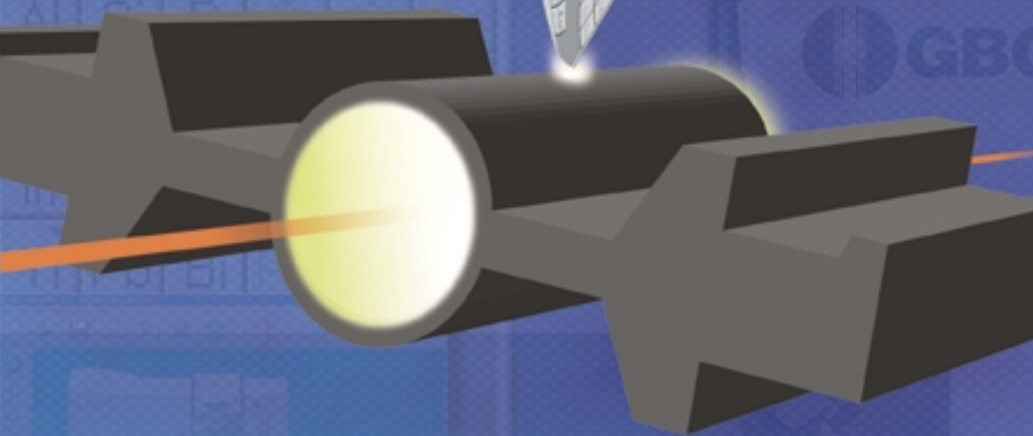138

Avanta

Ultra Z

**Graphite Furnace AAS
with zeeman-effect
Background Correction**

GBC

New technology
for a new millennium...

The Avanta Ultra Z AAS sets new standards in high-performance zeeman-effect graphite furnace analysis with superior sensitivity, accuracy, versatility and reliability.

Featuring a small footprint to suit today's space-conscious laboratories, the GBC Avanta Ultra Z provides everything you require in a compact, complete and convenient instrument... productivity, safety and convenience

ISO 9001 QUALITY ACCREDITATION

GBC has always placed a strong emphasis on quality in all aspects of our operation, from design and manufacture to the provision of service and support to our customers, and we are fully committed to continuous evaluation and improvement in all areas.

The GBC Quality Management System has been accredited to the ISO 9001 quality standard by Lloyd's Register Quality Assurance Limited. This certification is your assurance that the procedures and processes used to produce the goods and services which GBC provides comply with the relevant International Standard, and demonstrates our commitment to meeting the needs and expectations of our customers.

ISO 9001

Avanta

Ultra Z

The fastest zeeman-effect background correction for best sensitivity, detection limits and accuracy

Accurate background correction

Analysis of environmental samples for trace level analytes requires precise accurate measurement. This is critical where transient background and analyte signals in the graphite furnace change rapidly with time and can introduce measurement errors.

These difficulties, associated with high background absorbance and structured background, are eliminated by using high speed "Ultra Z" background correction. The Ultra Z method minimises background correction errors giving precise and accurate results. Conveniently, samples only need to be measured once.
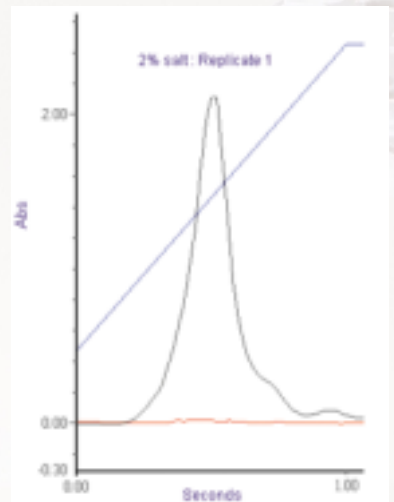
No significant over or under correction with GBC Ultra Z's unique patented high speed background correction system. Data collected at 193.7 nm with a maximum signal ΔAbs/time of 18.3 Abs/sec.

