

# vario MAX

Elementaranalysatoren



Maximale Leistung für

# N CN CNS CHN



elementar  
Analysensysteme GmbH

German Technology  
for quality and environment control



# simply convincing

## vario MAX

The analysis of real samples for carbon, nitrogen, sulfur or hydrogen content requires either laborious sample homogenization, or, the use of gram size sample aliquots. With the ever-increasing demands to analyze more samples with less personnel, the need to avoid time consuming sample pretreatment is becoming a requirement rather than a convenience.

However, large sample size is just a beginning. The successful macro elemental analyzer must be **simple**.

- simple in sample handling**
- simple in functional principle**
- simple in operation**
- simple in evaluation**
- simple in maintenance and troubleshooting**

This maxim stood at the beginning of the development of the new **vario MAX** analyzer line.

**But the simplest is often the most difficult to achieve.**

**100 years experience** in the development of elemental analyzers made it possible for **Elementar** as successor of **Heraeus** Analytical Systems and pioneer of the organic micro and macro analyzers to achieve a significant step forward toward a completely new generation of macro analyzers for the element combinations **N/CN**, **CN/CNS** and **CHN**.

The main feature of the **vario MAX** instruments is the "crucible technique" (stainless steel or ceramic) for the automatic feeding and emptying of the instrument with samples up to approx. 5 g weight or 5 ml volume.

Without any special pretreatment **feed material, coal, beer, soil, food and other organic or inorganic samples in their original condition** can be analyzed fully automatically. Simply fill in e.g. 1g of sample in an open crucible and weigh it. Everything else will be done by **vario MAX**.



## simply fill in and measure



## vario MAX

### Method

The basis of organic elemental analysis is combustion of the sample at 900°C to 1150°C. Depending on the sample material, reusable cups made of either stainless steel or ceramic with a volume of 5 ml are used for the sample. Oxygen is introduced during combustion through a jet injection, directed just on top of the sample. The high velocity of the oxygen stream and its optimal position results in an excess of oxygen at the point of combustion, without the need to use large amounts of oxygen. The helium carrier gas transports the combustion gases through the reduction furnace where NO<sub>x</sub> is reduced to N<sub>2</sub> and excess oxygen is absorbed. As an alternative to the classic copper as a reducing agent, tungsten may be used for the N/CN and CHN version (patent applied for). Tungsten has 3 to 4 times greater absorption capacity compared to copper.

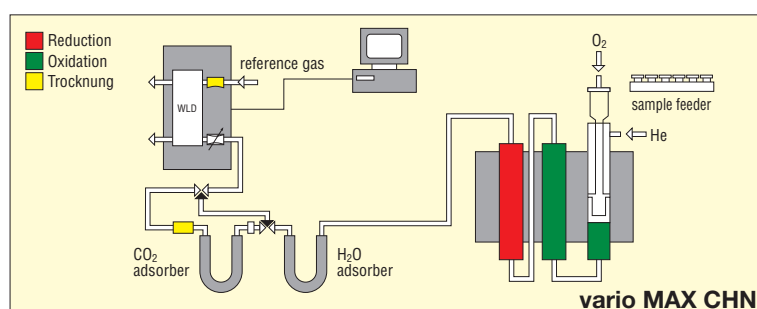
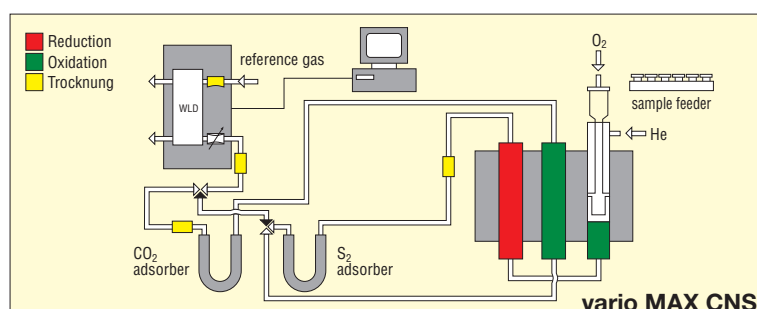
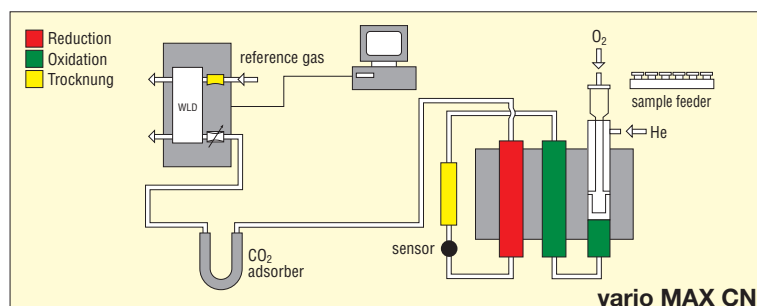
Nitrogen travels after further gas scrubbing with the carrier gas to the thermoconductivity detector (TCD) and is measured there quantitatively. Other gases to be analyzed like CO<sub>2</sub> for C, H<sub>2</sub>O for H and SO<sub>2</sub> for S will be adsorbed by means of specific traps in the corresponding versions and then sequentially released by thermal desorption and measured at the TCD. This is the same method of dynamic gas separation - proven over decades and further developed by Heraeus and Elementar - which is the prerequisite for a complete separation of components even with large variations in concentration as well as application for micro and macro analysis.

