



**GeminAA**

Tandem Atomic Absorption Spectrometer

GBC SCIENTIFIC EQUIPMENT PTY LTD

# Simply Precise

GBC Scientific Equipment Pty Ltd commenced operations in 1978. GBC designs, manufactures and markets a range of scientific instruments comprising Atomic Absorption spectrometers (AAS), UV-visible spectrometers (UV-Vis), Inductively Coupled Plasma Optical Emission spectrometers (ICP-OES), Inductively Coupled Plasma Time-of-Flight Mass spectrometers (ICP-TOFMS), High Performance Liquid Chromatography (HPLC), Rheological Analysis Equipment and X-ray analysers (XRD).

Endorsed by the international quality standard, ISO 9001:2008, the company prides itself on developing products, which not only meet, but exceed market expectations. GBC has been the recipient of many international export awards, acknowledging the superior standard and world acceptance of both the organisation and the products .

## ISO 9001:2008 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 9001:2008 quality standard by Lloyd's Register Quality Assurance Limited.

GBC customers benefit from our efficient and effective global organisation. Access to information, applications support and technical service is never more than a phone call or email away.



*"Sensitive Technology for a Sensitive World"*

*GBC Scientific Equipment will advance people's knowledge and their capacity to enhance the quality of life for all humankind.*



AAS



HPLC



ICP-OES



ICP-TOFMS



Rheometry



UV-Vis



XRD

# GeminAA

## Atomic Absorption Spectrometer

### Application

The GeminAA atomic absorption spectrophotometer can be widely used in the fields of metallurgy, petrochemical industry, geology, medical science, environmental protection, scientific research, agriculture, disease control, food, material science, quality inspection etc. The GeminAA can be used to analyze over 50 elements at both normal or trace levels.



### Features

#### Advanced Optical System

- The GeminAA features a unique suspension design for the optical system. Shaking of the instrument bench or change of the environmental temperature will have no effect on the instrument's stability.
- 1800 lines/mm diffraction grating, which increases resolution and energy efficiency.
- Optical system allows for low detection limits for elements such as As, Se among others.
- Six lamp turret with lamp auto peaking.
- Deuterium lamp background correction.
- Self-absorption background correction.

#### Integrated Design

- The GeminAA features an integrated flame and graphite furnace design that contains the optical system, atomizer, graphite furnace power supply and electronics all in one unit. This makes it one of the most compact Tandem AAS in the world.
- Optimized lamp power supply technology to prolong lifetime of hollow cathode lamps.

#### Automated Changeover between Flame and Graphite Furnace

- Features automated software controlled switching between flame and graphite furnace in less than 2 seconds.
- No need to change or replace anything when switching from flame to furnace or vice versa.

### Reliable Safety System

- Safe and reliable control alarm devices to ensure over-current protection for hollow cathode lamps.
- Instrument monitors low gas pressure, gas leakage, graphite furnace overheating and incorrect flame.

### Flexibility

- The autosampler in graphite furnace mode allows for automated preparation of standard solutions and automated analysis.
- Optional GeminAA hydride generator that utilizes a heated ceramic tube to realize trace analysis of As, Pb, Se, Hg, Bi, Sb, Sn, Te with high sensitivity.

### High Degree of Automation

- Automatic wavelength positioning, automatic slit switch and automatic optimization of lamp current and gain. All of these operations can be completed within 40 seconds.
- The six lamp rotating turret is computer controlled for automated element lamp selection, which allows for automated analysis of up to six elements in sequence.
- Automatic flame ignition, automatic control of the combustion gas flow rate, and automatic gas leakage alarm.



Six Lamp Rotating Turret

## Additional Features

#### Auxiliary Gas

Auxiliary gas, such as oxygen, can be used in the internal gas path of the graphite furnace to sufficiently remove organic components of the sample during the ashing treatment phase in order to reduce interference and increase analysis accuracy.

