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Operating Instructions

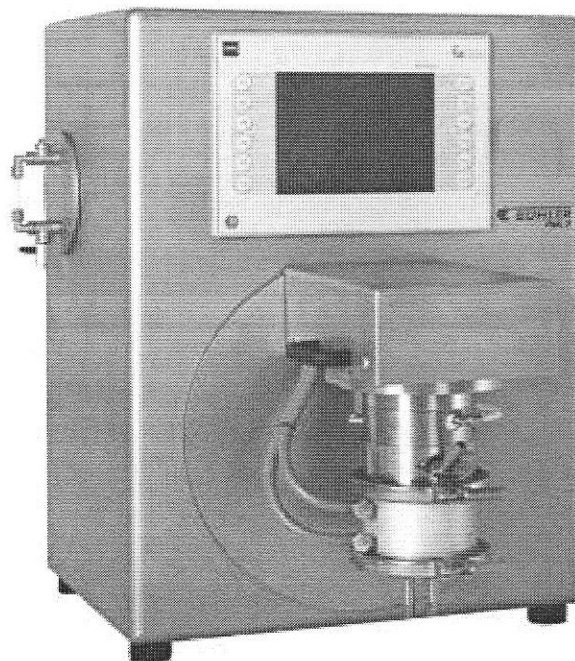
Laboratory Agitator Mill PML 2

FPML 2-A

FPML 2-A-Ex

FPML 2-M



FPML 2-M-Ex




Control Operation, see separate documentation (80503 or 80538)
Spare Parts Catalogue, see separate documentation

FPML_80958-1-en-1212

2.1.2 Type code

Laboratory Agitator Mill			
	Generation	Design ¹	Certification for potentially explosive atmosphere
			ATEX designation
FPML	2	-A	
FPML	2	-A	-Ex  II 2G EEx c T3 X - ***
FPML	2	-A	-Ex ²
FPML	2	-M	
FPML	2	-M	-Ex  II 2G EEx c T3 X - ***
FPML	2	-M	-Ex ²

Notified body
where ATEX documentation is deposited
and identification of the ATEX documentation

The "X" behind the ATEX designation indicates that the denoted ignition protection is only ensured under specific conditions. Specifications and restrictions to this are marked in these operating instructions with . It is thus indispensable that they are complied with in the certified explosion-dangerous area in order to ensure safe operation.

2.2 Use in accordance with intended purpose

The machine is exclusively designed for reducing and dispersing pre-crushed components of low-viscosity suspensions.

The product processing must not cause any chemical reactions in the machine.

Machine without approval for potentially explosive atmospheres



- **Machine and control cabinet must not be operated within a potentially explosive atmosphere.**
- **No potentially explosive products, consumables or cleaning fluids may be used.**

Machine approved for potentially explosive atmospheres

- In the EU, the machine may only be operated with approval in accordance with ATEX 95.
The certification can be seen from the ATEX designation on the nameplate, see sect. 2.1 "Identification".
- If the machine is approved for a potentially explosive area according to standards other than ATEX, it may not be operated in the EU region.
Approval certification can be seen on the nameplate, see sect. 2.1 "Identification".
- **The control cabinet must not be operated in the potentially explosive area.**

¹ Models A = "Premium", M = "Comfort". See sect. 2.3.

² Explosion protection conforming to other standards (no ATEX 95 approval)

-  The machine may only be used for processing inflammable products up to temperature class T3 (i.e. for substances with an ignition temperature over 200 °C, see sect. 2.1 "Identification").³
-  Only cleaning fluids and consumables up to temperature class T3 may be used. See sect. 2.1 "Identification".³

2.3 Models

"Comfort" version

- Frequency-controlled main drive
- Frequency-controlled pump drive
- Control panel with ampère meter, buttons and alarm lamp
- Diaphragm contact pressure gauge at product inlet
- Dial thermometer on product discharge