### The instrument family consists of the versions vario MAX N/CN, CHN and CNS.

The functional diagrams show the simple basic layout with a minimum of valves, sealings and movable mechanical parts.

A complete analysis of all combustion gases takes place. This ensures correct analytical results also for samples that slowly combust and results in longer maintenance-free periods. Interfering water or CO<sub>2</sub> will be primarily separated from the combustion gas without the use of chemical scrubbers.

This and a number of further measures serve for especially low analysis costs combined with simple operation and installation requirements. The modular construction allows the operation of **vario MAX CN** also in the fast N mode and the operation of **vario MAX CNS** also in CN mode.



# The performance package

## vario MAX



### Maximum sample weight range

Samples of a few milligram up to 5 g or 5 ml volume can be analyzed. This means suitability for heterogeneous natural products, substances with low concentrations but also pure chemicals.

### Maximum element selection

**vario MAX** is the only macro analyzer for the element combinations **N/CN**, **CN/CNS** and **CHN** with accuracy and precision of a research instrument and also suitable for robust routine analysis.

### Maximum concentration range

Due to "purge and trap" gas separation and wide range TCD detection element concentrations of 0.001 up to 100% relative or 0.02 to 400 mg (e.g. for C) absolute can be determined.

### For liquid and solid samples

Almost unlimited reuse of stainless steel crucibles for liquids. Water is removed by an efficient 3 stage process: forced air condenser, membrane drying followed by chemical drying. The high efficiency of the first two stages mean infrequent changing of chemical desiccant.

### Minimal installation requirements

70 x 60 cm table space (incl. 60 position sample feeder), power supply 230 V (or 110 V) 1.4 kW and 2 operating gases (O<sub>2</sub>, He) are sufficient. No exhaust, no cooling water, no extra power supply line, no compressed air.

### Analysis of all combustion gases

100% of analyte gases from the sample are analyzed. This ensures correct results even for slowly combustible

samples. This eliminates the need for troublesome and complex gas splitters.

### Long time operation with low maintenance

No frequent change or cleaning of filters, sealings or absorber chemicals. Daily factor and blank value are measured once a day and are stable for a very long time. Therefore, unattended overnight operation is routine.

### Low consumption cost

Sensor control reduces the O<sub>2</sub> consumption to approx. 0.4 - 0.8 l/analysis. CO<sub>2</sub> and most of the water are removed physically. This saves costs for absorbers and labor for the exchange. Robust steel combustion tubes and sample crucibles have a very long lifetime.

### Full automation

Feeding and emptying for 60 samples is done automatically. Operation and measuring value processing via PC under Windows®. Important parameters like analysis time and oxygen dosage are optimized automatically. Full integration into LIMS and networks, remote control and diagnosis via modem is also possible.

### Highest safety standard

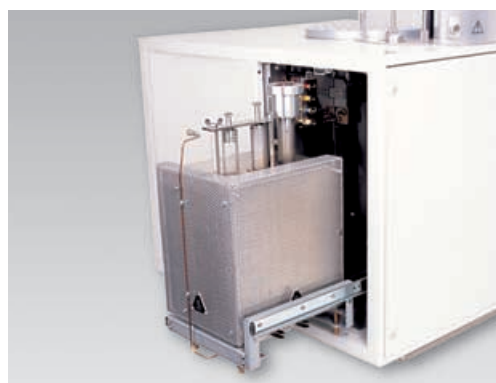
Our instruments are in accordance with all relevant safety standards like CE, DIN and EMC. Even the high temperature combustion furnace operates on low voltage and is not susceptible to damage even during abrupt power disruptions.

