



## 행성 볼 밀 PM 100

**The Planetary Ball Mill PM 100 is a powerful benchtop model with a single grinding station and an easy-to-use counterweight which compensates masses up to 8 kg. It allows for grinding up to 220 ml sample material per batch.**

**The extremely high centrifugal forces of Planetary Ball Mills result in very high pulverization energy and therefore short grinding times.**

The PM 100 can be found in virtually all industries where the quality control process places the highest demands on purity, speed, fineness and reproducibility.

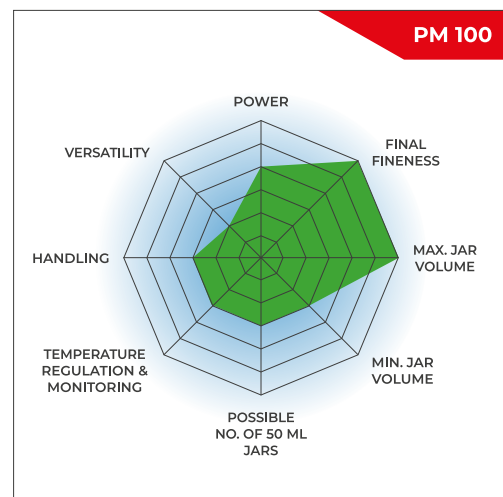
The mill is ideally suited for tasks in research like mechanochemistry (co-crystal screening, mechano-synthesis, mechanical alloying and mechanocatalysis), or ultrafine colloidal grinding on a nanometer scale, as well as for routine tasks such as mixing and homogenizing soft, hard, brittle or fibrous materials.



비디오 시청 클릭

### THE IDEAL BALL MILL FOR STANDARD APPLICATIONS

- | Max. speed 650 rpm
- | Up to 10 mm feed size and 0.1 µm final fineness
- | 1 grinding station for jars from 12 ml up to 500 ml
- | Jars of 12 – 80 ml can be stacked (two jars each)
- | GrindControl to measure temperature and pressure inside the jar.
- | Aeration lids to control the atmosphere inside the jar
- | Storable SOPs and cycle programs, 5 different jar materials for dry and wet grinding



## FAST & POWERFUL

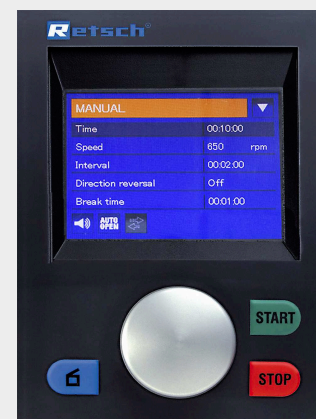
- | Loss-free size reduction down to the submicron range
- | Wet grinding yields particle sizes in the nanometer range (<100 nm)
- | Variable speed from 100 to 650 rpm, speed ratio 1:2
- | Grinding with up to 33.3 x acceleration of gravity
- | Batch-wise processing with max. 1 x 220 ml sample
- | 2 x 20 ml sample per batch with stacked jars



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## REPRODUCIBILITY, SAFETY AND EASY HANDLING

- | Reproducible results due to speed control
- | Easy and safe clamping of grinding jars
- | The Safety Slider prevents starting the machine without securely clamped jars
- | Perfect stability on the lab bench thanks to FFCS technology
- | Innovative counterweight and imbalance sensor for unsupervised operation
- | Comfortable parameter setting via display and ergonomic 1-button operation
- | Automatic grinding chamber ventilation
- | 10 SOPs can be stored, programmable starting time
- | Power failure backup ensures storage of remaining processing time



## SETTINGS & OPTIONS

- | Dry and wet grinding possible
- | Suitable for long-term trials, 99 h max.
- | Interval operation allows for cooling breaks
- | Direction reversal helps to minimize caking effects

## THE BEST ALTERNATIVE TO A RETSCH PLANETARY BALL MILL? A RETSCH MIXER MILL.

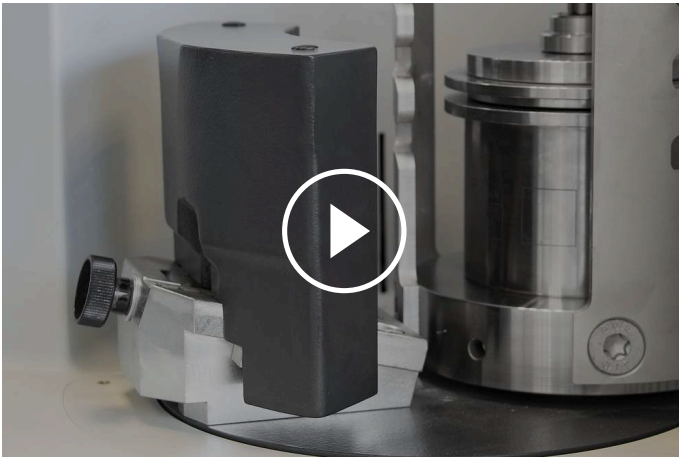


Benefit from particularly ergonomic handling while achieving the same finenesses down to the nanometer range.

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## SAFETY FIRST: COUNTERWEIGHT AND JAR CLAMPING

### COUNTERWEIGHT



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Planetary mills with a single grinding station require a counterweight for balancing purposes. In the planetary ball mill PM 100 this counterweight can be adjusted on an inclined guide rail to compensate for the different heights of the centers of gravity of differently-sized grinding jars and thus avoid undesired oscillations of the machine.

### SAFETY SLIDER



[비디오 시청 클릭](#)

Operation of the RETSCH planetary ball mills is particularly safe. They feature a robust Safety Slider which ensures that the mill can only be started after the grinding jar has been securely fixed with a clamping device. The self-acting lock ensures that the jar is seated correctly and securely. This proven solid mechanical system is less failure-prone than electronic solutions - the user has full access to the sample at any time. When the electronic system fails, it is not possible to unlock the jars, for example.

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## WET AND NANO-SCALE GRINDING WITH THE PM 100

Wet grinding is used to obtain particle sizes below 5  $\mu\text{m}$ , as small particles tend to get charged on their surfaces and agglomerate, which makes further grinding in dry mode difficult. By adding a liquid or dispersant the particles can be kept separated.

