

SETSYS Evolution

DTA, DSC, TGA, simultaneous TGA-DTA
and TGA-DSC, TMA / dilatometry



From ambient to 2400 °C

- Complete modular thermal analysis platform
- Single furnace for all temperatures
- Vertical hang down symmetrical balance
- Working under corrosive, humid atmospheres



SETSYS Evolution is the standard for high performance TGA, TG-DSC and TG-DTA applications. It is based on a modular thermal analysis platform that can be configured for any of the following market leading sensors:

- TGA, DTA and DSC
- Simultaneous TGA-DTA and TGA-DSC
- Dilatometry / TMA

SETSYS can be configured to operate up to 2400 °C and to use controlled humidity, vacuum and highly aggressive atmospheres.

The HIGHLIGHTS

SETSYS combines market leading sensors with a powerful furnace and atmosphere control system and market leading software to give you unparalleled data and flexibility.

- **Sensors** - the **SETSYS** TGA system features the most sensitive balance available designed specifically for thermogravimetric applications allowing for unmatched sensitivity and long term stability. The TMA module is also highly sensitive, and can work even with zero force applied for the most challenging samples.
- **Furnace** - **SETSYS** uses a single furnace to cover the entire temperature range, no need to change furnace for different samples. This is combined with different options to allow users to easily control active, corrosive and high humidity atmospheres for the simulation of even the most demanding atmospheres.
- **Cost of ownership** - like all Setaram systems **SETSYS** has been designed for many years operation, and key to that is to offer an open modular system allowing for ease of maintenance and low cost accessories and spare parts.

FURNACE

SETSYS comes equipped with a robust and high performance graphite furnace, offering also the lowest operational costs of any system available. There is no requirement to change furnaces as a single furnace covers all applications from ambient up to 2400 °C. Temperature ranges of the furnace are completed by simply and rapidly changing the control thermocouple (1000, 1600, 1750 or 2400 °C). This change can be done by the operator in less than 2 minutes.

High scanning rates (up to 100 °C/min) are available across the entire temperature range. Its efficient cooling system enables to program various temperature profiles including cooling steps and to maintain a fast turn around between experiments.

SETSYS provides both primary and secondary vacuum options.

ATMOSPHERES

A high-performance gas control panel equipped with MFC (Mass Flow Controllers) ensures a precise control of the atmosphere and of the gas mixtures.

Standard **SETSYS** configuration allows for any type of gas up to 1750 °C. Above 1750 °C, the furnace remains the same and a few accessories are replaced easily by the operator to allow operation up to 2400 °C.

A wide variety of configurations are offered for the control of the atmosphere: inert gas, reactive gas (oxidizing, reducing), corrosive gas, humid gas. Gas include H₂, CO₂, or NH₃ up to 100%...

Optional accessories are available for:

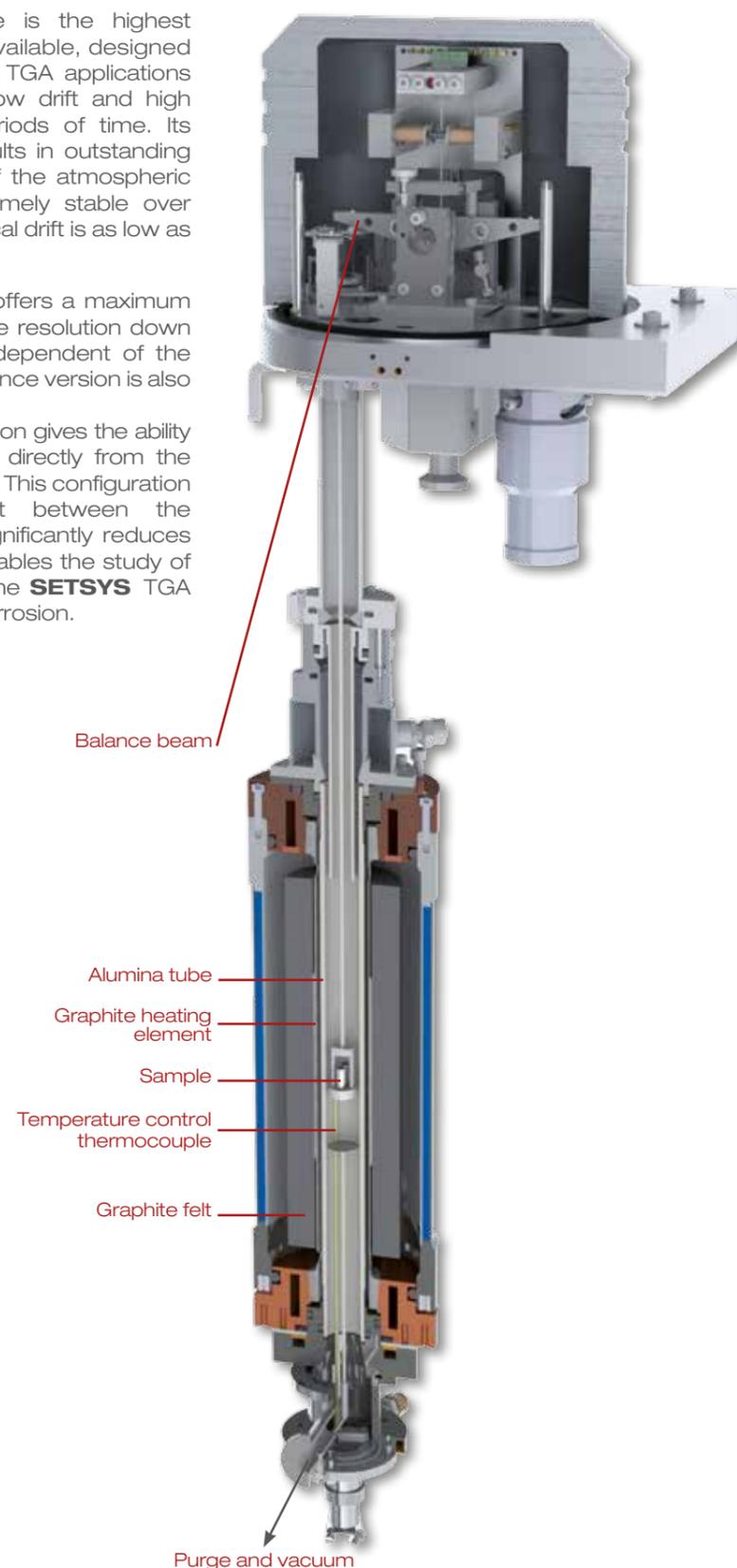
- ensuring hydrogen safety
- working under corrosive gas (allows evaluation of materials under 100% corrosive gas) thanks to a silica protective tube
- working under fluorine
- working under humidity using the humid gas generator **WETSYS**

SYMMETRICAL BALANCE

The **SETSYS** balance is the highest performance balance available, designed specifically and only for TGA applications resulting in extremely low drift and high precision over long periods of time. Its symmetrical design results in outstanding baseline independent of the atmospheric conditions and is extremely stable over long isotherms. The typical drift is as low as 0.1 µg / hour.

The **SETSYS** balance offers a maximum capacity of 35 g with the resolution down to 0.002 µg = 2 ng independent of the sample size. A 100 g balance version is also available.

Its hang-down configuration gives the ability to suspend the sample directly from the balance without crucible. This configuration improves the contact between the sample and the gas, significantly reduces buoyancy effect and enables the study of large samples making the **SETSYS** TGA the ideal tool to study corrosion.



ELECTRONICS & SOFTWARE

SETSYS comes equipped with **CALISTO**, the most powerful, user-friendly software on the market.

TGA

The large capacity of the balance (35 g or 100 g) combined with the highest resolution on the market can detect very small weight changes on both small and big samples. The 18 mm internal diameter tube is well suited for the investigation of all sample types, volumes and shapes.

Various crucibles are available depending on the temperature range to be investigated and the nature and form of the sample to be studied.

The crucible materials include aluminum, alumina, platinum, zirconia, tungsten, graphite.

