

**classic line · PLANETARY MILLS**



**IDEAL FOR**

GEOLOGY AND MINERALOGY  
CERAMICS  
CHEMISTRY  
BIOLOGY  
PHARMACEUTICALS  
METALLURGY  
MATERIAL TECHNOLOGY  
SAMPLE PREPARATION  
FOR ANALYSIS

**> classic line**

## 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



The FRITSCH family business is an internationally respected manufacturer of

application-orientated laboratory instruments. In 1961 FRITSCH applied for a

world wide patent for the first Laboratory Planetary Mill. In 1996 FRITSCH also

**FRITSCH. WE SET STANDARDS.**

patented the first ever Planetary Mill with only one working station (Mono Mill).

Since then FRITSCH Planetary Mills have become the standard in industry and

research laboratories worldwide.





PULVERISETTE 6

## 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.

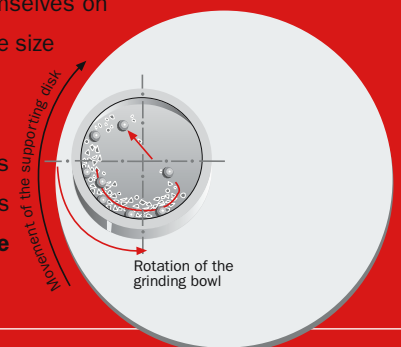
Depending on the fineness required, the grinding can be performed dry, in suspension or in inert gas. In addition to comminution, you can also use the Planetary Mills of the FRITSCH *classic line* for mixing and homogenising of emulsions and pastes or for mechanical alloying and activation in material 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 material to be ground 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 whilst rotating rapidly in the opposite direction. At a certain speed, with this configuration, the centrifugal force causes the ground sample material and grinding balls to separate from the inner wall of the grinding bowl. The grinding balls then cross the bowl at high speed and further grind the sample material by impact against the opposite bowl wall. In addition impact between the balls themselves on the sample material adds to the size reduction process.

Specific application examples and a table with grinding results can be found at [www.fritsch.de](http://www.fritsch.de)



Working principle of Planetary Ball Mills

## THE PROGRAMME

Planetary Mill PULVERISETTE 5 *classic line*

Fast and fine

4 working stations



2 working stations



<b>Working principle</b>	Impact force	Impact force
<b>Number of working stations</b>	4	2
<b>Grinding bowl sizes</b>	80, 250, 500 ml	80, 250, 500 ml
<b>Grinding ball diameter</b>	0.5 – 40 mm	0.5 – 40 mm
<b>Max. feed size</b> (depending on the material)	10 mm	10 mm
<b>Min. sample quantity</b>	10 ml	10 ml
<b>Max. sample quantity</b>	900 ml	450 ml
<b>Final fineness</b>	< 1 µm	< 1 µm
<b>Typical grinding time down to analytical fineness</b>	4 min	4 min
<b>Grinding process</b>	Dry/wet	Dry/wet
<b>Grinding in inert gas</b>	Yes	Yes
<b>Gas pressure and temperature measurement</b>	Yes	Yes
<b>Rotational speed of main disk</b>	50 – 400 rpm	50 – 400 rpm
<b>Transmission ratio grinding bowl/planetary disk</b>	$i_{\text{relative}} = 1 : -2.19$	$i_{\text{relative}} = 1 : -2.19$
<b>Effective diameter of main disk</b>	~ 250 mm	~ 250 mm
<b>Centrifugal acceleration (<math>g = 9.81 \text{ m/s}^2</math>)</b>	22 g	22 g
<b>Electrical details</b>	100-120/200-240 V/1~, 50-60 Hz, 1300/1600 watt	100-120/200-240 V/1~, 50-60 Hz, 1300/1600 watt
<b>Motor shaft power in accordance with VDE 0530, EN 60034</b>	1.5 kW	1.5 kW
<b>Weight</b>	Net: 120 kg, gross: 155 kg	Net: 100 kg, gross: 135 kg
<b>Dimensions w x d x h</b>	Bench top instrument: 58 x 67 x 57 cm	Bench top instrument: 58 x 67 x 57 cm
<b>Packing details</b>	Pallet case: 100 x 72 x 83 cm	Pallet case: 100 x 72 x 83 cm

➤ **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](http://www.fritsch.de) select menu item Sample Preparation / Solutions.

