BERGHOF

Microwave Digestion System

speedwave MWS-3+

Unique optical temperature and pressure monitoring of each individual sample during digestion.

BERGHOF realizing your ideas.

PRODUCTS + INSTRUMENTS

ZUNDEL Holding Enterprise

Features

Durable Digestion Vessels and Simplified Handling Reduces Operating Costs

For 10 years BERGHOF has successfully manufactured solid and durable TFM™-PTFE pressure vessels for microwave digestion applications and quotes 3 to 5 year service lives for its vessels, depending on their area of application and frequency of use. With this, pressure vessels are no longer seen as being consumables.

This allows users to annually save several thousands of Euros previously spent on replacement vessels.

Vent system prevents emissions and corrosion

All digestion vessels are sealed to a gas collection system which even in the event of a rupture disc bursting - safely captures and removes any released gases.
The oven chamber is continuously evacuated while the oven is running in order to contain any of gas or acidic vapor emissions.

Evaporating unit (optional)

BERGHOF offers a fuming unit that can be retrofitted to all digestion vessels for distillation fuming or concentrating acid solutions. This permits the simultaneous concentration of up to 12 acid solutions.

Safe, reproducible digestions thanks to optical reaction monitoring

Patented optical procedure to measure the temperature and pressure of each individual sample guarantees active and dependable reaction monitoring.
The sample material never comes into contact with sensors or probes.
Complicated connection of sensors to sample vessels is totally eliminated.

The right pressure vessel for every application

Task-specific pressure vessels made of high-quality TFM are available for every application area. They are characterized by their extraordinarily high levels of safety and durability while simultaneously being easy and simple to handle.
Optional accessories such as high-pressure inserts or multiple tube systems expand the possible application areas.

Value retention thanks to PFA-coated stainless steel housing

The high-quality PFA coating on the stainless steel housing provides effective protection against corrosion, thus ensuring that your **speedwave MWS-3^{+}** system retains its value.

For the highest level of safety and ease of handling: "SwingTop" with electronic lid locking

As the world's first "top-loader" microwave, the sturdy swiveling lid with its electronic lock mechanism gives the **speedwave MWS-3+** unsurpassed safety during pressure digestion. The microwave's "door" is protected by three interlocks and it cannot be manually opened during operation.
The large sample chamber is easily accessed from above to permit individual digestion vessels to be comfortably inserted into or removed from the sample turntable from above.

Built-in controller or external PC

Control of the **speedwave MWS-3+** system adapts to individual requirements:

BasicControl
Built-in Infineon controller and graphic display with membrane keypad.

PentiumControl
Built-in Pentium PC and 6" VGA color graphics display with touch-screen operation.

HighConvenience
Control via an external PC providing extensive display options.

Reproducible digestion processes thanks to homogeneous microwave distribution

The round, pressure-resistant oven chamber made of PFA-coated stainless steel ensures that the microwave radiation generated by the magnetron is evenly distributed throughout the chamber to uniformly heat each sample.
The user obtains reproducible digestion process results.

Power Control System + Sensors

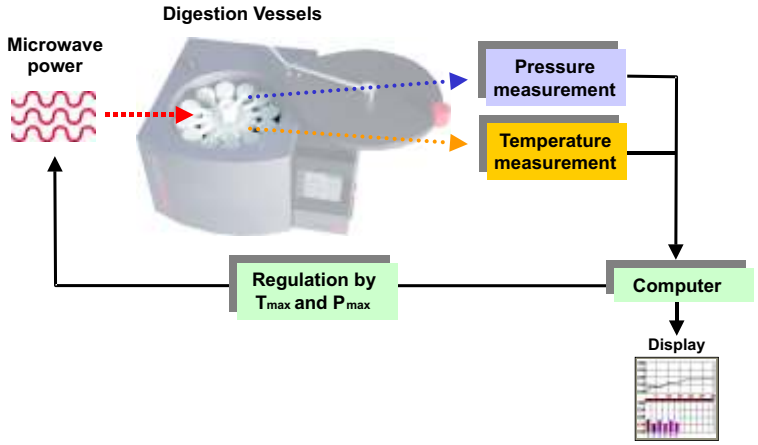
MWS AC
Auto Control

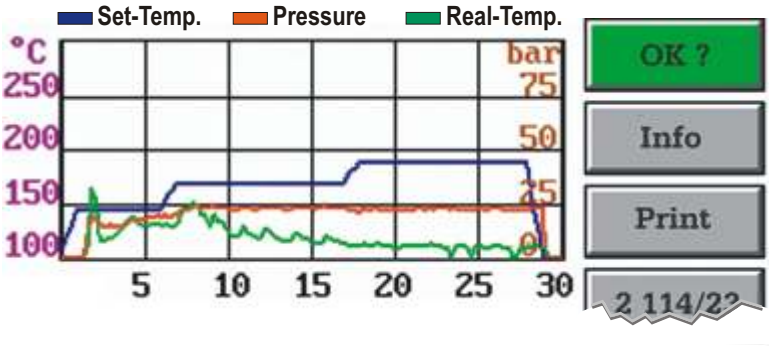
Sample digestion with active reaction monitoring

