

# Size reduction and homogenization with Mixer Mills



**Retsch**<sup>®</sup>  
Solutions in Milling & Sieving

# Mixer Mills

The RETSCH Mixer Mills grind and homogenize small sample volumes quickly and efficiently by impact and friction. They are suitable for dry, wet and cryogenic grinding as well as for cell disruption for DNA/RNA recovery.





**Milling**

- Jaw Crushers
- Rotor Mills
- Cutting Mills
- Knife Mills
- Mortar Grinders
- Disc Mills

**- Mixer Mills**

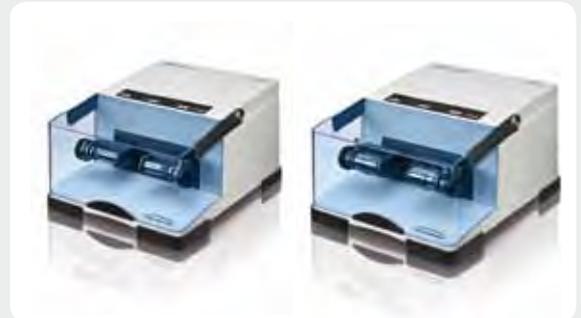
- Planetary Ball Mills

**Sieving**

**Assisting**

**Mixer Mills**

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**RETSCH Mixer Mills** are used for the pulverization of **hard, medium-hard, soft, brittle, elastic and fibrous materials**. The sample feed size depends on the mill and can be as large as 8 mm. If the feed size is larger than this then the sample must first undergo preliminary size reduction.

**Planetary Ball Mills**



Fine size reduction with impact and friction can also be carried out with RETSCH Planetary Ball Mills. They are used for **larger sample volumes** and **colloidal grinding** and achieve grind sizes down to the submicron range.

**Preliminary size reduction**



**For the coarse and preliminary size reduction** of hard, brittle or even tough materials, RETSCH Jaw Crushers are the instruments of choice. In contrast, bulky, soft, fibrous or elastic materials are best prepared in RETSCH Cutting Mills.

**Assisting**



For the subsequent pulverization a **representative part-sample** must first be obtained, e.g. with RETSCH's Sample Divider PT 100. For preparing solid samples for XRF analyses RETSCH offers two models of **hydraulic Pellet Presses**.

The main areas of application for Mixer Mills are:

#### Agriculture

cereals, grain, oil seeds, soils, straw, tobacco, wood

#### Biology

bones, hair, plant and animal tissues

#### Ceramics and glass

#### Chemicals and plastics

#### Environmental research

compost, electronic scrap, sewage sludge

#### Food

animal feed, cheese, fruit

#### Forensic sciences

#### Medicine and pharmaceuticals

drugs, tablets

#### Mineralogy and metallurgy

alloys, coal, minerals

#### Textile and wool

and many more...

# Applications

The RETSCH Mixer Mills are used for size reduction and pulverization of small volumes of **hard, medium-hard and brittle samples** as well as for **soft, elastic or fibrous** ones. Thanks to the high energy input, grinding times are usually very short. The CryoMill is ideal for grinding **temperature-sensitive materials** and **samples with volatile components**.

These laboratory "all-rounders" can also be used for **cell disruption** and DNA/RNA extraction.

## Free test grinding

As part of RETSCH's professional customer support we offer our customers the individual advice required to find the optimum solution for their sample preparation task.

To achieve this our application laboratories process and measure samples free-of-charge and provide a recommendation for the most suitable method and instrument.

For more information please visit our website [www.retsch.com/testgrinding](http://www.retsch.com/testgrinding).



## Application examples

CryoMill	General remarks	Grinding jar	Grinding balls	Feed size	Sample amount	Pre-cooling	Grinding time	Intermediate cooling	Frequency	Final fineness
<b>Bones</b>	Pre-cutting with Cutting Mill SM 2000	50 ml Stainless steel	1 x 25 mm Stainless steel	3 - 8 mm	6 g	10 min	5 x 2 min	1 min	30 Hz	10 µm
<b>Cheese</b>	Pre-cutting with a knife	50 ml Stainless steel	1 x 25 mm Stainless steel	1 - 8 mm	5 g	8 min	2 min	–	30 Hz	200 µm
<b>Rubber</b>	Pre-cutting with Cutting Mill SM 300	50 ml Stainless steel	1 x 25 mm Stainless steel	0 - 5 mm	6 g	10 min	4 x 2 min	1 min	30 Hz	400 µm

