Planetary Mills · classic line

IDEAL FOR
- GEOLOGY AND MINERALOGY
- MATERIAL RESEARCH/MECHANICAL ALLOYING
- CERAMICS
- CHEMISTRY
- BIOLOGY
- PHARMACEUTICALS
- METALLURGY
- SAMPLE PREPARATION FOR ANALYSIS

Planetary Mills
classic line

PLANETARY MILLS
THE LABORATORY STANDARD

ADVANTAGES TO YOU OF THE FRITSCH CLASSIC LINE AT A GLANCE:

• Fast grinding to below 1 µm
• Up to 800 rpm
• Safe clamping of the bowls with the Safe-Lock-System
• Simple, ergonomic handling and easy cleaning
• Grinding bowls and balls in 8 different materials to suit all needs and avoidance of contamination through abrasion

QUALITY MADE IN GERMANY

FRITSCH is more than just a brand: It is backed by a strong, medium-sized, family business in its fourth generation, which has been firmly embedded in the region since 1920 and globally active for decades. All FRITSCH-products are produced according to strict quality criteria, and our entire production is in-house. The innovative ideas of our development department are inspired by the close relationship with our customers and their practical work in the lab. Satisfied customers worldwide count on our quality, our experience and our service. This makes us proud and motivates us.

FRITSCH. ONE STEP AHEAD.
Worldwide standard

Worldwide, FRITSCH Planetary Mills of the **classic line** are the laboratory standard for the widest range of applications. The name PULVERISETTE is synonymous with fast, loss-free fine grinding of samples, operator friendly, consistent reproducibility and long, reliable service life even under continuous, heavy duty usage.

All **classic line** Planetary Mills are characterised by particularly easy, ergonomic operation, offer fast and easy cleaning and guarantee safe clamping of the bowls.

Depending on the fineness required, the grinding can be performed dry, in suspension or in inert gas. In addition to comminution, you can also use the Planetary Mills of the FRITSCH classic line for mixing and homogenising of emulsions and pastes or for mechanical alloying and activation in material research.

Select with confidence the right option for your special needs from the unique FRITSCH **classic line-range of Planetary Ball Mills**!

---

**Planetary Ball Mills – high-performance all-rounders in routine laboratory work**

In Planetary Ball Mills, the comminution of the sample material takes place primarily through the high-energy impact of grinding balls. To achieve this, the grinding bowl, containing the material to be ground and grinding balls, rotates around its own axis on a main disk rotating in the opposite direction. The overlapping of the centrifugal forces cause the sample material and grinding balls to bounce off the inner wall of the grinding bowl. The grinding balls cross the bowl diagonally at an extremely high speed and grind the sample material on the opposite wall of the bowl. The grinding bowls reach approximately twice the speed of the main disk during this process.

Specific application examples and a table with grinding results can be found at [www.fritsch.de/solution](http://www.fritsch.de/solution).
## Planetary Mill PULVERISETTE 5 classic line

**Fast and fine**

<table>
<thead>
<tr>
<th>4 working stations</th>
<th>2 working stations</th>
</tr>
</thead>
</table>

### Working principle
- Impact force
- Impact force

### Impact force

<table>
<thead>
<tr>
<th>Impact force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact force</td>
</tr>
</tbody>
</table>

### Number of working stations
- 4
- 2

### Grinding bowl sizes
- 80, 250, 500 ml
- 80, 250, 500 ml

### Grinding ball diameter
- 0.1 – 40 mm
- 0.1 – 40 mm

### Max. feed size (depending on the material)
- 10 mm
- 10 mm

### Min. sample quantity
- 10 ml
- 10 ml

### Max. sample quantity
- 900 ml
- 450 ml

### Final fineness (depending on the material)
- < 1 µm
- < 1 µm

### Typical grinding time down to analytical fineness
- 4 min
- 4 min

### Grinding process
- Dry/wet
- Dry/wet

### Grinding in inert gas
- Yes
- Yes

### Gas pressure and temperature measurement
- Yes
- Yes

### Rotational speed of main disk
- 50–400 rpm
- 50–400 rpm

### Transmission ratio planetary disk/grinding bowl
- \( i_{\text{relative}} = 1 : -2.19 \)
- \( i_{\text{relative}} = 1 : -2.19 \)

