

Ball Mills



IDEAL FOR

- CHEMICAL ANALYSIS
- ENVIRONMENTAL RESEARCH
- PHARMACEUTICALS AND MEDICINE
- BIOTECHNOLOGY
- FORENSIC ANALYSIS
- MATERIAL TECHNOLOGY
- ROHS

BALL MILLS

FINE COMMINUTION IN THE LAB

FRITSCH BALL MILLS: THE MOST EFFECTIVE MILLS FOR SMALL AND VERY SMALL QUANTITIES

- For fast batchwise grinding of medium-hard to hard samples
- For achieving the finest particle sizes
- Dry or wet grinding
- For mixing
- For homogenisation



FRITSCH is an internationally respected manufacturer

of application-oriented laboratory instruments. For more

than 80 years, laboratories worldwide have relied on our

FRITSCH. ONE STEP AHEAD.

experience, quality, service and innovation - for fast industrial



applications as well as for especially accurate results in

industry- and research laboratories. See for yourself.

FRITSCH Ball Mills

are the most effective laboratory mills for rapid batchwise comminution of medium-hard to hard samples down to the finest particle size. The grinding can take place dry

or wet. Grinding sets of many different materials are available. **FRITSCH Ball Mills** are also the ideal and reliable lab assistants for mixing and homogenising.

| Mini-Mill PULVERISETTE 23 | Vibratory Micro Mill PULVERISETTE 0 |
|--|--|
| The smallest instrument for small quantities | Fine comminution and sieving in one unit |
|  |  |

| | | |
|--|--|--|
| Operating principle | Impact force | Impact force |
| Optimal for material type | Medium-hard, brittle, moist | Medium-hard, brittle, temperature-sensitive, moist |
| Grinding bowl sizes | 5, 10, 15 ml | – |
| Grinding ball diameter | 0.1 – 15 mm | 50 – 70 mm |
| Max. feed size (depending on the material) | 6 mm | 5 mm |
| Min. sample quantity | 0.01 ml | 1 ml |
| Max. sample quantity | 5 ml | 10 ml |
| Final fineness (depending on the material) | 5 µm | 10 µm |
| Typical grinding time (depending on the material) | 2 min | 10 min |
| Cryogenic grinding | Liquid nitrogen can be used for pre-cooling in the PTFE bowl | Yes |
| Grinding process | Dry/wet | Dry/wet |
| Grinding bowl oscillations per minute | 900 – 3000 at 9 mm amplitude | 3000 – 3600 at 1 – 3 mm amplitude |
| Electrical details | 100-240 V/1~, 50-60 Hz, 90 watt | 100-240 V/1~, 50-60 Hz, 50 watt |
| Weight | Net: 7 kg, gross: 8 kg | Net: 21 kg, gross: 22 kg |
| Dimensions w x d x h | Bench top instrument: 20 x 30 x 30 cm | Bench top instrument: 37 x 40 x 20 cm |
| Packing details | Cardboard box: 37 x 25 x 34 cm | Cardboard box: 50 x 43 x 30 cm |

Grinding in a Ball Mill takes place through impact and friction of the sample between the grinding balls and the inside wall of the grinding bowl respectively the mortar.

For this, the grinding bowl or mortar performs vertically oscillating movements of high amplitude and high frequency, which are transferred to the grinding vessel.



PULVERISETTE 23

THE ULTRA-EFFECTIVE FRITSCH MINI-MILL

- For smallest sample quantities up to 5 ml
- Max. feed size 6 mm, final fineness 5 µm
- Dry, wet and cryogenic grinding in a single unit
- Extremely compelling in price and in performance
- Extremely effective grinding due to spherical grinding bowl with plug-style closure and practical quick clamping system
- Precisely adjustable configurable and reproducible grinding time
- Very simple operation, cleaning and maintenance



PTFE bowl for use in biotechnology

The ultra-compact FRITSCH Mini-Mill is the ideal assistant for fine comminution of smallest quantities – for wet grinding as well as for dry or cryogenic grinding. Its special, spherical grinding bowl ensures much better performance in grinding, mixing and homogenising compared with similar models. With a footprint of just 20 x 30 cm and a weight of 7 kg, it easily fits anywhere. It's smart, is extremely user-friendly, inexpensive, and convinces with impressive results: small, fast, effective.