Mixer Mill MM 400/MM 200	General remarks	Grinding jar	Grinding balls	Feed size	Sample amount	Grinding time	Frequency	Final fineness
<b>Brake linings</b>	Pre-cutting with a wire cutter	25 ml WC	1 x 15 mm WC	5 mm	7 g	1.5 min	30 Hz	63 µm
<b>Cardboard</b>		35 ml Stainless steel	1 x 20 mm Stainless steel	5 x 8 mm	1 g	2 min	25 Hz	120 µm
<b>Catalysts</b>		35 ml ZrO <sub>2</sub>	8 x 10 mm ZrO <sub>2</sub>	1 mm	10 ml	5 min	30 Hz	50 µm
<b>Cotton fabric</b>		35 ml ZrO <sub>2</sub>	8 x 10 mm ZrO <sub>2</sub>	10 x 10 mm	2 g	2 min	30 Hz	250 µm
<b>Hair</b>		50 ml Stainless steel	14 x 10 mm Stainless steel	50 mm length	0.5 g	5 min	25 Hz	100 µm
<b>Myxomyceten (powder of spores)</b>		Adapter for 5 reaction vials max. 2 ml	1 x 3 mm WC for each reaction vial	< 1 mm	1 ml	2 min	30 Hz	-
<b>Silica sand</b>	Addition of 3 drops ethanol	25 ml ZrO <sub>2</sub>	1 x 20 mm ZrO <sub>2</sub>	500 µm	5 g	2 min	30 Hz	45 µm
<b>Silicon carbide</b>		25 ml WC	4 x 12 mm WC	3 mm	10 g	4 min	30 Hz	50 µm
<b>Wood chips</b>		35 ml ZrO <sub>2</sub>	1 x 20 mm ZrO <sub>2</sub>	5 mm	1.3 g	2 min	30 Hz	150 µm

This chart serves only for orientation purposes.  
ZrO<sub>2</sub>: Zirconium oxide – WC: Tungsten carbide

RETSCH's application database contains more than 1,000 application reports. Please visit [www.retsch.com/applicationdatabase](http://www.retsch.com/applicationdatabase).

# CryoMill

Particularly safe

## Safe and efficient grinding at -196 °C

Thermally-sensitive and elastic substances can be successfully processed by cooling with liquid nitrogen.

The CryoMill is an impact ball mill specifically designed for cryogenic grinding. It features an integrated cooling system which continually cools the grinding jar with liquid nitrogen before and during the grinding process. **Thus the sample is embrittled and volatile components are preserved.**



## Benefits at a glance

- Fast, efficient cryogenic grinding
- Ideal for plastics, temperature-sensitive materials and samples with volatile components
- Particularly safe due to autofill system for liquid nitrogen
- Memory for 9 SOPs
- Highly reproducible grinding results
- Programmable cooling and grinding cycles
- Also suitable for dry and wet grinding

The liquid nitrogen flows through the system and is continually supplied from an **autofill system** in the exact amount which is required to keep the temperature at  $-196\text{ °C}$ . Thus the user never comes into direct contact with  $\text{LN}_2$  which ensures a high degree of operational safety. The automatic cooling system guarantees that the grinding process is not started before the sample is thoroughly cooled. This results in reduced consumption and guarantees reproducible grinding results.

With a **vibrational frequency of 30 Hz** the CryoMill grinds most materials very effectively in a few minutes. The combination of impact and friction leads to substantially finer grind sizes compared to other cryogenic mills.

The CryoMill is **very easy to operate**. Parameters such as oscillation frequency, pre-cooling or grinding time can be digitally set via a clearly structured keypad. LEDs in the display indicate the current state of operation, e.g. cooling or grinding.

Usually, grinding in the CryoMill only takes a few minutes so that the sample does not get warm during the process. If, however, longer grinding times are required, it is also possible to pre-select **periods of intermediate cooling** and the number of cryogenic cycles.

All instrument parameters are retained during standby operation for subsequent processes. The mill can also be operated without cooling which makes it suitable for a vast range of applications.

