

# Operating instructions

## PLANETARY MILL

### PULVERISETTE 5 *classic line*

Valid starting with: 05.5000/01370

Valid starting with: 05.6000/00589



**Read the instructions prior to performing any task!**

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Translation of the original operating instructions



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## Certifications and CE conformity

### Certification

Fritsch GmbH has been certified by the TÜV-Zertifizierungsgemeinschaft e.V.



An audit certified that Fritsch GmbH conforms to the requirements of the DIN EN ISO 9001:2008.

### CE Conformity

The enclosed Conformity Declaration lists the guidelines the FRITSCH instrument conforms to, to be able to bear the CE mark.



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## 1 Basic structure



- 1 Hood handle
- 2 Latch
- 3 Hood
- 4 Control panel
- 5 Safe-Lock
- 6 Bowl holder
- 7 Lock

- 8 Voltage rotary switch
- 9 Excess current protection switch
- 10 Main switch
- 11 Mains connection
- 12 Cover plate
- 13 Ventilation grid

## 2 Safety information and use

### 2.1 Requirements for the user

This operating manual is intended for persons assigned with operating and monitoring the Fritsch PULVERISETTE 5. The operating manual and especially its safety instructions are to be observed by all persons working on or with this device. In addition, the applicable rules and regulations for accident prevention at the installation site are to be observed. Always keep the operating manual at the installation site of the PULVERISETTE 5.

People with health problems or under the influence of medication, drugs, alcohol or exhaustion must not operate this device.

The PULVERISETTE 5 may only be operated by authorised persons and serviced or repaired by trained specialists. All commissioning, maintenance and repair work may only be carried out by technically qualified personnel. Qualified personnel are persons who, because of their education, experience and training as well as their knowledge of relevant standards, regulations, accident prevention guidelines and operating conditions, are authorised by those responsible for the safety of the machine to carry out the required work and are able to recognize and avoid possible hazards as defined for skilled workers in IEC 364.

In order to prevent hazards to users, follow the instructions in this manual.

Malfunctions that impair the safety of persons, the PULVERISETTE 5 or other material property must be rectified immediately. The following information serves both the personal safety of operating personnel as well as the safety of the products described and any devices connected to them: All maintenance and repair work may only be performed by technically qualified personnel.

This operating manual is not a complete technical description. Only the details required for operation and maintaining usability are described.

Fritsch has prepared and reviewed this operating manual with the greatest care. However, no guarantee is made for its completeness or accuracy.

Subject to technical modifications.

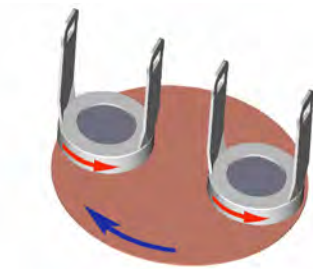
### 2.2 Scope of application

The PULVERISETTE 5 *classic line* can be applied universally for the fast, dry or wet grinding of inorganic and organic samples for analysis, quality inspection, material testing or mechanical alloying. During the synthesis, the PULVERISETTE 5 is used for mixing and homogenising dry samples, emulsions or suspensions.



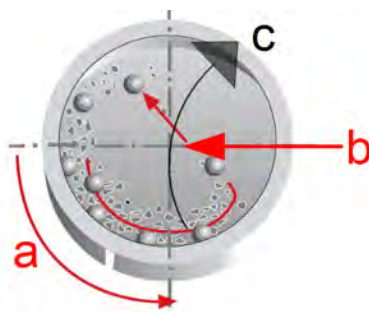
### 2.2.1 Operating principle

The grinding stock is crushed and ground by grinding balls in 2 or 4 grinding bowls. The centrifugal forces from the rotation of the grinding bowls around their own axis and from the rotating support disc act on the contents of the grinding bowl which consists of material to be ground and grinding balls.



The grinding bowl and the support disc have opposite directions of rotation, so that the centrifugal forces alternate in the same direction and in the opposite direction. The result is that the grinding balls run down the inside of the bowl's wall as friction effect and the grinding balls hit the opposite wall of the grinding bowl as impact effect. The impact effect is amplified by the impact of the grinding balls against each other.

The loss-free comminution, even when grinding suspensions, is ensured by the hermetic seal between the grinding bowl and the lid.



