



# G6 LEONARDO

● Inert Gas Fusion Analysis of Inorganics

# G6 LEONARDO – ECONOMIC Quality and Process Control with Inert Gas Fusion Analysis

## Ores, metals, alloys and ceramics shape our time.

For thousands of years, metals and alloys have played a prominent role in the evolutionary history of humanity and give names to entire epochs.

The three non-metals Oxygen (O), Nitrogen (N) and Hydrogen (H) determine the quality, service life and mechanical properties of all metallic materials. Unlike metallic alloy components, the amount of O, N and H sometimes changes considerably along the entire process chain, from the production of raw materials to the completion of the finished product.

## Light elements make heavy work.

Even when present in trace amounts, O, N and H have a very critical effect on the material properties. However, low concentrations are difficult to analyze with spectroscopic methods due to the atomic properties of O, N and H. So what can be done? Use the best method: Inert Gas Fusion Analysis (IGF). No other method provides better detection limits, reliability or stability.

## The Smart Molecule Sequence™ guarantees trustworthy results.

The G6 LEONARDO is available as single (O, N, or H) or dual element (ON or OH) analyzer. The analyzer comes with preconfigured methods for many standard applications like: ON or H in steel and titanium, O in copper, OH in magnetic materials and titanium alloy powders for additive manufacturing. As these powders have a high specific surface, the quality of the raw materials and the yield of the process are dominated by factors like powder aging due to moisture and oxygen exposition.

Each G6 LEONARDO configuration addresses industrial needs for economic analyzers with the choice of cost-effective argon carrier gas. Using Smart Molecule Sequence™, the G6 LEONARDO guarantees trustworthy results.





Oxygen



Nitrogen



Hydrogen

@ inorganics



### How does the G6 LEONARDO compare to other IGF analyzers?

- The G6 LEONARDO performs direct and unadulterated measurements of all gases emitted by the sample, in a 1:1 ratio – without chemical transformation, repetitive measurements, mathematical corrections or unpublished algorithms.
- The G6 LEONARDO can detect the exact temperature of the sample directly with FusionControl and thus ensures that only the measured gases (CO, N<sub>2</sub> and H<sub>2</sub>) are formed – no hydrocarbons.
- The G6 LEONARDO can measure even lowest hydrogen concentrations in the ng/g (ppb) range reliably, without compromises.
- The G6 LEONARDO does not require any further reagents for oxygen determination and uses cost effective argon carrier gas as standard.

### What are the advantages of Smart Molecule Sequence™?

- Each of the three elements O, N and H is analyzed 1:1, where the concentration of CO  $\triangleq$  O, N<sub>2</sub>  $\triangleq$  N and H<sub>2</sub>  $\triangleq$  H.
- Argon or nitrogen<sup>\*)</sup> can be used as standard carrier gas, instead of the often used, but expensive and rare carrier gas helium.
- Not only nitrogen, but hydrogen as well, is measured using a highly sensitive DualChannel Thermal Conductivity Detector (TCD) with a separate reference channel. Comparison of the measurement channel with the reference channel ensures scientifically proven analyses. The unique combination with a heat exchanger guarantees exactly the same temperature of reference and analysis gases.
- Smart analysis setup and exact temperature control result in less dust, offer system stability and higher uptime.
- Optimized gas flow in the ambient pressure system of the G6 LEONARDO eliminates the need for complex and error-prone flow compensation. In overpressure systems flow compensation is necessary, so that high oxygen concentrations do not lead to incorrect nitrogen results.

### G6 LEONARDO – Simplicity @ its best

<sup>\*)</sup> Nitrogen carrier gas only for H-mode

### Advanced electrode furnace with sample port

- Maintenance-free and reliable sample port without consumable parts.
- No jamming due to O-ring sealed slider.
- Different sample port inserts available for different sample types and crucibles.
- Upper and lower furnace electrodes can be replaced easily and separately.
- Ongoing, contact-free temperature measurement of the sample via FusionControl, Bruker only.

