MIXER MILL MM 500 CONTROL

The MM 500 control is a high energy laboratory ball mill that can be used for dry, wet and cryogenic grinding with a frequency of up to 30 Hz. It is the first mixer mill in the market that allows to monitor and control the temperature of a grinding process.

The temperature area covers a range from -100 to 100 °C. For maximum flexibility, the mill can be operated with various thermal fluids, enabling the use of different tempering devices for cooling or heating. If liquid nitrogen is chosen for cooling, the mill needs to be equipped with the optionally available extension device cryoPad. The innovative cryoPad technology allows to select and control a specific cooling temperature in the range from - 100 to 0 °C for the grinding process.

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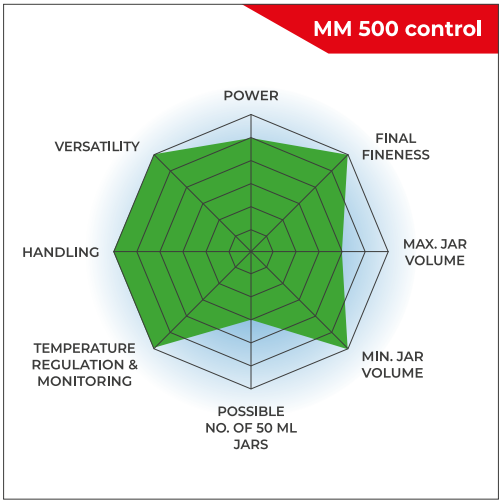
THE ONLY MIXER MILL WITH TEMPERATURE CONTROL

- Max. speed 30 Hz
- Horizontal oscillation causes strong impact effects for effective sample processing
- Up to 10 mm feed size and 0.1 µm final fineness
- 2 grinding stations for jars of min. 2 ml and max. 125 ml, adapter for 18 x 2 ml single use vials
- Various possibilities for heating or cooling with thermal fluid or liquid nitrogen for cryogenic grinding, temperature regulation between -100 °C and 100 °C, monitoring of temperature
- GrindControl to measure temperature and pressure inside the jar.
- Aeriation lids to control the atmosphere inside the jar
- Bench top model, touch screen, easy jar clamping, jars can stay clamped for subsampling, storable SOPs and cycle programs, 4 different jar materials for dry and wet grinding



ADVANTAGES THROUGH DESIGN

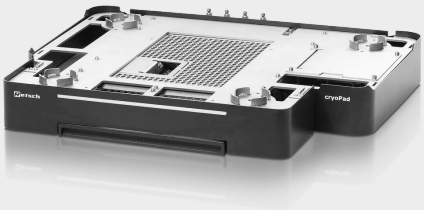
- Dry, wet and cryogenic grinding with up to 30 Hz for high energy grinding
- Fast and comfortable sample processing with two screw lock jars of up to 125 ml each
- Patented hermetically closed fluid system ensures the safe operation of thermal fluids
- Wide range of accessories available, including ventilation lids and heavy-metal-free grinding jars (also for cryogenic grinding)
- Ergonomic jar clamping, low noise level, user friendly parameter setting via touch display

TEMPERATURE MONITORING AND CONTROL

- Continuous temperature monitoring throughout a grinding process
- Cooling and heating in a range from -100 to 100 °C
- Operation is possible with liquid nitrogen or other thermal fluid
- High flexibility in terms of selecting a tempering device for temperature regulation (LN_2 supply, cryostat, chiller, ...).
- Low temperature grinding is possible without LN_2

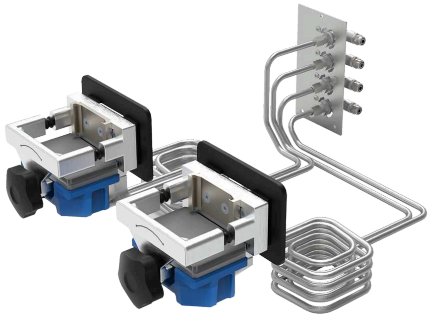
CRYOPAD

- Extension device cryoPad is required for the operation with LN_2
- The cryoPad regulates the flow of LN_2 through the thermal plate
- The cryoPad technology allows to select and maintain a specific cooling temperature in the range between -100 and 0 °C while using LN_2



TEMPERATURE REGULATION BASED ON THERMAL PLATES

The cooling and heating of the sample material is realized with the patented concept of thermal plates, making sample cooling with, e. g., open liquid nitrogen baths or dry ice obsolete. For tempering, the grinding jars are simply placed on top of the thermal plates. When the grinding jars come in contact with the thermal plates, heat is effectively transferred from or to the jars via the tempering device. The patented hermetically sealed fluid design allows to operate the mill with different thermal fluids, ensuring a flexible and safe temperature regulation and requiring only minimal effort for the user. Depending on the operational setup that is built up, the temperature of the thermal plates can be set in the range from - 100 to + 100 °C.