- a Rotation of the grinding bowl
- b Centrifugal force
- c Movement of the support disc

### 2.2.2 Drive motor and speed regulation

A maintenance-free three-phase motor operated via a frequency converter is used as the drive.

### 2.3 Obligations of the operator

Before using the PULVERISETTE 5, this manual is to be carefully read and understood. The use of the PULVERISETTE 5 requires technical knowledge; only commercial use is permitted.

The operating personnel must be familiar with the content of the operating manual. For this reason, it is very important that these persons actually receive the present operating manual. Ensure that the operating manual is always near the device.

The PULVERISETTE 5 may exclusively be used within the scope of applications set down in this manual and within the framework of guidelines put forth in this manual. In case of non-compliance or improper use, the customer assumes full liability for the functional capability of the PULVERISETTE 5 and for any damage or injury arising from failure to fulfil this obligation.

## Safety information and use

By using the PULVERISETTE 5 the customer agrees with this and recognizes that defects, malfunctions or errors cannot be completely excluded. To prevent risk of damage to persons or property or of other direct or indirect damage, resulting from this or other causes, the customer must implement sufficient and comprehensive safety measures for working with the PULVERISETTE 5.

Neither compliance with this manual nor the conditions and methods used during installation, operation, use and maintenance of the PULVERISETTE 5 can be monitored by Fritsch GmbH. Improper execution of the installation can result in property damage and thus endanger persons. Therefore, we assume absolutely no responsibility or liability for loss, damage or costs that result from errors at installation, improper operation or improper use or improper maintenance or are in any way connected to these.

The applicable accident prevention guidelines must be complied with.

Generally applicable legal and other obligatory regulations regarding environmental protection must be observed.

## 2.4 Information on hazards and symbols used in this manual

### Safety information

Safety information in this manual is designated by symbols. Safety information is introduced by keywords that express the extent of the hazard.



#### **DANGER!**

This symbol and keyword combination points out a directly hazardous situation that can result in death or serious injury if not avoided.



#### **WARNING!**

This symbol and keyword combination points out a possibly hazardous situation that can result in death or serious injury if not avoided.



#### **CAUTION!**

This symbol and keyword combination points out a possibly hazardous situation that can result in slight or minor injury if not avoided.



#### **NOTICE!**

This symbol and keyword combination points out a possibly hazardous situation that can result in property damage if not avoided.

**ENVIRONMENT!**

This symbol and keyword combination points out a possibly hazardous situation that can result in environmental damage if not avoided.

**Special safety information**

To call attention to specific hazards, the following symbols are used in the safety information:

**DANGER!**

This symbol and keyword combination points out a directly hazardous situation due to electrical current. Ignoring information with this designation will result in serious or fatal injury.

**DANGER!**

This symbol and keyword combination designates contents and instructions for proper use of the machine in explosive areas or with explosive substances. Ignoring information with this designation will result in serious or fatal injury.

**DANGER!**

This symbol and keyword combination designates contents and instructions for proper use of the machine with combustible substances. Ignoring information with this designation will result in serious or fatal injury.

**WARNING!**

This symbol and keyword combination points out a directly hazardous situation due to movable parts. Ignoring information with this designation can result in hand injuries.

**WARNING!**

This symbol and keyword combination points out a directly hazardous situation due to hot surfaces. Ignoring information with this designation can result in serious burn injuries due to skin contact with hot surfaces.

## Safety information and use

### Safety information in the procedure instructions

Safety information can refer to specific, individual procedure instructions. Such safety information is embedded in the procedure instructions so that the text can be read without interruption as the procedure is being carried out. The keywords described above are used.

Example:

1. ➤ Loosen screw.

2. ➤



**CAUTION!**

**Risk of entrapment at the lid.**

Close the lid carefully.

3. ➤ Tighten screw.

### Tips and recommendations



*This symbol emphasises useful tips and recommendations as well as information for efficient operation without malfunction.*

### Further designations

To emphasise procedure instructions, results, lists, references and other elements, the following designations are used in this manual:

Designation	Explanation
➤ 1., 2., 3. ...	Step-by-step procedure instructions
⇨	Results of steps in the procedure
📄	References to sections in this manual and relevant documentation
■	Lists without a specific order
[Button]	Operating elements (e.g. push button, switch), display elements (e.g. signal lamps)
'Display'	Screen elements (e.g. buttons, function key assignment)

## 2.5 Device safety information

Please observe!



