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

MIXER MILL MM 400

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.

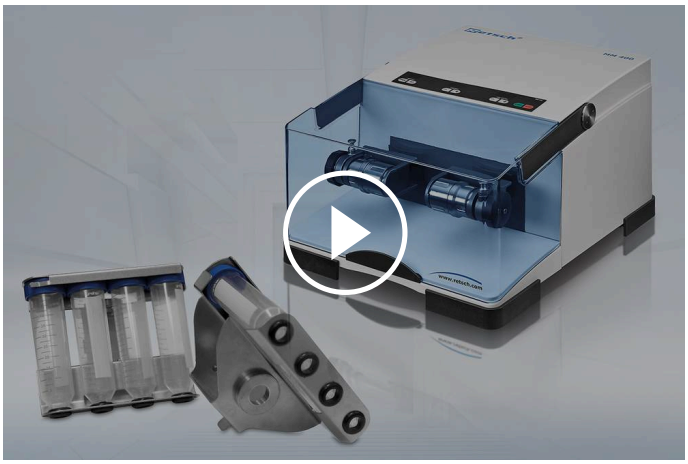
The MM 400 allows for efficient cell disruption of up to 240 ml cell suspension for DNA/RNA and protein extraction. For accurate diagnosis of infections, it is possible to isolate intact bacteria from tissue in 8 x 30 ml bottles or 10 x 5 ml vials by using adapters.

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

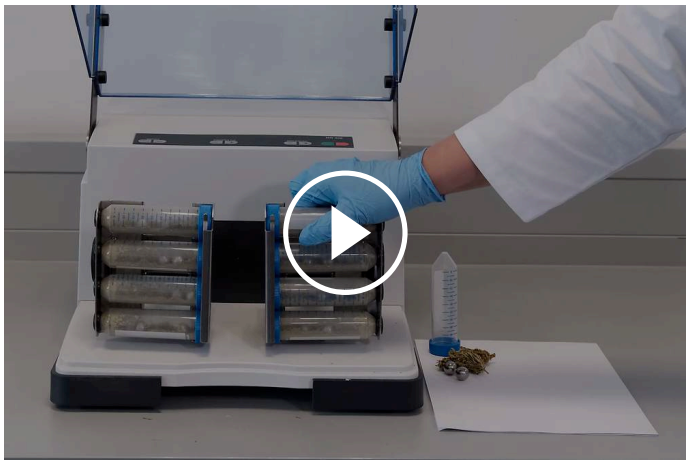
For the pulverization of 25 to 30 g plant material, such as cannabis flower, conical centrifuge tubes are best suited. Up to 8 tissue samples, like fresh liver in buffer solution, can also be homogenized in these 50 ml tubes using steel or zirconium oxide balls. To keep the mechanical stress on the vials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



Click to view video

Mixer Mill MM 400 - Homogenization of cannabis*

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

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*

MIXER MILL MM 400

APPLICATIONS IN MECHANOCHEMISTRY

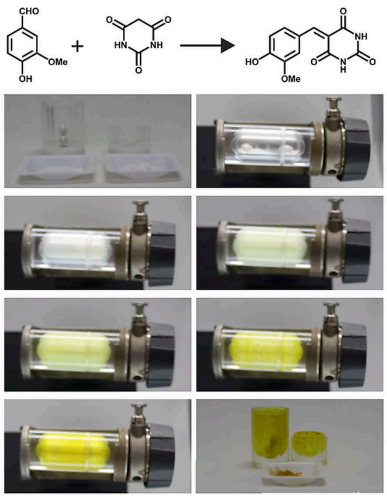
Mechanochemistry enables fast reactions of substances in a solvent-free environment. Some chemical reactions require the frictional forces of a planetary ball mill, while other reaction types need energy input through impact – that is where the Mixer Mill MM 400 comes into play.

