Multiwave PRO
Microwave Reaction System for Sample Preparation
Multiwave PRO
The Master of Sample Preparation Methods

The Multiwave PRO microwave reaction system delivers the sample preparation solutions you need to obtain excellent trace analysis results, even with complicated, demanding samples. Multiwave PRO masters high temperatures and provides comprehensive reaction control features. Its wide range of accessories allows digestion, leaching, oxygen combustion, solvent extraction, drying, evaporation, and UV digestion with one single system.

Advanced technology
Anton Paar has been working in the field of microwave technology for more than three decades. Using high-quality materials and innovative solutions, Anton Paar defines the standard for top-level instruments. Multiwave PRO is designed to be an extendable platform. This brochure focuses on the use of Multiwave PRO as a microwave reaction system for demanding applications in sample preparation for trace analysis professionals.

Secure investment
Once installed, Multiwave PRO keeps your costs down: its low operation costs and low costs for consumables result in a truly economical and sustainable investment. To ensure this, Anton Paar provides consumables and spare parts for many years. Anton Paar’s 90 years of experience in smart engineering and consistent use of high-quality components means you can rely on Multiwave PRO for years of operation.

Close to you
For the entire working life of your Multiwave PRO, specialists from Anton Paar are at your service. With subsidiaries and sales partners worldwide, you are close to an experienced team which speaks your language and provides application support and training. Quick and efficient service reduces downtimes to a minimum.
For Your Demanding Samples

➤ Acid digestion: Quick and hot

Multiwave PRO handles complete acid digestion of samples in a fraction of the time required by conventional techniques. Routinely providing temperatures up to 300 °C, Multiwave PRO successfully digests even the most demanding materials.

➤ Leaching: As standardized by EPA and ASTM

Multiwave PRO is fully compliant with EPA and ASTM standard leaching, digestion and extraction methods. Sensors monitor each vessel for continuous control and documentation of reaction parameters.

➤ Solvent extraction: Rapid

Applying high pressure allows extractions at temperatures far above the solvent’s normal boiling point. Multiwave PRO drastically reduces the reaction times compared to conventional methods.

➤ Oxygen combustion: Unique and brilliant

A unique accessory allows you to burn pelletized samples in pure oxygen above 1000 °C. Analytes are absorbed in small amounts of liquid, making this procedure quick, clean and safe.

➤ UV digestion: Unrivaled

A unique accessory produces intense UV radiation inside liquid samples. Radicals destroy organic matter within minutes, almost without acid.

➤ Additional methods: Drying, acid evaporation and protein hydrolysis

Multiwave PRO supports unique additional methods around acid digestion, all in one system. This includes drying samples before digestion and evaporation of acids after digestion. It also provides acid hydrolysis of proteins for structural analysis in biotechnology.
Solutions at their Best
Flexible and Extendable

The broad range of accessories on offer for Multiwave PRO gives you maximum flexibility in your choice of configurations. The same microwave system can be used for digestion, extraction, evaporation, leaching, oxygen combustion, drying and UV digestion. You can easily add other rotors at a later date.

➤ True power

Multiwave PRO brings you the strongest microwave power on the market. To sustain an output level of 1500 W (IEC 705) over years, Multiwave PRO is equipped with two reliable magnetrons of 850 W each. Unpulsed microwave power over the whole range ensures precise control of critical reactions.

➤ Convenient tool-free handling

Opening and sealing Multiwave PRO’s rotors, vessels and sensors is quick and simple - just use your hands. This tool-free handling is unique to Anton Paar and simplifies this frequently repeated work step.

➤ Satisfying results - with dual reaction control

Multiwave PRO has a dual solution for reaction control: an immersing temperature probe with integrated pressure sensor is positioned in one reference vessel and infrared sensors are located underneath the rotor to simultaneously measure the temperature and pressure of each vessel. This precise control of the temperature and pressure is essential for reproducible results and ensures safe processes every time.