## vario MAX

60 sample crucibles can be put onto the carousel. A patented gripper arm takes care of the automatic transportation into the combustion tube and the subsequent removal. The advantage is the simple handling, very compact construction and loading during running operation. The crucible shape and feeding technique allow the analysis without any losses of large liquid amounts or light powder material.



For maintenance work such as tube exchange the furnace will just be pulled out of the instrument. This makes an easy access to all components possible and reduces the time of interruption for measurements to only a few minutes. Since all sidewalls can be easily removed, the complete instrument can be maintained without any problems.



Especially robust combustion tubes made of stainless steel and stainless steel crucibles will be employed for the measurement of N, CN and CHN which are also very suitable for liquid samples. CNS measurements at high temperatures require quartz tubes and ceramic crucibles.



Large volume adsorption and desorption tubes serve for the thermally controlled separation of the gas components such as CO<sub>2</sub>, SO<sub>2</sub> or H<sub>2</sub>O for separate detection at the wide range TCD. This allows the measurement over particularly large concentration ranges and for N/protein measurements, the physical removal of CO<sub>2</sub> from the gas stream.



# the variety of application

## vario MAX



**Food and feed material** with its variety of cereals and cereal products, corn starch, milk and dairy products, meat and sausages, mixed feed, baby food, processed food, beer, wort and brewing malt can be analyzed for their protein content with **vario MAX CN**.



**Soil and plant material** is mainly characterized by its nitrogen, carbon (organically bound and inorganically bound) and often sulfur content.

Due to the heterogeneous composition and/or low contents the direct analysis of large sample amounts with **vario MAX CN** or **vario MAX CNS** offers special advantages.



**Fossile fuels** like brown coal and hard coal, peat and heating oil as well as raw materials like wood and other bio materials can be characterized by the elemental composition of C and H. The combustion of solid waste gains more importance for power generation and waste disposal. **vario MAX CHN** is the suitable instrument.



**Environmental** samples vary greatly in type and composition. They range from rubble, contaminated soils, slags from garbage incineration, sewage sludge to liquid waste material. The representative sampling and quantity is decisive in the field of environmental analysis and **vario MAX** has significant advantages.

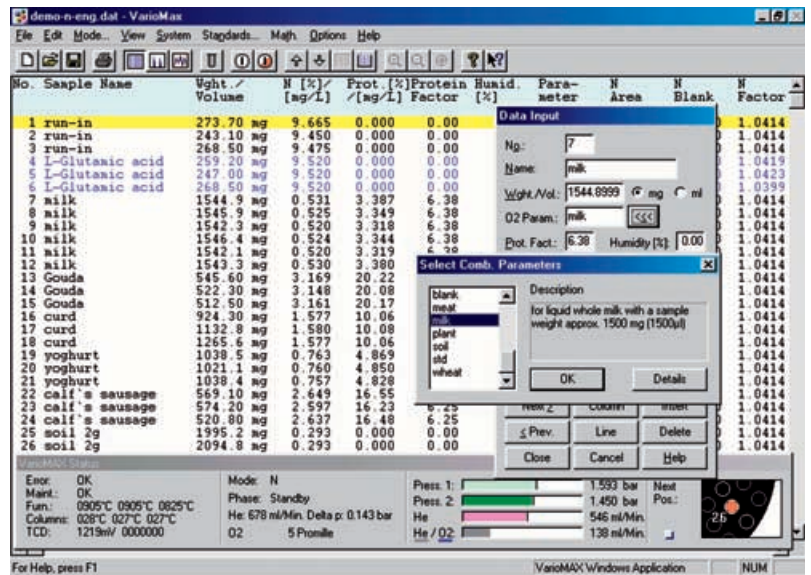


The pharmaceutical industry and biotechnology fields also have high requirements. Purity and quality control of substrates or final products as e.g. determination of low nitrogen contents in starch or lactose require high sample weights. Fermenter liquids and other suspensions can be measured advantageously by means of the steel crucible technique of **vario MAX CN**.

## vario MAX

The entire instrument control and measuring data processing is done via PC under Windows®. The measuring results and all relevant information appears in a clearly arranged measuring protocol. Editing via the enter window is simple. The selection of code words for the individual types of samples saves time consuming entering of the parameters. The instrument automatically sets the right parameters (e.g. sample type milk). The state of combustion temperatures, gas pressure and gas flow is being permanently updated and displayed.