#### Automatic Flame Height Adjustment

Automatically find the optimal flame height for best analysis condition.

#### Automatic Liquid Trap Protection

Flame ignition is controlled with a combination of a float inside the liquid trap and a solenoid to avoid acetylene leakage due to lack of water in the liquid trap. This increases operational safety.

## Configuration

The instrument comes in the following configuration.

Part No.	Major Configuration
99-0701-00	GeminAA with flame and graphite furnace Fast wavelength scan Automatic gain and slit control Six lamp rotating turret Automatic lamp current control Automatic EHT control Deuterium background correction Self-absorption background correction Electronic gas flow control
	Universal autosampler for flame and furnace analysis (included) Graphite furnace design allows for replaceable graphite cones Computer controlled flame ignition Air-acetylene burner Nitrous oxide-acetylene burner Automatic flame height adjustment
	Automated pneumatic switching between flame and graphite furnace Water level monitoring Water coolant flow monitoring Choice of two furnace gases Graphite furnace optical control temperature measurement Ethernet communication
	Accessories: Hydride Generator Air Compressor Water Cooling System

## Complete AAS Configuration

1. GeminAA with Graphite Furnace
2. Autosampler for Flame and Graphite Furnace (included)
3. Gas Sources: Oil-less Air Compressor (optional)
4. Hydride Generator (optional)
5. Graphite Furnace Water Cooling System (optional)
6. Hollow Cathode Lamps based on user selection (optional)
7. Spare Parts (optional)

## Excellent Graphite Furnace

### Advanced Longitudinal Heating Mode

Atomization temperature can reach 3000°C. This meets the atomization temperature demands of Ni, Mo, V, Co, etc.

### High Stability

Advanced optics system ensures high optical energy of the instrument. High signal-noise ratio ensures repeatable data.

### Maximum Sample Size Increased

Maximum sample size is 70  $\mu\text{L}$ . This feature is useful for multiple samples and analysis of samples with low concentrations.

### High Performance Background Correction

Continuum light source ( $\text{D}_2$ ) and self-absorption background correction is capable of 1 Abs of background correction.

### Fast Heating

Optical temperature control greatly increases heating rate and allows for rapid atomization.

### High Precision Homogeneous Heating

Unique design of the graphite furnace ensures homogeneous heating during atomization to obtain accurate data.

### Titanium Nebulizer and Burner

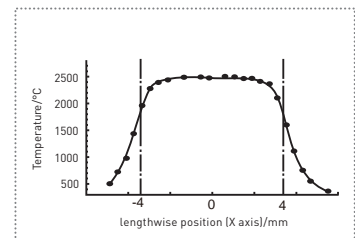
Utilizing aerospace technology, the industrial grade pure titanium nebulizer and burner head is cast using the paraffin method. These parts have excellent resistance to corrosion and oxidation, can withstand high temperatures, and are extremely durable.

### Convenient Injection Port

Design of the injection port simplifies sample injection and decreases error.

### Advanced Graphite Furnace

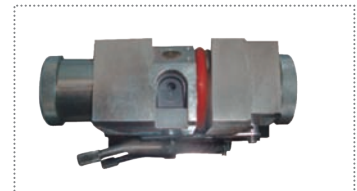
Graphite cones can be replaced when worn to ensure stable conductivity of electrodes.



