

RETSCH Product Navigator

Milling

Jaw Crushers
Rotor Mills
Cutting Mills
Mortar Grinders
Disc Mills
Ball Mills
– MM 200
– MM 301
– S 100
– PM 100
– PM 200
– PM 400

Sieving

Assisting

Size reduction and homogenization with ball mills



Unlimited applications

RETSCH ball mills are suitable for universal use. Depending on the model (planetary ball mill or mixer mill), they can be used for dry, wet or cryogenic grinding. Mixing, homogenizing, cell disruption, mechanical alloying or even colloidal grinding are further possible applications. Due to their versatility they can be used in virtually all sectors concerned with the mechanical treatment of solids in industry and research.

Retsch®

Solutions in Milling & Sieving

RETSCH ball mills are used for the pulverization of soft, fibrous, hard and brittle materials. They achieve a very high final fineness down to the submicron range. The feed size depends on the mill and can have a maximum size of 10 mm. If the sample feed size is larger than this then the sample must first undergo preliminary size reduction.

Preliminary size reduction



For the coarse and preliminary size reduction of hard, brittle or even tough materials, the RETSCH jaw crushers have proven themselves in practice. In contrast, bulky, soft, fibrous or elastic materials are best prepared in RETSCH cutting mills.

Sample dividers



For the subsequent pulverization a **representative part-sample** must first be obtained, e.g. with the sample divider PT 100 from RETSCH.

Tablet press



RETSCH offers a manual hydraulic tablet press for preparing solid samples for XRF studies.

Superiority in detail – technology from RETSCH

RETSCH offers a comprehensive range of ball mills for the preparation of soft to hard materials. The various models differ primarily from each other in their mode of operation.

Mixer mills MM 200, MM 301

Centrifugal ball mill S 100

Planetary ball mills PM 100, PM 200, PM 400

RETSCH ball mills are the right choice whenever efficient pulverization and homogenization of soft to hard materials are required. Unique features and innovative details prove this.

Mixer mill MM 301

Grinding jar attachment – simple and safe

The unique grinding jar attachment system of the MM 301 allows quick, simple and safe clamping of the jars. The automatic centering and exact placement of the grinding jars optimizes the reproducibility of the grinding process. The **self-locking device** prevents the grinding jars from becoming loose during the grinding process.



Cryogenic grinding – quick and efficient



Before grinding takes place the grinding jars are immersed in liquid nitrogen (-196 °C) in the cryo box for approx. 2 - 3 minutes

The mixer mill MM 301 is ideally suitable for cryogenic grinding. The sample and grinding ball charge are placed in the screw-top stainless steel grinding jars, which are then immersed in liquid nitrogen. They are fastened in the quick-clamping device of the MM 301; this holds the grinding jars securely, even at extremely low temperatures.

After a grinding time of only 2 - 3 minutes a completely homogenized sample is obtained.

This procedure saves time and is particularly economical due to the very low consumption of liquid nitrogen.

Mixer mills MM 200 and MM 301

Grinding, mixing, disrupting small amounts of sample



MM 200

RETSCH mixer mills MM 200 and MM 301 are laboratory "all-rounders". They have been developed specially for **dry, wet and cryogenic grinding of small amounts of sample**. They can mix and homogenize powders and suspensions in only a few seconds. They are also perfectly suitable for the **disruption of biological cells** as well as for DNA/RNA recovery.

The mixer mills can pulverize, mix or homogenize two samples from 0.2 to 20 ml at the same time. For cell disruption it is possible to process 20 samples simultaneously. The mixer mills MM 200 and MM 301 operate so effectively that the grinding time is very short and the sample is hardly warmed at all. **This means that most materials can be pulverized and mixed at ambient temperature, without any cooling.**

Overview

Quick, efficient pulverization and homogenization
Higher sample throughput due to short grinding times and two grinding stations
Reproducible results by digital preselection of grinding time and vibrational frequency
Large range of grinding jars
Safe wet grinding without loss of material with screw-top grinding jars
Simple and comfortable operation
Memory keys for three parameter combinations
Set parameters can be locked against accidental alteration
2 year warranty, CE-conforming

MM 200 and MM 301 – high-performance mixer mills for any type of material

The RETSCH mixer mills MM 200 and MM 301 are used for size reduction and pulverization of hard, medium-hard and brittle samples as well as for soft, elastic or fibrous ones. They pulverize **tissue, bones, hair, chemicals, drugs, coated and uncoated tablets, minerals, ores, alloys, glass, ceramics, soils, sludge, plant parts, cereal grains, oil seeds, plastics, waste samples, wool and textiles, to name just a few.**

With their ability to process small sample amounts to analytical fineness quickly and in a reproducible manner, RETSCH mixer mills are the ideal

device to prepare pressed tablets for subsequent **XRF analysis**.

