



# The GASPRO line

*HIGH PRESSURE. HIGH PERFORMANCE*



## GAS SORPTION & APPLICATIONS

### KEP Technologies is not simply an instrument company, but a full solution provider.

We do not claim that a single product is suited for all applications and have with our SETARAM brand developed a range of products with different characteristics to more closely meet your demands.

We are confident that with KEP Technologies you will find a dedicated gas sorption solution with the performance you need to get the best understanding of your materials. This being the case no matter which of our below market segments you may work in.



### ENERGY & ENVIRONMENT

Catalysts and sorbents sorption isotherms, kinetics, and selectivity  
CO<sub>2</sub> capture and sequestration  
Hydrogen storage materials characterization  
Selection of the best catalyst for an application based on heat of adsorption



### INORGANIC MATERIALS SCIENCE

Hydride formation from metals, alloys, intermetallics  
Gas sorption from porous ceramics, nanomaterials, geophysics, minerals behavior under gas pressure, shale gas sorption



### ORGANIC MATERIALS SCIENCE

Gas sorption in polymers and plastics in applications like packaging materials  
High pressure processing like polymers foaming



### LIFE SCIENCES

Gas sorption on food products (like dairy powder), on pharmaceutical materials



### PROCESS SAFETY

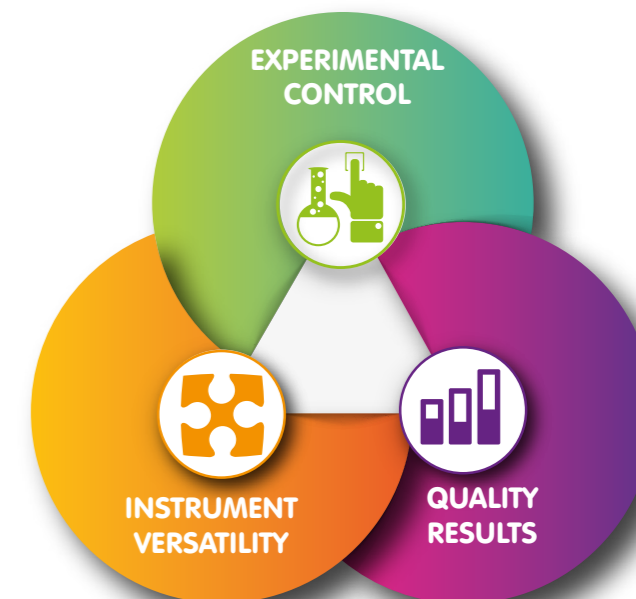
Heat of sorption measurements as input data for thermal management calculations

## THE KEP TECHNOLOGIES ADVANTAGE

Each GASPRO gas sorption analyzer also embodies our “Reimagine Material Characterization” value proposition. It does so by delivering the three core customer benefits of Experimental Control, Instrument Versatility and Quality Results.

We know that solutions that provide these benefits will deliver the highest value to our customers.

In addition to our core customer benefits, we are able to provide customized solutions by harnessing the engineering and project management expertise of our highly skilled organization.



### CUSTOMIZED SOLUTIONS

Modular design allows for upgraded and tailored functionality  
Access to all previous non-proprietary custom requests  
Open access to engineering development team

## THE GASPRO LINE

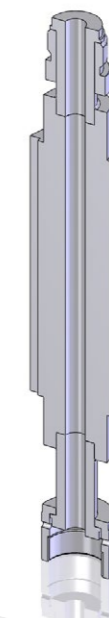
GASPRO is a fully automated Sievert's instrument line for the measurement of gas sorption properties of different materials. The Sievert's method consists of injecting gas doses of increasing pressure on a sample and measuring the pressure drop due to the sorption of this gas by the sample.

With its ability to rapidly switch between gases and a wide range of sample holders, GASPRO is ideally suited for the field of Energy & Environment, specifically for hydrogen storage, the study of CO<sub>2</sub> capture and sequestration, of methane sorption onto geological substrates, and for porous solids characterization.

GASPRO enables high precision measurements of small samples (mg), using the patented microdoser option (US8132476) to inject very small doses of gas on the sample.

The design of GASPRO is ideal for being coupled to a calorimeter to simultaneously analyze gas sorption and heat flow. It leads to direct thermodynamic measurements instead of uncertain indirect calculations like the Van't Hoff method.

Heat of sorption enables the understanding of the strength of gas and solid interaction and so better characterizes surface properties.



# GASPRO LINE INSTRUMENTS

Our range of gas sorption instruments for the characterization of materials across wide temperature ranges and using all common gas sorption techniques.