For N/protein measurements of large organic samples the online sensor measurement and the display of the residual oxygen is particularly advantageous.

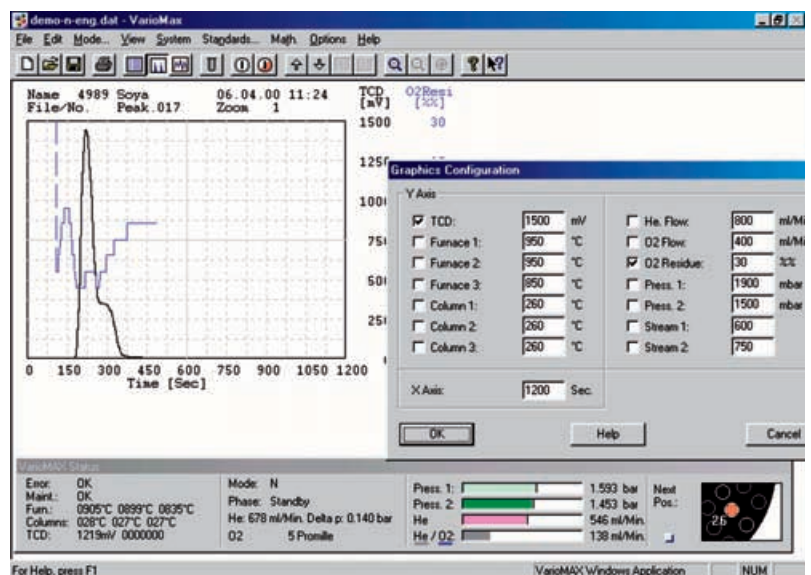


Five selected instrument parameters can be displayed graphically online in addition to the analysis signal.

The following software functions are available:

- automatic leak test
- error diagnosis
- maintenance cycles
- measuring results statistics and calibration
- automatic sleep/wake up control
- as well as the possibility of implementation into LIMS or other networks.

The PC under Windows® is part of the **vario MAX** system and was not added later on - which means the maximum benefit for the user.



# Specification

<b>method of analysis:</b>	combustion method at 850°-1150°C		
<b>according to:</b>	AOAC 990.03, AOAC 993.13, AOAC 968.06, AOAC 992.15, AOAC 992.23, ASBC, AACC (for fertilizer, meat, meat products, cereals, oil seeds, brewery cereals, flour, feed) DIN 10 467 milk and dairy products EN 61010, DIN/ISO 13878 (soil), LUFA, MEBAK (breweries) ASTM D5373-93 (C, H, N in coal and coke) ASTM D5291-91 (C, H, N in petroleum products and lubricants)		
<b>safety standards:</b>	CE label (EMC & low voltage directives) IEC 1010, DIN EN 50081-1/2, DIN EN 50082-1/2		
<b>sample weight:</b>	<b>CN</b> up to 1 g organic substance, approx. 1.5 g soil or max. 5 g or 5 ml liquid samples	<b>CNS</b> up to 300 mg organic substance, or approx. 1.5 g soil	<b>CHN</b> up to approx. 300 mg organic substance or approx. 1.5 g soil
<b>measuring ranges:</b>	<b>N:</b> 0.02 - 150 mg <b>C:</b> 0.02 - 400 mg <b>S:</b> - <b>H:</b> -	0.02 - 30 mg 0.02 - 200 mg 0.02 - 15 mg -	0.02 - 50 mg 0.02 - 200 mg - 0.02 - 15 mg
<b>analysis time:</b>	approx. 7-8 min in N mode for 350 mg test substance	approx. 10-11 min in CNS mode for 70 g test substance	approx. 15 min (depending on matrix)
<b>precision:</b>	≤ 0.5 % for test substances		
<b>calibration:</b>	matrix-free, approximation up to 4th order, stable for months		
<b>sample feeding:</b>	automatic sampler for 60 reusable ceramic or stainless steel crucibles with volume of 5 ml		
<b>power supply:</b>	230 V, 50/60 Hz, 1.4 kW (110 V on request)		
<b>Gas:</b>	He: 99.995 % O <sub>2</sub> : 99.995 %		
<b>dimensions:</b>	table top instrument with footprint 78 x 60 cm		

Issue: 02/2001, subject to alterations.



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