




vario MACRO  CUBE



 elementar

vario MACRO CUBE

The art of elemental analysis

100 years ago, in the center of Germany, near Frankfurt, the advanced technology company Heraeus developed and manufactured the world's first elemental analyzer for organic substances.

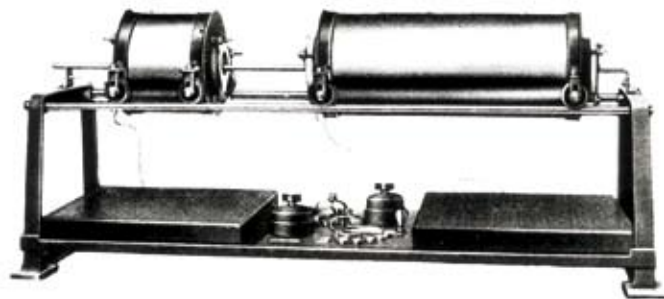
From that foundation, a continuous progression of technology in elemental analysis products led to the establishment of Elementar. Still at the same location today, Elementar is the world's leading producer of instruments for the analysis of C, H, N, S and O.

Elementar has utilized its century long experience to develop the next generation for multi element determination on macro sized samples. Consider these features:

- The only system for CHNS analysis in macro samples.
- Ability to analyze nearly all types of samples.
- No matrix dependency of the measurement.
- Highest precision and accuracy of the analytical results.
- Unsurpassed reliability and long time stability.
- Desing innovations which make the instrument easy to use and maintain.
- Lowest operating and maintenance costs due to robust design and hybrid technique.

Elementar has coupled the latest developments in micro electronics and mechanics with their vast experience in elemental analysis. Newly developed separation technology has expanded the already impressive analytical range of the predecessor vario MACRO model. Newly refined detectors with expanded element capability are available for the vario MACRO cube. Even the form and color of the vario MACRO cube are new.

The vario MACRO cube incorporates a century of experience in elemental analysis design technique with the very latest electronic flow and processing technology. The result is a system with range, accuracy and versatility heretofore unsurpassed.



Heraeus Micro Analyzer 1930



The instrument concept - simply right

The samples are weighed in tin or silver vessels and loaded in the integrated 60 position carousel. In a fully automated process, the sample is transferred through the ball valve into the combustion tube.

While in the ball valve, each sample is individually flushed with helium carrier gas (Heraeus patent) to remove atmospheric nitrogen, resulting in a zero blank sampling process.

Catalytic combustion is carried out at a permanent temperature of up to 1200 °C. Note that the furnace warranty is a full 10 years! Oxygen is injected via a lance directly at the hottest spot which results in optimum combustion of the combustion gases. A second furnace serves for complete post combustion in CHN/CN mode.

This is followed by reduction of the combustion gases on hot copper (or tungsten for non sulfur modes) in the reduction tube. The formed analyte gases, N_2 , CO_2 , H_2O and SO_2 remain in the He carrier gas stream. This multi-zone technique guarantees complete conversion even for very difficult

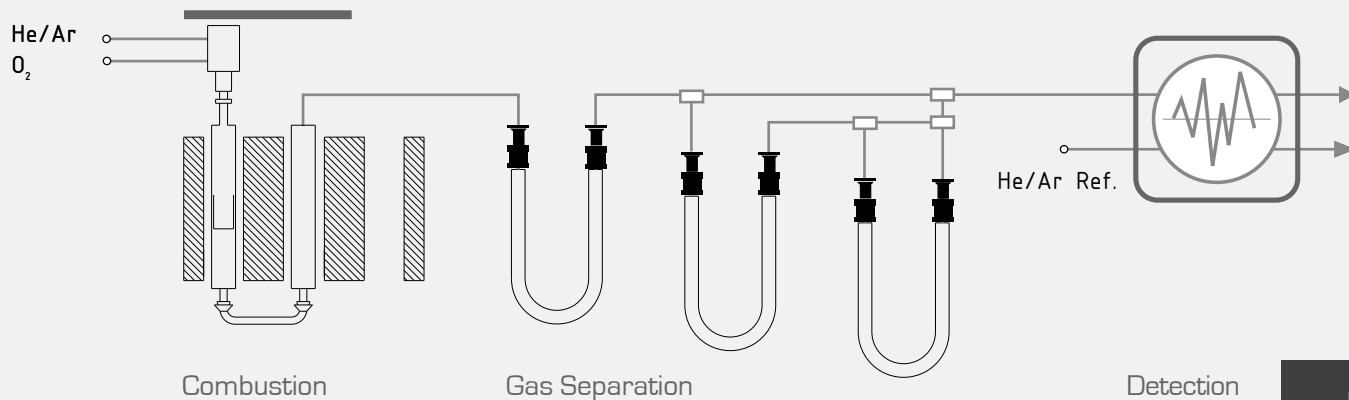
to combust sample materials.

