

S H C
O N



vario EL *III*

The ultimate standard in CHNOS analysis



elementar
Analysensysteme GmbH

German Technology
for quality and environment control



Bound by tradition

Technology from Heraeus

The past...

For more than 100 years the history of using instruments for elemental analysis has been connected with the house of Heraeus in Hanau, Germany. Starting from the first basic patents, more than 10 generations of instruments have been developed, each representing the highest technical standards of its own time. We continued this tradition by introducing the **vario EL**.

The instrument became the high end standard in elemental analysis in terms of accuracy and precision and versatility in hundreds of installations worldwide.

The steady development of the **vario EL** implies

- even higher dynamic concentration range
- capability for larger sample weights and volumes
- new Windows® software generation
- new inner and outer construction and design
- even lower cost per analysis

The outcome is the newest generation: **vario EL III**



...The fundamental of the future

The **vario EL III** is a universal CHNS-O elemental analyzer. Due to the unique design it can analyze a wide range of sample matrices, sizes and concentrations without compromising accuracy and precision.

Micro and macro samples, trace or higher level concentrations are analyzed by using just one basic unit. We are experienced specialists in optimizing complete high temperature combustion and **dynamic separation** of the resultant gases in CHNS-O analysis by the Dumas method.

for elemental analysis

The standard in variability

The elements CHNS and O can be analyzed individually or simultaneously over a wide range of sample matrices and concentrations. The **vario EL III** is ideally suited for research, quality control and quality assurance applications. The diverse demands of chemical, petrochemical, pharmaceutical, agricultural and environmental analysis are easily met with one basic unit.

The standard in a wide concentration range

The **vario EL III**'s unique **dynamic separation** technology detects elements from micrograms to absolute quantities, such as 30 mg carbon. The basic unit has an extremely large dynamic range when combined with the wide sample weight range.

The standard in analysis results

Programmable control of the direct oxygen **jet injection** during high temperature digestion combustion guarantees complete combustion. Exact reproducible control of gas flow and separation conditions as well as detection specific to the analysis maximizes precision and accuracy for the most difficult samples.

The standard in economy

The fully automatic, 79 place auto sampler saves valuable man hours through unattended, daily and overnight operation. Routine analysis is very economical due to the long service life of consumables and parts by avoiding expensive catalysts and special installation conditions.