Optimising magnetic field strength for each element improves sensitivity

The applied magnetic field can be varied from a low 0.6 Tesla to a high 1.1 Tesla. Once selected, the field strength remains constant for the duration of the measurement. This allows the operator to set optimum field strength for each element, improving the Zeeman effect as measured through the magnetic sensitivity ratio (MSR) and giving unmatched sensitivity.

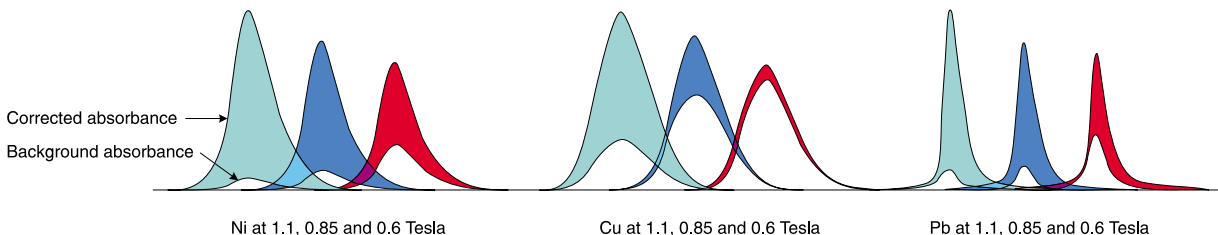| Element	λ (nm)	%MSR	% improvement in MSR
Be	234.9	70	9
Cu	324.7	79	24
Tl	276.8	67	7

Earlier Zeeman background correction technologies reduced performance for the primary line of some elements. For example, an alternative line for Al must be used to achieve reasonable sensitivity. This difficulty is not encountered with Ultra Z background correction since the field strength can be adjusted to overcome the problem.

Element	λ (nm)	Optimum Magnetic Field (T)	Sensitivity (pg)	Detection Limit 3σ (pg)
Al	396.2	0.85	4.9	0.5
As	193.7	0.95	5.6	1.0
Cd	228.8	1.1	0.2	0.2
Cr	357.9	0.9	1.4	0.7
Cu	324.7	1.1	1.7	1.4
Ni	232.0	1.05	5.0	3.0
Pb	283.3	1.1	4.5	0.2
Sb	217.6	1.05	9.0	8.0
Se	196.0	1.05	13.8	8.6
Tl	276.8	0.95	14.8	6.0
Ti	364.2	0.9	34	5.0

Adjusting the magnetic field to optimise background correction also reduces interferences providing unbeaten sensitivity and detection limits.

λ (nm)	Optimum Magnetic Field (T)	Sensitivity (pg)	Detection Limit 3σ (AU)
396.2	0.85	4.9	0.5
309.0	0.75	4.8	1

Varying the field strength enables comparable sensitivity for alternate Al wavelengths.

Use variable field strength settings to optimise interference correction

In some situations a higher field strength may enhance a spectral interferent more than the analyte. In this case, choosing a lower field strength may provide a better result. Only the Avanta Ultra Z gives you the option to choose the most appropriate field strength, achieving optimum results every time.

Corrected absorbance
Background absorbance

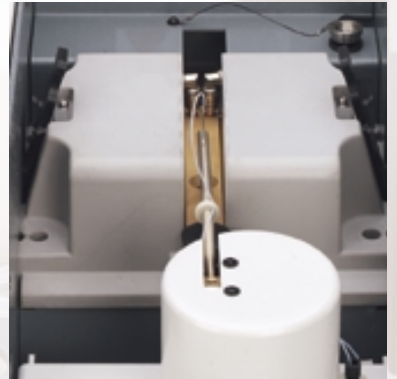Ni at 1.1, 0.85 and 0.6 Tesla   Cu at 1.1, 0.85 and 0.6 Tesla   Pb at 1.1, 0.85 and 0.6 Tesla

Corrected and background absorbance for nickel, copper and lead showing the dramatic effect on sensitivity achieved with variable magnetic field strength.