The gas mixture is separated in its components via purge & trap chromatography, then is detected by a thermal conductivity detector (TCD), which utilizes well proven thermistors. The Elementar solid state thermistor TCDs are stable for years and are not damaged even in the presence of high oxygen.

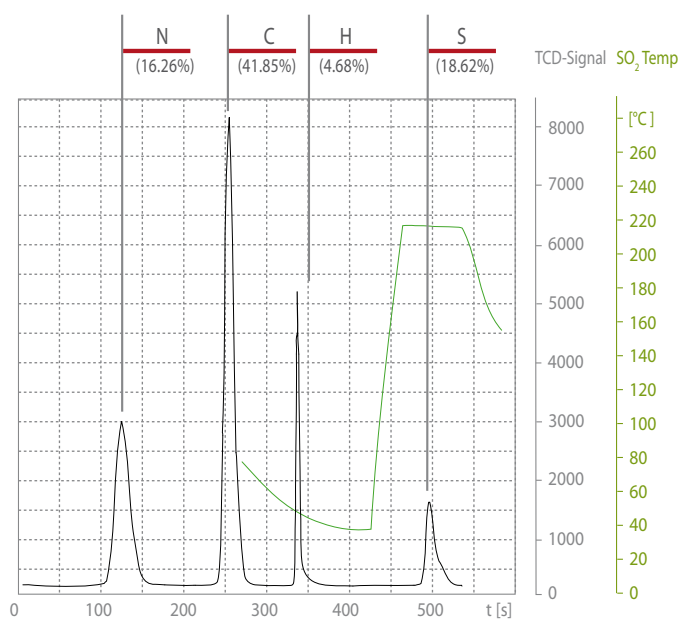
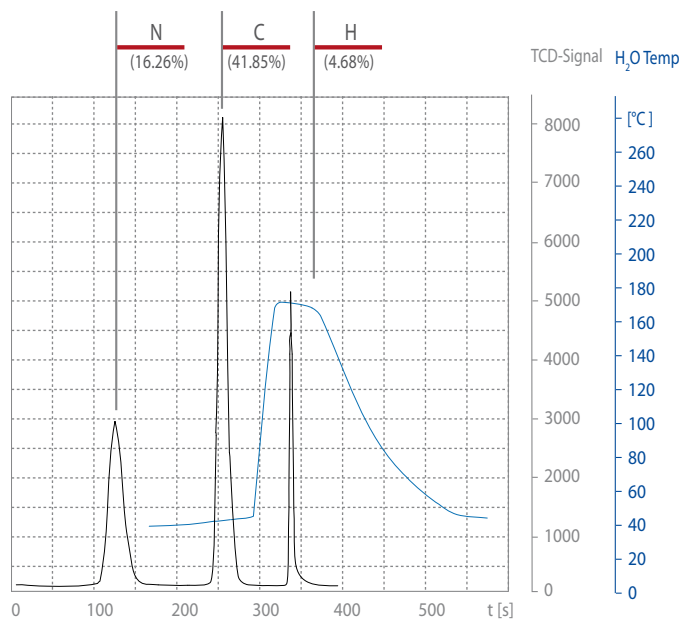
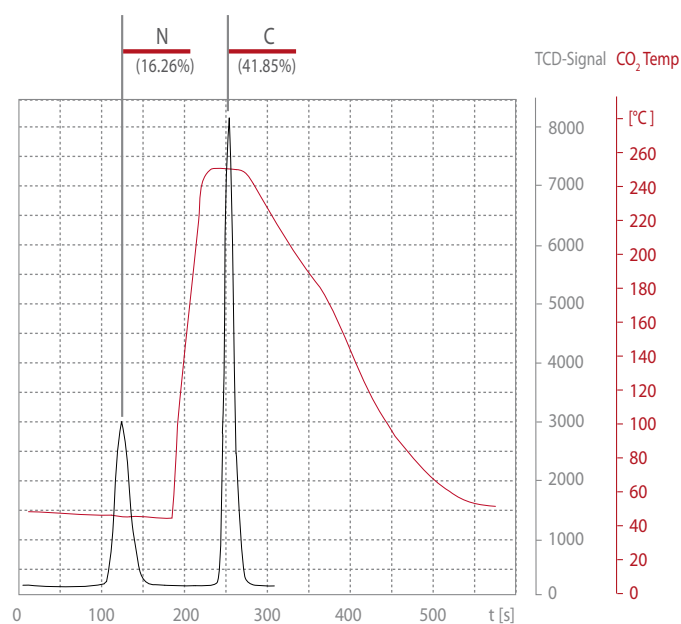
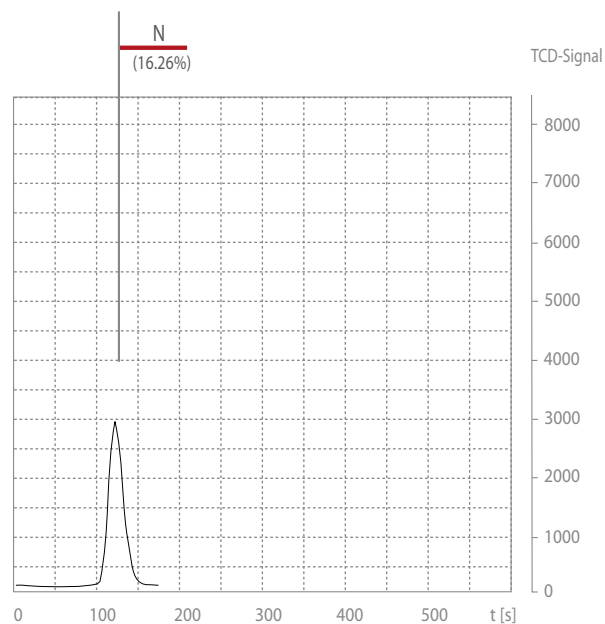
The TCD has a very large dynamic range which allows for the sequential analysis of very high concentrations next to very low concentrations, without the need to change any range or manual setting.

An electronic gas flow controller is positioned just before the detector and ensures absolutely stable pressure and flow conditions. This results in a stable instrument calibration over months or even years.

A connected PC computes the element concentration from the detector signal, and the sample weight on the basis of stored calibration curves.



Peak graphic - Sulfanilamide



The perfect gas separation

Purge&trap Chromatography with TCD: a dynamic combination

Elemental analysis is based on the high temperature combustion and subsequent analysis of the combustion gases. The perfect separation of the analyte gases prior to the detection is crucial for the performance of the instrument.

With the vario MACRO cube, Elementar uses a well proven technique to ensure the highest performance. The adsorption of combustion gases on three separation columns and subsequent controlled desorption allow for a very wide dynamic range.

CO₂, H₂O and SO₂ are sequentially adsorbed on specific columns. N₂ passes through all three columns and enters the TCD. After the detection of the N₂ peak, the CO₂ column is quickly heated. CO₂ is released to the TCD and detected. The H₂O column is then heated and the desorbed gas is diverted directly to the TCD. Finally, the SO₂ column is heated and the gas, by-passing the other two columns, is quantified by the TCD.