- Only use original accessories and original spare parts. Failure to observe this instruction can compromise the safety of the machine.
- Safe conduct must be strictly observed during all work.
- All currently applicable national and international accident prevention guidelines must be complied with.



### **CAUTION!**

#### **Wear hearing protection!**

If a noise level of 85 dB(A) is reached or exceeded, ear protection should be worn to prevent hearing damage.



### **WARNING!**

The maximum accepted concentration (MAC) levels of the relevant safety guidelines must be observed; if necessary, ventilation must be provided or the machine must be operated under an extractor hood.



### **DANGER!**

#### **Explosion hazard!**

- When grinding oxidisable substances, e.g. metal or coal, there is a risk of spontaneous combustion (dust explosion) if the proportion of fine particles exceeds a certain percentage. When grinding these kinds of substances, special safety measures must be taken and the work must be supervised by a specialist.
- The device is not explosion-protected and is not suitable for grinding explosive materials.

- Do not remove the information signs.



### **NOTICE!**

Immediately replace damaged or illegible information signs.

- Unauthorised alteration of the device will void Fritsch's declaration of conformity to European directives and void the guarantee.
- The PULVERISETTE 5 should only be used when it is in proper working order, as intended and in a safety- and hazard-conscious manner adhering to the operating manual. In particular, immediately rectify any malfunctions that could pose a safety hazard.
- If, after reading the operating manual, there are still questions or problems, please do not hesitate to contact our specialised personnel.
- Do not reuse damaged accessories.

## Safety information and use

- Do not leave the Planetary Mill running for several hours without cooling phases. Risk of overheating!
- The mill must never be left running unsupervised. In certain operating states, the vibrations may result in a shifting effect on the surface.

### 2.6 Protective equipment



*Protective equipment is to be used as intended and may not be disabled or removed.*

*All protective equipment is to be regularly checked for integrity and proper functioning.*

For start-up, the hood (3) has to be closed.

The hood (3) is locked:

- without mains connection
- during operation



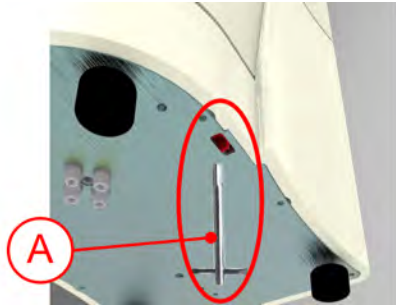
*The hood (3) can only be opened, if the mill's drive is at standstill.*

#### 2.6.1 Opening the hood without mains connection



#### **CAUTION!**

The emergency release must not be activated while the machine is running! Disconnect the machine from the mains before the emergency release. Failure to observe this will render void the guarantee, and releases us from liability for any resulting damage to the device or personal injury.



1. ➔ Insert the included triangular key (A) into the bore hole on the bottom side of the PULVERISETTE 5 *classic line* and turn it to the right.
2. ➔ Unlock the latch (2) by pressing the hood handle (1).
3. ➔ The hood (3) can now be opened.
4. ➔ The mill can only be switched on again if the hood (3) is closed and the safety lock (7) has been enabled again by turning the triangular key to the right.

## 2.6.2 Imbalance switch

The device switches off if there is excessive imbalance. (See [Chapter 6.6 'Mass balance' on page 37](#))



### CAUTION!

The imbalance switch can be disabled at your own risk. The Fritsch company will give no guarantee for damage resulting from disabling of the imbalance switch.



### NOTICE!

Change these settings only after all work as described in [Chapter 4 'Installation' on page 21](#) has been carried out!



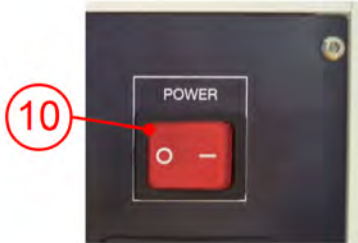
*In the default setting of the imbalance switch, it is activated!*

### Activation / deactivation of the imbalance switch in setup mode:

1. ➔ Press and hold the STOP button on the front of the control panel.