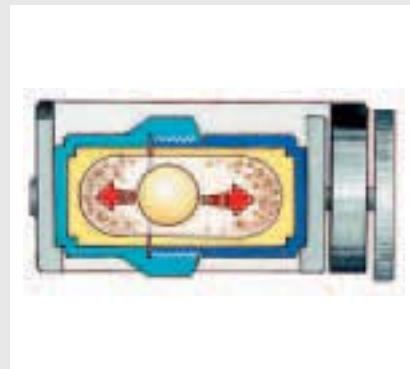
Mixer mills are primarily used in the following sectors:

Agriculture
Biology and Biotechnology
Ceramics and Glass
Chemicals and Plastics
Environmental Research
Foodstuffs
Forensic Science
Medicine and Pharmaceuticals
Metallurgy and Metallurgical
Engineering
Mineralogy
New Materials Research

MM 200 and MM 301 technology

The grinding jars perform radial oscillations in a horizontal position. The inertia of the grinding balls causes them to impact with high energy on the sample material at the rounded ends of the grinding jars and pulverize it. Also, the movement of the grinding jars combined with the movement of the balls result in the intensive mixing of the sample. The degree

of mixing can be increased even further by using several smaller balls. If several small balls are used (e.g. glass beads) then, for example, biological cells can be disrupted. The large frictional impact effects between the beads ensure effective cell disruption.



Maximum reproducibility



Both the MM 200 and the MM 301 are particularly easy to use. The vibrational intensity can be set accurately from 3 to 30 hertz. An electronic speed control keeps this value constant during the entire grinding process. The grinding and mixing time can be preset digitally in the range from 10 seconds to 99 minutes. All instrument parameters are retained during standby operation for subsequent processes. A memory function allows storage of 3 different parameter combinations which offer ultimate convenience in routine testing of various samples. At the same time this ensures the highest degree of reproducibility for the following sample preparation processes.

Wet grinding

The screw-top grinding jars provide the ideal preconditions for wet grinding with mixer mills. An Teflon seal prevents the escape of liquids and particles even at maximum vibrational frequency.



MM 301



MM 301 – the mixer mill with unsurpassed performance, safety and comfort

Due to the increased oscillation radius of the MM 301, the **energy input is approx. 30% greater** than that of the MM 200. This results in more fineness in less time. Large grinding jars with a capacity of 35 ml and 50 ml are available for the MM 301. In these jars, up to 20 ml of sample material with a **feed size of up to 8 mm** can be ground. Clamping and removing the grinding jars is easier and safer. The special **self-centering of the grinding jars** ensures that they are always located in exactly the same position, which optimizes the reproducibility of the grinding process. The **self-locking clamping device** fixes the grinding jars with maximum security.

Advantage MM 301

The mixer mill MM 301 is a real multi-talent with nearly unlimited applications...
reproducible **dry grinding**, e.g. for sample preparation for XRF analyses
loss-free **wet grinding** due to screw-top, leak-proof grinding jars
convenient **cryogenic grinding** of thermally sensitive products without long pre-cooling times and with a minimum consumption of liquid nitrogen
efficient **disruption** of plant or animal tissues or cell suspensions in adapter racks for 5 or 10 reaction vials



Cryogenic grinding with the mixer mill MM 301

Thermally-sensitive and elastic substances can be successfully processed by external cooling of the grinding jars. However, beakers made from agate and ceramics should not be cooled with liquid nitrogen in order to avoid damage during the grinding process. The screw-top grinding jars are particularly suitable for cryogenic grinding, as after the grinding process they remain hermetically sealed until they have regained room temperature. This prevents atmospheric humidity from con-

densing on the cold sample as water vapor which could penetrate the sample and falsify the analytical results.

