



MIXER MILL MM 400

A true multipurpose mill

The Mixer Mill MM 400 is a true multipurpose mill designed for dry, wet and cryogenic grinding of small volumes up to 2 x 20 ml. It mixes and homogenizes powders and suspensions with a frequency of 30 Hz within seconds – unbeatably fast and easy to operate.

The compact benchtop unit is suitable for classic homogenization processes, as well as for biological cell disruption for DNA/RNA and protein extraction. Long processing times up to 99 hours make the MM 400 ideally suited for research applications, for example in mechanochemistry.

With regard to performance and flexibility of this mill, there is no equivalent technology available in the market.

You may also be interested in the mixer mill models MM 500 nano and MM 500 vario which operate with the same functional principle at a frequency of 35 Hz but provide substantially higher performance. For applications which require cooling or heating the sample, the Mixer Mill MM 500 control is the perfect choice. Each RETSCH mixer mill has a specific application focus.



[Click to view video](#)

Product Video

PERFORMANCE AND DESIGN

- | Powerful size reduction and homogenization by impact and friction with up to 30 Hz
- | Equipped with 2 grinding stations for up to 20 samples per run
- | Memory for 12 Standard Operating Procedures (SOP) and 6 program cycles
- | Convenient touch display, significant noise reduction

UNMATCHED VERSATILITY

- | 3 different grinding modes: dry, wet or cryogenic
- | Mixes powdered sample and binder in plastic vessels prior to pelletizing, e. g. for XRF analysis
- | Suitable for research applications such as mechanochemistry or for biological cell disruption by bead beating
- | Extraction of pesticides (QuEChERS) and herbal ingredients



MIXER MILL MM 400

CALIBRATION ENSURES REPRODUCIBLE RESULTS

Reproducibility is paramount in the process chain from sampling to analysis. Lab equipment which can be calibrated guarantees reproducible results with minimum standard deviation every time. This is particularly useful when comparing results produced at different locations.



The MM 400 is the first laboratory mill which can be calibrated. RETSCH initially calibrates time and frequency of the mill and offers a regular calibration service to ensure reproducible milling processes.

This functionality is particularly suitable for

- | Testing labs with different locations
- | Accredited labs applying ISO/IEC 17025 or ISO 9000ff
- | Pharmaceutical products

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SOLUTIONS FOR BIOLOGICAL APPLICATIONS AND CELL DISRUPTION

Mixer mills are frequently used for homogenizing biological samples. The so-called bead beating with small glass beads is an established method for cell disruption of yeasts, microalgae or bacteria. The sample is only moderately warmed in the process which can be reduced to a minimum by pre-cooling.

The MM 400 allows for efficient cell disruption of up to 240 ml cell suspension for DNA/RNA and protein extraction. For accurate diagnosis of infections, it is possible to isolate intact bacteria from tissue in 8 x 30 ml bottles or 10 x 5 ml vials by using adapters.

The MM 400 can be operated with a range of adapters for single-use vials with the following capacities:

20 x 0.2 ml / 20 x 1.5 or 2 ml / 10 x 5 ml / 8 x 30 ml / 8 x 50 ml

For the pulverization of 25 to 30 g plant material, such as cannabis flower, conical centrifuge tubes are best suited. Up to 8 tissue samples, like fresh liver in buffer solution, can also be homogenized in these 50 ml tubes using steel or zirconium oxide balls. To keep the mechanical stress on the vials as low as possible, a reduced

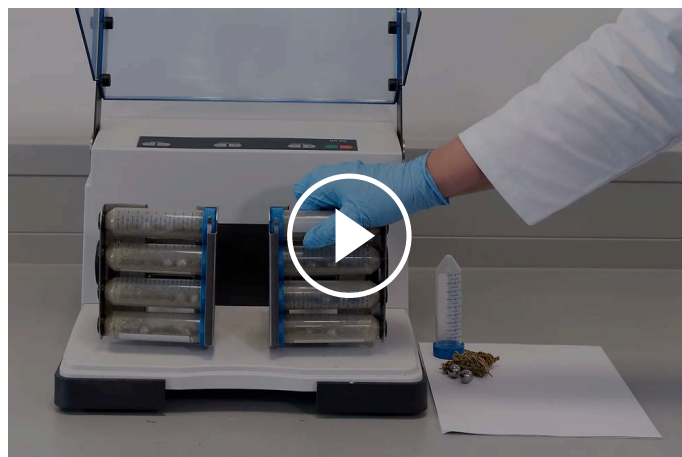
frequency and a high filling level, e. g. with buffer and sample, are recommended.