For convenient handling, the sensors transfer values to the Multiwave PRO wirelessly, so you do not need to connect cables before loading the rotor.
Cooling: fast and quiet

The integrated forced-air cooling system with unique air gap design cools the vessels within minutes after heating cycles. This optimized cooling results in short process times and increased working life of key components. You do not need to handle hot pressurized vessels or connect an external cooling unit. The air cooling system is powerful and reliable, yet remarkably quiet, contributing to a pleasant laboratory environment.

Safety without compromise

Multiwave PRO comes with built-in safety features. The pressure of each reaction vessel is measured approx. 50 times per second, which enables Multiwave PRO to control reactions so that they remain within safe operating limits.

Numerous active and passive safety features protect the system, operator and surroundings in all situations. The steel-reinforced door automatically reseals the cavity after a pressure release. Additional devices for releasing overpressure are built into the vessels.

Get in touch

Multiwave PRO has a large color touchscreen for convenient operation which is easy to read from a distance. The on-board PC provides a multilingual and intuitive software solution.

Ready to communicate: For traceable results Multiwave PRO provides data transfer to LIMS or a separate lab PC in pdf or spreadsheet format. The standard Ethernet connection allows network printing directly from Multiwave PRO.

Ready-to-use application library

A comprehensive library of tested methods gives you ready-to-use applications for a wide range of samples, including EPA methods. Adapting methods or creating new ones requires just minutes. Full application support for method creation is available at any time from Anton Paar.
Reaction Vessels: Ingeniously Simple

The reaction vessel is the heart of Multiwave PRO and the key to successful sample preparation. Multiwave PRO’s wide range of vessels and rotors results in a flexible platform which allows you to select the best-suited system for a wide variety of organic and inorganic sample types.

**Vessel cap**
- Only 2 turns to tightness: the cap is simply screwed on by hand.
- No exposure to hazardous reaction gases: pressure release and venting of gases before you open the rotor.

**Lip-type seal**
- Chemically inert and clean: made of high-purity PTFE-TFM.
- Hermetically sealed within seconds: no loss of volatile analytes.
- A long-life metal safety disk protects the vessel in case of overpressure.
- No risk of contamination and high overpressure tolerance.

**Liner**
- Chemically inert and clean: made of high-purity PTFE-TFM.
- Interchangeable: suitable for most rotors and methods.

**Pressure jacket**
- Withstands the highest vessel pressures: made of fiber-reinforced PEEK or aluminum oxide ceramics.
- For digestions which require maximum temperature and pressure simultaneously: strong quartz glass vessels.
- Significantly reduces the overall process time: rapid cooling of the vessel through the pressure jacket.
Best Pressure and Temperature Control Available

To obtain high-quality solutions and ensure safe operation, Multiwave PRO keeps pressure and temperature under control. See here how it works.

➤ By monitoring the temperature of each vessel with an IR sensor

The result: safe and reliable digestion processes.

An infrared sensor measures the temperature at the base of each reaction vessel. If the temperature rises too high, Multiwave PRO reduces microwave power so that the temperature does not exceed a preset limit.

➤ By measuring the pressure and temperature in a reference vessel

The result: quick and precise control, even of fast and spontaneous reactions.

A hydraulic pressure and temperature sensor is integrated into one of the reaction vessels. With Multiwave PRO you can define temperature ramps, making it a valuable tool for digesting unknown samples and for method development.

➤ By measuring the pressure in all vessels every 20 milliseconds

The result: an extremely quick and simultaneous pressure measurement in Rotor 8N makes Multiwave PRO considerably safer and more efficient. This allows you to apply the highest possible temperatures for acid digestion.

Critical situations emerging from, for example, spontaneous reactions are intercepted due to the high frequency of pressure measurement. Multiwave PRO immediately reduces microwave power and the unwanted reaction is stopped before it leads to pressure release.

Stable temperature measurement - guaranteed

Regular calibration with the special Anton Paar temperature calibration accessory ensures the temperatures remain correct over years.
Acid Digestion Rotors: High Performance

Choose from these rotors for high-performance digestion:

➤ High-end

Use Rotor 8N to obtain the highest digestion quality. Rotor 8N masters temperatures up to 300 °C at pressures up to 80 bar. Continuous pressure monitoring of all eight sample vessels ensures safe and precise reaction control, even with critical samples.

