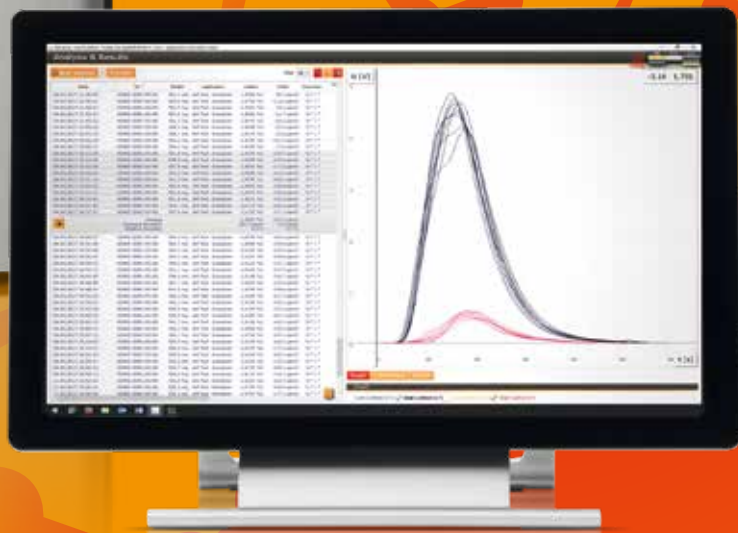# ELTRA®

## ELEMENTAL ANALYZERS

ELEMENTRAC® CS-*i*

# Carbon / Sulfur Analyzer

## ELEMENTRAC® CS-*i*

**NEW**

**ELTRA ELEMENTRAC CS-*i***

Precise Carbon / Sulfur Analysis by Inductive Combustion!

part of **VERDER** scientific

# ELTRA®

## ELEMENTAL ANALYZERS

**NEW** ELTRA® ELEMENTRAC® CS-*i*

The analyzers of ELTRA's new ELEMENTRAC series are a combination of high functionality, elegant design and innovative features. The user-friendly operation, robust construction and precision of the instruments are further indicators of the high product quality.

The new ELEMENTRAC CS-*i* is designed to reliably, accurately and safely analyze carbon and sulfur concentrations predominantly in inorganic sample materials by combustion in an inductive furnace.

- **Effective configuration with 2 or 4 infrared cells with selectable measuring range for carbon and sulfur analysis**
- **Novel vacuum system ensures higher measurement precision and stability**
- **Heated dust trap allows for improved sulfur detection**
- **Optimized catalyst permits more accurate carbon detection**
- **Control of induction power provides more precise analysis of samples with low melting point**
- **Intelligent lance management for loss-free combustion of dusty samples**
- **ELEMENTS software with comprehensive functionalities**

# Carbon / Sulfur Analysis

The determination of carbon and sulfur is required in a wide range of inorganic solid materials. Pure metals like copper, iron, titanium as well as metal alloys (steel, brass), glass, ceramics or slags are characterized by their carbon and sulfur content and display different properties depending on the C/S content. Iron, for example, gets more brittle and less elastic with increasing carbon content. Reliable and precise elemental analysis is also essential for the quality control of natural materials like ores, limestone, or soils.

The ELEMENTRAC CS-*i* analyzer is equipped with a powerful induction furnace with subsequent IR detection to allow quick, easy and reliable carbon and sulfur measurement in a concentration range from 1 ppm to 100 % in a variety of solid materials.

## Carbon / Sulfur Analyzer

**Carbon / Sulfur Analyzer ELEMENTRAC CS-*i***     **04**
The ELEMENTRAC CS-*i* is an inductive
combustion analyzer for reliable C/S determination
in mostly inorganic materials

**ELTRA also provides analyzers for:**

| ONH in inorganic samples | CHS in organic samples | Thermogravimetry |
|---|---|---|

The **ELEMENTRAC ONH-p** is ideally suited for the quick and accurate determination of oxygen, nitrogen and hydrogen in inorganic solids such as steel, copper, refractory metals and ceramic.

The **CHS-580** is used for the quick simultaneous determination of carbon, hydrogen and sulfur in sample materials such as coal, coke, ores, minerals, slag, and many more.

The **Thermostep** analyzer is used for the determination of different sample parameters such as moisture, volatiles, and ash in one single analysis cycle.

