KEP Technologies

THE HEAT CHECK LINE

Nuclear measurement

setsafe
KEP TECHNOLOGIES

NUCLEAR MEASUREMENT

KEP Technologies is a full solution provider. With **SETSAFE** we offer standard and customized nuclear measurement solutions. We manage entire projects from the feasibility study up until installation, training and maintenance, as required.

We are confident that with KEP Technologies you will find measurement solutions with the performance needed to characterize and efficiently manage your nuclear materials. This being the case no matter which of our below market segments you may work in.

WASTE & DISMANTLING

Characterization of waste for safety, for inventories, for selecting suitable storage, for historical/legacy wastes, material transportation and thermal management.

DEFENSE

Safeguard, accounting, inventory. Control of tritium or special nuclear materials. Radioactive materials inventory.

INDUSTRY

Safeguard, accounting, inventory. Waste Characterization.

RESEARCH

Thermal properties. Waste Characterization for dismantling research reactors.

THE KEP TECHNOLOGIES ADVANTAGE

Despite operating in demanding contexts, each **HEAT-CHECK** solution incorporates three essential elements to ensure the best nuclear measurement:

QUALITY RESULTS thanks to the application of our proprietary technologies or the integration of the most reliable technologies on the market

NUCLEAR SAFETY, taking into consideration your constraints: radiological environment (integration in glovebox or hot cell), data protection, seismic resistance

CUSTOM DESIGN, with solutions tailored to your specific needs in terms of measurement, automated or manual handling etc.

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

THE HEAT-CHECK LINE

HEAT-CHECK solutions can determine the mass of nuclear material in a container.

They use calorimetry, **a non-destructive method** that exploits the heat released during the decay of radioactive materials.

It is the **ideal addition to gamma spectrometry**

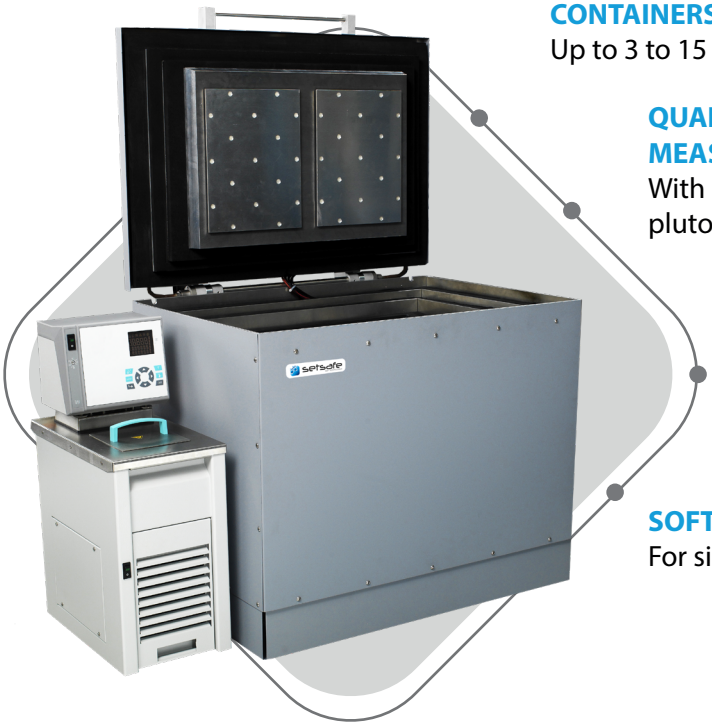
- Calorimetry measures a global quantity of material, but when it is associated with a gamma spectrum, it can indicate the mass of each isotope in the container
- Unlike gamma spectrometry, its measurement results are not affected by the material's matrix, container, or conditioning
- Calorimetry is the most reliable technique to characterize pure beta emitters like tritium

Calorimeters from the **HEAT-CHECK** line provide **more accurate and precise results**.

They use our proprietary technologies for thermal power (or heat flow) measurements, that **comply with international standards** like ASTM C1458.