### Effective diameter of main disk
- ~ 250 mm
- ~ 250 mm

### Centrifugal acceleration (\( g = 9.81 \text{ m/s}^2 \))
- 22 g
- 22 g

### Interfaces
- Yes
- Yes

### Electrical details
- 200–240 V/1~, 50-60 Hz, 1730 watt
- 100–120 V/1~, 50-60 Hz, 1470 watt
- 200–240 V/1~, 50-60 Hz, 1730 watt
- 100–120 V/1~, 50-60 Hz, 1470 watt
- 100–120/200–240 V/1~, 50-60 Hz, 740 watt
- 200–480 V/3~, 50–60 Hz, 6000 watt

### Weight
- Net: 120 kg, gross: 155 kg
- Net: 100 kg, gross: 135 kg

### Dimensions w x d x h
- Bench top instrument: 58 x 67 x 57 cm
- Bench top instrument: 58 x 67 x 57 cm

### Packing details
- Pallet case: 100 x 72 x 83 cm
- Pallet case: 100 x 72 x 83 cm
<table>
<thead>
<tr>
<th>Planetary Mono Mill</th>
<th>Planetary Micro Mill</th>
<th>Vario-Planetary Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PULVERISETTE 6 classic line</strong></td>
<td><strong>PULVERISETTE 7 classic line</strong></td>
<td><strong>PULVERISETTE 4 classic line</strong></td>
</tr>
<tr>
<td>High performance in minimum space</td>
<td>Ideal for the smallest quantities</td>
<td>Unique a variable transmission ratio</td>
</tr>
</tbody>
</table>

**Impact force**

<table>
<thead>
<tr>
<th> </th>
<th> </th>
<th> </th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>80, 250, 500 ml</td>
<td>12, 45 ml</td>
<td>12, 45, 80, 250, 500 ml</td>
</tr>
<tr>
<td>0.1–40 mm</td>
<td>0.1–15 mm</td>
<td>0.1–40 mm</td>
</tr>
<tr>
<td>10 mm</td>
<td>5 mm</td>
<td>10 mm</td>
</tr>
<tr>
<td>10 ml</td>
<td>0.5 ml</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>225 ml</td>
<td>40 ml</td>
<td>450 ml</td>
</tr>
<tr>
<td>&lt; 1 µm</td>
<td>&lt; 1 µm</td>
<td>&lt; 1 µm</td>
</tr>
<tr>
<td>4 min</td>
<td>3 min</td>
<td>4 min</td>
</tr>
<tr>
<td>Dry/wet</td>
<td>Dry/wet</td>
<td>Dry/wet</td>
</tr>
<tr>
<td>Yes</td>
<td>Only possible in glove box</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>100–650 rpm</td>
<td>100–800 rpm</td>
<td>0–400 rpm</td>
</tr>
<tr>
<td>$i_{relative} = 1 : -1.82$</td>
<td>$i_{relative} = 1 : -2$</td>
<td>Variable</td>
</tr>
<tr>
<td>121.6 mm</td>
<td>140 mm</td>
<td>~ 250 mm</td>
</tr>
<tr>
<td>29 g</td>
<td>50 g</td>
<td>22 g</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>100–120/200–240 V/1~, 50–60 Hz, 1000 watt</td>
<td>100–120/200–240 V/1~, 50–60 Hz, 740 watt</td>
<td>200–480 V/3~, 50–60 Hz, 6000 watt</td>
</tr>
<tr>
<td>Bench top instrument: 37 x 53 x 50 cm</td>
<td>Bench top instrument: 37 x 53 x 50 cm</td>
<td>Floor instrument: 60 x 80 x 110 cm</td>
</tr>
<tr>
<td>Wooden case: 68 x 54 x 72 cm</td>
<td>Wooden case: 68 x 54 x 72 cm</td>
<td>Wooden case: 85 x 85 x 155 cm</td>
</tr>
</tbody>
</table>

**Free FRITSCH-sample grinding!**

Send us your samples – we will advise you which mill is the right one for you. Or take a look in the practical grinding report database by logging on www.fritsch.de/grinding-reports.
**The FRITSCH Planetary Mill**

- Fast comminution of laboratory samples with up to 400 rpm
- Adjustable timer accurate to one second
- Suitable for grinding hard to soft materials, including in suspensions
- Perfect for homogenising of emulsions and pastes
- 4 or 2 working stations
- Simultaneous processing of up to 8 samples
- Useful capacity up to 4 x 225 ml
- Bowl sizes 80 ml, 250 ml, 500 ml volume