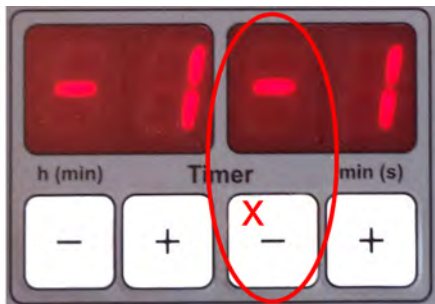
## Safety information and use



2. ➤ Switch on the device with the main switch (10) on the back side of the device, and release the STOP button.



3. ➤ If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.



4. ➤



### NOTICE!

In the display above the right "-" button (x) in the TIMER field, there must be a minus sign. That activates the imbalance switch and prevents a drift of the device and possible damage to the device resulting from it.

When the imbalance switch is deactivated a "1" will be displayed in the TIMER field over the right "-" button (x)!



5. ➤ To save and end setup mode, press the STOP button.



## 2.7 Hazardous points



### CAUTION!

- Crushing hazard when closing the hood (3).
- Crushing hazard at the grinding bowl safe-lock tensioning device (5).



### CAUTION!

#### Risk of splashing!

During wet grinding, the high temperature may have created overpressure.

Wear protective goggles.



### CAUTION!

The grinding bowls can be very hot after grinding.

Wear safety gloves.

## 2.8 Electrical safety


### 2.8.1 General information

- The main switch (10) separates the device from the mains on two poles.
- Switch off the main switch (10) if the planetary mono mill is down for a longer period of time (e.g. overnight).

### 2.8.2 Protection against restart

In case of power failure during operation or after switching off with the main switch (10), the hood (3) is locked. The hood lock (7) is opened when the power returns. For safety reasons, however, the mill does not restart.

### 2.8.3 Overload protection

- In the event of an overload, the device reduces the speed in a controlled manner. The REDUCED SPEED light is lit as a warning.
- The device switches off if the drive motor becomes too hot.
- The device switches off if the drive is blocked. (See  *Chapter 10 'Repairs' on page 55*)

#### 2.8.4 Imbalance detection

The device switches off if there is excessive imbalance. (See [↪ Chapter 10 'Repairs' on page 55](#))

#### 2.8.5 Operation on GFCI (Ground-Fault Circuit Interrupters)

It is possible that the leakage currents will become marginal during operation. This may trigger the earth leakage circuit breaker. These values can quickly be reached when all devices are added to the circuit.

Solution: Circuit without an earth leakage circuit breaker or, if possible, increase the earth leakage circuit breaker threshold.

### 3 Technical data

#### 3.1 Dimensions

**When the hood is open**

952 x 581 x 669 mm (height x width x depth)

**When the hood is closed**

570 x 581 x 669 mm (height x width x depth)

#### 3.2 Weight

**Net:**

100 kg with 2 bowl holders

120 kg with 4 bowl holders

**Gross:**

approximately 140 kg with 2 bowl holders

approximately 160 kg with 4 bowl holders

#### 3.3 Operating noise

Emissions value of workplace according to DIN EN ISO 3746:2005 is 74.9 dB(A) with a grinding element made from steel and grinding stock of sand! This value may vary depending on the type of grinding element and sample material.

#### 3.4 Voltage

The device can be operated in two voltage ranges:

- Single phase alternating current 100 - 120V  $\pm$  10%, and,
- Single phase alternating current 200 - 240V  $\pm$  10%.  
Transient overvoltage according to overvoltage category II is permitted.

#### 3.5 Current consumption

Depending on the voltage range, the maximum current consumption is as follows:

- 100 - 120V  $\rightarrow$  14 A
- 200 - 240V  $\rightarrow$  6 A

## Technical data

### 3.6 Power consumption

Depending on the voltage range, the maximum power consumption is as follows:

- 100 - 120V → 1500W
- 200 - 240V → 1300W

### 3.7 Electrical fuses

Circuit breaker: 16 A

Switch back on by pressing the excess current protection switch (9) on the back of the device.

### 3.8 Material

- Maximum feeding size 10 mm
- Maximum feeding volume 900ml divided into 4 x 500ml grinding bowls + grinding balls or 450ml divided into 2 x 500ml grinding bowl + grinding balls
- Achievable mean final fineness of up to  $d_{50} < 1 \mu\text{m}$

### 3.9 Final fineness

- Dry grinding up to  $d_{50} < 20 \mu\text{m}$  (depending on the material)
- Wet grinding up to  $d_{50} < 1 \mu\text{m}$  (depending on the material)

## 4 Installation

### 4.1 Transport

The device is delivered on a transport pallet with a wooden cover. We recommend using a forklift or pallet truck for transporting the packed device.