HEAT-CHECK SV

FOR THE MOST ACCURATE QUANTIFICATION OF SMALL CONTAINERS



MEASUREMENTS OF SMALL VOLUME WASTE OR CONTAINERS

Up to 3 to 15 liters

QUANTITATIVE AND NON-DESTRUCTIVE MEASUREMENTS

With the highest accuracy for isotopes like plutonium or tritium

RESULTS INDEPENDENT OF MATRIX AND CONDITIONING EFFECTS

Ideal addition to gamma spectrometry

SOFTWARE AND AUTOMATION OPTIONS

For simple and safe use

PERFORMANCE		
Lower quantification limit*	**Tritium**	5 to 10 mg
	Plutonium	0.8 to 1.5 g
	Others	Following the specific activities of the materials to characterize
Higher quantification limit*	**Tritium**	9 to 62 g
	Plutonium	1.5 to 10 kg
	Others	Following the specific activities of the materials to characterize
Measurement accuracy		Better than 2% or better than 0.5%
Measurement precision		Better than 0.15 to 0.2%
Measurement time**		3 to 4h
GENERAL		
Container volume		Up to 3.3 or 15 L, others on request
Temperature control of containers	**System**	Water or air flow
	Range	25 to 40°C
Dimensions (WxDxH)		700 x 460 x 750 to 1 040 x 780 x 850 mm
Weight		300 to 500 kg

* Following the limit in mW and the specific power of the radionuclide in mW/g

** Varies considerably with the mass, thermal conductivity and container shape. The measurement time indicated includes the use of predictive calculation algorithms.

CHARACTERIZATION OF SMALL VOLUME CONTAINERS

The supplied software has:
- A standard mode for pre-set test procedures
- An expert mode for more detailed test settings
- An algorithm for predictive calculations, that **improves testing throughput**
- A module for coupling with gamma spectrometry data to measure **the mass of each isotope** in the container.

Measurement quality also relies on the fine control of the containers' temperature, thanks to an air or water-based regulation and multi-layer insulation.

The measurement is made possible thanks to **high sensitivity thermal power** (or heat flow) **sensors**, located around an enclosure where the container to be characterized is placed. An empty container is inserted in a so-called reference enclosure, to improve the measurement's stability.

HEAT-CHECK MV

FOR THE MOST ACCURATE QUANTIFICATION OF MEDIUM CONTAINERS

MEASUREMENTS OF MEDIUM VOLUME WASTE OR CONTAINERS

Up to 20 to 60 liters

QUANTITATIVE AND NON-DESTRUCTIVE MEASUREMENTS

With the highest accuracy for isotopes like plutonium or tritium

RESULTS INDEPENDENT OF MATRIX AND CONDITIONING EFFECTS

Ideal addition to gamma spectrometry

SOFTWARE AND AUTOMATION OPTIONS

For simple and safe use

PERFORMANCE		
Lower quantification limit*	**Tritium**	5 to 30 mg
	Plutonium	0.8 to 5 g
	Others	Following the specific activities of the materials to characterize
Higher quantification limit*	**Tritium**	9 to 77 g
	Plutonium	1.5 to 13 kg
	Others	Following the specific activities of the materials to characterize
Measurement accuracy		Better than 1%
Measurement precision		Better than 0.5%
Measurement time**		3 to 4h

GENERAL		
Container volume		Up to 20 or 60 L, others on request
Temperature control of containers	**System**	Water or air flow
	Range	25 to 40°C
Dimensions (WxDxH)		970 x 830 x 1240 to 1 430 x 1 130 x 1 230
Weight		660 to 1000 kg

* Following the limit in mW and the specific power of the radionuclide in mW/g

** Varies considerably with the mass, thermal conductivity and container shape. The measurement time indicated includes the use of predictive calculation algorithms.

