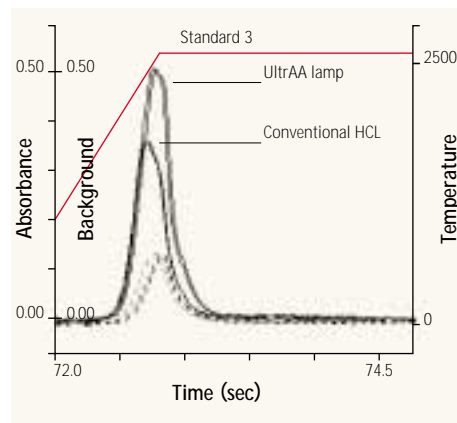
Whether you are using flame, furnace or vapor AA, Varian's range of UltraAA lamps increase sensitivity and reduce detection limits, allowing determinations of trace metals at even lower levels. The UltraAA lamp series of high intensity, boosted discharge, hollow cathode lamps can be used with all SpectrAA series instruments, for the most demanding applications.

Lamp operation

UltraAA lamps use the standard lamp current, but apply a second discharge within the lamp. This boost current is supplied from an external control module. The resulting sharper emission profile reduces self-absorption and line broadening, increasing sensitivity of AA determinations by up to 40%. Emission intensity is also increased by three to five times, reducing baseline noise levels. The lower baseline noise levels and the higher sensitivity ensure lower detection limits can be achieved.

Benefits of the UltraAA lamp

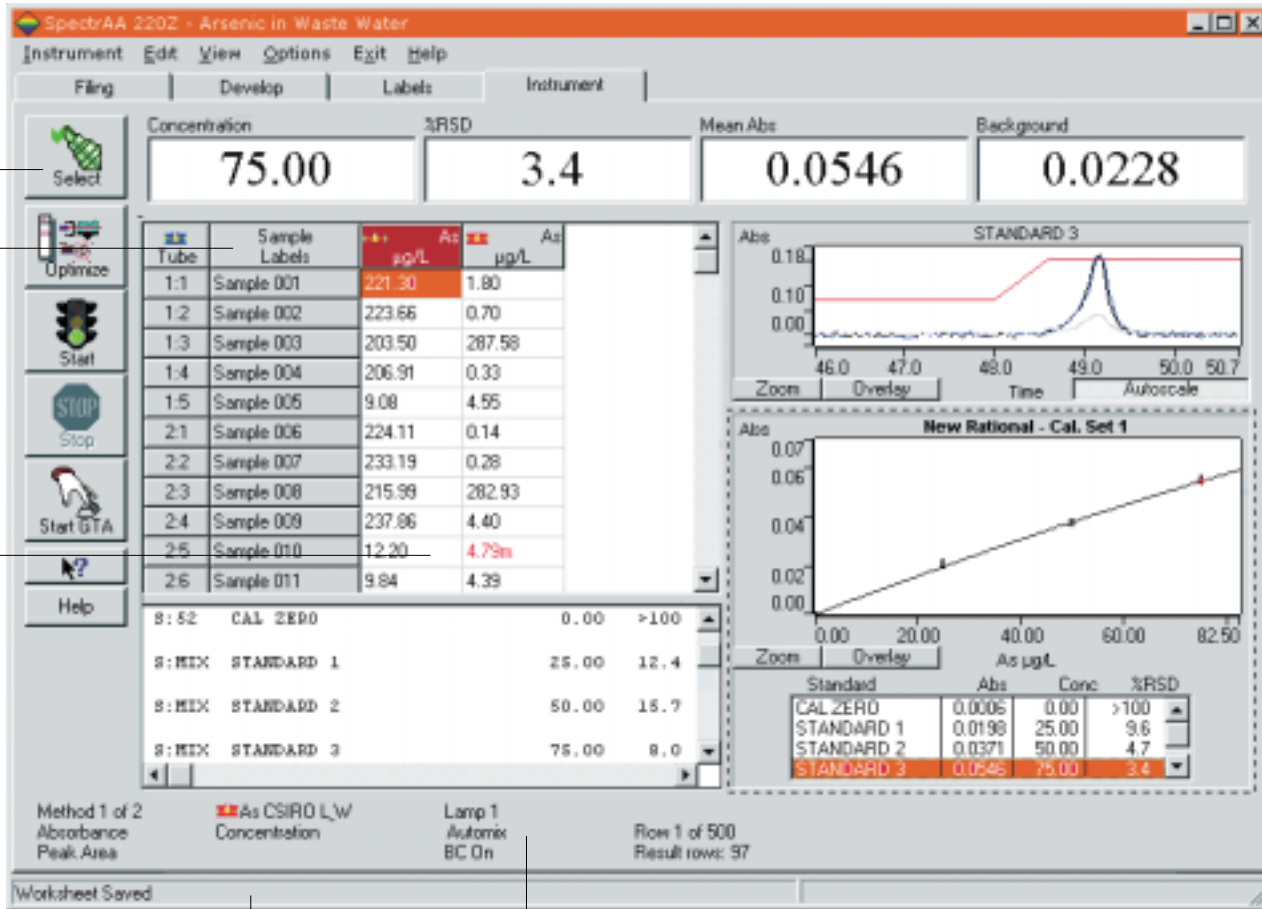
- Increased sensitivity—comparative signals for a 75 µg/L Se standard are shown.
- Reduced baseline noise.
- Lower detection limits, resulting from the enhanced signal-to-noise.
- Enhanced calibration linearity.
- Longer lamp lifetimes—typical lamp lifetimes exceed 8000 mA hours of operation.
- Simple installation—lamps are mounted directly into the socket (without any flying leads), just like conventional lamps.
- A fixed boost current eliminates difficult manual adjustments.
- Automatic lamp recognition enables the software to identify the lamp and select the recommended operating conditions.
- Enables simultaneous operation of two UltraAA lamps—one lamp to be in use while the other is being pre-warmed.



