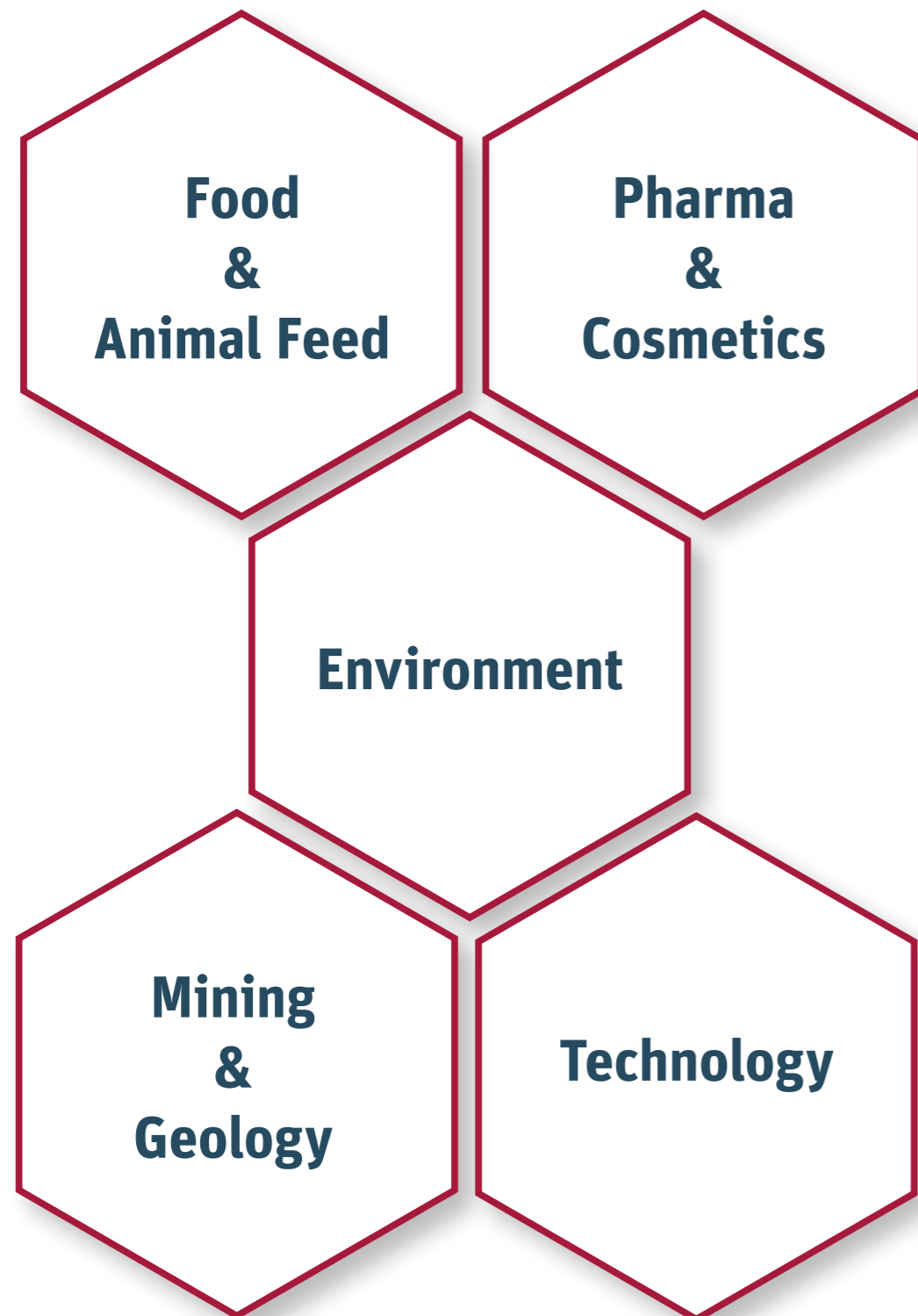


Applications



BERGHOF PRODUCTS + INSTRUMENTS GMBH

Speedwave[®]
Microwave sample preparation
to suit all needs



BERGHOF PRODUCTS + INSTRUMENTS GMBH

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Trace analysis comprises complex tasks:

From digestion systems for simple sample preparation in routine analysis to systems for complex samples: With the Speedwave® microwave digestion systems, the digestec pressure digestion systems and the Distillacid acid purification instrument, you will find the right solution for your needs at Berghof for sure.

digestec DAB

Large quantities of samples or most complicated samples? No problem with the Digestec DAB!



- Very easy to use
- Digestion of any kind of samples possible
- Extremely reliable and safe operations

distillacid BSB939-IR

Cutting the costs for ultra-pure acids by in-house purification



- Typically pays for itself within one year
- Metal-free system, made exclusively of TFM™-PTFE, PFA and PP, excluding contamination

speedwave® ENTRY

Simple samples in the sectors of food and environment quickly and safely digested



- Minimum operating costs thanks to durable vessels
- Easy and intuitive operation
- Active cooling with exhaust system

speedwave® XPERT/XTRACT

For professional microwave sample preparation in the fields of environment, food, pharma, geology and material science.



- Minimum operating costs thanks to extremely durable TFM™-PTFE
- Easy and intuitive operation
- Meets highest quality & safety standards

A unique combination – to your benefit

The high-performance plastic TFM™-PTFE stands out for its excellent chemical resistance and is able to resist service temperatures of up to 260°C. The extremely nonstick surface, combined with minimal microporosity and hydrophobic behavior ensures minimal cross-contamination and very easy cleaning. That's why we rely on this unique material when manufacturing our laboratory equipment. The production by our sister company Berghof Fluoroplastic Technology GmbH, which has been specializing in PTFE for more than 5 decades, guarantees very high material purity and quality. A unique combination!



→ TFM™-PTFE vessels with unique durability
→ Reproducible results

Minimum operating costs – guaranteed

HOW TO KEEP YOUR RUNNING EXPENSES IN CHECK

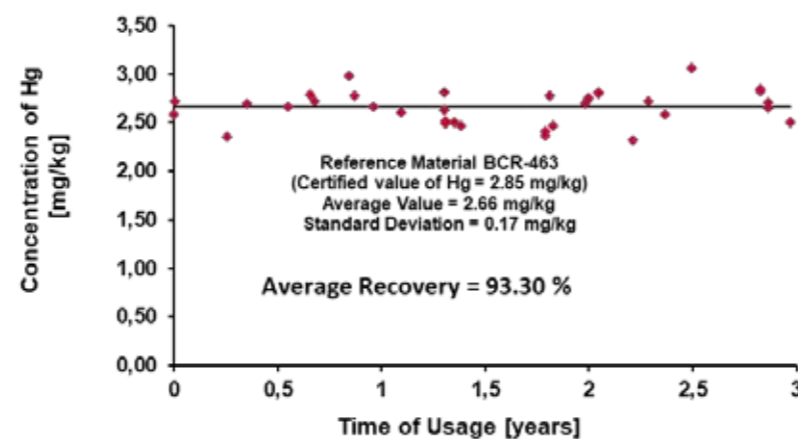


- Only at Berghof vessels are not subject to wear and tear
- That's why we are the only supplier on the market to include vessels in our warranty
- 5-year minimum durability of vessels
- 5-year extended warranty available