Efficient furnace design with accurate temperature control

Unique
one-piece
workhead
features
self-aligning
graphite tubes

Advanced furnace design provides accuracy and reliability

The efficient furnace design and accurate temperature control provide an optimised environment enabling consistent performance for extended analysis runs and unattended operation. Superb reliability and simplified maintenance requirements mean maximum up-time, profitability and low total cost of ownership.

Easy access, self-aligning tubes

The unique one-piece moulded workhead features an integrated magnet and graphite furnace, controlled by a state-of-the-art power supply. Major benefits of the modular design include open access to the furnace tube and self-alignment of the tube to simplify furnace cleaning or tube replacement.

The pivoting furnace clamp assembly is interlocked for safety, preventing operation when the furnace is open.

Perfect tube alignment is guaranteed by the unique tube profile which provides a one-way fit and automatic centreing of the injection port.

Automated eight-lamp turret for simplified multi-element analysis

The motorised lamp turret makes multi-element analysis without operator intervention a reality. The lamp sequence is pre-programmed, so the next lamp required is automatically warmed up. Simply load the element sequence and begin the analysis. Super Lamp provision is built-in.

Automatic lamp alignment ensures that lamps are aligned correctly every time. Instrument setup is not left to chance, and not subject to operator errors. Tedious pre-alignment procedures are eliminated.
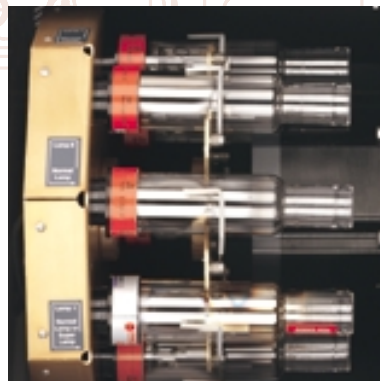
Extended operation with PAL4000 150 sample autoloader

PAL4000 High Capacity Programmable Auto Loader

The PAL4000 autoloader attaches to and is controlled by the Ultra Z spectrometer to provide automated graphite furnace analysis.

With 150 sample positions and ten modifier/bulk standard positions, the PAL4000 provides for extended batch mode or unattended operation.

A one litre rinse container ensures the availability of adequate rinsing solvent, while total random positioning allows up to 159 positions for samples.

The computer-controlled micro-stepped syringe reproducibly delivers unmatched dilution accuracy. There has been no compromise on solution volumes. Each sample holds up to 2 mL, and each bulk standard or modifier holds up to 10 mL.

Take control with Electronic Sample Viewing

Optimised sample injection and drying with Electronic Sample Viewing (ESV) takes the guesswork out of your analysis

The ESV in-line video monitor gives the operator ultimate control of the whole analytical process.

With ESV:

- Check probe alignment on-screen in real time. Probe injection depth is easily set or adjusted to suit the injection method (ambient or heated) and injection volume.

- Guarantee good sample injection for all volumes within two or three firings. No guesswork is involved since precise probe positioning is easily and quickly achieved.

- View all furnace program phases to further optimise reproducibility of results. Ensure optimum drying and ashing conditions.

- Develop new methods with confidence.

- Make your analysis transparent.
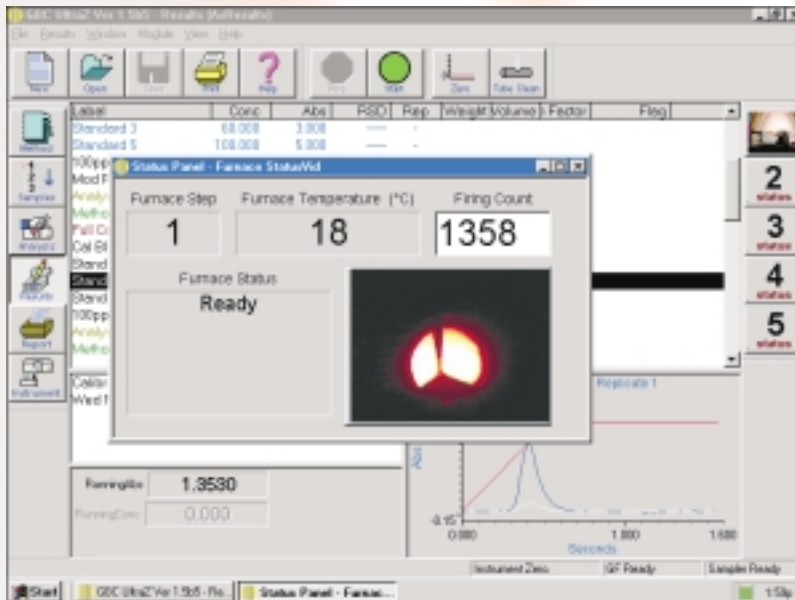
Fast and friendly multi-tasking software