A special cryo kit is available for precooling the grinding jars in liquid nitrogen; it consists of:
2 insulated containers (1 and 4 liter),
2 pairs of grinding jar tongs
1 pair of safety glasses.



Selection guide for mixer mills

The **MM 200** is mainly used for the size reduction of small amounts of sample.

The **MM 301**, with 30% higher energy, can pulverize samples finer and faster, with optimum reproducibility. Its

convenient self-locking clamp allows the use of large jars up to 50 ml and pre-chilled jars of stainless steel.

Performance data	MM 200	MM 301
Field of application	size reduction, mixing, homogenization, cell disruption	
Feed material	hard, medium-hard, soft, brittle, elastic, fibrous	
Feed size*	up to 6 mm	up to 8 mm
Final fineness*	approx. 10 µm	approx. 5 µm
Batch/Sample volume	max. 2 x 10 ml	max. 2 x 20 ml
Typical mean grinding time	2 minutes	2 minutes
Possible applications		
Dry grinding	yes	yes
Wet grinding	yes**	yes
Cryogenic grinding	no	yes
Cell digestion with reaction vials	max. 10 x 2.0 ml	max. 20 x 2.0 ml
Suitable grinding jars		
Grinding jar with push-fit lids	1.5 - 25 ml	no
Grinding jars with screw-top lids	1.5 - 25 ml	1.5 - 50 ml
Self-centering clamping device	no	yes
No. of grinding stations	2	2
Digital preselection of vibrational frequency	3 - 30 Hz (180 -1800 min ⁻¹)	3 - 30 Hz (180 - 1800 min ⁻¹)
Digital preselection of grinding time	10 s - 99 min	10 s - 99 min
Memory for parameter combinations	3	3
Parameter lock	yes	yes
Technical data		
Nominal power	76 W at 50 Hz / 64 W at 60 Hz	76 W at 50 Hz / 64 W at 60 Hz
W x H x D	300 x 182 x 465 mm	300 x 225 x 470 mm
Net weight	approx. 20 kg	approx. 20 kg
Noise values (noise measuring according to DIN 45635-31-01-KL3)		
Emission value with regard to workplace*	L _{pAeq} 61 dB(A)	L _{pAeq} 61 dB(A)
Sound power level	L _{WA} 71.4 dB(A)	L _{WA} 71.4 dB(A)
Measuring conditions:		
Feed material	8 ml broken quartz pebbles, approx. 4.0 – 6.0 mm	
Grinding jars used	2 x 25 ml steel	
Grinding balls used	1 steel ball 20 mm dia.	

*depending on feed material, grinding jars and vibrational frequency, **using screw-top grinding jars

Cell disruption with RETSCH mixer mills

Small amounts of sample, such as are normally used for the isolation of DNA and RNA, can be prepared in disposable reaction vials (e.g. Eppendorf). Adapter racks which accommodate either 5 or 10 disposable reaction vials can be used for this. In the mixer mills, efficient disruption is achieved so quickly that no additional cooling is necessary.

Stainless steel 12.5 ml jars are available for the MM 200 for the disruption of microorganisms and bacteria; these have a special opening for injection of cell suspensions.

12.5 ml grinding jar with special closure (1)
 Adapter rack for:
 5 reaction vials 1.5 and 2.0 ml (2)
 10 reaction vials 1.5 and 2.0 ml (3)
 10 reaction vials 0.2 ml (4)



Grinding jars and grinding balls for versatile use

The grinding result is greatly influenced by the choice of grinding tools. Jar volume, ball charge and the material depend on the type and amount of sample. In order not to falsify the subsequent analytical determination, a neutral-to-analysis material should be selected.



Screw-top grinding jars



Grinding jars with push-fit lids for MM 200

The pulverization energy is determined by the density and weight of the ball material. The higher the ball weight and density, the higher the pulverization energy. The jar and balls should always be made of the same material. The table shown below is intended to help you to select suitable grinding tools.

In addition to the standard grinding jars with push-fit lids for the MM 200, superior screw-top grinding jars are available.

