P-6

PLANETARY MILL

FRITSCH

TECHNICAL SPECIFICATIONS



EASY WORKING. GREAT RESULTS.

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TECHNICAL DATA

P-6 – Planetary Mill

Working principle	impact force
Material type	hard, medium-hard, soft brittle, tough, moist
Field of application	geology and mineralogy metallurgy material technology ceramics pharmaceuticals chemistry biology sample preparation for analysis
Working stations	1 station
Grinding tools	grinding bowls + balls
Materials grinding tools	agate, hardened stainless steel, hardmetal tungsten carbide, sintered corundum, zirconium oxide, silicon nitride
Grinding bowl sizes	12 ml, 45 ml (with adapter) 80 ml, 250 ml, 500 ml
Grinding ball sizes	1–40 mm
Max. initial size / feeding size	10 mm
Sample quantity	0.5–225 ml
Final fineness *(depends on application)*	< 1 µm colloidal grinding
Average grinding time to analytical fineness	4 min
Grinding process	dry/wet
Grinding in inert gas *(Additional lock-system required)*	yes
Gas pressure and temperature measurement	yes
Rotational speed of main disk	100–650 rpm

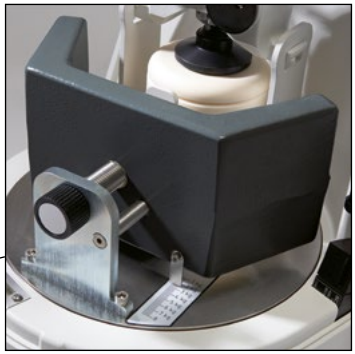
Transmission ratio planetary disk/grinding bowl	$i_{relative}$ = 1 : -1.82
Relative bowl speed	1,183 rpm
Effective diameter of main disk	121.6 mm
Centrifugal acceleration (g = 9.81 m/s²)	29 g
Interface	yes
Power consumption	1,000 W
Electrical details	100–120 / 200–240 V/1; 50–60 Hz
Emission sound pressure level at the workplace acc. to DIN EN ISO 3746 *(workplace related)*	up to approx. L_{pAd} = 85 dB
Weight	63 kg
Safety class	IP21
Dimensions (W x D x H)	benchtop 37 x 53 x 50 cm

ACCESSORIES

P-6 – Planetary Mill

Order no.	Article
	**Instrument without grinding bowls and balls, incl. Safe-Lock clamping system**
06.2000.00	for 100–120 / 200–240 V/1~, 50–60 Hz, 1,000 W *Voltage indicated by customer is set*
	Certification
96.0240.00	IQ/OQ documentation *(Questionnaire format – implementation not included)*





Imbalance compensation through simple compensation mechanism



Grinding bowls for Planetary Mill P-6

Order no.	Article
	Grinding bowls with lid and seal ring
	Grinding bowls 500 ml volume
50.1055.00	Agate, with steel casing
50.1060.00	Sintered corundum (99.7 % Al_2O_3)
50.1110.00	Zirconium oxide
50.1090.00	Hardened, stainless steel
50.1310.00	Silicon nitride, with steel casing
50.2661.20	Replacement seal ring PTFE 121/110 mm dia. for agate bowls of 500 ml volume
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
	Grinding bowls 250 ml volume
50.2055.00	Agate, with steel casing
50.2060.00	Sintered corundum (99.7 % Al_2O_3)
50.2110.00	Zirconium oxide
50.2090.00	Hardened, stainless steel
50.2080.00	Hardmetal tungsten carbide, with steel casing
50.2310.00	Silicon nitride, with steel casing
50.2011.20	Replacement seal ring PTFE 85/70 mm dia. for agate bowls of 250 ml volume
50.2010.20	Replacement seal ring PTFE 85/76 mm dia. for silicon nitride bowls of 250 ml volume