REPRODUCIBLE RESULTS

Our unique TFM™-PTFE vessels of our own production guarantee you

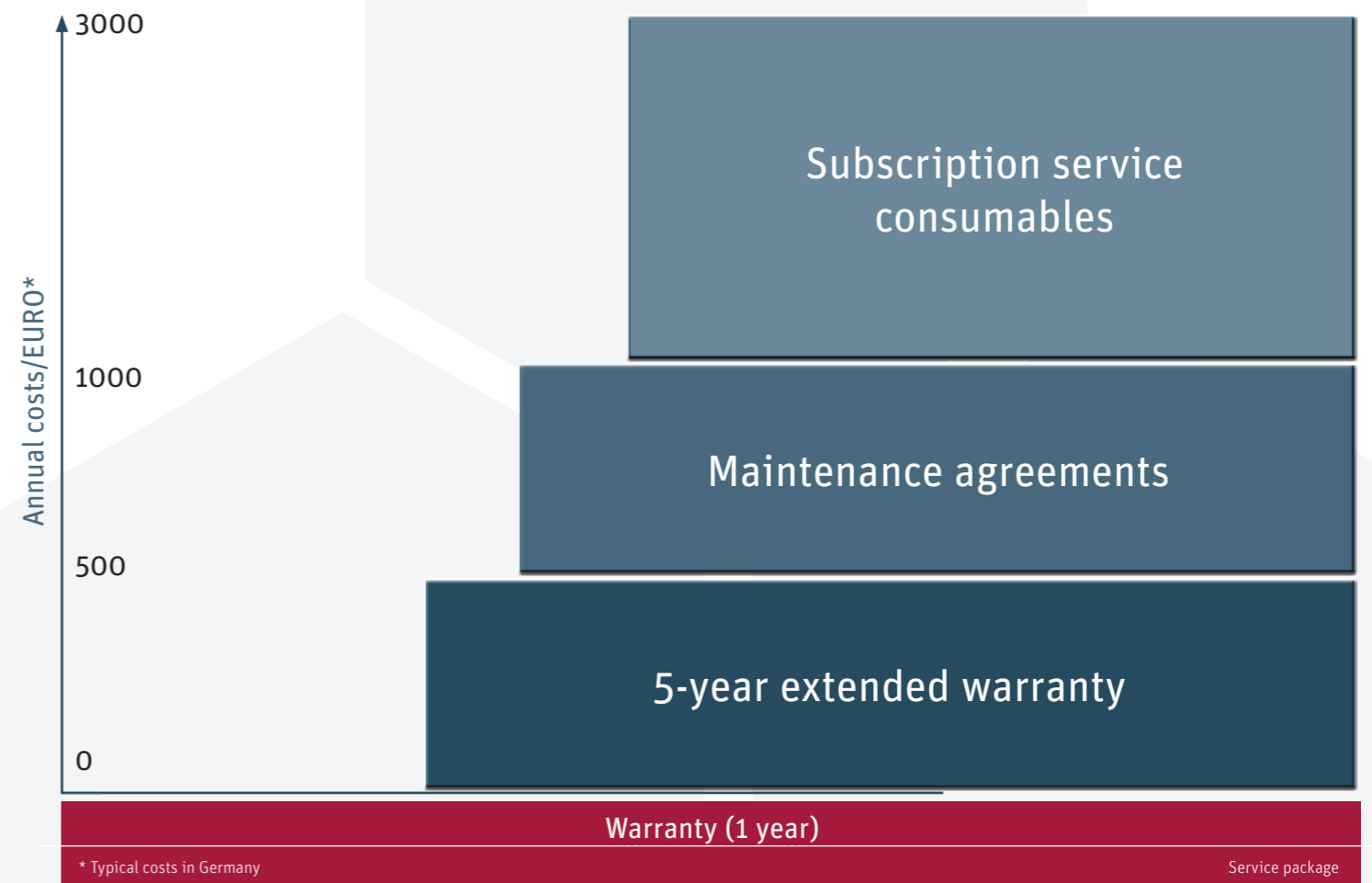
- Maximum quality and purity
- No cross-contamination – thanks to minimal surface porosity
- Easy and fast cleaning



Service offerings keep operating costs under control

OUR SERVICE – YOUR BENEFIT:

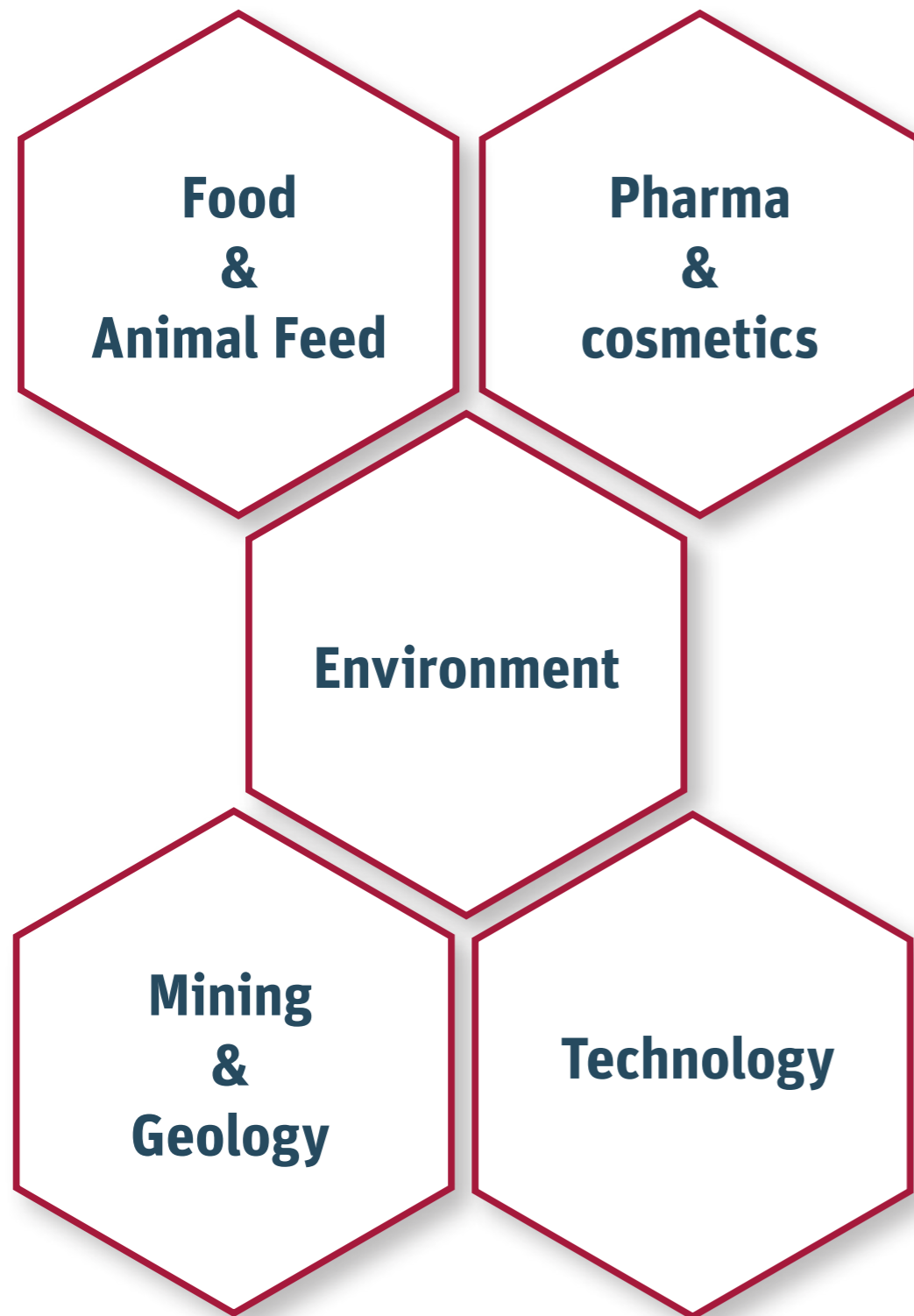
- Warranty (1 year, basic instrument and vessels)
- Maintenance agreements avoid down-times
- Extended warranty reduce repair costs
- Consumables subscription control costs on consumables



* Typical costs in Germany

Service package

Applications



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speedwave® XPERT

Microwave sample preparation
to suit all needs

Berghof Swing-Top

The robust top-loading microwave oven offers maximum user convenience. The vessels can be individually inserted into the rotor and removed again. Never again laborious transportation of packed rotors!