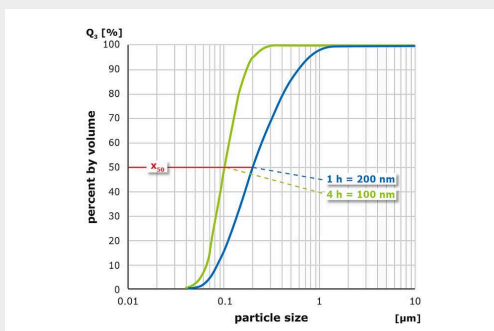
To produce very fine particles of 100 nm or less (nano-scale grinding) by wet grinding, friction rather than impact is required. This is achieved by using a large number of small grinding balls which have a large surface and many friction points. The ideal filling level of the jar should consist of 60 % small grinding balls.

For more details on jar filling, wet grinding and sample recovery watch the video.



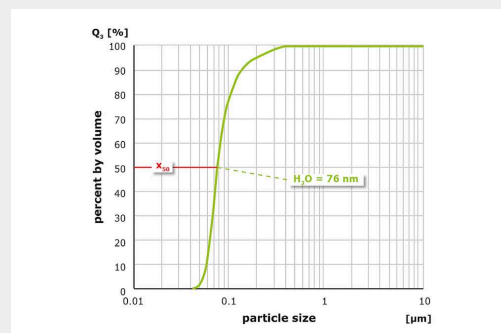
[비디오 시청 클릭](#)

The graphic shows the result of grinding alumina ( $\text{Al}_2\text{O}_3$ ) at 650 rpm in the PM 100. After 1 h of size reduction in water with 1 mm grinding balls, the mean value of the particle size distribution is 200 nm; after 4 h it is 100 nm.



Grinding of alumina in water with 1 mm grinding balls (left) after 1 hour (blue) and after 4 hours (green)

In another trial, the material was first pulverized for 1 hour with 1 mm grinding balls and then for 3 hours with 0.1 mm grinding balls. In this case, an average size of 76 nm was achieved.



Grinding of alumina with 1 mm grinding balls (1 hour) and then with 0.1 mm balls (3 hours) in water

The results show that planetary ball mills can produce particle sizes in the nanometer range. The choice of the right ball size, the type of liquid and the liquid/solid ratio (viscosity level) play a crucial role in this process.



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## EASYFIT GRINDING JARS FOR EXCELLENT RESULTS

The performance and the result of sample preparation are also determined by the choice of the grinding jar and its ball charge. The EasyFit range of jars has been specially designed for extreme working conditions such as long-term trials, even at maximum speed of 800 rpm, wet grinding, high mechanical loads and maximum speeds as well as for mechanical alloying. This line of jars is suitable for all RETSCH planetary ball mills.

The new EasyFit grinding jar series features a structure on the bottom of the 50-500 ml jars called Advanced Anti-Twist (AAT). This ensures that the jars are tightly fixed without the risk of twisting, even at high speed, and that wear and tear is drastically reduced. Secure clamping of the jars is made much easier: to find the correct clamping position, a maximum twist of 60° is required.

The geometry of the EasyFit jars in the 50 ml and 250 ml sizes has been enlarged in diameter and reduced in height compared to the previous "comfort" models. This offers two advantages: better grinding results and interchangeable lids, as there are only three diameter dimensions for the entire grinding jar range.

### Diameter categories

- | Diameter 1: 12 ml and 25 ml grinding jars
  - | Diameter 2: 50 ml, 80 ml and 125 ml grinding jars
  - | Diameter 3: 250 ml and 500 ml grinding jars
- 
- | Available jar sizes: 12 ml / 25 ml / 50 ml / 80 ml / 125 ml / 250 ml / 500 ml
  - | Innovative Advanced Anti-Twist (AAT) function ensures secure fit of grinding jars
  - | High flexibility thanks to suitability of three lid sizes for all seven jar sizes
  - | Pressure-tight and dust-proof O-ring sealing prevents material spillage
  - | Jars and balls available in 5 materials: hardened stainless steel, tungsten carbide, agate, sintered aluminium oxide, zirconium oxide
  - | Stainless steel protective jacket for agate, sintered aluminium oxide, zirconium oxide and tungsten carbide grinding jars
  - | A groove between jar body and lid allows for easy opening of the lid, e. g. with the help of a spatula, if there are underpressure effects inside the jar



## JARS & LIDS FOR SPECIAL APPLICATIONS

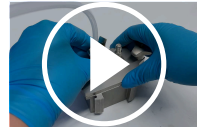
- | For colloidal or wet grinding, the use of a grinding jar with a special closure device is recommended
- | The special closure device is designed for ergonomic handling
- | Aeration lids are designed for working under inert atmosphere, for example if oxygen can influence the grinding process or the mechanosynthesis. The lids allow the introduction of gases like argon or nitrogen into the grinding jar.
- | Optional pressure and temperature measuring system PM GrindControl



GrindControl



Aeration lid



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Video:  
Aeration lid

Both the aeration lid and GrindControl can now be equipped with inlays of different materials. Thus, the lid can be used for, e. g. a steel and a zirconium oxide jar by simply exchanging the inlay.

## ADAPTER FOR SPECIAL APPLICATIONS

With a special adapter, co-crystal screening can be carried out in a planetary ball mill, using disposable vials such as 1.5 ml GC glass vials. The adapter features 24 positions arranged in an outer ring with 16 positions and an inner ring with 8 positions. The outer ring accepts up to 16 vials, allowing for screening up to 64 samples simultaneously when using the Planetary Ball Mill PM 400. The 8 positions of the inner ring are suitable to perform trials with different energy input, e.g. for mechanosynthesis research.