## COUPLING



**CALVET**  
Calorimetry

Measurement of heat of sorption



**MICROCALVET**  
Microcalorimetry

Heat of sorption on small samples



Sub-ambient to 500 °C



**GASPRO**

EXPERIMENTAL OPTIONS & VERSATILITY

**GASPRO HA**



Sub-ambient to 500 °C



## PLUG-IN ACCESSORIES



**FLEXI HP MS**  
Evolved gas

High pressure mass spectrometer

## GAS SORPTION SOFTWARE

The powerful software suite provided for all SETARAM gas sorption analyzers is composed of HY-DATA and HY-ANALYSIS.

- HY-DATA is dedicated to the programming of the testing processes. Fifteen different processes are available for measurements like PCT, Kinetics and Cycle-life, and for operations like calibration or sample preparation. The test parameters are set through a user-friendly interface. HY-DATA also displays live data and generates the PCT and kinetics data files.
- HY-ANALYSIS is the data analysis software solution for plotting and analyzing the experimental data files.

The equations of state used for the different test gases are based on the industry standard NIST Refprop database.

**GAS SORPTION ANALYSIS**  
Characterizes material sorption capacities and rates

**CORROSIVE AND REACTIVE GASES**  
Able to run in various aggressive atmospheres

**PRESSURE VACUUM**  
Operates under high pressure and vacuum

**COUPLING**  
Couples with CALVET or MICROCALVET instruments



**WIDE TEMPERATURE RANGE ENABLING A VARIETY OF APPLICATIONS**

From sub-ambient operations up to 500 °C

**VARIETY OF MODES OF OPERATION**

ability to combine PCT, kinetics and cycle-life modes to 200 bar all in one instrument and operation

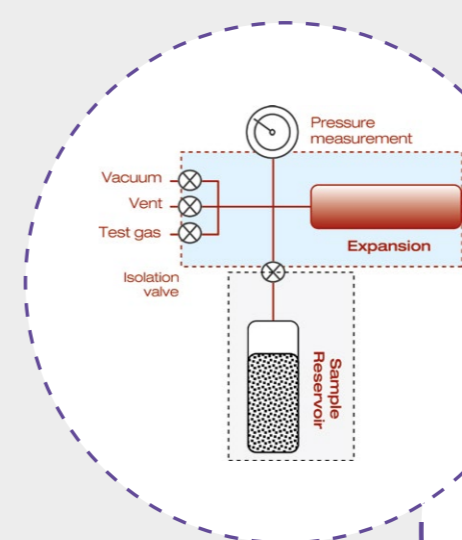
**PRECISION MEASUREMENT OF SMALL SAMPLES**

using the patented microdoser option (US8132476) to inject small doses of gas on the sample

**EXTERNAL CALORIMETER COUPLING CAPABILITY**

to simultaneously analyze gas sorption and heat flow, and understand the strength of gas-solid interactions

TEMPERATURE	
<b>GASPRO</b>	
<b>Temperature range (°C)</b>	-260 °C to 500 °C with different sample holder options Higher temperatures on request
<b>Calibrated reservoirs</b>	5 high pressure calibrated volumes ranging from ~12 ml to ~1.2 l
<b>Sorption gas (Test gas)</b>	Carbon Dioxide, Methane, Nitrogen, Argon, Hydrogen, Deuterium, Helium, Neon, Ammonia, n-alkanes from C2 to C6, more on request.
<b>Safety</b>	Flammable gas detector, emergency vented cabinet, burst disk
Pressure	
<b>Operating pressure range</b>	From vacuum to 200 bar Pressure regulation: automated, PID software controlled aliquot sizing – Fixed P, ΔP or f(ΔP)
<b>Pressure control (regulation)</b>	2 transducers for vacuum to 200 bar
<b>Sample pressure measurement</b>	1 transducer for vacuum to 200 bar 1 transducer for vacuum to 5 bar Accuracy: 1% of the reading
<b>Maximum sensitivity</b>	3 μmole of gas (with the MicroDoser attachment)



GASPRO is based on **expansion reservoirs** (5 available) of calibrated volume, controlled temperature and measured pressure.

The test gas is supplied to the expansion reservoir at the desired pressure using a sophisticated **pressure control unit**. It is then injected in the sample reservoir.

**15 different automated processes** are provided, including for measurements of:

- Pressure-Composition **Isotherms** (PCT, PCI)
- **Kinetics** and rate constants vs. pressure and temperature
- Charge and discharge **cycling** with repeated kinetic or PCT measurements

GASPRO is well suited for **gas-solid** sorption in any form (powders, bulk, films), as well as some gas-liquid sorption.