<b>Planetary Mono Mill</b> <b>PULVERISETTE 6 classic line</b>	<b>Planetary Micro Mill</b> <b>PULVERISETTE 7 classic line</b>	<b>Vario-Planetary Mill</b> <b>PULVERISETTE 4 classic line</b>
<b>High performance</b> <b>in minimum space</b>	<b>Ideal for the smallest quantities</b>	<b>Unique a variable transmission ratio</b>
		

Impact force	Impact force	Impact force
1	2	2
80, 250, 500 ml	12, 45 ml	12, 45, 80, 250, 500 ml
0.5 – 40 mm	0.5 – 15 mm	0.5 – 40 mm
10 mm	5 mm	10 mm
10 ml	0.5 ml	0.5 ml
225 ml	40 ml	450 ml
< 1 µm	< 1 µm	< 1 µm
4 min	3 min	4 min
Dry/wet	Dry/wet	Dry/wet
Yes	Only possible in glove box	Yes
Yes	No	Yes
100 – 650 rpm	100 – 800 rpm	0 – 400 rpm
$i_{\text{relative}} = 1 : -1.82$	$i_{\text{relative}} = 1 : -2$	Variable
121.6 mm	140 mm	~ 250 mm
29 g	50 g	22 g
100-120/200-240 V/1~, 50-60 Hz, 1100 watt	100-120/200-240 V/1~, 50-60 Hz, 880 watt	400 V/3~, 50-60 Hz, 6000 watt
0.75 kW	0.37 kW	2.2 kW supporting disk, 2.5 kW planetary disk
Net: 63 kg, gross: 83 kg	Net: 35 kg, gross: 55 kg	Net: 320 kg, gross: 380 kg
Bench top instrument: 37 x 53 x 50 cm	Bench top instrument: 37 x 53 x 50 cm	Floor instrument: 60 x 80 x 110 cm
Wooden case: 68 x 54 x 72 cm	Wooden case: 68 x 54 x 72 cm	Wooden case: 85 x 85 x 140 cm



# PULVERISETTE 5 *classic line*

## 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



Also available: The p-5 *classic line* with 2 working stations

## FAST AND FINE

The ideal Planetary Mill: Quick and reliable thanks to the particularly high-energy effect of the grinding balls, the PULVERISETTE 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.



## TECHNICAL DATA

### Electrical details

100-120/200-240 V/1~, 50-60 Hz, 1300/1600 watt

### Motor shaft power in accordance with

VDE 0530, EN 60034

1.5 kW

### Weight with 4 working stations 2 working stations

Net 120 kg 100 kg

Gross 155 kg 135 kg

### Dimensions w x d x h

Bench top instrument: 58 x 67 x 57 cm

### Packing w x d x h

Pallet case: 100 x 72 x 83 cm

### Emissions value of workplace

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 2 working stations

05.5000.00 05.6000.00



Fast and reliable: The practical Safe-Lock-System



Saves time: Simultaneous grinding of up to 8 samples

## APPLICATION EXAMPLES

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

## FACTS AND ADVANTAGES

- Toothed belt drive for bowls provides constant transmission ratio
- Rotational speed regulated by microprocessor
- Digital display of the actual rotational speed of the supporting disk
- Programmable grinding and break 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
- 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)
- Certified safety CE
- 2-year guarantee



# PULVERISETTE 6 *classic line*

## THE FRITSCH PLANETARY MONO MILL

- Special grinding force due to a rotational speed of up to 650 rpm
- Low space requirements and ergonomic design
- Particularly easy-to-use
- Timer programming precise to  $\pm$  one second
- Suitable for grinding hard to soft materials, dry or in suspension
- Perfect mixing and homogenising of emulsions
- Simultaneous processing of up to 2 samples
- Useful capacity up to 225 ml
- Bowl sizes 80 ml, 250 ml and 500 ml volume

## 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.

Advantage to you: 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.





## TECHNICAL DATA

### Electrical details

100-120/200-240 V/1~, 50-60 Hz, 1100 watt

**Motor shaft power in accordance with VDE 0530, EN 60034**

0.75 kW

### 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

Up to approx. 85 dB(A)

*(depending on the material to be ground, grinding bowls/balls, selected rotational speed)*

### Order no.

06.2000.00



Imbalance compensation with simple mechanical adjustment



Practical: The membrane keyboard can be operated when the mill is closed



## APPLICATION EXAMPLES

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

## 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 break 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
- Certified safety CE
- 2-year guarantee



# PULVERISETTE 7 *classic line*

## THE FRITSCH PLANETARY MICRO MILL

- Rotational speed up to 800 rpm
- Fast fine grinding of small quantities
- Small footprint
- Programmable microprocessor control
- Up to 99 repetitions of the grinding cycle
- Suitable for grinding hard to soft materials, including in suspension
- Simultaneous processing of up to 2 samples
- Useful capacity up to 2 x 20 ml
- Grinding bowl sizes of 12 and 45 ml volume