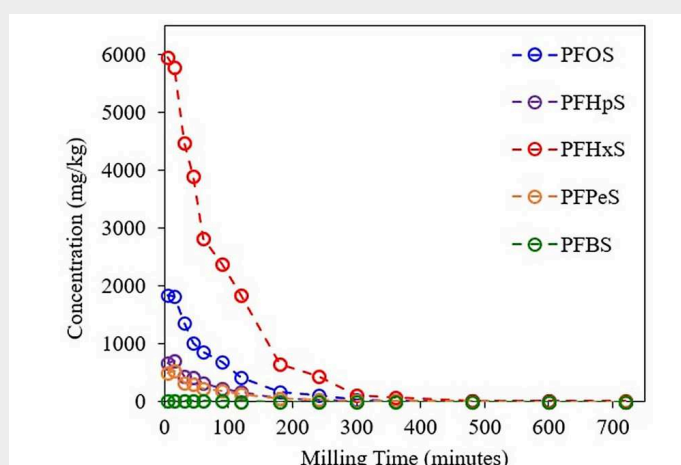
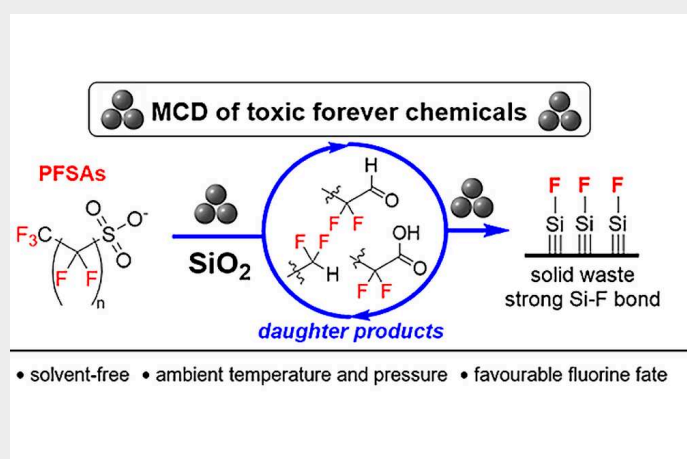




## MECHANOCHEMICAL DESTRUCTION OF FOREVER CHEMICALS IN PM 100

In a detailed study, Gobindlal et al. (2022) [10] investigated the mechanochemical destruction (MCD) of perfluorosulfonic acids (PFSAs), a subclass of persistent per- and polyfluoroalkyl substances (PFASs), using the PM 100.

- Milling Setup: 0.05 g of PFAS standards were mixed with 5 g of quartz sand in a 50 ml stainless steel jar with ten 10 mm stainless steel balls.
- Milling was performed at ambient temperature and pressure, without solvents or chemical additives. Samples were milled for up to 720 minutes, under relatively mild conditions, to assess degradation kinetics and establish the underlying degradation mechanisms.
- The PM 100 achieved 99.99% degradation of total PFSA content after 720 minutes. Individual compounds like PFOS, PFHpS, PFHxS, PFPeS, and PFBS showed rapid degradation, with PFBS reaching complete destruction by 180 minutes.



Decreasing concentration of different Perfluorosulfonic acids (PFAs) while grinding in the PM100 over a period of 700 min; Results presented by the group of Kapish Gobindlal [1]

### MECHANISM OF ACTION:

Quartz sand, when ground in the PM 100, generates reactive surface radicals that initiate PFAS breakdown. These radicals facilitate C-F bond cleavage, one of the strongest in organic chemistry, leading to the mineralization of fluorine into stable Si-F bonds. Another study by the same group highlights the scalability and effectiveness of MCD using the Retsch PM 100 planetary ball mill for the remediation of PFAS-contaminated land and the destruction of stockpiled AFFFs.

MECHANOCHEMISTRY IN THE PHARMACEUTICAL INDUSTRY

## SUSTAINABLE PRODUCTION OF ACTIVE PHARMACEUTICAL INGREDIENTS WITH MAXIMUM EFFICIENCY

Discover how mechanochemical methods can contribute to the production of active pharmaceutical ingredients—with higher atomic efficiency, fewer byproducts, and a significantly reduced environmental footprint.

Mechanochemistry opens up new avenues for more sustainable chemical synthesis: By utilizing mechanical energy, reactions can be carried out in the solid state—often with no solvents at all or only minimal use of solvents. This reduces waste, lowers energy consumption, and simultaneously improves process efficiency.

Vibrating mills such as the MM 500 nano enable precise control of grinding parameters and are particularly suitable for fast, efficient syntheses on a laboratory scale. For more demanding applications requiring higher energies, the planetary ball mill PM 100 offers optimal conditions for carrying out even complex reactions in a targeted manner.

Take a look!



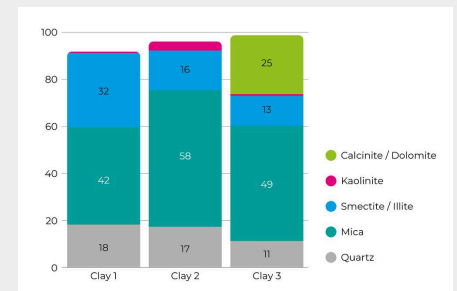
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Courtesy of Clara B. Gomez, LAQV  
REQUIMTE

