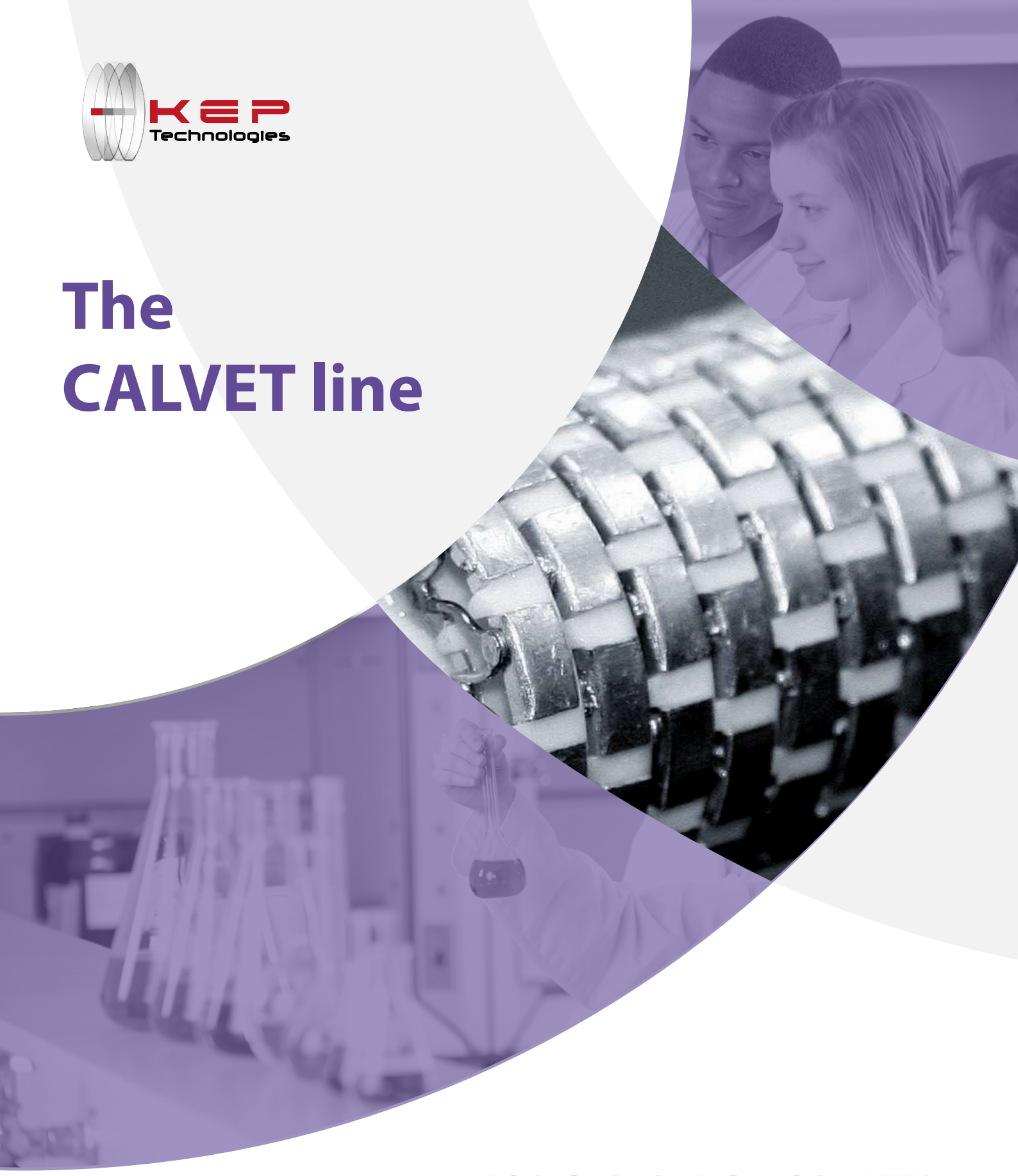
KEP Technologies

The CALVET line



FOR CAPABLE CALORIMETRY

setaram
KEP TECHNOLOGIES

CALORIMETRY & 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 calorimetry 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

Heat of sorption for the characterization of catalysts, sorbents, CO_2 capture and sequestration processes, H_2 storage materials. Gas hydrates formation and dissociation, wax appearance. Characterization of heat storage materials. Thermal stability of nuclear wastes. Thermal stability of batteries.



INORGANIC MATERIALS SCIENCE

Thermophysical properties of ceramics, glass, metals and alloys, cements. Setting and hydration properties of cements. Heat of formation of oxides or intermetallics.



ORGANIC MATERIALS SCIENCE

Polymers and plastics thermal and thermophysical properties, impact of high pressure process conditions.



PROCESS SAFETY

Thermal stability of substances, Process understanding under normal or runaway conditions, Risks related to pressure build up.



LIFE SCIENCES

Polymorphism / Crystallinity, Thermal stability of drugs, Biomolecules denaturation and aggregation.
Thermal behavior of food, and of food components like lipids, carbohydrates, proteins: it includes melting, crystallization, stability vs. oxidation, powder dissolution, gel formation etc.
Metabolism of living organisms.