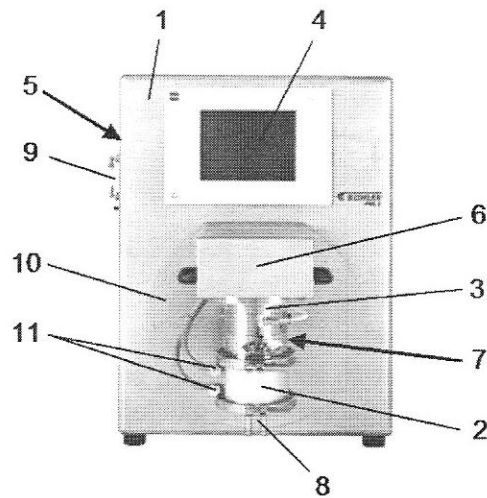
"Premium" model

- Programmable logic control (PLC) in machine stand for use in a not potentially explosive atmosphere
- Control cabinet with programmable logic control (PLC) for separate installation outside the potentially explosive atmosphere, for machines with approval for a potentially explosive atmosphere, see sect. 2.1 "Identification"
- Frequency-controlled main drive
- Frequency-controlled pump drive
- Touch panel with graphic user interface
- Interface to process data recording (option), e.g. with "WinTrend", see separate documentation 80494
- Pressure sensor on product inlet
- Resistance thermometer PT100 at product discharge

³

In the case of temperature class T3, safety distances in accordance with EN 1127 1:1997, section 6.4.2 or EN 13463-5:2003, section 4.5.1, for min. ignition temperature of substances in temperature class T3 (200° C) are taken into consideration in accordance with EN 1127 1:1997, section 6.4.2.

2.4 Design and function



- | | |
|--------------------------------------|------------------------------------|
| (1) Stand | (7) Product inlet |
| (2) Process zone (stator and rotor) | (8) Product discharge |
| (3) Mechanical seal and bearing | (9) Barrier liquid level indicator |
| (4) Control panel ("Premium" design) | (10) Pivoting device |
| (5) Main switch | (11) Cooling water distribution |
| (6) Belt guard | |

Fig. 2.3: Laboratory Agitator Mill PML 2

2.4.1 Process zones

The dispersing and milling process takes place in the process zone (stator and rotor).

Continuous process zone

SuperFlow™ 4, Centex™ S, MicroMedia™ L

The product is distributed on entering the process zone and flows through the grinding media filling from the inlet area on the bearing housing to the slotted screen discharge.

Product quality is achieved by the effect of the shear and impact forces of the grinding media and elements of the process zone on the product itself.

The screen on the product discharge and the centrifugal forces occurring in the process zone hold the grinding media back in the grinding chamber.

Discontinuous process zone

Centex™ S1 diskonti

The product is filled into the process zone together with the grinding media and the zone is then sealed.

Product quality is achieved by the effect of the shear and impact forces of the grinding media and elements of the process zone on the product itself.

The process zone is opened again when production is completed and the product is drained together with the grinding media. The grinding media are then separated from the product.

Process zone positions

The process zone can be pivoted into vertical or horizontal position for operation and service.



CAUTION!

When pivoting the process zone the product supply lines have to be dismantled as they can be damaged.

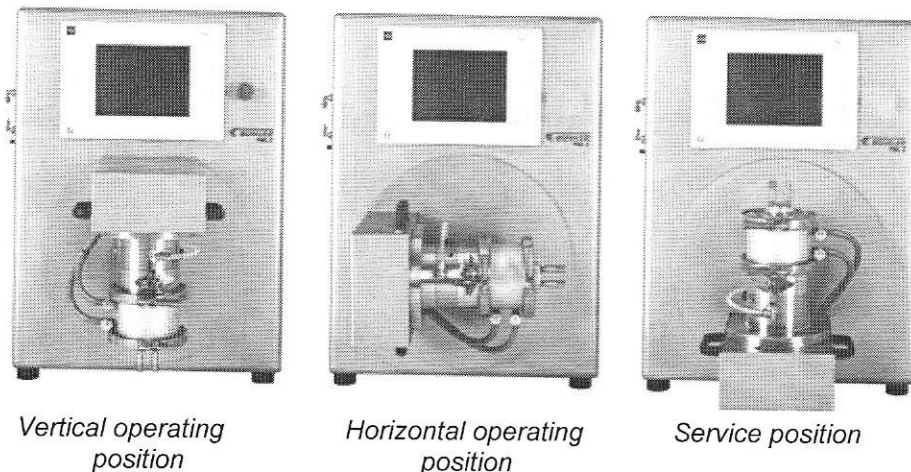


Fig. 2.4

Operating position:

Horizontal or vertical, depending on process zone, see sect. 2.5.4, .



CAUTION!

If the process zones are not operated in the specified operating positions, there is an operation failure.

Service position

- for mounting the process zone;
- for filling grinding media (depending on mounted process zone)
- for Cleaning the machine, see sect. 8.4.

The service position is monitored by limit switches. The main motor and product pump cannot be started in the service position.