**Fast and fine**

The ideal Planetary Mill: Quick and reliable thanks to the particularly high-energy effect of the grinding balls, the PULVERISSETTE 5 classic line delivers loss-free grinding results down to colloidal fineness of dry laboratory samples or solids in suspension and even mixes and homogenises emulsions and pastes. The fixed transmission ratio, rotational speed regulation and precision quartz timing ensure exactly reproducible grinding conditions.
FACTS AND ADVANTAGES

- Toothed belt drive for bowls provides constant transmission ratio
- Rotational speed regulated by microprocessor and digital display of the actual rotational speed of the main disk
- Programmable grinding and pause times and grinding sequences – for short-time operation adjustable down to the second
- Smaller grinding bowls also possible with an adapter
- RS232 interface for transmission of process parameters (validation)
- Reversing function
- Overload protection with automatic rotational speed adjustment and display
- Maintenance-free drive due to electronically regulated rotary current motor (1.5 kW) with frequency converter and permanently lubricated bearings
- Grinding chamber hood safety lock with stoppage monitoring
- Membrane keyboard and robust housing of impact-resistant plastic
- Grinding chamber with forced air ventilation
- Gas pressured springs for easy opening of the cover
- Energy-save-function (electricity-saving mode)
- 2-year guarantee

TECHNICAL DATA

**Electrical details**
- 200-240 V/1~, 50-60 Hz, 1730 Watt
- 100-120 V/1~, 50-60 Hz, 1470 Watt

**Weight**
- 4 working stations: 120 kg
- 2 working stations: 100 kg

**Gross**
- 155 kg
- 135 kg

**Dimensions w x d x h**
- Bench top instrument: 58 x 67 x 57 cm
- Pallet case: 100 x 72 x 83 cm

**Emissions value of workplace according to DIN EN ISO 3746:2005**
- Up to approx. 83 dB(A) (depending on the material to be ground, grinding bowls/balls, selected rotational speed)

**Order no. for**
- 4 working stations: 200-240 V/1~ 05.5020.00
- 100-120 V/1~ 05.5010.00
- 2 working stations: 200-240 V/1~ 05.6020.00
- 100-120 V/1~ 05.6010.00

APPLICATION EXAMPLES

- **Geology and mineralogy**
  - Rock, gravel, sand, minerals

- **Ceramics**
  - Porcelain, sintered ceramics, clay, fireclay

- **Chemistry**
  - Pesticides, fertilisers, salts, inorganic and organic materials

- **Biology**
  - Plants, leaves, freeze-dried samples

- **Pharmaceuticals**
  - Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets

- **Metallurgy**
  - Ores, sinters

- **Material research/ Mechanical alloying**
  - Pigments, precious materials, new materials, alloys, mechanical alloying and activation

- **Analysis preparation**
  - Spectroscopy, X-ray fluorescence, X-ray structure analysis, chromatography
High performance in minimum space

The PULVERISETTE 6 classic line is a high-performance Planetary Ball Mill with a single grinding bowl mount and practical, easily adjustable imbalance compensation. Your advantage: Particularly easy use and high-energy effect up to 650 rpm. This ensures a constantly high grinding performance with extremely low space requirements for loss-free grinding results even in suspension.

The electronic timer adjustable to one second and the programmable, automated reversing feature ensure precise, consistent reproducibility and grinding of even the smallest samples. At the same time, the PULVERISETTE 6 classic line is ideally suited for mechanical alloying or for mixing and perfect homogenising of emulsions and pastes.
FACTS AND ADVANTAGES

- Large rotational speed range with accurate display
- Grinding chamber completely encapsulated but easy to open
- Cooling of the grinding chamber with a built-in fan for long grinding times
- Exactly reproducible grinding results thanks to a regulated drive, precise transmission ratio (toothed belt), programmable microprocessor control electronics
- Programmable interval and pause times
- Smaller grinding bowls also possible with an adapter
- RS232 interface for outputting process data (validation)
- Monitoring of the grinding parameters even when grinding chamber is open through an ergonomically positioned and always visible, splash-proof IP65 membrane keyboard
- Easy cleaning of the grinding elements
- Recyclable plastic housing
- Extensive range of accessories
- Energy-save-function (electricity-saving mode)
- Mains voltage (100-120/200-240 V) configurable at the instrument
- 2-year guarantee