Safety through rapid reaction monitoring

The extremely rapid heating of samples in the microwave field coupled with occasionally induced spontaneous reactions necessitate very rapid reaction monitoring in order for digestion processes to be performed safely.

The **speedwave MWS-3+** is controlled by continuously adjusting the microwave power. The prerequisites in order for this to be performed successfully is a delay-free temperature measurement and continuous monitoring of pressure developments in every pressure vessel.
Only in this way can spontaneous reactions be effectively suppressed and a safe reaction progress be ensured.





Reproducible digestion processes through precise power control

Sample temperature and sample pressure in each vessel are simultaneously acquired in a contactless process during every rotation of the sample turntable, and the microwave power level is adjusted accordingly.
In addition, microwave power is also controlled on the basis of the number of samples actually present in the turntable. This graduated regulation concept leads to reproducible heating curves and therefore to reproducible digestion process results.

No sample loss due to excess pressure reactions

Initially, power control is dependent on the sample temperature.
As the pressure in the sample vessels nears the predefined maximum pressure, the sample pressure takes on a larger role in controlling power. This prevents the overpressure control (rupture discs) from being activated, thus effectively preventing sample loss.

Safety

During microwave pressure digestion, risks generally arise as a result of reactions going "out of control". The innovative sensor, control, and safety concept of the **speedwave MWS-3+** reduces these risks to a minimum, providing the highest possible level of safety in all operating conditions.

- Durable, pressure-resistant PFA-coated stainless steel housing;
- Swiveling lid with electronic lock;
- 3 interlock switches to monitor the swing top lid;
  3 excess temperature switches to monitor the oven chamber and the electronics;
- Temperature and pressure monitoring of all samples in real time;
- Shut down in case of critical operating conditions;
- Reliable rupture discs to provide protection in case of excess pressure;
- Integrated gas collection system to effectively prevent emissions;
- Controlled release of residual pressure when the digestion vessels are opened.

Sensors

- Not influenced by microwave radiation.
  All sensors and their circuits lie outside the microwave field.
- All sensor equipment in the oven chamber is completely chemically resistant.
- No sensors in the sample vessel and therefore no risk of contamination of the samples and no risk of sensor damage or wear as a result of frequent installation and removal.
- The sample chambers have no dead volume and are therefore easy to clean.

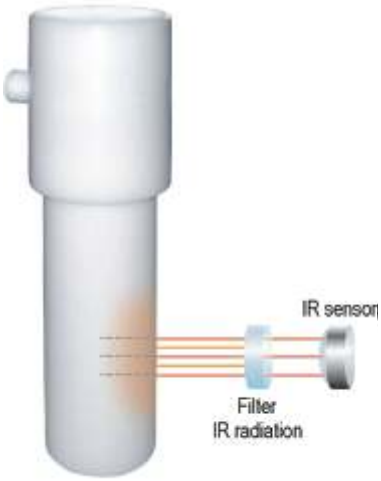
MWS mid-IR

Optical Temperature Control

Sample temperature acquisition without contact and directly in real time

Conventional IR temperature measurement methods using broadband instruments can only measure the surface temperature of digestion vessels.

With its **MWS mid-IR** thermometer, BERGHOF follows a new and different path:
The thermal radiation in the middle IR range at which the TFM and quartz materials do not absorb thermal radiation is measured in a "touch-free" process. Filtering out the IR radiation radiating from the pressure vessels' surfaces makes this procedure extremely precise and reliable. The thermal radiation of each individual sample can be detected directly and in real time.



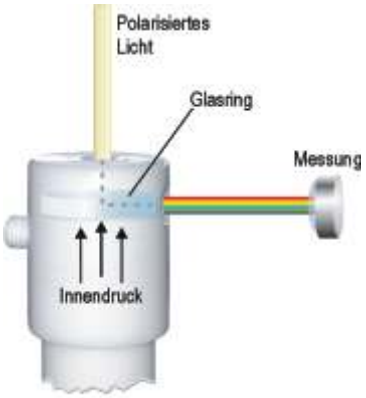
MWS OPC

Optical Pressure Control

Contact-free, optical, pressure measurement (optional)

The patented **MWS OPC** optical pressure measurement and pressure monitoring procedure specially developed by BERGHOF for microwave digestion processes operates totally contact-free.

