Anton Paar

# Multiwave 3000

Microwave Sample Preparation
Platform System

::: Clear Solutions in Sample Preparation

# Multiwave 3000
## Microwave Platform System

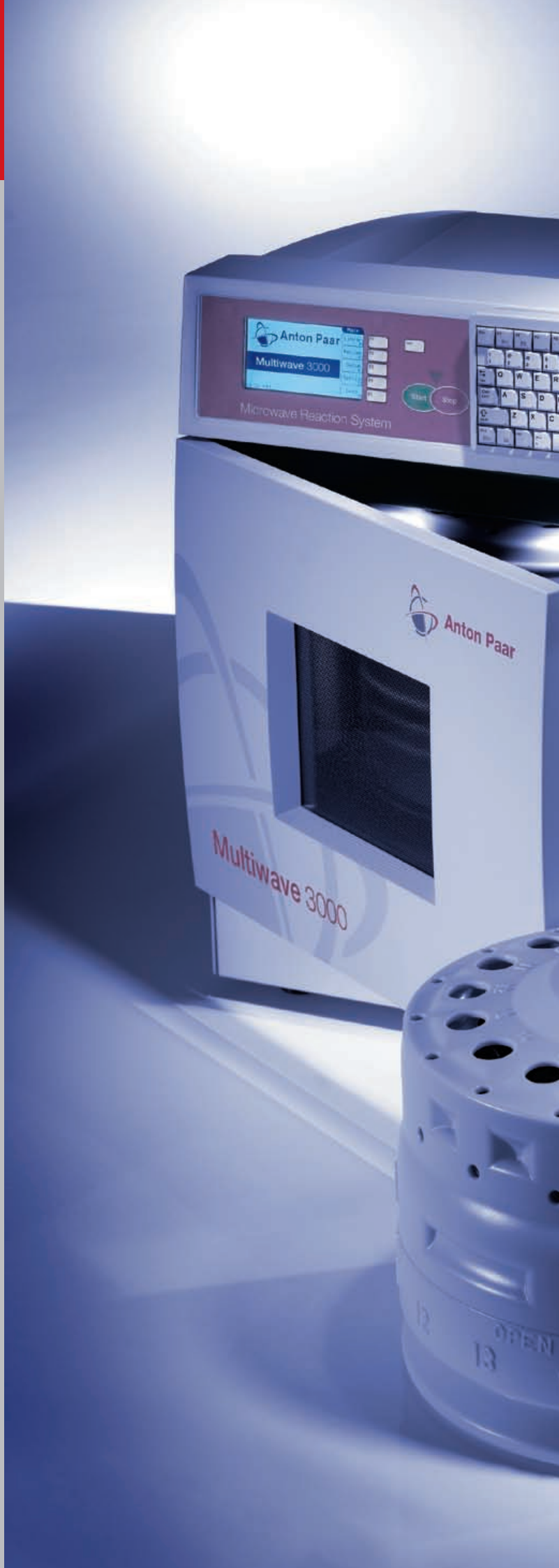
### Clear solutions for great results
For more than 25 years, Anton Paar has been a leading supplier of sample preparation instruments. Our vast experience and thorough understanding of the needs of analytical chemists enable us to offer advanced solutions in sample preparation.