### Highest Reliability and Economics

The G6 LEONARDO introduces SampleCare™ into oxygen, nitrogen and hydrogen analysis to achieve the highest level of robustness and economics for industrial applications. SampleCare™ consists of:

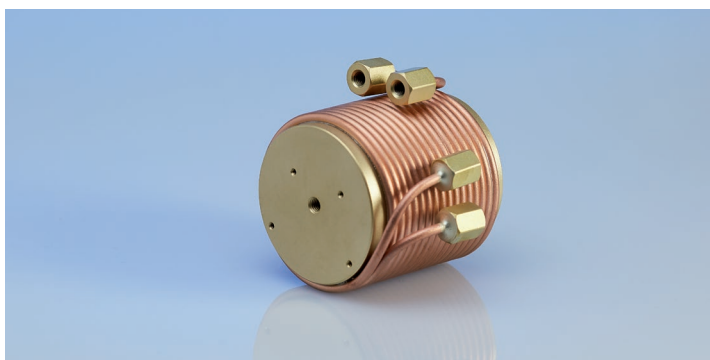
- EZDrive: The lower electrode movement is controlled by a direct-feedback electronic motion module that provides security and eliminates the need for working gases. Automatic and torque limited position readjustment ensures an ideal contact between crucible and electrodes to protect furnace, crucible and operator.
- The sample port integrated into the water-cooled furnace shields the sample from undesirable heating during crucible outgassing for better hydrogen results.
- The high-capacity dust trap is followed by an efficient in-line particle filter.

### Optimized with user-friendly features

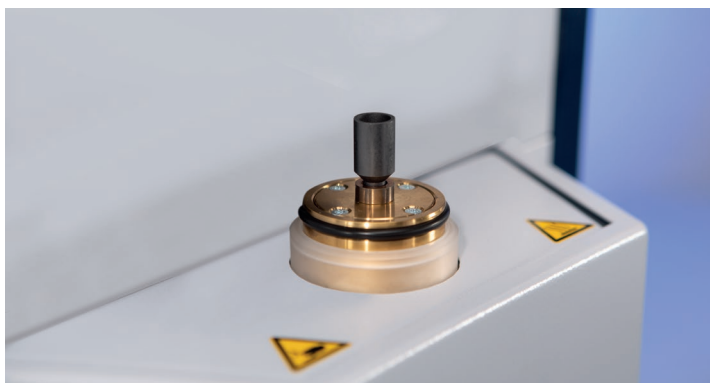
- Extra-long reagent tubes ensure efficient usage of reagents and flexibility for a mixed material packing (e.g. halide trap).
- Sintered metal filter inserts act as reagent stop, particle filter and laminar flow element for high fluidic precision and easy maintenance.
- Optimized oxidation furnace provides improved nitrogen analysis and safe and easy operation.



Electrode furnace with SampleCare™ and FusionControl for real-time sample temperature detection, Bruker only.



DualChannel TCD with integrated heat exchanger for identical temperature of reference and analysis gases



Improved electrode design for highest durability and illuminated work area for easy maintenance



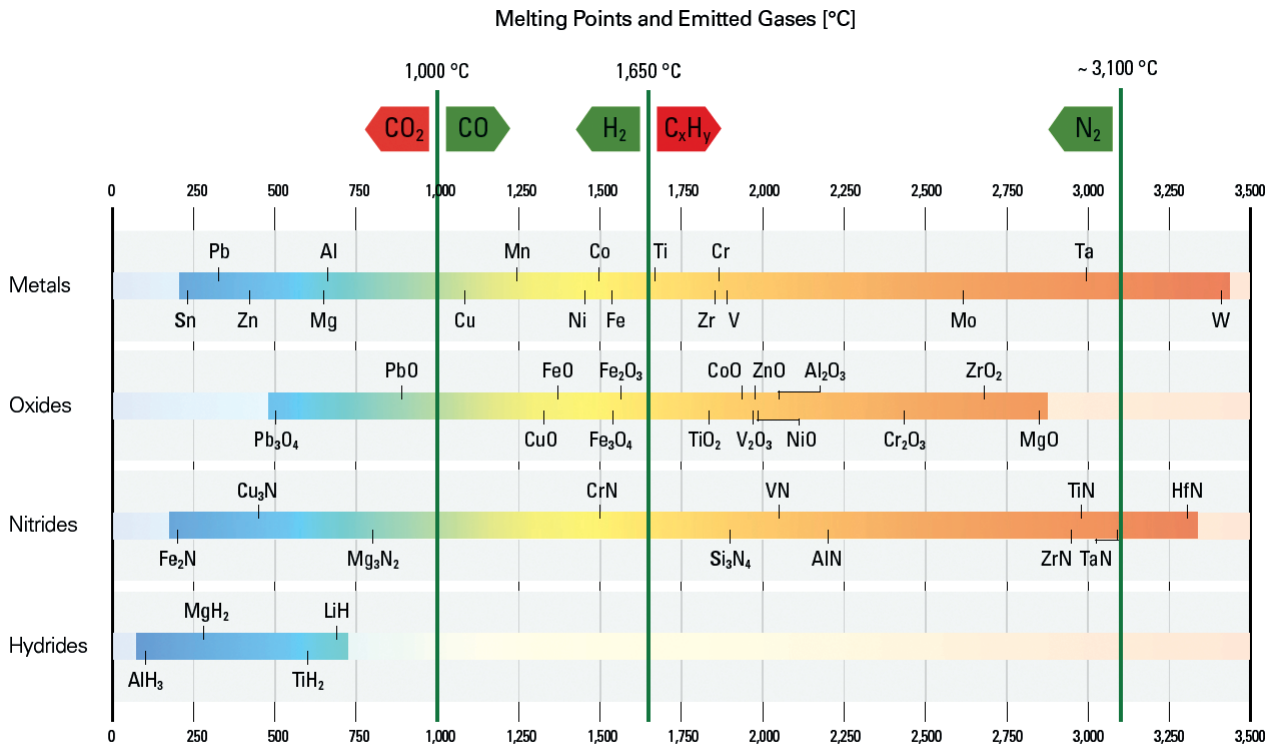
Extra-long, high efficiency reagent tubes for efficient usage of reagents. All reagents are located at the front behind a door for fast, convenient and safe operation