# Carbon / Sulfur Analyzer
## ELEMENTRAC® CS-*i*

Carbon  Sulfur  Induction Furnace  Resistance Furnace

# Precise and economic elemental analysis

## Benefits

- Rapid C/S analysis (40 seconds)
- Virtually no sample preparation
- Wide measuring range from 1 ppm to 100 % for C and S
- Analysis of pins, wires, powders, dust
- Easy operation
- Calibration independent of matrix

**The combustion analyzer ELEMENTRAC CS-*i* measures the carbon and sulfur concentration in predominantly inorganic samples through combustion in an induction furnace and the subsequent analysis of the gaseous combustion products $CO_2$ and $SO_2$.**

The high temperature of more than 2,000 °C ensures complete decomposition of the sample and thus relia-ble and accurate analysis over a wide concentration range.

The ELEMENTRAC CS-*i* meets and exceeds the requirements of all common standards for carbon and sulfur measurement, such as ASTM E1019, DIN EN ISO 15350.

## Typical sample materials

**Steel, iron, cast iron, copper, alloys, ceramics, carbides, soils etc.**

ELEMENTRAC CS-*i*

# ELEMENTRAC® CS-*i*: Reliable analysis results & easy operation

Operation of the ELEMENTRAC analyzer is pretty straightforward and only requires a few steps. The typical sample volume for carbon/sulfur analysis lies between approx. 50 and 1000 mg; concentrations from 1 ppm to 100 % can be reliably detected. Prior to combustion in the ELEMENTRAC CS-*i*, sample ex- traction from the initial body is required for which various methods can be applied. International stan- dards such as DIN EN ISO 14284 (sampling for steel and iron) give some orientation.
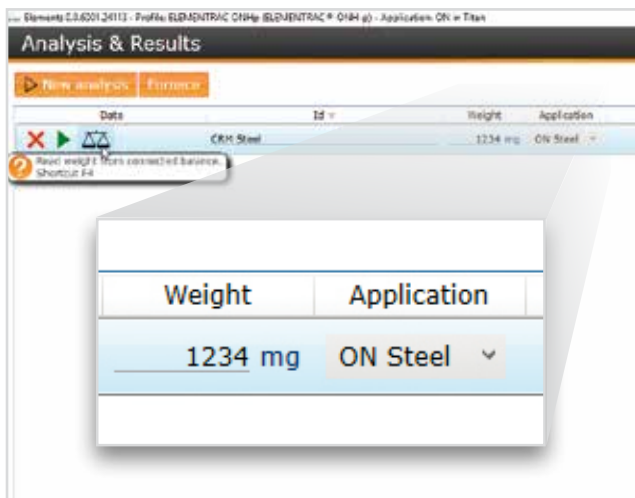


**Step 1: Logging the sample into the ELEMENTS software**
The sample is logged with an ID in the software and the sample weight (see step 2) is automatically transfered.



**Step 2: Weighing and adding of accelerators**
Sample volumes of 50 mg to 1000 mg are typical for C/S analysis. The sample is weighed in a ceramic crucible and accelerators like tungsten are added. The geometry of the sample (e. g. wire, powder, pin etc.) is not essential for a reliable analysis.



**Step 3: Analysis**
The ceramic crucible is then placed on the pedestal and the analy- sis is started via the ELEMENTS software. The software controls all subsequent steps like combustion and evaluation.
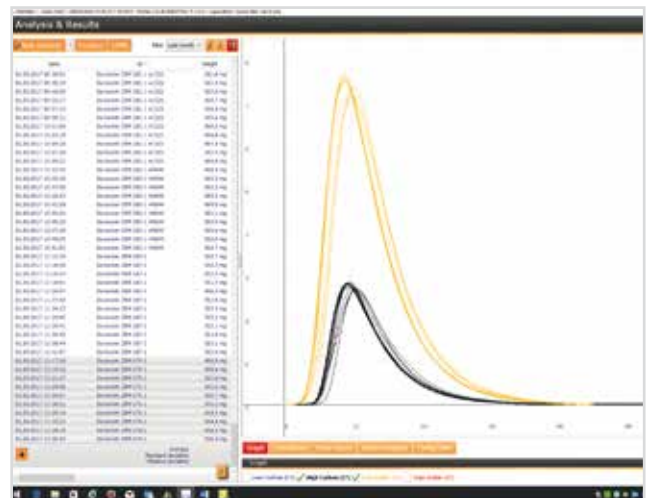


**Step 4: Data output and export**
45-60 seconds after the analysis has started, the measured carbon and sulfur concentrations are available for export as a report or via LIMS.