[Click to view video](#)

Mixer Mill MM 400 - Yeast Cell Disruption*

*The video shows the previous model with identical functional principle.



[Click to view video](#)

Mixer Mill MM 400 - Homogenization of cannabis*

MIXER MILL MM 400 SOLUTIONS FOR CRYOGENIC GRINDING

The CryoKit is a cost-effective solution for cryogenic sample processing with the Mixer Mill MM 400. The set consists of two insulated containers, two tongs and safety glasses.

The sample to be embrittled and the grinding ball are filled into the stainless-steel grinding jar which is tightly screwed. Indirect embrittlement is effected by pre-cooling the jar in a liquid nitrogen bath. After approximately 2 minutes, the sample is sufficiently cooled for cryogenic processing.

If direct contact with liquid nitrogen is to be avoided, the CryoMill or Mixer Mill MM 500 control are suitable options. Both mills can be operated with jars made of other materials than steel for cryogenic grinding.



[Click to view video](#)

Mixer Mill MM 400 - Cryogenic Grinding*

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APPLICATIONS IN MECHANOCHEMISTRY

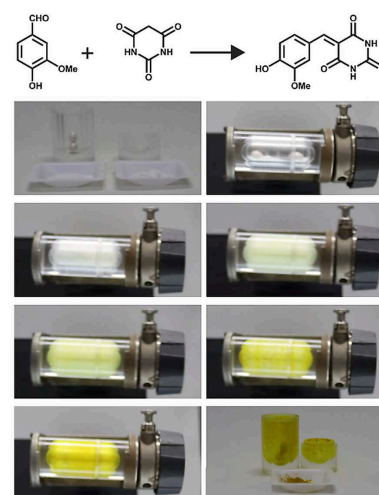
Mechanochemistry enables fast reactions of substances in a solvent-free environment. Some chemical reactions require the frictional forces of a planetary ball mill, while other reaction types need energy input through impact – that is where the Mixer Mill MM 400 comes into play.

The sample volumes available for research applications are often very low. This makes small grinding jar sizes of up to 50 ml, like they are available for the MM 400, beneficial. Due to the frequently long reaction times, the possibility to program process times of several hours is another important aspect.

Mixer mills offer a unique advantage over planetary ball mills in mechanochemical applications: the use of transparent jars in combination with the typical horizontal jar movement enables in-situ RAMAN spectroscopy. This permits real-time monitoring of the reaction process to identify the optimal time for maximum yield and avoid prolonged processing.

The MM 400 offers many advantages for mechanochemical applications:

- | Process times of up to 99 h
- | Various grinding jar sizes and materials
- | Transparent PMMA grinding jars enable in-situ RAMAN spectroscopy
- | Programmable frequency and break times
- | Adapter for 4 x 5 ml stainless-steel grinding jars permits up to 8 simultaneous reactions



Time course of the Knoevenagel reaction between vanillin and barbituric acid under mechanochemical conditions using 2x10mm zirconium oxide grinding balls in 19 ml PMMA grinding jar at 30 Hz. Reaction running over 30 minutes with visible progress indicated by color change.

Courtesy of Dr. Sven Grätz, Ruhr-University Bochum, Faculty of Chemistry and Biochemistry, AG Prof. Borchardt.

FOR SAFE AND EFFECTIVE GRINDING PROCESSES

ACCESSORIES FOR THE MIXER MILL MM 400



GRINDING JARS IN 7 DIFFERENT MATERIALS

The nominal volume of the screw-top grinding jars ranges from 1.5 ml to 50 ml; available materials include hardened steel, stainless steel, agate, tungsten carbide, zirconium oxide and PTFE, ensuring contamination-free sample preparation.

