

# compEAct Elemental Analysis



## Technical Data

### compEAct

## General

The compEAct is a powerful elemental analyzer with a convincing overall concept and bench space-saving design. In combination with the suitable sampling system, it can be used for analysis of liquids, pressurized gases and under pressure liquefied gases (LPG). The system can be automated flexibly, depending on matrix type and throughput requirements. From semi-automatic analysis for just a few samples a week over small sample series up to the fully automated unattended use in 24/7-operation – everything is possible. The compEAct is available in 3 versions - for the determination of nitrogen, for the determination of sulfur and for the interference-free sulfur determination in fuel analysis. The system combines maximum reliability and robustness with an amazingly simple operation. It satisfies the requirements of relevant national and international standards, e.g. DIN, ISO, ASTM, IP and others.

## Feature

- Wide application field - TS or TN in liquids (with boiling point up to 400 °C and normal viscosity), gases and LPG samples
- **EAsy Fit** – smallest system footprint in elemental analysis thanks to compact design. Fully integrated data evaluation and control unit with robust touchscreen operation. Only one power socket required for a fully automated liquids analysis system!
- **EAsy Touch** – up-to-date operating concept with EEvolution software and highly responsive, low-reflection touch screen
- Remote access – integrated LAN simplifies remote access via external devices (smartphone, PC etc.), on-line service and support, data backup, import / export, network printing, LIMS integration and much more
- Easy to use – EEvolution software – intuitive user guidance, clearly structured menus, well-arranged display windows, quick access sidebar function for fast access to all menu items, memory function and much more
- Standard-compliant operation – Library with approved methods and ready-made calibration sequences, compliant with the relevant national and international standards and test regulations
- Plug-and-Start – easiest installation, short warming-up time, fast startup thanks to factory tuning, pre-calibration, and pre-installed EEvolution software
- **HiPerSens** detection – highest sensitivity for Nitrogen and Sulfur determination
- Outstanding wide operation range from lowest ppb up to wt-%, high linearity till upper end of operation range
- **MPO** technology – interference-free TS analysis, correct results when analyzing fuels with N-containing cetane improvers (also applicable for other comparable analytical tasks)
- Maximum efficiency by flexible automation of analysis process - optimized sampling systems for any throughput requirement and matrix type
- **EAsy Protect** – High operational safety, minimal maintenance, minimum down time thanks to hardware-integrated safety features

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- **Self Check System** (control of temperature, gas flow, pressure etc.) for trouble-free operation and maximum operating convenience, ensures low maintenance effort
- Automatic leak check for failure-free operation and minimized maintenance effort
- **High performance gas-box** - maximum flexibility in personal method development and adaptation, high operational reliability and trustable results
- Revolutionary **FAST** connection technique guarantees easiest, tool-free operation, free of gas leaks
- Robust, durable materials, a minimum of consumables, all easily accessible
- Predictive maintenance - automatic monitoring of maintenance intervals ensuring easy, fast and cost-effective maintenance

## Benefits for the User

- **Efficiency**  
High sample throughput, fast readiness for operation, short analysis times, wide concentration range, broad application spectrum, perfectly suited for unattended 24/7-operation, minimal maintenance, low downtime
- **Resource-saving** and cost-effective  
Stand-alone design, smallest footprint, > 50 % space saving compared to other compact analyzers, only one socket required, low power consumption, fully automatable analysis process, unattended operation – minimum need for user interventions, durable, robust materials, almost no consumables, standby and gas shut-off functions, minimal consumption of solvents and samples, minimum waste generation
- **Standard-compliant**  
Compliant operation according to relevant ASTM, ISO, UOP, IP standards, software-integrated method library and calibration sequences, reporting, automatic legal limit verify
- **Easy to use**  
Powerful, integrated control unit, highly reactive touchscreen with multi-touch control, integrated method library, prefabricated calibration sequences, intuitive, clearly structured EAvolution software, maintenance assistant, remote access for fast online support, automatic backups, smart access - access via external devices, LAN networking
- **Reliable and Robust**  
EAsy Protect: automatic control and adjustment of all process-relevant parameters, prevention of incomplete combustion and other dangerous situations (Self Check System, high performance gas-box, automatic leak check), use of robust long-living materials (FAST), effective protection mechanisms against particles and aerosols (Auto Protection), MPO technology for trouble-free fuel analysis, automatic system performance check (DF, AQA) etc.