Corrosion protection

- High-quality oven coatings ensures the long-lasting value of the system

TFM™-PTFE vessels

- Easy operation with only 3 different parts
- Opening and closing without any tools
- Only Berghof extends warranty to vessels

Operating at a minimum of noise

- Dynamic control of the exhaust units

Dual microwave system

- Two magnetrons providing for high performance

Gas sampling system

- Connecting all digestions vessels
- Avoiding emissions

speedwave® XTRACT

Solvent Safety Module

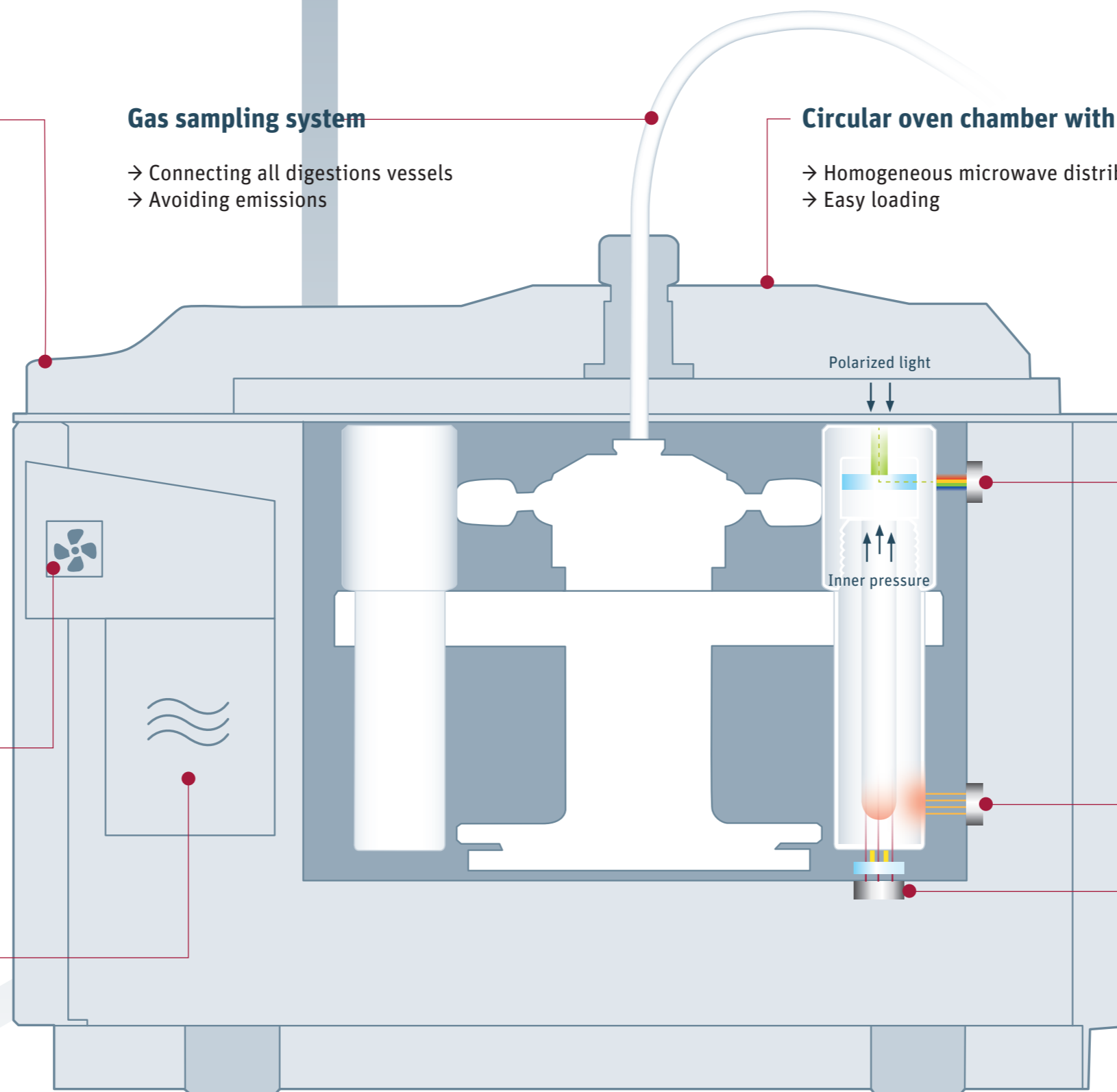
- Allows safe working with highly flammable solvents

Stirring

- Magnetic stirrer with stirring bar in each container

Circular oven chamber with TOP-Loading

- Homogeneous microwave distribution
- Easy loading



speedwave® OPC

- Patent-protected optical pressure monitoring
- Touch-free measurement of internal vessel pressures in real time
- No reference vessels necessary

speedwave® OTC

- Touch-free measurement of surface temperatures of all vessels in real time
- Increased safety and durability of the digestion vessels
- Individually programmable temperature limitation

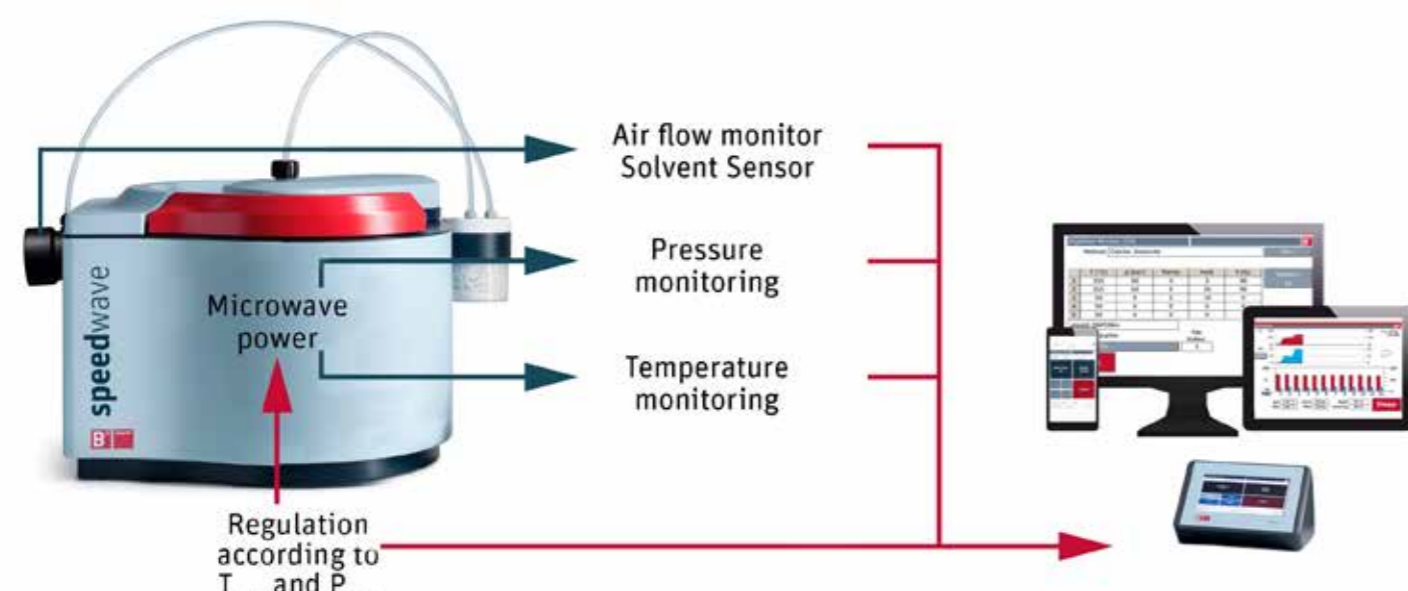
speedwave® DIRC

- Patent-protected optical temperature monitoring
- Touch-free measurement of all sample temperatures in real time
- No reference vessels necessary