APPLICATION EXAMPLES

- Geology and mineralogy: Rock, gravel, sand, minerals
- Ceramics: Porcelain, sintered ceramics, clay, fireclay
- Chemistry: Pesticides, fertilisers, salts, inorganic and organic materials
- Biology: Plants, leaves, freeze-dried samples
- Pharmaceuticals: Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets
- Metallurgy: Ores, sinters
- Material research/ Mechanical alloying: Pigments, precious materials, new materials, alloys, mechanical alloying and activation
- Analysis preparation: Spectroscopy, X-ray fluorescence, X-ray structure analysis, chromatography

TECHNICAL DATA

Electrical details
100-120/200-240 V/1~, 50-60 Hz, 1000 watt
Weight
Net 63 kg
Gross 83 kg
Dimensions w x d x h
Bench top instrument: 37 x 53 x 50 cm
Packaging w x d x h
Wooden case: 68 x 54 x 72 cm
Emissions value of workplace according to DIN EN ISO 3746:2005
Up to approx. 85 dB(A)
(depending on the material to be ground, grinding bowls/balls, selected rotational speed)
Order no.
06.2000.00
Ideal for smallest quantities

The PULVERISETTE 7 classic line is ideally suited to fast, uniform, and extremely fine comminution of very small samples down to colloidal fineness or for mixing and perfect homogenisation of emulsions or pastes.

The special microprocessor control with up to 99 programmable repetitions of the grinding cycle ensures exceptionally fast, precise, reproducible results. A mill that combines particularly high grinding performance with low bench space requirements!
Application Examples

- Geology and mineralogy: Rock, gravel, sand, minerals
- Ceramics: Porcelain, sintered ceramics, clay, fireclay
- Chemistry: Pesticides, fertilisers, salts, inorganic and organic materials
- Biology: Plants, leaves, freeze-dried samples
- Pharmaceuticals: Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets
- Metallurgy: Ores, sinters
- Material research/Mechanical alloying: Pigments, precious materials, new materials, alloys, mechanical alloying and activation
- Analysis preparation: Spectroscopy, X-ray fluorescence, X-ray structure analysis, chromatography

**FACTS AND ADVANTAGES**

- Large rotational speed range
- Grinding chamber completely encapsulated but easy to open
- Cooling of the grinding chamber with a built-in fan for long grinding times
- Programmable microprocessor control
- Precise rotational speed regulation with display of set/actual values
- Programme-timer for grinding operation and cooling phases
- Reversing function
- Energy-save-function (electricity-saving mode)
- RS232 interface for output of process data and programming of grinding cycles
- Ergonomic IP64 membrane keyboard
- Maintenance-free drive with asynchronous motor and frequency converter
- Mains voltage (100-120/200-240 V) configurable on the instrument
- Recyclable plastic housing
- 2-year guarantee
**PULVERISETTE 4 classic line**

**THE FRITSCH VARIO-PLANETARY MILL**

- Flexible configurable grinding conditions: impact and/or friction
- Rotational speed up to 400 rpm
- Ideal for mechanical alloying and activation
- Simultaneous processing of up to 4 samples
- Specially suited for material research and development applications
- Ultimate fineness down to 0.1 µm
- Useful capacity of 2 x 0.5 ml to 2 x 225 ml
- Bowl sizes 12 ml, 45 ml, 80 ml, 250 ml and 500 ml capacity

**Unique: with variable transmission ratio**

In contrast to conventional Planetary Mills, the rotational speed of the grinding bowls and main disk can be configured separately in the PULVERISETTE 4 classic line. Your advantage: A single mill for mechanical activation and alloying providing optimum grinding conditions suited to the respective sample material and the size of the grinding bowls and balls! For results that cannot be achieved with other Ball Mills.

The mill is controlled by integral software, in which up to 9 programmes can be saved and then loaded quickly and easily via the mill display.

