



행성 볼 밀 PM 200

The Planetary Ball Mill PM 200 is a powerful benchtop model with 2 grinding stations for grinding jars with a nominal volume of 12 ml to 125 ml.

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

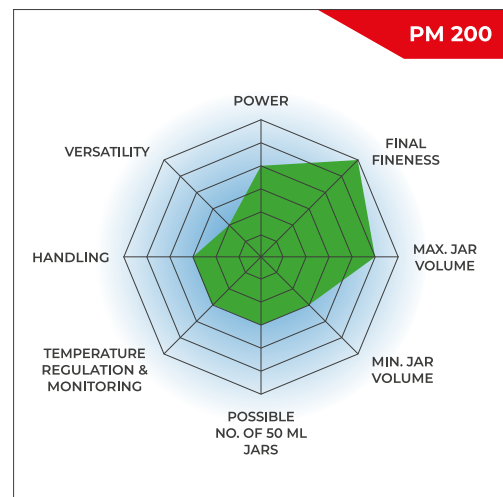
The PM 200 can be found in virtually all industries where the quality control process places the highest demands on purity, speed, fineness and reproducibility.

The mill is ideally suited for tasks in research like mechanochemistry (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.



TWO GRINDING STATIONS FOR STANDARD APPLICATIONS

- | Max. speed 650 rpm
- | Up to 10 mm feed size and 0.1 µm final fineness
- | 2 grinding stations for jars from 12 ml up to 125 ml, jars of 12 and 25 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

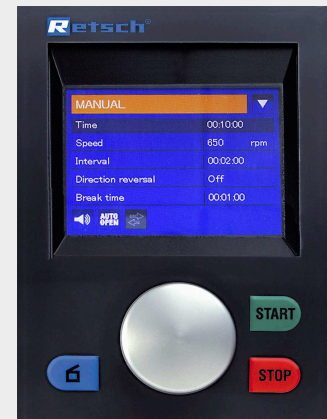
- | Loss-free size reduction down to the submicron range
- | Wet grinding yields particle sizes in the nanometer range (<100 nm)
- | Variable speed from 100 to 650 rpm, speed ratio 1:-2
- | Grinding with up to 33.3 x acceleration of gravity
- | Batch-wise processing with max. 2 x 50 ml sample
- | Wide range of materials for contamination free grinding

PM 200

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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: JAR CLAMPING

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.



비디오 시청 클릭

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WET AND NANO-SCALE GRINDING WITH THE PM 200

Wet grinding is used to obtain particle sizes below 5 μm , 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.

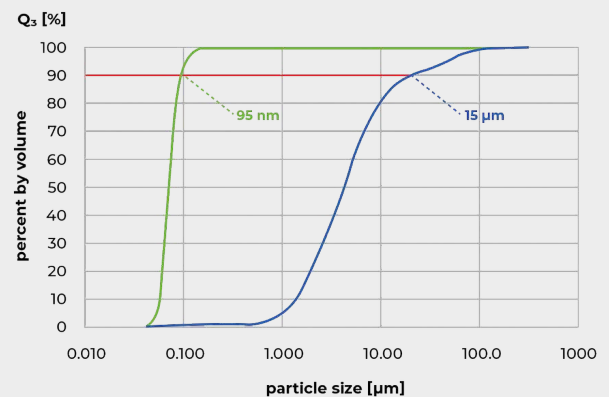
For more details on jar filling, wet grinding and sample recovery watch the video.



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The video shows wet grinding in the Planetary Ball Mill PM 100.

The graphic shows the result of grinding barium titanate at 500 rpm in the PM 200. After 5 h of pulverization in heptane and oleic acid mixture with 0.5 mm grinding balls, the D90 value of the original sample was reduced from 15 μm to 95 nm.



Grinding of barium titanate in heptane and oleic acid mixture with 0.5 mm grinding balls.

Blue curve: original sample; green curve: pulverized sample after 5 h.

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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
-
- | Available jar sizes: 12 ml / 25 ml / 50 ml / 80 ml / 125 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 aluminum 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.



Aeration lid



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Video: Aeration lid

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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, 50 ml of a sample consisting of 3 mm particles, a 125 ml jar and grinding balls sized at least 10 mm or larger are recommended. According to the table, 30 grinding balls are required.