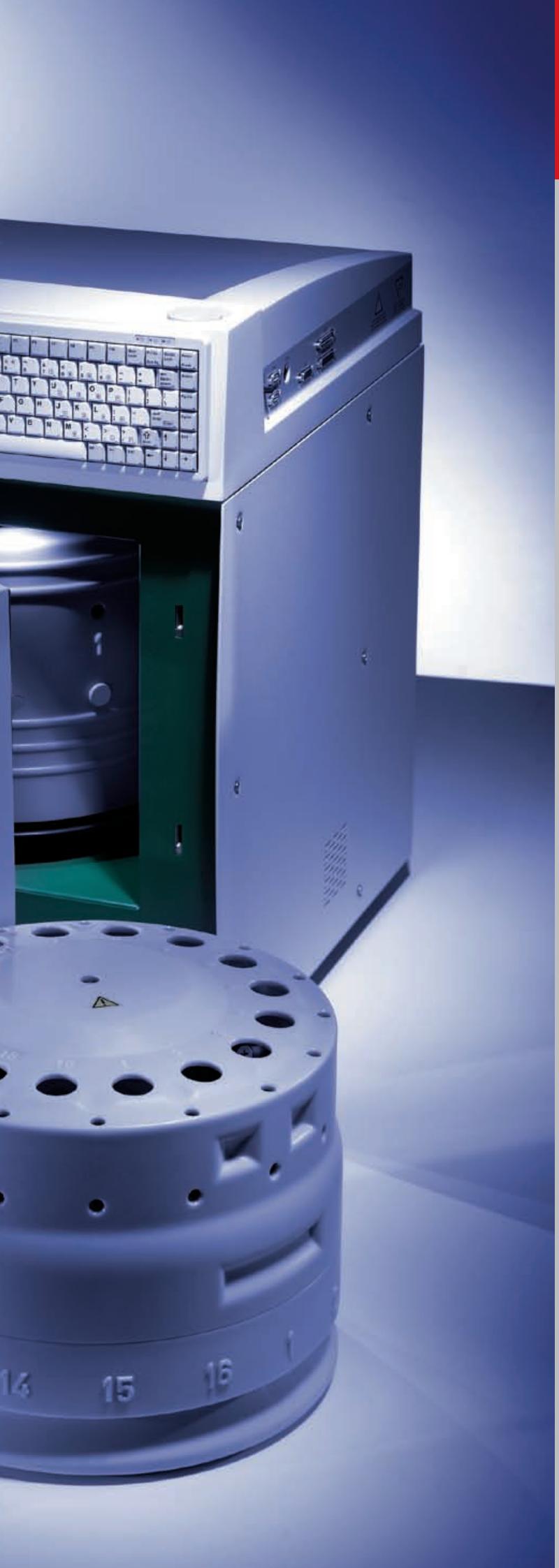
### ISO 9001 certified
We are dedicated to quality and produce instruments with exceptional performance and reliability. Anton Paar also offers worldwide application and service support. Excellent reasons to make Anton Paar your ideal partner in modern sample preparation!

### Sophisticated technology
The Multiwave 3000 microwave system provides high performance, reliable quality and unrivaled safety, which is required in sample preparation in order to achieve superior analytical results.

### Top performance
The closed vessel technique helps to speed up reactions by allowing higher temperatures, while preventing the loss of volatile analytes. The resulting low reagent consumption saves time and money and also helps to minimize exposure to corrosive gases and hazardous solvent vapors.

### Versatility and flexibility
Multiwave 3000 is designed to bridge the gap between sample and analysis, whether you need wet acid digestion, solvent extraction or other special applications. The compatibility of system accessories makes it easy to customize and enhance your Multiwave 3000.





# Microwave Sample Preparation at its Best

## Digestion

Multiwave 3000 meets all your acid digestion requirements, from routine environmental analyses to the most demanding material testing applications.
Advanced microwave-, sensor- and safety technologies and a unique cooling system guarantee safe and complete digestion of samples in a fraction of the time required by conventional techniques.

## Leaching

Multiwave 3000 is ideally equipped for standardized leaching procedures. US-EPA and ASTM methods are available as standard. Sophisticated remote sensor technology allows continuous control and documentation of each reaction parameter.

## Solvent extraction

Multiwave 3000 is the perfect instrument to perform Microwave-Assisted Extractions (MAE), which dramatically shorten reaction times as compared to conventional methods such as Soxhlet. The system can be ideally used for combined extraction and derivatization techniques. The optional pressure filtration unit facilitates sample clean-up after extraction.

## Evaporation

Multiwave 3000 will evaporate acids and pre-concentrate aqueous solutions directly from reaction vessels under fully controlled clean room conditions. Acid vapors are safely exhausted to external scrubbers and neutralized.

## Drying

Multiwave 3000 easily performs gentle drying without carbonization or contamination of samples, in a quarter of the time required by conventional techniques. The exhaust unit of the Multiwave 3000 draws off humidity and unpleasant odors.

## Special Applications

Oxygen combustion for the determination of halogens, UV digestion of liquid samples or acid hydrolysis of proteins further extend the scope of applications of the versatile Multiwave 3000 system.

