FRITSCH

Planetary Mills · classic line

IDEAL FOR

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

classic line

PLANETARY MILLS

THE LABORATORY STANDARD

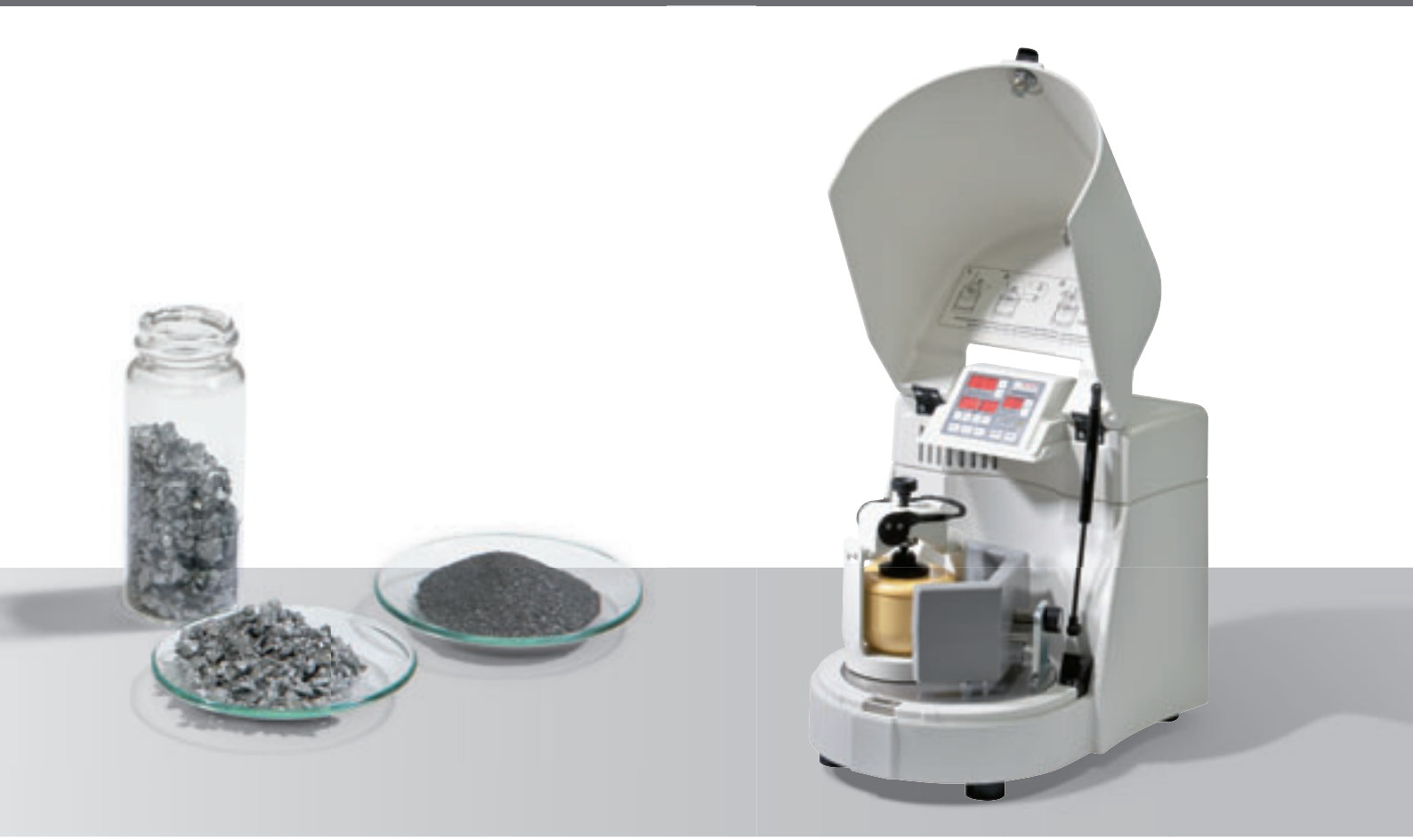
ADVANTAGES TO YOU OF THE FRITSCH *CLASSIC LINE* AT A GLANCE:

- **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.



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.