**How the variable PULVERISETTE 4 classic line functions**

You can directly influence the movement and paths of the grinding balls by varying the transmission ratio between the grinding bowls and main disk: Depending on the setting, you can obtain high impact energy or high friction, according to your needs, or have your PULVERISETTE 4 classic line operate as a Centrifugal Mill. You are free to choose all intermediate levels and combinations between friction-based and impact-based comminution. This makes the mill uniquely versatile.
Material research/
Mechanical alloying

Pigments, precious materials, new materials, alloys, mechanical alloying and activation

Geology and mineralogy

Rock, gravel, sand, minerals

Ceramics

Porcelain, sintered ceramics, clay, fireclay

Chemistry

Insecticides, fertilisers, salts, inorganic and organic materials

Biology

Plants, leaves, freeze-dried samples

Pharmaceuticals

Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets

Metallurgy

Ores, Sinters

Analysis preparation

Spectroscopy, X-ray fluorescence, X-ray structure analysis, chromatography

FACTS AND ADVANTAGES

- Free programming of the grinding parameters, incl. grinding and pause times and grinding cycles through PC software
- Real-time display of the rotational speed for monitoring of the grinding process
- WINDOWS™ control and evaluation programme
- Reversing function
- Forced air ventilation of the grinding chamber
- Safety interlock of the grinding chamber with standstill monitoring
- Overload protection through rotational speed adjustment
- Maintenance-free drive
- Fault free long service life due to high-performance belt drives and permanently lubricated bearings
- Robust steel housing, service-friendly design
- Membrane keyboard
- 2-year guarantee

APPLICATION EXAMPLES

TECHNICAL DATA

Electrical details

- 380-480 V/3~, 50-60 Hz, 6000 watt
- 200-240 V/3~, 50-60 Hz, 6000 watt

Weight

- Net 320 kg
- Gross 380 kg

Dimensions w x d x h

- Floor instrument: 60 x 80 x 110 cm
- Wooden case: 85 x 85 x 155 cm

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

Up to approx. 81 dB(A)

Order no.

- 380-480 V/3~: 04.1030.00
- 200-240 V/3~: 04.1020.00

The PULVERISETTE 4 grinding in inert gas
This Gas Pressure and Temperature Measuring System developed in cooperation with the Fraunhofer Institute for Applied Material Research (IFAM) in Dresden, is for use with the Planetary Mills PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 of the FRITSCH classic line transform them into analytical measurement systems. Through the continuous direct measurement of gas pressure and temperature, it is possible to monitor thermal effects as well as physical and chemical reactions or pressure variations within the grinding bowl. To achieve this, the grinding bowl is simply used with a radio transmitter located in the lid, without any modification to the mill itself. The monitored data is passed by a receiver to a computer running a special WINDOWS™ programme and allows for graphical presentation of the measurement values and collating them in an Excel™ table.

- For use with PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6
- Data evaluation via PC
- Range of pressure build up to 15 m
- Operating time with fully charged battery approx. 80 h
- Adaptation of the measurement rate to the signal dynamic for maximum possible battery life
- Sleep mode of the radio transmitter with consistent measurement signals
Your advantages with GTM

The GTM-System can be used wherever batch quantities are ground in a totally enclosed container. Special grinding bowls made of stainless steel in capacities 250 ml and 500 ml are available.

The GTM-System provides valuable information
- Investigations in the area of mechanical alloying for the production of new amorphous and nano-crystalline materials
- Monitoring and optimisation of grinding processes in industrial applications

Through measurement of the grinding bowl temperature, it is possible to make an integral statement on temperature as a process variable that takes account of the effects of all friction, impact and transformation processes. The continuous and highly sensitive measurement of the gas pressure in the grinding bowl allows the detection of very rapid reactions. The measured gas pressure describes, amongst other things, the interactions of the gas with the surfaces created during grinding (adsorption and desorption of gases).

Extremely rapid phase formations can for the first time be observed IN SITU as an adiabatic process without heat exchange from the system.

Adjustment of the grinding parameters rotational speed, balls/sample material ratio and grinding time can be performed first time without expensive, time-consuming and abortive trials.

Due to precise measurement of reaction times, for example, new materials can be prepared through specific addition of reaction partners, or produced with special mechano-chemical properties.

### TECHNICAL DATA

- System requirements: Standard WINDOWS™-PC
- UHF radio transmitter, 10 mW, no approval or fees necessary
- Up to two transmitter components can be operated simultaneously in the mill
- Measurement rate for single and dual transmission operation of up to approx. 200 measurement value/s
- Pressure measurement range 0 to 800 kPa (8 bar)
- Temperature measurement range of the transmitter component 10 to 70 °C
- Resolution of pressure signal: < 0.024 kPa
- Resolution of temperature signal: 0.025 K
- Permissible transient (-2 s) heat of reaction 30 kJ
- Receiver component also functions as charging station for the batteries of the transmitter component
- Range of pressure up to 15 m
- RS232 connection to PC
- 250 ml or 500 ml bowls made of stainless steel
GRINDING BOWLS AND GRINDING BALLS classic line

All grinding bowls classic line and the corresponding balls are available in 7 different materials to directly prevent contamination of the sample as a result of undesired abrasion. In normal cases, grinding bowls and balls of the same material are used. You can select different grinding ball sizes in order to adapt the grinding to your specific application. Our tip: To shorten the grinding time, grinding bowls and balls with a higher density and correspondingly higher impact energy can be used.