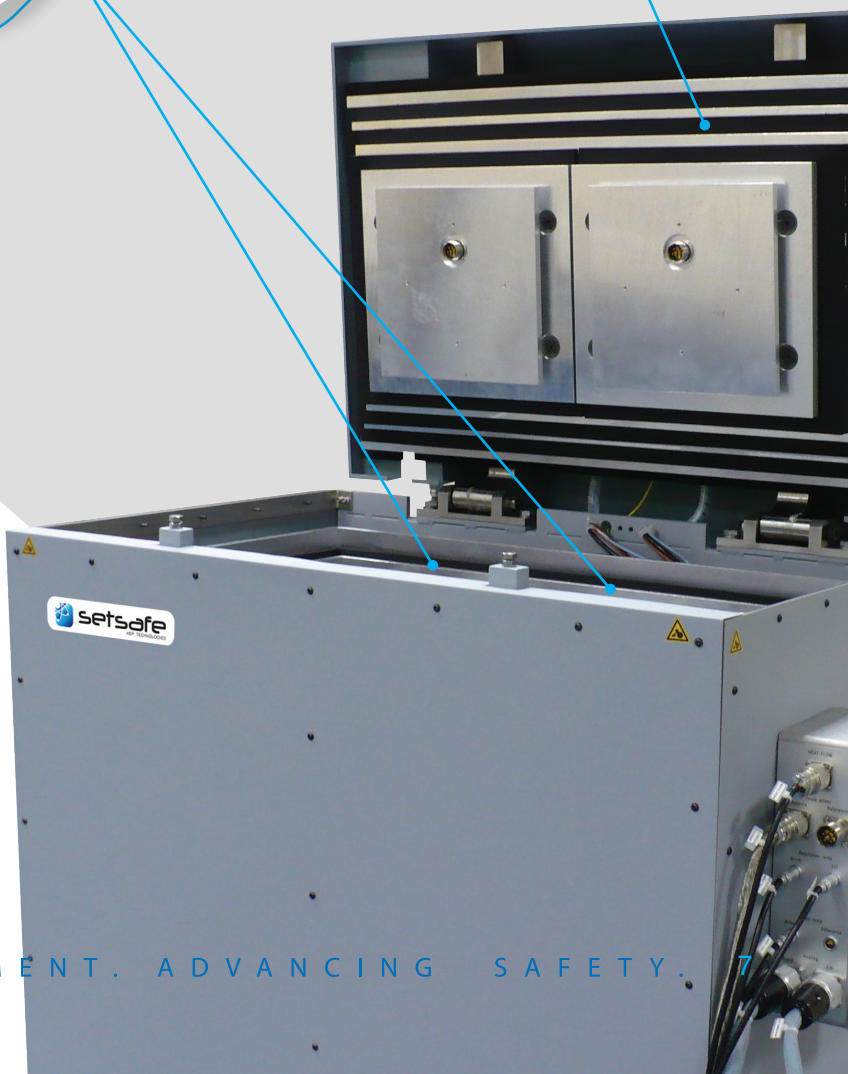
CHARACTERIZATION OF MEDIUM SIZE CONTAINERS

The software has:
- A standard and an expert mode for operators with various qualifications
- An algorithm for predictive calculations, that **improves testing throughput**
- A module for coupling with gamma spectrometry data to measure **the mass of each isotope** in the container.

Measurement is made possible thanks to **high sensitivity thermal power (or heat flow) sensors,** located around an enclosure where the container to be characterized and a reference enclosure are placed. The number and position of the sensors may be adjusted during the design phase, based on the required detection range and specific power of the isotopes to be measured.

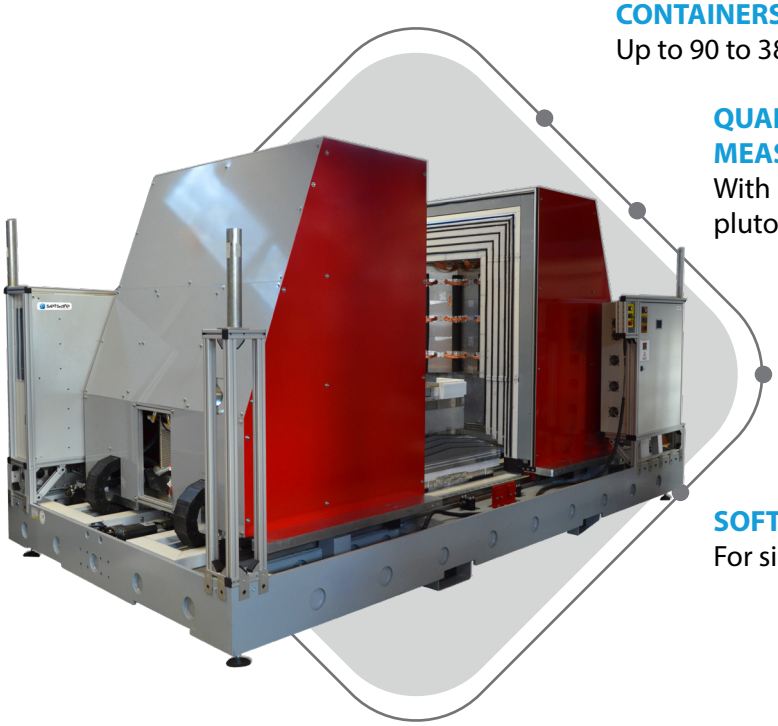
Measurement quality also relies on the **fine control of the containers' temperature,** thanks to an air or water-based regulation and multi-layer insulation.