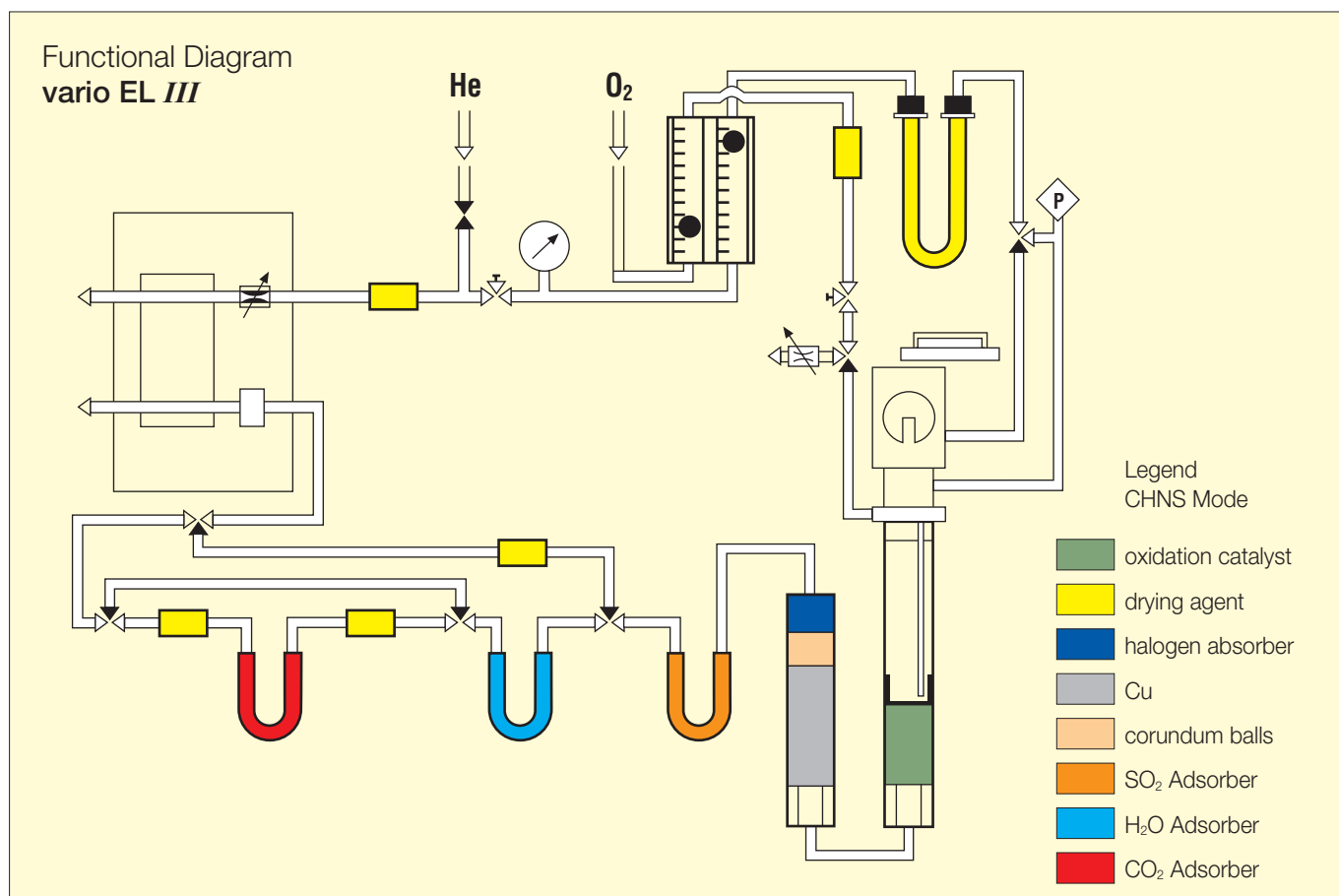
The standard in sample sizes

Both micro and macro analysis are combined in one unit. Optimizing analysis to both homogeneity and concentration is achieved through a broad sample weight range of 0.02 mg to 1 g (depending on the matrix). Even samples of low density and concentrations can be analyzed up to a volume of 1 cm³.

The standard in user-friendliness

The special Windows® software **WinVar** offers:

- automatic leak check
- automatic sleep and wake-up function
- maintenance control charts
- statistical reports
- LIMS transfer capability
- and much more



Principle of Analysis

The basic principle of quantitative CHNS-O analysis is high temperature combustion of organic and many inorganic solid or liquid samples. The gaseous combustion products are purified, separated into their various components and analyzed with a suitable detector (TCD, IR et al).

1. Variable sample introduction

Samples are weighed into various sized tin vessels depending on the homogeneity and aggregation of the samples. Solid samples weighing from less than 1 mg up to 200 mg are packed into tin boats.

Thin beakers of tin are ideally suited for larger samples, such as 800 mg of soil. Liquids from 25 µl to 200 µl are sealed inside gas-tight tin capsules.

For larger samples, the 39 place carousel can replace the autosamplers standard 79 place carousel with no additional modification to the **vario EL III**.

2. Variable combustion

Samples are dropped into the combustion tube automatically, at user selected temperatures up to 1200°C. The use of tin vessels further elevates the sample's combustion temperature up to 1800°C. Complete combustion of all sample types is ensured with our special oxygen **jet injection**.

A unique program for each sample matrix combined with efficient post combustion ensure complete combustion without special or expensive catalysts. The oxygen content of the sample is determined by converting O to CO at 1150°C on a carbon black contact.

vario EL *III*

3. Variable separation

The helium carrier gas transfers the gaseous combustion products into the copper tube. The nitrogen oxides are reduced to nitrogen and the gaseous mixture enters the **dynamic separation** system. The nitrogen travels directly to the TC detector while the CO₂, H₂O and SO₂ are retarded in specific adsorption traps. When the TCD's signal for nitrogen returns to baseline, the adsorption traps are thermally desorbed and the corresponding gases detected sequentially. Overlapping of separated gases is prevented by waiting for the TCD to return to baseline before desorbing the next trap. This approach ensures the largest dynamic range in the shortest analysis time possible. Variations in concentration ranges and measuring modes – CHNS, CNS, CHN, etc. – are possible by simply changing adsorption traps.

4. Variable detection

The thermoconductivity detector (TCD) is universally used for CHNS and O analysis. For special applications the following detectors may be substituted or added: infrared (IR), ultraviolet (UV), isotope mass spectrometer (IRMS), quadrupole mass spectrometer (QMS), chemiluminescence (CLD) and UV-flourescence (UVFI).