# Multiwave 3000
## Simply the Best

- 1400 W microwave power output via two magnetrons – ensures fast and direct heating
- Unpulsed microwave power over the whole range – for precise control of critical reactions
- High quality vessels and rotors – high reaction performance guaranteed
- Reliable pressure and temperature sensors – for enhanced reaction control and safety
- Remote sensor technology – installation-free for convenient handling
- Integrated high-performance cooling system – for reduced overall process times
- Full application support – assistance available whenever you need it


### Ingenious sensor design

Precise control of the temperature is essential for reproducible results. Multiwave 3000 offers a dual solution: an accurate immersing temperature probe in one reference vessel and an IR sensor underneath the cavity for sensing each vessel.

- Remote sensing – no installation, easy handling
- Protection against overheating with high boiling reagents
- Gas bulb thermometer – no microwave interference
- Simultaneous measurement of pressure and temperature

### Integrated forced-air cooling system

The unique, patented (U.S. Patent No. 5,345,066) air gap design provides effective heat transfer and cooling of vessels within minutes after decomposition.

- Drastically reduced cycle times
- No external cooling required
- No handling of hot pressurized vessels
- Increased lifetime of key components

### PTFE-coated cavity

Durable, industrial-quality components make the Multiwave 3000 suitable for harsh lab conditions. A multi-layer PTFE coating efficiently protects its 66-liter stainless steel cavity.

- Maximum corrosion resistance
- Easy cleaning and maintenance
- Prepared for future system expansions

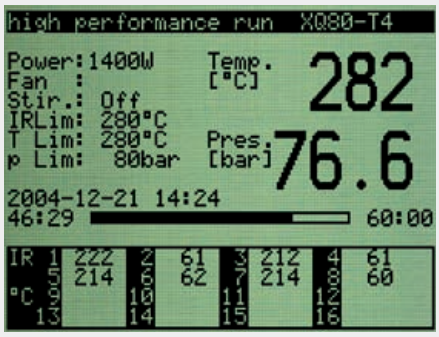

# Features and Benefits

- Tool-free handling of rotors, vessels and sensors – unrivaled convenience for the operator
- Intuitive software – easy routine operation with documentation
- Multiple safety system – efficient user protection
- Optional programmable magnetic stirrer – for reduced reaction times and increased recoveries
- Broad range of accessories – maximum flexibility in the choice of configurations
- Versatile platform design – the same microwave oven for digestion, extraction, evaporation, drying, etc.

## Safety without compromise

Safety is one of the major benefits of the Multiwave 3000. The sophisticated sensor technology for reaction control and numerous active and passive safety measures open a new dimension of safety for sample preparation.

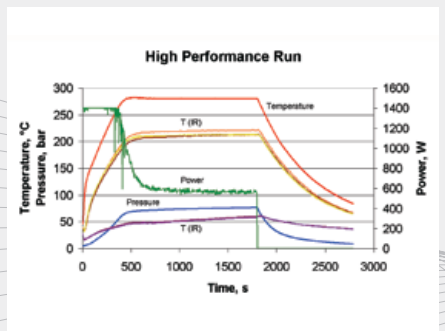
- Impact-resistant safety door with interlocks – the cavity is resealed automatically after a pressure release
- Multiple overpressure release devices
- Protection shields on rotors and vessels
- Certified safety system – only the Multiwave 3000 comes with ETL and GS („approved safety“) certificates




## Straightforward software solutions

The built-in micro-controller of the Multiwave 3000 provides intelligent, comfortable, and intuitive software solutions.

- Comprehensive library of tested methods – ready-to-use applications for a wide range of samples, including US-EPA and ASTM methods
- Storage of up to 600 methods – adapt or create your own methods
- Multilingual user interface – English, Spanish, German, and French
- Easy operation under lab conditions – process parameters and online data at a glance
- Documentation at the push of a button – simple data transfer to a printer or to Microsoft™ Excel™



# The Vessels
## High Performance Modularity

The reaction vessel is the heart of any digestion system and the key to successful sample preparation. Each Multiwave 3000 system offers a wide range of vessels and rotors with exceptional modularity and interchangeability. Its flexibility allows you to select optimized systems for a wide variety of organic and inorganic matrices.