**ELEMENTRAC
CS-*i***

Reliable analysis
of C and S
in inorganic
materials

# ELEMENTRAC® CS-*i:*
# Integrated standard solutions

The chemicals and filters required for operation of the ELEMENTRAC CS-*i* are conveniently arranged on the front of the analyzer and may be concealed behind a removable door. This arrangement substantially reduces maintenance time and increases usability.

Innovative details of the ELEMENTRAC CS-*i* significantly improve the reproducibility of carbon and sulfur measurements.



removable door

heated catalyst
(hidden)

NEW

Dust trap

Cellulose filter

Carrier gas scrubber

Particle filter

Moisture filter

Crucible support
with ceramic crucible

ON-/OFF switch

Connection for vacuum
system on the back

## Catalyst

A heated catalyst is integrated in the CS-*i* analyzer to ensure accurate determination of carbon contents, particularly in carbides and cast iron. Its extended reaction path guarantees complete oxidation of incomplete combustion products (carbon monoxide) and thus optimum reproducibility even for very high carbon concentrations.

## Easily accessible heated dust trap

The dust generated by inductive combustion is collected in an external dust filter which is easily emptied. Efficient heating of the dust trap prevents condensation of water vapor which significantly improves the recovery rate and reproducibility of sulfur measurements.
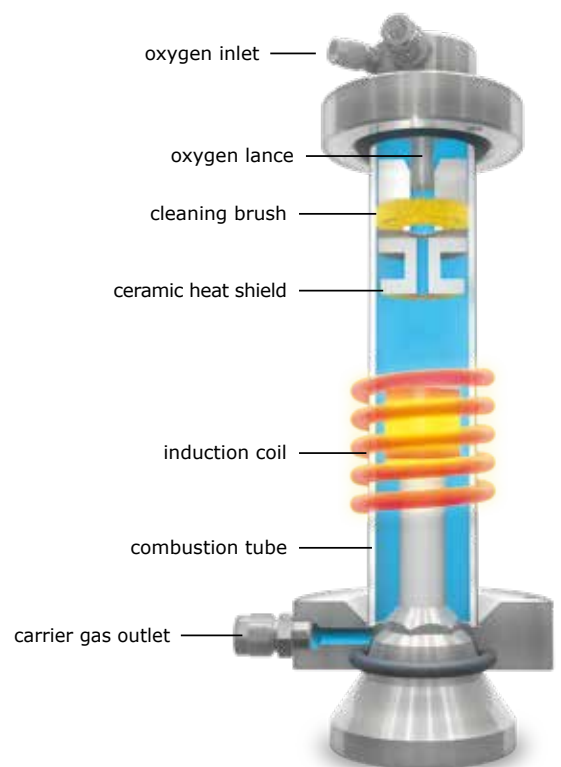
## Control of induction power

For optimized combustion of metals with a low melting point, such as copper, tin or magnesium, the ELEMENTS software provides an intuitive function to control the induction power. When the power in the induction furnace is reduced to e. g. 80 %, the sample will not splash during heating. This helps to avoid sample loss and guarantees accurate and reliable carbon and sulfur measurement.

## Intelligent lance management / oxygen supply

Depending on the sample material and properties, the ELEMEN-TRAC CS-*i* permits individual control of the oxygen supply during inductive combustion. When a solid iron sample is analyzed, a lance flushes the entire oxygen flow to the center of the crucible to ensure complete oxidation of the carbon and sulfur contained in the sample. For dusty samples, the oxygen flow is alternatively supplied through the combustion chamber to avoid swirling and loss of sample material. This procedure allows for accurate analysis of low density samples like SiC.