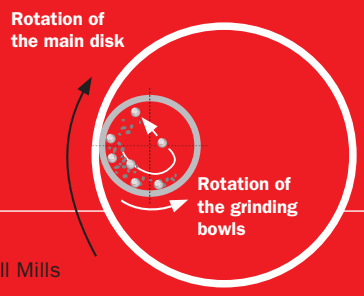
Depending on the fineness required, the grinding can be performed dry, in suspension or in inert gas. In addition to comminution, you can also use the Planetary Mills of the FRITSCH classic line for mixing and homogenising of emulsions and pastes or for mechanical alloying and activation in material 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 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 can be found at **www.fritsch-international.com/solution.**



Working principle of Planetary Ball Mills

THE PROGRAMME

Planetary Mill PULVERISETTE 5 *classic line*	
Fast and fine	
4 working stations	**2 working stations**

Working principle	Impact force	Impact force
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	$i_{relative} = 1 : -2.19$	$i_{relative} = 1 : -2.19$
Effective diameter of main disk	~ 250 mm	~ 250 mm
Centrifugal acceleration (g = 9.81 m/s²)	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
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

Individual 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-international.com/grinding-reports.

Planetary Mono Mill **PULVERISETTE 6** *classic line*	**Planetary Micro Mill** **PULVERISETTE 7** *classic line*	**Vario-Planetary Mill** **PULVERISETTE 4** *classic line*
High performance in minimum space	**Ideal for the smallest quantities**	**Unique a variable transmission ratio**
Impact force	Impact force	Impact force
1	2	2
80, 250, 500 ml	12, 45 ml	12, 45, 80, 250, 500 ml
0.1–40 mm	0.1–15 mm	0.1–40 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
$i_{relative} = 1 : -1.82$	$i_{relative} = 1 : -2$	Variable
121.6 mm	140 mm	~ 250 mm
29 g	50 g	22 g
Yes	Yes	Yes
100–120/200–240 V/1~, 50–60 Hz, 1000 watt	100–120/200-240 V/1~, 50–60 Hz, 740 watt	200–480 V/3~, 50–60 Hz, 6000 watt
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 155 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
200-240 V/1~, 50-60 Hz, 1730 Watt
100-120 V/1~, 50-60 Hz, 1470 Watt

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

Emission sound pressure level at the workplace according to DIN EN ISO 3746
Up to approx. L_{pAd} = 83 dB
(depending on the material to be ground, grinding bowls/balls, selected rotational speed)

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

Fast and reliable: The practical Safe-Lock-System

Saves time: Simultaneous grinding of up to 8 samples

IQ/OQ documentation available to support equipment qualification.

GTM compatible
INFORMATION PAGE 14/15

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

- 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 pressure springs for easy opening of the cover
- Energy-save-function (electricity-saving mode)
- 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 ± 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.
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.

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

Emission sound pressure level at the workplace according to DIN EN ISO 3746
Up to approx. L_{pAd} = 85 dB
(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

IQ/OQ documentation available to support equipment qualification.

GTM compatible
INFORMATION PAGE 14/15

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 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

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, 740 watt

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

Emission sound pressure level at the workplace according to DIN EN ISO 3746
Up to approx. L_{pAd} = 82 dB
(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

IQ/OQ documentation available to support equipment qualification.

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**

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 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.

TECHNICAL DATA

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

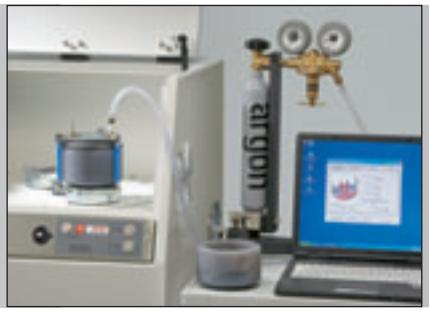
Weight
Net 320 kg
Gross 380 kg

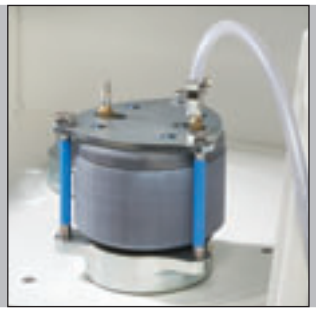
Dimensions w x d x h
Floor instrument: 60 x 80 x 110 cm

Packaging w x d x h
Wooden case: 85 x 85 x 155 cm

Emission sound pressure level at the workplace according to DIN EN ISO 3746
Up to approx. L_{pAd} = 81 dB
(depending on the material to be ground, grinding bowls/balls, selected rotational speed)

Order no.	380-480 V/3~	200-240 V/3~
	04.1030.00	04.1020.00





The PULVERISETTE 4 grinding in inert gas

APPLICATION EXAMPLES

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

GTM compatible
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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