Our engineering and automation skills are applied in solutions including **automated container handling** or even **automated measurement lines.**



HEAT-CHECK LV

FOR THE MOST ACCURATE QUANTIFICATION OF LARGE CONTAINERS



MEASUREMENTS OF LARGE VOLUME WASTE OR CONTAINERS
Up to 90 to 380 liters

QUANTITATIVE AND NON-DESTRUCTIVE MEASUREMENTS
With the highest accuracy for isotopes like plutonium or tritium

RESULTS INDEPENDENT OF MATRIX AND CONDITIONING EFFECTS
Ideal addition to gamma spectrometry

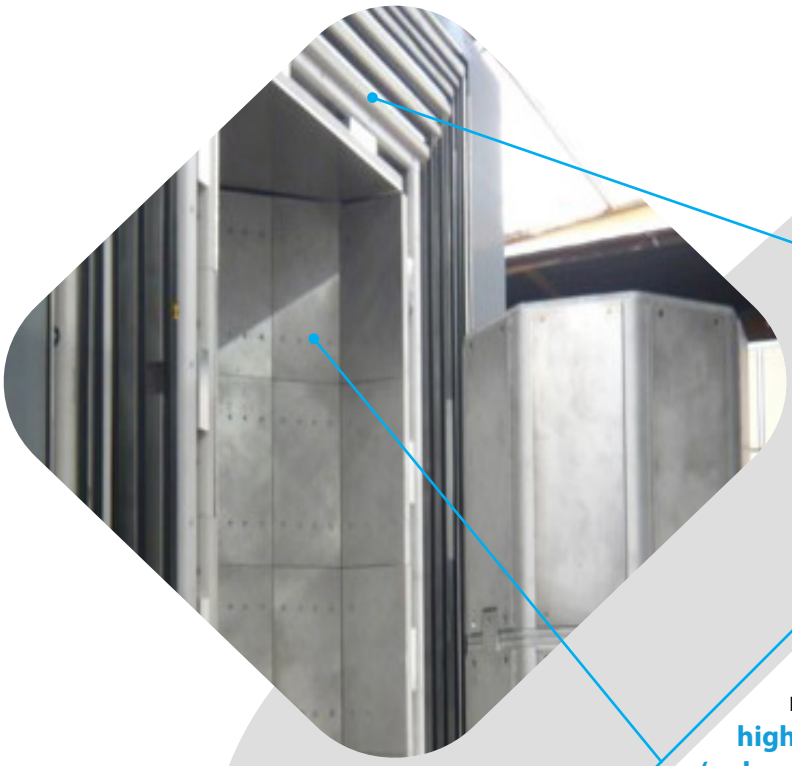
SOFTWARE AND AUTOMATION OPTIONS
For simple and safe use

PERFORMANCE		
Lower quantification limit*	**Tritium**	30 to 45 mg
	Plutonium	5 to 8 g
	Others	Following the specific activities of the materials to characterize
Higher quantification limit*	**Tritium**	9 to 80 g
	Plutonium	1.5 to 13.5 kg
	Others	Following the specific activities of the materials to characterize
Measurement accuracy		Better than 1%
Measurement precision		Better than 0.5% to 1 %
Measurement time**		5 to 10h

GENERAL		
Container volume		Up to 90 or 380 L, others on request
Temperature control of containers	**System**	Water or air flow
	Range	25 to 40°C
Dimensions (WxDxH)		1500 x 1000 x 1260 to 4260 x 2400 x 3010
Weight		1200 to 12000 kg

* Following the limit in mW and the specific power of the radionuclide in mW/g
** Varies considerably with the mass, thermal conductivity and container shape. The measurement time indicated includes the use of predictive calculation algorithms.