All the features and convenience

The Avanta Ultra Z Windows®-based software provides an easy-to-navigate modular user interface while offering all the functionality required to perform any analysis.

The analytical task is usefully separated into method, sample identification, analysis, instrument set-up, results and report generation, providing a natural sequence of events and information for analysis, method development or training.

The instrument may be run in real mode or optionally, the various sections of the spectrometer may be activated in virtual mode for economical training and familiarisation.

Context-sensitive on-line help explains every aspect of hardware setup, hardware and software operation, maintenance and safety.

Learning to use the instrument is made easy through multi-media tutorials. While running a tutorial or displaying context-sensitive help the operator can work through the Ultra Z software to build an application, using as much or as little help as may be required.
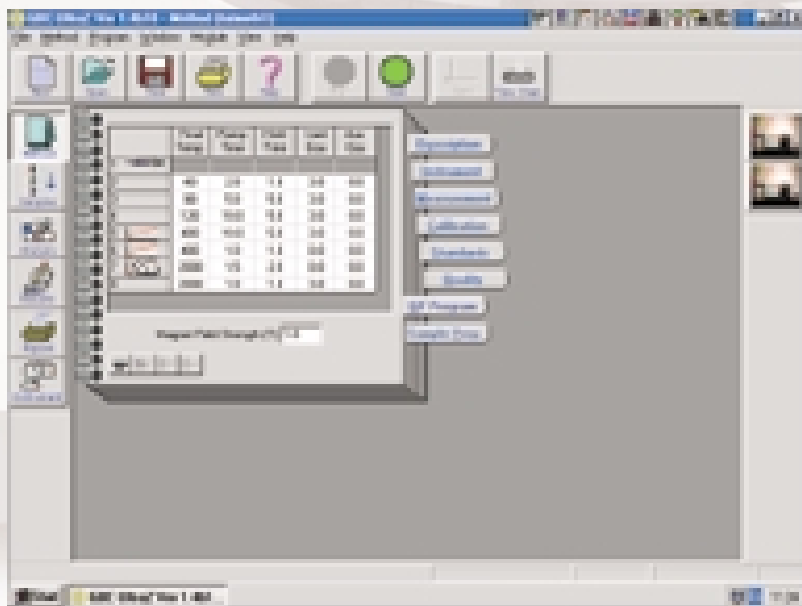
Rapid method development

The method module of the software allows the operator to set up and store all parameters associated with an elemental analysis including instrument, quality control, calibration, flame and graphite furnace, hydride and measurement parameters.

As all the parameters are within one module it is a simple task to develop a method. Once an element is selected from the periodic table, and the appropriate wavelength determined, based on the required working range of analysis, recommended conditions are recalled.

Methods can be created or modified, even while the instrument is collecting data. Password protection can be applied to method files to ensure that unauthorised changes or erasure cannot take place.
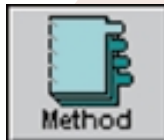
Complete instrument diagnostics

The instrument module controls all hardware functions of the instrument, from initial setup to optimisation and diagnostics. It provides an invaluable tool for problem solving, method optimisation and trouble shooting, saving valuable time and money for your laboratory.