GTM *classic line*

Gas Pressure and Temperature Measuring System

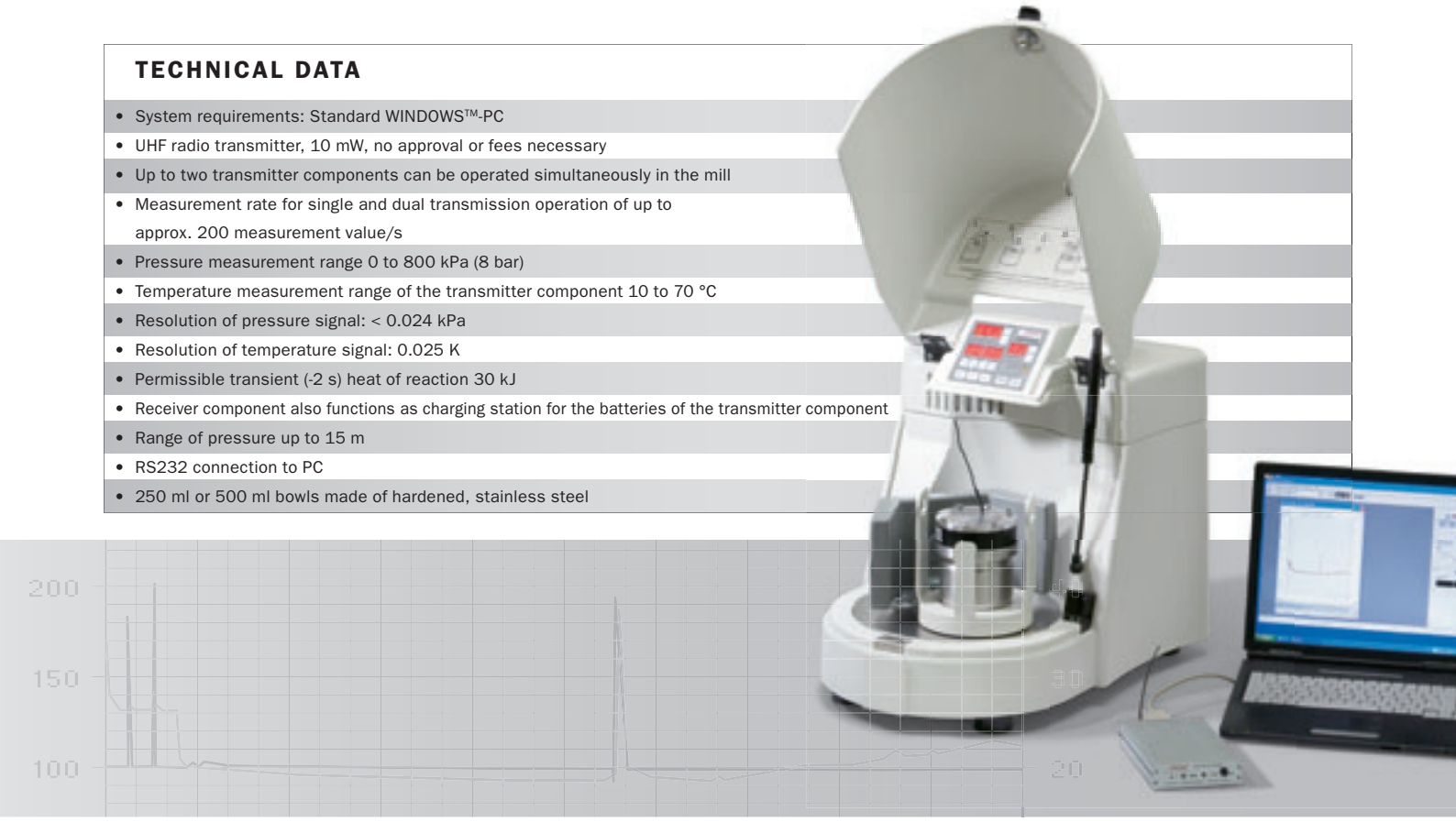
- **For use with PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6**
- **Data evaluation via PC**
- **Range of pressure build up to 15 m**
- **Operating time with fully charged battery approx. 80 h**
- **Adaptation of the measurement rate to the signal dynamic for maximum possible battery life**
- **Sleep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

