

pulverisette 4



Vario-Planetary Mill

- Grinding conditions infinitely variable
- Mechanical alloying and activation
- Particularly suitable for research and development

milling sample
planetary ball mill preparation
for your lab

FRITSCH

Application

Field of application

The pulverisette 4 vario-planetary mill is capable of emulating ball mills of conventional design, precisely simulating the types of stress entailed and thus reproducing or optimising grinding processes. Due to the high flexibility available for selecting the grinding parameters, it is possible to achieve results unattainable with any other ball mills.

This is the ideal mill for mechanical activation and alloying. The main applications are in the field of materials research and, of course, wherever a powerful, innovative planetary mill is required.

When particles < 10 mm are fed in, a final fineness up to 0.1 µm can be achieved. The useful capacity is between 2 x 30 ml in the case of 80 ml grinding bowls and 2 x 225 ml when 500 ml grinding bowl are used.

Examples of application

Material technology

pigments, precious material, new materials, alloys, mechanical alloying/activation

Geology and mineralogy

stones, pebbles, sand, minerals

Ceramics

porcelain, sintered ceramic, clay, fireclay

Chemistry

plant protectives, fertilisers, slats, inorganic and organic materials

Biology

plants, leaves, freeze-dried samples

Medicine, pharmacology and galenite research

eye therapeutics, jellies, crèmes, extracts, drugs, pastes, dragées, tablets

Nuclear research

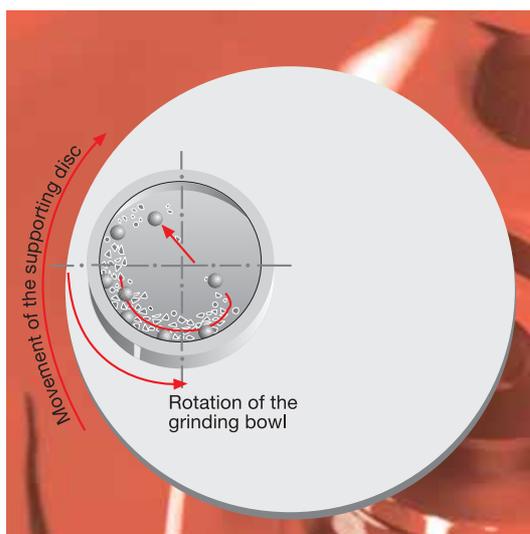
radioactive samples

Analytic preparation

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



quality control
fine grinding
Vario-Planetary Mill



working principle



pulverisette 4

Method of operation

With standard planetary ball mills the grinding bowls are rotating and mounted eccentrically on a rotating support disc. The rotational speed of the supporting disc can be selected at will; the grinding bowl rotates at a fixed transmission ratio.

Due to the overlapping of grinding bowls and supporting disc, the material to be ground and the grinding balls execute movements and trajectories in the grinding bowl whose form and effect depend on the transmission ratio. Comminution is the result of a combination of friction and impact at high energy. Planetary ball mills with a fixed transmission ratio are optimised for a single grinding process only.

But with the pulverisette 4 vario-planetary mill the rotational speeds of grinding bowls and supporting disc can be adjusted completely independently of each other. By varying the transmission ratio it is possible to control the movements and trajectories of the grinding balls at will so that the balls strike the inner wall of the bowl vertically (high impact energy), approach each other tangentially (high friction) or just roll down the inner wall of the bowl (centrifugal mills).

All intermediate levels and combinations of frictional and impact pressures can be set as required. By changing the transmission ratio it is therefore possible for the first time to carry out mechanical activation as well as mechanical alloying.

Furthermore, it is also possible for the first time to optimally adjust a planetary ball mill to the material to be ground, the size of the grinding bowls and the grinding balls.