PTFE bowl

The 5 ml PTFE bowl is specially suited for using the FRITSCH PULVERISETTE 23 in biotechnology applications. For example, it is possible to break up fungus or yeast cells, deep frozen tissue and cells in only a few minutes with this special plastic bowl and a 10 mm steel ball. It is also possible to pre-cool the entire bowl in liquid nitrogen.

UNMATCHED EFFECTIVENESS WITH SPHERICAL GRINDING BOWLS

Available only from FRITSCH: In special consideration of the ball mill grinding concept, we developed for the PULVERISETTE 23 a grinding bowl with interior walls that are spherical instead of cylindrical. Your advantage: Unmatched grinding performance with a significantly improved grinding effect, much easier recovery and simpler cleaning.

Typical FRITSCH!

Especially practical: The spherical grinding bowls of the PULVERISETTE 23 are assembled simply and quickly, just twist and turn!

METAL-FREE GRINDING

With grinding bowls made of zirconium oxide, you can ensure that your samples remain absolutely metal-free.

TECHNICAL DATA

Electrical details

100-240 V/1~, 50-60 Hz, 90 watt

Weight

Net 7 kg

Gross 8 kg

Dimensions w x d x h

Bench top instrument 20 x 30 x 30 cm

Packaging w x d x h

Cardboard box 37 x 25 x 34 cm

Emissions value of workplace according to DIN EN ISO 3746:2005

Approx. 75 dB(A)

(depending on the material to be ground and grinding bowl/balls used)

Order no.

23.1000.00



Practical and effective: Spherical grinding bowls for easy assembly



Operating panel with integrated, easy-to-clean glass keyboard

IDEAL FOR

Chemical analysis

Comminution and homogenisation of grinding samples for creation of compacts for x-ray fluorescence and infrared spectroscopy (e.g. potassium bromide tablets)

Environmental research

Soils in contaminant analysis, humic acid determination, botanical materials in residue analysis of fertilisers and pesticides, pulping of seeds

Pharmaceuticals and medicine

Kidney and gallstone analysis, breaking up tablets, pharmaceutical ingredients

Forensic analysis

Hair analysis for genetic testing and drug tests, preparation of extremely small particles for chemical analysis, textile fibre and bone analysis

Biotechnology

Comminution of deep frozen tissue samples

Material synthesis

Creating mixtures for catalytic tests on polymers, ceramic analysis

FACTS AND ADVANTAGES

- Fast, reproducible comminution
- Small grinding bowl volumes
- Low contact surface area with grinding elements
- Accessories: Grinding bowls and grinding balls in 4 different materials (ordered separately)
- Grinding bowl oscillations: 900 - 3,000 oscillations/min at 9 mm amplitude
- Regulated oscillation frequency (15 - 50 Hz)
- CE mark
- 2-year guarantee



PULVERISETTE 0

THE FRITSCH VIBRATORY BALL MILL

- Max. feed size 5 mm
- Max. sample quantity 10 ml
- Final fineness 10 µm
- Effective comminution in a narrow, homogeneous particle size range
- Loss-free grinding in a closed vessel – dry or in suspension
- Cryogenic grinding and simple embrittling in the cryo-box
- Modular system for simple conversion to dry or wet sieving
- Adjustable oscillation amplitude for easy adaption of the vibration energy to the grinding sample



FRITSCH cryo-box for fast, simple embrittlement

The **FRITSCH PULVERISETTE 0** is the ideal laboratory mill for fine comminution of medium-hard, brittle, moist or temperature-sensitive samples – dry or in suspension – as well as for homogenising of emulsions and pastes.