Most applications can be resolved using compound designs of microwave-transparent ceramics together with precisely tooled PTFE-TFM or PFA liners. While ceramics give excellent temperature and pressure resistance, the fluoroplastic provides the required chemical inertness. High purity quartz glass vessels are best suited for challenging digestion tasks which require both maximum temperature and pressure simultaneously.

### Handling

The vessel system is designed for utmost convenience. Just add your samples and reagents, the rest is simple.

- Easy, tool-free hand tightening of vessels and rotors
- Installation-free sensor technology
- Pressure release prior to rotor opening – no exposure to hazardous reaction gases

### Sealing

The lip-type seal, made of chemically inert TFM, allows hermetic closure of the reaction vessels tool-free within seconds. The vessels in the 48-position rotor are sealed by the newly designed cone seal. To protect the vessels in case of overpressure, the seal has a long-life metal safety disk.

- No loss of volatile analytes
- No risk of contamination
- High overpressure tolerance – trouble-free operation even under extreme conditions

### Cooling

An integrated patented air-gap cooling helps to speed up every application and ensures high sample throughput.

- Drastically reduced overall process times
- Vessel cooling prevents overheating and increases service life of components
- No handling of hot and pressurized vessels or rotors

# The Digestion Rotors
## Everything You Need

Continuously increasing demand for high sample throughput requires an appropriate solution. The 48-position rotor eliminates this bottleneck in sample preparation and convinces with speed and ease of work.

Designed for both high productivity and high digestion performance, the 16-position rotor is the perfect choice for a wide selection of samples, which require pressures and temperatures up to 40 bar and 240 °C.

The highest decomposition quality is achieved with the 8-position rotor, meeting demanding pressure and temperature requirements and converting samples that are difficult to decompose into clear solutions. Continuous pressure monitoring of all eight sample vessels allows for safe and precise reaction control, even with critical samples.

| Rotors | 48MF50 | 16MF100 | 16HF100 | 8SXF100 | 8SXQ80 |
|---|---|---|---|---|---|
| No. of vessels | 48 | 16 | 16 | 8 | 8 |
| Reaction control | ▸ One reference vessel with immersing temperature probe and pressure sensor<br>▸ Remote IR temperature control in 16 positions | | | ▸ Simultaneous pressure control in all positions<br>▸ Remote IR temperature control in all positions<br>▸ One reference vessel with immersing temperature probe | |
| Vessels | MF50 | MF100 | HF100 | XF100 | XQ80 |
| Liner material | PFA | PTFE-TFM | PTFE-TFM | PTFE-TFM | n/a |
| Pressure jacket | PEEK | PEEK | Ceramic | Ceramic | Quartz |
| Volume | 50 mL | 100 mL | 100 mL | 100 mL | 80 mL |
| Controlled pressure[1)] | 20 bar (290 psi) | 20 bar (290 psi) | 40 bar (580 psi) | 60 bar (870 psi) | 80 bar (1160 psi) |
| Max. pressure[2)] | 30 bar (435 psi) | 70 bar (1000 psi) | 70 bar (1000 psi) | 120 bar (1740 psi) | 120 bar (1740 psi) |
| Test pressure[3)] | 140 bar (2000 psi) | 140 bar (2000 psi) | 140 bar (2000 psi) | 140 bar (2000 psi) | 140 bar (2000 psi) |
| Max. temperature | 200 °C | 200 °C | 240 °C | 260 °C | 300 °C |
| HF resistant | Yes | Yes | Yes | Yes | No |
| Typical applications | Water, effluents, sewage sludge, plant material, soil, sediment, US-EPA procedures, biological material | | Food samples, contaminated soil, metals, alloys, geological material, glass, quartz | Mixed waste, semiconductors, ceramics, ores, ashes, slag, refractories | Fatty foodstuffs, plastics, fibers, oil, fat, coal, pharmaceuticals, chemicals |

[1)] via pressure sensor, [2)] opening pressure of the safety disk, [3)] certified test pressure for 1 minute

# The Sensor Technology
## Sophisticated and Unique

Detailed information on pressure and temperature during a microwave-heated process is of crucial importance for reproducibility and quality. Temperature and pressure limits must not be exceeded to ensure safe operation of the instrument.