Advantages of the screw-top grinding jars

Exceptionally simple and safe handling

Dust-proof and air-tight
(no loss of material, no escape of e.g. inert atmosphere)
Suitable for wet and cryogenic grinding
Ultimate reproducibility by automatic centering and uniform jar design (MM 301)
Ergonomic gripping flanges on jar and lid

Stainless steel protective jacket (for agate, zirconium oxide and tungsten carbide jars)

The screw-top grinding jars have been specially designed for the mixer mill MM 301. Grinding jars up to 10 ml made of all materials and the 25 ml stainless steel grinding jar can also be used in the MM 200.

In addition to the instrument settings, the filling level of the jar is also of crucial importance for the success of the grinding process in mixer mills. A jar filling should consist of about 1/3 sample and 1/3 ball charge. The remaining third is the free jar volume that is necessary for the free movement of the balls. The following table provides guidelines.

Grinding jar filling levels – guidelines for sample volume and ball charge

Grinding jar nominal volume	Sample amount	Max. feed size	Recommended ball charge						
			Ø 5 mm	Ø 7 mm	Ø 9/10 mm	Ø 12 mm	Ø 20 mm	Ø 25 mm	Ø 30 mm
1.5 ml	0.2 – 0.5 ml	1 mm	1 to 2 pcs.	–	–	–	–	–	–
5.0 ml	0.5 – 2.0 ml	2 mm	–	1 to 2 pcs.	–	–	–	–	–
10.0 ml	2.0 – 4.0 ml	4 mm	–	–	1 to 2 pcs.	1 to 2 pcs.	–	–	–
25.0 ml	4.0 – 10.0 ml	6 mm	–	–	–	2 pcs.	1 pc.	–	–
35.0 ml	6.0 – 15.0 ml	6 mm	–	–	–	–	1 pc.	1 pc.	–
50.0 ml	8.0 – 20.0 ml	8 mm	–	–	–	–	–	1 pc.	1 pc.

Material composition guidelines

Grinding jar	Material no.	MM 200 MM 301	approx. hardness	Material analysis (in %)
Chrome steel	1.2080		62-63 HRC	Fe (84.89), Cr (12), C (2.2), Mn (0.45), Si (0.4), P (0.03), S (0.03)
Stainless steel	1.4034	–	48-52 HRC	Fe (82.925), Cr (14.5), C (0.5), Mn (1), Si (1), C (0.5), P (0.045), S (0.03)
	1.4112	–	55-57 HRC	Fe (76.5), Cr (19), Mo (1.3), Mn (1), Si (1), C (0.95), V (0.12), P (0.04), S (0.03)
Tungsten carbide			1180-1280 HV 30	WC (94), Co (6)
Agate			6.5-7 Mohs	SiO ₂ (99.91), Al ₂ O ₃ (0.02), Na ₂ O (0.02), Fe ₂ O ₃ (0.01), K ₂ O (0.01), MnO (0.01), MgO (0.01), CaO (0.01)
Sintered corundum		–	1750 HV	Al ₂ O ₃ (99.7), CaO (0.07), MgO (0.075), SiO ₂ (0.075), Na ₂ O (0.01), Fe ₂ O ₃ (0.01)
Zirconium oxide*			1200 HV	ZrO ₂ (94.5), Y ₂ O ₃ (5.2)

The above percentages are mean values. We reserve the right to make alterations.

*yttrium-stabilized

Mixer mills order data

Mixer mill MM 200					Item No.
MM 200 (please order grinding jars and grinding balls separately)					
MM 200	for 220-240 V, 50/60 Hz				20.738.0001
MM 200	for 100-110 V, 50/60 Hz				20.738.0002
Grinding jars with lids for MM 200	1.5 ml	5 ml	10 ml	25 ml	
Chrome steel	02.462.0056	02.462.0058	02.462.0060	02.462.0052	
Stainless steel	02.462.0057	02.462.0059	02.462.0061	02.462.0119	
Tungsten carbide	01.462.0114	01.462.0115	01.462.0009	-	
Agate	01.462.0112	01.462.0113	01.462.0008	-	
Sintered corundum	01.462.0110	01.462.0111	01.462.0007	-	
Zirconium oxide	-	-	01.462.0194	01.462.0195	
Teflon	-	02.462.0183	02.462.0184	02.462.0051	
Mixing jars, polystyrene, 28 ml, 100 pcs.					22.041.0003
The following grinding jars with screw-top lids for the MM 301 can also be used in the mixer mill MM 200:					
1.5 ml, 5 ml, 10 ml: all materials; 25 ml: stainless steel and chrome steel					