Graphic: Combustion module CS-*i*

oxygen inlet

oxygen lance

cleaning brush

ceramic heat shield

induction coil

combustion tube

carrier gas outlet

# ELEMENTRAC® CS-*i:*
# Configurations and options

**The ELEMENTRAC CS-*i* is available in various configurations and with a range of optional accessories. All CS-*i* standard configurations come with the lance management, catalyst and power control as described above.**
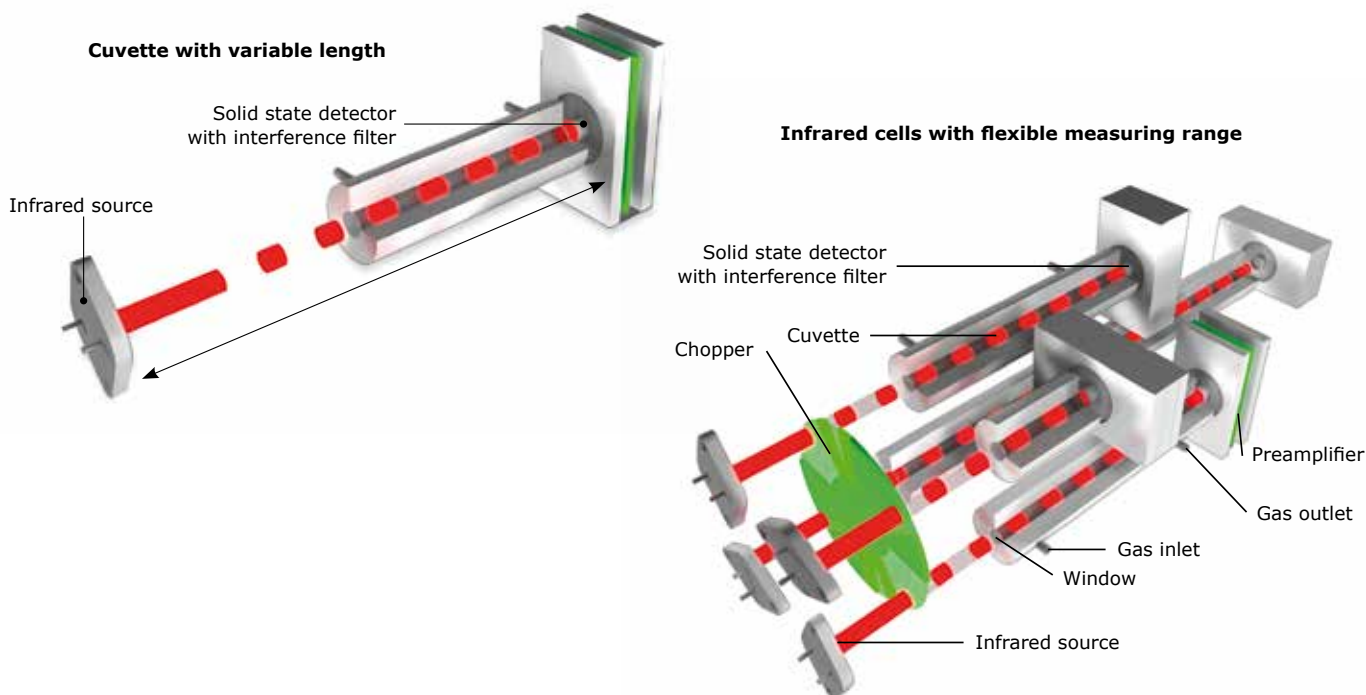
The variable measuring range of the ELEMENTRAC CS-*i* is defined by the configuration of the infrared cells but also by the sample quantity to be analyzed. Thanks to the complete decomposition of the sample, very high concentrations of carbon and sulfur (e.g. in silicon carbide, zinc sulfide) may be reliably detected by reducing the sample amount (e.g. 50 mg).

## Configuration CS-*i*

- Cuvette made of aluminum or gold
- Measurement of C, S or both
- 1 or 2 IR cells per element
- Standard or advanced configuration **(NEW)**

## Configuration of the measuring range (infrared cells)

The ELEMENTRAC CS-*i* can control up to 4 IR cells which differ in their cuvette lengths and the element to be determined. The longer the cuvette, the more sensitive it is for low concentrations, e.g. 10 ppm. Shorter cuvettes, like the 3 mm one in the 88200-1010 configuration, also allow measurement in the low ppm range, however with increasing standard deviation of the measured values. For optimum analysis of low and high concentrations, a configuration of two IR cells for one element should be selected. The use of latest detector technology permits an advanced configuration, e.g. 88200-1013, which reliably covers the measuring range from 0.6 ppm to more than 6 % for a sample weight of 1000 mg. Optional gold cuvettes provide higher reliability for the analysis of halogenated samples.