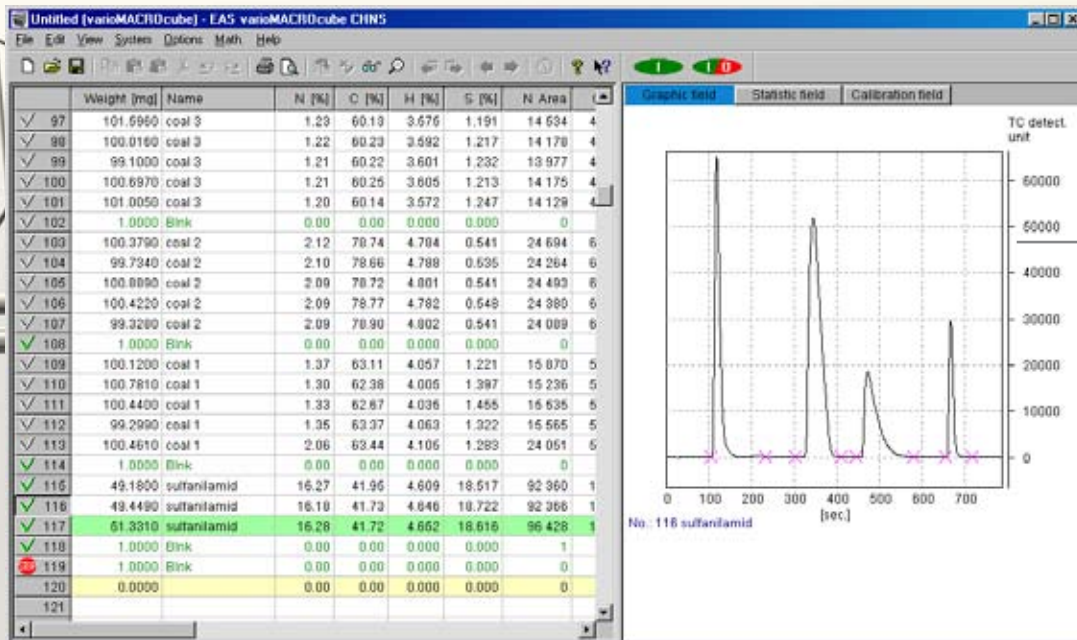
Each heating step takes place only after the subsequent peak has passed the detector, resulting in baseline resolution, even for samples with very large differences in relative concentration. This technique also results in automatic optimization of the time of analysis.

The purge & trap chromatography approach enables large amounts of organic material, up to 150 mg carbon absolute, to be analyzed even when there are large concentration differences between the elements. Thus, the vario MACRO cube can analyze both micro and macro samples with excellent precision and accuracy.

Problems that are typical for alternative methods (matrix dependency, peak overlapping and drift) are not issues for the vario MACRO cube.

vario MACRO cube CN Continuous Flow Hybrid for economical operation - the robust and elegant solution!

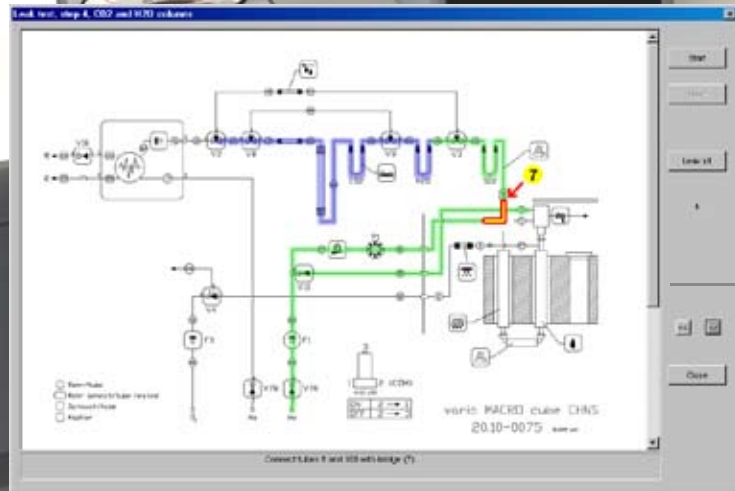
It is important for labs with a very high sample throughput to have the lowest possible cost per analysis. The Continuous Flow Hybrid (CF-Hybrid) option for the vario MACRO cube CN results in significant savings in operation reagents. With no moving parts, CF-Hybrid technology streams only a user defined percentage of the combustion gases to the reduction tube. The method is most precise for labs which run larger batches of samples with a similar matrix.