## 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!



## TECHNICAL DATA

### Electrical details

100-120/200-240 V/1~, 50-60 Hz, 880 watt

**Motor shaft power in accordance with VDE 0530, EN 60034**

0.37 kW

### Weight

Net 35 kg

Gross 55 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

Up to approx. 82 dB(A)

*(depending on the material to be ground, grinding bowls/balls, selected rotational speed)*

### Order no.

07.4000.00



Unbeatably fast: **Rotational speed up to 800 rpm**



Impressive: Fast and fine grinding of smallest quantities

## APPLICATION EXAMPLES

<b>Geology and mineralogy</b>	Rock, gravel, sand, minerals
<b>Ceramics</b>	Porcelain, sintered ceramics, clay, fireclay
<b>Chemistry</b>	Pesticides, fertilisers, salts, inorganic and organic materials
<b>Biology</b>	Plants, leaves, freeze-dried samples
<b>Pharmaceuticals</b>	Ophthalmological agents, gels, creams, extracts, drugs, pastes, dragées, tablets
<b>Metallurgy</b>	Ores, sinters
<b>Material technology</b>	Pigments, precious materials, new materials, alloys, mechanical alloying and activating
<b>Analysis preparation</b>	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
- Certified safety CE
- 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 activating
- 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



Particularly versatile: The FRITSCH grinding bowl programme

## UNIQUE: WITH VARIABLE TRANSMISSION RATIO

In contrast to conventional Planetary Mills, the rotational speed of the grinding bowls and supporting disk can be configured separately in the PULVERISETTE 4 *classic line*. Advantage to you: A single mill for mechanical activating and alloying providing optimum grinding conditions suited to the respective material to be ground 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 supporting 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.



## TECHNICAL DATA

### Electrical details

400 V/3~, 50-60 Hz, 6000 watt

**Motor shaft power in accordance with VDE 0530, EN 60034**

2.2 kW supporting disk

2.5 kW planetary disk

### Weight

Net 320 kg

Gross 380 kg

### Dimensions w x d x h

Floor instrument: 60 x 80 x 110 cm

### Packaging w x d x h

Wooden case: 85 x 85 x 140 cm

### Emissions value of workplace

Up to approx. 81 dB(A)

*(depending on the material to be ground, grinding bowls/balls, selected rotational speed)*

### Order no.

04.1030.00



The PULVERISETTE 4 grinding in inert gas

## APPLICATION EXAMPLES

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



## FACTS AND ADVANTAGES

- Free programming of the grinding parameters, incl. grinding and break 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
- Certified safety CE
- 2-year guarantee



## GTM - Gas Pressure and Temperature Measuring System

- 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

**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.

## 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



## 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.

## GRINDING BOWLS AND GRINDING BALLS

To avoid the risk of contaminating the samples with abrasion from the grinding elements, we offer grinding bowls and grinding balls in 8 different materials for the FRITSCH *classic line*. In normal cases, grinding bowls and balls of the same material are used. To shorten the grinding time, balls with a higher density and correspondingly higher impact energy can be used, e.g. tungsten carbide balls in a steel bowl or zirconium oxide balls in a silicon nitride bowl.



### 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.



## TECHNICAL DATA

### Material Data for Grinding Bowls/Grinding Balls

Material	Main component of the material*	Density g/cm <sup>3</sup>	Abrasion resistance	Use for material to be ground
Agate	SiO <sub>2</sub>	2.65	Good	Soft to medium-hard samples
Sintered corundum	Al <sub>2</sub> O <sub>3</sub>	3.8	Fairly good	Medium-hard, fibrous samples
Silicon nitride	Si <sub>3</sub> N <sub>4</sub>	3.1	Excellent	Abrasive samples, iron-free grinding
Zirconium oxide	ZrO <sub>2</sub>	5.7	Very good	Fibrous, abrasive samples
Stainless steel	Fe – Cr – Ni	7.8	Fairly good	Medium-hard, brittle samples
Tempered steel	Fe – Cr	7.9	Good	Hard, brittle samples
Hardmetal tungsten carbide	WC	14.89	Very good	Hard, abrasive samples
Polypropylene disposable bowl (only for PULVERISETTE 7 classic line)		0.9		For homogenisation

\* At [www.fritsch.de](http://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

Grinding Bowl / Useful capacity (sample volume)	12 ml 0.5 – 5 ml	45 ml 3 – 20 ml	80 ml 10 – 30 ml	250 ml 30 – 125 ml	500 ml 80 – 225 ml
Balls diameter					
40 mm					4
30 mm				6	8
20 mm			5	15	25
15 mm		7	10	45	70
10 mm	6	18	25	50	100
5 mm	50	180	250	1200	2000