speedwave® XPERT – sensor technology

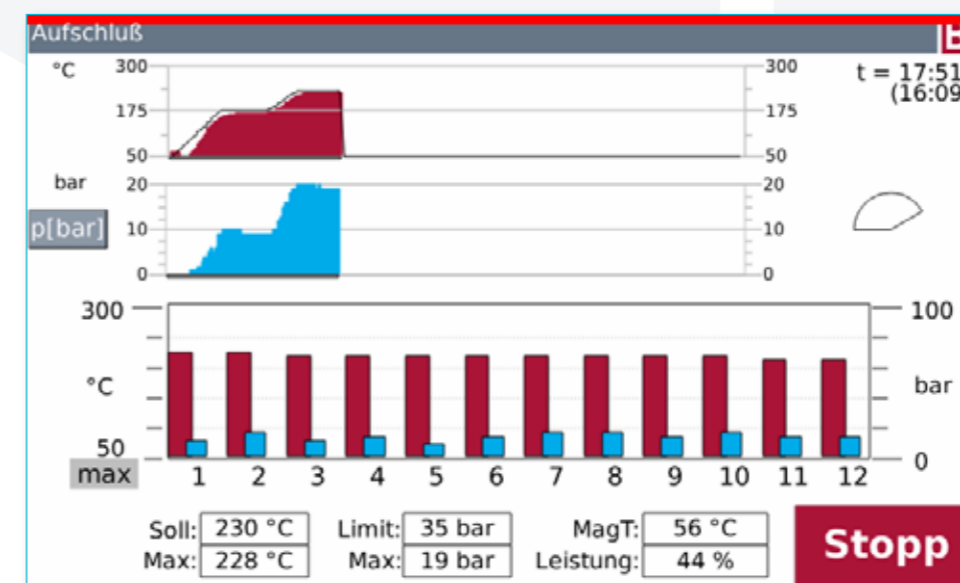
TEMPERATURE MEASUREMENT AND PRESSURE MONITORING

In order to minimize safety risks due to non-uniform heating or spontaneously induced exothermic reactions, permanent monitoring of the reaction parameters pressure and temperature is of particular importance. Since samples rarely behave identically during digestion, monitoring of the reaction parameters pressure and temperature in each vessel is essential. The optical sensor technology developed and patent-protected by Berghof is not only responsible for measuring pressure and temperature, it also controls, based on this data, the microwave power – thus improving safety quite decisively.



Being always in the picture

The Berghof optical sensor technology records pressure and temperatures of all samples contact-free and individually. You can see all data in real time on the 7" display or on connected mobile devices. So at any time, you have an overview of the digestion process and full traceability – for each vessel and each sample.



BENEFITS OF OPTICAL TEMPERATURE AND PRESSURE MONITORING

→ Reproducible digestions and extractions

The Speedwave® Xpert measures all parameters without delay regulating the irradiated wave power accordingly.

→ Minimization of contamination risk

The optical sensors of Speedwave® Xpert do not come into contact with the samples at any time. This avoids contamination.

→ Easy to use

Thanks to non-contact temperature measurement and pressure monitoring using optical sensors, you do not need to additionally wire control vessels or equip them with temperature probes.

→ Improved safety

The Speedwave® Xpert controls the microwave power according to the measured T and P data effectively preventing critical conditions.

SENSOR TECHNOLOGY IN DETAIL

→ Optical Pressure Control (OPC)

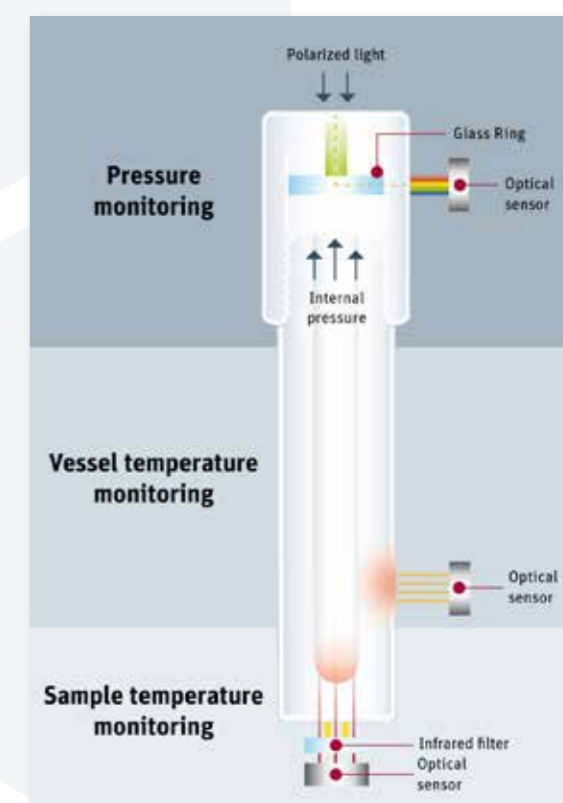
Pressure control of all vessels in real time

→ Optical Temperature Cut-Off (OTC)

Optical capture of vessel surface temperature

→ Direct Infrared Control (DIRC)

capture of all sample temperatures in real time



speedwave® XPERT – SafePrep

We have designed and developed the Speedwave® Xpert especially for digestion applications and the handling of hot, concentrated mineral acids. The result is a system that has been thought out in meticulous detail and that is characterized not least by the consistent **SafePrep** safety concept. Berghof makes no compromises here. The oven chamber and the digestion vessels are robust and durable, technical protective measures effectively prevent corrosion and the sophisticated sensor system reliably wards off critical situations. Consequently, our **SafePrep** concept guarantees you maximum safety.



Corrosion prevention

- Permanent ventilation of the oven chamber
- Safe expulsion of acid fumes by means of gas sampling system
- Neutralization of acid fumes
- High-quality oven coatings

Vessels

- Completely made of acid resistant TFM™-PTFE
- Safe opening with monitored removal of remaining pressure
- Overpressure safeguard via rupture discs or **SafeVent** Technology

Solvent Safety

speedwave® XTRACT

- Allows safe working with highly flammable solvents
- Permanent ventilation exchanges air in the oven chamber 100 times per minute
- Air flow monitor ensures permanent oven ventilation
- Solvent sensor detects solvent vapours

Special sensor technology

- Real-time control of all critical parameters
- T-monitoring of all samples
- P-monitoring of all samples



Automatic shut-off device

- In case of insufficient oven ventilation
- As soon as solvents escape

Robust Oven design

- Microwave oven especially designed for digestions
- Robust, pressure-resistant, PFA-coated stainless steel oven
- Swing-Top with electronic locking lid



speedwave® XPERT – vessel options

NUMEROUS VARIANTS FOR A WIDE RANGE OF APPLICATION

Our sister company Berghof Fluoroplastic Technology GmbH, which has been specializing in the production of high-performance plastics for more than 50 years, manufactures the Speedwave® Xpert vessels strictly observing the highest quality standards. They are made of high-quality TFM™-PTFE convincing with their reliability and above-average durability. The volumes of the vessels cover a wide range, from 40 to 100 ml. By using multiple crucible systems or quartz glass inserts, the use of the vessels can be made even more variable, so that you can use our Speedwave® Xpert for almost all applications in the field of microwave digestion.