# Grinding jars and accessories



## Grinding jars

The **screw-top grinding jars** of hardened steel and stainless steel have been specially designed for use in the CryoMill. The fact that no sample material can escape makes them particularly safe. They are available with **volumes of 5 ml (1), 10 ml (2), 25 ml (3), 35 ml (4) and 50 ml (5)**. For applications where steel jars cannot be used due to possible sample contamination, RETSCH offers a 25 ml grinding jar of zirconium oxide and matching grinding balls. Grinding jars of PTFE are also available.

**Various adapters** make the CryoMill a versatile instrument. If only very small sample amounts need to be processed, an adapter (6) for 2 resp. 4 grinding jars of 5 ml is recommendable. It is also possible to use **2 ml reaction vials** with the CryoMill thanks to a special adapter (7) which can hold up to 6 tubes.

The jar wrenches (8), which greatly facilitate opening grinding jars of all sizes, are placed conveniently at the sides of the mill.

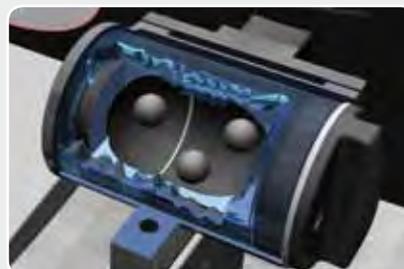
The grinding result is greatly influenced by the grinding tools. The choice of jar volume, ball charge and material depends on the type and amount of sample. In order not to falsify the subsequent analytical determination, a neutral-to-analysis material should be selected. The pulverization energy is 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 on page 11 provides information about the recommended grinding jar filling levels as well as the composition of the grinding jar materials.

## CryoMill technology

The grinding jar of the CryoMill performs 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 jar and pulverize it. The grinding jar

is continually cooled with liquid nitrogen from the integrated cooling system before, during and after the grinding process.



## LN<sub>2</sub> container



For **safe and comfortable operation** of the CryoMill, RETSCH provides an autofill system for liquid nitrogen which is available **with a 50 liter container** (for up to 20-30 samples).

It is also possible to connect existing cryo tanks to the mill. For such applications, a **connection tube with safety valve** is available.

Performance data		CryoMill	
		www.retsch.com/cryomill	
Applications	size reduction, mixing, homogenization, cell disruption		
Feed material	hard, medium-hard, soft, brittle, elastic, fibrous		
Feed size*	up to 8 mm		
Final fineness*	approx. 5 µm		
Batch/Sample volume	max. 20 ml		
Typical mean grinding time	pre-cooling: 10 minutes, grinding: 4 minutes		
Possible applications			
Cryogenic grinding	yes		
Wet grinding	yes		
Dry grinding	yes		
Cell disruption with reaction vials	max. 6 x 2.0 ml		
Suitable grinding jars	5, 10, 25, 35, 50 ml		
No. of grinding stations	1		
Digital preselection of vibrational frequency	5 - 30 Hz (300 - 1800 min <sup>-1</sup> )		
Digital preselection of grinding time	30 s - 99 min		
Memory for parameter combinations	9		
Technical data			
Power consumption	260 W		
W x H x D	385 x 370 x 675 mm		
Net weight	approx. 45 kg		
Noise values (Noise measurement according to DIN 45635-31-01-KL3)			
Emission value with regard to workplace*	L <sub>pAeq</sub> 65 dB(A)		
Measuring conditions:			
Feed material	8 ml broken quartz pebbles, approx. 4.0 – 6.0 mm		
Grinding jar used	1 x 50 ml steel		
Grinding ball used	1 steel ball 25 mm dia.		
*depending on feed material and instrument configuration/settings			

## Order data

CryoMill						Item No.
CryoMill (please order Autofill with LN <sub>2</sub> container and safety valve, grinding jars and balls separately)						
CryoMill for 100–240 V, 50/60 Hz						20.749.0001
Grinding jars	5 ml*	10 ml	25 ml	35 ml	50 ml	
Hardened steel	01.462.0300	–	01.462.0330	01.462.0329	01.462.0328	
Stainless steel	01.462.0290	01.462.0331	01.462.0334	01.462.0333	01.462.0332	
Zirconium oxide	–	–	01.462.0336	–	–	
PTFE	–	–	01.462.0335	–	–	
*to be used with adapter 02.706.0304						
Accessories						
Autofill with LN <sub>2</sub> container and safety valve, 50 litres						02.480.0002
Connection tube, incl. safety valve (for LN <sub>2</sub> supply provided by customer)						05.871.0001
Adapter for use of 2/4 grinding jars, 5 ml						02.706.0304
Adapter for use of 2/4/6 reaction vials, 2 ml						02.706.0303
Safe-Lock reaction vials 2 ml, 1000 pcs.						22.749.0001
IQ/OQ documentation for CryoMill						99.200.0016