CONFIGURATIONS

To control the temperature of a grinding process, the mill needs to be connected to an external tempering device. Basically, there are two options:

1. Temperature regulation with liquid nitrogen

The mill is operated with liquid nitrogen and connected to a nitrogen tank. In this setup the mill must be extended with the optionally available extension device cryoPad. The patented PID (proportional–integral–derivative) system of the cryoPad controls the flow of liquid nitrogen and herewith the temperature of the thermal plates. In this setup, it is possible to select and maintain the temperature of the thermal plates at a specific value. The desired temperature is adjusted via the touch display and can be selected within a range from -100 to 0 °C, in steps of 10.

Setup 1: Extension device cryoPad and LN_2 tank for the operation with liquid nitrogen.

2. Cooling or heating with a liquid thermal fluid

In this setup, the mill can either be connected to a cryostat, to a chiller or to the water tap. The external tempering device regulates the corresponding thermal fluid to a defined temperature and the thermal fluid transfers this temperature to the thermal plates. As during a grinding process, a significant amount of heat may also develop inside the jar, the temperature of the thermal plates may be manipulated. To sum up, the actual temperature of the thermal plates depends on both, on the temperature of the thermal fluid and on grinding parameters, like frequency, time, jar volume, size of grinding balls. For a maximum control of the grinding process, the actual temperature of the thermal plates is continuously monitored in the touch display.

Setup 2: Operation with an external tempering device; e.g. water tap, chiller or thermostat.

APPLICATION EXAMPLES

The temperature regulation of the MM 500 control is especially designed for the processing of temperature-sensitive sample materials. Cooling or heating may have different objectives.

Cooling can be used for example:

- Preserving temperature-sensitive analytes (like volatile substances or pharmaceutical and food ingredients)
- Embrittlement
- Wet grinding below room temperature
- Mechanochemistry

Some applications are improved if the sample material is heated up during the process. Examples for heating are:

- Paste making (in food industry)
- Intensifying mechanochemical reactions

The required temperatures and the operational setup depend on the specific application.

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PRESERVING TEMPERATURE-SENSITIVE ANALYTES

Some analytes are modified, destroyed or vaporized if the sample material gets too warm. If specific temperature levels are exceeded, the structure of, for example, proteins, pharmaceutical substances or food ingredients may be essentially changed.

By keeping the temperature at a moderate level throughout the grinding process, temperature-sensitive natural substances are physically preserved in their original state for analysis.

Grinding of coffee beans at low temperatures for natural substance analysis.

CRYOGENIC GRINDING

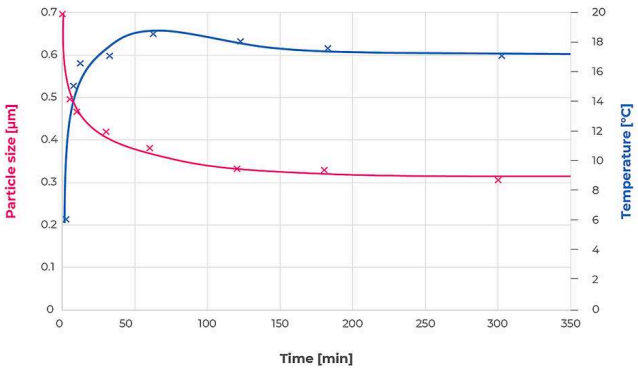
Temperatures below 0 °C are suitable for the embrittlement and homogenization of for example ductile or sticky food. If heavy-metal-free grinding is required, jars of zirconium oxide or tungsten carbide can be used.

If cooled down to -100 °C, it is also possible to successfully embrittle some polymers.

Fast milling of black Flurocarbon rubber (FKM) by embrittling the sample in two 125 ml jars at –100 °C.

WET GRINDING < 30 °C

If using a chiller, powerful wet grinding can be performed at 30 Hz and below room temperature without considering any cooling breaks.