Flexible sample handling

The samples module is used to identify the samples, determine the order in which they will be analysed, and specify when spike recoveries, check samples, re-calibrations and re-slopes will be carried out.
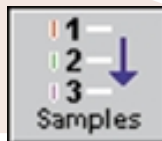
Sample files can be saved for later use or modification. Sample weights and dilutions which can be used to calculate the element concentration in the original sample are also included. The weights can be read in directly from an electronic balance with an RS232 port or the information can be imported from other software packages.

For rapid manual sampling analysis, accept default sample names and click to start. It's that simple.

Automatic report generation

Reports are generated automatically to a user-specified layout, in either the single element format or as a combined multi-element report, with control over table dimensions, fonts, headers, footers, margins, and header files. Any combination of available information such as replicates, calibration graph, method parameters and weights and volumes may be included.

Simple automated analysis

The analysis module is used to bring together the method and sample details for the measurements that are to be taken. These may be linked to provide fully automated multi-element analyses using the optional motorised lamp turret and programmable gas controller. This information can be saved as individual files. Single- or multi-element analysis can be initiated with just three mouse clicks.
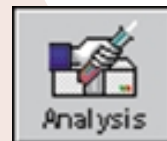
Integrity of results is assured

The Results module is used to collect, display and process data collected by the instrument. As all the raw data is collected for each standard and sample it is possible to re-calculate results post-run, based on different criteria. For example, results that were collected in peak area mode can be re-calculated in peak height mode. This can be invaluable for method development. The calibration routine can also be changed post-run to get the best possible fit of the calibration. Weight and dilution data can be added after the analysis and results re-calculated. The entire results section can be password protected to ensure the integrity of the original data for statutory compliance.
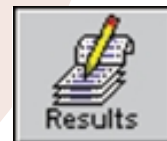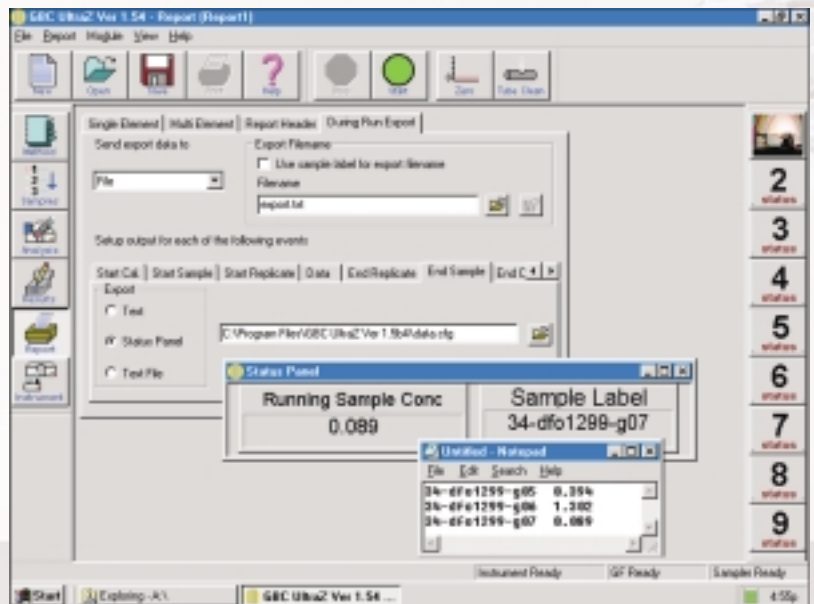
Automation of analytical functions makes every analyst an expert

Regulatory Compliance

The selective use of quality control protocols enables compliance with any regulatory requirement and ensures that your laboratory maintains good laboratory practice.

Real time data export is easy to use and transparent to the user.

Auto-optimisation for furnace program

Find optimum furnace program parameters the easy way with the built-in furnace optimisation routine. For a specified stage of the furnace program, simply select the parameter(s) you wish to optimise, (such as final temperature, ramp rate or magnetic field strength) set appropriate limits, and the software will run a series of analyses without operator intervention. Using the Results file, choose the optimum set of parameters and your Method development is complete.