THE KEP TECHNOLOGIES ADVANTAGE

Each Calvet calorimeter 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.

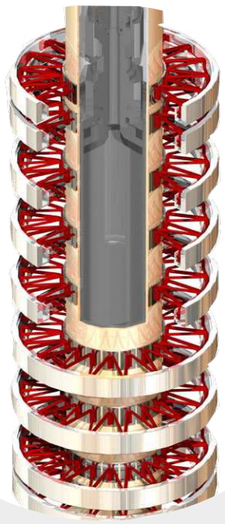


CUSTOMIZED SOLUTIONS

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

THE CALVET LINE

Owing to their 3D sensors and Joule effect calibration, the CALVET line of calorimeters provide the most accurate measurements of temperature and of:
• Heat: for the characterization of any heat releasing or heat absorbing phenomenon
• Specific Heat Capacity (C_p) : for any application requiring this key thermophysical property, like heat transfer calculation or heat management



The calorimeters of the CALVET line use the superior 3D sensor design in which a sample and reference cells are totally surrounded by an array of thermocouples allowing for the measurement of all heat including radiation, convection or conduction. The 3D sensor is up to 95% efficient whereas typical plate DSC sensors are between 30-50%.

CALVET line sensors use a specific electrical calibration also called Joule effect. It can be performed at any constant temperature, or under scanning conditions, and does not require reference materials.

The combination of 3D sensor efficiency and absolute Joule effect calibration provides an unparalleled accuracy of measurement independent of sample nature or matrix – solid, liquid, gas, powder etc.

CALVET LINE CALORIMETERS

Our range of calorimeters for the characterization of materials across wide temperature ranges and using all common calorimetry techniques.



500°C to 1000°C

3D CP

CALVET DC ALEXSYS



Ambient to 600°C

3D CP

CALVET HT



-196°C to 200°C

3D CP

CALVET CRYO



-120°C to 830°C

2D 3D CP

CALVET PRO

EXPERIMENTAL OPTIONS & VERSATILITY



Ambient to 200°C

3D

CALVET LV / CALVET LV 4C



Ambient to 1500°C

3D CP

CALVET DC



Ambient to 300°C

3D CP

CALVET

CALISTO - CALORIMETRY SOFTWARE

CALISTO 2.0 is the industry standard calorimeter software developed for all Setaram instrumentation and applications. It's quick to install and comprises of two independent parts:

- **CALISTO ACQUISITION:** dedicated to the control and data acquisition of our calorimetry systems.
- **CALISTO PROCESSING:** for the treatment of calorimetry data independent of instrument type.

CALISTO software includes over 100 customer-requested features and promises to be the most powerful, flexible and intuitive data treatment software in calorimetry.

See calisto-software.com for more information on the power of Calisto 2.0 software.

PLUG-IN ACCESSORIES



FLEXI HP
High Pressure

Measurement and control of sample pressure



FLEXI WET
Humidity Control

Stand alone wet gas generator



FLEXI HP MS
Evolved gas

High pressure mass spectrometer

2D DSC – DIFFERENTIAL SCANNING CALORIMETRY
Measures heatflow, heat and heat capacity

3D 3D CALVET SENSOR
Three dimensional measurement capturing up to 95% of heat for unparalleled accuracy and precision

CP HEAT CAPACITY
Ideal tool for accurate heat capacity measurements

DROP CALORIMETRY
Measures heat when the sample is dropped from outside into the calorimeter

EGA – EVOLVED GAS ANALYSIS
Combines your DSC, TGA or STA with any gas analyser for quantitative analysis using techniques such as FTIR, MS, GC-MS, FTIR/MS or FTIR/GC-MS

GAS SORPTION ANALYSIS
Characterizes materials sorption capacities and rates

HUMIDITY
Can be coupled with FLEXI WET or other relative humidity accessories

PRESSURE VACUUM
Operates under high pressure and vacuum

MIXING
Can mix two or more samples inside the calorimeter sensor for heat of mixing measurements

CORROSIVE AND REACTIVE GASES
Able to run in various aggressive atmospheres according to the calorimeter's configuration

COUPLING
Couples with GASPRO option

TGA – THERMOGRAVIMETRIC ANALYSIS
Measures mass loss and uptake, thermal stability, decompositions and solid-gas reactions

CALVET



HIGHEST HEAT MEASUREMENT ACCURACY
Calvet 3D sensor based on thermocouples with Joule effect calibration

ISOTHERMAL OR TEMPERATURE SCANNING MODES
for increased flexibility and replication of real life conditions

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (up to 1000 bar) and high vacuum
- pressure measurement and control
- mixing/stirring experiments