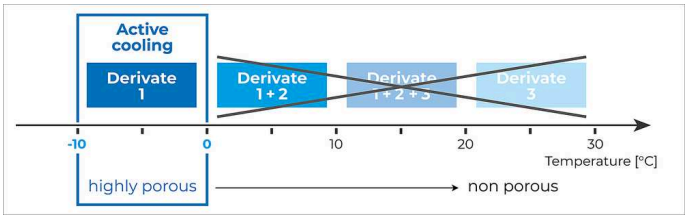


Particle size and temperature development for TiO_2 in a wet grinding process with 30 Hz and 2 x 125 ml jars

MECHANOCHEMISTRY

By cooling the sample throughout a mechanochemical process, the formation of undesired derivatives can be prevented. It is also possible to apply some heating, for example to initiate chemical reactions and increase product yields.

By keeping the temperature below 0 °C, the formation of non-porous zeolitic metal organic compound is inhibited.



By increasing the temperature during synthesis, the yield of a metal organic compound can be increased.
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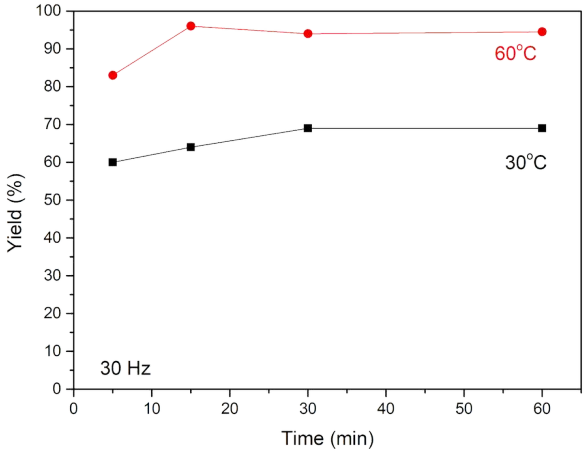

ACCESSORIES FOR MAXIMUM FLEXIBILITY

GRINDING JARS IN 3 DIFFERENT MATERIALS

Available grinding jar sizes are 50 ml, 80 ml and 125 ml, materials include stainless steel, tungsten carbide and zirconium oxide, ensuring contamination-free sample preparation. Heavy-metal-free grinding is possible, also at -100 °C

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AERATION LID (VIDEO)

RETSCH offers a special aeration lid for the grinding jars designed for applications where a special atmosphere is to be maintained in the ball mill jar.

GRINDCONTROL

The GrindControl measures temperature and pressure inside the jar. The system includes a sensor and transmission unit as well as an analysis software.

MULTI-CAVITY JARS & ADAPTER

Simultaneous processing of several small samples is possible with the multi-cavity jars and an adapter for reaction vials. This is a typical requirement, for example, for pharmaceutical, chemical and biochemical applications. The small cavity jars provide new opportunities for mechanochemical research activities involving small amounts of chemicals.

The cavities in the jars have an oval shape which ensures effective mixing. The pouring aids allow for safe sample handling. The multi-cavity jars are made of stainless steel, thus providing effective heat transfer to or from the sample.

The adapter accommodates up to 18 disposable reaction vials of 1.5 or 2.0 ml (e.g. Eppendorf vials) or nine 2.0 ml steel tubes. With its two grinding stations, the MM 500 control mixer mill can now process up to 36 samples in one working run. 2.0 ml steel tubes should be used if samples need to be frozen or heated, as polymeric reaction vessels cannot withstand mechanical load at extreme temperatures. The adapter is made of aluminum so that heat is efficiently transferred to and from the reaction tubes.

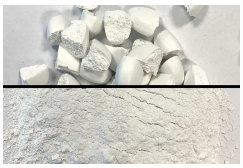
Multi-cavity jars of 4 x 10 ml and 2 x 25 ml, made of stainless steel, incl. PTFE pouring aids.

Adapter for 18 x 2 ml safe-lock reaction vials or 9 x 2 ml steel tubes, made of aluminum

TYPICAL SAMPLE MATERIALS

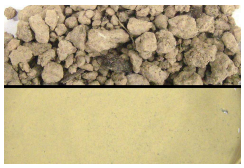
As the MM 500 control can be used with or without cooling, the mill offers a wide variety of applications. It can be used to homogenize, for example, waste, soil, chemical products, coated tablets, drugs, ores, grain, tissue, glass, hair, ceramics, bones, plastics, alloys, minerals, oil seeds, plants, sewage sludge, pills, textiles, wool etc.

raisins



coated tablets

polystyrene



soil

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Parsley

FUNCTIONAL PRINCIPLE

The grinding jars of the mixer mill MM 500 control 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. High energy milling is possible by operating at high frequencies up to 30 Hz. The movement of the grinding jars combined with the movement of the balls further causes grinding effects due to friction and additionally result in an effective mixing of the sample. The degree of mixing can be increased even further by using several smaller balls.