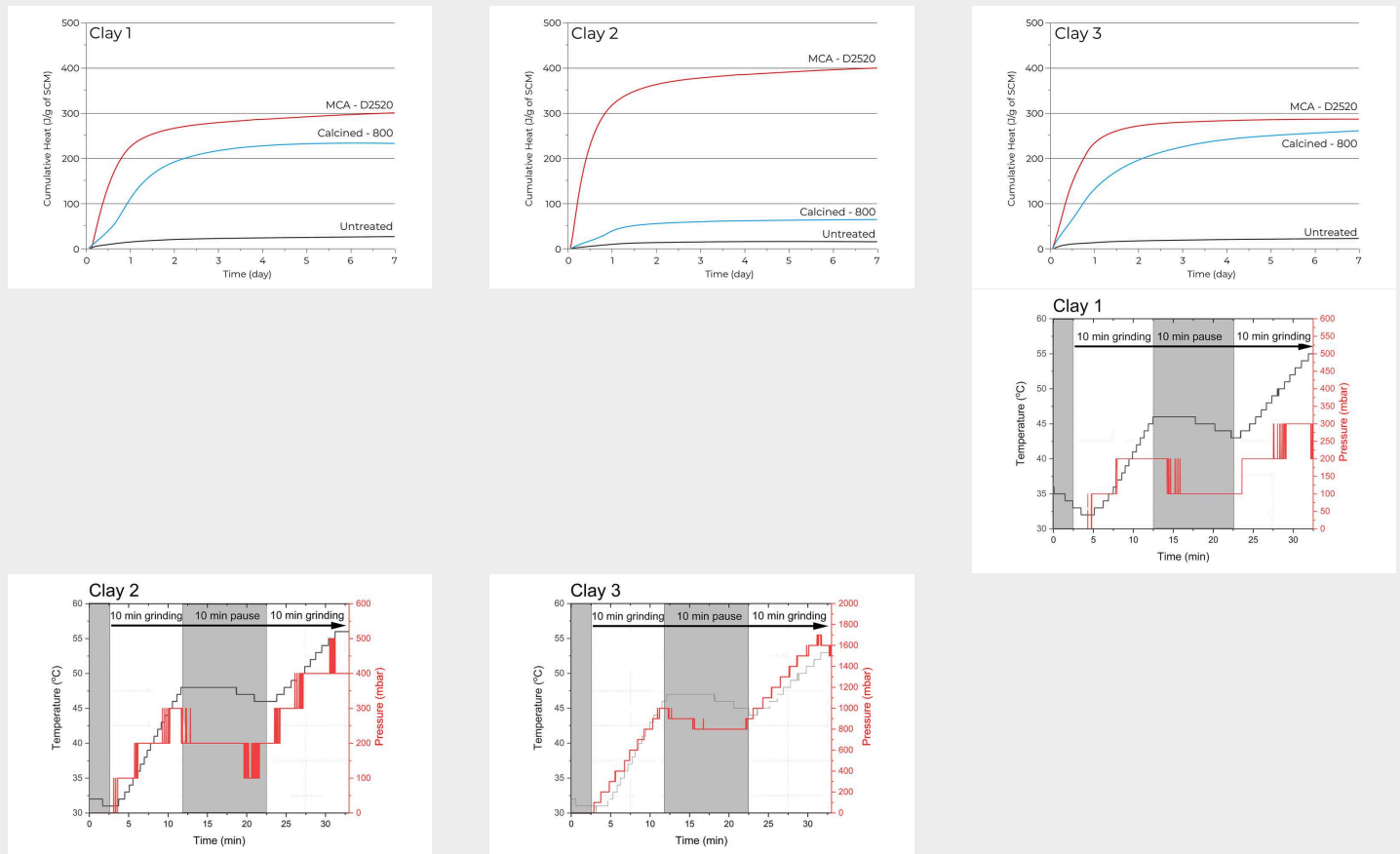
## MECHANOCHEMISTRY MEETS CEMENT: CLAY CALCINATION ALTERNATIVES AND ACTIVATION TECHNOLOGY FOR CLAYS

Activated clays are among the most promising supplementary cementitious materials (SCMs) because they are globally available, can be locally sourced, and enable significant clinker reduction. Traditionally, reactive clays are produced via clay calcination, but mechanochemical activation is an emerging activation technology that can provide a compelling alternative in certain applications. Mechanochemical activation of clay - particularly using ball mills such as the PM 100 or PM 300 - uses mechanical energy to alter the crystal structure, enable amorphization, and increase reactivity, making a wide range of local clay types usable as cement replacement materials. The PM 100 and PM 300 are ideally suited for this process at laboratory and pilot scale. Studies show that mechanically activated clays are finer, structurally modified, and more chemically reactive than calcined clays, especially those with a high mica content.

A key element of activation technology process control is the GrindControl system, which continuously measures temperature and pressure inside the grinding jar, helps prevent overheating, and provides important insights into mechanochemical reactions. The sensors are compatible with various jar sizes. During clay activation, temperature and pressure rise significantly, indicating gas release and mineral transformation; this monitoring is essential for controlling reactivity and ensuring consistent SCM product quality. The data can also support conclusions about clay composition - for example, materials with higher dolomite content generate higher pressures due to CO<sub>2</sub> release [1].



## REACTIVITY OF DIFFERENT CLAYS AFTER THERMAL AND MECHANICAL ACTIVATION; GRINDCONTROL PRESSURE INCREASE REFLECTS DOLOMITE CONTENT



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## RECOMMENDED JAR FILLINGS

To produce optimum grinding results, the jar size should be adapted to the sample amount to be processed. The grinding balls are ideally sized 3 times bigger than the largest sample piece. Following this rule of thumb, the number of grinding balls for each ball size and jar volume is indicated in the table below. To pulverize, for example, 200 ml of a sample consisting of 7 mm particles, a 500 ml jar and grinding balls sized at least 20 mm or larger are recommended. According to the table, 25 grinding balls are required.

| Grinding jar nominal volume | Sample amount | Max. feed size | Recommended ball charge (pieces) |     |      |      |      |      |
|-----------------------------|---------------|----------------|----------------------------------|-----|------|------|------|------|
|                             |               |                | Ø 5 mm                           | Ø 7 | Ø 10 | Ø 15 | Ø 20 | Ø 30 |

|        |                  |        |             | mm        | mm        | mm      | mm    | mm |
|--------|------------------|--------|-------------|-----------|-----------|---------|-------|----|
| 12 ml  | up to -까지 ≤5 ml  | <1 mm  | 50          | 15        | 5         | -       | -     | -  |
| 25 ml  | up to -까지 ≤10 ml | <1 mm  | 95 – 100    | 25 – 30   | 10        | -       | -     | -  |
| 50 ml  | 5 – 20 ml        | <3 mm  | 200         | 50 – 70   | 20        | 7       | 3 – 4 | -  |
| 80 ml  | 10 – 35 ml       | <4 mm  | 250 – 330   | 70 – 120  | 30 – 40   | 12      | 5     | -  |
| 125 ml | 15 – 50 ml       | <4 mm  | 500         | 110 – 180 | 50 – 60   | 18      | 7     | -  |
| 250 ml | 25 – 120 ml      | <6 mm  | 1100 – 1200 | 220 – 350 | 100 – 120 | 35 – 45 | 15    | 5  |
| 500 ml | 75 – 220 ml      | <10 mm | 2000        | 440 – 700 | 200 – 230 | 70      | 25    | 8  |

The table shows the recommended charges (in pieces) of differently sized grinding balls in relation to the grinding jar volume, sample amount and maximum feed size.