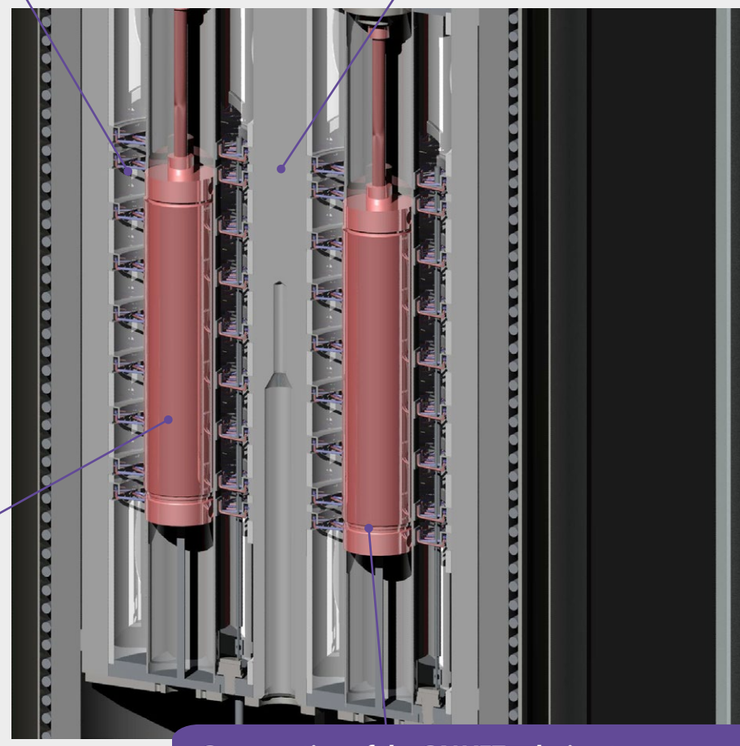
EXTERNAL COUPLING CAPABILITY
designed to increase your research options including manometry, BET instrumentation, gas analyzers, humidity controllers and gas panels

TEMPERATURE	CALVET
Temperature range (°C)	Ambient to 300
Temperature accuracy (°C)	+/- 0.3*
Temperature precision (°C)	+/- 0.15*
Programmable temperature scanning rate (°C/min)	0.001 to 2
HEAT & HEAT FLOW	
Enthalpy accuracy (%)	+/- 0.4*
Calorimetric precision (%)	+/- 0.4*
RMS noise (µW)	1
Resolution (µW)	0.1
Dynamic Range (mW)	+/- 660; +/- 2 000
GENERAL	
Cells volume (ml)	Up to 12.5 (standard cell)
Pressure measured and controlled (bar [psi])	350 [5,075]; 600 [8,700]; 1000 [14,600]
Weight (kg)	30
Dimensions (Height/Width/Depth)	60/25/31 cm 23.6/9.8/12.2 inch
Power requirements	230V-50/60 Hz

** Based on indium melting tests*

The 3D sensor of CALVET is composed of 2 cylindrical thermopiles: each has 9 concentric rings, and each ring contains 19 thermocouples (171 in total). Each thermopile totally surrounds either the sample or the reference zone to **measure heat in all directions**.

CALVET is based on a highly robust calorimetric block, controlling the measurement zone at **a constant temperature or heating rate,** between room temperature and 300 °C.



Cross section of the CALVET calorimeter

The sample, within a measurement cell, is placed directly into the center of the measurement zone.

The cell can be a simply closed cylinder, or equipped with tools for mixing and stirring, pressure measurement and gas or liquid flow.

Cells and tools are made of temperature and corrosion resistant metals and polymers.

New cells can be designed and configured to suit your application.

Specific cells are designed **to couple CALVET with other analytical tools like sorption analysis instruments (Sievert's, BET), or atmosphere control systems** (FLEXI-WET humid gas controller, FLEXI HP).

CALVET CRYO



HIGHEST HEAT MEASUREMENT ACCURACY
Calvet 3D sensor based on thermocouples with Joule effect calibration

SUB-AMBIENT TEMPERATURE OPERATIONS
with solutions adapted to your need down to as low as -196°C

ISOTHERMAL OR TEMPERATURE SCANNING MODES
for increased flexibility and replication of real life conditions

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (up to 1000 bar) and high vacuum
- pressure measurement and control
- mixing/stirring experiments

EXTERNAL COUPLING CAPABILITY

TEMPERATURE	CALVET CRYO
Temperature range (°C)	-196 to 200
Temperature accuracy (°C)	+/- 0.5*
Temperature precision (°C)	+/- 0.25*
Programmable temperature scanning rate (°C/min)	0.01 to 1
HEAT & HEAT FLOW	
Enthalpy accuracy (%)	+/- 0.2*
Calorimetric precision (%)	+/- 0.5*
RMS noise (µW)	1
Resolution (µW)	0.1
Dynamic Range (mW)	+/- 50; +/- 500; +/- 1 500
GENERAL	
Cells volume (ml)	Up to 12.5 (standard cell)
Pressure measured and controlled (bar [psi])	100 [1,450]; 600 [8,700]; 1000 [14,600]
Weight (kg)	60 (excluding cooling system)
Dimensions (Height/Width/Depth)	105/40/40 cm 41.3/15.7/15.7 inch
Power requirements	230V-50/60 Hz

** Based on indium melting tests*

The 3D sensor of CALVET CRYO is composed of 2 cylindrical thermopiles: each has 480 thermocouples. Each thermopile totally surrounds either the sample or the reference zone **to measure heat in all directions.**

CALVET CRYO is based on a calorimetric block, controlling the measurement zone at a constant temperature or heating rate, up to 200°C.