IMPACT AND FRICTION

The FRITSCH Vibratory Micro Mill PULVERISETTE 0 grinds your sample through impact and friction by which the mortar vibrates electromagnetically and the grinding material transfers the vibrations to the grinding ball.

At the beginning of the grinding, the comminution of the coarse particles is achieved by the impact effect of the grinding ball. Next, the fine particles are comminuted through friction by the tumbling motion of the grinding ball as the vibrations subside. The impact energy of the grinding ball is freely adjustable thus, allowing it to be precisely adapted to the sample being ground.

CRYOGENIC GRINDING

For fast embrittlement of soft, slightly oily, fatty or moist materials for cryogenic grinding, we offer the **FRITSCH cryo-box**: Simply insert the filled grinding set into the cryo-box and fill it with liquid nitrogen with this method even extremely difficult-to-grind samples can be ground down to analysis fineness. And the thick insulation ensures a particularly efficient use of coolant.

GRINDING AND SIEVING IN ONE UNIT

For dry and wet sieving, the FRITSCH PULVERISETTE 0 can be converted to a Vibratory Sieve Shaker for quantitative particle size analysis of solids (measuring range 32 µm – 63 µm) and suspensions (measuring range 20 µm – 10 mm) by simply inserting corresponding sieves. All related information can be found at www.fritsch.de/sieveshakers.

ROHS

The FRITSCH Vibratory Micro Mill PULVERISETTE 0 is recommended for sample preparation of RoHS tests (Restriction of Hazardous Substances).

TECHNICAL DATA

Electrical details

100-240 V/1~, 50-60 Hz, 50 watt

Weight

Net 21 kg

Gross 22 kg

Dimensions w x d x h

Bench top instrument 37 x 40 x 20 cm

Packaging w x d x h

Cardboard box 50 x 43 x 30 cm

Emissions value of workplace according to

DIN EN ISO 3746:2005

Approx. 68 dB(A), with sound absorption hood approx. 53 dB(A)
(depending on the material to be ground and mortar/grinding balls used)

Order no.

00.6020.00



Grinding and sieving in one unit: the PULVERISETTE 0 as ANALYSETTE 3 SPARTAN



Teeth before and after grinding with the FRITSCH PULVERISETTE 0

IDEAL FOR

| | |
|-------------------------------------|--|
| Chemical analysis | Electron microscopy |
| Environmental research | Soil samples, comminution of botanical materials – also possible deep frozen |
| Pharmaceuticals and medicine | Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets |
| Biotechnology | Tissue samples, botanical matter |
| Forensic analysis | Teeth, bones |
| Materials technology | Pigments, precious materials, new materials |
| RoHS | Mobile phone circuit boards, mobile phone cameras, mobile phone LCD glass panels, mobile phone keypads, electronic chips, LCD diffusion panels |

FACTS AND ADVANTAGES

- Grinding and sieving in one unit
- Agglomeration phenomena avoided
- Ergonomically positioned membrane keyboard IP65, splash-proofed
- Recyclable plastic housing
- Convertible for cryogenic grinding
- Window for observing the grinding progress
- Digital timer
- Standard equipment includes grinding head (included in price)
- Accessories: Mortars and grinding balls in 6 different materials (ordered separately). All mortars are rimmed in an aluminium shell.
- Grinding bowl oscillations 3,000 – 3,600 oscillations/min at 1 – 3 mm amplitude
- CE mark
- 2-year guarantee



PULVERISETTE 23



GRINDING BOWLS AND GRINDING BALLS

For your FRITSCH Mini-Mill PULVERISETTE 23, you require one grinding bowl and the corresponding number of grinding balls. To avoid undesired contamination of the sample through abrasion, we offer a selection of 4 different material types. Normally, grinding bowls and balls of the same material are used. In principle, the grinding bowl material must be harder than the material to be ground. Important: Pay attention to the specified useful capacity as this is not identical to the bowl volume!