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### Efficient Sample Digestion

#### High Temperature Combustion

High combustion temperatures of up to 1,100 °C guarantee complete oxidation of the sample and thus reliable analysis results. Thanks to the high combustion temperatures, no additional, expensive catalyst is required for the quantitative sample digestion.

Necessary gases: Argon 99.996% (minimum quality 4.6) and Oxygen 99.995% (minimum quality 4.5)\*.

\* in case of lower gas qualities a suitable gas purification unit can be used to enable operation

#### Combustion in Vertical Furnace

The special geometry of the combustion tube guarantees complete and trouble-free combustion of liquid, gaseous and LPG samples. Only one combustion tube is required for all sample matrices. The combustion process takes place in two phases. In the first phase the sample is dosed into an argon-purged evaporation zone. The light volatile sample components are evaporated, the heavier components are pyrolyzed completely afterwards. The gaseous compounds are transferred into the oxygen-rich combustion zone, where they are converted quantitatively. In the second process phase, the evaporation zone is purged with pure oxygen and all pyrolysis products are oxidized rapidly and completely. This effectively protects the analyzer against the formation of soot and other deposits, which can cause memory effects and thereby incorrect measurements. The maintenance effort is reduced significantly and the device provides stable, reliable results even for more demanding samples.

#### Powerful Sample Digestion

The highly efficient sample digestion is achieved by optimization of the hardware components, intelligent automatic adaptation of the combustion parameters and the utilization of state-of-the-art automation technology. The **HiPerSens** detection and the use of multi-range calibrations reduce the time needed for analysis significantly. Unnecessary repeat measurements, recalculations or a re-calibration of the analysis system become dispensable.

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### Sensitive Detection

#### TN and TS analyses

The TN resp. TS determination is carried out fully automatically using optical detection techniques. The determination of nitrogen resp. sulfur contents is realized by means of chemiluminescence resp. UV fluorescence detection. The average duration of an analysis (standard application range) is 3 to 5 minutes, depending on concentration, sample size and application.

- **HiPerSens** detection – unique sensitivity combined with an extremely wide linear operation range - no sample dilution, no multiple dosing or huge injection volumes, no time loss due to trap-and-release techniques
- **Auto-zero** - automatic zero adjustment before each measurement, elimination of disturbing environmental influences
- **Temperature-stabilized detectors** – high baseline stability
- **Maximum dryer capacity** for optimum analysis results even with long analysis sequences or in 24/7 shift operation thanks to auxiliary gas flushing and integrated vacuum pump
- **TN determination** – chemoluminescence detection with integrated pump for high-performance vacuum, unique LOD
- Innovative **two-stage ozone destruction** for maximum protection of operating personnel and analyzer
- **MPO** – innovative solution for the interference-free determination of sulfur in presence of increased TN contents - no sample pretreatment, no multiple dosing, no time loss due to trap-and-release techniques

## **EASy Protect – Safety and Protection Systems**

### **Self Check System (SCS)**

The integrated Self Check System prevents erroneous measurements and contamination of the analysis system while saving sample material and precious working time.

Several times per second all parameters, which are relevant for the device safety and analysis quality, are checked automatically. In case of deviations from the set nominal values, the EAVolution software takes the necessary measures. In dangerous situations, all active system functions are automatically deactivated and a warning message is displayed for the operator. This allows trouble-free operation, maximum operating comfort and operational safety.