The CALVET CRYO calorimeter is **linked to a liquid nitrogen tank or to a high performance chiller for low temperature operations.** The cooling fluid is injected in an internal enclosure around the calorimetric block.

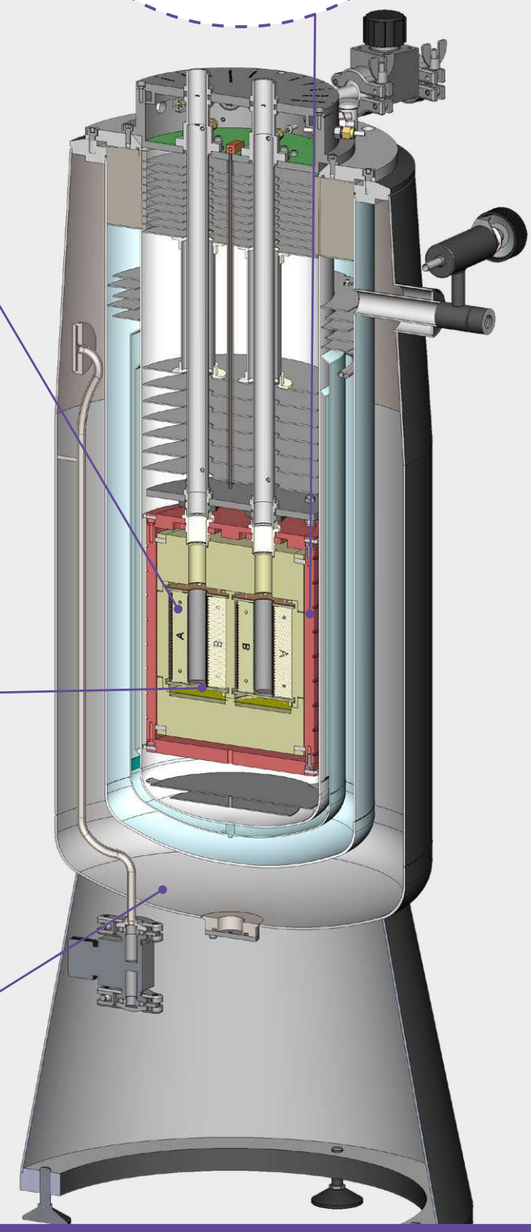
The sample, within a measurement cell, is placed directly into the center of the measurement zone. The atmosphere around the cell is controlled to avoid the presence of humidity.

The cell can be a simply closed cylinder, or equipped with tools for mixing and stirring, pressure measurement, and coupling to extra instrumentation.

Cells and tools are made of temperature and corrosion resistant metals and polymers.

New cells can be designed and configured to suit your application.

The external enclosure is placed under permanent vacuum to **improve insulation** and avoid most moisture condensation on the outside of the calorimeter.



Cross section of the CALVET CRYO calorimeter

CALVET HT



HIGH TEMPERATURE OPERATIONS
up to 600 °C

ISOTHERMAL OR TEMPERATURE SCANNING MODES
for increased flexibility and replication of real life conditions

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (up to 400 bar) and high vacuum
- pressure measurement and control
- mixing/stirring experiments

EXTERNAL COUPLING CAPABILITY

TEMPERATURE	CALVET HT
Temperature range (°C)	Ambient to 600
Temperature accuracy (°C)	+/- 1*
Temperature precision (°C)	+/- 0.5*
Programmable temperature scanning rate (°C/min)	0.01 to 2
HEAT & HEAT FLOW	
Enthalpy accuracy (%)	+/- 1*
Calorimetric precision (%)	+/-1.5*
RMS noise (µW)	2
Resolution (µW)	0.5
Dynamic Range (mW)	+/- 3500
GENERAL	
Cells volume (ml)	Up to 7
Pressure measured and controlled (bar [psi])	100 [1,450]; 300 [4,350]; 400 [5,800]
Weight (kg)	50
Dimensions (Height/Width/Depth)	64/35.5/50.5 cm 25.2/14/19.9 inch
Power requirements	230V-50/60 Hz

** Based on indium melting tests*

CALVET HT is based on a heated calorimetric block **to reach temperatures as high as 600°C**, at a constant temperature or heating rate.

A cooling water circuit enables the outer surfaces of the calorimeter to stay at a safe temperature level.