Gassing lid
Through the use of a special lid on the grinding bowl, you can also grind your samples in inert atmospheres. Two valves allow for easy and safe filling of the bowls with inert gas while they are firmly clamped in the mill. A special Additional Lock-System is required for gas-tight removal and transportation (see below).

Additional lock-system
With this special Additional Lock-System, you can gas-tight seal your grinding bowls for transport between filling in the glove box and the mill. With an additional adapter, it can also be used for small grinding bowls.

Please note: The material of the grinding elements must always be harder than the material to be ground.
# Technical Data

## Material data for grinding bowls/grinding balls

<table>
<thead>
<tr>
<th>Material</th>
<th>Main component of the material*</th>
<th>Density g/cm³</th>
<th>Abrasion resistance</th>
<th>Use for sample material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agate</td>
<td>SiO₂</td>
<td>2.65</td>
<td>Good</td>
<td>Soft to medium-hard samples</td>
</tr>
<tr>
<td>Sintered corundum</td>
<td>Al₂O₃</td>
<td>3.8</td>
<td>Fairly good</td>
<td>Medium-hard, fibrous samples</td>
</tr>
<tr>
<td>Silicon nitride</td>
<td>Si₃N₄</td>
<td>3.25</td>
<td>Excellent</td>
<td>Abrasive samples, metal-free grinding</td>
</tr>
<tr>
<td>Zirconium oxide</td>
<td>ZrO₂</td>
<td>5.7</td>
<td>Very good</td>
<td>Fibrous, abrasive samples</td>
</tr>
<tr>
<td>Hardened, stainless steel</td>
<td>Fe – Cr</td>
<td>7.65</td>
<td>Good</td>
<td>Hard, medium-hard, brittle samples</td>
</tr>
<tr>
<td>Hardmetal tungsten carbide</td>
<td>WC</td>
<td>14.95</td>
<td>Very good</td>
<td>Hard, abrasive samples</td>
</tr>
<tr>
<td>Polypropylene disposable bowl (only for PULVERISETTE 7 classic line)</td>
<td></td>
<td>0.9</td>
<td></td>
<td>For homogenisation</td>
</tr>
</tbody>
</table>

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

## Recommended Bowl Filling

### I. Grinding balls ≥ 5 mm: Recommended number of balls per grinding bowl

<table>
<thead>
<tr>
<th>Grinding Bowl / Useful capacity (sample volume)</th>
<th>12 ml</th>
<th>45 ml</th>
<th>80 ml</th>
<th>250 ml</th>
<th>500 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balls diameter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 mm</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>30 mm</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>20 mm</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>15 mm</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>10 mm</td>
<td>6</td>
<td>18</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>5 mm</td>
<td>50</td>
<td>180</td>
<td>250</td>
<td>1200</td>
<td>2000</td>
</tr>
</tbody>
</table>

### II. Grinding balls ≤ 3 mm: Recommended ball mass per grinding bowl in grams

<table>
<thead>
<tr>
<th>Grinding Bowl / Useful capacity (sample volume)</th>
<th>12 ml</th>
<th>45 ml</th>
<th>80 ml</th>
<th>250 ml</th>
<th>500 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zirconium oxide</td>
<td>20</td>
<td>70</td>
<td>100</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>Hardened, stainless steel</td>
<td>30</td>
<td>90</td>
<td>150</td>
<td>500</td>
<td>1100</td>
</tr>
<tr>
<td>Hardmetal tungsten carbide</td>
<td>50</td>
<td>200</td>
<td>300</td>
<td>1000</td>
<td>2100</td>
</tr>
</tbody>
</table>

Grinding balls with a diameter of 3 mm or less must be weighed out. The above table provides you with the required mass per grinding bowl.