The SCS consists of the following features:

- **Electronic Flow Control:** The high performance gas-box ensures accurate and stable gas flows. Manual adjustment is not necessary. The gas flows are monitored and displayed. If a flow rate is too high or too low for a safe combustion (gas leak), the operation is automatically interrupted to protect the compEAct against formation of soot. Stable gas flows are a prerequisite for the quantitative combustion and reliable analysis results. Moreover, the maintenance effort is remarkably reduced.
- **Electronic Pressure Control:** The system pressure is controlled permanently and precisely. In the case of overpressure, the analysis process is automatically interrupted by the SCS in order to protect the operator and the device from damages.
- **Monitoring of the Detection Systems:** The detector signal, status displays, baseline stability etc. are monitored and displayed permanently in real time.
- **Monitoring of the Detector Components:** converter temperature, pump vacuum, ozone generator, ozone destroyer, MPO, radiation sources etc. are monitored permanently. This increases both the precision and the reliability of the analysis system.
- **Electronic Temperature Monitoring:** All important temperatures are monitored and displayed. If a temperature is outside the permissible range, the SCS blocks all active functions, measurements cannot be started. This eliminates the risk of incomplete combustion and thereby caused system contamination.

### **Auto-Protection (AP)**

The Auto-Protection assembly is an integral part of any compEAct device. It effectively protects the system against damage from particles (ash, soot formation) and aerosols. Thanks to the integrated heating, it prevents premature condensation of the combustion water and, associated therewith, too low readings for the sulfur and nitrogen determination.

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## Sample Supply Systems

For the analysis of liquid samples the compEAct can be flexibly automated depending on sample volume and throughput requirements. From semi-automatic operation with autoinjector for occasional measurements over small series up to the high throughput solution with automatic sampler - everything is possible. For the dosing of gases and liquefied pressurized gases (LPG) application-optimized modules are available. They combine extraordinary operating comfort and ultra-modern technologies with maximum operational safety.

### Autoinjector – Automatic Injection as Precise as an Autosampler

The autoinjector is the smallest and lightest constant rate syringe drive on the market. Flexible filling volumes and dosing speeds allow an optimal adaptation to every sample type and concentration range. The sampling takes place manually by the operator, the injection is carried out automatically, controlled by the EEvolution software. The autoinjector can be installed in less than 1 min. A time-consuming adjustment is not necessary.

### LS 1 – comfortable automation for small sample series

The LS 1 sampler offers space of 18 liquid samples in glass vials. The sample is injected directly into the combustion tube.

### LS 2 – optimal solution for high throughput applications

The LS 2 sampler offers space of 120 liquid samples in glass vials. The sample is injected directly into the combustion tube.

### LS-T – optimal solution for the safe dosing of very light volatile liquids

The LS-T sampler offers space of 112 liquid samples in glass vials. The sample is injected directly into the combustion tube. The dosing syringe and the sample tray can be cooled to prevent effectively sample loss and a too early evaporation when analyzing very light volatile liquid samples.

The sample quantity and dosing speed are set by the operator. Additional automatic rinsing cycles with sample and/or solvent are possible at any time. This protects the system from contamination and increases the stability of the analysis results, ideal too for sample series with widely varying concentrations.

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#### LPG Module – Unique Precision Independent of the Sample Pressure

The LPG module is ideally suited for precise, automatic dosing of pressurized liquefied gases (LPG). A time-consuming sample pre-treatment by compression or the expansion in Tedlar™ bags is not necessary. The sample is taken directly from the liquid phase, this prevents changes of the sample or loss of sample components successfully. The high-performance Peltier cooling of the dosing valve avoids an uncontrolled, too early expansion of the sample matrix and thus a bubble formation. The dosing volumes are variable over a wide range, thus allows an optimal adaptation to the expected concentration range. A heated evaporation chamber ensures the complete transfer of all sample components (odorants, inhibitors, etc.) to the gaseous state. The Perma-Purge technology ensures the quantitative transfer of the sample into the combustion system. Adsorption losses or memory effects do not occur thanks to Sulfinert™ coated system components.

#### GSS/LPG combi module – Intelligent Combination for Gas Analysis

This space-saving combination of two matrix-optimized gas samplers is the perfect solution for flexible gas analysis. The GSS and LPG sample branches are separated from each other, which means that cross-contamination is impossible. The sample volumes for both sample types are freely selectable, this enables unique flexibility. In addition to the two classical methods of gas / LPG calibration, this also enables a cost-effective and simpler variant, calibration with only one standard sample, using different dosing volumes.

The GSS branch has been especially developed for the dosing of pressurized gases.