The 3D sensor of CALVET HT is composed of 2 cylindrical thermopiles: each has 144 thermocouples. Each thermopile totally surrounds either the sample or the reference zone to **measure heat in all directions.**

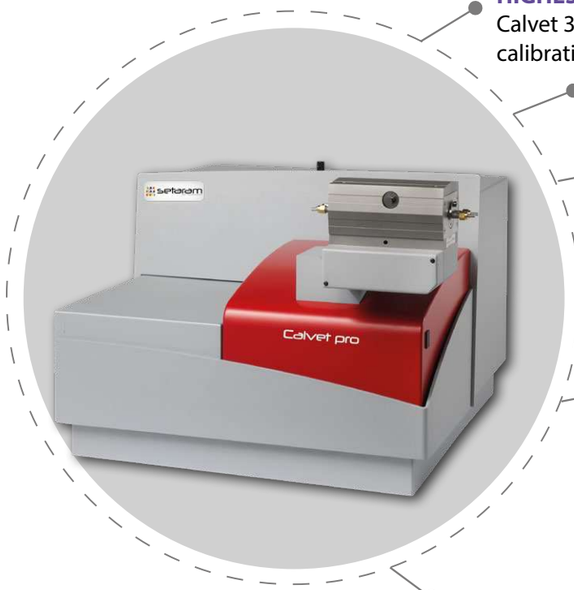
The sample, within a measurement cell, is placed directly into the center of the measurement zone. **The cell can be a simply closed cylinder, or equipped with tools for mixing and stirring, pressure measurement and gas or liquid flow.**

Cells and tools are made of temperature and corrosion resistant metals.

New cells can be designed and configured to suit your application.

Cross section of the CALVET HT calorimeter

CALVET PRO



HIGHEST HEAT MEASUREMENT ACCURACY
Calvet 3D sensor based on thermocouples with Joule effect calibration

HIGHEST MASS VARIATION ACCURACY
with its optional Hang-down Symmetrical Beam Balance

SUB-AMBIENT TO HIGH TEMPERATURE OPERATIONS
with solutions from -120 to 830 °C

ISOTHERMAL OR TEMPERATURE SCANNING MODES
for increased flexibility and replication of real life conditions

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (up to 500 bar) and high vacuum
- pressure resistance, measurement or control
- packed bed reactor experiments

EXTERNAL COUPLING CAPABILITY

TEMPERATURE	CALVET PRO
Temperature range (°C)	Ambient to 830°C -120 to 200 °C (with cooling accessory)
Temperature accuracy (°C)	+/- 0.05*
Temperature precision (°C)	+/- 0.15*
Programmable temperature scanning rate (°C/min)	0.01 to 30
HEAT & HEAT FLOW	
Enthalpy accuracy (%)	+/- 0.8*
Calorimetric precision (%)	+/- 0.4*
RMS noise (µW)	0.2
Resolution (µW)	0.35 ; 0.035
Dynamic Range (mW)	+/- 290; +/- 2900
MASS VARIATION* **	
Weighing accuracy (%)	+/- 0.1**
Weighing precision (%)	+/- 0.05**
RMS noise (µg)	0.5
Resolution (µg)	0.02; 0.002
Baseline dynamic drift (µg)	< 15
Weight Range (mg)	+/- 200
GENERAL	
Crucible or cells volume (ml)	Up to 0.32 depending on the chosen design and material (aluminium, incoloy, graphite, alumina, platinum, etc)
Pressure (bar [psi])	400 [5,800] (measured and controlled); 500 [7,250] (resistant)
Weight (kg)	45 55***
Dimensions (Height/Width/Depth)	45 / 53 / 58 cm 17.7 / 20.9 / 22.8 in 60 (closed) 80 (open)/53/58 cm*** 23.6 (closed) 31.4 (open)/20.9/22.8 in***
Power requirements	230V-50/60 Hz

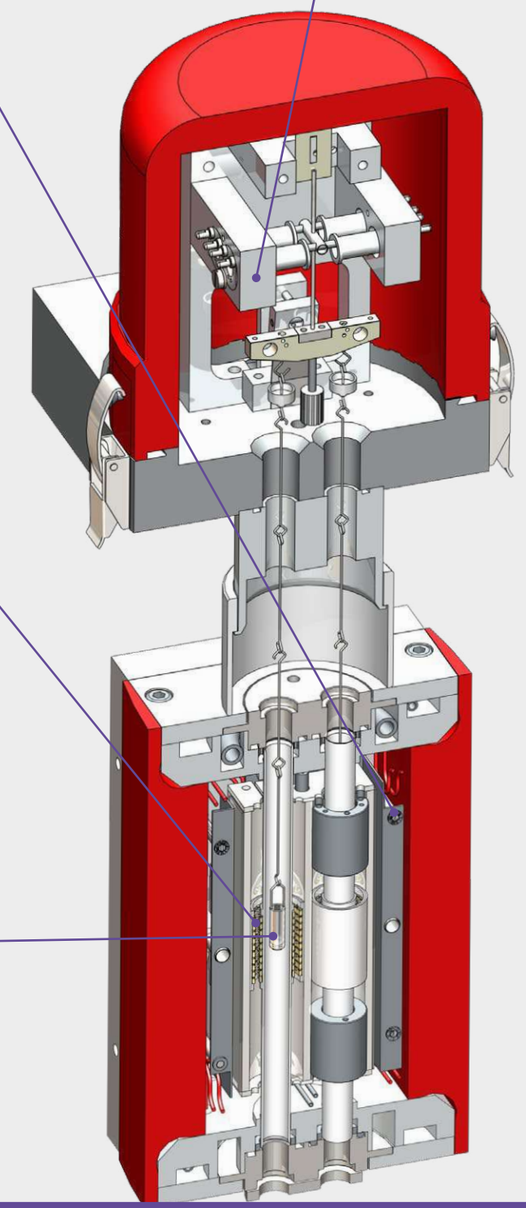
** Based on indium melting tests **Based on CuSO4. 5H2O dehydration ***With TG option*