5. Variable evaluation

The detector signals are integrated by using the calibration curves stored in the PC. The concentrations of the various elements are calculated, displayed and stored in memory. A comprehensive printout of all data and measuring protocol is available for documentation. Interfaces for the automatic transfer of weighing data or LIMS coupling are standard with the **vario EL *III***.

6. Variable versions

Based on the proven concept of the basic unit, different versions are available for special applications:

- **vario EL Liquid Injection** for CHNOS analysis of oil products
- **vario TRACE S** for sulfur analysis down to < 1 ppm
- **vario TRACE N** for low level N analysis*
- **vario EL IRMS** for isotope ratio mass spectrometry

* also TRACE S/N available

Chemistry and Pharmacy, e.g.

- Fine chemicals
- Medicine
- Fertilizers
- Organo metallic compounds
- Catalysts

Synthetic materials, e.g.

- Polymers
- Plastics

Materials, e.g.

- Synthetic rubber
- Leather goods
- Building and insulating materials

Coal, oils and derivatives, e.g.

- All types of coal, from anthracite to lignite
- Substances of difficult combustibility such as graphite and coke
- Crude oil, gasoline, heating fuel oil
- Petroleum derivatives

Geological substances, e.g.

- Sediments from seas and rivers
- soil samples
- Rocks and minerals

Agricultural products, e.g.

- Plants and leaves
- Wood
- Food products
- Dairy products, e.g. milk

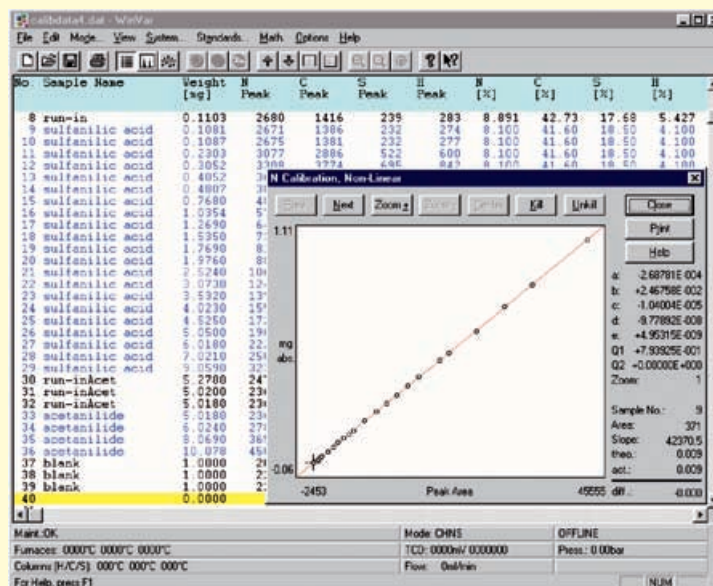
Environmental samples, e.g.

- sludges
- compost
- solid and liquid waste

Analytical performance

uncomprimising

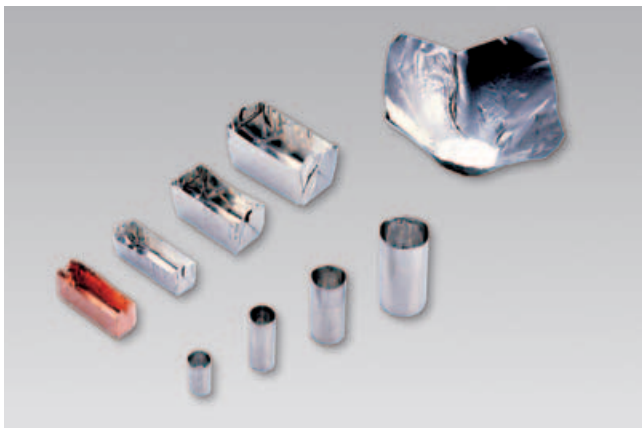
Sample	Measuring mode	Weight [mg]	Element content [%]							
			C		H		N		S	
Sulfanilic acid	CHNS	5	41.62 ± 0.09	4.13 ± 0.03	8.11 ± 0.07	18.47 ± 0.15				
Sulfanilic acid	CHNS	0.5	41.68 ± 0.19	4.21 ± 0.30	8.10 ± 0.15	18.56 ± 0.34				
Paper pulp	CHNS	25	22.82 ± 0.04	3.33 ± 0.04	0.35 ± 0.02	0.14 ± 0.03				
Coal I	CHNS	100	31.07 ± 0.04	2.60 ± 0.001	0.71 ± 0.014	1.25 ± 0.01				
Oil I	CHNS	10	84.82 ± 0.03	14.22 ± 0.07	0.123 ± 0.006	0.13 ± 0.01				
Acetanilide	CHN	5	71.15 ± 0.049	6.68 ± 0.0261	10.30 ± 0.007					
Coal II	CHN	35	70.29 ± 0.01	3.02 ± 0.01	1.05 ± 0.02					
Soil I	CNS	300	1.01 ± 0.01		0.104 ± 0.001	0.16 ± 0.01				
Flue dust	CNS	20	11.59 ± 0.07		0.27 ± 0.01	2.85 ± 0.03				
Spruce needles	CNS	21	50.58 ± 0.0252		1.87 ± 0.0153	0.17 ± 0.0021				
Soil II	CN	815	1.085 ± 0.003		0.030 ± 0.003					
Wool	CN	52	51.21 ± 0.013		0.044 ± 0.001					
Fertilizer	N	10			20.2 ± 0.02					
Feedstuff	N	50			1.804 ± 0.005					
Mineral oil II	TRACE N	40 µl			1.96 ± 0.026 mg/kg					
Mineral oil III	TRACE S	80 µl							0.15 ± 0.01 mg/kg	
Benzoic acid	O (IR)	5	26.08 ± 0.06	% O						
Coal	O (TCD)	10	4.03 ± 0.03	% O						