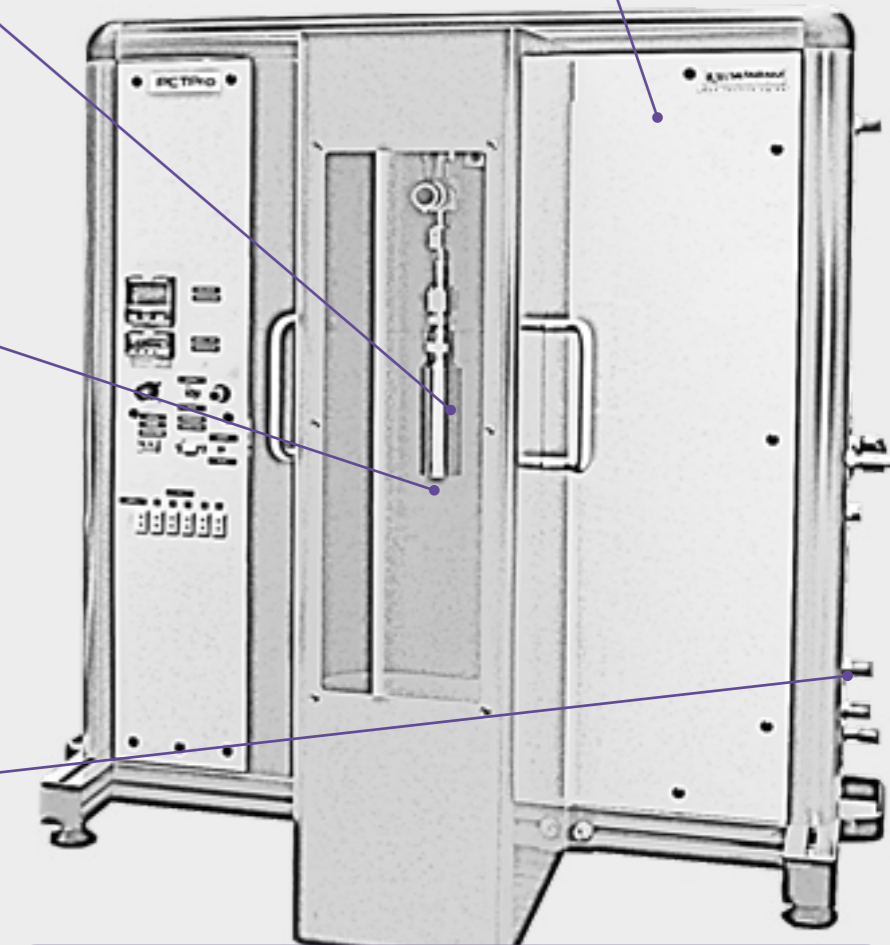
The GASPRO cells or sample holders are connected **outside the instrument**. Cells with various volumes and temperature ranges can be connected for a greater versatility.

This design allows for **coupling to other instrumentation including calorimetry**.

The **unique and patented Microdoser** system is an option for small samples down to **less than 100 mg**.

Heaters **up to 500 °C** (or more on request) and cooling systems **down to -260 °C** can be supplied to satisfy changing measurement needs

**Gas & vacuum connections** (test gas, pneumatic supply, vent, vacuum, helium for calibration, burst disk) are placed on a side panel for **convenient installation in the lab**.



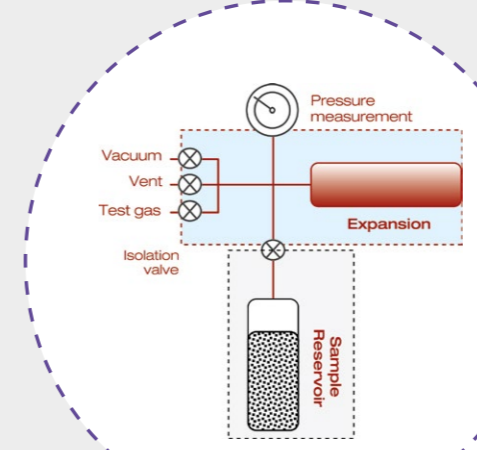
**Schematics of the GASPRO**

# GASPRO HA



- HIGH ACCURACY VERSION**  
to reduce cumulative error across multiple measurement points
- WIDE TEMPERATURE RANGE ENABLING A VARIETY OF APPLICATIONS**  
from sub-ambient operations up to 500+ °C with a customized solution
- VARIETY OF MODES OF OPERATION**  
ability to combine PCT, kinetics and cycle-life modes to 200 bar to determine the quantity and rate of sample/gas interaction and its ageing characteristics all in one instrument and operation
- PRECISION MEASUREMENT OF SMALL SAMPLES**  
using the patented microdoser option (US8132476)
- EXTERNAL CALORIMETER COUPLING CAPABILITY**