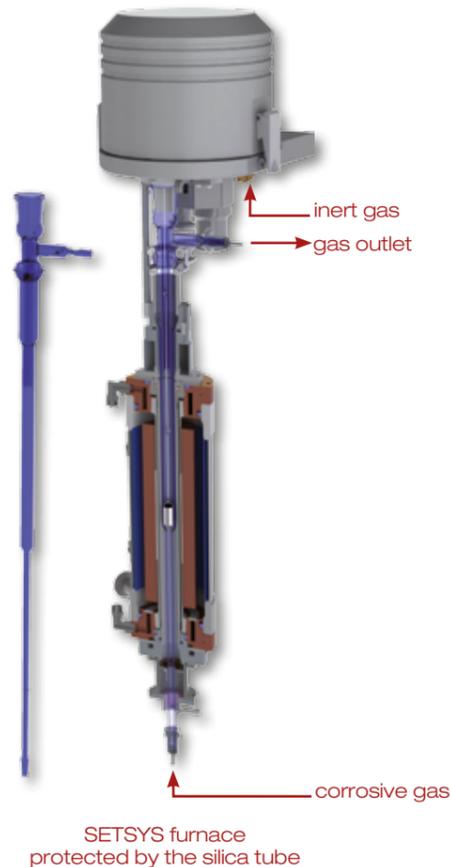


The solid sample can also be suspended directly from the balance.

Open wire mesh and three-tray crucibles can also be used for better optimized surface interactions.

Corrosive gas accessory

It is also available to carry out TGA measurements under 100% pure corrosive gas. In such a configuration, the analysis chamber is protected by a silica tube, and the balance is protected by an inert gas.



SETSYS furnace protected by the silica tube

Long isotherm at high temperature

Sapphire suspensions and crucibles are also available for high temperature and long term oxidation studies.

SETSYS features a unique design of furnace allowing it to be the only system on the market designed to operate lengthy isotherms over 1350 °C without risk of reducing the furnace lifetime.



Sapphire suspensions and crucibles

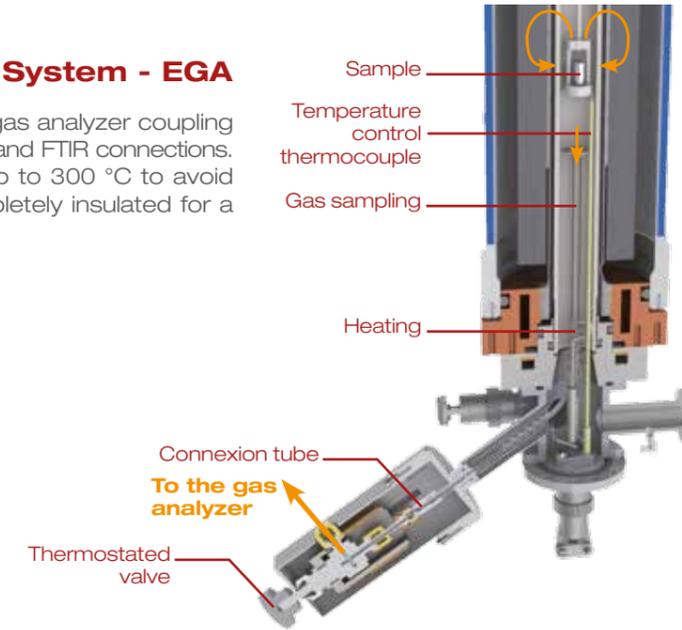
Relative Humidity Accessory - WETSYS

WETSYS generates a humid carrier gas up to 90% relative humidity at 70 °C. It can be used up to 1750 °C. Gases include Air, He, N₂, CO₂,... and complex humidity profiles can be programmed.



Evolved Gas Coupling System - EGA

SETSYS offers a "Plug & Play" gas analyzer coupling device enabling simultaneous MS and FTIR connections. The coupling device is heated up to 300 °C to avoid any gas condensation and completely insulated for a safe handling.



TAG

The TAG features the same symmetrical balance beam and aggressive atmosphere control seen in the SETSYS system. In addition it incorporates a pair of matched furnaces which totally compensates buoyancy effects and provides for unparalleled performance. If you are studying long term corrosion and / or oxidation then nothing comes close to the TAG's performance.