Grinding balls for CryoMill							Item No.
Grinding balls	5 mm Ø	7 mm Ø	10 mm Ø	12 mm Ø	15 mm Ø	20 mm Ø	25 mm Ø
Hardened steel	05.368.0029	05.368.0030	05.368.0059	05.368.0032	05.368.0108	–	–
Stainless steel	05.368.0034	05.368.0035	05.368.0063	05.368.0037	05.368.0109	05.368.0062	05.368.0105
PTFE with steel core	–	–	05.368.0045	05.368.0046	05.368.0114	05.368.0047	–
For grinding balls for reaction vials and wet/ultrafine grinding as well as glass beads, please refer to page 12.							

# Mixer Mills MM 200 and MM 400

Grinding, mixing, disrupting small amounts of sample



MM 200

RETSCH Mixer Mills MM 200 and MM 400 are laboratory "all-rounders". They have been developed specially for **grinding, homogenizing and mixing of small sample amounts** quickly and efficiently. They are also perfectly suitable for the **disruption of biological cells** as well as for DNA/RNA extraction. The MM 400 can also be used for **wet and cryogenic grinding**.

The "all-rounders"  
in the laboratory

## Benefits at a glance

- Quick, efficient pulverization and homogenization
- High 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
- Up to 9 parameter combinations can be stored
- 2-year warranty, CE-conform

## High-performance Mixer Mills

The Mixer Mills can pulverize 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 400 operate so effectively that the sample is hardly warmed at all due to the very short grinding time. **Thus most materials can be pulverized and mixed at ambient temperature, without any cooling.**

With their ability to process small sample amounts to analytical fineness quickly and reproducibly, RETSCH Mixer Mills are the ideal devices to mix powdered sample and binder, using disposable polystyrene vessels, prior to pelletizing for **XRF analysis**.

## MM 200 and MM 400 technology

The grinding jars perform 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 many very 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.

As a function of frequency, up to 1800 impacts per minute are achieved resulting in a high degree of pulverization in very short times.



## Maximum reproducibility



Both mills are particularly easy to use. The vibrational intensity can be set accurately from 3 to 25/30 hertz. An electronic speed control keeps this value constant during the entire grinding process. The grinding 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. Up to 9 parameter combinations can be stored. 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. A PTFE gasket prevents the escape of liquids and particles even at maximum vibrational frequency.



MM 400

## MM 400 – unsurpassed in performance, safety and comfort

With a vibrational frequency of 30 Hz the MM 400 grinds most materials very effectively in a few minutes. It usually achieves a **higher fineness in less time** compared to the MM 200. In addition, large grinding jars with a capacity of 35 ml and 50 ml are available for the MM 400. 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 easy and safe. 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.

### Advantages MM 400

The Mixer Mill MM 400 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 precooling 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 400



The CryoKit is a cost efficient solution for occasional cryogenic grinding with the Mixer Mill MM 400. This set of insulated containers, tongs and safety glasses is used for pre-cooling the grinding jar in liquid nitrogen.

The screw-top grinding jars are particularly suitable for cryogenic grinding, as they remain hermetically sealed until they have regained room temperature. This prevents atmospheric humidity from condensing on the cold sample as water vapor which could penetrate the sample and falsify the analytical results. However, jars made from agate or ceramics should not be cooled with liquid nitrogen in order to avoid damages during the grinding process.



The CryoKit 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 400**, with 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.

The **CryoMill** is designed for grinding samples with liquid nitrogen which cannot be processed at room temperature.