CALVET PRO is based on a highly robust calorimetric block, **controlling the measurement zone between -120 and 830 °C.**

The optional Hang-down Symmetrical Beam Balance measures sample mass variations while **improving gas/sample interaction with the maximum exposure of sample to gas environment.**

With **near-zero drift or buoyancy effect,** it performs the most reliable long term stability studies.

The 3D sensor of CALVET PRO is composed of 2 cylindrical thermopiles: each has 10 concentric rings, and each ring contains 12 thermocouples (120 in total). Each thermopile totally surrounds either the sample or the reference zone to **measure heat in all directions.**



The sample, within a measurement crucible, is placed directly into the center of the measurement zone.

The crucible can be a **simply open or closed cylinder, or equipped with tools to couple CALVET PRO with other analytical tools** like evolved gas analyzers (FTIR, MS, GCMS, MS-FTIR, or FTIR-GCMS), sorption analysis instruments (Sievert's, BET), or atmosphere control systems (FLEXI WET humid gas controller, FLEXI HP)

Crucibles and cells are made of temperature and corrosion resistant metals or ceramics.

New cells can be designed and configured to suit your application.

Cross section of the CALVET PRO

CALVET LV



HIGHEST HEAT MEASUREMENT ACCURACY
with Calvet 3D sensor based on thermocouples with Joule effect calibration

ISOTHERMAL CONDITIONS
from ambient to 200 °C

LARGE SAMPLE VOLUMES
up to 100 mL, or two D-type batteries

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
to perform even the most demanding experiments using one instrument :
- high pressure (up to 350 bar) and high vacuum
- pressure resistance, measurement and control
- mixing/stirring experiments
- batteries charge/discharge cycles

4 CELL VERSIONS
for a higher throughput

TEMPERATURE	CALVET LV
Temperature range (°C)	Ambient to 200
Temperature accuracy (°C)	+/- 0.4*
Temperature modes	Isothermal or scanning < 2°C/h
HEAT & HEAT FLOW	
Enthalpy accuracy (%)	+/- 0.2*
RMS noise (µW)	0.5
Resolution (µW)	0.08
Dynamic Range (mW)	+/- 500
GENERAL	
Cells volume (ml)	Up to 93.3 (standard cell)
Pressure measured and controlled (bar [psi])	100 [1,450]; 350 [5,075]
Weight (kg)	230
Dimensions (Height/Width/Depth)	110/70/88 cm 43.3/27.6/34.6 inch
Power requirements	230V-50/60 Hz

** Based on indium melting tests*

The 3D sensor of CALVET LV is composed of 2 or 4 cylindrical thermopiles. Each has up to 1316 thermocouples. Each thermopile totally surrounds either the sample or the reference zone **to measure heat in all directions.**

CALVET LV is based on a large and stable calorimetric block, controlling the measurement zone at a constant temperature up to 200°C.

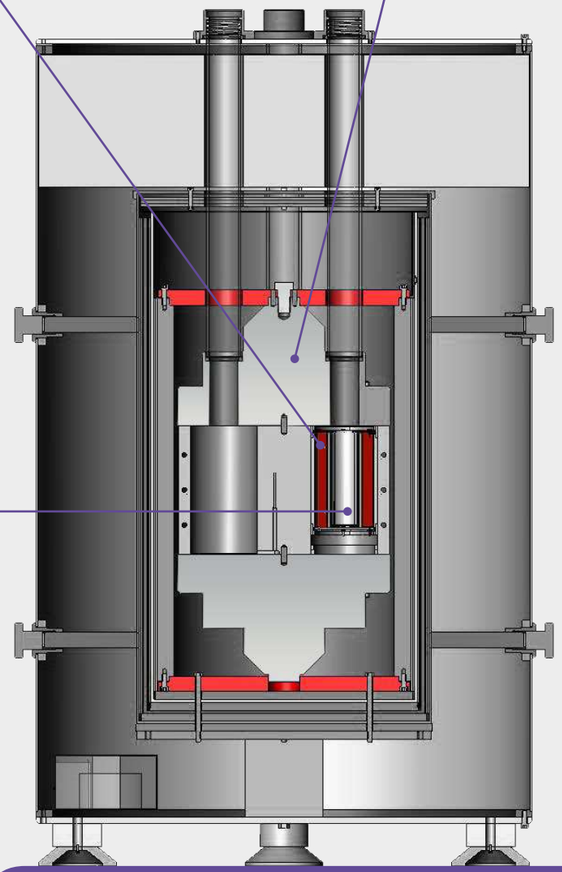
It can be provided with 2 or 4 calorimetric wells, for 1 or 2 pairs of measurement cells (sample + reference).