User Interface
Instrument Software

116. Name: sulfanilamid N [%]: 16.28 C [%]: 41.84 H [%]: 4.676 S [%]: 18.622

Process:	Defector	Temperatures [°C]	Flow [ml/min]	Press. [mbar]
Standby	TC detect 0 inactive	1145 CO2 column 34	MFC TCD 198	Press. 15.11
	TCD 99.6 °C	Product tube 846 H2O column 34	MFC O2 60	Maintenance 0%
		Post comb. 34 SO2 column 40	Flow He 215	
		Valve 34		



Audit Trail
in accordance with
21 CFR Part 11

System Check

Logbook for month 03/2009

01.03.2009 14:21:25 (ID=100)	varioMACROcube supervisor (varioMACROcube service)	Start system
01.03.2009 14:22:44 (ID=204)	varioMACROcube supervisor (varioMACROcube service)	Save file: "C:\MSD\1\Glastic acid"
01.03.2009 14:23:32 (ID=204)	varioMACROcube supervisor (varioMACROcube service)	Load file: "C:\MSD\1\Glastic acid"
01.03.2009 14:23:53 (ID=204)	varioMACROcube supervisor (varioMACROcube service)	varioMACROcube program start online
	varioMACROcube version: CHNS	
	varioMACROcube version: V1.1.0.31.08.2008	
	varioMACROcube version: V1.1.0.31.08.2008	
	Serial No.: 470	
01.03.2009 14:23:53 (ID=204)	varioMACROcube supervisor (varioMACROcube service)	Start system

Good software - good instrument

The cube instruments of Elementar set new standards as the first elemental analyzers in which all instrument functions are digitally controlled and monitored. This results in completely new possibilities for automatic operation and optimization as well as remote control and diagnosis over the internet.

The basis for this is the use of the latest micro processors and electronic sensors for all gas flows and pressures.

The vario MACRO cube's firmware (internal software of the analyzer) is stored on flash memories, which can be easily updated via PC or the internet. The critically important fast signal communication between components in the analyzer (such as the detector signal) is handled by the fail-safe CAN bus technology.

A commercial PC or laptop serves as the user interface for control and evaluation. Our software runs under the Windows® operating system and offers state of the art features and capabilities:

- almost unlimited storage capacity of analytical data, including graphics and statistics
- automatic optimization of instrument operating conditions
- monitoring of maintenance intervals
- integration into existing networks
- data transfer into LIMS
- data transfer to calculation programs like Excel®

Self-explanatory user navigation and content-sensitive help screens make printed manuals almost obsolete. Graphical leak checking with pictorial guides for each step are a new favorite feature of users.

The system is designed for intuitive operation, but content sensitive help is just a click away. User friendliness is designed into the software at all levels. Instrument operators do not need special skills to take advantage of the instruments powerful capabilities.

The software is designed in accordance with the strict requirements of 21 CFR Part 11 data safety.

All Elementar instrument software is developed and maintained internally to ensure the highest quality and performance.