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

Grinding Bowl / Useful capacity (sample volume)	12 ml 0.5 – 5 ml	45 ml 3 – 20 ml	80 ml 10 – 30 ml	250 ml 30 – 125 ml	500 ml 80 – 225 ml
Material					
Zirconium oxide	20	70	100	400	800
Tempered steel	30	90	150	500	1100
Hardmetal tungsten carbide	50	200	300	1000	2100

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 quantity of grinding balls may be reduced by up to 15%; but, increased abrasion will occur. The specified number/mass of balls per bowl is the minimum quantity; depending on the material properties, it may need to be increased.

In normal cases, grinding bowls and balls of the same material are used. To shorten the grinding time, larger or heavier balls with higher density can be used, e.g.: Tungsten carbide balls in a steel bowl or zirconium oxide balls in a silicon nitride bowl.

ORDERING DATA



Order No. Article

PLANETARY MILLS classic line

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

- with 4 grinding bowl fasteners
- 05.5000.00 For 100-120/200-240 V/1~, 50-60 Hz, 1300/1600 watt\*
- with 2 grinding bowl fasteners
- 05.6000.00 For 100-120/200-240 V/1~, 50-60 Hz, 1300/1600 watt\*



**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, 1100 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, 880 watt\*



**VARIO-PLANETARY MILL PULVERISETTE 4**  
Instrument without grinding bowls and balls, incl. clamping system  
The PULVERISETTE 4 can only be operated on a three-phase supply network.

- 04.1030.00 For 400 V/3~, 50-60 Hz, 6000 watt



\* The voltage specified in the order is set.

GTM - GAS PRESSURE AND TEMPERATURE MEASURING SYSTEM

- 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!



Order No. Article

GRINDING BOWL WITH LID AND SEAL RING classic line

**Grinding bowl 500 ml volume**  
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6

- 50.1050.00 Agate
- 50.1060.00 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 50.1070.00 Sintered corundum-2 (97% Al<sub>2</sub>O<sub>3</sub>)
- 50.1310.00 Silicon nitride, with steel casing
- 50.1110.00 Zirconium oxide
- 50.1100.00 Stainless steel
- 50.1090.00 Tempered steel
- 50.1010.20 Replacement seal ring PTFE 110/101 mm diameter for silicon nitride grinding bowls
- 50.1230.20 Replacement seal ring PTFE 116/100 mm diameter for all other grinding bowls

**Grinding bowl 250 ml volume**  
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6

- 50.2055.00 Agate, with steel casing
- 50.2060.00 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 50.2070.00 Sintered corundum-2 (97% Al<sub>2</sub>O<sub>3</sub>)
- 50.2310.00 Silicon nitride, with steel casing
- 50.2110.00 Zirconium oxide
- 50.2100.00 Stainless steel
- 50.2090.00 Tempered steel
- 50.2080.00 Hardmetal tungsten carbide, with steel casing
- 50.2010.20 Replacement seal ring PTFE 85/76 mm diameter for agate and silicon nitride grinding bowls
- 50.2230.20 Replacement seal ring PTFE 90/75 mm diameter for all other grinding bowls

**Grinding bowl 80 ml volume**  
for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6

- 50.4050.00 Agate
- 50.4060.00 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 50.4310.00 Silicon nitride
- 50.4110.00 Zirconium oxide
- 50.4100.00 Stainless steel
- 50.4090.00 Tempered steel
- 50.4080.00 Hardmetal tungsten carbide, with steel casing
- 50.4230.20 Replacement seal ring PTFE 80/65 mm diameter for all grinding bowls
- 90.1120.09 Adapter (essential, when only one grinding bowl is located in the grinding bowl holder)

**Grinding bowl 45 ml volume**  
for PULVERISETTE 4 and PULVERISETTE 7

- 50.7050.00 Agate
- 50.7060.00 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 50.7310.00 Silicon nitride
- 50.7110.00 Zirconium oxide
- 50.7100.00 Stainless steel
- 50.7090.00 Tempered steel
- 50.7080.00 Hardmetal tungsten carbide
- 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 diameter for all grinding bowls

**Grinding bowl 12 ml volume**  
for PULVERISETTE 4 and PULVERISETTE 7

- 50.5050.00 Agate
- 50.5060.00 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 50.5310.00 Silicon nitride
- 50.5110.00 Zirconium oxide
- 50.5100.00 Stainless steel
- 50.5090.00 Tempered steel
- 50.5080.00 Hardmetal tungsten carbide
- 50.5250.20 Replacement seal ring PTFE 37/26 mm diameter for all grinding bowls