**Cuvette with variable length**

Solid state detector with interference filter

Infrared source

**Infrared cells with flexible measuring range**

Solid state detector with interference filter

Chopper

Cuvette

Preamplifier

Gas outlet

Gas inlet

Window

Infrared source

# Further options

## Dust extraction

The dust which is generated during combustion can be extracted with an optional vacuum system. This improves the reproducibility of carbon/sulfur measurements and reduces maintenance. The dust extraction can be equipped with either a regular folded filter or an efficient HEPA filter to safely handle class H dust.

## Gas purification furnace

ELTRA's gas purification furnace has a large capacity for cleaning the carrier gas oxygen to improve the precision of carbon measurements in the lower ppm range.

## Pre-heating furnace

Pre-heating of the ceramic crucibles may improve the measurement precision for carbon concentrations below 0.1 %. ELTRA offers a pre-heating furnace with ceramic tube with a maximum temperature of 1,000 °C which allows for removal of single crucibles.

## Automatic sample loading with „Autoloader"

An autoloader with 36 or 130 positions is available to increase speed and throughput. It is connected to the analyzer and comes with a closeable housing for sample handling without contamination even in dusty environments.

### Benefits

- High reliability
- Easy loading with crucibles
- Safe housing
- Retrofittable

# NEW: ELEMENTS Software

**The comprehensive Windows-based ELEMENTS software is an essential part of the ELEMENTRAC CS-*i*.**

A central window (analysis and results) is the starting point from which all functionalities required for the daily routine are easily accessible. From here it is possible to group and export measured samples, or register and measure new samples. The user may call up various subordinate functionalities like measurement settings, calibration, diagnosis, or status.

## ELEMENTS functionalities

- Comprehensive report functions
- LIMS
- Diagnosis and status window
- Filter for analysis results
- Different user levels
- Leakage test

and many more!

## Analysis & Results

- Display of graphs and results
- Result statistics
- Search function for previous measurements
- Commenting of results
- Indication also as $CO_2$; $SO_3$; $SO_4$



## Calibration /Regression

- Single point / Multi point calibration
- Weighting factor of standards
- Forced zero-crossing
- Display of regression coefficient



## Diagnosis

- Display of all relevant instrument settings
- Selectable time frame
- Export function
- Zoom function



## Leakage test

- Full leakage test
- Segmented leakage test
- Display of pressure stability
- Display of history



## Analyzer Status

- Synoptical status summary
- Definition of maintenance intervals
- Vacuum cleaner function
- Monitoring base line
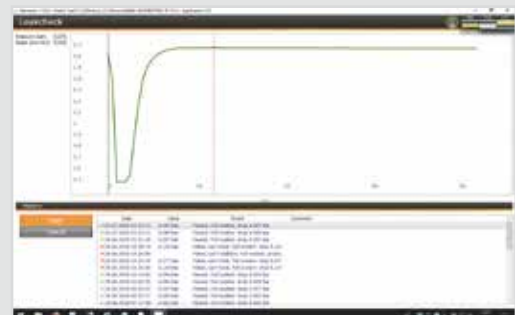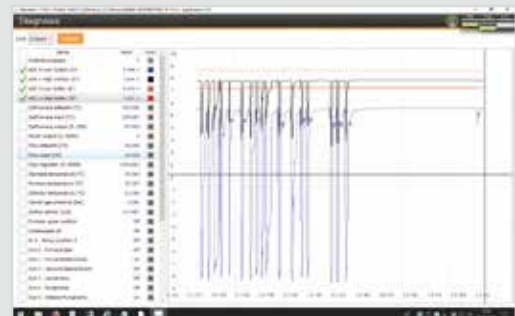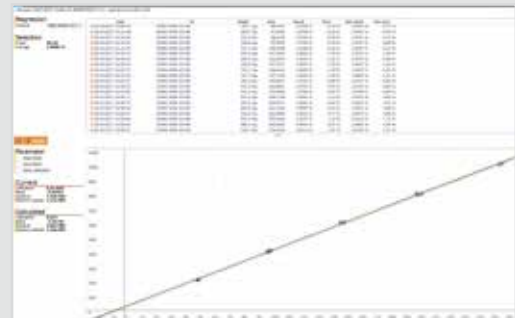
# ELEMENTRAC® CS-*i* applications: Metals