Symmetrical balance and furnaces of TAG

Temperature range	Ambient to 1600 °C or 1750 °C
Programmable temperature scanning rate (heating and cooling)	0.01 to 100 °C
Balance capacity	35 g
Gases	3 carriers gases (MFC from 4 to 200 ml / min) + 1 auxiliary or reactive gas (MFC from 0.3 to 16 ml / min)
Crucibles	From 55 to 1500 µl Alumina, Tungsten, Graphite, Platinum, Quartz, Aluminum
Rods	TGA, DTA and DSC interchangeable rods

Modularity

All the DTA or DSC rods can be used alone for single DTA or DSC measurements or they can be used on the TGA analyzer providing simultaneous TGA-DTA or TGA-DSC measurements. The rods can be simply fixed to the balance of the **SETSYS** TGA in less than 10 seconds thanks to the « Easy Fit » DTA or DSC rod connectors. The user can switch from one type of sensor rod to another one very easily.

DTA and DSC rods

Four types of sensor rods are available for DTA and DSC measurements:

• **Type P, S and B tricouples DTA sensors**

These tricouple DTA rods cover temperatures ranging ambient up to respectively 1000 °C, 1600 °C and 1750 °C. The tricouple DTA rod is used when weak transitions have to be measured as it doubles the sensitivity of the sensor. There is no risk of sticking because the platinum pan is not in direct contact with the thermocouple.



• **Type P, S and B protected DTA sensors**

These protected DTA rods cover temperatures ranging ambient up to respectively 1000 °C, 1600 °C and 1750 °C. They are used when aggressive gases may evolve from the sample during the heating. In these particular DTA rods the thermocouples are more protected.



• **Type E, S and B DSC plate rods**

These DSC plate rods cover temperatures ranging ambient up to respectively 800 °C, 1500 °C and 1600 °C. They provide quantitative results on thermal events.



• **W₅ DTA rod**

This tungsten DTA rod is used for operation up to 2400 °C and when measurements are done under a reducing atmosphere (H₂ or CO).



TGA / TMA modules change

The measurement heads (balance for TGA or displacement transducer for TMA) can be changed in less than one hour and installed on the same structure. It is no need to purchase a second instrument if there is a low work load.

SETSYS TMA is built on a vertical design. The TMA probe is held by the electromagnetic suspension so that virtually no force is applied on the sample. Many advantages come with this vertical design:

- Soft materials can be easily evaluated
- For volumetric measurements on powders, the sample can be placed in the container
- Traction measurements are also possible on films and fibers

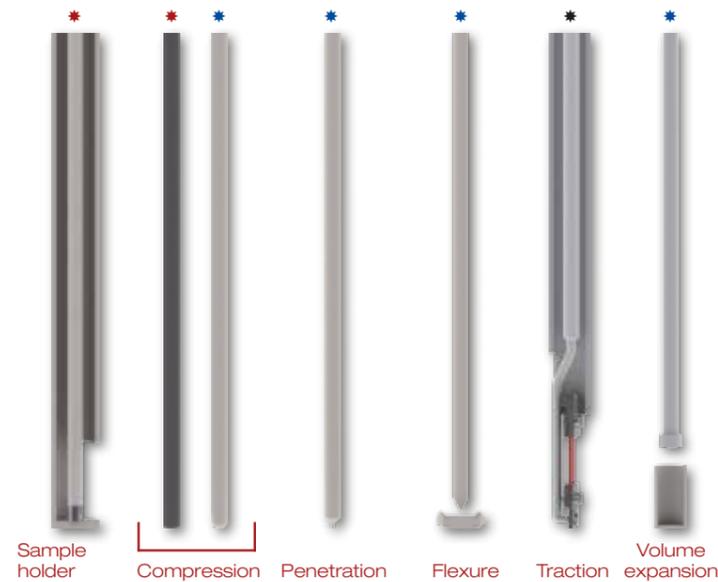
With its outstanding RMS noise of 5 nm, **SETSYS** can detect very small dimensional changes and there is no need of long sample for accurate measurements.