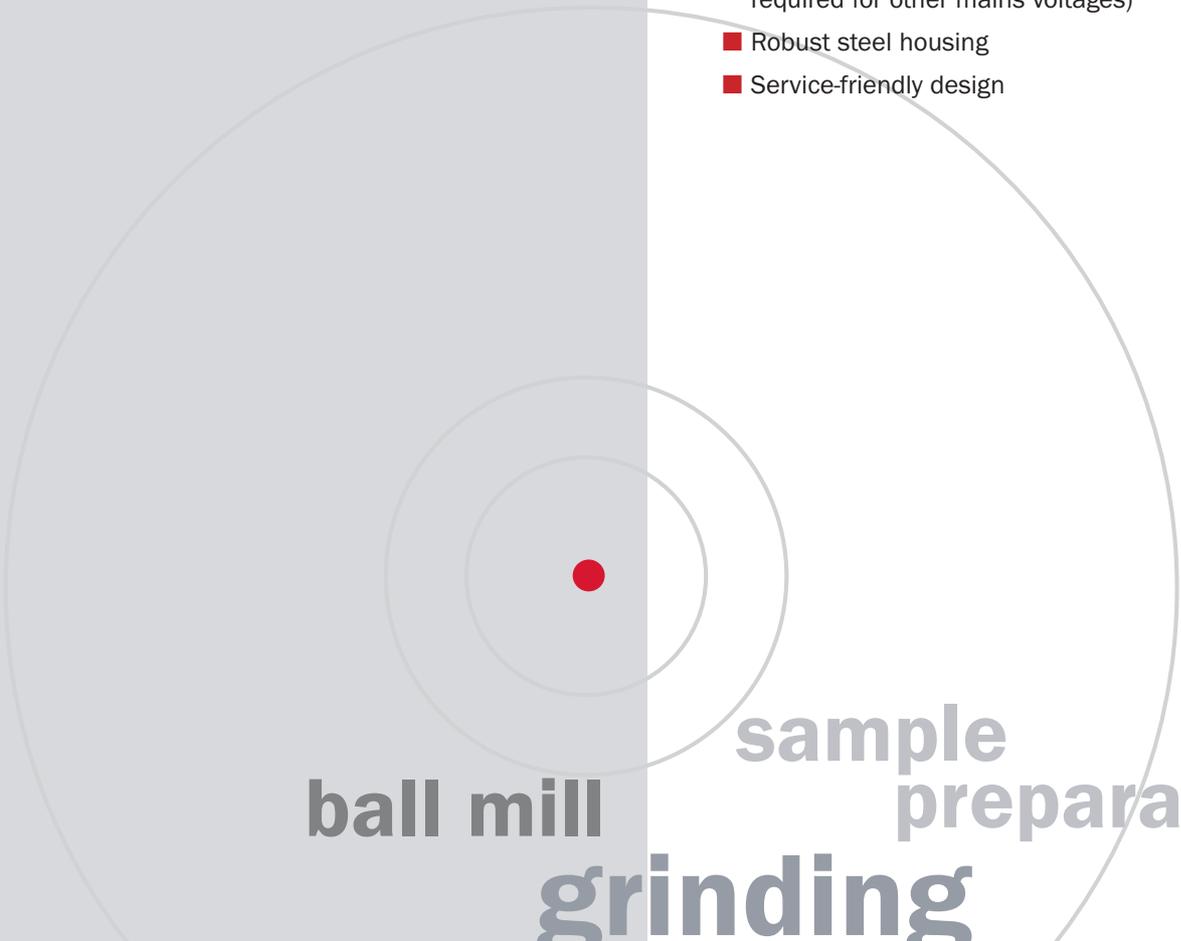
Features

Advantages

- Unique free selectable transmission ratio
- Programming of the grinding parameters by PC software as desired
- Emulation of various ball mills
- Variably adjustable pressure on sample (friction and/or impact)
- Final fineness < 1 µm
- Simultaneous grinding of up to 4 samples
- Quick, secure fastening of the grinding bowls
- Ease of cleaning
- Wide choice of accessories
- Safety tested (CE mark)
- 2 year guarantee