Material data for grinding bowls and grinding balls

| Material | Main component of the material* | Density g/cm ³ | Abrasion resistance | Use for material to be ground |
|-----------------|----------------------------------|---------------------------|---------------------|-------------------------------|
| Zirconium oxide | ZrO ₂ | < 5.9 | Very good | Fibrous, abrasive samples |
| Stainless steel | Fe – Cr – Ni | 7.8 | Fairly good | Medium-hard, brittle samples |
| Hardened steel | Fe – Cr | 7.9 | Good | Hard, brittle samples |
| PTFE | C _x – F _{2x} | 2.16 | Sufficient | Frozen tissue samples |

* At www.fritsch.de, you can find the corresponding element analyses with detailed information about the materials.

Recommended number of balls per grinding bowl

| Grinding bowl/ Useful capacity (sample volume) | 15 ml 0.5 – 5 ml | 10 ml 0.2 – 1 ml | 5 ml 0.01 – 1 ml |
|---|---------------------|---------------------|---------------------|
| Balls diameter | | | |
| 15 mm | 2 | 1 | |
| 10 mm | 5 | 3 | 1 |
| 5 mm | 60 | 30 | 20 |



PULVERISETTE 0



MORTAR AND GRINDING BALLS

For the FRITSCH Vibratory Micro Mill PULVERISETTE 0, you require a mortar, which must be equipped with a grinding ball. All FRITSCH mortars are rimmed, regardless of the material, in a robust shell of shock-resistant aluminium, which protects the actual mortar. To optimally adapt the grinding to any sample type, you can choose between 6 different materials, whereby mortars and grinding balls of the same material are generally used. Important: The mortar material must always be harder than the material to be ground. For cryogenic grinding, use mortars and grinding balls made of steel or tungsten carbide. The PULVERISETTE 0 can also be converted to a Vibratory Sieve Shaker ANALYSETTE 3 SPARTAN for dry and wet sieving. All related information can be found at www.fritsch.de/sieveshakers – or simply ask us!

Material data for mortars and grinding balls

| Material | Main component of material* | Density g/cm ³ | Abrasion resistance | Use for material to be ground |
|---------------------------------|--------------------------------|---------------------------|---------------------|-------------------------------|
| Agate ¹⁾ | SiO ₂ | 2.65 | Good | Soft to medium-hard samples |
| Sintered corundum ¹⁾ | Al ₂ O ₃ | 3.8 | Fairly good | Medium-hard, fibrous samples |
| Zirconium oxide | ZrO ₂ | < 5.9 | Very good | Fibrous, abrasive samples |
| Stainless steel | Fe – Cr – Ni | 7.8 | Fairly good | Medium-hard, brittle samples |
| Hardened steel | Fe – Cr | 7.9 | Good | Hard, brittle samples |
| Hardmetal tungsten carbide | WC | 14.95 | Very good | Hard, abrasive samples |

* At www.fritsch.de, you can find the corresponding element analyses with detailed information about the materials.

¹⁾ Grinding sets made of agate and sintered corundum are not suitable for cryogenic grinding.

EXCELLENT GRINDING RESULTS WITH FRITSCH BALL MILLS**ENVIRONMENTAL ROHS – MOBILE PHONES ARE REDUCED TO DUST**

For comminution of individual electronic components, such as mobile phones for RoHS analysis, the FRITSCH Vibratory Micro Mill PULVERISETTE 0 delivers very good results – depending on the sample characteristics at room temperature or with cryogenic grinding after embrittlement with liquid nitrogen in the practical FRITSCH cryo-box.



Mobile phone keypad: Grinding results after embrittlement under freezing conditions

PHARMACEUTICALS – BONE PREPARATION FOR RESEARCH

For comminution of bones, e.g. for XRF analysis for medication development, we recommend the Vibratory Micro Mill PULVERISETTE 0 with mortar and grinding ball made of zirconium oxide or steel. The special advantage: Gentle sample preparation without development of heat or thermal loads.