	Carbon *		Hydrogen *		Nitrogen *		Sulfur *	
Sulfanilamide	41.84	± 0.01	4.676	± 0.008	16.28	± 0.009	18.622	± 0.03
Measurements: 6 Weight: 20 mg								
Polyethylene	84.61	± 0.03	14.301	± 0.006	0.034	± 0.011	0.015	± 0.006
Measurements: 4 Weight: 50 mg								
Coal	78.87	± 0.05	4.723	± 0.008	2.148	± 0.014	0.533	± 0.005
Measurements: 4 Weight: 100 mg								
Oil	86.3	± 0.30	13.4	± 0.03	0.054	± 0.008	0.13	± 0.018
Measurements: 4 Weight: 40 mg								
Tobacco	41.37	± 0.02	5.442	± 0.003	2.888	± 0.022	0.339	± 0.024
Measurements: 4 Weight: 100 mg								
Fertilizer	0.23	± 0.003	-	-	12.4	± 0.06	8.87	± 0.05
Measurements: 5 Weight: 50 mg								
Flue ash	1.36	± 0.04	0.258	± 0.006	0.108	± 0.005	-	-
Measurements: 5 Weight: 150 mg								
Fish meal	42.48	± 0.09	-	-	11.41	± 0.04	-	-
Measurements: 4 Weight: 200 mg								
Starch	39.78	± 0.03	-	-	0.058	± 0.010	-	-
Measurements: 5 Weight: 150 mg								
Wheat	-	-	-	-	1.908	± 0.009	-	-
Measurements: 5 Weight: 150 mg								

* Element concentration in [%], Standard deviation in [%]

The most flexible CHNS analyzer

Today's best ensures we are ready for the future

Elementar's elemental analyzers have a very long lifetime. Instrument requirements typically change over time as the laboratory's external requirements change. Due to intelligent modular design and a wide variety of options, the vario MACRO cube is ready for your needs today, as well as those of the future.

The vario MACRO cube is the most flexible instrument available for the macro elemental analysis of CHNS (optionally O and Cl).

The applications cover all organic and the majority of inorganic samples of solid or liquid form. The instrument's particular strength lies in its flexibility. Sample weights in the milligram range or in the macro range can be analyzed in the same instrument run. No other analyzer can match the vario MACRO cube with respect to detection limit, dynamic concentration range and the ability to handle the most difficult types of samples.

An example for this versatility is the ability to analyze both organic samples up to a weight of 150 mg in the CHNS mode, as well as 1 gram of soil samples.

This is possible due to the high temperature digestion at a continuous high furnace temperature of up to 1200 °C.

Competitive analyzers have difficulty achieving complete combustion of samples which generate very large amounts of combustion gas. The vario MACRO cube uses oxygen "jet-injection" through a ceramic lance to completely combust this and other types of difficult samples.

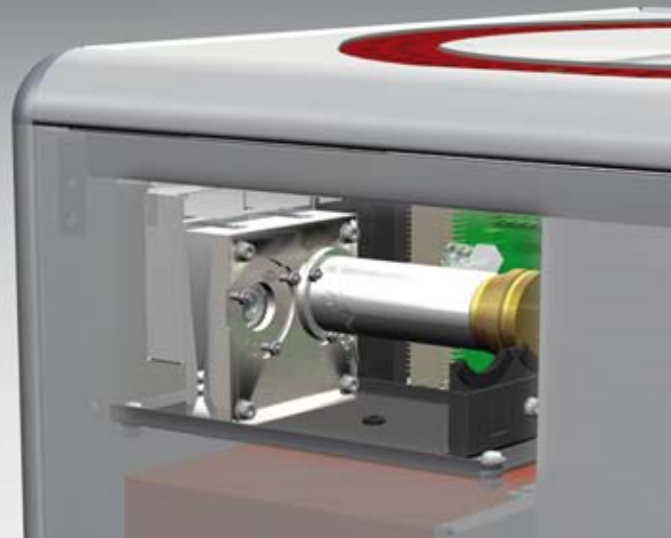
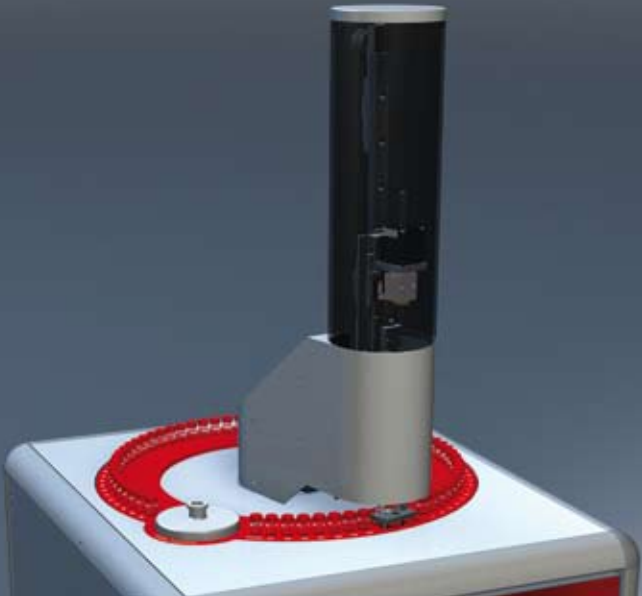
Element concentrations of well below 50 ppm to 100% are detectable with the standard detector (TCD).

