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a VERDER company

PLANETARY BALL MILL

PM 300

retsch.com/products/milling/ball-mills/planetary-ball-mill-pm-300/

PM 300

PLANETARY BALL MILL

The Planetary Ball Mill PM 300 is a powerful and ergonomic benchtop model with two grinding stations for grinding jar volumes up to 500 ml. This setup allows for processing up to 2 x 220 ml sample material per batch. Thanks to the high maximum speed of 800 rpm, extremely high centrifugal forces result in very high pulverization energy and consequently in short processing times.

The PM 300 is ideally suited for virtually all industries where the quality control process places the highest demands on purity, speed, fineness and reproducibility. Thanks to its enormous energy input of up to 64.4 times the acceleration of gravity, this mill is the perfect choice for tasks in research like mechanochemistry (co-crystal screening, mechanosynthesis, mechanical alloying and mechano-catalysis), or for ultrafine colloidal grinding on a nanometer scale.

THE POWERFUL, ERGONOMIC PLANETARY BALL MILL

- Max. speed 800 rpm, large sun wheel
- Up to 10 mm feed size and 0.1 µm final fineness
- 2 grinding stations for jars of min. 12 ml and max. 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
- Benchtop model, touch screen, storable SOPs and cycle programs, 5 different jar materials for dry and wet grinding

PM 300

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 50 to 800 rpm, speed ratio 1:-2
- Milling with up to 64.4 x acceleration of gravity
- Batch-wise processing with max. 2 x 220 ml sample
- Possibility to stack jars enables simultaneous processing of 4 samples

Two freely accessible grinding stations accommodate EasyFit jars of different sizes.

PM 300

SAFE AND EASY HANDLING

- Easy and safe clamping of the grinding jars thanks to lockable sun wheel
- The Safety Slider prevents starting the machine without securely clamped jars
- Perfect stability on the lab bench thanks to FFCS technology
- Comfortable parameter setting via touch display
- Automatic grinding chamber ventilation with directed air stream for perfect jar cooling
- Programmable starting time
- Both grinding jars are freely accessible
- Ergonomic clamping unit with smooth surfaces

PM 300

SETTINGS & OPTIONS

- Dry and wet milling possible
- Suitable for long-term trials, 99 h max.
- Programmable breaks e.g. for cooling
- Automatic calculation of the total process time
- Direction reversal helps to minimize caking effects
- Smart service interval notification based on usage

PM 300

REPRODUCIBILITY

- Reproducible results due to speed control
- Indication of load-defined speed, independent of set speed
- 12 SOPs and 4 cycle programs can be stored
- Power failure backup ensures storage of remaining processing time

PM 300

SAFETY FIRST: AUTOMATED NOTIFICATION OF CLAMPING FORCE

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.

A unique safety feature of the PM 300 is an acoustic signal and notification in the display when the clamping unit has been fixed with the required force of 25 Nm. RETSCH offers a convenient clamping aid to facilitate the process. This is particularly helpful when the machine is operated in the upper speed range between 600 and 800 rpm.

PM 300

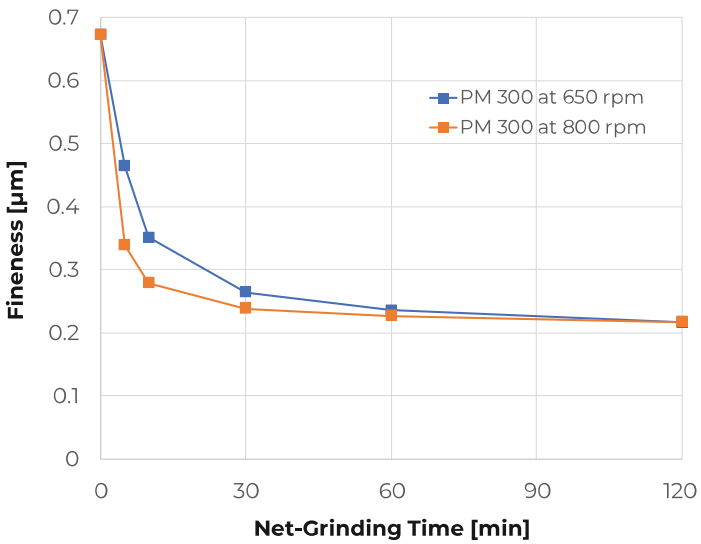
WET AND NANO-SCALE GRINDING

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.

TITANIUM DIOXIDE IN 125 ML JAR

The graphic shows the result of pulverizing titanium dioxide (TiO2) at 650 rpm and 800 rpm in the PM 300 and the net processing time. With the higher energy input at 800 rpm, the particle size decreases faster. However, the increased warming effects at 800 rpm should also be considered, as they might make longer breaks necessary.