Bone material before and after grinding with the FRITSCH PULVERISETTE 0

ANALYSIS – DRUG TESTS THROUGH HAIR ANALYSIS

For fast and simple preparation of hair samples for analysis for drug traces, roughly 300-500 mg of hair can be ground to a fine powder (< 100 µm) in just 5 minutes in the FRITSCH Mini-Mill PULVERISETTE 23 using a 15 mm steel ball in a 15 ml steel bowl.



Hair sample before and after grinding with the FRITSCH PULVERISETTE 23

PLASTICS/TEXTILES – FIBRE ANALYSIS WITH KBR TECHNOLOGY

For fibre analysis with infrared spectroscopy, the PULVERISETTE 23 provides the ideal preparation of the sample for creation of homogeneous pellets of potassium bromide (KBr). With addition of 20 mg of KBr, the fibre sample is ground to a homogeneous powder in 3 minutes. With an additional 250 mg of KBr that was ground for 90 seconds to a fine consistency in the PULVERISETTE 23, the ground sample is then ground further and homogenised in only 30 seconds.



KBr pellets for analysis of fibre samples

ORDERING DATA

Order no. Article

MINI-MILL PULVERISETTE 23

PULVERISETTE 23



23.1000.00 **Instrument without grinding bowl and balls**
for 100-240 V/1~, 50-60 Hz

Grinding bowl 15 ml volume
23.1427.00 Zirconium oxide
23.1410.00 Stainless steel
23.1409.00 Tempered steel

Grinding bowl 10 ml volume
23.1327.00 Zirconium oxide
23.1310.00 Stainless steel
23.1309.00 Tempered steel

Grinding bowl 5 ml volume
23.1600.00 PTFE

Grinding balls 15 mm diameter
55.0150.27 Zirconium oxide
55.0150.10 Stainless steel
55.0150.09 Tempered steel

Grinding balls 10 mm diameter
55.0100.27 Zirconium oxide
55.0100.10 Stainless steel
55.0100.09 Tempered steel

Grinding balls 5 mm diameter
55.0050.27 Zirconium oxide
55.0050.10 Stainless steel
55.0050.09 Tempered steel

Smaller grinding balls (0.1 - 3 mm Ø) are also available!

Order no. Article

VIBRATORY MICRO MILL PULVERISETTE 0

PULVERISETTE 0



00.6020.00 **Instrument incl. grinding head, without mortar and grinding ball**
for 100-240 V/1~, 50-60 Hz

Mortars
40.0150.05 Agate
40.0140.06 Sintered corundum (99.7 % Al₂O₃)
40.0220.27 Zirconium oxide
40.0130.10 Stainless steel
40.0120.09 Tempered steel
40.0110.08 Hardmetal tungsten carbide

Grinding balls
40.0170.05 Agate 50 mm diameter, polished
40.0210.05 Agate 70 mm diameter, polished
40.0170.06 Sintered corundum (99.7 % Al₂O₃) 50 mm diameter
40.0230.27 Zirconium oxide 50 mm diameter
40.0180.10 Stainless steel 50 mm diameter
40.0190.09 Tempered steel 50 mm diameter
40.0200.08 Hardmetal tungsten carbide 50 mm diameter

Further accessories
00.2000.00 Cryo-box (device for grinding in liquid nitrogen)
00.0130.17 Sound absorption hood plexiglas

Accessories for dry and wet sieving
Vibratory Sieve Shaker ANALYSETTE 3 SPARTAN

Ask for a detailed brochure! Or have a look at www.fritsch.de/sieveshakers



Grinding reports online!

At www.fritsch.de/solutions, you will find a comprehensive database of grinding reports for various materials and industries. It's worth to take a look!



Alternatively, send us your sample for a free grinding trial. We will then submit you a fully documented grinding report identifying the mill, which is the right one for you.

Do you have questions?
We would be happy to assist you!

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