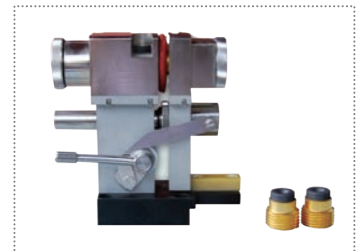
Iso-temperature Line During Atomization



Titanium Nebulizer

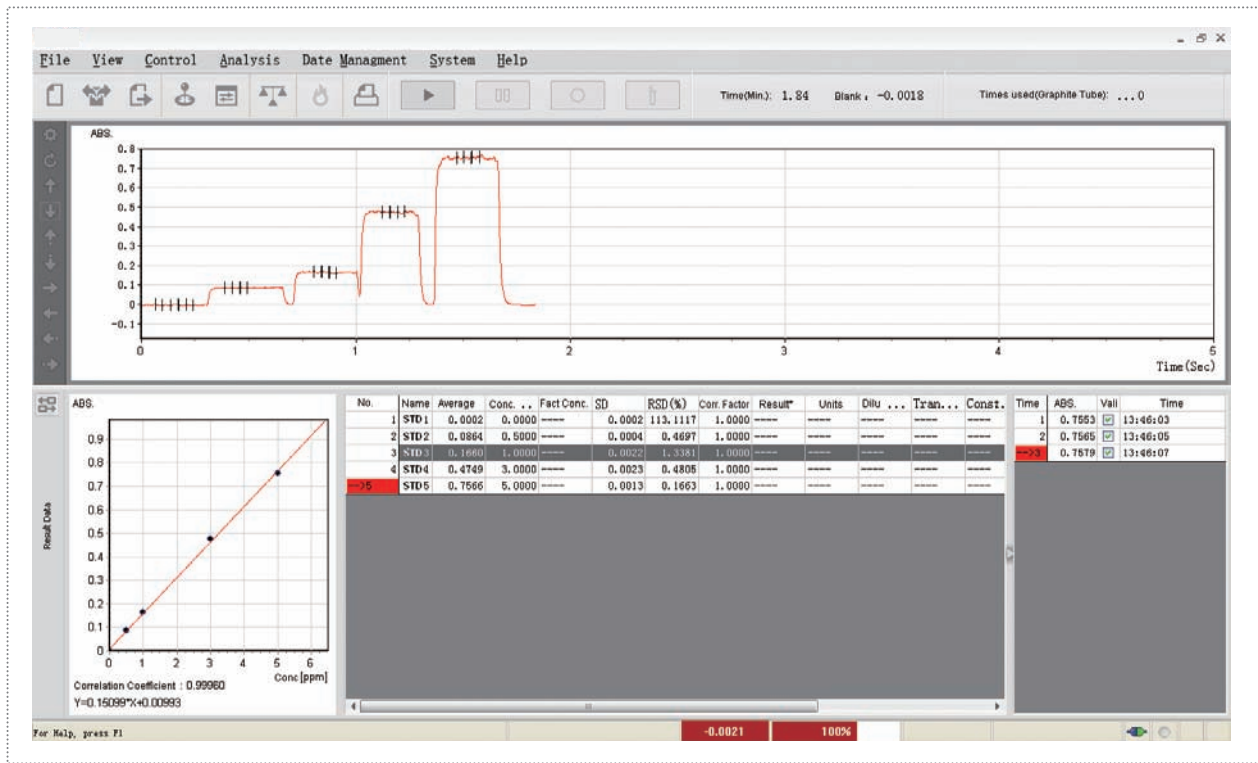


Convenient Injection Port



Graphite Furnace and Graphite Cone

## Data Processing Workstation



Software Interface

### User Friendly Interface

Runs on Windows operating system. The GeminAA software is available in several languages.

### Strong Analysis Capabilities, Fault-tolerant Processing, and Flexible Modification of Curve Fitting Equation

#### Report Printing

Customizable report templates are capable of generating reports of any format the user may need.

### Powerful Data Management

The workstation has powerful data management capabilities including backup and subsequent treatment of historic data, including search, edit, sort, etc. Data files can be exported into many different formats.

### QA/QC Control

The QA/QC feature allows for automated determination of whether the analysis result or some function of the result exceeds user-defined limits. If the result exceeds the limit, the system automatically runs the analysis again according to setup parameters. Functions of QA/QC include standard deviation (SD) detection, relative standard deviation (RSD) detection, correlation coefficient detection, QC detection,

baseline drift (sensitivity correction) detection, sample upper limit detection (automatic online dilution available with furnace autosampler).