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

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 seal your grinding bowls gas-tight 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/cm³	Abrasion resistance	Use for sample material
Agate	SiO_2	2.65	Good	Soft to medium-hard samples
Sintered corundum	Al_2O_3	3.8	Fairly good	Medium-hard, fibrous samples
Silicon nitride	Si_3N_4	3.25	Excellent	Abrasive samples, metal-free grinding
Zirconium oxide	ZrO_2	5.7	Very good	Fibrous, abrasive samples
Hardened, stainless steel	Fe – Cr	7.65	Good	Hard, medium-hard, brittle samples
Hardmetal tungsten carbide	WC	14.3	Very good	Hard, abrasive samples
Polypropylene disposable bowl (only for PULVERISETTE 7 *classic line*)		0.9		For homogenisation

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

Size of the grinding balls

Type of sample material	Suitable grinding ball diameter
Hard samples with a maximum feed size of 10 mm	30 mm* or 40 mm*
Average feed size of ≤ 5 mm	20 mm*, 15 mm or 10 mm
Fine material < 0.5 mm	10 mm or smaller
Homogenisation of dry or liquid samples	20 mm*, 10 mm or smaller
Homogenisation of viscous samples	20 mm*

* not suitable for Planetary Micro Mill PULVERISETTE 7 *classic line*

The specified grinding ball sizes are application-dependent reference values. It is not recommended to mix balls of different diameters.
Grinding balls with a diameter of 40 mm should only be used for a short grinding time.

Recommended bowl filling

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

Grinding Bowl /	12 ml	45 ml	80 ml	250 ml	500 ml
Useful capacity (sample volume)	**0.5 – 5 ml**	**3 – 20 ml**	**10 – 30 ml**	**30 – 125 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 /	12 ml	45 ml	80 ml	250 ml	500 ml
Useful capacity (sample volume)	**0.5 – 5 ml**	**3 – 20 ml**	**10 – 30 ml**	**30 – 125 ml**	**80 – 225 ml**
Material					
Zirconium oxide	20	70	100	400	800
Hardened, stainless 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 useful capacity depends on the type of material. 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

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

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

• with 2 grinding bowl fasteners

05.6020.00	For 200-240 V/1~, 50-60 Hz, 1730 watt
05.6010.00	For 100-120 V/1~, 50-60 Hz, 1470 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, 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*

VARIO-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 <u>only</u> be operated on a three-phase supply network.

* The voltage specified in the order is set.

GTM – GAS PRESSURE AND TEMPERATURE MEASURING SYSTEM

for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 *classic line*

GTM for continuous measurement of gas pressure and temperature

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

for PULVERISETTE 7 *classic line*

96.0280.00	IQ/OQ documentation (questionnaire format – for filling out by customer)

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 *classic line*

50.1055.00	Agate, with steel casing
50.1060.00	Sintered corundum (99.7% Al_2O_3)
50.1310.00	Silicon nitride, with steel casing
50.1110.00	Zirconium oxide
50.1090.00	Hardened, stainless steel
50.2661.20	Replacement seal ring PTFE 121/110 mm dia. for agate bowls 500 ml volume
50.1010.20	Replacement seal ring PTFE 110/101 mm dia. for silicon nitride bowls 500 ml volume
50.1230.20	Replacement seal ring PTFE 116/100 mm dia. for all other bowls 500 ml volume

Grinding bowl 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% Al_2O_3)
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 250 ml volume
50.2010.20	Replacement seal ring PTFE 85/76 mm dia. for silicon nitride bowls 250 ml volume
50.2230.20	Replacement seal ring PTFE 90/75 mm dia. for all other bowls 250 ml volume

Grinding bowl 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% Al_2O_3)
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 80 ml volume
50.4230.20	Replacement seal ring PTFE 80/65 mm dia. for all other bowls 80 ml volume
90.1120.09	Adapter for grinding bowls 80 ml volume (essential, if only one grinding bowl is inserted in the grinding bowl holder)

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

50.7050.00	Agate
50.7060.00	Sintered corundum (99.7% Al_2O_3)
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 45 ml volume

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

50.5050.00	Agate
50.5060.00	Sintered corundum (99.7% Al_2O_3)
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 12 ml volume

ACCESSORIES FOR GRINDING IN INERT GAS AND FOR MECHANICAL ALLOYING

for PULVERISETTE 4, PULVERISETTE 5 and PULVERISETTE 6 *classic line*

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

50.8010.00	Agate, with steel casing
50.9150.00	Silicon nitride, with steel casing
50.9100.00	Zirconium oxide
50.8400.00	Hardened, stainless steel
50.8013.16	Replacement seal ring Viton for gassing lid for agate bowls 500 ml volume
50.1230.16	Replacement seal ring Viton for gassing lid for all other bowls 500 ml volume