The specified ball filling per bowl is the minimum quantity and should possibly be increased depending on the material properties. In exceptional cases, the number of grinding balls can be reduced by up to 15%. However, increased abrasion should be expected.
ORDERING DATA

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.2510.00</td>
<td>Incl. 250 ml grinding bowl made of stainless steel with special lid, transmitter and separate receiver</td>
</tr>
</tbody>
</table>

**PLANETARY MILL PULVERISETTE 5**
Instrument without grinding bowls and balls, incl. Safe-Lock clamping system

- 05.5020.00 For 200-240 V/1~, 50-60 Hz, 1730 watt
- 05.5010.00 For 100-120 V/1~, 50-60 Hz, 1470 watt

- with 4 grinding bowl fasteners
- with 2 grinding bowl fasteners

**PLANETARY MONO MILL PULVERISETTE 6**
Instrument without grinding bowls and balls, incl. Safe-Lock clamping system

06.2000.00 For 100-120/200-240 V/1~, 50-60 Hz, 1000 watt*

**PLANETARY MICRO MILL PULVERISETTE 7**
Instrument without grinding bowls and balls, incl. clamping system

07.4000.00 For 100-120/200-240 V/1~, 50-60 Hz, 740 watt*

**VARI-PLANETARY MILL PULVERISETTE 4**
Instrument without grinding bowls and balls, incl. clamping system

04.1030.00 For 380-480 V/3~, 50-60 Hz, 6000 watt
04.1020.00 For 200-240 V/3~, 50-60 Hz, 6000 watt

The PULVERISETTE 4 can only be operated on a three-phase supply network.

**GTM – GAS PRESSURE AND TEMPERATURE MEASURING SYSTEM**
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 classic line

- 50.2510.00 Incl. 250 ml grinding bowl made of stainless steel with special lid, transmitter and separate receiver
- 50.2540.00 Incl. 500 ml grinding bowl made of stainless steel with special lid, transmitter and separate receiver

If further grinding bowls and transmitters are required, please ask!

**CERTIFICATION**
for PULVERISETTE 5 classic line
96.0220.00 IQ/OQ documentation (questionnaire format – for filling out by customer)

for PULVERISETTE 6 classic line
96.0240.00 IQ/OQ documentation (questionnaire format – for filling out by customer)

**GRINDING BOWL WITH LID AND SEAL RING classic line**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.1055.00</td>
<td>Agate, with steel casing</td>
</tr>
<tr>
<td>50.1060.00</td>
<td>Sintered corundum (99.7% Al₂O₃)</td>
</tr>
<tr>
<td>50.1310.00</td>
<td>Silicon nitride, with steel casing</td>
</tr>
<tr>
<td>50.1110.00</td>
<td>Zirconium oxide</td>
</tr>
<tr>
<td>50.1090.00</td>
<td>Hardened, stainless steel</td>
</tr>
<tr>
<td>50.2661.20</td>
<td>Replacement seal ring PTFE 121/110 mm dia. for agate bowls</td>
</tr>
<tr>
<td>50.1010.20</td>
<td>Replacement seal ring PTFE 110/101 mm dia. for silicon nitride bowls</td>
</tr>
<tr>
<td>50.1230.20</td>
<td>Replacement seal ring PTFE 116/100 mm dia. for all other bowls</td>
</tr>
</tbody>
</table>

**Gassing lid 250 ml volume**
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 classic line

- 50.2055.00 Agate, with steel casing
- 50.2060.00 Sintered corundum (99.7% Al₂O₃)
- 50.2310.00 Silicon nitride, with steel casing
- 50.2110.00 Zirconium oxide
- 50.2090.00 Hardened, stainless steel
- 50.2080.00 Hardmetal tungsten carbide, with steel casing
- 50.2011.20 Replacement seal ring PTFE 85/70 mm dia. for agate bowls |
| 50.2010.20 | Replacement seal ring PTFE 85/76 mm dia. for silicon nitride bowls |
| 50.2230.20 | Replacement seal ring PTFE 90/75 mm dia. for all other bowls |

**Gassing lid 80 ml volume**
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 classic line

- 50.4055.00 Agate, with steel casing
- 50.4060.00 Sintered corundum (99.7% Al₂O₃)
- 50.4310.00 Silicon nitride
- 50.4110.00 Zirconium oxide
- 50.4090.00 Hardened, stainless steel
- 50.4080.00 Hardmetal tungsten carbide, with steel casing
- 50.2011.20 Replacement seal ring PTFE 85/70 mm dia. for agate bowls |
| 50.4230.20 | Replacement seal ring PTFE 80/65 mm dia. for all other bowls |
| 90.1120.09 | Adapter for grinding bowls 80 ml volume |