For even lower detection limits, special detectors can be employed. As one example an IR photometer allows the detection of sulfur down to 10 ppm, e.g. in soil. The accuracy and precision of this detector relies on the vario MACRO cube's high dynamic range electronic amplification of the detector signal as well as extremely stable gas flow via the electronic mass flow controller.

Thus, the entire range of applications - organic, pharmaceutical, petrochemical, industrial, fossil fuels, environmental and bio materials - can be readily analyzed by the vario MACRO cube.

The vario MACRO cube is part of a family of Elementar macro scale instruments. Note that one member of this family, the vario MAX, is designed for difficult to handle inhomogeneous samples, and/or for very high sample weights.

Chlorine measurements:	Conostan standard (1%)	Chlorine:	1.007	± 0.01 %
	Measurements:	6		
	Weight:	0.2 mg		
Coal	Coal	Chlorine:	0.0072	± 0.0004 %
	Measurements:	6		
	Weight:	25 mg		
Fuel surrogate	Fuel surrogate	Chlorine:	1.046	± 0.11 %
	Measurements:	6		
	Weight:	55 mg		
Oxygen measurements TCD:	Benzoic acid	Oxygen:	26.14	± 0.03 %
	Measurements:	6		
	Weight:	2 mg		
Oxygen measurements IR:	Oil	Oxygen:	0.396	± 0.006 %
	Measurements:	6		
	Weight:	7 mg		
Sulfur measurements IR:	Soil	Sulfur:	0.0097	± 0.0002 %
	Measurements:	5		
	Weight:	300 mg		



Adding value systematically

Versatility makes him a winner

In addition to the standard CHNS determination, easy add-on options provide the broadest application range for the elemental analysis:

vario MACRO CN Continuous Flow Hybrid Option

results in the lowest cost of analysis by greatly increasing the life of consumable reagents. This can be added as a kit, and allows the user to select only a portion of the combustion gases to go through the reduction tube and detector.

Upgrade kits for oxygen determination

using high temperature pyrolysis. Conversion to CO in the presence of carbon at high temperature. CO is measured with standard TCD, or with IR detection for lower detection limits.

Sulfur measurement with IR photometer

To achieve a sulfur detection limit of approx. 10 ppm. This can be used simultaneously with CHN determination by TCD.

vario Liquid Sampler - VLS

is an automatic sampler which allows the efficient measurement of syringe injectable liquid samples. The VLS can be swapped out for the solid sampler in just a few minutes.

Accessory for chlorine analysis

with absolutely new sensor detection of HCl in the combustion gas over a large concentration range (patent applied for).

Accessories for special applications

The measurement of total organic carbon (TOC) is possible with the TOC option. Inorganic carbon (TIC) in solids can be directly measured by means of the soliTIC attachment.

Software for quality assurance

Options are available for the safety of electronic data (21 CFR Part 11), analytical quality assurance (AQS) and instrument validation (IQ, OQ).