The LPG branch is optimized for precise, automatic dosing of pressurized liquefied gases. A laborious sample pre-treatment by compression or an expansion in Tedlar™ bags is not necessary. The sampling takes place directly from the liquid phase, so sample changes in composition or the loss of sample components is effectively avoided. The high-performance Peltier cooling of the dosing valve prevents an uncontrolled, too early evaporation of the sample matrix and thus a bubble formation. A heated evaporation chamber ensures the complete transfer of all sample components (odorants, inhibitors, etc.) into the gaseous state.

#### GSS module – Pressure-independent Flexibility in Gas Analysis

This gas sampler is the perfect solution for the direct analysis of pressurized and unpressurized gases. The GSS is suited for the safe introduction of gas samples under ambient pressure via gas bag or gas bladder. In combination with the optional GSS adapter box the direct introduction of pressurized gases is possible without a treatment step. The sample volume and the dosing speeds can flexibly be adapted to the specific needs of each sample matrix and concentration range. In addition to the two classical methods of gas calibration, this also enables a cost-effective and simpler variant, calibration with only one standard sample, using different dosing volumes.

The Perma-Purge technology ensures a complete transfer of the sample into the combustion system, which effectively prevents memory effects.



## System Control and Data Evaluation

### Intelligent Design – Efficient Operation in the Smallest of Spaces

The compact design combines low space requirement with a future-oriented operating concept. Thanks to its integrated, high-performance computer and a touch screen for control and data evaluation, it is the first stand-alone elemental analyzer in its class. The highly-responsive, contrast-optimized touch screen is almost angle-independent and easily operated with protective gloves. Alternatively, the compEAct can also be controlled via external keyboard, mouse and monitor and other external devices (PC, smartphone etc.). Nano-coating ensures a high resistance to chemicals and mechanical stress.

Interface problems or third-party software-related complications are ruled out by the integrated controller. A direct LAN connection makes the compEAct network-compatible and allows bidirectional communication with various external devices (e.g. tablet, smartphone, etc.). This means the compEAct can be operated from the control room, when on the move, or via remote access from home PC.

### Intuitive User Guidance via EEvolution Software

The analyzers of the compEAct series are controlled using the new EEvolution software. The user interface is optimized to the point: clear pictograms, straightforward menus, flat substructures, Quick Access sidebar for fast switching between menu items, memory function and much more. This allows even inexperienced users a simple and intuitive work without special training.

Designed like a simple smartphone app, EEvolution offers full access to all important functions of a device software, measurement process and analyses results are clearly displayed.

A library with ASTM, UOP, IP and ISO-compliant standard methods, calibration sequences and report defaults are integral parts of the software, this allows an immediate start without any time-consuming development and method optimization.

Essential features such as the messaging function, the maintenance assistant, the service module and the Self Check System reduce the need for operator intervention to an absolute minimum.

All device functions and important process parameters are monitored and displayed permanently.

The unique flexible, but easy-to-understand operating software enables analysis of samples and data evaluation at the same time.

Various system performance tests, the implemented legal limit check and the possibility to connect to a LIMS are indispensable for quality assurance.

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#### Software-Features at a Glance:

- Easy operation via integrated robust, highly responsive touch screen
- LAN connection for direct LIMS implementation
- Remote access – access and data evaluation via external devices (PC, smartphone etc.)
- Integrated web server for easy and fast on-line service support
- Optimized user interface, intuitive operation, multi-touch control, Quick Access sidebar and much more
- Data export, flexible data evaluation and processing, automatic backup
- Integrated library of proven and compliant methods
- Maintenance assistant, messaging function, service module and much more
- Implemented quality and legal limit checks
- Linear and quadratic calibration models, single and multi-range calibration, EasyCal, automatic and manual blank correction, statistical evaluation
- Automatic gas shut-off, standby and wake-up functions
- Full standard compliance (ASTM, DIN, ISO, IP etc.)