# FusionControl & SampleCare™ for Highest Accuracy and Reliability

## FusionControl – Temperature matters

The aim of an IGF analysis is to determine the sample content of the light elements O, N and H in the trace range with absolute accuracy. That is why our G6 LEONARDO applies the Smart Molecule Sequence™ and measures CO, N<sub>2</sub> and H<sub>2</sub> directly, absolutely unchanged, 1:1, and with ideal detection techniques. To us, IGF analysis must be simple or it's simply not accurate.

The temperature applied to the sample is the most important parameter for an accurate analysis. FusionControl in the G6 LEONARDO prevents the formation of hydrocarbons and other undesirable byproducts that result from excessively high sample temperatures. Thanks to FusionControl's exact sample temperature control, the traditional approach of heating up the sample as high as possible is no longer necessary.



There is no temperature equally suited for measuring O, N and H. As a matter of principle and also with respect to sample preparation, simultaneous systems cannot work optimally for each of the elements at the same time.

# Process Gases

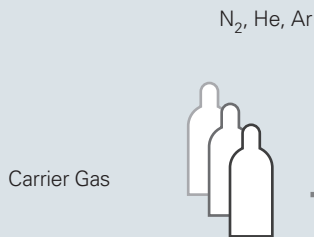
# Electrode Furnace

# SampleCare™

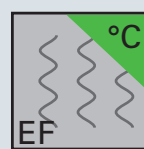
Carrier Gas:  
Argon, Helium: O, N  
Nitrogen: H

EZDrive

Dust and Particle Filters



Electrode Furnace



Sample



- Flexible choice of carrier gases with fast switch-over
- N<sub>2</sub> measurement with argon carrier gas: same analytical quality, without restriction, more affordable and greater supply reliability
- Automatic stand-by mode with lowest gas consumption
- Integrated carrier gas pre-cleaning

- Advanced water-cooled electrode furnace
- Precise temperature control of the sample with FusionControl<sup>\*)</sup> – exclusively from Bruker
- Easy accessible and innovative design for high reliability, maximum uptime and low service costs
- Work area convenient illuminated by LED element

<sup>\*)</sup> Option

- Additional reagent tube positions available for halogen trapping or further dust trap capacity

### SampleCare™

- High-capacity dust trap for long maintenance cycles
- High efficiency in-line particle filtering

Integrated in the Electrode Furnace:

- EZDrive operated lower electrode for enhanced safety and reliability
- Shielded rotating sample port

# Nondispersive Infrared Detectors (NDIR)



ng/g to %

# Smart Molecule Sequence™

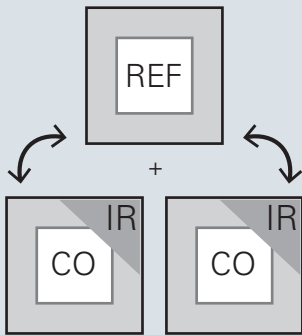
Emitted = Measured  
 1:1 Oxygen  
 1:1 Nitrogen  
 1:1 Hydrogen