ACCESSORIES FOR GRINDING IN INERT GAS AND FOR MECHANICAL ALLOYING

- Gassing lid with 2 valves and seal ring for grinding bowls 500 ml**
- 50.8000.00 Agate
  - 50.8200.00 Stainless steel
  - 50.8400.00 Tempered steel
  - 50.1230.16 Replacement seal ring Viton for gassing lid

- Gassing lid with 2 valves and seal ring for grinding bowls 250 ml**
- 50.8100.00 Agate
  - 50.8300.00 Stainless steel
  - 50.8500.00 Tempered steel
  - 50.8600.00 Hardmetal tungsten carbide
  - 50.2230.16 Replacement seal ring Viton for gassing lid

- Gassing lid with 2 valves and seal ring for grinding bowls 80 ml**
- 50.8800.00 Stainless steel
  - 50.8700.00 Tempered steel
  - 50.8880.00 Hardmetal tungsten carbide
  - 50.4230.16 Replacement seal ring Viton for gassing lid

- 90.1400.00 Additional lock-system for all grinding bowls 500 ml, 250 ml, 80 ml volume (for the transport of the closed grinding bowl with gassing lid)



Order No. Article

**GRINDING BALLS (PER PIECE)**

**Grinding balls 40 mm diameter**

- 55.0400.06 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 55.0400.31 Silicon nitride
- 55.0400.27 Zirconium oxide
- 55.0400.10 Stainless steel
- 55.0400.09 Tempered steel
- 55.0400.08 Hardmetal tungsten carbide

**Grinding balls 30 mm diameter**

- 55.0300.05 Agate, polished
- 55.0300.06 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 55.0300.31 Silicon nitride
- 55.0300.27 Zirconium oxide
- 55.0300.10 Stainless steel
- 55.0300.09 Tempered steel
- 55.0300.08 Hardmetal tungsten carbide

**Grinding balls 20 mm diameter**

- 55.0200.05 Agate, polished
- 55.0200.06 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 55.0200.31 Silicon nitride
- 55.0200.27 Zirconium oxide
- 55.0200.10 Stainless steel
- 55.0200.09 Tempered steel
- 55.0200.08 Hardmetal tungsten carbide

**Grinding balls 15 mm diameter**

- 55.0150.05 Agate, polished
- 55.0150.06 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 55.0150.31 Silicon nitride
- 55.0150.27 Zirconium oxide
- 55.0150.10 Stainless steel
- 55.0150.09 Tempered steel
- 55.0150.08 Hardmetal tungsten carbide

**Grinding balls 10 mm diameter**

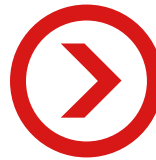
- 55.0100.05 Agate, polished
- 55.0100.06 Sintered corundum (99.7% Al<sub>2</sub>O<sub>3</sub>)
- 55.0100.31 Silicon nitride
- 55.0100.27 Zirconium oxide
- 55.0100.10 Stainless steel
- 55.0100.09 Tempered steel
- 55.0100.08 Hardmetal tungsten carbide

**Grinding balls 5 mm diameter**

- 55.0050.05 Agate, polished
- 55.0050.27 Zirconium oxide
- 55.0050.10 Stainless steel
- 55.0050.09 Tempered steel
- 55.0050.08 Hardmetal tungsten carbide

**GRINDING BALLS ≤ 3 MM IN DIAMETER (100-G PACKAGE)**

- 55.0030.27 Zirconium oxide 3 mm diameter
- 55.0020.27 Zirconium oxide 2 mm diameter
- 55.0015.27 Zirconium oxide 1.5 mm diameter
- 55.0007.27 Zirconium oxide 0.7 mm diameter
- 55.0005.27 Zirconium oxide 0.5 mm diameter
  
- 55.0030.09 Tempered steel 3 mm diameter
- 55.0010.09 Tempered steel 1 mm diameter
  
- 55.0030.08 Hardmetal tungsten carbide 3 mm diameter
- 55.0016.08 Hardmetal tungsten carbide 1.6 mm diameter
- 55.0006.08 Hardmetal tungsten carbide 0.6 mm diameter



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Fritsch GmbH

Manufacturers of Laboratory Instruments

Industriestrasse 8

55743 Idar-Oberstein

Germany

Phone +49 67 84 70 0

Fax +49 67 84 70 11

[info@fritsch.de](mailto:info@fritsch.de)

[www.fritsch.de](http://www.fritsch.de)