To drain the grinding media, a service position inclined downward by 15° from the horizontal operating position is possible. See sect. 8.3.

2.4.2 Main drive

With “Comfort“ model

Continuous rotor speed control with frequency converter, can be set by potentiometer.

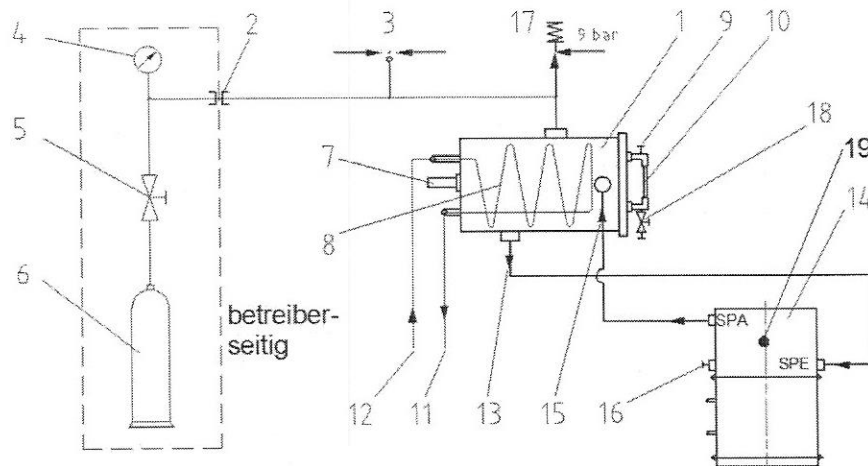
Toothed belt drive.

With “Premium” model

Continuous rotor speed control with frequency converter, can be set on control panel.

Toothed belt drive.

2.4.3 Barrier circuit



- | | |
|--|-----------------------------|
| (1) Barrier liquid tank | (10) Level indicator |
| (2) Compressed gas connection, G $\frac{1}{4}$ " inside | (11) Cooling water return |
| (3) Pressure controller | (12) Cooling water advance |
| (4) Pressure gauge (provided by customer) | (13) Barrier liquid advance |
| (5) Reducing valve with depressurization device (operator) | (14) Mechanical seal |
| (6) Compressed gas supply (provided by customer) | (15) Barrier liquid return |
| (7) Float switch | (16) Leakage connection |
| (8) Cooling serpentine coil | (17) Safety valve |
| (9) Filling nozzle with ball valve and plug, G $\frac{1}{4}$ " | (18) Drain valve |
| | (19) Bleeding screw |

Fig. 2.5

The barrier liquid is overlaid with barrier pressure (gas pressure) which generates static pressure in the mechanical seal (14).

The barrier pressure depends on the permissible pressure in the grinding chamber and can be adjusted on the reducing valve (5). The barrier pressure must be higher than the admissible pressure in the grinding chamber to prevent the product penetrating the mechanical seal, see also sect. 2.5.9.

The pressure controller (3) monitors the barrier pressure. For adjustment of the pressure controller (3), see sect. 4.5.

The safety valve (17) is preset to 9 bar, see also sect. 2.5.9.

The barrier liquid level can be viewed on a level indicator (10) on the outside of the machine stand.

Barrier liquid can be topped up in pressureless condition through the filling nozzle (9) on top of the level indicator (10), see also sect. 4.5.

The filling level is monitored with a float switch (7). If the barrier liquid level is too low, the machine switches off.

Barrier liquid cooling occurs in the barrier liquid tank (1) via a cooling coil (8) in the tank.

2.6.2, see sect. Barrier liquid.

2.4.6 Product pump (optional)

Product pump	Recommended use for process zone	Pump capacity range (Standard) [l/h]
"IPV" gear pump	SuperFlow™4	10 ... 35 25 ... 100
"Watson-Marlow" hose pump	Centex™ S1 Centex™ S2	4 ... 30 10 ... 80
"Watson-Marlow" hose pump	MicroMedia™L	1 ... 70 l/h
"Prominent" diaphragm pump		1 ... 98 l/h

Tab. 2.1

See also corresponding separate documentation.

2.4.7 Software for process data recording (option)

With "Premium" model

The machine control has a serial interface.

Process data can be recorded and evaluated with the "WinTrend" software.

See separate documentation (80494).

2.5 Technical data

2.5.1 Machine data

Active grinding chamber volume:	0.07 ... 1.05 dm ³
Barrier liquid tank volume:	2.4 dm ³
Barrier liquid pressure:	max. 7 bar
Agitator	
Motor shaft output:	2.2 kW at 3000 min ⁻¹
Rotor speed:	500 ... 4000 min ⁻¹



Note:

Only operate the rotor within the indicated speed range.