Design Characteristics

- Free selectable, controlled rotation speed for grinding bowls and supporting disc
- Variable transmission ratio adjustable
- RS232 interface for programming and to transfer grinding parameters to the PC (Validation) as well as for controlling the pulverisette 4
- PC-programmable grinding and break times as well as grinding cycles
- Real-time display of the speeds to monitor the grinding process
- WINDOWS™ control and evaluation programme
- Reversing option
- Forced-air-ventilated grinding chamber
- High-performance drive belts for long service life
- Safety interlock of the grinding chamber with downtime monitoring
- Overload protection through adaptation to speed of rotation
- Maintenance-free drive
- Permanently lubricated bearings
- Membrane keyboard
- Connection to 3~ 400 V mains (transformer required for other mains voltages)
- Robust steel housing
- Service-friendly design



ball mill
sample preparation
grinding



grinding bowls and balls

Accessories

Grinding bowls and balls

Grinding bowls and balls are available in 8 different materials to avoid contamination of samples due to unwanted wear of grinding elements.

An adapter makes it possible to use grinding bowls of 12, 25 and 45 ml volume.

Material	Density g/cm ³	Abrasion resistance	Material to be ground
Hard metal tungsten carbide 93.8 % WC + 6 % Co	14.95	very good	hard, abrasive samples
Tempered steel bowls: 11-12 % Cr balls: 1-1.65 % Cr	7.9	good	hard brittle samples
Stainless steel bowls: 17-19 % Cr + 8-10 % Ni balls: 12.5-14.5 % Cr + 1 % Ni	7.8	fairly good	medium-hard, brittle samples
Agate 99.9 % SiO ₂	2.65	good	soft to medium-hard samples
Silicon nitride 91 % Si ₃ N ₄	3.25	extremely good	abrasive samples, iron-free grinding
Sintered corundum 99.7 % Al ₂ O ₃	>3.9	fairly good	medium-hard, fibrous samples
Sintered corundum-2 97 % Al ₂ O ₃	3.85	fairly good	medium-hard, fibrous samples
Zirconium oxide 94.2 % ZrO ₂	5.7	very good	fibrous, abrasive samples

Recommended number of balls per grinding bowl

Grinding bowl/ useful capacity	12 ml 0.5-5 ml	45 ml 3-20 ml	80 ml 1-30 ml	250 ml 30-125 ml	500 ml 80-225ml
Balls					
5 mm	50	180	250	1200	2000
10 mm	6	18	30	50	100
15 mm		7	10	45	70
20 mm			5	15	25
30 mm				6	10
40 mm					4

The quoted number of balls per bowl is the minimum quantity; depending on the material behaviour it shall be possibly increased.

Normally grinding bowls and balls of the same material are used. To shorten the grinding time, larger or heavier balls (higher density) can be used (high grinding energy): e.g. tungsten carbide balls in the steel grinding bowl.

Smaller grinding balls (0.5 - 4 mm dia.) to archive a fineness down to the Nanometer-range are available on request!

Vario-Planetary
Mill

Special accessories

Special accessories

Grinding in an inert atmosphere

- Special lid – Using a special lid for the grinding bowl, material can also be ground in an inert atmosphere. The cover is fitted with an inlet and outlet valve with quick-action vent.
- Additional lock-system - If the grinding bowl should be filled in a glove box, the additional lock-system must be used for the transport of the filled grinding bowl.
- Special lid and additional lock-system can also be combined.

GTM - Gas pressure and temperature measuring system

This system enables the vario-planetary mill to be converted in an analytical measuring system. Continual monitoring of gas pressure and temperature enable thermal effects and physical and chemical reactions (pressure increase or decrease) to be monitored "in situ" in the grinding bowl. Without having to modify the mill itself, a grinding bowl is used with an integral radio transmitter in the lid.

A receiver transfers the data to a computer, and a WINDOWS™ program presents the measured values in graph form. In Excel™, the data is presented in tabular form.