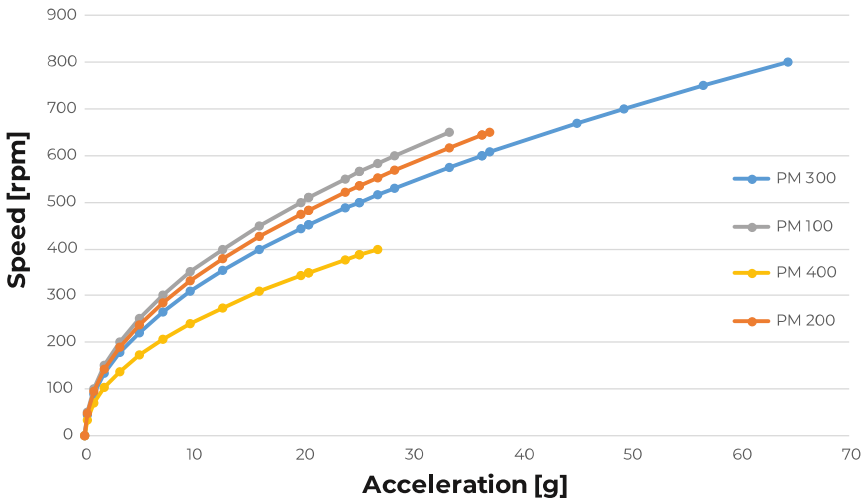
Net processing time of titanium dioxide with 0.1 mm grinding balls in sodium phosphate solution.

PM 300

APPLICATIONS IN MECHANOCHEMISTRY

RETSCH Planetary Ball Mills are perfectly suited for processes like mechanical alloying or mechanosynthesis. For most reactions, the 1:-2 speed ratio of jar to sun wheel of the models PM 100 and PM 200 is fully adequate, as the ball charge produces enough impact energy. However, greater energy is required for some reactions. Here the PM 400 MA can be used with the increased speed ratio of 1:-2.5 or 1:-3.0.

The PM 300 works with a speed ratio of 1:-2, but in contrast to other models, it reaches up to 64.4 x acceleration of gravity thanks to the maximum speed of 800 rpm and the large sun wheel. Together with the option to use four small, stackable grinding jars sized 12 to 80 ml for small scale operations, or two jars sized up to 500 ml for upscaling purposes, this planetary ball mill is highly suitable for research applications in mechanochemistry.



Achievable acceleration in different planetary ball mills dependent on speed setting.

MECHANOCHEMISTRY → retsch.com/applications/mechanochemistry/

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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 mechanical alloying. This line of jars is suitable for all RETSCH planetary ball mills.

The 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

Jars and balls are available in hardened stainless steel, tungsten carbide, agate, sintered aluminium oxide and zirconium oxide.

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JARS AND 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. An optional pressure and temperature measuring system PM GrindControl is available.

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.

GRINDCONTROL

Optional pressure and temperature measuring system for the grinding jar.

AERATION LID

Allows introduction of gases such as argon or nitrogen to control the grinding atmosphere.

ADAPTER FOR SPECIAL APPLICATIONS

For co-crystal screening in disposable vials such as 1.5 ml GC glass vials. The adapter features 24 positions: 16 in an outer ring and 8 in an inner ring.

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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. 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.

Jar	Sample	Feed	Ø 5*	Ø 7*	Ø 10*	Ø 15*	Ø 20*	Ø 30*
12 ml	≤5 ml	<1 mm	50	15	5	–	–	–
25 ml	≤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	200–300	70	25	8

* Recommended ball charge (pieces). The number of grinding balls given reflects the minimum amount per jar. A better result is obtained with a larger number of suitable balls, if indicated. In exceptional cases, the number can be reduced by not more than 15%; however, that will result in increased wear of the grinding tools.

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FUNCTIONAL PRINCIPLE

The grinding jars are arranged eccentrically on the sun wheel of the planetary ball mill. The direction of movement of the sun wheel is opposite to that of the grinding jars in the ratio 1:-2. The grinding balls are subjected to superimposed rotational movements, the so-called Coriolis forces. The difference in speeds between the balls and grinding jars produces an interaction between frictional and impact forces, which releases high dynamic energies.

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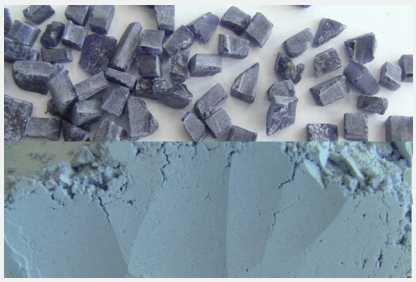
TYPICAL SAMPLE MATERIALS

RETSCH planetary ball mills are suitable for size reduction of 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 and wood.