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

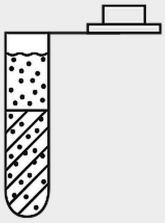
Adapters for 0.5 / 1.5 / 2 / 5 ml single-use vials can be used in the MM 400. For larger sample amounts, e. g. for protein extraction, adapters for 50 ml conical centrifugation tubes or 30 ml wide-mouth bottles are available.

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.

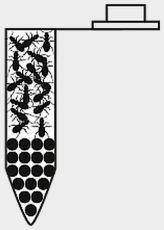
VIALS, BOTTLES AND TUBES AVAILABLE FOR MM 400

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



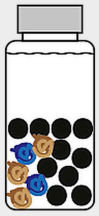
- Cell disruption for DNA/RNA proteins/ metabolites
- Cryogenic grinding of soft sample (tissue, plants, cell pellets, insects)
- Dry or wet homogenization of soft samples (tissue, insects)

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



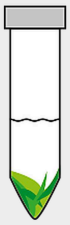
- Cell disruption for DNA/RNA proteins/ metabolites
- Cryogenic grinding of soft sample (tissue, plants, cell pellets, insects)
- Dry or wet homogenization of soft samples (tissue, insects)

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

MIXER MILL MM 400

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.

MIXER MILL MM 400

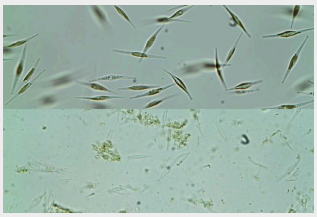
TYPICAL SAMPLE MATERIALS

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 LN_2 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 LN_2 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 LN_2 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.

MIXER MILL MM 400

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

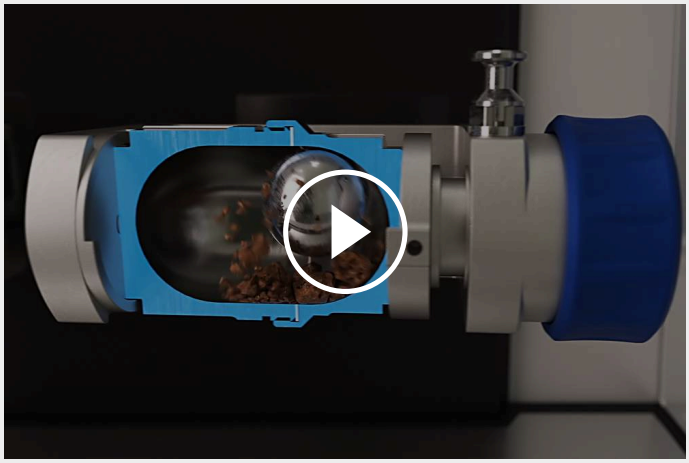
*depending on feed material and instrument configuration/settings

MIXER MILL MM 400

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

ORDER DATA

MIXER MILL MM 400

Mixer Mill MM 400 with quick release clamp
(please order grinding jars and balls separately)

20.715.0001		MM 400	100–240 V, 50/60 Hz

GRINDING JARS MM 400, SCREW TOP DESIGN

HARDENED STEEL

01.462.0237		25 ml

STAINLESS STEEL

01.462.0230		1.5 ml
01.462.0231		5 ml
01.462.0290		5 ml (for use with adapter 02.706.0351)
01.462.0236		10 ml
01.462.0213		25 ml
01.462.0214		35 ml
01.462.0216		50 ml

TUNGSTEN CARBIDE

01.462.0235		10 ml
01.462.0217		25 ml

AGATE		
01.462.0232		5 ml
01.462.0233		10 ml

ZIRCONIUM OXIDE		
01.462.0234		10 ml
01.462.0201		25 ml
01.462.0215		35 ml

PTFE		
01.462.0238		25 ml
01.462.0244		35 ml
22.041.0003		Mixing beakers of polystyrene, 28 ml, 100 pieces
22.041.0004		Mixing beakers of polystyrene, 56 ml, 100 pieces