The vessels consist of a few individual parts. They can be easily opened and closed by hand without additional tools. When the vessels are opened, the remaining pressure escapes safely and in a controlled manner. For overpressure protection, the vessels are equipped with either a bursting safety device or **SafeVent** pressure control.

During operation, all vessels are connected to a gas sampling system. This system absorbs any acid vapors that may be released and leads them to the exhaust air instead of blowing them off into the oven chamber.



DAP-60	DAP-100	DAK-100	TS-85X	TS-85S
12 positions	12 positions	8 positions	16 or 32 positions	16 positions
Food, Feed, Pharma, Cosmetic, Environment Geology, Technology		Geology, Plastics, High sample weights	Food, Feed, Pharma, Cosmetic, Environment	Solvent extraction
<300 mg organic <1 g inorganic sample	<400 mg organic <1 g inorganic sample	<1 g organic <3 g inorganic sample	<1 g organic <2 g inorganic sample	1-20 g organic inorganic samples

NEW

TS-85 vessels for high efficiency

Our new TurboSafe rotors are ideal for laboratories with high sample throughput – and thus predestined for environmental analysis, food analysis and pharmaceuticals. 32 or 16 samples can be digested at the same time – and the vessels convince with easy closing / opening in no time.

- Very easy to use
- Automatic SafeVent pressure control in each vessel
- No loss of volatile analytes
- Gas sampling system, no blowing off into the oven chamber
- In-Situ DIRCaund OTC temperature monitoring of all vessels
- Cool-down time max. 15 min.
- Ideal for organic samples up to a weight of 1g



External Controller

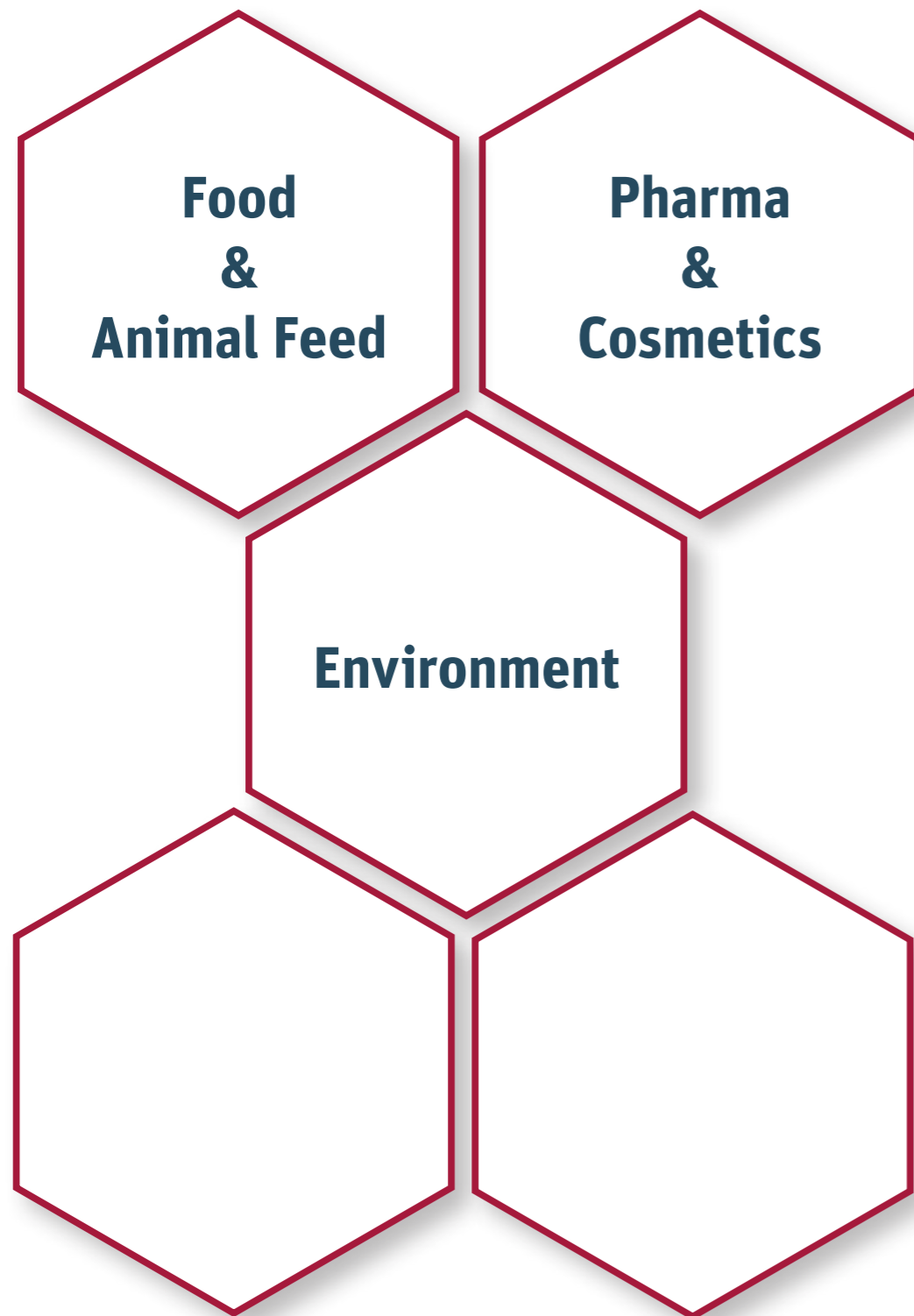
Equipped with a high-resolution, color touchscreen display as well as featuring operability via mobile devices, the external controller provides for intuitive and flexible control. The extensive application database supports you in selecting the right digestion program.

COMPLYING WITH PHARMA REGULATIONS

An optional software package, compliant with 21 CFR Part 11, is available for the Speedwave® Xpert. The software package includes user management, password protection, audit trail, documentation, and export and print functions. We also offer an IQ/OQ package for the Speedwave® Xpert. This qualification package ensures that the Speedwave® Xpert complies with legal requirements during use. Because the combination of 21 CFR Part 11-compliant control and IQ/OQ package enables continuous traceability and documentation on the use of the Speedwave® Xpert. This guarantees that the Speedwave® Xpert complies with internationally applicable regulations in the pharmaceutical sector, in particular those of the FDA and GLP/GMP or GAMP.



Applications



BERGHOF PRODUCTS + INSTRUMENTS GMBH

speedwave® ENTRY The efficient instrument



Stripped down to the essentials

Ideal solution for routine analysis in research institutions, for training and at universities.