Please ask for the detailed brochure on the gas pressure and temperature measuring system (GTM).



grinding in an inert atmosphere



pulverisette 4 with GTM-System

mechanical
activation

quality
control

pulverisette 4

Technical data

working principle	impact force
max. feed size (depending on the material)	10 mm
min. sample quantity	0.5 ml
max. sample quantity	450 ml
final fineness	< 1 µm
typical grinding time (e. g. for quartz sand up to < 40 µm)	10 min
grinding process	dry / wet
speed of the main disc	0 - 400 rpm
transmission ratio	variable
electrical details	400 V/3~, 50-60 Hz, 9000 watt
motor-shaft-power according to VDE 0530, EN 60034	4 kW supporting disc, 1.5 kW planetary disc
noise development	approx. 70 dB(A) with 250 ml bowls and 10 mm balls
weight	net: 320 kg, gross: 380 kg
dimensions w x d x h	floor instrument: 60 x 80 x 110 cm
packing details	wooden case: 85 x 85 x 140 cm

Special accessories

Order no.	Description
	Accessories for grinding in an inert atmosphere and for mechanical alloying
	Grinding bowls 500 ml volume with lid with 2 valves and seal ring
50.8000.00	agate, 500 ml volume
50.8200.00	stainless steel, 500 ml volume
50.8400.00	tempered steel, 500 ml volume
50.1230.16	replacement seal ring made of Viton for lid with 2 valves for all bowls of 500 ml volume
	Grinding bowls 250 ml volume with lid with 2 valves and seal ring
50.8100.00	agate, 250 ml volume
50.8300.00	stainless steel, 250 ml volume
50.8500.00	tempered steel, 250 ml volume
50.8600.00	hardmetal tungsten carbide, 250 ml volume
50.2230.16	replacement seal ring made of Viton for lid with 2 valves for all bowls of 250 ml volume
	Grinding bowls 80 ml volume with lid with 2 valves and seal ring
50.8800.00	stainless steel, 80 ml volume
50.8700.00	tempered steel, 80 ml volume
50.4230.16	replacement seal ring made of Viton for lid with 2 valves for all bowls of 80 ml volume
90.1400.00	additional lock-system (for the transport of the closed grinding bowl)