Both transducer calibration and force control are done by the computer for ease-of-use operation.

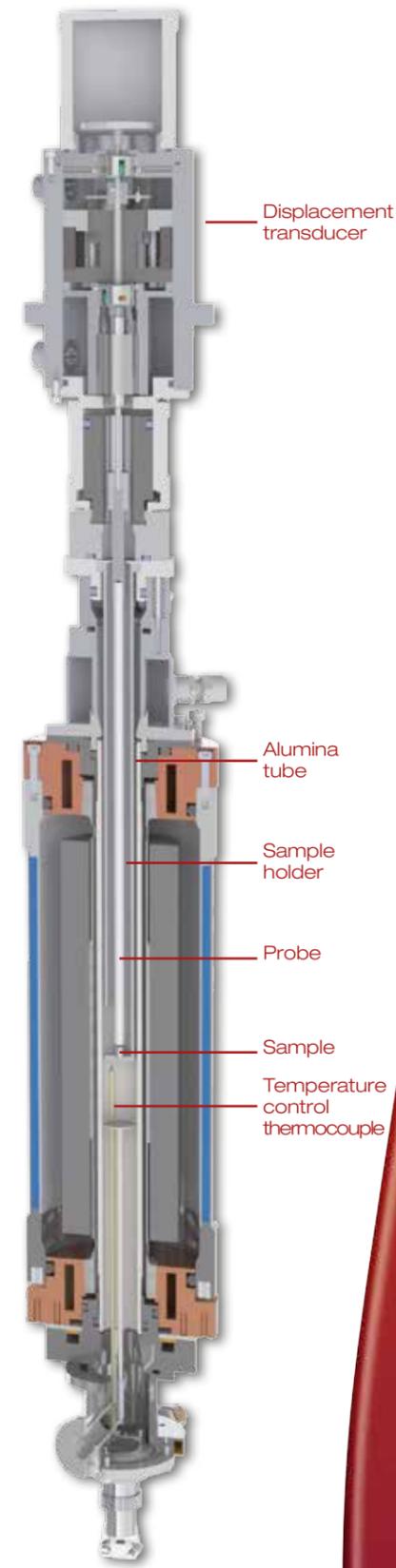
Various types of probes are available, depending on the measurement to be carried out:

- Compression
- Penetration
- Flexure
- Traction
- Volume expansion

They are made of silica (use up to 1000 °C), alumina (use up to 1750 °C) or graphite (use up to 2400 °C).



Silica, alumina and graphite * Silica and alumina * Silica *



Controlled sintering rate

Properties of a material are improved by maintaining a constant and slow rate of shrinkage during the sintering process. Key parameters are maximum heating rate and sintering rate. The heating rate can be automatically lowered to follow predefined sintering rate and reincreased at the end of the process. This mode is used to generate an optimized temperature profile and to simulate the sintering process.

Applications

SETSYS TGA is designed for the most demanding atmospheres and long term isotherms. Its applications include studies on oxidation / corrosion of metals and alloys, reaction between a material and a gas, isothermal stability of materials under particular atmospheres, phase transitions of metals, etc...

SETSYS TMA is used for measuring variations in size of solids or powders. Applications include characterization of materials (softening, glass transition, degradation, reticulation) under varied stresses, study of films and fibers, sintering of ceramics, study of the thermal behavior of alloys and more generally for measuring coefficients of expansion.

Register on our website www.setaram.com to view all the application and technical notes available in your field.

Specifications

Setsys Evolution	DTA	DSC	TGA	TMA
			balance 35 g / 100 g	
Temperature range (C°)	Ambient to 2400	Ambient to 1600	Ambient to 2400	Ambient to 2400
Crucible volume (µl)	30 / 100	80 / 100	50 / 3000	-
Max. size of the sample (mm)	-	-	L:20 Ø 14	L:20 Ø 10
Resolution	0.4 µW	1 µW	0.002 µg / 0.02 µg	0.2 nm
Measuring range	-	-	±200 mg / ±2 g	±2 mm

Option: AKTS Thermokinetics software for comprehensive investigation of reaction or decomposition 



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