Press the 'Select' button to select samples for analysis or tag selected results for export to LIMS or another software package.

Autocopy and unique pattern recognition capabilities simplify manual label entry. Alternatively, you can import directly from LIMS or use bar code readers to scan sample labels directly into the software.

View concentration results, precision and absorbance results as the analysis progresses. Color coding and flags (displayed after the sample result) highlight out-of-range results, uncalibrated results or other errors.



Using OLE-2, results can be exported online during analysis to other commercial software programs (e.g., Microsoft Excel), for custom data manipulation.

The message line informs you of the system status and provides operational hints.

Status display provides an instant summary of instrument conditions for the selected element and keeps you informed of progress during analysis.

The SpectrAA Zeeman software is modeled on Varian's acclaimed worksheet software. Using the multi-tasking capabilities of Windows, you can start today's analysis while simultaneously preparing a report on yesterday's results. Imagine the productivity improvements you will achieve. The spreadsheet concept at the heart of the SpectrAA software and the simplified interface also means minimal training is required.

The Worksheet AA

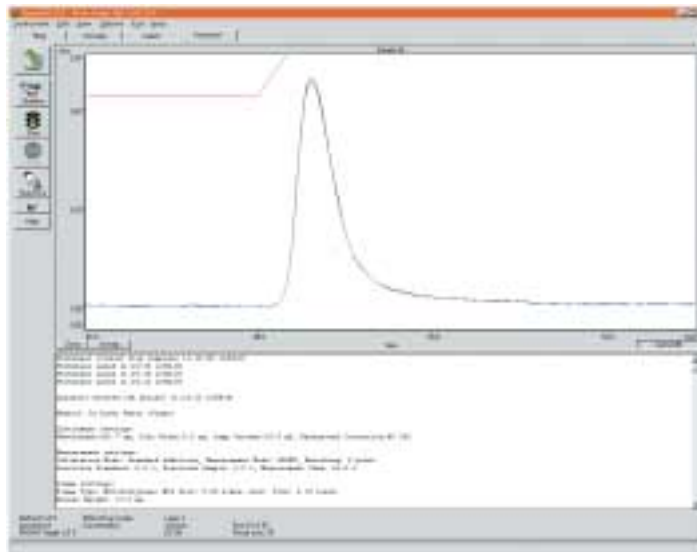
Final concentration results are displayed (after weight/volume correction if required) in a spreadsheet concept common to many business applications. Results for flame, vapor and furnace determinations are displayed simultaneously so that you can view results for the entire batch of samples.

Quality Control

Extensive rate and label driven Quality Control Protocols are provided to validate data as it is collected. The optional Quality Control Protocols software provides even greater capability for full compliance with all international regulatory requirements. This includes the capability to create custom QC tests.

Which operating system?

Choose from Windows 95/98, Windows NT or Windows 2000 operating systems.



Click on an individual result to display the signal graphics where stored. You can customize the display to view only the information you need. For example, select from the worksheet, signal graphics, calibration graph with full calibration data or the data log with complete analytical results. The data log is date and time stamped and includes all measurement parameters, raw data, final results and error messages.



Comprehensive multi-media Help includes step-by-step audio and video instructions on hardware setup and routine maintenance.

Couple the VGA-77 and ETC-60 for hydride generation capability with the Zeeman series. This offers an easy and reliable way of validating GFAA results and analyzing difficult matrices.



Varian's fully automated modular VGA-77 Vapor Generation Accessory is ideal for rapid trace level analyses of mercury (using the proven cold vapor technique) and other hydride forming elements at part per billion ($\mu\text{g/L}$) concentrations. The hydride vapor generated by the VGA-77 is electrically heated and atomized using the ETC-60 Electrothermal Temperature Controller. Using hydride generation techniques with SpectrAA Zeeman, you can verify your graphite furnace results, or eliminate complex and time consuming furnace programs.