Mixer mill MM 301							Item No.
MM 301 with quick-clamping device (please order grinding jars and grinding balls separately)							
MM 301	for 220-240 V, 50/60 Hz					20.741.0001	
MM 301	for 100-115 V, 50/60 Hz					20.741.0002	
Grinding jars with screw-top lid	1.5 ml	5 ml	10 ml	25 ml	35 ml	50 ml	
Chrome steel	–	–	–	01.462.0237	–	–	
Stainless steel	01.462.0230	01.462.0231	01.462.0236	02.462.0213	01.462.0214	01.462.0216	
Tungsten carbide	–	–	01.462.0235	01.462.0217	–	–	
Agate	–	01.462.0232	01.462.0233	–	–	–	
Zirconium oxide	–	–	01.462.0234	01.462.0201	01.462.0215	–	
Teflon	–	–	–	01.462.0238	–	–	
Accessories							
Jar wrench for screw-top jars, 25 ml tungsten carbide, 35 ml stainless steel or zirconium oxide, 50 ml stainless steel						02.486.0001	
Cryo kit for cooling grinding jars with liquid nitrogen						22.354.0001	

Grinding balls for MM 200 and MM 301							Item No.
Grinding balls	5 mm Ø	7 mm Ø	9/10 mm Ø	12 mm Ø	20 mm Ø	25 mm Ø	30 mm Ø
Chrome steel	05.368.0029	05.368.0030	05.368.0031	05.368.0032	05.368.0033	-	-
Stainless steel	05.368.0034	05.368.0035	05.368.0036	05.368.0037	05.368.0062	05.368.0105	05.368.0061
Tungsten carbide	05.368.0038	05.368.0039	05.368.0040	05.368.0041	05.368.0070	-	-
Agate	05.368.0024	05.368.0025	05.368.0026	05.368.0027	-	-	-
Sintered corundum	05.368.0019*	05.368.0020*	05.368.0021	05.368.0022	-	-	-
Zirconium oxide	-	-	-	05.368.0096	05.368.0093	05.368.0106	-
Teflon with steel core	-	-	05.368.0045	05.368.0046	05.368.0047	-	-
Polyamide for mixing vessel	05.368.0042	05.368.0043	05.368.0044	05.368.0003	-	-	-
*Hard porcelain							

Accessories for cell and tissue disruption with MM 200 and MM 301					Item No.
Adapter racks, PTFE, for reaction vials for MM 200 and MM 301					
Adapter rack	for 10 reaction vials, 1.5 and 2.0 ml (for MM 301 only)				22.008.0008
Adapter rack	for 5 reaction vials, 1.5 und 2.0 ml				22.008.0005
Adapter rack	for 10 reaction vials, 0.2 ml				22.008.0006
Safe-Lock reaction vials		0.2 ml	1.5 ml	2.0 ml	
Safe-Lock reaction vials, 1000 pcs.		22.749.0004	22.749.0002	22.749.0001	
Grinding balls for reaction vials		3 mm Ø	4 mm Ø	5 mm Ø	
Stainless steel, approx. 200 pcs.		22.455.0002	22.455.0001	22.455.0003	
Tungsten carbide, approx. 200 pcs.		22.455.0006	22.455.0005	22.455.0004	
Zirconium oxide, approx. 200 pcs.		22.455.0007	-	22.455.0009	
Glass beads for reaction vials	0.10-0.25 mm Ø	0.25-0.50 mm Ø	0.50-0.75 mm Ø	0.75-1.00 mm Ø	1.00-1.50 mm Ø
500 g	22.222.0001	22.222.0002	22.222.0003	22.222.0004	22.222.0005
Grinding jars with special closure for disruption of microorganisms and bacteria with MM 200					
Grinding jars with special closure, 12.5 ml made from stainless steel					01.462.0117