**DANGER!**

Do not step under the transport pallet during transport.

**WARNING!**

Improper lifting can lead to personal injury or property damage. The machine is only to be lifted with suitable equipment and by qualified personnel.

The guarantee excludes all claims for damage due to improper transport.

### 4.2 Unpacking

- Pull out the nails that fasten the lid to the surrounding packaging.
- Remove the lid.
- Take out the accessories.
- Pull out the nails that fasten the surrounding packaging to the transport pallet.
- Then lift the wooden surround over and away from the device.
- The pre-perforated segments can be detached so that the foam parts can be removed more easily.
- Please store the transport packaging so that it can be reused if you need to return the product. Fritsch GmbH accepts no liability for damage caused by improper packaging (packaging that is not from Fritsch).
- Compare the contents of the delivery with your order.

## Installation



*Grinding bowls made of tempered steel may have recesses on the surface caused during production. They do not have an impact on grinding or the grinding results and usually disappear after the first grinding operation.*

*These recesses on the surface, if present, are within the range of the permissible production tolerances. Complaints relating to such grinding bowls therefore cannot be accepted.*

### 4.3 Setting up



#### **DANGER!**

Do not step under the transport pallet during transport.



#### **CAUTION!**

The weight of the planetary mill is approx. 120kg!



#### **NOTICE!**

Never operate the planetary mill while it is standing on the transport pallet!



#### **NOTICE!**

Keep the air outlet on the side ventilation grate free. Risk of overheating!

- Lift the mill from the transport pallet.
- 7 screws connect the mill to the transport pallet. Remove the screws.
- Place the mill with the transport pallet back down.
- Lift the mill off the transport pallet.
- Place the mill on a flat, stable surface. It is not necessary to fasten it in place.  
The mill can be placed on a stable table.
- Make sure that the mill is easily accessible. There has to be sufficient space to reach the main switch on the back side of the device.

#### 4.4 Ambient conditions

**WARNING!****Mains voltage!**

- The device may only be operated indoors.
- The surrounding air may not carry any electrically conductive dust.
- Maximum relative humidity 80% for temperatures up to 31°C, linearly decreasing down to 50% relative humidity at 40°C.

- The room temperature has to stay between 5 - 40°C.
- Altitudes up to 2000 m
- Degree of pollution 2 according to IEC 664.

#### 4.5 Electrical connection

**DANGER!****Provide short-circuit protection!**

Risk of damage due to short-circuits.

- Make sure that the socket is connected to a mains line protected with a residual current circuit breaker.

**DANGER!****Mains voltage!**

Changes to the connection line may only be made by a qualified person.

**CAUTION!**

Ignoring the values on the type plate may result in damage to the electrical and mechanical components.

Before establishing the connection, compare the voltage and current values stated on the type plate with the values of the mains system to be used.

1. ➔ Plug the supplied power cord into the port (11) at the back of the device.
2. ➔ Then connect the device to the mains using the power cord!



The mains voltage has been set at the factory to that of the specific country. The mains voltage only has to be adjusted if it deviates from the value on the type plate. If adjustment is necessary, proceed as in [↪ Chapter 4.5.1.1 'Adjusting the mains voltage with the rotary switch \(8\)' on page 24](#) and [↪ Chapter 4.5.1.2 'Adjusting the mains voltage in setup mode' on page 25](#).



### NOTICE!

Fritsch mills are speed controlled. The devices are equipped for this with frequency converters. In order to comply with the EMC directive, many measures must be taken to prevent operational transient emissions.

The possible leakage currents resulting from filtering measures can trigger a conventional residual current circuit breaker in the mains line. **This is no defect!**

To prevent this, special residual current circuit breakers, which are adapted for operation with frequency converters, are commercially available.

Operation without a residual current switch is possible, but must be done in accordance with the relevant regulations.

## 4.5.1 Adjusting the mains voltage

### 4.5.1.1 Adjusting the mains voltage with the rotary switch (8)



### CAUTION!

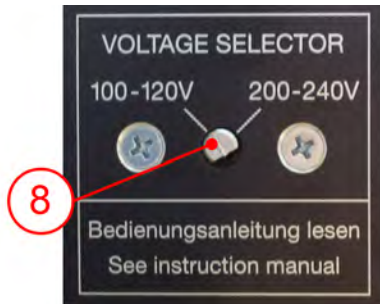
Only qualified personnel may change the voltage range on the device!