Unattended operation

With the addition of the SPS-5 flame and vapor autosampler, unattended multi-element determinations are also possible. The versatile SPS-5 provides capacity for up to 400 samples, loaded in convenient polypropylene racks, and has a separate rack dedicated to standards. For greater flexibility, you can program the SPS-5 to accept any rack type using the Custom Rack definition feature.

Advantages of Continuous Flow Vapor Generation

The continuous flow VGA-77 offers these advantages over competitive techniques, such as Flow Injection:

- Maximum sensitivity.

- Enhanced precision of 1-2 % RSD is achieved using integration of the steady state signal. Flow Injection produces transient signals, requiring multiple injections for accurate, reproducible results.
- Greater productivity—results are obtained in less than a minute.
- High sample throughput of up to 70 samples per hour with 3 replicates per sample.
- Low sample consumption—less than 8 mL per element during analysis.
- Modular construction to simplify change-over between elements with conflicting chemistries. Eliminate cross contamination by changing modules.
- Simple and automatic operation—each sample is automatically combined with a continuous flow of acid and reagents.



Reducing the cost of ownership

The SpectrAA series was designed with cost of ownership in mind. The easy-to-use software will minimize training and get your lab up and running faster.

For protection in dusty or corrosive environments, the optics are completely sealed and all mirrors are quartz overcoated for long term, stable performance. When connected to a supply of clean, dry air, the internal air purge ensures total protection from attack in corrosive, humid or dust-filled environments.

Comprehensive diagnostics assist rapid trouble shooting and fault diagnosis, maximizing instrument uptime.

Varian's Telediagnosics option connects you to our worldwide network of support personnel for online assistance. This remote diagnosis service minimizes on-site calls and reduces down-time. Telediagnosics also gives you the freedom to access your data at any time. You can view the progress of your analysis from your home, exchange methods or results with other users or connect to other laboratories in your company.

GLP Compliance and Validation

The SpectrAA software complies with many international standards for Good Laboratory Practice (GLP). If you need to validate your SpectrAA system, Validation documentation is available for SpectrAA instruments, software and accessories. Varian, Inc. service organizations around the world support validation of our instruments in a number of ways, including training programs, support agreements, hotlines, Telediagnosics, service contracts and certification. An overview of the Validation documentation and services Varian, Inc. provides is available from your local Varian, Inc. office.



Safety

It is Varian's policy to manufacture safe products and to meet all legal requirements governing the design, manufacture and sale of safe products. As with all similar products, the following hazards may be present: high temperatures, high pressure gases, explosive gases, UV and visible light and electricity. Each product is designed to protect operators from potential hazards.

Varian, Inc. supplies instructions that describe the correct procedures for the operation and maintenance of each product.

For clarity, some images in this brochure may depict the spectrometer being used without safety covers. Ensure all safety covers, chimney etc. are in place for normal operation.

SpectrAA atomic absorption spectrometers are designed to determine the concentrations of trace and major elements in solution.

World Wide Web

Varian's home page <http://www.varianinc.com> is another part of our on-going commitment to customer support. You can access application notes, newsletters and updates about the latest product developments or you can email us if you have a question. Use our online Parts and Supplies catalog to identify any consumables you need. Immediate access to information, applications support and technical service is never more than a mouse click, or a phone call away.

CE The SpectrAA Zeeman series instruments are certified to comply with the requirements of the EMC and LV directives of the European Union.

The SpectrAA Zeeman series also complies with the guidelines established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for exposure to time varying magnetic fields.

Varian Analytical Instruments
serving worldwide markets in:

Agriculture
Basic Chemical
Biotechnology
Clinical
Electronics
Environmental
Photonics
Toxicology
Pharmaceutical
Food and Beverage
Metals and Mining
Petroleum and Petrochemical



Varian is committed to a process of continuous improvement which demands that we understand and then meet or exceed the needs and expectations of our customers—both inside and outside the company—in everything we do.



• Varian Sales and Dealer Offices



VARIAN

GC • GC/MS • HPLC • AAS • ICP-OES • ICP-MS • UV-Vis-NIR • Fluorescence • NMR • Analytical Supplies

Varian Analytical Instruments

www.varianinc.com

North America 800.926.3000, 1.925.939.2400

Europe The Netherlands 31.11.867.1000

Asia Pacific Australia 613.9560.7133

Latin America Brazil 55.11.3845.0444

China 86.21.6375.6969

Japan 81.3.5232.1239

Korea 82.2.3452.2452

Taiwan 886.22.698.9555

India 91.22.857.0181

Other sales offices and dealers throughout the world

Specifications subject to change without notice.
© Varian Australia Pty Ltd Part number 8510161900
Printed in Australia 2/2001
Windows® is a registered trademark
of Microsoft Corporation
1. Under exclusive worldwide licence from
SGL Carbon and Analytik Jena.