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대표 시료

RETSCH planetary ball mills are perfectly suitable for size reduction of, for example, alloys, bentonite, bones, carbon fibres, catalysts, cellulose, cement clinker, ceramics, charcoal, chemical products, clay minerals, coal, coke, compost, concrete, electronic scrap, fibres, glass, gypsum, hair, hydroxyapatite, iron ore, kaolin, limestone, metal oxides, minerals, ores, paints and lacquers, paper, pigments, plant materials, polymers, quartz, seeds, semi-precious stones, sewage sludge, slag, soils, tissue, tobacco, waste samples, wood, etc.

**TOUGH-FIBROUS:  
WOOD**



40 g sample  
500 ml stainless steel  
grinding jar  
8 x 30 mm stainless  
steel grinding balls  
5 min at 380 rpm

**HARD-BRITTLE:  
MAGNETITE**



315 g sample  
250 ml tungsten  
carbide grinding jar  
15 x 20 mm tungsten  
carbide grinding balls  
5 min at 500 rpm

**MEDIUM-HARD: SOIL**



45 ml sample  
125 ml stainless steel  
grinding jar  
7 x 20 mm stainless  
steel grinding balls  
2 min at 400 rpm

**FIBROUS: DRIED  
GRASS**



200 ml sample  
250 ml zirconium oxide  
grinding jar  
15 x 20 mm zirconium  
oxide grinding balls  
30 min at 480 rpm

**MEDIUM-HARD/섬유질:**  
오수 침전물



20 g sample  
125 ml zirconium oxide  
grinding jar  
50 x 10 mm zirconium  
oxide grinding balls  
30 min at 380 rpm with  
direction reversal

**MEDIUM-HARD: 석회암**



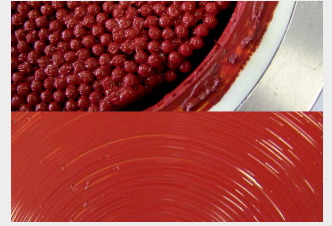
170 ml sample  
500 ml zirconium oxide  
grinding jar  
8 x 30 mm zirconium  
oxide grinding balls  
3 min at 450 rpm

**HARD-BRITTLE: LAPIS  
LAZULI**



4 sample pieces  
50 ml zirconium oxide  
grinding jar  
3 x 20 mm zirconium  
oxide grinding balls  
2 min at 420 rpm

**SOFT - WET GRINDING:**  
CAROTENE



50 g sample + 70 g oil  
50 ml zirconium oxide  
grinding jar  
1100 g 3 mm zirconium  
oxide grinding balls  
2 h at 480 rpm (interval  
operation with 10 min  
grinding / 10 min break  
= net grinding time 1 h)

샘플 준비 작업에 가장 적합한 솔루션을 찾으려면 애플리케이션 데이터베이스를 방문하십시오.



## 행성 볼 밀 PM 100

### 작동 원리

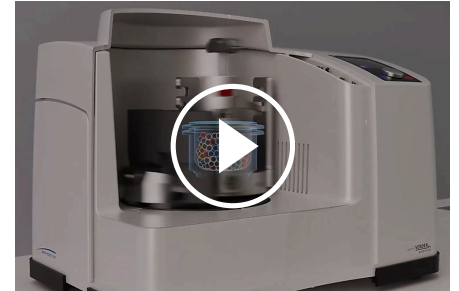
분쇄 용기는 행성 볼 밀의 sun wheel에 편심 배치됩니다. 용기의 운동 방향은 sun wheel에 대하여 1:-2 비율로 반대 운동합니다.

분쇄 용기 내 분쇄용 볼은 소위 코리올리 힘 (Coriolis forces)이라 불리는 중첩 회전 운동을 받습니다. 볼과 분쇄 용기 간 속도 차는 높은 동적 에너지를 방출하며 마찰력과 충격 사이에서 상호 작용을 발생시킵니다. 이러한 힘 사이의 상호 작용은 행성 볼 밀의 분쇄를 매우 효과적이며 높은 수준으로 만듭니다.

하나의 분쇄 구간이 있는 행성 볼 밀은 균형을 위하여 평형 추를 필요로 합니다. 볼 분쇄기 PM 100의 평형 추는 경사진 가이드 레일에서 조정될 수 있습니다. 이러한 방식으로, 제품의 방해 진동을 피하기 위해 분쇄 용기 무게 중심을 보정할 수 있습니다.

남아있는 진동은 약간의 자유 운동이 있는 다리에 의해 보정됩니다 (Free-Force Compensation Sockets). 이 혁신적인 FFCS 기술은 d'Alembert 원리를 기반으로 하며 자동 질량 상쇄를 만들어내는 제품 하우징의 아주 작은 원운동을 생성합니다. 실험실의 벤치는 이 다리에서 발생하는 마찰력을 최소화합니다.

이러한 방식으로 PM 100은 분쇄 용기 내부에 가장 큰 분쇄력이 존재하더라도 진동의 최대 상쇄로 조용하고 안전한 작업을 보장하므로 무 감독 자율 벤치에서 작동될 수 있습니다.