The rotor speed influences the productivity and service life of the process zone.

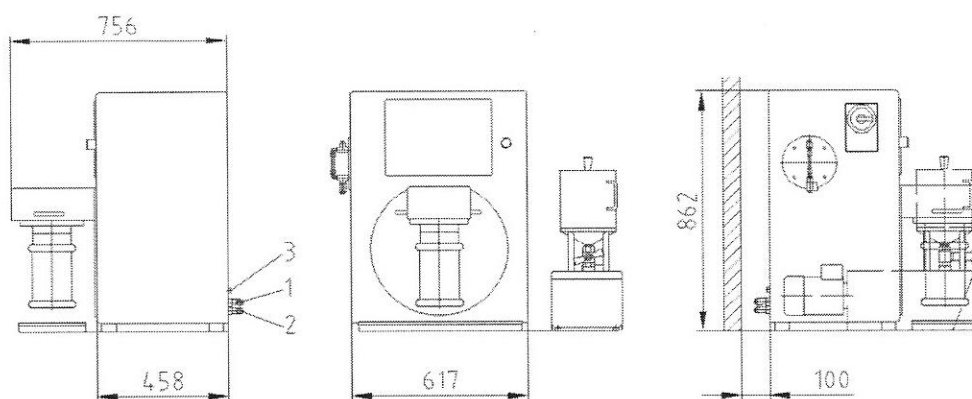
Unnecessarily high rotor speeds can cause premature wearing, whereas rotor speeds that are too low lead to insufficient cooling of the mechanical seal.

2.5.2 Weight

Machine:	150 kg
Hose pump:	30 kg
Gear pump:	25 kg
Laboratory hose pump:	8 kg
Product container:	5 kg
Trough:	1.5 kg

2.5.3 Dimensions

Machine



- (1) Cooling water inlet, G $\frac{1}{2}$ "
- (2) Cooling water outlet, G $\frac{1}{2}$ "
- (3) Compressed gas connection, G $\frac{1}{4}$ "

Fig. 2.8: Dimensional drawing

Control cabinet

Control cabinet for wall-mounting, only for machines approved for potentially explosive atmosphere.⁴

Height:	800 mm
Width:	800 mm
Depth:	300 mm

2.5.4 Process zones

	SuperFlow™ 4	MicroMedia™ L	Centex™	
			S1	S2
Operating position	Vertical	Vertical	Horizontal	Horizontal
Active grinding chamber volume [dm ³]	0,27	0,07	0,22	0,6
Rotor outside diameter [mm]	90 ⁵	58 ⁵	58	70
Flow rate ⁶ [l/h]	10 ... 50	1 ... 15	1 ... 20	10 ... 50
Max. power consumption [kW/h]	2.2	1.1	2.2	
Max. permissible operating pressure [bar]	3			
Max. permissible operating temperature [°C]	70			

Tab. 2.2

Configuration of the process zones and peripheries

SuperFlow™ 4

Double cylinder agitator mill with pins and counter pins

Rotor / stator material: stainless steel / stainless steel

Product line cross section: DN 10

Possible product pump: hose pump / gear pump

MicroMedia™ L

Double-cylinder agitator mill with pins in the rotor and inner stator

Rotor / stator material: Stainless steel / stainless steel

Ceramic SiC / ceramic SiC

Ceramic ZrO₂ / ceramic ZrO₂

Product line cross section: DN 6

Possible product pump: Hose pump / diaphragm pump

Additional equipment: Laboratory setup with product lines

See sect. 2.4.5

Centex™ S1

Agitator mill with 2 agitating disks

Rotor / stator material: stainless steel / stainless steel

Ceramic SiC / ceramic SiC

Product line cross section: DN 10

Possible product pump: hose pump / gear pump

⁵ Diameter incl. pins.

⁶ Product properties and product consistency influence the flow rate. If there is a deviation from the limits, contact Bühler AG, see sect. 9 "After-sales service".