Order no.	Article
50.2230.20	Replacement seal ring PTFE 90/75 mm dia. for all other bowls of 250 ml volume
	Grinding bowls 80 ml volume
50.4055.00	Agate, with steel casing
50.4060.00	Sintered corundum (99.7 % Al_2O_3)
50.4110.00	Zirconium oxide
50.4090.00	Hardened, stainless steel
50.4080.00	Hardmetal tungsten carbide, with steel casing
50.4310.00	Silicon nitride
50.2011.20	Replacement seal ring PTFE 85/70 mm dia. for agate bowls of 80 ml volume
50.4230.20	Replacement seal ring PTFE 80/65 mm dia. for all other bowls of 80 ml volume
90.1120.09	Adapter for grinding bowls 12 ml, 45 ml, 80 ml volume *(Essential, if only one grinding bowl is inserted in the grinding bowl holder)*
	Grinding bowls 45 ml volume for P-6
50.7050.00	Agate
50.7060.00	Sintered corundum (99.7 % Al_2O_3)
50.7110.00	Zirconium oxide
50.7090.00	Hardened, stainless steel
50.7080.00	Hardmetal tungsten carbide, with steel casing
50.7310.00	Silicon nitride
50.7250.20	Replacement seal ring PTFE 50/40 mm dia. for all bowls of 45 ml volume
	Grinding bowls 12 ml volume for P-6
50.5050.00	Agate
50.5060.00	Sintered corundum (99.7 % Al_2O_3)
50.5110.00	Zirconium oxide

Order no.	Article
	Grinding bowls 12 ml volume for P-6
50.5090.00	Hardened, stainless steel
50.5080.00	Hardmetal tungsten carbide
50.5310.00	Silicon nitride
50.5250.20	Replacement seal ring PTFE 37/26 mm dia. for all bowls of 12 ml volume
90.1120.09	Adapter for grinding bowls 12 ml, 45 ml, 80 ml volume for P-6 *(Essential, if only one grinding bowl 80 ml volume per grinding bowl holder or if grinding bowls 12 ml resp. 45 ml are inserted into the P-6)*
	Accessories for single-use technology for P-6
50.3200.00	Aluminium grinding bowl, modified to customer specifications, for use with tubes
50.3010.00	Aluminium grinding bowl with 8 x 20 ml tubes



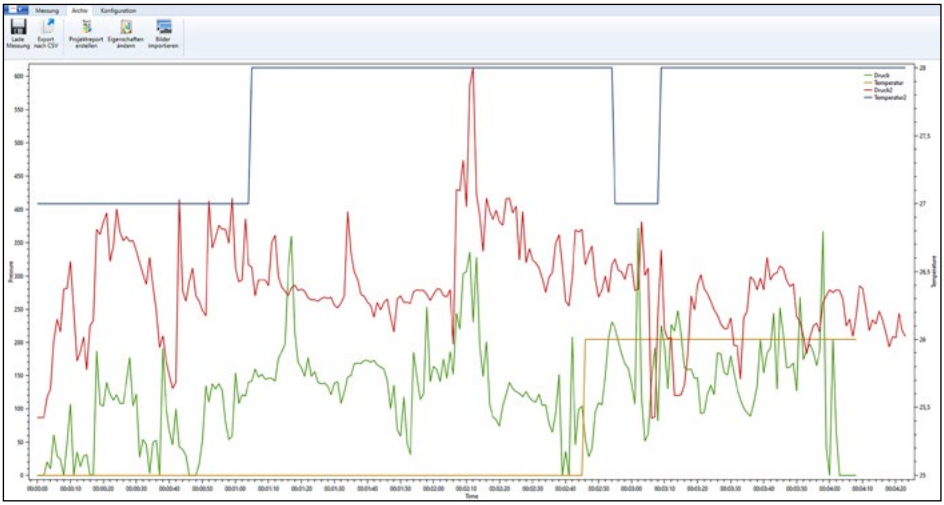
To specifically prevent contamination of samples due to unwanted abrasion, all grinding bowls and the corresponding grinding balls are available in 6 different materials.