#### Maintenance and Care

Thanks to its compact design and the drastic reduction of consumables, maintenance and care of the compEAct is carried out more simply and quickly than with any other elemental analyzer. The few remaining components are easily accessible via the front door. The following features reduce the maintenance and care effort to a minimum:

- Utilization of chemically and thermally resistant, durable materials
- FAST connection technology for tool-free, fast, safe and leak-free connections
- Auto-Protection - heated, system-integrated particle filter to protect the entire analysis system
- High performance gas-box including automatic leak check function - for electronic monitoring and control of gas flows and pressures in real-time
- Self Check System for electronic control and adjustment of all important system parameters, automatic status displays and safety shutdown in case of dangers
- Prefabricated methods with optimal process parameters for liquids, gases and LPG samples
- 2-phase combustion process for the quantitative conversion of all organic sample components, prevention of soot and formation of deposits
- Stable low system blanks thanks to integrated self-cleaning function
- Software-integrated maintenance assistant for fully automatic monitoring of maintenance intervals for maximum service life of consumables enables a predictive maintenance

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### Operation Range \*\*

Total Sulfur (UVFD): 0 – 10,000 mg/L \*\*

Total Nitrogen (CLD): 0 – 10,000 mg/L \*\*

### Detection Limits \*\*/\*\*

Total Sulfur (UVFD): 5 µg/L \*\*/\*\*

Total Nitrogen (CLD): 15 µg/L \*\*/\*\*

\*\* depending on configuration, method parameters and sample quantity used

\*\* depending on the purity of reagents and gases, the cleanliness of device and tools used

### Standard Compliance

The devices of the compEAct series meet the requirements of the relevant standards for sulfur resp. nitrogen analysis

#### Determination of Total Nitrogen (TN) with compEAct N:

IP 379, ASTM D 4629 (CLD, traces, liquid petroleum hydrocarbons)

ASTM D 7184 (CLD, ultra-traces, aromatic hydrocarbons)

DIN 51444 (CLD, petroleum products)

UOP 936 (CLD, LPG)

UOP 981 (CLD, very light volatile liquid hydrocarbons)

#### Determination of Total Sulfur (TS) with compEAct S with and without MPO

ASTM D 5453 (UVFD, light volatile hydrocarbons, fuels)

ASTM D 6667 (UVFD, LPG, gaseous hydrocarbons)

ASTM D 7183 (UVFD, aromatic hydrocarbons)

ASTM D 7551 (UVFD, LPG, NG, gaseous hydrocarbons)

IP 490 (UVFD, petroleum products)

DIN EN 15486 (UVFD, ethanol)

DIN EN ISO 20846 (UVFD, petroleum products)

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DIN EN 17178 (UVFD, LPG)

UOP 987 method A (UVFD, very light volatile liquid hydrocarbons)

	compEAct N	compEAct S
Detection Principle	Chemiluminescence (CLD)	UV-fluorescence (UVFD)
Operation Range **	0 – 10,000 mg/L	0 – 10,000 mg/L
Detection Limit		
relative ***	15 µg/L N	5 µg/L S
absolute ***	0.6 ng N	0.2 ng S
Typical Sample Quantities****	5 - 100 µL (liquids) 2 - 100 mL (gases) 5 - 50 µL (LPG)	
Analysis Time **	3 – 5 min	
Furnace Temperature	max. 1,100 °C	
Gas Supply*	Argon 99.996 % (4.6), Oxygen 99.995 % (4.5) (free of halogen compounds and hydrocarbons)*	
Power Supply	100 – 240 VAC, 50/60 Hz, max. 16 A	
Power Consumption	max. 1100 VA, average 500 VA	
Space Requirement (H x B x T)	analyzer (without sampler): 540 mm x 510 mm x 530 mm  analyzer incl. autoinjector AI-SC: 820 mm x 510 mm x 530 mm  analyzer incl. auto sampler LS 1 resp. LS 2: 950 mm x 530 mm x 530 mm  gas sampler (without analyzer): 470 mm x 300 mm x 550 mm	

\* in case of a lower gas quality a suitable gas purification unit can be used to enable operation

\*\* depending on configuration, method parameters and sample quantity used and element content

\*\*\* depending on sample quantity, sample matrix, the purity of reagents and gases, the cleanliness of device and tools used

\*\*\*\* depending on element content and sample matrix analyzed

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