**The ELEMENTRAC CS-*i* series is suitable for measuring the carbon and sulfur content in virtually any type of metal.**

The typical sample amount ranges from approx. 500 mg for cast iron up to 1000 mg for steel and copper. Usually 1.5 to 2 g of tungsten, a mixture of tungsten and tin, or a combination of tungsten and pure iron are added as accelerator. Copper samples are analyzed with a weight of 2000 mg, or 1000 mg if the sample is mixed with 1000 mg copper accelerator.

Due to the one hundred percent combustion of the sample, the ELEMENTRAC CS-*i* can be calibrated with steel or primary substances like sodium carbonate. The net analysis time is usually about 40 to 60 seconds.

## Example: Steel



The following measurement results were obtained with the ELEMENTRAC CS-*i* (10 measurements per sample).
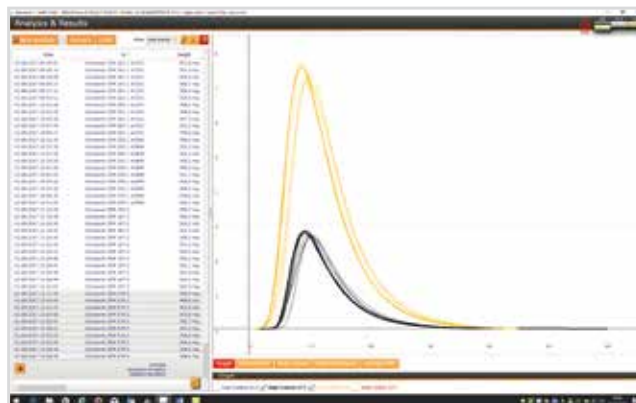


**Typical measurement results**

Sample volume: approx. 500 mg, accelerator: 1.5 g tungsten

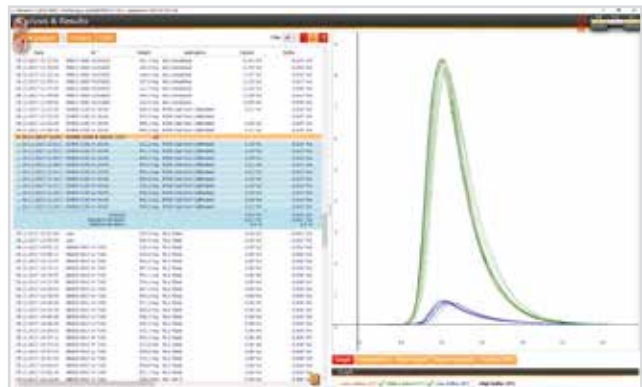| Sample | Sample type | % C | % S |
|---|---|---|---|
| ZRM 079-2 | Machine steel | 0.596 ± 0.0035 (0.6 %) | 0.192 ± 0.003 (1.6 %) |
| ZRM 187-2 | Case-hardened steel | 0.204 ± 0.001 (0.5 %) | 0.03 ± 0.0003 (0.9 %) |
| CRM 281-1 | High-alloy steel | 0.048 ± 0.0002 (0.4 %) | 0.016 ± 0.0002 (1.1 %) |
| CRM 292-1 | Nb-stabilized stainless steel | 0.036 ± 0.002 (0.5 %) | 0.005 ± 0.0001 (2.6 %) |

For amounts up to 1000 mg reliable results are achieved by adding 1.5 g tungsten accelerator:

| Sample | Sample type | % C | % S |
|---|---|---|---|
| AR 875 | Steel | 0.799 ± 0.002 (0.3 %) | 0.012 ± 0.0002 (1.2 %) |

# Example: Cast iron

The following measurement results were obtained with the ELEMENTRAC CS-*i* (10 measurements per sample).
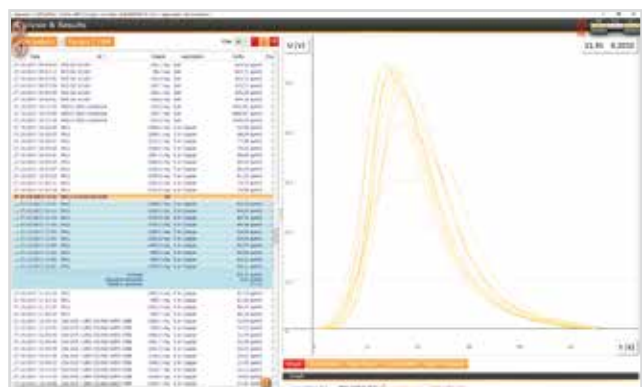