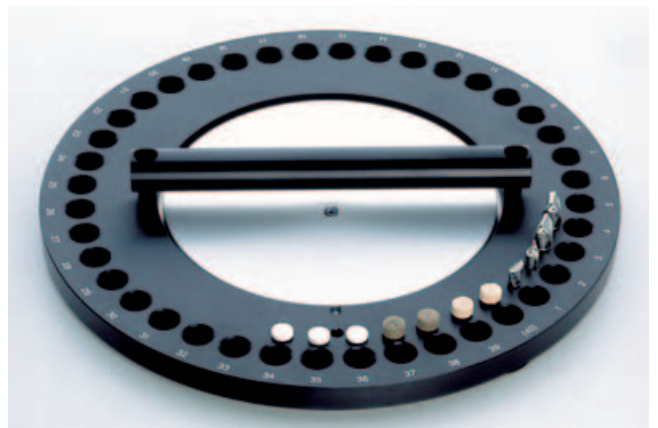
in all details

PC, balance and printer are part of the complete **vario EL III** analyzing system.

Solid samples are packed in tin boats or different sized metal-foil beakers.



Large sample volumes are no problem with the special 39 place carousel.



Different capsule presses are available to form and compress voluminous samples.



Special adsorption traps extend the dynamic range of the **vario EL III**.



Liquids are sealed in gastight tin capsules with the special capsule press.



The pull-out furnace reduces the times needed for replacing the crucible to a minimum.



Technical specifications

Operation modes:	CHNS, CHN, CNS, CN, N, S, O (with TCD), O (with IR as option)
Detection ranges*:	C: 0.004 - 30 mg abs. (or 100 %) H: 0.002 - 3 mg abs. (or 100 %) N: 0.001 - 10 mg abs. (or 100 %) S: 0.005 - 6 mg abs. (or 100 %) O: 0.005 - 2 mg abs. (or 100%)
Standard deviation:	≤ 0.1 % abs. (CHN simultaneous, 4-5 mg test substance)
Calibration:	matrix-free, multiple-point calibration, longterm stability
Sample weights:	0.02 mg up to approx. 1 g (depending on substance)
Sample feeding:	Standard carousel with 79 sample positions Carousel with 39 positions for sample volumes up to 1 cm ³ (optional)
Digestion temperatures:	950-1200 °C (1800 °C by combustion in tin boats)
Analysis time:	self-adjusting, depending on element content and weight e.g. CHN simultaneous: 6-12 min CHNS simultaneous: 10-14 min
Gas consumption per analysis:	with CHN simultaneous determination: 2 - 3 mlitres Helium 30 - 50 ml O ₂
Gas purity:	He: 99.995% purity O ₂ : 99.995% purity
Operation control and data processing	PC for operation/control under Windows®, interface units for coupling balance and PC already built in.
Data outlet:	V24 / RS 232 C as standard and analog outlets for control purposes
Power supply:	110/230 V, 50 / 60 Hz / 1.8 KW
Dimensions:	78 x 60 x 70 cm (length x width x height)
Weight:	approx. 120 kg

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* depending on type of sample, measuring mode and measuring parameter



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