**Gassing lid 45 ml volume**
for PULVERISETTE 4 and PULVERISETTE 7 classic line

- 50.7050.00 Agate
- 50.7060.00 Sintered corundum (99.7% Al₂O₃)
- 50.7310.00 Silicon nitride
- 50.7110.00 Zirconium oxide
- 50.7090.00 Hardened, stainless steel
- 50.7080.00 Hardmetal tungsten carbide, with steel casing
- 50.7200.00 Polypropylene disposable bowl (only for PULVERISETTE 7 classic line)
- 07.3280.13 Bowl adapter for disposable bowl (only for PULVERISETTE 7 classic line)
- 50.7250.20 Replacement seal ring PTFE 50/40 mm dia. for all bowls |

**Gassing lid 12 ml volume**
for PULVERISETTE 4 and PULVERISETTE 7 classic line

- 50.5050.00 Agate
- 50.5060.00 Sintered corundum (99.7% Al₂O₃)
- 50.5310.00 Silicon nitride
- 50.5110.00 Zirconium oxide
- 50.5090.00 Hardened, stainless steel
- 50.5080.00 Hardmetal tungsten carbide
- 50.5250.20 Replacement seal ring PTFE 37/26 mm dia. for all bowls |

**ACCESSORIES FOR GRINDING IN INERT GAS AND FOR MECHANICAL ALLOYING**
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 classic line

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.8010.00</td>
<td>Agate, with steel casing</td>
</tr>
<tr>
<td>50.9150.00</td>
<td>Silicon nitride, with steel casing</td>
</tr>
<tr>
<td>50.9100.00</td>
<td>Zirconium oxide</td>
</tr>
<tr>
<td>50.8400.00</td>
<td>Hardened, stainless steel</td>
</tr>
<tr>
<td>50.8013.16</td>
<td>Replacement seal ring Viton for gassing lid for agate bowls</td>
</tr>
<tr>
<td>50.1230.16</td>
<td>Replacement seal ring Viton for gassing lid for all other bowls</td>
</tr>
</tbody>
</table>

**Gassing lid with 2 valves and seal ring for grinding bowls 500 ml**

- 50.8100.00 Agate, with steel casing
- 50.8900.00 Silicon nitride, with steel casing
- 50.8950.00 Zirconium oxide
- 50.8500.00 Hardened, stainless steel
- 50.8600.00 Hardmetal tungsten carbide, with steel casing
- 50.2011.16 Replacement seal ring Viton for gassing lid for agate bowls |
| 50.2010.16 | Replacement seal ring Viton for gassing lid for silicon nitride bowls |
| 50.2230.16 | Replacement seal ring Viton for gassing lid for all other bowls |

**Gassing lid with 2 valves and seal ring for grinding bowls 250 ml**

- 50.8100.00 Agate, with steel casing
- 50.8900.00 Silicon nitride, with steel casing
- 50.8950.00 Zirconium oxide
- 50.8500.00 Hardened, stainless steel
- 50.8600.00 Hardmetal tungsten carbide, with steel casing
- 50.2011.16 Replacement seal ring Viton for gassing lid for agate bowls |
| 50.2010.16 | Replacement seal ring Viton for gassing lid for silicon nitride bowls |
| 50.2230.16 | Replacement seal ring Viton for gassing lid for all other bowls |
Always nearby

Wherever you use your FRITSCH instruments: we are nearby. With direct contact persons for application consulting and technical service – and in Europe with the FRITSCH mobile laboratory for practical demonstrations on-site.

Grinding reports online

An extensive database of grinding reports for various materials and industries is available online at www.fritsch.de/grinding-reports. It’s worth taking a look!

Free sample grinding

Send us your sample for a free-of-charge sample grinding. We will then send you a detailed grinding report, identifying the right choice of mill for your grinding task.

Or simply give us a call – our experts will be happy to assist you.

+49 67 84 70 150
service@fritsch.de
www.fritsch.de
Fritsch GmbH
Milling and Sizing
Industriestrasse 8
55743 Idar-Oberstein
Germany
Phone +49 67 84 70 0
Fax +49 67 84 70 11
info@fritsch.de
www.fritsch.de