[비디오 시청 클릭](#)

## 행성 볼 밀 PM 100

### 기술 데이터

|                                          |                                                                                                                                  |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 응용 분야                                    | pulverizing, mixing, homogenizing, colloidal milling, mechanical alloying, mechanosynthesis, nano grinding, co-crystal screening |
| 응용분야                                     | 건축 재료, 농업, 생물학, 엔지니어링 / 전자 공학, 유리 / 세라믹, 의학 / 제약, 지질학 / 야금, 화학, 환경 / 재활용                                                         |
| 투입 시료                                    | 연질, 경질, 취성, 섬유질 - 건식 또는 습식                                                                                                       |
| 크기 축소 원리                                 | 충격, 마찰                                                                                                                           |
| 최대 투입 크기*                                | < 10 mm                                                                                                                          |
| 최종 분말 입도*                                | < 1 µm, 습식 분쇄 시 < 0.1 µm                                                                                                         |
| 시료 일괄 처리량*                               | 최대. 1 x 220 ml, 최대. 2 x 20 ml 장착된 분쇄조                                                                                            |
| 분쇄조 수                                    | 1                                                                                                                                |
| 속도 비율                                    | 1 : -2                                                                                                                           |
| 선 휠 속도                                   | 100 - 650 min <sup>-1</sup>                                                                                                      |
| 효율적인 선 휠 직경                              | 141 mm                                                                                                                           |
| 중력 (G-force)                             | 33.3 g                                                                                                                           |
| 분쇄 용기 종류                                 | EasyFit, optional aeration covers, safety closure devices                                                                        |
| 분쇄 도구 재질                                 | 경화 스틸, 스테인레스 스틸, 탄화 텅스텐, 마노, 소결 산화 알루미늄, 질화규소, 산화 지르코늄                                                                           |
| 분쇄 용기 크기                                 | 12 ml / 25 ml / 50 ml / 80 ml / 125 ml / 250 ml / 500 ml                                                                         |
| <b>Stackable grinding jars</b>           | 12 ml / 25 ml / 50 ml / 80 ml                                                                                                    |
| <b>Adapter for single-use glas vials</b> | 24 x 1.5 ml / 7 x 20 ml                                                                                                          |
| 분쇄 시간 설정                                 | 디지털, 00:00:01 에서 99:59:59                                                                                                        |
| 인터벌 작업                                   | 가능, 역방향                                                                                                                          |
| 인터벌 작업 시간                                | 00:00:01 에서 99:59:59                                                                                                             |
| 일시정지 시간                                  | 00:00:01 에서 99:59:59                                                                                                             |
| 표준 운영 절차 저장 가능 수                         | 10                                                                                                                               |
| 인터페이스                                    | RS 232 / RS 485                                                                                                                  |
| 구동                                       | 주파수 변환기를 가진 3상 비동기식 모터                                                                                                           |
| 구동 전력                                    | 750 W                                                                                                                            |
| 전원 공급 데이터                                | 다른 전압                                                                                                                            |
| 전원 연결                                    | 단상                                                                                                                               |
| 안전 보호 코드                                 | IP 30                                                                                                                            |

|                   |                                                                                  |
|-------------------|----------------------------------------------------------------------------------|
| 소비 전력             | ~ 1250W (VA)                                                                     |
| 폭 x 높이 x 깊이 닫혔을 때 | 640 x 480 (780) x 420 mm                                                         |
| 중량                | ~ 86 kg                                                                          |
| 표준                | CE                                                                               |
| 특허 / 실용 특허        | Counter weight (DE 20307741), FFCS (DE 20310654), SafetySlider (DE 202008008473) |

\*투입 재료와 장비 환경, 설정에 따라

## REFERENCES

[1] Kapish Gobindlal, Zoran Zujovic, Jacob Jaine, Cameron C. Weber, Jonathan Sperry; Solvent-free ambient temperature and pressure destruction-of PFSA's under MCD presents a detailed study on the mechanochemical destruction (MCD) of perfluorosulfonic acids (PFSA's), Environmental Science & Technology 2023, DOI: 10.1021/acs.est.2c06673.

[www.retsch.com/pm100](http://www.retsch.com/pm100)

## 주문 정보

### 행성 볼 밀 PM 100

(분쇄 용기, 볼 별도 주문)

20.540.0001



PM 100 분쇄 스테이션 1 개, 속도 비율 1: -2

다른 전력 버전도 동일한 가격으로 제공

### ACCESSORIES PLANETARY BALL MILLS

22.661.0002



Clamping unit for PM 100 / PM 400

03.025.0178

Adapter for stacking grinding jars 50 ml - 80 ml

22.221.0002



애드-온 웨이트, PM 100 용

02.728.0048



Counter aid for sun wheel PM 100, PM 200 and PM 400

03.486.0062

Opening aid for clamping unit of planetary ball mills

99.200.0006



IQ/OQ Documentation for PM 100

### PRESSURE AND TEMPERATURE MEASURING SYSTEM GRINDCONTROL FOR PLANETARY BALL MILLS

**incl. sensors and transmitter unit, insert of lid, software, case, opening aid and cleaning accessories for PM (please order grinding jars separately)**

22.782.0033



GrindControl for PM grinding jar EasyFit 50 - 125 ml

22.782.0034



GrindControl for PM grinding jar EasyFit 250 - 500 ml

### GRINDCONTROL LID INSERTS

03.474.0243

GrindControl lid insert for 50, 80, 125 ml, stainless steel

|             |                                                             |
|-------------|-------------------------------------------------------------|
| 03.474.0246 | GrindControl lid insert for 50, 80, 125 ml, zirconium oxide |
| 03.474.0244 | GrindControl lid insert for 250 or 500 ml, stainless steel  |
| 03.474.0247 | GrindControl lid insert for 250 or 500 ml, zirconium oxide  |

## ACCESSORIES FOR PM GRINDCONTROL WITH GRINDING JARS EASYFIT

|             |                                                                                    |                                                       |
|-------------|------------------------------------------------------------------------------------|-------------------------------------------------------|
| 05.114.0056 |   | O-ring for 50, 80 or 125 ml                           |
| 05.114.0054 |   | O-ring for 250 ml - 500 ml grinding jars EasyFit (PM) |
| 03.111.0438 |                                                                                    | Flat gasket for 50 ml, 80 ml or 125 ml                |
| 03.111.0439 |                                                                                    | Flat gasket for 250 ml - 500 ml                       |
| 22.186.0007 |                                                                                    | Sintered filter with O-ring, set of 10 pieces         |
| 22.864.0001 |  | Valve set M8x1 for GrindControl and aeration lids     |