PMMA, TRANSPARENT JARS FOR MECHANOSYNTHESES		
01.462.0539		10 ml, 10 pieces

02.462.0539		10 ml, 2 pieces

ACCESSORIES FOR GRINDING JARS MM 400

22.486.0005		Jar wrench for grinding jars
02.706.0351		Adapter for use of 2/4 grinding jars 5 ml (01.462.0290)
22.085.0007		Gasket for grinding jar 1.5 ml, 10 pieces
22.085.0008		Gasket for grinding jar 5 ml, 10 pieces
22.085.0009		Gasket for grinding jar 10 ml, 10 pieces
22.085.0006		Gasket for grinding jar 25 ml hardened steel and stainless steel, 10 pieces
22.085.0003		Gasket for grinding jar 25 ml zirconium oxide and tungsten carbide, 10 pieces
22.085.0005		Gasket for grinding jar 35 ml stainless steel, 10 pieces
22.085.0004		Gasket for grinding jar 35 ml zirconium oxide, 10 pieces
22.085.0002		Gasket for grinding jar 50 ml stainless steel, 10 pieces
22.749.0008		2.0 ml steel tubes, 316L stainless steel, 10 pieces

ACCESSORIES FOR MIXING AND CELL DISRUPTION MM 400

22.001.0020		Adapter for 4 conical centrifuge tubes (e.g. Falcon® Tubes), 2 pieces, incl. 20 tubes
05.026.0001		Conical centrifuge tubes, 50 ml, 20 pieces
22.001.0021		Adapter for 4 wide mouth bottles, 2 pieces, incl. 12 wide mouth bottles, 30 ml

ACCESSORIES FOR COLD GRINDING MM 400

22.354.0001		Cryo kit for cooling the grinding jars with liquid nitrogen (incl. 2 insulated containers (1 and 4 liter), 2 pairs of grinding jar tongs, 1 pair of safety glasses)

ACCESSORIES MM 400

99.200.0043		IQ/OQ Documentation for MM 400

ACCESSORIES FOR CELL AND TISSUE DISRUPTION

22.008.0010		Adapter for 5 reaction vials 5.0 ml, made of PTFE (for MM 400 / MM 500 vario)
22.008.0008		Adapter for 10 reaction vials 1.5 and 2.0 ml, made of PTFE (for MM 400 / MM 500 vario)
22.008.0005		Adapter for 5 reaction vials 1.5 and 2.0 ml, made of PTFE
22.008.0006		Adapter for 10 reaction vials 0.2 ml, made of PTFE
22.749.0006		Safe-lock reaction vials 5.0 ml, 200 pcs.
22.749.0001		Safe-lock reaction vials 2.0 ml, 1000 pcs.
22.749.0002		Safe-lock reaction vials 1.5 ml, 1000 pcs.
22.749.0004		Safe-lock reaction vials 0.2 ml, 1000 pcs.

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

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

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

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

ZIRCONIUM OXIDE

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)
05.368.0094		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

PTFE WITH STEEL CORE

05.368.0045		10 mm Ø
05.368.0046		12 mm Ø
05.368.0114		15 mm Ø
05.368.0047		20 mm Ø

POLYAMIDE FOR MIXING BEAKERS

05.368.0042		5 mm Ø

05.368.0043		7 mm Ø
05.368.0044		9 mm Ø
05.368.0003		12 mm Ø

GLASS BEADS		
22.222.0001		0.10 – 0.25 mm Ø, 500 g (approx. 320 ml)
22.222.0002		0.25 – 0.50 mm Ø, 500 g (approx. 320 ml)
22.222.0003		0.50 – 0.75 mm Ø, 500 g (approx. 320 ml)
22.222.0004		0.75 – 1.00 mm Ø, 500 g (approx. 320 ml)
22.222.0005		1.00 – 1.50 mm Ø, 500 g (approx. 320 ml)