The high-end rotors can withstand the highest temperatures for extended periods of time. This makes even the toughest materials soluble.

➤ Workhorse

Take advantage of the 16-position rotors to increase your productivity in high-performance routine applications.

A selection of interchangeable pressure jackets, liners and seals make it possible to digest a wide range of sample types, ranging from environmental samples to biological material, food to metals, alloys to geological materials. Even solvent extraction is covered.

➤ High throughput

The 48-position rotor meets the demand for high sample throughput and eliminates your bottlenecks in sample preparation.

Convenient and quick tool-free handling is ensured by the ready-assembled screw cap with cone-type seal.

➤ Microsamples

Requiring up to 20 mg of sample and approx. 1 mL of acid, the 64-position rotor is unique for the large-scale digestion of microsamples, e.g. for biological materials.
## Technical Data

<table>
<thead>
<tr>
<th>Rotor</th>
<th>64MG5</th>
<th>48MF50</th>
<th>16MF100</th>
<th>16HF100</th>
<th>8NXF100</th>
<th>8NXQ80</th>
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</thead>
<tbody>
<tr>
<td>No. of vessels</td>
<td>64</td>
<td>48</td>
<td>16</td>
<td>16</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Reaction control</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>Simultaneous pressure control in all positions</td>
<td></td>
</tr>
<tr>
<td>IR temperature</td>
<td>Remote IR temperature control in 16 positions</td>
<td>Remote IR temperature control in all positions</td>
<td>One reference vessel with immersing temperature probe and pressure sensor</td>
<td>One reference vessel with immersing temperature probe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature and pressure</td>
<td>n.a.</td>
<td>One reference vessel with immersing temperature probe and pressure sensor</td>
<td>One reference vessel with immersing temperature probe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vessels</td>
<td>MG5</td>
<td>MF50</td>
<td>MF100</td>
<td>HF100</td>
<td>XF100</td>
<td>XQ80</td>
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<tr>
<td>Liner material</td>
<td>Glass (PTFE seal)</td>
<td>PFA or PTFE-TFM</td>
<td>PTFE-TFM</td>
<td>PTFE-TFM</td>
<td>PTFE-TFM</td>
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<td>Pressure jacket</td>
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<td>PEEK-GF</td>
<td>PEEK-GF</td>
<td>Ceramic</td>
<td>Ceramic</td>
<td>Quartz</td>
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<tr>
<td>Volume</td>
<td>5 mL</td>
<td>50 mL</td>
<td>100 mL</td>
<td>100 mL</td>
<td>100 mL</td>
<td>80 mL</td>
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<tr>
<td>Operation parameters</td>
<td>200 °C @ 20 bar (290 psi)</td>
<td>200 °C @ 20 bar (290 psi)</td>
<td>200 °C @ 20 bar (290 psi)</td>
<td>240 °C @ 40 bar (580 psi)</td>
<td>260 °C @ 60 bar (870 psi)</td>
<td>300 °C @ 80 bar (1160 psi)</td>
</tr>
<tr>
<td>Max. design pressure</td>
<td>33 bar (479 psi)</td>
<td>60 bar (870 psi)</td>
<td>115 bar (1670 psi)</td>
<td>115 bar (1670 psi)</td>
<td>140 bar (2000 psi)</td>
<td>140 bar (2000 psi)</td>
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<tr>
<td>Max. design temperature</td>
<td>310 °C</td>
<td>260 °C (PFA) 310 °C (TFM)</td>
<td>310 °C</td>
<td>310 °C</td>
<td>310 °C</td>
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<td>HF resistant</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Typical applications</td>
<td>Biological material</td>
<td>Water, effluents, sewage sludge, plant material, soil, sediment, US-EPA procedures, biological material</td>
<td>Food samples, contaminated soil, metals, alloys, geological material, glass, quartz</td>
<td>Mixed waste, semiconductors, ceramics, ores, ashes, slag, refractories</td>
<td>Fatty foodstuffs, plastics, fibers, oil, fat, coal, pharmaceuticals, chemicals</td>
<td></td>
</tr>
</tbody>
</table>
Some samples require special treatment. Multiwave PRO provides unique methods which are efficient alternatives to digestion.