During Run Export (DRE) for data

Results data may be easily and automatically exported, before or after the completion of an analytical run, to third party applications such as LIMS software or process control applications without additional software.

This enables faster turn-around of individual results during batch mode analyses, or real-time data collection for on-line analyses or process control.

Over 350 separate parameters may be included for export, making this a powerful research and diagnostics tool.

GMP/GLP Compliance

Extensive quality control protocols are included in the software to assure the quality of your data. They include:

- Upper and lower limits for quality assurance of samples, ideal for samples that must fall within a pre-determined range. Samples outside the specified range will be flagged.

- Check sample analysis. Once a check sample has been analysed, further analysis is dependent on the result of the check sample. If the check sample falls within the selected range, analysis will proceed as normal. If the check sample falls outside the selected range then analysis will follow a pre-selected action. Possible actions include: Stop, Continue and Flag, Re-slope and Continue, Re-calibrate and Continue, Re-slope and Repeat all the affected samples or Re-calibrate and Repeat all the affected samples.

- Spike recovery samples follow sample measurement as a check for possible interferences. If the spike fails a pre-determined recovery range, analysis will proceed according to the parameters specified by the operator. These include all those available for check sample error.

- Sample blank is used when the standards and samples have different matrices and so may require separate blanks.

- Calibration fit gives the operator the option of pausing if the calibration has failed an operator-determined curve fit criteria.

- Automatic re-slope rate can be set either as a function of time or of the number of samples being analysed, thus further ensuring data quality.

- Automatic re-calibration rate can also be set either as a function of time or of the number of samples that have been analysed.

- Automatic date and time stamping of all results.

Automatic Sensitivity Correction

Automatic Sensitivity Correction (ASC) is a unique GBC feature which provides automatic compensation for sample results affected by changes in conditions during an analytical run (for example, aging of a graphite furnace tube). It means that samples need not be re-analysed and that re-slopes only need to be performed when required. The productivity improvements and savings on consumables using ASC can significantly increase your profitability.
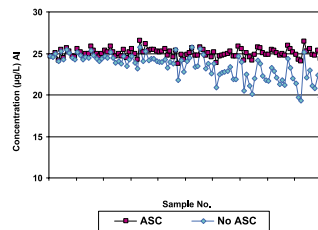
Auto Sensitivity Correction maintains result accuracy and precision during graphite tube degradation. The graph shows repeated measurements on a 25 ppb Al sample.

Software and Hardware Specifications

Operating System

Microsoft Windows®98 operating platform for true multi-tasking.

Controls AVANTA Ultra Z spectrometer and PAL4000 furnace autosampler.

Data Processing

Provides analysis by atomic absorption or emission. Absorbance range to 3.0 Abs. Measurement by integration, running mean, peak height or peak area. Mean and RSD of up to 50 replicate readings. Calibration using up to 10 standards. Linear least squares curve correction, linear least squares through zero curve correction, exact fit curve correction, concentration least squares (polynomial) curve correction, standard additions or bracketing standards. Programmable re-slope using a single standard or complete re-calibration, rate settable by either time or frequency of samples. Password protected result editing to prevent the editing or removal of readings on either samples or standards. Weight and dilution correction. All editing available either during the run or post run.

Data Storage

Storage is provided for all data including the linking of the graphics trace to the result. Also stored are the methods, sample labels, sample sequences, method sequences, weights and dilutions, report headers and footers, calibrations and the results.

Graphics

High resolution colour display of atomic absorbance, background signals, furnace temperature programs, calibration curves, peaking meters and wavelength scans. Graphics can be displayed in a number of different modes including overlaying non-successive peaks. Selectable absorbance scale for traces. Graphics cursor can be used to obtain numerical information from graphics traces. Zoom function allows graphics traces to be expanded.

Report Generation

Reports may be printed from all stored results in either single element or multi-element format with results being combined from different runs and different measurement techniques. All operating parameters, calibration graphs, headings, footers, method notes, sample labels, results statistics and weight and dilution factors may be printed. Software supports a full range of printers.