### Instrument Control

Automatic selection of element lamps, automatic wavelength scanning, automatic slit switch, automatic setup of lamp current.

### Status Monitoring

Real-time dynamic monitoring of working conditions. For flame method: type of burner head (air + acetylene or nitrous oxide + acetylene), water level of the liquid trap, status and pressure of the combustion gas and the oxidant gas, flow rate of the combustion gas, acetylene leakage alarm. For graphite furnace method: over-current protection, water temperature, water flow rate, pressure of the protection gas.

### Management of Lamp Use Time

Automatically records the usage hours of hollow cathode lamps. Recording of individual lamps enabled by their serial number.

## Technical Specifications

### Optical System

Wavelength range: 190~900 nm  
 Monochromator: Czerny-Turner Grating  
 Monochromator  
 Wavelength repeatability:  $\leq 0.05$  nm  
 Blaze Wavelength: 250 nm  
 Resolution: better than 0.1nm

Spectral bandwidth: Automatic switching between 5  
 levels: 0.1, 0.2, 0.4, 1.0, 2.0 nm  
 Wavelength accuracy:  $\pm 0.1$  nm  
 Grating: 1800 lines/mm  
 Baseline Stability:  $\leq \pm 0.003A/30$  min (Static)  
 $\leq \pm 0.002A/30$  min (Dynamic)

### Flame Method

Benchmark Concentration of Cu:  $\leq 0.02$   $\mu\text{g/mL}$   
 Precision RSD:  $\leq 0.6\%$   
 Position Adjustment: Adjustable height and angle  
 Flame to hydride can be  
 switched in less than 1 minute

Detection Limit:  $\leq 0.003$   $\mu\text{g/mL}$

### Graphite Furnace Method

Benchmark Concentration of Cd:  $\leq 3.0 \times 10^{-13}\text{g}$   
 Temperature Range: Room temperature to 3000°C  
 Temperature Control Program: Max 20 step  
 temperature program. 3 modes of temperature  
 rise: step, slope and flat  
 Max Power Temperature Rise Rate:  $\geq 2000^\circ\text{C/s}$

Detection Limit:  $\leq 2.0 \times 10^{-13}\text{g}$   
 Precision RSD:  $\leq 2\%$   
 Optical Control Temperature Rise Rate:  $\geq 3000^\circ\text{C/s}$   
 Heating Modes: Max power heating and optical control  
 rapid heating

### Background Correction

Background correction is available for both flame and graphite furnace method.  
 Correction modes: Deuterium lamp or self-absorption.

### Data Processing

Measurement methods: Flame absorption, flame emission, graphite furnace, and hydride method.  
 Analysis method: Linear fitting, nonlinear fitting, standard addition method.  
 Printing output: Calibration curve, spectrum, analysis conditions, analysis parameters, and analysis results can be  
 automatically stored and printed.

### Main Unit with Integrated Graphite Furnace Power Supply

Dimensions: 880 (L) x 540 (W) x 450 (H) mm, 125 kg



## High Accuracy Graphite Furnace Analysis System

The most important specification of a graphite furnace analysis system is the repeatability of analysis data. The precision requirement of trace analysis depends on the concentration level of the sample, which varies based on application. A quality graphite furnace analysis system must satisfy all such requirements. Additionally, it must have accurate temperature control, high quality graphite tubes, a fast heating system, fast signal processing electronics and easy to use analysis software. GeminAA satisfies all these requirements.

### High Precision Analysis of Boundary Wavelength Elements

Boundary atomic absorption wavelengths elements include As (193.7 nm) and Cs (852.1 nm). Their spectral lines have very low energies on the high or low end of the monochromator grating. Analysis performance of these two elements can be used to evaluate the optical characteristics of an instrument. Analysis results of these two elements by graphite furnace method are shown in Figure 1.