## GRINDING JARS EASYFIT

**(grinding jars EasyFit are suitable for all planetary ball mills)**

### HARDENED STAINLESS STEEL

|             |                                                                                     |        |
|-------------|-------------------------------------------------------------------------------------|--------|
| 01.462.0239 |  | 12 ml  |
| 01.462.0240 |  | 25 ml  |
| 01.462.0516 |                                                                                     | 50 ml  |
| 01.462.0517 |                                                                                     | 80 ml  |
| 01.462.0518 |                                                                                     | 125 ml |
| 01.462.0519 |                                                                                     | 250 ml |
| 01.462.0520 |                                                                                     | 500 ml |

### TUNGSTEN CARBIDE

|             |        |
|-------------|--------|
| 01.462.0494 | 50 ml  |
| 01.462.0495 | 80 ml  |
| 01.462.0527 | 125 ml |
| 01.462.0497 | 250 ml |

#### 아게이트 (마노)

|             |        |
|-------------|--------|
| 01.462.0509 | 50 ml  |
| 01.462.0511 | 80 ml  |
| 01.462.0515 | 125 ml |
| 01.462.0502 | 250 ml |
| 01.462.0506 | 500 ml |

#### 소결 알루미늄 옥사이드

|             |        |
|-------------|--------|
| 01.462.0507 | 50 ml  |
| 01.462.0512 | 125 ml |
| 01.462.0499 | 250 ml |
| 01.462.0503 | 500 ml |

#### ZIRCONIUM OXIDE

|             |        |
|-------------|--------|
| 01.462.0508 | 50 ml  |
| 01.462.0510 | 80 ml  |
| 01.462.0513 | 125 ml |
| 01.462.0500 | 250 ml |
| 01.462.0504 | 500 ml |

#### ADAPTER FOR GLASS VIALS

01.462.0540  Adapter for 24 x 1.5 ml glass vials, stainless, hardened steel

22.749.0009  Glass vial 1.5 ml incl. septum cap, 100 pieces

05.181.0112 Replacement pressure spring for adapter for 24 x 1.5 ml glass vials, 1 piece

|             |                                                                            |
|-------------|----------------------------------------------------------------------------|
| 01.462.0541 | Adapter for 7 x 20 ml glass vials, stainless, hardened steel               |
| 22.749.0010 | Glass vial 20 ml incl. septum cap, 100 pieces                              |
| 05.181.0044 | Replacement pressure spring for adapter for 7 x 20 ml glass vials, 1 piece |

## ACCESSORIES FOR GRINDING JARS EASYFIT FOR WET GRINDING, GRINDING WITH INERT ATMOSPHERE AND MECHANICAL ALLOYING (MA)

### AERATION LIDS (INCL. INLAY)

|             |                                                                     |
|-------------|---------------------------------------------------------------------|
| 22.107.0613 | for grinding jars EasyFit 50 ml - 125 ml, hardened stainless steel  |
| 22.107.0616 | for grinding jars EasyFit 50 ml - 125 ml, tungsten carbide          |
| 22.107.0617 | for grinding jars EasyFit 50 ml - 125 ml, agate                     |
| 22.107.0615 | for grinding jars EasyFit 50 ml - 125 ml, zirconium oxide           |
| 22.107.0618 | for grinding jars EasyFit 250 ml - 500 ml, hardened stainless steel |
| 22.107.0621 | for grinding jars EasyFit 250 ml - 500 ml, tungsten carbide         |
| 22.107.0622 | for grinding jars EasyFit 250 ml - 500 ml, agate                    |
| 22.107.0620 | for grinding jars EasyFit 250 ml - 500 ml, zirconium oxide          |
| 22.107.0619 | for grinding jars EasyFit 250 ml - 500 ml, aluminum oxide           |
| 22.864.0001 | Spare valve set for aeration lids M8x1                              |



### INLAY FOR AERATION LID

|             |                                                                     |
|-------------|---------------------------------------------------------------------|
| 03.474.0225 | for grinding jars EasyFit 50 ml - 125 ml, hardened stainless steel  |
| 03.474.0207 | for grinding jars EasyFit 50 ml - 125 ml, tungsten carbide          |
| 03.474.0208 | for grinding jars EasyFit 50 ml - 125 ml, agate                     |
| 03.474.0206 | for grinding jars EasyFit 50 ml - 125 ml, zirconium oxide           |
| 03.474.0226 | for grinding jars EasyFit 250 ml - 500 ml, hardened stainless steel |
| 03.474.0210 | for grinding jars EasyFit 250 ml - 500 ml, tungsten carbide         |
| 03.474.0211 | for grinding jars EasyFit 250 ml - 500 ml, agate                    |
| 03.474.0209 | for grinding jars EasyFit 250 ml - 500 ml, zirconium oxide          |
| 03.474.0215 | for grinding jars EasyFit 250 ml - 500 ml, aluminum oxide           |



## AERATION LIDS FOR GRINDING JARS EASYFIT

INCL. O-RINGS AND SINTERED FILTER (PLEASE ORDER LID INSERT AND GRINDING JAR SEPARATELY)

|             |                                                       |
|-------------|-------------------------------------------------------|
| 22.107.0636 | Aeration lid for grinding jar EasyFit 50 ml - 125 ml  |
| 22.107.0637 | Aeration lid for grinding jar EasyFit 250 ml - 500 ml |

### INSERT FOR GRINDING JAR EASYFIT

|             |                                                                                   |
|-------------|-----------------------------------------------------------------------------------|
| 03.474.0261 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, stainless steel  |
| 03.474.0262 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, zirconium oxide  |
| 03.474.0263 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, tungsten carbide |
| 03.474.0268 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, agate            |
| 03.474.0264 | Aeration lid insert for grinding jar EasyFit 250 oder 500 ml, stainless steel     |
| 03.474.0265 | Aeration lid insert for grinding jar EasyFit 250 oder 500 ml, zirconium oxide     |
| 03.474.0266 | Aeration lid insert for grinding jar EasyFit 250 oder 500 ml, tungsten carbide    |
| 03.474.0267 | Aeration lid insert for grinding jar EasyFit 250 oder 500 ml, aluminum oxide      |
| 03.474.0269 | Aeration lid insert for grinding jar EasyFit 250 oder 500 ml, agate               |
| 22.186.0007 | Sintered filter with O-ring, set of 10 pieces                                     |
| 22.864.0001 | Valve set M8x1 for GrindControl and aeration lids                                 |