### CAUTION!

The voltage range may only be adjusted after the mains has been disconnected.





1. ➤ Disconnect the device from the mains!
2. ➤ The rotary switch (8) for adjusting the mains voltage is located on the back side of the device. Rotate this switch to the required voltage.
3. ➤ Connect the device to the mains.

#### 4.5.1.2 Adjusting the mains voltage in setup mode



1. ➤ Press and hold the STOP button on the front of the control panel.



2. ➤ Switch on the device with the main switch (10) on the back side of the device, and release the STOP button.
3. ➤ If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.



4. ➤ **ROTATIONAL SPEED control panel area**  
Use the +/- ROTATIONAL SPEED buttons to adjust the level of the mains voltage (90-260 V) to the existing mains system.

## Installation



5. ➔ To save and end setup mode, press the STOP button.

### 4.6 Setting device specification in setup mode



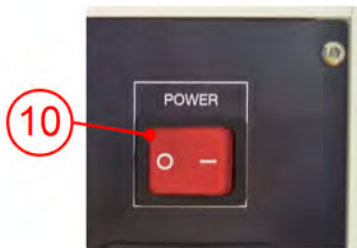
#### NOTICE!

"P5" must always be displayed in the REPETITIONS field. The Fritsch company will give no guarantee for damage resulting from disabling of the imbalance switch.

## 5 Initial start-up

Perform initial start-up only after all work as described in [Chapter 4 'Installation'](#) on page 21 has been carried out.

### 5.1 Switching on



- The device must be connected to the power supply if this has not been done already.
- Switch on the device with the main switch (10) on the back side of the device.
- The POWER SUPPLY lamp on the control panel lights up.

### 5.2 Function check



#### CAUTION!

Only conduct the functional test at a speed of 100 1/min!



- Open the hood (3).
- Take out the grinding bowl tensioning device (Safe-Lock) and transport securing device (wooden block). No loose parts may remain inside the device.
- Close the hood (3).
- Set the speed to 100 1/min. (See [Chapter 6.8.1 'Setting the speed'](#) on page 39).
- Press START on the control panel.
- The hood (3) is locked and the mill starts up at the preselected speed.

## 6 Using the device



### **DANGER!**

Before starting the machine, make sure that the grinding bowl has been tensioned correctly and that there are no loose parts inside the device. There is a risk of loose grinding bowls or parts being projected. Failure to observe this will render void the guarantee, and releases us from liability for any resulting damage to the device or personal injury.



### **CAUTION!**

The grinding element is subject to normal wear when used. Before every grinding operation, check the wall thickness of the grinding bowls. In the event of severe wear, replace the grinding bowl. If this is not done, the prevailing high centrifugal forces during grinding may cause the grinding balls to penetrate the bowl's wall and damage the mill. Failure to observe this will void the guarantee and release us from liability for any resulting damage to the device or personal injury.



### **NOTICE!**

During grinding, the temperatures in the grinding bowl may get very high.

In encased grinding bowls, the inserts are glued into the casing with a two-component construction adhesive.

The adhesive is resistant to temperatures up to approx. 140 °C. Above 140 °C, the adhesive will liquefy and accumulate below the insert in the casing. When the adhesive cools down, it solidifies and pushes the casing up. That can cause irreparable damage to the insert. The grinding bowl will definitely be rendered unusable.

Above temperatures of 200 °C, the adhesive will be destroyed. The same applies for encased grinding bowl lids.



*V-belt, seals, and motor require some time at the beginning before they can reach the optimal output and/or rotation. This means that initially a well-filled and heavy grinding set may be able to operate with less rotations than after an introductory phase of approx. 1 - 2 hours running time.*

## 6.1 Choice of grinding bowls and grinding balls


**CAUTION!**

If the grinding elements used are not genuine accessories, we assume no guarantee and exclude all liability for damage to the device or for personal injury.

The hardness and density (specific weight) of the grinding bowl and grinding balls used must be greater than that of the material used to prevent excessive wear by abrasion.