- Cost efficient
- Safe
- User friendly

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Easy, safe and efficient

Perfect for routine analysis, study and training

Corrosion-resistant oven coating



Exhaust unit connection

- The additional exhaust unit ensures that the samples cool down faster
- Maximum sample throughput possible

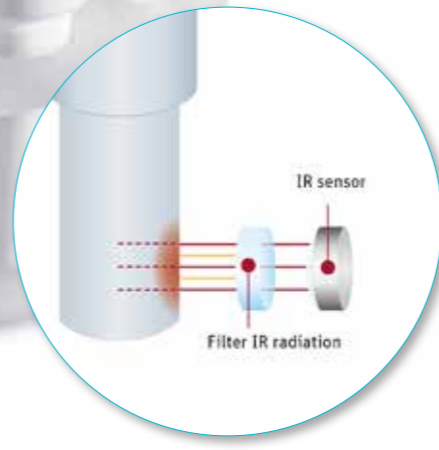


Vessels made of TFM™-PTFE

- Easy to use thanks to only three components
- Manual Opening and closing without tools
- Outstanding quality digestion vessels made of isostatically molded TFM™-PTFE with improved surface structure and minimum porosity
- Only Berghof extends warranty to vessels

Integrated Gas sampling system

- Safe interception and removal of released gases



speedwave® DIRC

- Optical measurement of sample temperature, no reference vessels necessary
- Touch-free measurement of thermal radiation in the mid infrared range, in which the materials TFM™-PTFE and quartz cannot absorb radiation
- Filtering out infrared radiation emitted from the surface of the pressure vessels leads to exceptionally precise measurement results
- Reliable reaction monitoring by temperature detection in real time

InSight

- Illuminated oven chamber
- During the complete digestion process, you can have an eye on the rotor and the samples

Filter IR radiation

QuickStart

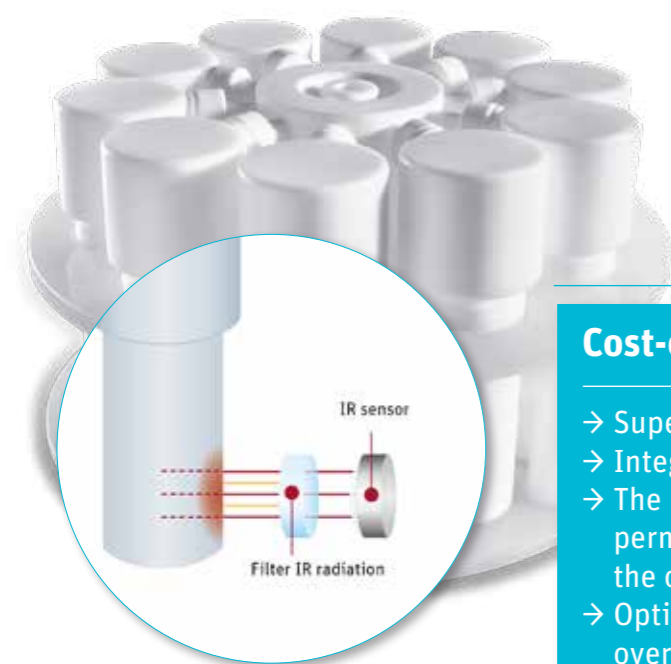
- Intuitive operating software
- Only requires two key presses to start
- Pool of pre-installed applications, including the latest DIN and EPA standards
- Temperature program for individual configuration



speedwave® ENTRY

STRIPPED DOWN TO THE ESSENTIALS

The Speedwave® Entry shows its strengths in application areas where cost efficiency is a key issue. Therefore, it is often used in routine analysis for standardized digestions in research institutions, for training and at universities.



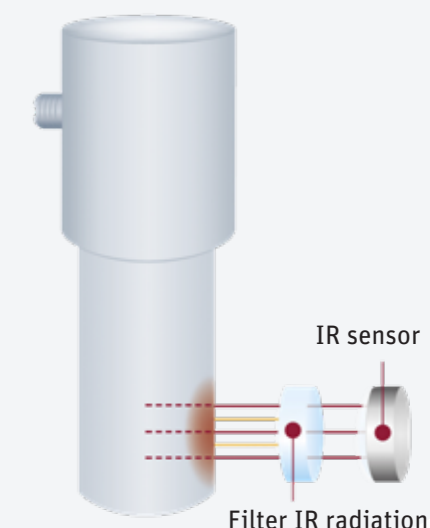
Cost-efficient

- Superior durability of TFM™ PTFE pressure vessels
- Integrated gas sampling system
- The Durability of the instrument is prolonged by permanent ventilation and removal of all vapors from the oven chamber
- Optical temperature monitoring protects vessels from overheating
- External ventilation system (recommended for HF und HCl)
- Corrosion-resistant oven coating

speedwave® ENTRY vessels

PATENT-PROTECTED SENSOR TECHNOLOGY

The patented optical measuring method Speedwave® Dirc provides for direct and non-contact real-time measurement of the sample temperature in the digestion vessel. We monitor the temperature inside the vessels by using infrared radiation. In contrast to other suppliers, we do not use a reference vessel to monitor the sample temperature. Instead, we permanently check all vessels in real time reading out the maximum sample temperature.



SURVEY OF VESSEL TYPES

	DAP-60K	DAQ-10
Volume	60 ml	10 ml
Operating pressure	40 bar	75 bar
Operating temperature	230° C	230° C
Rotor	10 vessels	24 vessels

Reproducible & efficient

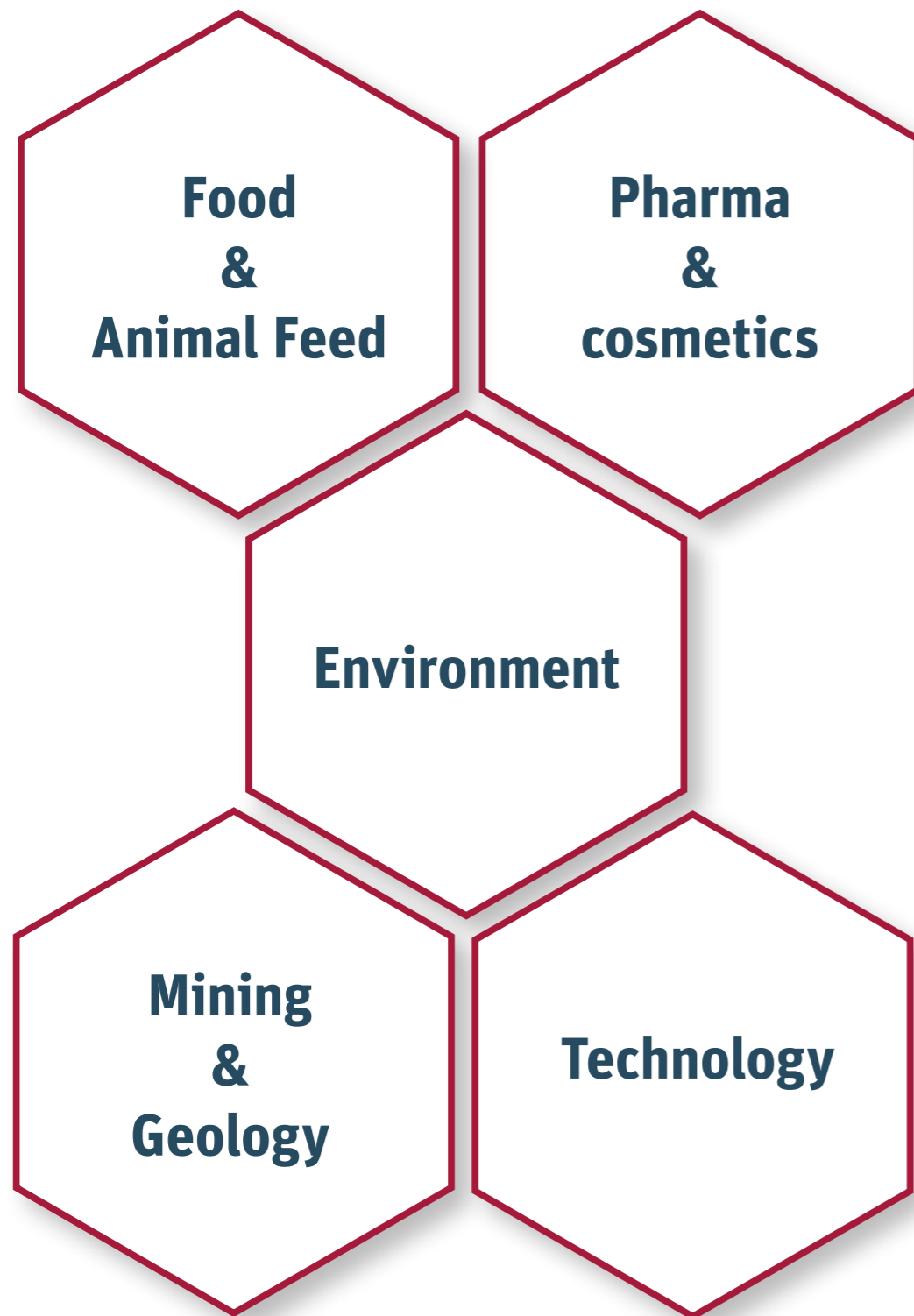
- No cross-contamination thanks to minimal porosity of the vessel surface
- Real-time monitoring of all sample temperatures
- Above average long durability of the vessels (more than 10,000 digestions)