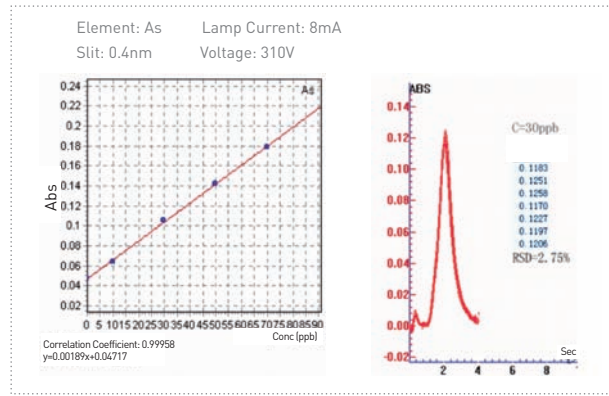


Figure 1 Linearity and %RSD of element As

The figures to the right show an %RSD of 2.95% for 7 consecutive manual samples of 20  $\mu$ L of 5  $\mu$ g/L Cs solution, and an %RSD of 2.75% for 7 consecutive manual samples of 20  $\mu$ L of 30  $\mu$ g/L As solutions.

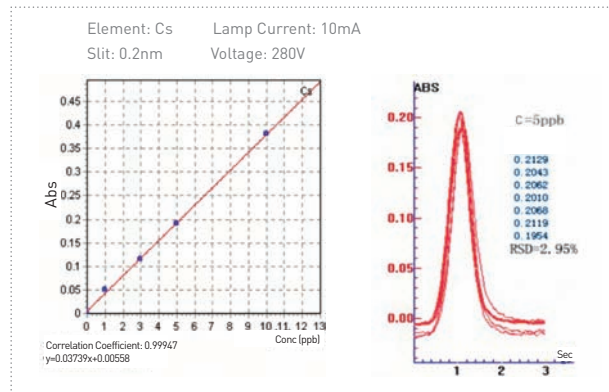


Figure 2 Linearity and %RSD of element Cs

### Analysis of Cd and High Atomization Temperature Element Mo

The element Cd is selected for analysis by graphite furnace due to its high sensitivity. High atomization temperature element Mo can easily form a carbide in graphite furnace, so its analysis data reflects high temperature behaviors of the graphite furnace, the quality of graphite tubes and the sensitivity of high atomization temperature elements.



Below are the graphite furnace analysis results for Cd and Mo.

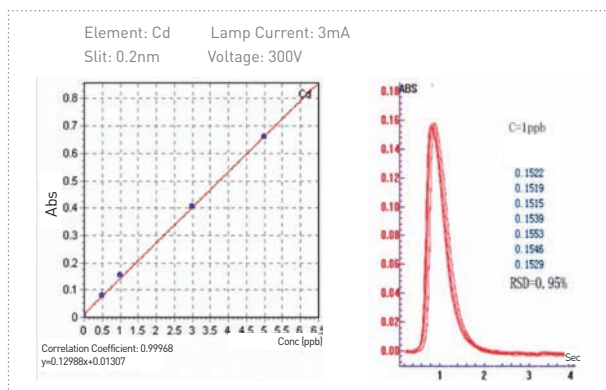


Figure 3 Linearity and %RSD of element Cd

The figures above show an %RSD of 0.95% for 7 consecutive manual samples of 20  $\mu\text{L}$  of 1  $\mu\text{g/L}$  Cd solution, and an %RSD of 1.49% for 7 consecutive manual samples of 20  $\mu\text{L}$  of 40  $\mu\text{g/L}$  Mo solutions.