CHARACTERIZATION OF LARGE CONTAINERS



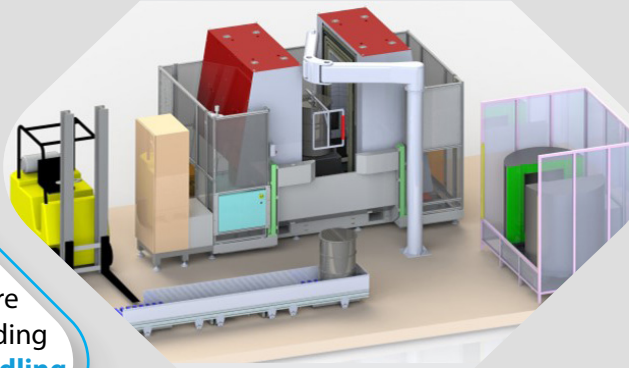
Measurement quality also relies on the fine control of the containers' temperature, thanks to an air or water-based regulation and multi-layer insulation.

Measurement is made possible thanks to **high sensitivity thermal power (or heat flow) sensors**, located around an enclosure where the container to be characterized is placed. For very large dimensions:

- An internal reference is used to limit the instrument's dimensions (Patented Technology WO 2014/111382 A1)
- The container is loaded on the front of the instrument, the enclosure being split in two half-shells.

The software has:

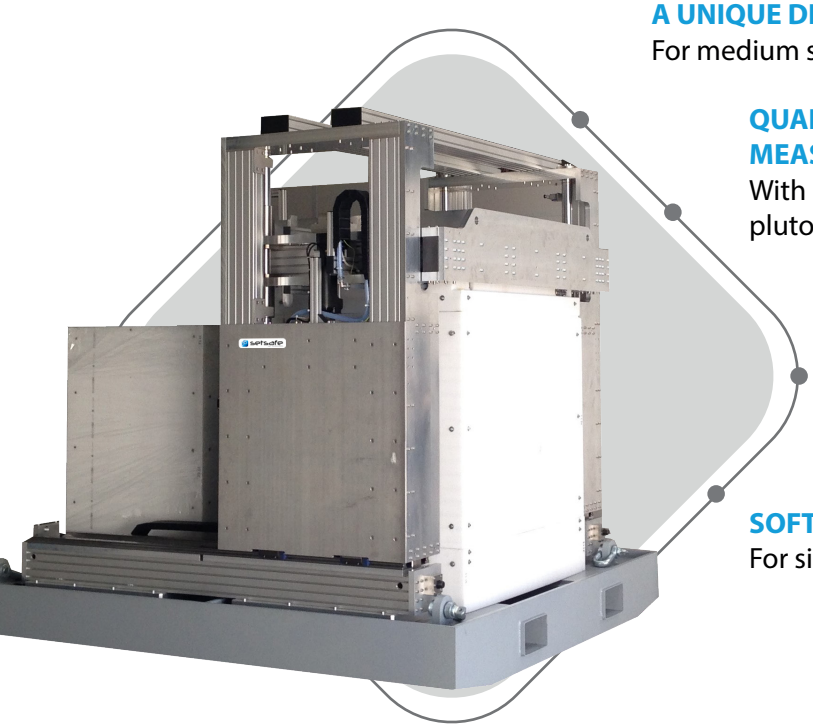
- A standard and an expert mode for operators with various qualifications
- An algorithm for predictive calculations, that **improves testing throughput**
- A module for coupling with gamma spectrometry data to measure **the mass of each isotope** in the container.