## 안전 폐쇄 장치

|             |                                           |
|-------------|-------------------------------------------|
| 22.867.0011 | for grinding jars EasyFit 50 ml - 125 ml  |
| 22.867.0012 | for grinding jars EasyFit 250 ml - 500 ml |
| 02.486.0055 | Opening aid for safety closure device     |

## GASKETS FOR GRINDING JARS EASYFIT

### O 링

|             |                                                  |
|-------------|--------------------------------------------------|
| 05.114.0086 | O-ring for 12 ml grinding jar EasyFit            |
| 05.114.0085 | O-ring for 25 ml grinding jar EasyFit            |
| 05.114.0054 | O-ring for 250 ml - 500 ml grinding jars EasyFit |



|             |                                                                                   |                                                         |
|-------------|-----------------------------------------------------------------------------------|---------------------------------------------------------|
| 05.114.0056 |  | O-ring for 50 ml - 125 ml grinding jars EasyFit         |
| 05.114.0063 |  | O-ring for 250 ml - 500 ml grinding jars EasyFit, agate |
| 03.111.0438 |                                                                                   | Flat gasket for 50 ml, 80 ml or 125 ml                  |
| 03.111.0439 |                                                                                   | Flat gasket for 250 ml - 500 ml                         |

## 분쇄용 볼

### HARDENED STEEL

|             |                                                                                     |         |
|-------------|-------------------------------------------------------------------------------------|---------|
| 05.368.0029 |    | 5 mm Ø  |
| 05.368.0030 |   | 7 mm Ø  |
| 05.368.0059 |  | 10 mm Ø |
| 05.368.0032 |  | 12 mm Ø |
| 05.368.0108 |  | 15 mm Ø |
| 05.368.0033 |  | 20 mm Ø |
| 05.368.0057 |  | 30 mm Ø |

### STAINLESS STEEL

|             |                                                                                     |                          |
|-------------|-------------------------------------------------------------------------------------|--------------------------|
| 22.455.0010 |  | 2 mm Ø, 500 g (약 110 ml) |
| 22.455.0011 |  | 3 mm Ø, 500 g (약 120 ml) |
| 22.455.0002 |  | 3 mm Ø, 200 개 (약 6 ml)   |

|             |                                                                                     |                         |
|-------------|-------------------------------------------------------------------------------------|-------------------------|
| 22.455.0001 |    | 4 mm Ø, 200 개 (약 14 ml) |
| 22.455.0003 |    | 5 mm Ø, 200 개 (약 25 ml) |
| 05.368.0034 |    | 5 mm Ø                  |
| 05.368.0035 |    | 7 mm Ø                  |
| 05.368.0063 |    | 10 mm Ø                 |
| 05.368.0037 |    | 12 mm Ø                 |
| 05.368.0109 |    | 15 mm Ø                 |
| 05.368.0062 |  | 20 mm Ø                 |
| 05.368.0105 |  | 25 mm Ø                 |
| 05.368.0061 |  | 30 mm Ø                 |

#### TUNGSTEN CARBIDE

|             |                                                                                     |                         |
|-------------|-------------------------------------------------------------------------------------|-------------------------|
| 22.455.0006 |  | 3 mm Ø, 200 개 (약 6 ml)  |
| 22.455.0005 |  | 4 mm Ø, 200 개 (약 14 ml) |
| 22.455.0004 |  | 5 mm Ø, 200 개 (약 25 ml) |
| 05.368.0038 |  | 5 mm Ø                  |
| 05.368.0039 |  | 7 mm Ø                  |

|             |                                                                                   |         |
|-------------|-----------------------------------------------------------------------------------|---------|
| 05.368.0071 |  | 10 mm Ø |
| 05.368.0041 |  | 12 mm Ø |
| 05.368.0110 |  | 15 mm Ø |
| 05.368.0070 |  | 20 mm Ø |
| 05.368.0069 |  | 30 mm Ø |

#### 아게이트 (마노)

|             |                                                                                     |         |
|-------------|-------------------------------------------------------------------------------------|---------|
| 05.368.0024 |    | 5 mm Ø  |
| 05.368.0025 |   | 7 mm Ø  |
| 05.368.0067 |  | 10 mm Ø |
| 05.368.0027 |  | 12 mm Ø |
| 05.368.0111 |  | 15 mm Ø |
| 05.368.0028 |  | 20 mm Ø |
| 05.368.0065 |  | 30 mm Ø |

#### 소결 알루미늄 옥사이드

|             |                                                                                     |         |
|-------------|-------------------------------------------------------------------------------------|---------|
| 05.368.0021 |  | 10 mm Ø |
| 05.368.0112 |  | 15 mm Ø |

05.368.0054



20 mm Ø

05.368.0053



30 mm Ø

05.368.0052



40 mm Ø

#### ZIRCONIUM OXIDE

32.368.0005



0.1 mm Ø, 0.5 kg (약 135 ml)

32.368.0003



0.5 mm Ø, 0.5 kg (약 135 ml)

32.368.0004



1 mm Ø, 0.5 kg (약 135 ml)

05.368.0089



2 mm Ø, 0.5 kg (approx. 135 ml)

05.368.0090



3 mm Ø, 0.5 kg (approx. 140 ml)

22.455.0007



3 mm Ø, 200 개 (약 6 ml)

22.455.0009



5 mm Ø, 200 개 (약 25 ml)

05.368.0146

7 mm Ø

05.368.0094



10 mm Ø

05.368.0096



12 mm Ø

05.368.0113



15 mm Ø

05.368.0093



20 mm Ø

05.368.0106



25 mm Ø

05.368.0092



30 mm Ø