Transparent PMMA grinding jars are used for in-situ RAMAN spectroscopy but also enable applications with photochemical reactions. Moreover, these are resistant to a variety of chemicals. The jars can be used with the predecessor of the MM 400 just like older jar models are compatible with the latest mixer mill model.



ADAPTERS FOR SINGLE-USE VIALS

Adapters for 0.5 / 1.5 / 2 / 5 ml single-use vials can be used in the MM 400. For larger sample amounts, e. g. for protein extraction, adapters for 50 ml conical centrifugation tubes or 30 ml wide-mouth bottles are available.



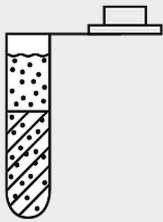
ADAPTERS FOR INCREASED SAMPLE THROUGHPUT

The MM 400 can be equipped with adapters that accommodate four 5 ml stainless-steel grinding jars, allowing for simultaneous pulverization of a maximum of 8 samples. This increased throughput is particularly beneficial for mechanochemical applications.

VIALS, BOTTLES AND TUBES AVAILABLE FOR MM 400

1.5 or 2 ml

Safe-lock
single-use vials
2 x 10 ml max.



- | Cell disruption for DNA/RNA proteins/metabolites
- | Cryogenic grinding of soft sample (tissue, plants, cell pellets, insects)
- | Dry or wet homogenization of soft samples (tissue, insects)

5 ml

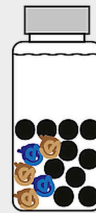
Safe-lock
single-use vials
2 x 5 ml max.



- | Cell disruption for DNA/RNA proteins/metabolites
- | Cryogenic grinding of soft sample (tissue, plants, cell pellets, insects)
- | Dry or wet homogenization of soft samples (tissue, insects)

30 ml

disposable wide
mouth bottles
2 x 4 bottles max.



- | Cell disruption for DNA/RNA proteins/metabolites
- | Dry or wet homogenization of soft samples (tissue, insects)
- | Dry milling of hard samples (quartz sand)

50 ml

disposable conical
centrifugation tubes
2 x 4 tubes max.



- | Cell disruption for DNA/RNA proteins/metabolites
- | Dry or wet homogenization of soft samples (tissue, insects)
- | Extraction of pesticides from food/plants (QuEChERS)
- | Mixing of powder and wax to press pellets for XRF

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RECOMMENDED JAR FILLINGS

The jar size should be adapted to the sample volume to ensure optimum results. Ideally, the grinding balls are 3 times the size of the largest sample piece. The numbers and sizes of balls given in the table below follow this rule of thumb. To pulverize, for example, 20 ml of a sample consisting of 8-mm sized particles, the use of a 50 ml jar and 25 mm balls is recommended. According to the table, one grinding ball is required. 20 ml of a sample with 5-mm particles, however, can be homogenized with four 15 mm balls.

Grinding jar nominal volume	Sample amount	Max. feed size	Recommended ball charge (pieces)						
			Ø 5 mm	Ø 7 mm	Ø 10 mm	Ø 12 mm	Ø 15 mm	Ø 20 mm	Ø 25 mm
1.5 ml	0.2 - 0.5 ml	1 mm	1 - 2	-	-	-	-	-	-
5 ml	0.5 - 2 ml	2 mm	-	1 - 2	-	-	-	-	-
10 ml	2 - 4 ml	4 mm	-	5 - 7	1 - 2	1 - 2	-	-	-
25 ml	4 - 10 ml	6 mm	-	-	5 - 6	2 - 4	1 - 2	-	-
35 ml	6 - 15 ml	6 mm	-	-	6 - 9	4 - 6	2 - 3	1	-
50 ml	8 - 20 ml	8 mm	-	-	12 - 14	6 - 8	3 - 4	1	1

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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TYPICAL SAMPLE MATERIALS

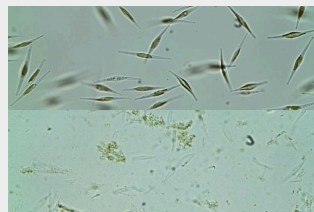
RETSCH mixer mills are true allrounders. They homogenize, for example, alloys, animal feed, bones, ceramics, cereals, chemical products, coal, coke, drugs, electronic scrap, glass, grains, hair, minerals, oil seeds, ores, paper, plant materials, plastics, sewage sludge, soils, straw, tablets, textiles, tissue, tobacco, waste samples, wood, wool, etc.