Order no.	Article



EASY-GTM – Gas pressure and temperature measuring system for Planetary Mill P-6

	EASY-GTM for continuous measurement of gas pressure and temperature
50.2480.00	incl. 250 ml grinding bowl made of hardened, stainless steel with special lid, transmitter, separate receiver and software EASY-GTMControl
50.2490.00	incl. 500 ml grinding bowl made of hardened, stainless steel with special lid, transmitter, separate receiver and software EASY-GTMControl
	If further grinding bowls and transmitters are needed, please ask for the respective order numbers.



With the new EASY GTM gas pressure and temperature measurement system, you can transform your P-6 planetary mill into an analytical measurement system.

Order no.	Article
	**Gassing lids for Planetary Mill P-6**
	Accessories for grinding in inert gas and for mechanical alloying
	Gassing lids with 2 valves and seal ring for grinding bowls 500 ml volume
50.8010.00	Agate, with steel casing
50.9100.00	Zirconium oxide
50.8400.00	Hardened, stainless steel
50.9150.00	Silicon nitride, with steel casing
50.8013.16	Replacement seal ring made of Viton for gassing lid for agate bowls 500 ml volume
50.1230.16	Replacement seal ring made of Viton for gassing lid for all other bowls 500 ml volume
	Gassing lids with 2 valves and seal ring for grinding bowls 250 ml volume
50.8100.00	Agate, with steel casing
50.8950.00	Zirconium oxide
50.8500.00	Hardened, stainless steel
50.8600.00	Hardmetal tungsten carbide, with steel casing
50.8900.00	Silicon nitride, with steel casing
50.2011.16	Replacement seal ring made of Viton for gassing lid for agate bowls 250 ml volume
50.2010.16	Replacement seal ring made of Viton for gassing lid for silicon nitride bowls 250 ml volume
50.2230.16	Replacement seal ring made of Viton for gassing lid for all other bowls 250 ml volume
	Gassing lids with 2 valves and seal ring for grinding bowls 80 ml volume
50.8100.00	Agate, with steel casing
50.8840.00	Zirconium oxide

Order no.	Article
50.8700.00	Hardened, stainless steel
50.8880.00	Hardmetal tungsten carbide, with steel casing
50.2011.16	Replacement seal ring made of Viton for gassing lid for agate bowls 80 ml volume
50.4230.16	Replacement seal ring made of 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.



By using a special lid on the grinding bowl, you can also grind your samples under protective gas and mechanically alloy/activate them.



Grinding balls for Planetary Mill P-6

Order no.	Article
	Grinding balls 40 mm dia. for grinding bowls 500 ml
55.0400.06	Sintered corundum (99.7 % Al_2O_3)
55.0400.27	Zirconium oxide
55.0400.09	Hardened, stainless steel
55.0400.31	Silicon nitride
	Grinding balls 30 mm dia. for grinding bowls 500 ml, 250 ml
55.0300.05	Agate, polished
55.0300.06	Sintered corundum (99.7 % Al_2O_3)
55.0300.27	Zirconium oxide
55.0300.09	Hardened, stainless steel
55.0300.08	Hardmetal tungsten carbide
55.0300.31	Silicon nitride
	Grinding balls 20 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml
55.0200.05	Agate, polished
55.0200.06	Sintered corundum (99.7 % Al_2O_3)
55.0200.27	Zirconium oxide
55.0200.09	Hardened, stainless steel
55.0200.08	Hardmetal tungsten carbide
55.0200.31	Silicon nitride
	Grinding balls 15 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml
55.0150.05	Agate, polished
55.0150.06	Sintered corundum (99.7 % Al_2O_3)
55.0150.27	Zirconium oxide