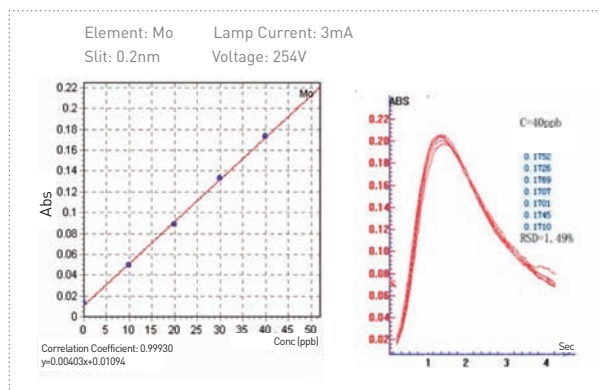


Figure 4 Linearity and %RSD of element Mo

The linearity of the results shown above in addition to using a high voltage of no more than 300 V shows the sensitivity and stability of the graphite furnace system. Even for a high atomization temperature, low sensitivity element such as Mo, the system delivers satisfactory sensitivity.

### State-of-the-art Graphite Tube Design

The graphite tube is the core component of the graphite furnace system. In addition to using high grade graphite material, a sound mechanical design of the graphite tube is a key factor to creating an isothermal state. Figure 5 shows a cross-sectional view and figure 6 is a temperature diagram of the GeminAA graphite tube.

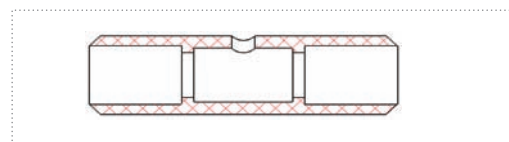


Figure 5 Cross-Sectional View of GeminAA Graphite Tube

To create isothermal conditions in the atomization zone, two rings with a smaller inner diameter were added in the middle of the graphite tube. The tube wall between the two rings and the ends of the tube was thinned in order to increase the electric current density to ensure isothermal conditions in the 8 mm long, 170  $\text{mm}^3$  volume atomization zone. This design increases the sensitivity and precision while reducing the interference of the system. Figure 6 shows the isothermal condition of the 8 mm long atomization zone. The maximum capacity of the tube is 70  $\mu\text{L}$ .

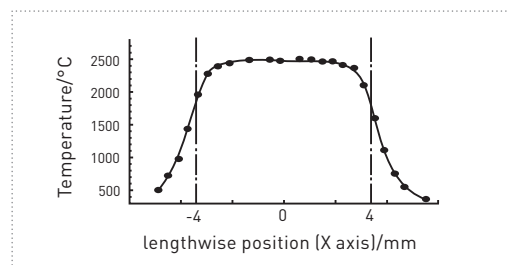


Figure 6 Temperature Diagram of the Graphite Oven

As you can see, the GeminAA graphite furnace analysis system is an excellent analysis system with high accuracy and precision, and can compete with any advanced graphite furnace system on the market. Additionally, the small graphite furnace with low energy cost (maximum 4 KW, 220 V) is economical and suitable for lab use.

## GeminAA Hydride Generator

The GeminAA Hydride Generator uses a peristaltic pump for sample injection, and has an atomizer consisting of a ceramic electric heating tube heating a quartz tube. It allows for ultra low trace analysis of the eight elements (As, Se, Hg, Pb, Bi, Sb, Sn and Te), which have relatively low sensitivity using the atomic absorption method. The instrument is fast and easy to operate.

### Features

- Samples are continuously pumped by 3 channels using a peristaltic pump. Injection volume is 1~5 mL.
- Uses Tygon wear-resistant durable pump tube. The life span of these pump tubes can be as long as 500~1000 hr.
- Using a uniquely designed ceramic electric heating tube, the Hydride Generator is oxidation-resistant and expels no waste. It can withstand temperatures of up to 1000°C for many hours with no damage to the quartz tube.
- Temperature control is fast and accurate. The temperature range is 100~1000°C with an accuracy of  $\pm 2^\circ\text{C}$ . The optimal atomizing temperature can be quickly reached and precisely controlled.
- Compact design and easily mounted on the AAS.



Hydride Generator

## Water Cooling System

The Water Cooling System is designed for various industrial applications with a strong protection and alarm system. It has the unique option of a purification configuration that ensures pure water is produced. This system provides a variety of alarms and output connections, along with a water level alarm, over temperature alarm and water flow alarm. All configurations can be customized according to the user's requirements.