Material (bowl and balls)	Main components of the material	Density in g/cm <sup>3</sup> High density means high impact energy!	Abrasion resistance	Use for grinding stock
Agate	(99.9% SiO <sub>2</sub> )	2.65	Good	Soft to medium-hard samples
Silicon nitride	(90% Si <sub>3</sub> N <sub>4</sub> )	3.25	Extremely good	Abrasive samples, metal-free grinding
Sintered corundum	(99.7% Al <sub>2</sub> O <sub>3</sub> )	3.9	Fairly good	Medium-hard, fibrous samples
Zirconium oxide	(96,2% ZrO <sub>2</sub> )	5.7	Very good	Fibrous, abrasive samples
Stainless steel	Bowl: (17-19% Cr + 8-10% Ni) Balls: (12.5-14.5% Cr + 1% Ni)	7.8	Fairly good	Medium-hard, brittle samples
Tempered steel	Bowl: (11-12% Cr) Balls: (1.0-1.65% Cr)	7.9	Good	Hard, brittle samples
Tungsten carbide	(93% WC+6% Co)	14.9	Very good	Hard, abrasive samples

The grinding bowls and grinding balls made of zirconium oxide are resistant to acids - apart from hydrofluoric acid.

Normally choose a grinding bowl and grinding balls that are made of the same material.

Exception: Tungsten carbide balls (<20 mm) may be temporarily (a few minutes) combined with grinding bowls made of tempered steel.

## Using the device

### 6.1.1 Size of the grinding balls

Type of feed material	Suitable 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
Fine material < 0.5 mm	10 mm or 5 mm
Homogenisation of dry or liquid samples	10 mm
Homogenisation of viscous samples	20 mm

**These are reference values: The size of bowls and grinding balls may need to be determined through experimentation.**



**NOTICE!**

It is not advisable to mix balls of different diameters. (If balls with different diameters are used, increased wear to the balls is to be expected.)



**NOTICE!**

Balls with a diameter of 40 mm are rarely used for grinding, because this ball size can cause damage to the grinding bowl fast if the grinding duration is too long. Only use grinding balls of this diameter for brief grinding durations.

### 6.1.2 Number of balls per grinding bowl (independent of the material quantity)

A higher number of balls will reduce the grinding time and the grinding result will have a smaller particle size distribution.

Ball diameter (mm)	Grinding bowl volume (ml)	80	250	500
5	Number of balls (pcs)	250 - 300	1200 - 1300	2000 - 2500
10	Number of balls (pcs)	25 - 30	50 - 150	100 - 250
15	Number of balls (pcs)	10	45 - 50	70 - 100
20	Number of balls (pcs)	5	15 - 20	25 - 35
30	Number of balls (pcs)	-	5 - 6	10
40	Number of balls (pcs)	-	-	4

These are reference figures: The number of balls may need to be determined through experimentation.



**CAUTION!**

When grinding with a ball size of Ø 30 mm or Ø 40 mm, do not let the device run unsupervised. The vibrations may lead to shifting.

## Using the device

### 6.1.3 Calculated weight of a ball

Ball diameter in mm		5	10	15	20	30	40
Material	Density in g/cm <sup>3</sup>	Calculated weight of a ball in g					
Agate	2,65	0,17	1,39	4,68	11,1	37,46	88,8
Silicon nitride	3,25	0,21	1,7	5,74	13,61	45,94	108,91
Sintered corundum	3,9	0,25	2,04	6,89	16,33	55,13	130,69
Zirconium oxide	5,7	0,37	2,99	10,07	23,88	80,58	191,01
Stainless steel	7,8	0,51	4,08	13,78	32,67	110,27	261,38
Tempered steel	7,9	0,52	4,13	13,96	33,09	111,68	264,73
Tungsten carbide	14,9	0,97	7,8	26,33	62,41	210,64	499,3

To determine the weight of the required balls, the "calculated weight of a ball" is multiplied by the "number" of balls required.

Example: A 250 ml agate bowl is to be filled with 1221 agate balls with a diameter of 5 mm.

Calculation:  $0.17\text{g} * 1221 \text{ St} \approx 208 \text{ g}$

208 g of grinding balls can be weighed and inserted in the grinding bowl, thus avoiding the time required for counting the balls.

## 6.2 Filling quantities of grinding bowls



### NOTICE!

Never operate the mill without grinding stock! This can lead to grinding balls and grinding bowls getting damaged.