The Multiwave 3000 offers several alternatives for measuring these important reaction criteria and provides precise data for reaction control along with detailed documentation.

Sensor signals are sent to the control unit via optical transmission, no electrical or mechanical connections are needed. The sensors are easy to handle, no tools are required.

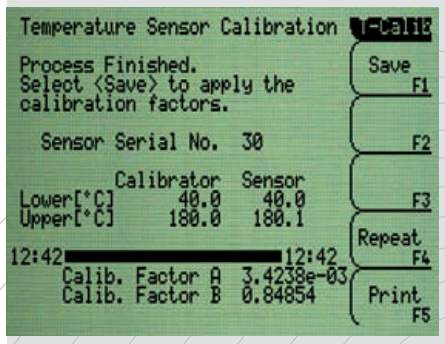
### Everything under control

- The patented (U.S. Patent No. 5,601,745) pressure-temperature sensor allows precise reaction control within a reference vessel. The immersing temperature probe, protected by a stable and resistant sapphire tube, allows accurate measurements inside the solution while the load-cell type pressure sensor is not in contact with the sample.
- An external IR sensor monitors the temperature at the base of each reaction vessel.
- Rotor 8 is equipped with a patented (U.S. Patent No. 5,637,803) hydraulic pressure system for simultaneous pressure monitoring of all vessels. Accurate reaction control is achieved by using the highest pressure level or fastest pressure increase in any of the vessels. An immersing temperature probe is optionally available.
- Control of the pressure increase rate is essential in case of exothermic reactions. If a predefined value of this rate is exceeded, microwave power is reduced.

### Temperature calibration accessory

For checking and calibrating the infrared sensor or immersing temperature probes to improve the accuracy of your digestion results.

- Fast and easy to perform
- Software-supported procedure
- GLP-compliant



# Rotor 16SOLV
## Excellent Extractions

Rotor 16SOLV expands the possibilities of the Multiwave 3000 from inorganic to organic sample preparation, allowing you to replace slow and tedious classical extraction methods.

Extremely fast, safe and easy Microwave-Assisted Extraction (MAE) improves both the performance and throughput of HPLC- or GC-based analysis.

Extractions of PCBs, PAHs and hydrocarbons from environmental and food samples, derivatization reactions prior to analysis or polymer extractions can be performed within 15 to 30 minutes.

### For digestion and extraction

The Multiwave 3000 can be upgraded to a dual-use configuration by simply interchanging the screw caps.


### Benefits

- Significant reduction in extraction times
- Solvent consumption reduced to a minimum
- High-throughput extractions of up to 16 samples simultaneously
- Meets requirements of US-EPA and ASTM methods
- Vessels are hermetically sealed and easy to handle
- Highest safety standards with GS and ETL certificates
- Temperature and pressure-controlled procedures in closed vessels – perfect extractions within 15 to 30 minutes
- Magnetic stirring for increased recovery

### Passive heating elements

Non-polar solvents do not absorb microwave energy sufficiently, but are required in many applications. The use of passive heating elements overcomes this drawback!

- Inert, stable, and reusable material
- No contamination of samples
- Excellent coupling efficiency

### Pressure filtration unit

An integrated filtration device for direct connection to the extraction vessels simplifies your sample work-up significantly. Applying pressure reduces the time required for filtration and rinsing to a few seconds.

- No loss of volatile analytes
- No exposure to solvent vapors

# Rotor 8EVAP & Rotor 1DRY
## Evaporation & Drying

### Versatility in sample preparation
The Multiwave 3000 supports more than just digestion and extraction. Concentration of aqueous samples, drying of sample material prior to digestion or removal of acids after decomposition can be done with the Multiwave 3000 in a fraction of the time required by conventional techniques.