Variable

- Intelligent vessel concepts for a wide range of applications:
- DAP-60K vessels are made entirely of TFM™-PTFE featuring high chemical resistance to all mineral acids and high mechanical strength
- DAQ quartz glass inserts enable the digestion of small sample volumes

Applications



BERGHOF PRODUCTS + INSTRUMENTS GMBH

digestec DAB
Pressure digestion vessels
Robust design



Robust digestion in pressure vessels up to 200bar/20°C and up to 72h.

→ The optimum solution for complex samples or quantities with a weight of up to 5g

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Technical specifications



diges^{tec} DAB-2 | DAB-3 | DAB-3 XXL

		DAB-2	DAB-3	DAB-3 XXL
General	Material	Stainless steel 316Ti (1.4571) combined with TFM™-PTFE		
	Max. temperature	250° C	250° C	250° C
	Max. pressure	200 bar	200 bar	200 bar
Reactor vessel	Inner diameter	39 mm	ca. 74 mm	ca. 74 mm
	Inner height	180 mm	183 mm	264 mm
TFM™-PTFE insert	Volume	ca. 25 ml / ca. 50 ml	ca. 150 ml / ca. 210 ml	ca. 420 ml
	Inner diameter	18 mm / 24 mm	44 mm / 53 mm	55 mm
	Inner height	108 mm / 108 mm	90 mm / 97 mm	176 mm
Instruments	Standard instruments	Rupture disk		
Heating (optional)	Heating block	✓	✓	✓

Product benefits

The Berghof Digestec pressure vessels DAB-2, DAB-3 and DAB-3 XXL impress users with their simple, user-friendly handling. Their robust design enables them to be used at pressures of up to 200 bar and maximum temperatures of up to 250 °C.



Safe

- Easy to handle and maximum user safety
- Bayonet lock for easy and fast opening and closing
- Overpressure protection by means of rupture disk
- Controlled pressure release during opening
- Designed and manufactured according to AD 2000 and Pressure Equipment Directive 2014/68/EU

Efficient

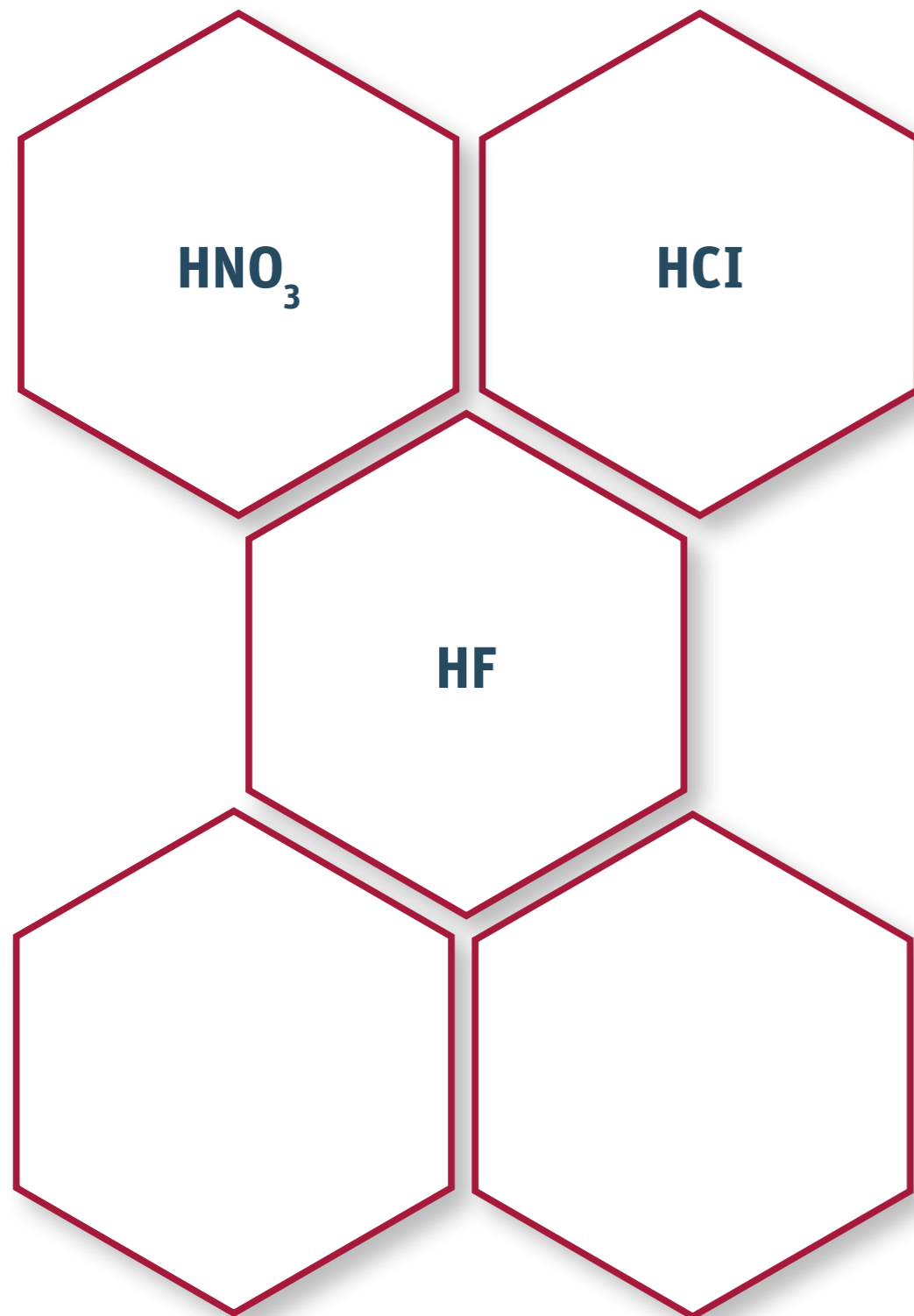
- Cost-effective use of DAB pressure vessels
- Long durability thanks to robust design
- High acid resistance by using TFM™ PTFE inserts
- Minimal risk of contamination thanks to easy cleaning of the TFM™ PTFE inserts
- Simultaneous heating of up to 12 pressure vessels

Modular structure

Vessels made of stainless steel 316 Ti (1.4571) combined with TFM™-PTFE inserts
→ Easy insertion and removal of PTFE inserts