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 250 ml volume
50.2010.16	Replacement seal ring Viton for gassing lid for silicon nitride bowls 250 ml volume
50.2230.16	Replacement seal ring Viton for gassing lid for all other bowls 250 ml volume

Order No.	Article
	Gassing lid with 2 valves and seal ring for grinding bowls 80 ml
50.8810.00	Agate, with steel casing
50.8840.00	Zirconium oxide
50.8700.00	Hardened, stainless steel
50.8880.00	Hardmetal tungsten carbide, with steel casing
50.2011.16	Replacement seal ring Viton for gassing lid for agate bowls 80 ml volume
50.4230.16	Replacement seal ring Viton for gassing lid for all other bowls 80 ml volume
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)

Gassing lids with Swagelok valves are available on request.

GRINDING BALLS 40 MM – 5 MM DIAMETER (PIECE)

	Grinding ball 40 mm diameter **for grinding bowls 500 ml**
55.0400.06	Sintered corundum (99.7% Al_2O_3)
55.0400.31	Silicon nitride
55.0400.27	Zirconium oxide
55.0400.09	Hardened, stainless steel
55.0400.08	Hardmetal tungsten carbide
	Grinding ball 30 mm diameter **for grinding bowls 500, 250 ml**
55.0300.05	Agate, polished
55.0300.06	Sintered corundum (99.7% Al_2O_3)
55.0300.31	Silicon nitride
55.0300.27	Zirconium oxide
55.0300.09	Hardened, stainless steel
55.0300.08	Hardmetal tungsten carbide
	Grinding ball 20 mm diameter **for grinding bowls 500, 250, 80 ml**
55.0200.05	Agate, polished
55.0200.06	Sintered corundum (99.7% Al_2O_3)
55.0200.31	Silicon nitride
55.0200.27	Zirconium oxide
55.0200.09	Hardened, stainless steel
55.0200.08	Hardmetal tungsten carbide
	Grinding ball 15 mm diameter **for grinding bowls 500, 250, 80, 45 ml**
55.0150.05	Agate, polished
55.0150.06	Sintered corundum (99.7% Al_2O_3)
55.0150.31	Silicon nitride
55.0150.27	Zirconium oxide
55.0150.09	Hardened, stainless steel
55.0150.08	Hardmetal tungsten carbide
	Grinding ball 10 mm diameter **for grinding bowls 500, 250, 80, 45, 20, 12 ml**
55.0100.05	Agate, polished
55.0100.06	Sintered corundum (99.7% Al_2O_3)
55.0100.31	Silicon nitride
55.0100.27	Zirconium oxide
55.0100.09	Hardened, stainless steel
55.0100.08	Hardmetal tungsten carbide
	Grinding ball 5 mm diameter **for grinding bowls 500, 250, 80, 45, 20, 12 ml**
55.0050.05	Agate, polished (100 pieces weigh approx. 17 g) [1]
55.0050.27	Zirconium oxide (100 pieces weigh approx. 38 g) [1]
55.0050.09	Hardened, stainless steel (100 pieces weigh approx. 52 g) [1]
55.0050.08	Hardmetal tungsten carbide (100 pieces weigh approx. 97 g) [1]

[1] With aid of the indication of the weight, can the high number of balls per grinding bowl be determined by weighing.

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

	Grinding ball ≤ 3 mm diameter **for grinding bowls 500, 250, 80, 45, 20, 12 ml**
55.0030.27	Zirconium oxide 3 mm dia.
55.0020.27	Zirconium oxide 2 mm dia.
55.0015.27	Zirconium oxide 1.5 mm dia.
55.0010.27	Zirconium oxide 1 mm dia.
55.0005.27	Zirconium oxide 0.5 mm dia.
55.0001.27	Zirconium oxide 0.1 mm dia.
55.0030.09	Hardened, stainless steel 3 mm dia.
55.0010.09	Hardened, stainless steel 1 mm dia.
55.0030.08	Hardmetal tungsten carbide 3 mm dia.
55.0016.08	Hardmetal tungsten carbide 1.6 mm dia.
55.0006.08	Hardmetal tungsten carbide 0.6 mm dia.

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