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TECHNICAL DATA

MIXER MILL MM 500 CONTROL

Applications	mechanochemistry, mechanical alloying, size reduction, mixing, homogenization, cryogenic grinding
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*	<= 10 mm
Final fineness*	~ 0.1 µm
Batch size / feed quantity*	max. 2 x 45 ml
Grinding chamber volume	max. 2 x 125 ml
No. of grinding stations	2
Vibrational frequency	3 - 30 Hz (180 -1800 min-1)
Setting of temperature setpoint	digital, 0 ... -100 °C (only with cryoPad)
Setting of sample cooling time	digital, 0 ... 60 min (only with cryoPad)
Setting of grinding time	digital, 10 s - 8 h
Total grinding time	99 h
Storable SOPs	12
Number of storable cycle programs	4 (with 99 repeats)
Typical mean grinding time	30 s - 2 min
Dry grinding	yes
Wet grinding	yes
Cryogenic grinding	yes
Type of grinding jars	screw-lock jar with integrated safety closure devices, multi cavity jar, adapter for safe-lock reaction vials
Material of grinding tools	hardened steel, stainless steel, tungsten carbide, zirconium oxide
Grinding jar sizes	10 ml / 25 ml / 50 ml / 80 ml / 125 ml
Electrical supply data	100-120 V, 50/60 Hz; 200-230 V, 50/60Hz
Power connection	1-phase
Protection code	IP 30
Power consumption	750 W

W x H x D closed	690 x 375 x 585 mm
W x H x D closed with cryoPad	690 x 485 x 585 mm
Net weight	~ 63 kg
Standards	CE
Connection thread size device input	G 1/4" (inner thread)
Connection thread size tubing set	G 3/8" (outer thread)
Permissible operating pressure cooling device (provided by customer)	0 ... 5 bar
typical pressure range of continous cooling unit e.g. cryostat	1 ... 2 bar
permissible pressure range of LN2 supply	1.2 ...1.4 bar
Permissible fluids	water, water-glycole mixture, thermal oil, liquid nitrogen
Thermal applications	embrittling, cooling, heating, temperature control
temperature range of fluids	+100 °C ... -196 °C
temperature range of cooling plates	+100 °C ... -100 °C

*depending on feed material and instrument configuration/settings

TECHNICAL DATA

CRYOPAD

Applications	cryogenic grinding with liquid nitrogen
Interface	RS-232 (MM 500 control)
Communication connection	via included connection cable
Power supply	via external power supply
Electrical supply data (input external power supply)	100-230V, 50/60 Hz
External power supply classification	Medical grade isolation level
Electrical supply data (input cryoPad)	24 V, 1 A
Accessories	LN2 Autofill 150L, LN2 Autofill 50L
LED status light	yes
W x H x D	670 x 110 x 590 mm
Net weight	~ 26 kg
Standards	CE
Connection thread size device input	G 1/4" (inner thread)
Connection thread size of stainless steel tubing adapter	UNF 3/4"
Permissible pressure range of LN2 supply	1.2 ...1.4 bar
Permissible fluids	Liquid nitrogen
Emissions	Liquid nitrogen gas, condensation
Connection	via included tubing set
Exhaust outlet	via included Exhaust adapter and aluminum corrugated tube
temperature range of fluids	-196 °C
temperature control algorithm	PID temperature control
Setting of temperature setpoint	digital, 0 ... -100 °C
Setting of sample cooling time	digital, 0 ... 60 min

www.retsch.com/mm500-control

ORDER DATA

MIXER MILL MM 500 CONTROL

Mixer Mill MM 500 control with quick release clamp (please order grinding jars, balls and items required for temperature controlled grinding seperately)

20.767.0001		MM 500 control 200–230 V, 50/60 Hz
20.767.0002		MM 500 control 100–120 V, 50/60 Hz

For temperature control please order a Mixer Mill MM 500 control set or accessories as shown in table “Items required for temperature control”

DEVICE EXTENSION CRYOPAD FOR THE OPERATION WITH LN2

DEVICE EXTENSION CRYOPAD FOR LN2 CONTROL

70.950.0002		cryoPad 100–230 V, 50/60 Hz (incl. connection tube, safety valve; for LN2 supply provided by customer)