**Typical measurement results**

Sample volume: approx. 500 mg, accelerator: 1.5 g tungsten + 0.7 g pure iron; alter-natively: 2 g tungsten/zinc

| Sample | Sample type | % C | % S |
|---|---|---|---|
| 92400-3100 (LOT 1014C) | Cast iron | 4.20 ± 0.01 (0.2 %) | 0.023 ± 0.001 (3.54 %) |

# Example: Copper

Contrary to reference materials based on iron, copper materials often don't have certified carbon values. The ELEMENTRAC CS-*i* allows for reliable determination of carbon and sulfur concentrations in one single measurement:





**Typical measurement results**

Sample volume: approx. 1000 mg, accelerator: 1 g copper

| Sample | Samply type | ppm C | ppm S |
|---|---|---|---|
| CRM 90/1 | Copper | Not certified | 83.71 ± 0.91 (1.09 %) |
| IARM 158 B | Copper | 17.21 ± 2 (12 %) | 29.45 ± 0.94 (3.1 %) |

# ELEMENTRAC® CS-*i* applications: Nonmetals

**The ELEMENTRAC CS-*i* is also suitable to analyze the carbon and sulfur content in nonmetals.**

The maximum sample weight is approx. 250 mg. Contrary to iron-based materials, nonmetals usually require a combination of accelerators (e.g. pure iron and tungsten or pure iron and copper) to ensure complete release of $CO_2$ and $SO_2$ from the sample. Steel, primary substances and other suitable certified reference materials are used as calibration substances for the analysis of nonmetals. The net analysis time is about 45 to 60 seconds which is comparable to iron-based samples.

Samples with a very high sulfur content (e.g. ZnS) cannot be measured with the standard configuration of the ELEMENTRAC CS-*i*; a configuration with extended measuring range is required.

## Example: Tungsten carbide, silicon carbide

The following measurement results were obtained with the ELEMENTRAC CS-*i* (10 measurements per sample).



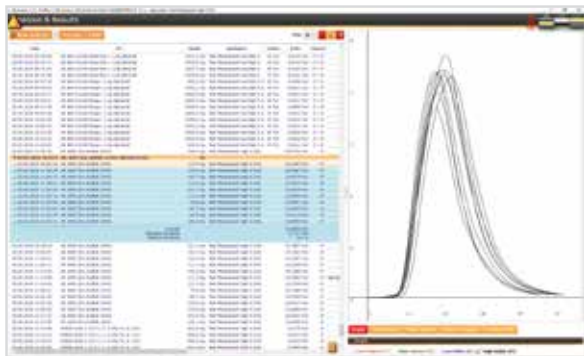| Typical measurement results | | |
|---|---|---|
| Sample volume: approx. 250 mg, accelerator: 1 g copper / 1 g pure iron | | |
| **Sample** | **Sample type** | **% C** |
| ELTRA 90816-3001 Lot: 914 C | Tungsten carbide | 6.13 ± 0.0051 (0.1 %) |
| ECRM 783-1 | Tungsten carbide | 6.18 ± 0.0053 (0.09 %) |
| BAM-S003 | Silicon carbide [*1] | 29.9 ± 0.03 (0.09 %) |

[*1] Sample weight approx. 80 mg

# Example: Sulfide, ore

The following measurement results were obtained with the ELEMENTRAC CS-*i* (10 measurements per sample).
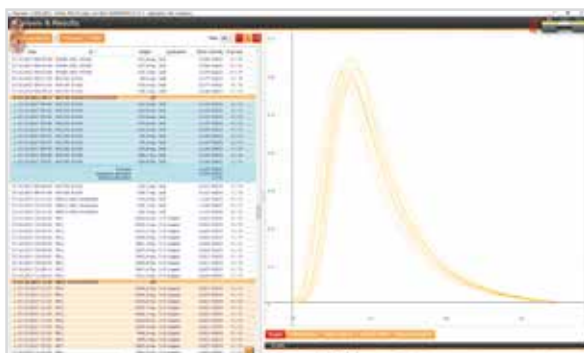