Our engineering and automation skills are applied in solutions including **automated container handling** or even **automated measurement lines.**

HEAT-CHECK ULTRA

FOR THE MOST SENSITIVE MEASUREMENTS



A UNIQUE DETECTION LIMIT

For medium size container characterization

QUANTITATIVE AND NON-DESTRUCTIVE MEASUREMENTS

With the highest accuracy for isotopes like plutonium or tritium

RESULTS INDEPENDENT OF MATRIX AND CONDITIONING EFFECTS

Ideal addition to gamma spectrometry

SOFTWARE AND AUTOMATION OPTIONS

For simple and safe use

PERFORMANCE		
Lower quantification limit*	**Tritium**	0.3 mg
	Plutonium	0.05 g
	Others	Following the specific activities of the materials to characterize
Higher quantification limit*	**Tritium**	1.5 g
	Plutonium	260 g
	Others	Following the specific activities of the materials to characterize
Measurement accuracy		Better than 1%**
Measurement precision		Better than 1%
Measurement time**		48 h
GENERAL		
Container volume		Up to 40 L, others on request
Temperature control of containers	**System**	Water flow or oil
	Range	36°C
Dimensions (WxDxH)		2400 x 3000 x 2600 mm
Weight		9000 kg

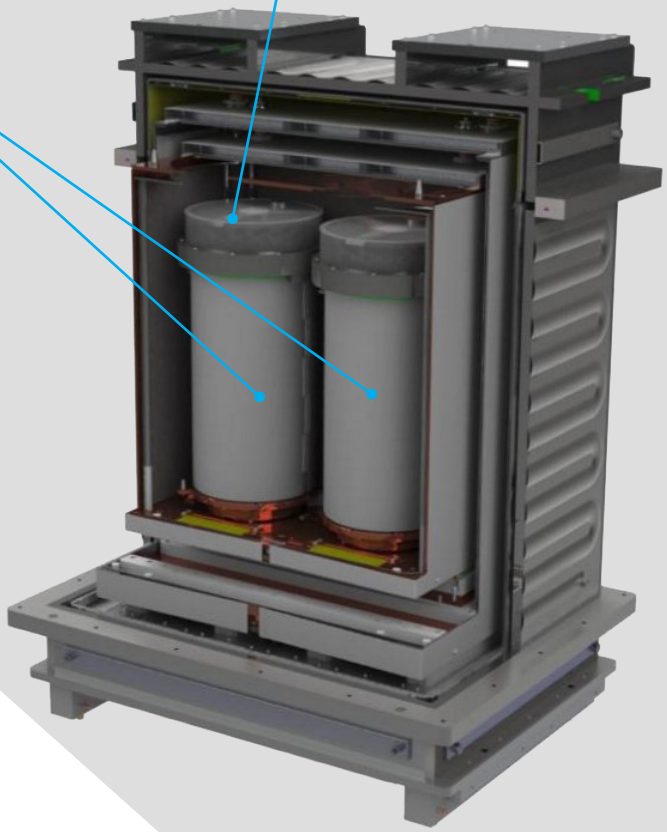
* Following the limit in mW and the specific power of the radionuclide in mW/g

** Varies considerably with the mass, thermal conductivity and container shape. The measurement time indicated includes the use of predictive calculation algorithms.

HIGH SENSITIVITY CHARACTERIZATION

HEAT-CHECK ULTRA uses, on top of a classical multi-layer insulation, **an external enclosure placed under high vacuum**. Its outer walls are set to a constant temperature thanks to water circulation.

The thermal power sensors are placed below two enclosures where the container to be characterized and the reference both sit. They are designed so that the smallest thermal effect is transferred to the sensors. This concept provides **HEAT-CHECK ULTRA with a unique detection limit** of 100 microwatt.



The software has:

- A standard and an expert mode for operators with various qualifications
- A module for coupling with gamma spectrometry data to measure **the mass of each isotope** in the container.