ACCESSORIES FOR TEMPERATURE CONTROL

02.480.0003		Autofill 150 l, incl. connection tube and safety valve
02.480.0002		Autofill 50 l, incl. connection tube and safety valve
02.707.0188		Tubing set for liquid thermal fluids

SCREW-LOCK GRINDING JARS MM 500 CONTROL/NANO

HARDENED STEEL

01.462.0463		50 ml

01.462.0468		80 ml
01.462.0470		125 ml

STAINLESS STEEL		
01.462.0447		50 ml
01.462.0467		80 ml
01.462.0420		125 ml

TUNGSTEN CARBIDE		
01.462.0466		50 ml
01.462.0479		80 ml

ZIRCONIUM OXIDE		
01.462.0464		50 ml
01.462.0417		80 ml
01.462.0471		125 ml

MULTI CAVITY GINDING JARS MM 500 CONTROL/NANO

01.462.0537		4 x 10 ml, 1.4112 stainless steel, incl. 3 pouring aids
22.462.0014		Pouring aid for 10 ml Multi cavity jar

01.462.0536		2 x 25 ml, 1.4112 stainless steel, incl. 1 pouring aid
22.462.0015		Pouring aid for 25 ml Multi cavity jar

ACCESSORIES FOR GRINDING IN 1.5 OR 2 ML VIALS

22.008.0012		Adapter made of aluminum for 18 x 2.0 ml / 1.5 ml Safe-lock reaction vials or 9 x 2.0 ml reaction vials made of stainless steel 316L
22.749.0001		Safe-lock reaction vials 2.0 ml, 1000 pcs.
22.749.0002		Safe-lock reaction vials 1.5 ml, 1000 pcs.
22.749.0008		Reaction vials made of stainless steel 316L, 2.0 ml, 10 pcs.

ACCESSORIES FOR GRINDING UNDER INERT ATMOSPHERE

AERATION LID FOR SCREW-LOCK GRINDING JARS

ACCESSORIES FOR GRINDING JARS MM 500 CONTROL/NANO

22.486.0006		Grinding jar stabilization pad
02.486.0050		Jar wrench for grinding jars
05.114.0057		O-ring for grinding jars 50 ml, 1 piece
05.114.0158		O-ring for grinding jars 80 ml, 1 piece
05.114.0122		O-ring for grinding jars 125 ml, 1 piece

ACCESSORIES FOR COLD GRINDING MM 500 CONTROL/NANO

22.354.0003	Cryo kit for cooling the grinding jars with liquid nitrogen (incl. insulated container 4-liter, 2 grinding jar holders, 1 pair of safety glasses)

ACCESSORIES MM 500 CONTROL/NANO

05.114.0197	O-ring PTFE for grinding jars 50 ml, 1 piece, for cryogenic grinding
05.114.0196	O-ring PTFE for grinding jars 80 ml, 1 piece, for cryogenic grinding
05.114.0195	O-ring PTFE for grinding jars 125 ml, 1 piece, for cryogenic grinding
05.114.0208	O-ring for multi cavity jars, 4 x 10 ml, 1 piece
05.114.0207	O-ring for multi cavity jars, 2 x 25 ml, 1 piece
05.114.0212	O-ring for multi cavity jars, 4 x 10 ml, 1 piece, for cryogenic grinding
05.114.0213	O-ring for multi cavity jars, 2 x 25 ml, 1 piece, for cryogenic grinding
99.200.0040	IQ/OQ Documentation for MM 500 control

PRESSURE AND TEMPERATURE MEASURING SYSTEM GRINDCONTROL FOR MIXER MILLS

incl. sensors and transmitter unit, case, opening aid and cleaning accessories for MM 500 control / nano / Emax (please order lid insert and grinding jar separately)

22.782.0032	GrindControl for MM 500 control/nano/Emax grinding jar 125 ml
03.474.0242	GrindControl lid insert for MM 500 control/nano and Emax grinding jar 125 ml, stainless steel
03.474.0245	GrindControl lid insert for MM 500 control/nano and Emax grinding jar 125 ml, zirconium oxide

ACCESSORIES FOR MM 500 CONTROL/NANO GRINDCONTROL

05.114.0122		O-ring for 125 ml grinding jars (MM 500 control/nano and Emax)
22.186.0007		Sintered filter with O-ring, set of 10 pieces
22.864.0001		Valve set M8x1 for GrindControl and aeration lids

GRINDING BALLS

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 (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)
22.455.0003		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

TUNGSTEN CARBIDE		
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

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