➤ You want to digest combustible solids quickly and cleanly?

**Microwave-induced oxygen combustion (MIC)**

- Unique, clean and quick method.
- Halogens or metals are trapped in a low-concentration absorption solution which can be measured without dilution.
- Suitable for all combustible solids such as wood, paper, coal, food or polymers.
- Parallel combustion of up to 8 samples in highly resistant quartz vessels.
- It replaces steel combustion bombs.

➤ You need to digest liquid samples containing organic compounds?

**UV digestion**

- Unique microwave-powered UV lamps produce radicals which digest the sample.
- The resulting low-concentration solution can be measured without dilution.
- For ultra-trace analysis of e.g. seawater, effluents, sewage, body fluids or beverages.
- Low analytical blanks.

➤ You want to run protein hydrolysis in a fraction of the time?

**Microwave-assisted protein hydrolysis**

- Reduction of the overall process time to less than one hour, compared to several hours with classical thermal methods.
- Precise temperature measurement ensures accurate reaction control.
- For milligram to gram amounts.
- Use of disposable glass inserts.
- No cross-contamination between vessels.
- Inert gas atmosphere can be applied.
Extraction

Multiwave PRO supports more than just digestion procedures. Microwave-Assisted Extraction (MAE) improves both the performance and throughput of HPLC- or GC-based analysis.

➤ You want to extract organic trace compounds?

Microwave-assisted extraction

- Microwave-assisted extraction with Rotor 16SOLV replaces slow and tedious classical solvent extraction methods.
- It significantly reduces extraction times from hours to minutes.
- For extractions of PCBs, PAHs and hydrocarbons from environmental and food samples, derivatization reactions prior to analysis and polymer extractions.
- High sample throughput: up to 16 samples simultaneously.
- Optional magnetic stirring increases recoveries.
- Rotor 16SOLV is equipped with the same rotor and vessels as for digestion.
- Cone-type seal for quick handling without tools.
- Meets the requirements of US-EPA and ASTM methods.
- Precise temperature and pressure control in closed vessels allows extractions in 15 to 30 minutes.

➤ You need to use non-polar solvents?

Passive heating elements

- For non-polar solvents such as hexane and toluene.
- Heating without contamination.
- Made of silicon carbide (SiC): inert, stable and clean.
- Can be reused.
- Provide excellent coupling efficiency.
Evaporation & Drying

Concentration of aqueous samples, drying of sample material prior to digestion and removal of acids after digestion can be undertaken with Multiwave PRO in a fraction of the time required by conventional techniques.

➤ You want to accelerate your evaporation procedures?

Microwave-assisted evaporation

- Rotor 8EVAP simplifies and accelerates the microwave-assisted evaporation of acids and concentration of aqueous sample solutions.
- After digestion, acids can be fumed off directly from reaction vessels under controlled clean-room conditions.
- The external scrubber neutralizes the acid vapors, washing out up to 95%.
- Prior to digestion, sample solutions can be concentrated to increase analyte levels and improve digestion efficiency.
- After evaporation, just transfer the liner into the digestion rotor.

➤ You want to dry samples before digestion?

Microwave drying

- Rotor 1DRY efficiently dries samples.
- Microwave drying with Multiwave PRO takes a quarter of the time required by conventional methods.
- It provides samples without carbonization or contamination.
- The exhaust unit of Multiwave PRO removes humidity and unwanted odors.
Instruments for:
Density & concentration measurement
Rheometry & viscometry
Sample preparation
Microwave synthesis
Colloid science
X-ray structure analysis
Refractometry
Polarimetry
High-precision temperature measurement