TEMPERATURE	GASPRO HA
<b>Temperature range (°C)</b>	-260 °C to 500 °C with different sample holder options Higher temperatures on request
<b>Calibrated reservoirs</b>	5 high pressure calibrated volumes ranging from ~5 ml to ~1.2 l
<b>Sorption gas (Test gas)</b>	Carbon Dioxide, Methane, Nitrogen, Argon, Hydrogen, Deuterium, Helium, Neon, Ammonia, n-alkanes from C2 to C6, more on request.
<b>Safety</b>	Flammable gas detector, emergency vented cabinet, burst disk
Pressure	
<b>Operating pressure range</b>	From vacuum to 200 bar Pressure regulation: automated, PID software controlled aliquot sizing – Fixed P, ΔP or f(ΔP)
<b>Pressure control (regulation)</b>	2 transducers for vacuum to 200 bar
<b>Sample pressure measurement</b>	1 transducer for vacuum to 200 bar Accuracy < 0.025% full scale 1 transducer for vacuum to 18 bar Accuracy < 0.12% of the reading
<b>Maximum sensitivity</b>	3 μmole of gas (with the MicroDoser attachment)



GASPRO HA uses a set of two **High Accuracy pressure sensors** delivering the best measurement of sorbed gas quantities, **even after multiple gas dose injections**, when cumulative error with standard transducers may affect measurements.

GASPRO HA is based on the same elements as GASPRO :

- **expansion reservoirs** (5 available) of calibrated volume, controlled temperature and measured pressure
- a sophisticated pressure control unit
- **15 different automated processes** for Isotherms, kinetics and cycling

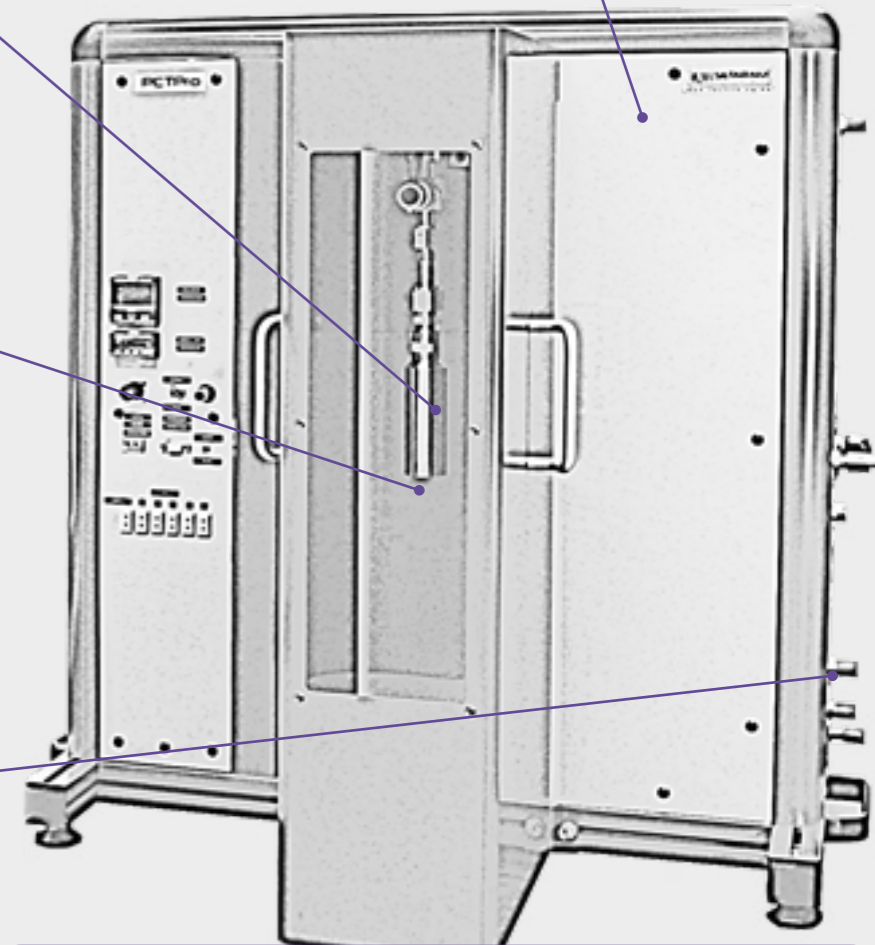
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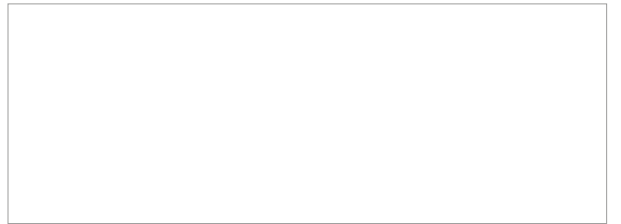
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**Schematics of the GASPRO HA**



Switzerland – France – China – United States – India – Hong Kong  
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