### Features

- Large volume open tank, easy to clean, easy to do water bath testing.
- Multiple alarm protection, including water level alarm, water flow alarm and over temperature alarm.



Water Cooling System

## GeminAA Universal Autosampler for Flame and Graphite Furnace

The GeminAA Universal Flame and Graphite Furnace Autosampler is a multifunctional and highly accurate autosampler for both flame and graphite furnace AAS. Analysis accuracy (%RSD) can be improved to 1% or better. This autosampler can also be used to automate sample preparation.

### Features

- Allows 133 samples including 5 large holders for modifiers, bulk standards etc.
- Automatic sampling can be switched from flame to graphite furnace or vice versa without moving the autosampler. Manual furnace or flame sample introduction can be achieved without removing the autosampler.
- Sampling depth and injection depth are software controlled.
- Sampling of samples, standards and chemical modifiers are all software controlled.
- After solution injection, the software will start the graphite furnace heating program automatically.
- After each injection, the system runs an automatic rinse procedure to prevent samples from being contaminated.
- Automatic concentration and dilution.
- Graphite furnace supports hot injection.



Universal Flame and Graphite Furnace Autosampler

## Air Compressor

- The air compressor is a double cylinder piston compressor that is stable, reliable and oil-less.
- It uses three filters (two filters for gas inlet and one filter for gas outlet) to ensure that the gas output is pure.
- Provides clean and dry compressed air with constant pressure for atomic absorption spectrometers.

Part No.	Gas Flow	Pressure Range	Dimensions	Features	Note
75-0054-00 75-0055-00 75-0056-00	20 L/min	0.005~0.3 Mpa	400 × 300 × 635 mm	Quiet oil-less dual piston compressors	Manual drain



Air Compressor

## Ordering Information

### GeminAA

99-0701-00

Each GeminAA is supplied with universal autosampler for flame and graphite furnace, air-acetylene burner, nitrous oxide-acetylene burner, spray chamber, adjustable inert nebulizer, gas hoses, operation manual and software for operation of the instrument and all accessories.

### Accessories

Hydride Generator	99-0702-00
GeminAA Universal Autosampler for Flame and Graphite Furnace (supplied with GeminAA)	99-0703-00
Air Compressor (oil-less) 220/240 V, 50 Hz	75-0054-00
Air Compressor (oil-less) 110 V, 60 Hz	75-0055-00
Air Compressor (oil-less) 220 V, 60 Hz	75-0056-00
Water Cooling System 220 V, 50 Hz	96-0104-00
Water Cooling System 115 V, 60 Hz	96-0104-01

## GBC Products

**OptiMass 9500** ICP Time-of-Flight Mass Spectrometer

**SavantAA** Atomic Absorption Spectrometer

**SensAA** Atomic Absorption Spectrometer

**XplorAA** Atomic Absorption Spectrometer

**GeminAA** Tandem Atomic Absorption Spectrometer

**Cintra 1010/2020/3030/4040** UV-Vis Spectrometer

**Quantima** ICP Optical Emission Spectrometer

**Integra XL** ICP Optical Emission Spectrometer

**EMMA** X-ray Powder Diffractometer

High Performance Liquid Chromatography

**MFR 2100** Micro Fourier Rheometer

### GBC SCIENTIFIC EQUIPMENT PTY LTD

ABN 30 005 472 686

4 Lakewood Boulevard

Braeside Victoria 3195

Australia

Phone: 61-3-95886666

Fax: 61-3-95886677

Website: [www.gbcsoci.com](http://www.gbcsoci.com)

Email: [gbc@gbcsoci.com](mailto:gbc@gbcsoci.com)

GBC Scientific Equipment reserves the right to change specifications without prior notice.

GBC publication number 01-1035-01, March 2015.

All trade-marks and trade-names are the property of their respective owners.