A glass ring on which the internal vessel pressure acts is employed as the sensor element. This glass ring is integrated into the pressure vessel lid and is illuminated by a beam of polarized light. Any color change to the polarized light caused by the effects of pressure is measured. This allows the pressure in each vessel to be individually detected.



Controller + PC Software

Built-in controller or external PC

BasicControl
The basic version using a 16-bit Infineon controller and an illuminated fluorescent graphic display (128 x 64 pixels) equipped with a membrane keypad.
10 default applications have been preprogrammed, with an additional 10 available for programming as required. Up to 64 records can be stored.

PentiumControl
Additional comfort is offered by this version with its built-in Pentium PC and the 16" VGA color graphics display with touchscreen operation.
10 default applications have been preprogrammed, with an additional 14 available for programming as required. Memory capacity has been designed for up to 500 records.

HighConvenience
The highest level of user comfort is achieved by controlling the **speedwave MWS-3^{+}** via an external PC.
Key advantages of this option include comprehensive graphic display options, practically unlimited storage capacity for applications and records, as well as easy and simple data archiving. Up to four microwave units can be controlled from a single PC.

Intuitive operation supports simple handling.

The microwave system's self-explanatory and intuitively understandable user interface simplifies handling. Temperature and pressure data for all samples can be displayed in real time for documentation in accordance with the requirements of currently applicable quality standards. Viewing and analyzing these data can provide valuable information for method and process development.

Default programs which meet the requirements of numerous standards such as EPA 3051, EPA 3052, or EPA 3015 are preinstalled and can be easily called up.

These programs can also be modified or can be supplemented by new programs which the user can freely define.

A single program processes up to five program steps covering parameters for target temperature, maximum power, maximum pressure, duration of heating, and holding time.

Pressure Digestion Vessels

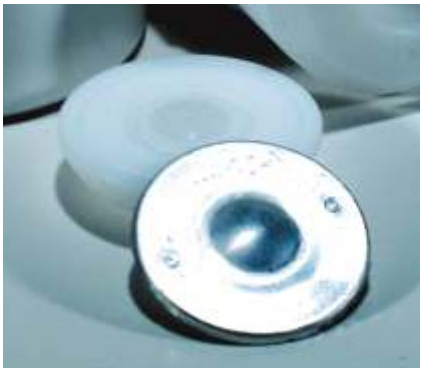
Easy Handling

The pressure vessels comprise only a few components and can be opened and closed without the need for tools. Residual pressure is released in a controlled manner during opening, providing safety for the user.
The design is free of dead-spaces, making the vessels easy to clean.

Patented, optical measuring procedures for temperature and pressure, together with the integrated gas collection system eliminate the need for connections for hoses and sensors.

Flexibility and Productivity

The pressure vessels are positioned in the microwave oven by suspending them in a rotor system. The standard design allows for 12 vessels per rotor. High sample throughput as is frequently required for routine applications is also ensured by a 24-holder rotor.
Vessels and the rotor system represent independent components, allowing the pressure vessels to be individually removed or installed. Digestion with only partially filled rotors is also possible.
Vessels and samples can be exchanged after only a short cooling off period and without having to first vent the system.
This flexibility results in high sample throughput rates and thus to extraordinarily high productivity.



Safety

All pressure vessels are equipped with metal rupture discs to provide protection against overpressure. Their large diameter guarantees reliable, reproducible activation behavior and ensures the required, rapid pressure reduction.

Emissions are effectively avoided during digestion because all vessels are absolutely sealed to a gas collection system.

Pressure Measurement (optional)

The vessels can also be equipped with a "touch-free" optical pressure measuring system. This retrofit merely involves replacement of the vessel lid. Any desired number of vessels can be outfitted with this option, from a reference vessels right up to individual measurement of all samples.

Pressure measurement is a contactless process performed by a sensor mounted on the microwave oven's interior wall.

Application Areas

Active temperature monitoring in all vessels permits even high-boiling acids (sulfuric acid, phosphoric acid) to be used at any desired concentrations and in combination with other chemicals.

DAP-40+, Digestion vessel for high sample throughput for routine applications in areas of food, environmental and medical analyses. Up to 300mg of organic or 1g of inorganic sample material.

DAP-30+: small-volume vessel, particularly well suited for digestion of hard-to-digest, inorganic samples; oxides, metals, and alloys < 300mg; polymers < 300mg.