Ordering data

Order no.	Description
04.1030.00	Vario-Planetary Mill pulverisette 4 without grinding bowls and balls, incl. clamping system for 400 V/3~, 50-60 Hz, 9000 Watt
50.1090.00	Grinding bowls
50.1100.00	Grinding bowls 500 ml volume with lid and seal ring
50.1050.00	tempered steel
50.1310.00	stainless steel
50.1060.00	agate
50.1070.00	silicon nitride, with steel casing
50.1110.00	sintered corundum (99.7 % Al ₂ O ₃)
50.1010.20	sintered corundum-2 (97 % Al ₂ O ₃)
50.1230.20	zirconium oxide
50.1010.20	replacement seal ring PTFE 110/101 mm dia. for silicon nitride bowls of 500 ml volume
50.1230.20	replacement seal ring PTFE 116/100 mm dia. for all other bowls of 500 ml volume
50.2080.00	Grinding bowls 250 ml volume with lid and seal ring
50.2090.00	hardmetal tungsten carbide, with steel casing
50.2100.00	tempered steel
50.2055.00	stainless steel
50.2310.00	agate, with steel casing
50.2060.00	silicon nitride, with steel casing
50.2070.00	sintered corundum (99.7 % Al ₂ O ₃)
50.2110.00	sintered corundum-2 (97 % Al ₂ O ₃)
50.2010.20	zirconium oxide
50.2230.20	replacement seal ring PTFE 85/76 mm dia. for agate and silicon nitride bowls of 250 ml volume
50.2230.20	replacement seal ring PTFE 90/75 mm dia. for all other bowls of 250 ml volume
50.4080.00	Grinding bowls 80 ml volume with lid and seal ring
50.4090.00	hardmetal tungsten carbide, with steel casing
50.4100.00	tempered steel
50.4050.00	stainless steel
50.4310.00	agate
50.4060.00	silicon nitride
50.4110.00	sintered corundum (99.7 % Al ₂ O ₃)
50.4230.20	zirconium oxide
90.1120.09	replacement seal ring PTFE 80/65 mm dia. for all bowls of 80 ml volume
90.1120.09	adapter for grinding bowl of 80 ml volume (essential, if only one grinding bowl is inserted in the grinding bowl holder)
50.7080.00	Grinding bowls 45 ml volume with lid and seal ring
50.7090.00	hardmetal tungsten carbide
50.7100.00	tempered steel
50.7050.00	stainless steel
50.7310.00	agate
50.7060.00	silicon nitride
50.7110.00	sintered corundum (99.7 % Al ₂ O ₃)
50.7200.00	zirconium oxide
07.3280.13	polypropylene (disposable bowl)
50.7250.20	bowl adapter for disposable bowl
90.1120.09	replacement seal ring PTFE 50/40 mm dia. for all bowls of 45 ml volume
90.1120.09	adapter for grinding bowl of 45 ml volume to use with pulverisette 4
50.5080.00	Grinding bowls 12 ml volume with lid and seal ring
50.5090.00	hardmetal tungsten carbide
50.5100.00	tempered steel
50.5050.00	stainless steel
50.5310.00	agate
50.5060.00	silicon nitride
50.5110.00	sintered corundum (99.7 % Al ₂ O ₃)
50.5250.20	zirconium oxide
90.1120.09	replacement seal ring PTFE 37/26 mm dia. for all bowls of 12 ml volume
90.1120.09	adapter for grinding bowl of 12 ml volume to use with pulverisette 4
55.0400.08	Grinding balls
55.0400.09	Grinding balls 40 mm dia. for grinding bowls 500 ml
55.0400.10	hardmetal tungsten carbide
55.0400.31	tempered steel
55.0400.06	stainless steel
55.0400.27	silicon nitride
	sintered corundum (99.7 % Al ₂ O ₃)
	zirconium oxide
55.0300.08	Grinding balls 30 mm dia. for grinding bowls 500 ml, 250 ml
55.0300.09	hardmetal tungsten carbide
55.0300.10	tempered steel
55.0300.05	stainless steel
55.0300.31	agate, polished
55.0300.06	silicon nitride
55.0300.27	sintered corundum (99.7 % Al ₂ O ₃)
	zirconium oxide
55.0200.08	Grinding balls 20 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml
55.0200.09	hardmetal tungsten carbide
55.0200.10	tempered steel
55.0200.05	stainless steel
55.0200.31	agate, polished
55.0200.06	silicon nitride
55.0200.27	sintered corundum (99.7 % Al ₂ O ₃)
	zirconium oxide
55.0150.08	Grinding balls 15 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml
55.0150.09	hardmetal tungsten carbide
55.0150.10	tempered steel
55.0150.05	stainless steel
55.0150.31	agate, polished
55.0150.06	silicon nitride
55.0150.27	sintered corundum (99.7 % Al ₂ O ₃)
	zirconium oxide
55.0100.08	Grinding balls 10 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 12 ml
55.0100.09	hardmetal tungsten carbide
55.0100.10	tempered steel
55.0100.05	stainless steel
55.0100.31	agate, polished
55.0100.06	silicon nitride
55.0100.27	sintered corundum (99.7 % Al ₂ O ₃)
	zirconium oxide
55.0050.08	Grinding balls 5 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 12 ml
55.0050.09	hardmetal tungsten carbide (100 pieces weigh approx. 97 g)*
55.0050.10	tempered steel (100 pieces weigh approx. 52 g)*
55.0050.05	stainless steel (100 pieces weigh approx. 51 g)*
55.0050.06	agate, polished (100 pieces weigh approx. 17 g)*
55.0050.27	silicon nitride (100 pieces weigh approx. 38 g)*
	zirconium oxide (100 pieces weigh approx. 38 g)*

*due to the indication of weight, the high number of balls per grinding bowl can be weight.