The sample, within a measurement cell, is placed directly into the center of the measurement zone.

The cell can be a simply closed cylinder, or equipped with tools for mixing and stirring, pressure measurement, gas flow, or coupling to a battery cycler for example.

Cells and tools are made of temperature and corrosion resistant metals and polymers.

New cells can be designed and configured to suit your application



Cross section of the CALVET LV calorimeter

CALVET DC



IMPROVED HEAT CAPACITY AND HEAT MEASUREMENTS
with Calvet 3D sensor based on thermocouples

HIGH TEMPERATURE MEASUREMENTS BY DROP CALORIMETRY
for accurate heat capacity, and heat content measurements

HIGH TEMPERATURE MEASUREMENTS BY HEAT FLUX DSC
for accurate heat capacity, heat of phase transitions, and glass transition measurements

ISOTHERMAL OR TEMPERATURE SCANNING CONDITIONS
up to 1500 °C or 1600 °C

CONVENIENT AUTOMATED sample charger
for multiple successive drops

TEMPERATURE	CALVET DC	
Temperature range (°C)	Up to 1300 or 1500	Up to 1400 or 1600
Temperature accuracy (°C)	-	+/-2
Temperature stability (°C)	0.3°C	-
HEAT & HEAT FLOW		
Calorimetric accuracy (%)	+2%*	2.5%*
RMS noise (µW)	300	80
Resolution (µW)	5	4
GENERAL		
Cells volume (ml)	Up to 5 (platinum crucible) or 5.7 (alumina crucible)	Up to 0.45
Weight (kg)	185	
Dimensions (Height/Width/Depth)	150/70/65 cm 59.1/27.6/25.6 inch	
Power requirements	230V-50/60 Hz	

** Based on published data*

CALVET DC is based on a modular high temperature furnace, that can be equipped **with two exchangeable sensor types** for distinct high temperature measurements: **Heat Flux DSC or Drop Calorimetry.**

The Drop sensor is composed of **56 thermocouples** placed between a reference zone and a sample zone. It is calibrated by dropping sapphire pellets between each experiment.

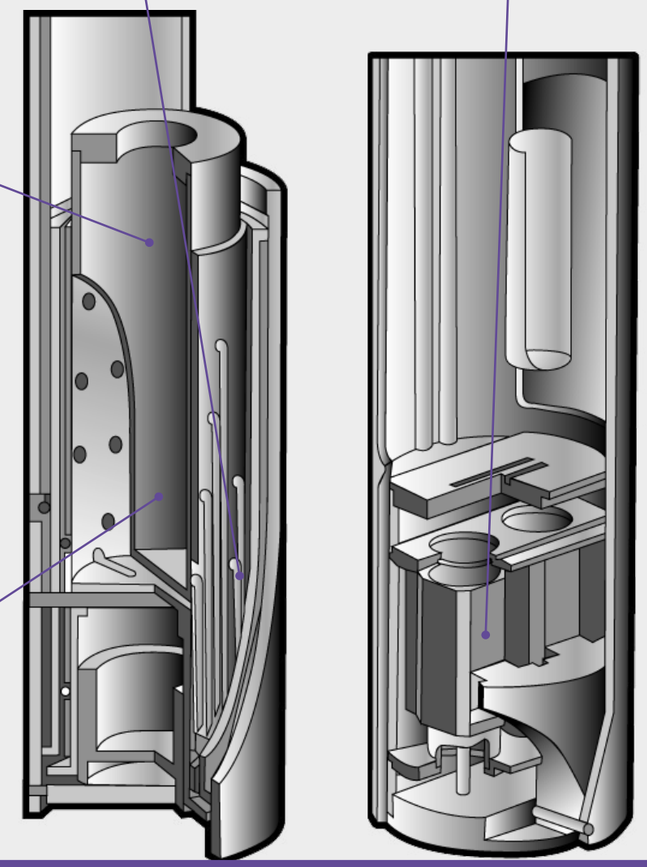
The HF-DSC sensor is composed of **20 thermocouples** placed between a reference zone and a sample zone. It is calibrated by melting of standard materials.

Drop calorimetry simply consists of letting a sample of material drop at room temperature into a calorimeter placed at high temperature.

The drop calorimeter **measures the heat necessary to change the temperature of the sample from room temperature to the high temperature.**

The Drop Calorimetry module can be used with an **airless sample transfer** system for oxygen or moisture sensitive materials. A convenient **automated sample charger** is also available as an option.