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

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

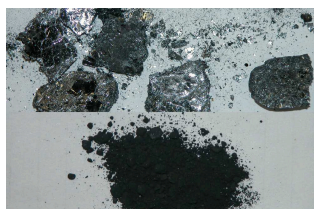
RETSCH planetary ball mills are perfectly suitable for size reduction of, for example, alloys, bentonite, bones, carbon fibres, catalysts, cellulose, cement clinker, ceramics, charcoal, chemical products, clay minerals, coal, coke, compost, concrete, electronic scrap, fibres, glass, gypsum, hair, hydroxyapatite, 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.

Medium-hard: 바이오매스



35 g sample
125 ml stainless steel grinding jars
7 x 20 mm stainless steel grinding balls
15 min at 500 rpm

Brittle: tin sulfide



52 g sample
125 ml agate grinding jars
50 x 10 mm agate grinding balls
60 min at 550 rpm
10 min intervals and direction reversal

Fibrous: 볏짚



7 g sample
125 ml zirconium oxide grinding jars
50 x 10 mm zirconium oxide grinding balls
40 min at 300 rpm
10 min intervals and direction reversal

Hard: natural rocks



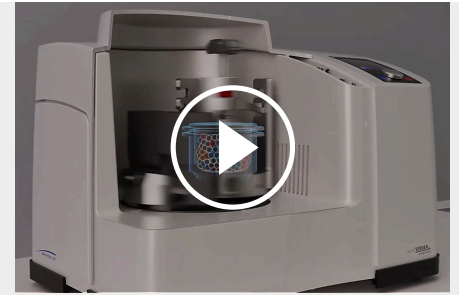
60 g sample
125 ml stainless steel grinding jars
7 x 20 mm stainless steel grinding balls
10 min at 420 rpm

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작동 원리

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

분쇄 용기 내 분쇄용 볼은 소위 코리올리의 힘 (Coriolis forces)이라 불리는 중첩 회전 운동을 받습니다. 볼과 용기간의 상이한 속도는 높은 동적 에너지를 방출하는 마찰력과 충격 사이에서 상호 작용을 발생시킵니다. 이러한 힘 사이의 상호 작용은 행성 볼 밀의 분쇄를 매우 효과적이며 높은 수준으로 만듭니다.



[비디오 시청 클릭](#)

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기술 데이터

응용 분야	pulverizing, mixing, homogenizing, colloidal milling, mechanical alloying, mechanosynthesis, nano grinding
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*	< 4 mm
최종 분말 입도*	< 1 µm, 습식 분쇄 시 < 0.1 µm
시료 일괄 처리량*	최대. 2 x 50 ml
분쇄조 수	2
속도 비율	1 : -2
선 휠 속도	100 - 650 min ⁻¹
효율적인 선 휠 직경	157 mm
중력 (G-force)	37.1 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
Stackable grinding jars	12 ml / 25 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
투입 에너지 측정 가능성	가능
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	~ 1250 W (VA)

폭 x 높이 x 깊이 닫혔을 때	640 x 480 (780) x 420 mm
중량	~ 76 kg
표준	CE
특허 / 실용 특허	SafetySlider (DE 202008008473)

*투입 재료와 장비 환경, 설정에 따라

www.retsch.com/pm200

주문 정보

행성 볼 밀 PM 200

(분쇄 용기, 볼 별도 주문)

20.640.0001



PM 200 분쇄 스테이션 2 개, 속도 비율 1: -2

다른 전력 버전도 동일한 가격으로 제공

ACCESSORIES PLANETARY BALL MILLS

22.661.0003



Clamping unit for PM 200

03.025.0178

Adapter for stacking grinding jars 50 ml - 80 ml

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

99.200.0008



PM 200 IQ/OQ 문서

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

TUNGSTEN CARBIDE

01.462.0494	50 ml
01.462.0495	80 ml
01.462.0527	125 ml

아게이트 (마노)

01.462.0509	50 ml
01.462.0511	80 ml
01.462.0515	125 ml

소결 알루미늄 옥사이드

01.462.0507	50 ml
01.462.0512	125 ml

ZIRCONIUM OXIDE

01.462.0508	50 ml
01.462.0510	80 ml
01.462.0513	125 ml

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
22.864.0001	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
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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

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
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
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
05.114.0056	O-ring for 50 ml - 125 ml grinding jars EasyFit
03.111.0438	Flat gasket for 50 ml, 80 ml or 125 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

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

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

아게이트 (마노)

05.368.0024		5 mm Ø
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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

소결 알루미늄 옥사이드

05.368.0021		10 mm Ø
05.368.0112		15 mm Ø
05.368.0054		20 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