Order no.	Article
55.0150.09	Hardened, stainless steel
55.0150.08	Hardmetal tungsten carbide
55.0150.31	Silicon nitride
	Grinding balls 10 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 12 ml
55.0100.05	Agate, polished
55.0100.06	Sintered corundum (99.7 % Al_2O_3)
55.0100.27	Zirconium oxide
55.0100.09	Hardened, stainless steel
55.0100.08	Hardmetal tungsten carbide
55.0100.31	Silicon nitride
	Grinding balls 5 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 12 ml
55.0050.05	Agate, polished (100 pieces weigh approx. 17 g)[1)]
55.0050.06	Sintered corundum (99.7 % Al_2O_3) (100 pieces weigh approx. 48 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)]
55.0050.31	Silicon nitride (100 pieces weigh approx. 48 g)[1)]
	[1)] The number of balls per grinding bowl can be calculated by weighing using the weight specification.
	Grinding balls ≤ 3 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 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.

Order no.	Article
	Grinding balls ≤ 3 mm dia. for grinding bowls 500 ml, 250 ml, 80 ml, 45 ml, 12 ml
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.
	Further grinding balls ≤ 3 mm dia. are available. *Grinding balls also available in further sizes.*



By selecting the size of the grinding balls, you can optimally adjust the grinding process to each individual application.

Material data grinding bowls/grinding balls

Material	Main component of the material*	Density g/cm3	Abrasion resistance	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	extremely good	abrasive samples, metal-free grinding
Zirconium oxide	ZrO_2	5.7	very good	fibrous, abrasive samples
Hardened stainless steel	Fe – Cr	7.7	good	hard, medium-hard, brittle samples
Hardmetal tungsten carbide	WC	14.3	very good	hard, abrasive samples

** At www.fritsch.de, you will find the standard analyses with detailed information on the materials directly next to the respective grinding bowls and balls.*

Recommended grinding ball size

Application	Suitable ball diameter
Maximum feed size 10 mm	30 mm or 40 mm
Average feed size ≤ 5 mm	20 mm, 15 mm or 10 mm
Fine material ≤ 0.5 mm	10 mm or smaller
Homogenising dry or liquid samples	20 mm, 10 mm or smaller
Homogenising viscous samples	20 mm or 15 mm

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

Recommended filling per grinding bowl

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 10–35 ml	250 ml 30–125 ml	500 ml 80–225 ml
Balls diameter	5 mm	50	180	250	1200	2000
	10 mm	6	18	25	50	100
	15 mm	–	7	10	45	70
	20 mm	–	–	5	15	25
	30 mm	–	–	–	6	8
	40 mm	–	–	–	–	4

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 10–35 ml	250 ml 30–125 ml	500 ml 80–225 ml
Material	Zirconium oxide	20 g	70 g	100 g	400 g	800 g
	Hardened, stainless steel	30 g	90 g	150 g	500 g	1100 g
	Hardmetal tungsten carbide	50 g	200 g	300 g	1000 g	2100 g

Grinding balls with a diameter of 3 mm and smaller must be weighed. The above table shows the required weight per grinding bowl.

The usable capacity depends on the type of material.

The specified ball filling per bowl is the minimum quantity; depending on the material behaviour, it may need to be increased.

In exceptional cases, the quantity of grinding balls can be reduced by up to 15 %. In order to achieve consistent grinding results in line with our recommendations, a longer grinding time is necessary, which may result in increased abrasion.

APPLICATION EXAMPLES

P-6 – Planetary Mill

Sample 1: silicon carbide

Milling:

- 80 ml tungsten carbide grinding bowl
- 5 x 20 mm grinding balls
- 200 rpm
- 30 sec





Sample 2: paper

Milling:

- 250 ml sintered corundum grinding bowl
- 6 x 30 mm grinding balls
- 200 rpm
- 2 min





Sample 3: basalt

Milling:

- 250 ml steel grinding bowl
- 15 x 20 mm grinding balls
- 200 rpm
- 2 min





Sample 4: acrylic paint

Mixing:

- 80 ml zirconium oxide grinding bowl
- 5 x 10 mm grinding balls
- 200 rpm
- approx. 1 min





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Contact person:

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for a non-binding consultation or individual test grinding to identify your ideal device configuration and optimal grinding parameters.

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