The cells are designed to receive a sample dropped through a drop tube, and may contain a molten solvent to conduct drop solution experiments at high temperature.



Cross sections of the HF-DSC (left) and Drop (right) CALVET DC sensors

CALVET DC ALEXSYS



BEST IN CLASS HIGH TEMPERATURE MEASUREMENTS BY DROP CALORIMETRY
improved heat capacity, heat of phase transitions, heat content measurements

HIGHLY SENSITIVE HIGH TEMPERATURE CALVET 3D SENSOR
dual drop capability with a measurement drop tube and a reference drop tube

ISOTHERMAL CONDITIONS
up to 800 or 1000 °C

FINE CONTROL OF THE SAMPLE REACTIVITY
and preserved sensor lifetime with an Inconel protective tube, a chemically inert silica based drop tube with optional platinum liner, and the control of the atmosphere above the sample

TEMPERATURE	CALVET DC ALEXSYS	
Temperature range (°C)	500 to 800	500 to 1000
Temperature stability (°C)	+/- 0.2	+/- 0.2
HEAT & HEAT FLOW		
Calorimetric precision (%)	+/- 1%*	+/- 1%*
RMS noise (µW)	30	30
Resolution (µW)	12.5	12.5
GENERAL		
Cells volume (ml)	Up to 28 ml (quartz cell) or 20 ml (platinum crucible)	
Weight (kg)	300	300
Dimensions (Diameter /Height)	800 / 880 mm, Separate electronics	
Power requirements	230V-50/60 Hz	

** Based on sapphire drop*

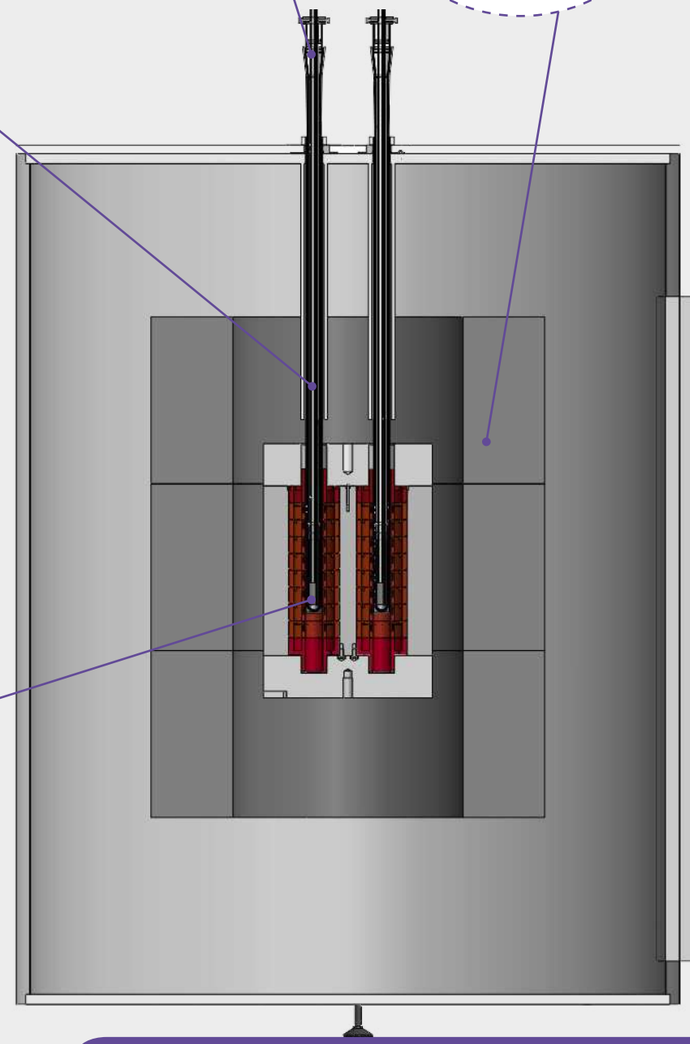
Drop calorimetry simply consists of letting a sample of material drop at room temperature into a calorimeter placed at high temperature.

The **drop calorimeter measures the heat necessary to change the temperature of the sample from room temperature to the high temperature.**

The 3D sensor of CALVET DC ALEXSYS is composed of 2 cylindrical thermopiles: each has 128 thermocouples. Each thermopile totally surrounds either the sample or the reference zone **to measure heat in all directions.**

The sensor is calibrated by dropping sapphire pellets. As **the calibration factor of CALVET DC ALEXSYS is stable over time**, the calibration can be done periodically rather than after each experiment.

CALVET DC ALEXSYS is based on a calorimetric block and three temperature control zones used to **keep the whole sensor at the temperature setpoint.**



The cells are designed to receive a sample dropped through a drop tube, and may contain a molten solvent to conduct drop solution experiments at high temperature with optional bubbling to assist dissolution.

Cells and tools are made of temperature and corrosion resistant metals and ceramics.

Cross section of the CALVET DC ALEXSYS

MC • Specifications are given as indications only and are not contractual • 07/20



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