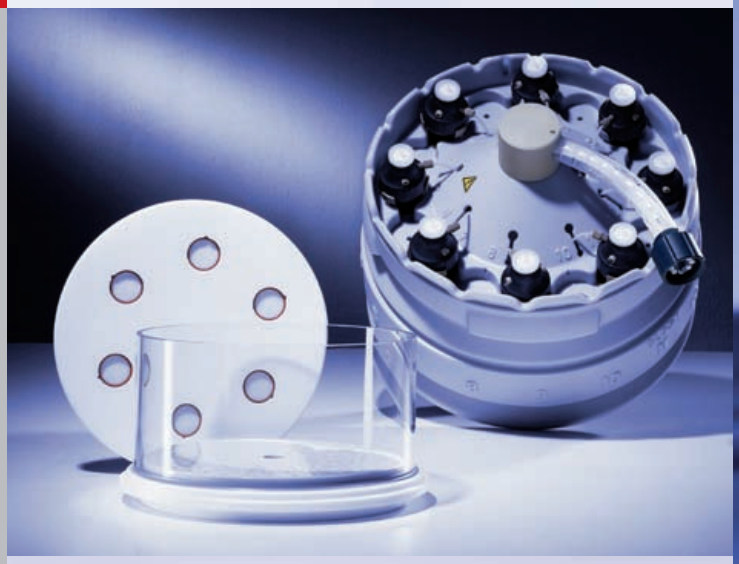
### Rotor 8EVAP
The evaporation rotor greatly simplifies and accelerates the microwave-assisted evaporation of acids and concentration of aqueous sample solutions.
Prior to digestion, sample solutions can be reduced in volume in order to increase analyte concentrations and improve digestion efficiency.

After digestion, acids can be fumed off directly from reaction vessels under controlled clean room conditions. Acid vapors are safely exhausted to an external scrubber and neutralized.

- Increased sample throughput
- No liquid transfer required
- Clean room conditions – no risk of contamination

### Scrubber
Rotor 8EVAP requires efficient acid fume and reaction gas exhaust. The optional scrubber washes and neutralizes the reagent vapors, which arise from microwave-heated acid evaporation and concentration processes. Efficient gas diffusers help to wash out up to 95% of acids. Simply connect the scrubber to the Multiwave 3000 lead-through.

### Rotor 1DRY
The drying rotor is the ideal accessory for efficient handling of samples prior to decomposition. Microwave drying takes a quarter of the time required by conventional methods, without carbonization or contamination of samples. The integrated exhaust unit removes humidity and unwanted odors.




# Special Solutions
## for Special Applications

Anton Paar has a long tradition of co-operation with international universities and research institutes. Our ongoing development and enhancement of innovative solutions ensures the satisfaction of all our customers' needs, including those with special requirements on a global basis.

### Oxygen combustion

Microwave-Induced Oxygen Combustion is an innovative method for sample preparation for all kinds of combustible solids such as wood, paper, coal, food or polymers. Volatile compounds such as halogens or several metals released during this combustion process are trapped in an absorption solution, which is subsequently analyzed via ion chromatography or atomic spectrometry.

- Replacement of steel combustion bombs
- Parallel combustion of up to 8 samples
- No handling of electrical connections or ignition wires
- No metal parts inside the combustion chamber – reduced risk of sample contamination

### UV digestion

Microwave-Assisted UV Digestion is a powerful technique for ultra-trace analysis of liquid samples with a high content of organic compounds, e.g. seawater, effluents, sewage, body fluids or beverages.

- Microwave-energized UV lamps
- Minimum amounts of reagents required
- No need for concentrated mineral acids
- Low analytical blanks

### Protein hydrolysis

Protein hydrolysis in liquid or gas phase is a well-established procedure for sample preparation and structure analysis. Microwave protocols reduce the overall process time to less than one hour, compared to several hours of heating in classical thermal methods.

- For milligram to gram amounts
- Disposable glass inserts
- No cross contamination
- Inert gas atmosphere applicable
- Accurate reaction control


Fotos: Croce & Wir

Anton Paar

**Anton Paar**® GmbH
Anton-Paar-Str. 20
A-8054 Graz
Austria - Europe
Tel: +43 (0)316 257-0
Fax: +43 (0)316 257-257
E-mail: info@anton-paar.com
Web: www.anton-paar.com

**Instruments for:**
Density & concentration measurement

Rheometry & viscometry

Sample preparation

Microwave synthesis

Colloid science

X-ray structure analysis

Refractometry

Polarimetry

High-precision temperature measurement

Specifications subject to change without notice.

01/09 B83IP01-D