DAP-60+ / DAP-100+: standard vessels with a wide application spectrum. Inorganic samples such as oxides, metals, and alloys < 200 mg; polymers; food products < 500 mg, as well as environmental samples such as soils, sludges, waste water.

DAK-100: high-pressure vessel for digesting hard-to-digest inorganic samples such as oxides, metals, and alloys < 500 mg and larger sample volumes of organic sample materials; polymers, pharmaceuticals; food products < 1000 mg.

Liner Systems

Using the **MT multiple tube system** for the DAK-100 high-pressure vessel and the DAP-100+ vessel, up to 24 samples can be digested simultaneously. Typical applications include food products < 300 mg and samples from the pharmaceutical industry or from medical labs.

The **DAQ-20H quartz glass inserts** can be used to retrofit the DAP-60+ and DAP-100+ vessels for smaller sample volumes e.g., medical and pharmaceutical products.

The **DAC-17** high-pressure insert expands the application area for DAP-100+ vessels to include hard-to-digest samples such as SiC, Alumina, Coke.

speedwave MWS-3+

Technical Specifications for the MWS-3+

Power supply	230 V, 50/60Hz, 1,850W
Microwave power output	1,450 W
Frequency	2,460 MHz
Weight	approx. 72 kg
Dimensions (WxDxH)	640 x 570 x 450 mm
Interior diameter x height	360 x 250 mm
Noise level	< 60dB
Ambient conditions	15-35°C / 85 % rel. humidity
Interfaces	Seriell (RS-232) and parallel; port to connect a keyboard; I^2C-Interface (Controller version only)
Languages (software)	German/English/French/Italian/Spanish/Turkish
Coating	90µm PFA (fired at least 350°C)
Computer compatibility	Windows 98 or XP for external software
Interne diagnostic	Magnetron status, magnetron temperature, oven temperature, High voltage transformer, lid block
Temperature measurement	Range: 100 - 300°C Accuracy: 1°C bei 200°C
Pressure Measurement (option)	Range: 0-150 bar (0 - 2,180 psi) Accuracy: 5 bar
Turntable function	Continous clockwise rotation at approx. 6 rpm
Safety testing	CE conformity, complies with EN 335-25, EN 50081, EN 50082 and EN 61010
Warranty	12 months, including digestion vessels

Vessel owerview

Vessel type	Volume	Operating pressure	Test pressure	Temperature continuous	Temperature max.	Sample capacity vessels/rotor	Options				
DAP-40+	40 ml	40 bar (580 psi)	55 bar (798 psi)	230°C	260°C	24				X	
DAP-30+	30 ml	80 bar (1,160 psi)	120 bar (1,740 psi)	230°C	260°C	12				X	X
DAP-60+	60 ml	40 bar (580 psi)	60 bar (870 psi)	230°C	260°C	12		X		X	X
DAP-100+	100 ml	40 bar (580 psi)	55 bar (798 psi)	230°C	260°C	12	X	X	X	X	X
DAK-100	100 ml	100 bar (1,450 psi)	150 bar (2,180 psi)	250°C	300°C	8			X	X	
Liner systems expand the vessels application area											
(X = option can be used in conjunction with the indicated vessel type)											
DAC-17 high pressure insert	17 ml	130 bar (1,880 psi)	190 bar (2,760 psi)	280°C	300°C	12					
DAQ-20H	20 ml	100 bar (1,450 psi)	150 bar (2,180 psi)	250°C	260°C	12					
MT multiple tube system	10 ml	100 bar (1,450 psi)	150 bar (2,180 psi)	230°C	260°C	24					
Accessories to complete or compliment the vessels											
(X = option can be used in conjunction with the indicated vessel type)											
Lid, w./o. pressure measurement											
Lid, w. pressure measurement											

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Competent, powerful, and reliable

For more than 25 years, BERGHOF Products + Instruments GmbH has been manufacturing digestion systems for the determination of trace elements using AAS, ICP-AES, ICP-MS, and voltammetry.

One of our strengths lies in our special knowledge and abilities in processing PTFE and TFM. Using this know-how, we produce high-quality digestion vessels characterized by their extremely high levels of durability and economy.

Our quality management system certified in accordance with DIN EN ISO 9001:2000, our application laboratory accredited in accordance with ISO 17025:2000, and our worldwide support network combine to provide you with the assurance of working together with a competent and reliable partner.

We can provide informational material concerning the following topics on request:

- Temperature measurement;
- Pressure measurement;
- Safety;
- Digestion vessels;
- Evaporating units;
- Accessories;
- Applications.

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realizing your ideas.

PRODUCTS + INSTRUMENTS

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