VERY HARD, ABRASIVE: INDUSTRIAL DIAMONDS

11 g sample · 50 ml tungsten carbide grinding jars · 4 × 20 mm balls · 4 min at 400 rpm

HARD-BRITTLE: SODALITE MINERAL



85 g sample · 125 ml zirconium oxide grinding jars · 7 × 20 mm balls · 12 min at 500 rpm

NANO GRINDING: ALUMINUM OXIDE

100 g sample + 190 ml sodium-phosphate solution · 500 ml zirconium oxide jars · 1 kg 2 mm balls · 3:30 min net-grinding at 650 rpm

MEDIUM-HARD, TOUGH: POLYESTER TEREPHTHALATE RESIN

125 g sample · 500 ml zirconium oxide grinding jars · 8 × 30 mm balls · 3 min at 350 rpm

APPLICATION DATABASE → retsch.com/applications/application-database-retsch/

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TECHNICAL DATA

Applications	pulverizing, mixing, homogenizing, colloidal milling, mechanical alloying, mechanochemistry, co-crystal screening
Field of application	agriculture, biology, chemistry, construction materials, engineering / electronics, environment / recycling, geology / metallurgy, glass / ceramics, medicine / pharmaceuticals
Feed material	soft, hard, brittle, fibrous – dry or wet
Size reduction principle	impact, friction
Max. feed size	< 10 mm
Final fineness	< 1 µm, for colloidal grinding < 0.1 µm
Batch size / feed quantity	max. 2 x 220 ml
No. of grinding stations	2
Speed ratio	1 : -2
Sun wheel speed	50 - 800 min-1
Effective sun wheel diameter	180 mm
G-force	64 g
Type of grinding jars	optional areation covers, safety closure devices
Material of grinding tools	hardened stainless steel, tungsten carbide, agate, sintered aluminium oxide, zirconium oxide
Grinding jar sizes	12 ml / 25 ml / 50 ml / 80 ml / 125 ml / 250 ml / 500 ml
Stackable grinding jars	12 ml / 25 ml / 50 ml / 80 ml

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TECHNICAL DATA · CONTINUED

Adapter for single-use glas vials	24 x 1.5 ml / 7 x 20 ml
Setting of grinding time	digital, 00:00:01 to 99:59:59
Interval operation	yes, with direction reversal
Interval time	00:00:01 to 99:59:59
Pause time	00:00:01 to 99:59:59
Storable SOPs	12
Storable cycling programs	4
Measurement of input energy possible	yes
Interface	USB, RASPI
Drive	3-phase asynchronous motor with frequency converter
Drive power	2,5 kW
Electrical supply data	200-240 V, 50/60 Hz
Power connection	1-phase
Power consumption	~ 3335 VA
Protection code	IP 20
W x H x D closed	745 x 525 x 580 mm
Net weight	~ 118 kg
Standards	CE
Patent / Utility patent	yes

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ORDERING INFORMATION

PLANETARY BALL MILL PM 300

Please order grinding jars and balls separately.

20.570.0001	PM 300 · with 2 grinding stations, speed ratio 1 : -2

ACCESSORIES PLANETARY BALL MILLS

22.661.0005	Clamping unit for PM 300
03.025.0178	Adapter for stacking grinding jars 50 ml - 80 ml
03.025.0182	Adapter for the use of grinding jars 12 ml and 25 ml (only for PM 300)
03.486.0062	Opening aid for clamping unit of planetary ball mills
99.200.0041	IQ/OQ Documentation for PM 300

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

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ORDERING INFORMATION

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
01.462.0498	500 ml

AGATE

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

SINTERED ALUMINUM OXIDE

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

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ORDERING INFORMATION

GRINDING JARS EASYFIT · 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, INERT ATMOSPHERE AND 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

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ORDERING INFORMATION

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 EasyFit 50, 80 or 125 ml, stainless steel
03.474.0262	Aeration lid insert for EasyFit 50, 80 or 125 ml, zirconium oxide
03.474.0263	Aeration lid insert for EasyFit 50, 80 or 125 ml, tungsten carbide
03.474.0268	Aeration lid insert for EasyFit 50, 80 or 125 ml, agate
03.474.0264	Aeration lid insert for EasyFit 250 or 500 ml, stainless steel
03.474.0265	Aeration lid insert for EasyFit 250 or 500 ml, zirconium oxide
03.474.0266	Aeration lid insert for EasyFit 250 or 500 ml, tungsten carbide
03.474.0267	Aeration lid insert for EasyFit 250 or 500 ml, aluminum oxide
03.474.0269	Aeration lid insert for EasyFit 250 or 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

SAFETY CLOSURE DEVICES

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-RINGS AND FLAT GASKETS

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

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ORDERING INFORMATION

GRINDING BALLS

For efficient milling, the ball should be at least 3 times larger than the largest particle in the sample. Grinding jars and balls should always be made of the same material.

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 (approx. 110 ml)
22.455.0011	3 mm Ø, 500 g (approx. 120 ml)
22.455.0002	3 mm Ø, 200 pieces (approx. 6 ml)
22.455.0001	4 mm Ø, 200 pieces (approx. 14 ml)
22.455.0003	5 mm Ø, 200 pieces (approx. 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 pieces (approx. 6 ml)
22.455.0005	4 mm Ø, 200 pieces (approx. 14 ml)
22.455.0004	5 mm Ø, 200 pieces (approx. 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

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ORDERING INFORMATION

GRINDING BALLS · CONTINUED

AGATE

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

SINTERED ALUMINUM OXIDE

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 (approx. 135 ml)
32.368.0003	0.5 mm Ø, 0.5 kg (approx. 135 ml)
32.368.0004	1 mm Ø, 0.5 kg (approx. 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 pieces (approx. 6 ml)
22.455.0009	5 mm Ø, 200 pieces (approx. 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

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