Specifications vario MACRO cube

Analysis method:	High temperature combustion or pyrolysis of the sample and conversion of the elements into gaseous products. Separation of the analysis gases by purge & trap chromatography at up to 3 specific columns and detection at TCD (IR or chemosensor optional).
Operating modes:	CHNS, CHN, CNS, CN, N, S as standard with TCD, depending on mode S with IR detection optional, O with TCD or IR detection optional, Cl with chemosensor detection optional.
Digestion temperatures:	adjustable up to 1200°C (by combustion of the tin vessels a temperature of approx. 1800°C is temporarily reached).
in accordance with the safety standards:	CE-label, EN 61010-1, EMV low voltage directives 73/23/EEC
in accordance with:	AOAC 990.03, AOAC 968.06, AOAC 993.13, AOAC 992.15, AOAC 992.23, ASBC, AACC, (for fertilizer, meat, meat products, cereals, oil seed, flour, feed), DIN 10467 (milk and dairy products), DIN/ISO 13878 (soil), LUFA, MEBAK (breweries), DIN 51724-3 (testing solid fuels - determination of the sulfur content, ASTM D5373-93, (CHN in coal and coke), ASTM 5291-91 (CHN in oil products and lubricants), ISO 15178:2000(E) Soil quality - determination of total sulfur in dry combustion
Detection range*:	C: 0-150 mg (or 100%) O: 0-6 mg* N: 0-100 mg (or 100%) Cl: 0-4 mg H: 0-15 mg (or 100%) S: 0-18 mg (or 100%)
Detection limit*:	CN with TCD: < 50 ppm (for 300 mg soil sample) S with IR: < 10 ppm (for 300 mg soil sample)
Standard deviation*:	< 0.2% rel. (100 mg glutamic acid)

* depending on sample kind, analysis mode and options

Specifications vario MACRO cube

Calibration:	Multi point calibration, regression linear to the 4th order, stable over months.
Sample weight*:	up to 200 mg organic substance or up to 1.5 g soil sample.
Analysis time*:	self-optimizing depending on element content and sample weight e. g. N 4-5 min (150 mg wheat) CHN 7-8 min (100 mg flue ash) CHNS 10-12 min (40 mg sulfanilic acid))
Autosampler:	60 positions in a magazine as standard reloadable any time during operation 80 or 120 positions for smaller sample sizes optional manual or automatic injection of liquid or gaseous samples optional
Gases:	He: 99.995% purity 7 l/analysis O ₂ : 99.995% purity 0.05 l/analysis Ar: alternative carrier gas
Instrument control:	Operation and control via PC under Windows®; All instrument functions are digitally controllable, the comprehensive operation software includes e.g. automatic leak test, extensive error diagnosis, monitoring of the maintenance cycles, sleep-/wake up function, statistical evaluation and almost unlimited memory capacity for analysis data incl. graphics. Integration in data networks like LIMS and the possibility of remote control and diagnosis via the internet. In full compliance with 21 CFR Part 11 (option).
Electrical connections:	100/110/200/230 V, 50/60 Hz, 1,8 kW
Dimensions:	48 x 55 x 55 cm (W x D x H)
Weight:	approx. 65 kg

* depending on sample kind, analysis mode and options

vario MACRO cube is the most flexible instrument for the macro elemental analysis of C, H, N, S and O and Cl. Number, combination and occurrence of the analyzed elements as well as precision of their determination by using most modern technologies represent the most advanced state of instrumental analysis for application areas like:



Chemistry and Pharmaceuticals

Fine chemicals, pharmaceuticals, catalysts, polymers, oil products, etc.

Industrial quality control

Rubber, fertilizers, building materials, dyestuffs, cosmetics, glue, etc.



Agriculture and Environment

Plants, soil, food, compost, sewage sludge, waste, etc.



Fossil fuels and power generation

Coal, coke, petrochemical products, residual waste



Special applications

Chlorine determination, oxygen determination, filter samples