HEAT-CHECK FAST
FOR FASTER MEASUREMENTS

INHERENTLY FASTER
Up to 30% time saved for equivalent container volumes, even without predictive calculation

QUANTITATIVE AND NON-DESTRUCTIVE MEASUREMENTS
With the highest accuracy for isotopes like plutonium or tritium

RESULTS INDEPENDENT OF MATRIX AND CONDITIONING EFFECTS
Ideal addition to gamma spectrometry

SOFTWARE AND AUTOMATION OPTIONS
For simple and safe use

PERFORMANCE		
Lower quantification limit*	**Tritium**	90 mg
	Plutonium	15 g
	Others	Following the specific activities of the materials to characterize
Higher quantification limit*	**Tritium**	9 g
	Plutonium	1.5 kg
	Others	Following the specific activities of the materials to characterize
Measurement accuracy		1.5%
Measurement precision		Better than 1%
Measurement time**		2 to 3 h

GENERAL		
Container volume		Up to 15 L, others on request
Temperature control of containers	**System**	Air flow
	Range	30 °C
Dimensions (WxDxH)		1100 x 790 x 920
Weight		500 kg

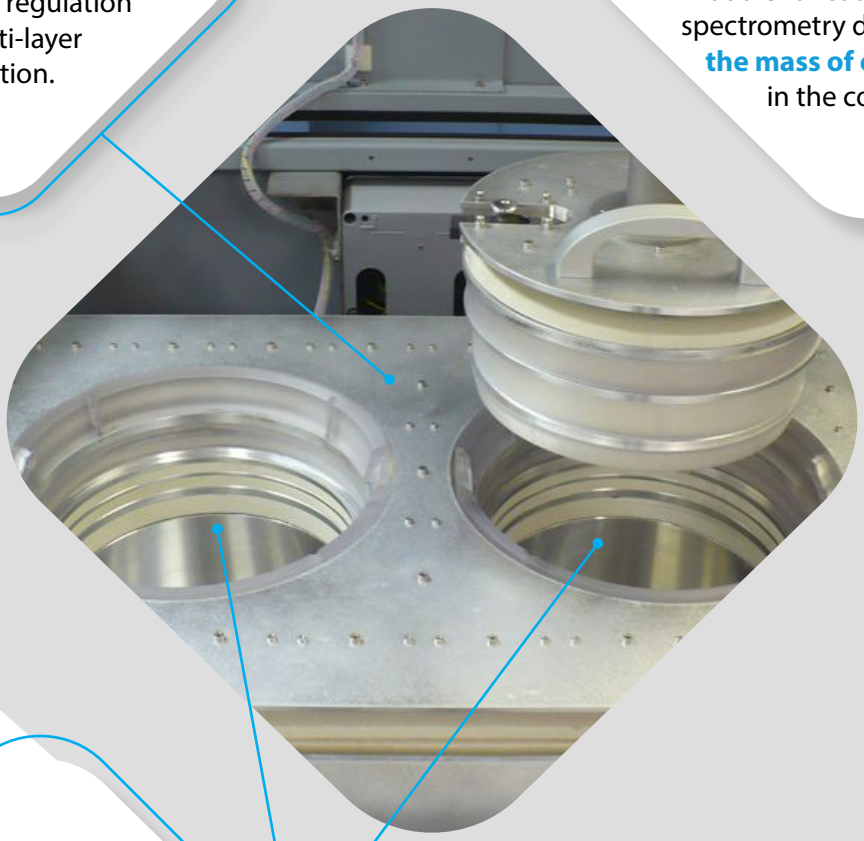
* Following the limit in mW and the specific power of the radionuclide in mW/g
** Varies considerably with the mass, thermal conductivity and container shape. The measurement time indicated includes the use of predictive calculation algorithms.

FASTER CHARACTERIZATION

Measurement quality also relies on the fine control of the containers' temperature, thanks to an air or water-based regulation and multi-layer insulation.

The software has:

- A standard and an expert mode for operators with various qualifications
- An algorithm for predictive calculations, that **improves testing throughput**
- A module for coupling with gamma spectrometry data to measure **the mass of each isotope** in the container.



HEAT-CHECK FAST measures heat using the compensation principle. It is based on the acquisition of the necessary power used to maintain the calorimeter at a set temperature, when it holds a container to be characterized. **This principle is faster than the usual thermal flow measurement.** HEAT-CHECK FAST still has both a measurement and a reference enclosure for better thermal stability.

EC • Specifications are given as indications only and are not contractual - 01/21

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