Performance data	MM 200	MM 400	CryoMill
	<a href="http://www.retsch.com/mm200">www.retsch.com/mm200</a>	<a href="http://www.retsch.com/mm400">www.retsch.com/mm400</a>	<a href="http://www.retsch.com/cryomill">www.retsch.com/cryomill</a>
Applications	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	up to 8 mm
Final fineness*	approx. 10 µm	approx. 5 µm	approx. 5 µm
Batch/Sample volume	max. 2 x 10 ml	max. 2 x 20 ml	max. 1 x 20 ml
Typical mean grinding time	30 s – 2 min	30 s – 2 min	pre-cooling: 10 minutes, grinding: 4 minutes
Possible applications:			
Dry grinding	yes	yes	yes
Wet grinding	no	yes	yes
Cryogenic grinding	no	yes	yes
Cell disruption with reaction vials	yes, max. 10 x 2.0 ml	yes, max. 20 x 2.0 ml	yes, max. 6 x 2.0 ml
Mixing with conical centrifuge tubes	yes	yes	no
Suitable grinding jars			
Grinding jar with push-fit lids	1.5 - 25 ml	no	no
Grinding jars with screw-top lids	no	1.5 - 50 ml	5 - 50 ml
Self-centering clamping device	no	yes	–
No. of grinding stations	2	2	1
Digital preselection of vibrational frequency	3 - 25 Hz (180 - 1500 min <sup>-1</sup> )	3 - 30 Hz (180 - 1800 min <sup>-1</sup> )	5 - 30 Hz (300 - 1800 min <sup>-1</sup> )
Digital preselection of grinding time	10 s - 99 min	10 s - 99 min	30 s - 99 min
Memory for parameter combinations	9	9	9
<b>Technical data</b>			
Power consumption	100 W	150 W	260 W
W x H x D	371 x 266 x 461 mm	371 x 266 x 461 mm	385 x 370 x 675 mm
Net weight	approx. 25 kg	approx. 26 kg	approx. 45 kg
<b>Noise values</b> (Noise measurement according to DIN 45635-31-01-KL3)			
Emission value with regard to workplace*	L <sub>pAeq</sub> 65 dB(A)	L <sub>pAeq</sub> 65 dB(A)	L <sub>pAeq</sub> 65 dB(A)
Measuring conditions:			
Feed material	1.5 ml broken quartz pebbles, approx. 1.5 mm	1.5 ml broken quartz pebbles, approx. 1.5 mm	8 ml broken quartz pebbles, approx. 4.0 - 6.0 mm
Grinding jars used	2 x 5 ml, steel	2 x 5 ml, steel	1 x 50 ml, steel
Grinding balls used	1 x 7 mm dia., WC	1 x 7 mm dia., WC	1 x 25 mm dia., steel

\*depending on feed material and instrument configuration/settings

## Cell disruption and mixing with RETSCH Mixer Mills

Smallest 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). In the Mixer Mills, efficient disruption is achieved so quickly that no additional cooling is necessary.



RETSCH offers various adapter racks of PTFE for:

- 5 reaction vials 1.5 and 2.0 ml (1)
- 10 reaction vials 1.5 and 2.0 ml (2)
- 10 reaction vials 0.2 ml (3)

For sample preparation according to QuEChERS 10 ml acetonitrile and an aqueous salt mixture are added to the food sample. This mixture is then agitated for 1 to 3 minutes. This can be done in the MM 400 equipped with two adapters holding up to 4 Falcon tubes each. The thorough mixing of the sample is beneficial for the subsequent extraction process.



Grinding jars of polystyrene are also available for the mixing of solid sample materials.

# Grinding jars and grinding balls for versatile use

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

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 for the MM 400 are available.



Screw-top grinding jars for MM 400



Grinding jars with push-fit lids for MM 200

## 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
  - 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 400.

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. Exceptions to this are voluminous materials, such as wool, leaves, grasses. In these cases a material filling level of 70-80% is necessary. 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 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 pcs.	–	–	–	–	–	–
5.0 ml	0.5 – 2.0 ml	2 mm	–	1–2 pcs.	–	–	–	–	–
10.0 ml	2.0 – 4.0 ml	4 mm	–	–	1–2 pcs.	1–2 pcs.	–	–	–
25.0 ml	4.0 – 10.0 ml	6 mm	–	–	5–6 pcs.	2–4 pcs.	1–2 pcs.	–	–
35.0 ml	6.0 – 15.0 ml	6 mm	–	–	6–9 pcs.	4–6 pcs.	2–3 pcs.	1 pc.	–
50.0 ml	8.0 – 20.0 ml	8 mm	–	–	12–14 pcs.	6–8 pcs.	3–4 pcs.	1 pc.	1 pc.