# Thermal Conductivity Detector (TCD)



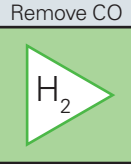
ng/g to %

NDIR Detectors  
 +  
 Reference Channel



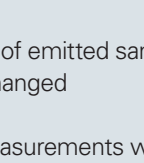
- Powerful NDIR detector choices with two measuring ranges as standard
- Ranges merged into one element channel for easy calibration and high linear dynamic range
- Drift free, due to reference channel
- Reliable, no moving parts, and mature detector technology

## H<sub>2</sub> Configuration



## N<sub>2</sub> Configuration

Remove CO and H<sub>2</sub>



- 1:1 analysis of emitted sample gases, unchanged
- Oxygen measurements without consumption of chemicals
- Measurement for each element with optimal temperature and optimized sample preparation
- No disruptive CO<sub>2</sub>, no unwanted hydrocarbons

TCD  
 +  
 Reference Channel



ng/g to %

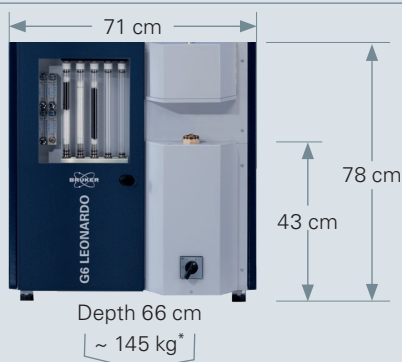
- Scientifically proven comparative measurement against reference channel
- Heat exchanger for exactly the same temperature of reference and analysis gas
- Software optimizable measuring range of the TCD

### Depending on Configuration:

- N<sub>2</sub> measurement with argon carrier gas without restrictions
- H<sub>2</sub> measurement with highly sensitive TCD

## Overview of Features and Benefits

	Specification	Benefit
<b>Samples</b>		
Sample Types	Inorganic, dry, any form or shape	Flexibility
Sample Dimensions	8 x 8 mm cross section (pieces, chips, pins, granules), different sample ports available for special applications	Wide variety of sample materials
<b>Detectors</b>		
Oxygen	Nondispersive IR absorption of CO, no moving parts, multiple range detectors with reference beam and on-board linearization	Reliable, maintenance-free performance without drift
Nitrogen and Hydrogen	Thermal conductivity detector with reference channel and adjustable gain amplifier	Reliable, adjustable ranges, drift free
<b>Furnace</b>	Water-cooled Electrode Furnace with FusionControl	Solid high temperature operation for refractories, precise temperature control
<b>SampleCare™</b>		
EZDrive	Lower electrode movement by reliable electronic motion module	Robust, cost-saving operation without working gas. Automatic, torque limited readjustment ensures ideal crucible:electrode contact and safety for crucible, furnace and operator.
Sample Port	Rotating sample port integrated into water cooled furnace block	Shields sensitive samples from heat input and hydrogen losses before analysis. Allows capsule-free measurement of grains without jamming.
Particle Filtering	High-capacity dust trap followed by in-line particle filtering	Stable analytical results with reduced maintenance and component protection
<b>Cooling Water</b>	4 l/min at 3 bar supply pressure	Fits on every usual tap water line, tap, water-saving design with solenoid valve, chiller also possible
<b>Carrier Gas</b>	Ar (O, N), He (O, N), N <sub>2</sub> (H) each 99.995 % purity (99.9990 % for trace analysis)	Flexible carrier gas choice without compromises
<b>Noise Emission</b>	< 55 dB(A) peak	Enjoy the silence
<b>Calibration</b>	Single and multipoint calibration, advanced weighting algorithm with error bars and range merging	Easy simultaneous calibration of all ranges with confidence
<b>Reagents</b>	<ul style="list-style-type: none"> <li>• Magnesium perchlorate</li> <li>• Sodium hydroxide on support</li> <li>• Copper oxide, rare earth base (N-model)</li> <li>• Schuetze reagent (H-model)</li> </ul>	
<b>Power Supply</b>	400 – 480 VAC (± 10 %), 50 – 60 Hz, 32 A, 7 kVA, 1 Phase plus N or 2 Phase, grounding wire 230 VAC (± 10 %), 50 – 60 Hz, 64 A, 7 kVA available as option	Compatible to worldwide power and current configurations
<b>Models Available</b>	Single or dual element O, N, H, ON, OH	Ideal tool for process and quality control



\*1 Depending on configuration

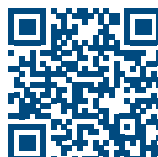
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