Centex™ S1 diskonti

Agitator mill with 2 agitating disks

Rotor / stator material:

Stainless steel / stainless steel

Ceramic SiC / ceramic SiC

Product line cross section:

DN 10

Possible product pump:

hose pump / gear pump

Centex™ S2

Agitator mill with 4 agitating disks

Rotor / stator material:

Chill cast chrome / hardened stainless steel

Polyurethane / hardened stainless steel

Polyurethane / polyurethane

Product line cross section:

DN 10

Possible product pump:

hose pump / gear pump

2.5.5 Product lines

Diameter:

DN 6 or DN 10

with Tri-Clamp connections

Material:

Teflon hoses with metal jacket

Check valve on supply line

for SuperFlow™ 4

standard

for MicroMedia™ L

standard

for Centex™ S

option

2.5.6 Grinding media

Grinding media nominal diameter: 0.2 ... 2.0 mm
 Recommended materials:⁷ Draison[®], Chromresist[®]
 Weight of 1 dm³ grinding media: 3.7 kg Draison[®]
 5.4 kg Chromresist[®]

	Process zone			
	MicroMedia™ L	SuperFlow™ 4	Centex™	
			S1	S2
Grinding media nominal diameter	0.03 ... 0.10	0.2 ... 0.8	0.2 ... 2.0	
Recommended grinding media filling level [%]	70 ... 100	70 ... 90	60 ... 80	
Active grinding chamber volume [dm ³]	0.07	0.275	0.222	0.6

Grinding media filling level [%]	Volume [cm ³ = ml]			
	MicroMedia™ L	SuperFlow™ 4	Centex™	
			S1	S2
60	–	–	133	360
65	–	–	144	390
70	49	193	156	420
75	52	206	167	450
80	56	220	178	480
85	59	234	–	
90	63	248	–	
95	66	–	–	
100	70	–	–	

Tab. 2.3: Grinding media

2.5.7 Gap width of the screen

Material	Gap width [mm]	Process zone			
		MicroMedia™ L	SuperFlow™ 4	Centex™	
				S1	S2
Ceramic	0.10	–	–	–	X
	0.15	–	–	–	X
	0.20	–	–	–	X
	0.30	–	–	–	X
	0.40	–	–	–	X
	0.50	–	–	–	X
Nickel	0.01	X	–	–	–
	0.02	X	–	–	–
	0.04	X	–	–	–
Stainless steel	0.05	–	X	–	–
	0.10	X	X	X	X
	0.15	–	–	X	X
	0.22	–	X	X	X
	0.35	–	X	X	X
	0.50	–	X	X	X
	0.80	–	–	X	X

x available

– not available

Tab. 2.4



Notes:

- The gap width of the screen must be max. 50% of the grinding media diameter.
- When using MicroMedia™ screens of 0.01 mm, 0.02 mm and 0.04 mm, screen out the product before every grinding procedure.
- With SuperFlow™4 process zone the combination 0.8 mm grinding media nominal diameter and 0.5 mm gap width of the screen is allowed when using Draison® grinding media.


2.5.8 Electrical connected loads

Voltage/frequency:	3 x 200 V / 50 Hz
	3 x 220 V / 50 Hz
	3 x 380 V / 50 Hz
	3 x 400 V / 50 Hz
	3 x 415 V / 50 Hz
	3 x 200 V / 60 Hz
	3 x 220 V / 60 Hz
	3 x 440 V / 60 Hz
	3 x 460 V / 60 Hz
	3 x 480 V / 60 Hz
	3 x 600 V / 60 Hz
Control voltage:	24 VDC

2.5.9 Compressed air system for barrier pressure

For models certified for potentially explosive atmosphere

Compressed air as pressure gas: 5 bar

 For models certified for the potentially explosive atmosphere

Nitrogen as pressure gas: 5 bar



HAZARD OF NITROGEN!

Make sure that no nitrogen escapes uncontrolled.

Inhalation of pure nitrogen will cause unconsciousness and death.

Setting of the safety valve

Model for operating pressure	Setting of the safety valve
3 bar	9 bar

2.5.10 Noise-level data

A-graded equivalent
sound pressure level:⁸

< 70 dB(A)

2.6 Consumables

2.6.1 Cooling water

Mains pressure: max. 3 bar

Consumption: up to 5 l/min

Temperature: 5 ... 25° C

Recommended water quality

pH-value: 6.5 ... 8.5

Chlorides: max. 50 mg/l

Solids: 50 ... 300 mg/l

Irons: max. 0.3 mg/l

Sulphates: max. 50 mg/l

Degree of hardness: max. 10° dH

Electric conductivity: approx. 600 µS/cm



Notes:

- Only use filtered, purified and softened water.
No solids should form on warm surfaces.
- Do not use fully-demineralised water (corrosion risk).
- Do not use river water.