### Material composition guidelines

Grinding jar	Material no.	MM 200	MM 400	CryoMill	approx. hardness	Material analysis (in %)
Hardened 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), P (0.045), S (0.03)
	1.4112	–	■	■	45-47 HRC	Fe (76.56), 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 <sub>2</sub> (99.91), Al <sub>2</sub> O <sub>3</sub> (0.02), Na <sub>2</sub> O (0.02), Fe <sub>2</sub> O <sub>3</sub> (0.01), K <sub>2</sub> O (0.01), MnO (0.01), MgO (0.01), CaO (0.01)
Zirconium oxide*		■	■	■	1200 HV	ZrO <sub>2</sub> (94.5), Y <sub>2</sub> O <sub>3</sub> (5.2), SiO <sub>2</sub> / MgO/ CaO/ Fe <sub>2</sub> O <sub>3</sub> / Na <sub>2</sub> O/ K <sub>2</sub> O (< 0.3)
PTFE		■	■	■	53 Shore	PTFE (100)

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

\*Yttrium-part-stabilized

## Mixer Mills order data

Mixer Mill MM 200								Item No.
MM 200 (please order grinding jars and grinding balls separately)								
MM 200 for 100-240 V, 50/60 Hz								20.746.0001
Grinding jars MM 200, with push-fit lid								
	1.5 ml	5 ml	10 ml	25 ml				
Hardened steel	–	–	–	–				02.462.0052
Stainless steel	02.462.0057	02.462.0059	02.462.0061	02.462.0119				
Tungsten carbide	–	01.462.0115	01.462.0009	–				
Agate	–	01.462.0113	01.462.0008	–				
Zirconium oxide	–	–	01.462.0194	01.462.0195				
PTFE	–	–	02.462.0184	02.462.0051				
Mixer Mill MM 400								Item No.
MM 400 with quick-clamping device (please order grinding jars and grinding balls separately)								
MM 400 for 100-240 V, 50/60 Hz								20.745.0001
Grinding jars MM 400, screw top design								
	1.5 ml	5 ml	10 ml	25 ml	35 ml	50 ml		
Hardened 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	–		
PTFE	–	–	–	01.462.0238	01.462.0244	–		
Accessories MM 400								
Jar wrench for grinding jars, 1 pair								22.486.0005
CryoKit for cooling grinding jars with liquid nitrogen								22.354.0001
IQ/OQ documentation for MM 400								99.200.0004
Grinding balls for MM 200 and MM 400								Item No.
Grinding balls	5 mm Ø	7 mm Ø	10 mm Ø	12 mm Ø	15 mm Ø	20 mm Ø	25 mm Ø	
Hardened steel	05.368.0029	05.368.0030	05.368.0059	05.368.0032	05.368.0108	–	–	
Stainless steel	05.368.0034	05.368.0035	05.368.0063	05.368.0037	05.368.0109	05.368.0062	05.368.0105	
Tungsten carbide	05.368.0038	05.368.0039	05.368.0071	05.368.0041	05.368.0110	–	–	
Agate	05.368.0024	05.368.0025	05.368.0067	05.368.0027	–	–	–	
Zirconium oxide	–	–	05.368.0094	05.368.0096	05.368.0113	05.368.0093	–	
PTFE with steel core	–	–	05.368.0045	05.368.0046	05.368.0114	05.368.0047	–	
Accessories for mixing with MM 200 and MM 400								Item No.
Adapter for 4 conical centrifuge tubes (e.g. Falcon Tubes), 2 pieces, incl. 20 tubes (only for MM 400)								22.001.0015
Conical centrifuge tubes, 20 pieces (for adapter 22.001.0015)								20 ml: 05.026.0001
Mixing beakers of polystyrene, 100 pcs.								28 ml: 22.041.0003 56 ml: 22.041.0004
Accessories for cell and tissue disruption with MM 200 and MM 400								Item No.
Adapter racks, PTFE, for reaction vials for MM 200 and MM 400								
Adapter rack for 10 reaction vials, 1.5 and 2.0 ml (for MM 400 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 and wet/ultra fine grinding								2 mm Ø 3 mm Ø 4 mm Ø 5 mm Ø
Stainless steel 500 g								22.455.0010 22.455.0011 – –
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 500 g								05.368.0089 05.368.0090 – –
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
Glass 500 g								22.222.0001 22.222.0002 22.222.0003 22.222.0004 22.222.0005



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