| Typical measurement results | | | |
|---|---|---|---|
| Sample volume: approx. 100 mg accelerator: 0.7 g pure iron / 1.5 g tungsten | | | |
| **Sample** | **Sample type** | **% C** | **% S** |
| AR 3085 (LOT W28D016) | Zinc sulfide [*1] | Not certified | 32.9 ± 0.16 (0.5%) |
| ELTRA 91900-1001 (LOT 514A) | Ore | 1.38 ± 0.019 (1.4%) | 1.44 ± 0.009 (0.7%) |

[*1] Extended measuring range for sulfur required

# Example: Glass

For glass it is common practice to indicate the measured sulfur concentration in $\%\ SO_3$. The ELEMENTRAC CS-*i* supports this indication.





| Typical measurement results | | |
|---|---|---|
| Sample volume: approx. 100 mg, accelerator: 0.7 g pure iron / 1.5 g tungsten | | |
| **Sample** | **Sample type** | **% SO3** |
| NCS DC 61103 | Soda-lime glass | 0.17 ± 0.004 (2.3%) |
| IARM 158 B | Copper | 17.21 ± 2 (12%) |

[*1] Extended measuring range for sulfur required

# Technical Data

| CS Analyzer | ELEMENTRAC® CS-*i* |
|---|---|



## Measurement ranges (1, 2), 2 IR Cell configuration

| 88200-1010 | C: 0.002 – 70 mg / | S: 0.002 – 4.2 mg | |
|---|---|---|---|
| | C: 2 ppm – 7 % / | S: 2 ppm – 0.42 % | for 1000 mg sample |
| | C: 4 ppm – 14 % / | S: 4 ppm – 0.84 % | for 500 mg sample |

## Measurement ranges (1, 2), 4 IR Cell configuration

| 88200-1008 (robust configuration) | C: 0.0006 – 35 mg / | S: 0.0006 – 23 mg | |
|---|---|---|---|
| | C: 0.6 ppm – 3.5 % / | S: 0.6 ppm – 2.3 % | for 1000 mg sample |
| | C: 1 ppm – 7 % / | S: 1 ppm – 4.6 % | for 500 mg sample |
| 88200-1013 (extended configuration) | C: 0,0006 – 70 mg / | S: 0,0006 – 64 mg | |
| | C: 0.6 ppm – 7 % / | S: 0.6 ppm – 6.4 % | for 1000 mg sample |
| | C: 1 ppm – 14 % / | S: 1 ppm – 12.8 % | for 500 mg sample |

## General data

| | |
|---|---|
| Analysis time | 40 seconds (nominal) |
| Cycle time | 80 seconds (nominal) |
| Sample throughput | 45 samples/h (nominal) |
| Typical volume | 50 – 1000 mg |
| Measuring technique | Combustion in an induction furnace followed by IR detection of carbon dioxide ( C ) and sulfur dioxide (S) |
| Chemical reagants | Magnesium perchlorate, sodium hydroxide, platinized silica, cellulose |
| Required gasses | Oxygen 99.5 % (2 – 4 bar) Compressed air (4 – 6 bar) |
| Gas consumption | Oxygen 180 L/h (during analysis) |
| Furnace | Induction 2.2 kVA (power adjustable from 0 – 100 %) |
| Ambient conditions | 15 – 35 °C; 20 – 80 % humidity (not condensating) |
| Power supply | 230 VAC ± 10 %; 50/60 Hz; 16 A |
| Weight | approx. 150 kg |
| Dimensions (W x H x D) | 520 x 840 x 750 mm |
| Required accessories | PC, monitor, balance |
| Options | Autoloader, gas purification furnace |
| Compliant with ASTM standards | E1587; E1915; E1941; E1019 |
| Compliant with DIN/EN/ISO standards | 1744; 24935; 7526; 9556; 15349-2; 15350 |
| Further compliance with | ISO: 4689-3; 7524; 13902 UOP 703-09 |

(1) Selected configurations: more on request
(2) Detection limit was calculated from 2 Sigma blank value variation.
   Detection limit may vary depending on sample and application.