FIBROUS: HAIR



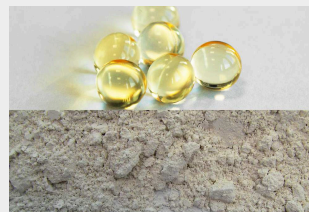
30 ml sample
50 ml stainless steel jar
1 x 25 mm stainless steel ball
2 min at 30 Hz

**CELL DISRUPTION:
MICROALGAE**



30 ml cell suspension
8 x 50 ml conical centrifuge tubes (adapter)
with 25 ml glass beads each; 0,5-0,75 mm
30 s at 30 Hz

**ELASTIC-LIQUID:
CAPSULES WITH LIQUID**



15 ml sample
50 ml stainless steel jar
1 x 25 mm stainless steel ball
embrittlement in LN₂ for 3 min
4 x 2 min at 30 Hz with intermediate cooling

**MEDIUM-HARD/
FIBROUS: SOIL**



20 ml sample
50 ml stainless steel jar
1 x 25 mm stainless steel ball
1 min at 30 Hz

**TOUGH-FIBROUS:
WOOD**



5 ml sample
10 ml zirconium oxide
jar
2 x 12 mm zirconium
oxide balls
3 min at 30 Hz

**ELASTIC-TOUGH:
POLYURETHANE
PELLETS**



20 ml sample
50 ml stainless steel jar
1 x 25 mm stainless steel
ball
embrittlement in LN₂
for 3 min
4 x 2 min at 30 Hz with
intermediate cooling

FIBROUS: CANNABIS



3 g sample
50 ml stainless steel jar
1 x 25 mm stainless steel
ball
embrittlement with LN₂
for 2 min
90 s at 30 Hz

**HARD-BRITTLE:
CONCRETE**



10 ml sample
25 ml zirconium oxide
jar
2 x 15 mm zirconium
oxide balls
2 min at 30 Hz

To find the best solution for your sample preparation task, visit our application database.

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TECHNICAL DATA

Applications	size reduction, mixing, homogenization, cell disruption, cryogenic grinding, mechanochemistry
Field of application	agriculture, biology, chemistry / plastics, construction materials, engineering / electronics, environment / recycling, food, geology / metallurgy, glass / ceramics, medicine / pharmaceuticals
Feed material	hard, medium-hard, soft, brittle, elastic, fibrous
Size reduction principle	impact, friction
Material feed size*	<= 8 mm
Final fineness*	~ 5 µm
Batch size / feed quantity*	max. 2 x 20 ml
No. of grinding stations	2
Vibrational frequency	3 - 30 Hz (180 - 1800 min-1)
Typical mean grinding time	30 s - 2 min
Max. grindig time	99 h
Dry grinding	yes
Wet grinding	yes
Cryogenic grinding	yes
Cell disruption with reaction vials	yes, up to 20 x 2.0 ml
Self-centering clamping device	yes
Type of grinding jars	screw top design
Material of grinding tools	hardened steel, stainless steel, tungsten carbide, agate, zirconium oxide, PTFE, PMMA
Grinding jar sizes	1.5 ml / 5 ml / 10 ml / 25 ml / 35 ml / 50ml
Setting of grinding time	digital, 10 s - 8 h
Storable SOPs	12
Storable cycling programs	6
Electrical supply data	100-240 V, 50/60 Hz
Power connection	1-phase
Protection code	IP 30
Power consumption	165W
W x H x D closed	385 x 350 x 470 mm

Net weight ~ 27,5 kg

Standards CE

*depending on feed material and instrument configuration/settings

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FUNCTIONAL PRINCIPLE

The grinding jars of the mixer mill MM 400 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 jars and pulverize it. Also, the movement of the 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.



[Click to view video](#)

www.retsch.com/mm400