Quality Control Protocols

Complete range of quality control functions available including check samples, spike recovery, upper and lower QC limits, calibration correctness. Automated tests can be applied to assess data validity and results can be flagged if tests are failed or an alternative response can be initiated.

Quality control software satisfying GLP and GMP is supplied as standard.

Optics

Sealed aluminium casting for stability. All-reflective system with quartz overcoating on mirrors for maximum protection and longevity. Optical system is impervious to dust.

Automatic Lamp Turret

Eight-lamp turret with automatic lamp selection. Automatic optimisation for maximum light throughput. Automatic multi-element operation, with the next lamp in the sequence automatically warmed up. Compatible with standard hollow cathode lamps and Super Lamps.

Monochromator

Ebert-Fastie design with 333 mm focal length and 185–900 nm wavelength range. Continuously adjustable slits from 0.2 to 2.0 nm spectral bandwidth. Diffraction grating with 1800 lines/mm with dual-blazed profile (at 250 and 490 nm). Linear reciprocal dispersion is 1.6 nm/mm

Background Correction

Longitudinal (AC) Zeeman effect with Ultra Z background correction operating at 200 (50 Hz) or 240 (60 Hz) measurements/second.

Data Control System

Recommended minimum PC configuration: Pentium®100 MHz processor, 32 Mb RAM, SVGA graphics, MS Windows®98.
Complete computer control of instrument and accessories plus data handling and reporting, using Avanta software in Windows®98 or NT environment.

Graphite Furnace

Fixed position requiring no alignment. A protective gas stream is externally applied with purge gas to remove unwanted volatile vapours from the graphite tube. Two gas streams are fully computer controlled.
Unlimited steps per program. Unlimited ramp and hold times in steps of 0.1 seconds. Temperature range: Ambient to 2700 °C. Internal gas flow: None or 0.5 to 3 L/min.

Cooling System

Mains or recirculated (preferred) water supply required. Water pressure 100–200 kPa. Water temperature not to exceed 30°C. Water flow of at least 1.5 L/min.

Gas supply

Recommended gas pressure range of 70–200 kPa at the instrument.

Dimensions

860 x 550 x 390 mm (WxDxH)

Weight

Unpacked 96 kg, Packed 135 kg

Electrical Requirements

220/240 volts AC, 50/60 Hz, 3600 VA. Outlet should be rated at 16 A, single phase.

Environment Requirements

Ambient temperature: 10°C to 35°C
Humidity: 20 to 80% non condensing.

PAL4000 Furnace Autosampler

Accommodates 150 sample positions catering for 2 mL vials and 10 bulk standard/modifier positions catering for 10 mL beakers. Dispensed volume is 1–100 µL, programmable in 1 µL increments. All-PTFE capillary. One litre rinse container. Removable carousel and inert probe. Probe set-up controlled by computer with co-ordinates stored in memory. Program options include automatic mixing of standards, automatic injection of chemical modifier(s), multiple injection, heated injection, automatic re-slope or complete re-calibration, check sample, and spike recovery.

Connections for power and gas from the spectrometer.

Dimensions

22 x 29 x 14 cm

Weight

Unpacked 7 kg, Packed 9 kg

Technical Standards

All equipment is certified to CE compliance, including safety and EMC standards covering electromagnetic compatibility, emissions and immunity.

Avanta
Ultra Z

Ordering Information

GBC Avanta Ultra Z (1 Super Lamp)	99-0389-00
GBC Avanta Ultra Z (4 Super Lamp)	99-0390-00
Graphite furnace tubes, pyrolytically coated	45-0012-00
Sample vials for PAL4000 (pack of 500)	99-0022-00
Recommended spares and consumables for two years operation	
Ultra Z	95-0405-00
PAL4000	95-0406-00
Refrigerated cooling system (recommended)	
220 V, 50 Hz	96-0063-00
110 V, 60 Hz	96-0063-01

GBC was the overall winner of the inaugural SIRF award in Australia for excellence in manufacturing for 1999, recognising our total commitment to building better instruments.

ISO 9001