Applications



LABORATORY INSTRUMENTS

Acid purification

High purity acids permanently available



Producing your own high-purity acids or recycling them

→ This means that high-purity acids are available cost-effectively at any time

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GETTING OUT OF THE COST TRAP

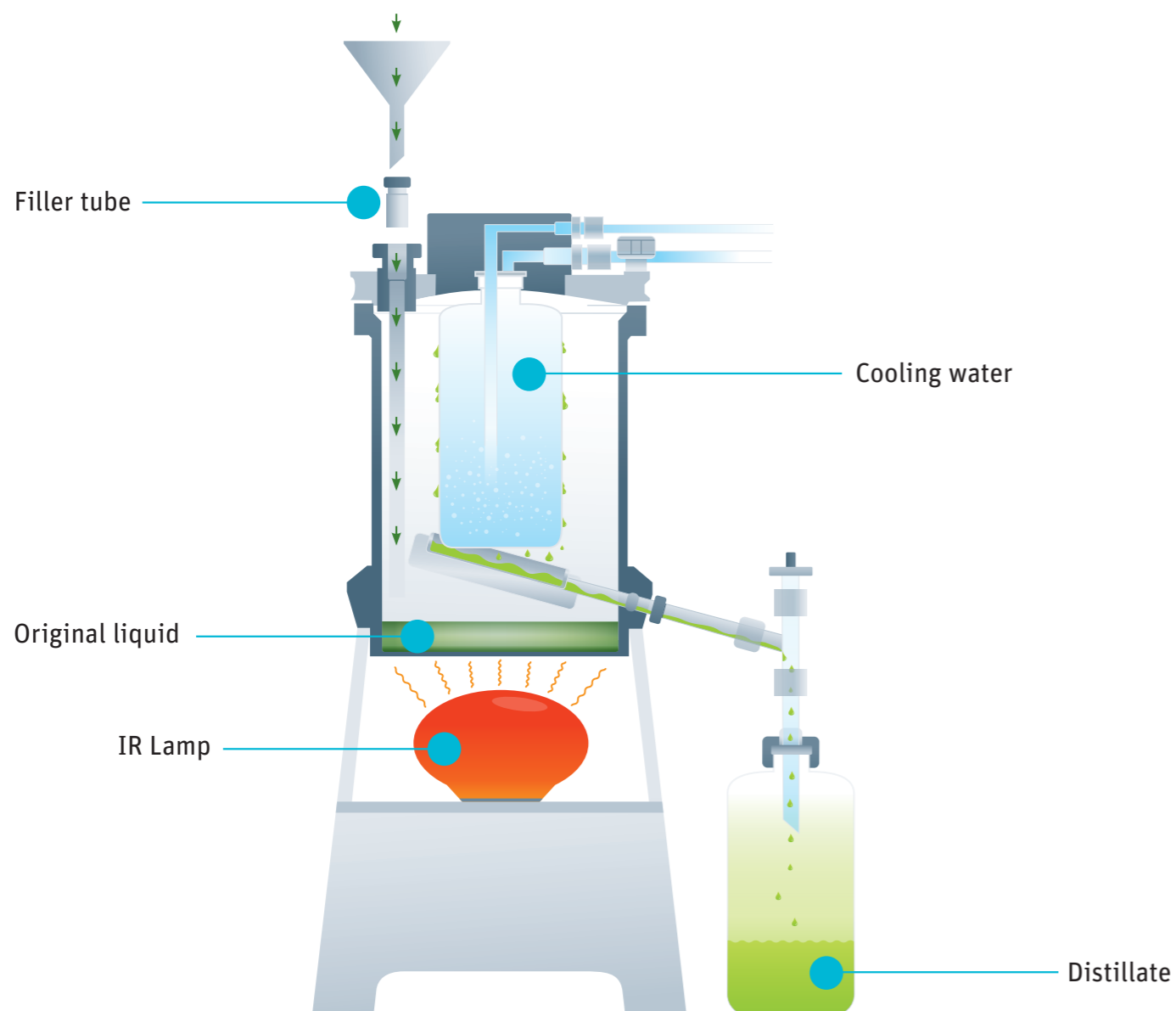
On the one hand, modern analytical laboratories have to perform high-quality analyses in the ultratrace range, but on the other hand they also have to minimize the costs for chemicals and consumables. The Berghof subboiling apparatus produces quality and pays for itself quickly. As a user, you benefit from absolutely pure acids at the lowest possible operating costs.

SUBBOILING-PRINCIPLE:

The subboiling apparatus is used to produce high-purity acids for ultratrace analysis. Via infrared heating, it distills the acid at temperatures of 10-20°C below the boiling point very carefully. This prevents the formation of droplets and aerosols and ensures a uniquely efficient purification.

→ Fields of application: HNO₃, HCL, HF und H₂O

→ Distillation volumes: **Less is more** – lower distillation volumes mean higher purity of the acid yielded.
In 24 h, approximately 1.2 L HNO₃, 1.1 L HCL, 1.0 L HF or 1.8 L H₂O are gained.



Distillacid

PURITY LEVELS



Unmatched purity

- Starting from p.a. qualities, high-purity acids with contaminations in the sub-ppb range are obtained
- **Multiple-Subboiling**
Leads to even purer acids at sup-ppt level
- **Cost-effective**
The system pays for itself within one year
- **High durability**
The system consists solely of high-purity materials such as TFM™-PTFE, PTFE and PP

Concentrations in ng/g (=ppb)		Concentrations in ng/g (=ppb)	
Ag	<0,05	In	<0,05
AL	0,2	K	0,6
As	<0,05	Li	<0,05
Au	<0,05	Mg	0,08
Ba	<0,05	Mn	<0,0 5
Be	0,1	Mo	<0,05
Bi	<0,05	Na	0,6
Ca	0,1	Ni	0,3
Cd	<0,05	Pb	<0,05
Co	<0,05	Sb	<0,05
Cr	<0,05	Sn	<0,05
Cu	<0,05	Sr	<0,05
Fe	0,25	Ti	0,1
Ga	<0,05	V	<0,05
Ge	0,4	Za	<0,05

Services

Berghof Products + Instruments GmbH

Technical Support – Service

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Pharmaceutical package

The combination of 21 CFR Part 11 compliant software and IQ/OQ package enables end-to-end traceability and documentation of the Speedwave® Xpert application.

This guarantees that Speedwave® Xpert complies with internationally applicable regulations when used in the pharmaceutical industry, especially those of the FDA and GLP/GMP or GAMP.



Pharma Software

Optional 21 CFR Part 11 compliant software for the Speedwave® Xpert. The software includes user management, password protection, audit trail, documentation, and export and print functions.



IQ/OQ-Packages

We offer an IQ/OQ package for the Speedwave® Xpert. This qualification package guarantees that the Speedwave® Xpert meets the legal and safety requirements.



MAINTENANCE AGREEMENTS

Berghof laboratory instruments stand for reliability and quality. To ensure their long-term efficient use and minimize downtimes, we offer you maintenance agreements with attractive conditions and flexible terms. We adapt the scope of service as well as the duration to your individual requirements.



EXTENDED WARRANTY

Durability and highest quality – Berghof microwaves convince users with an above-average durability. With Berghof extending warranty to instruments and digestion vessels, you as a customer also receive this additional security in writing, including legal claims for subsequent performance.

CONSUMABLES SUBSCRIPTION

The unique Berghof offering – to make sure you always have operating costs under control

- Up to 5-year warranty for basic instruments and vessels
- Consumables-subscription covering all typical consumables