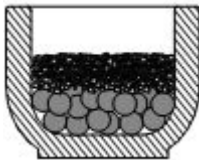
### NOTICE!

If the minimum filling quantity is fallen short of, increased wear due to abrasion is to be expected. This can cause irreparable damage to the mill components.



Grinding bowl	min. sample volumes	max. sample volumes
500ml	80ml	225ml
250ml	30ml	125ml
80ml	1ml	30ml

### 6.3 Filling the grinding bowl



**Do not fail to comply with the following sequence:**

1. ➤ Place the grinding balls in the empty bowl.
2. ➤ Fill grinding stock onto the balls.
3. ➤ Place the seal ring on the rim of the grinding bowl.
4. ➤ Place the lid on the grinding bowl.

### 6.4 Factors with an impact on grinding

#### 6.4.1 Running time (grinding duration)

A longer grinding time will increase the percentage of fine material. To reduce the grinding time, you can use a grinding bowl and grinding balls with a higher density, and thus a higher impact energy.

#### 6.4.2 Speed

Higher speeds shorten the grinding time and increase the share of fine particles.

#### 6.4.3 Reverse mode

- Useful for mechanical alloying
- Improvement of the homogeneity of the sample

#### 6.4.4 Number and size of the balls

Pre-grind course, hard material with large balls:  
reduced percentage of fine material!

Many small balls increase the percentage of fine material during extended running time.

## Using the device

### 6.4.5 Weight of the balls (type of material)

A higher mass (specific weight) of the grinding balls accelerates grinding. (see table in [Chapter 6.1 'Choice of grinding bowls and grinding balls'](#) on page 29).

### 6.4.6 Dry grinding

Below a particle size of approx. 20 µm, the surface forces prevail and the material to be ground starts to "stick".

Additional dry comminution can be achieved by adding surface-active substances to the material to be ground.

Examples (maximum amount to be added in mass%)

- Stearic acid 2-3%
- Aerosil (fine-particle silicic acid) 0.5-2%
- Quartz sand ~ 2%
- Glass powder ~ 2%

### 6.4.7 Wet grinding (grinding in a suspension)



#### **DANGER!**

#### **Explosion hazard! Ignition hazard!**

The device is not explosion-protected. If flammable liquids are used, make sure that the heat developing in the grinding bowl does not reach the solvent's boiling point. Program appropriate cooling phases. If the vapour pressure is too high, vapours may escape and ignite.

If it can be avoided, we recommend using non-flammable liquids or liquids with a high boiling point. The boiling point should be above 80 °C and above 100 °C for a long grinding duration.

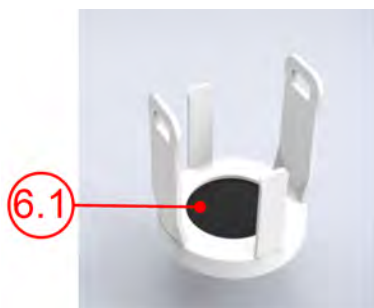
During the transition to grinding in suspension, you can add a liquid auxiliary agent with high boiling point and low vapour pressure, e.g. water, white spirits (boiling point 100 - 140°C), alcohols with a high boiling point (e.g. isopropanol)

## 6.5 Clamping the grinding bowls

### 6.5.1 Clamping with the "Safe-Lock" (5) tensioning device



*Fritsch GmbH confirms that every Safe-Lock clamping system has been manufactured and tested to our internal quality standards. Fritsch GmbH measures the clamping force of each individual Safe-Lock clamping system. The clamping force must be in the range of 11.2 - 11.3 kN +/- 0.2kN.*

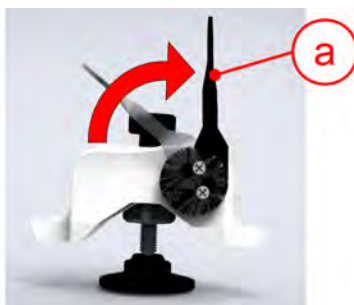


Carry out the following checks for every grinding before clamping the grinding bowls:

- Has the rubber disc (6.1) been inserted into the grinding bowl holder? The rough side should be facing upwards!
- Check the rubber disc in the grinding bowl holder for damage: Replace the rubber disc if it has been pressed flat!
- The Teflon flat seal (for the sealing between lid and bowl) may not be damaged or soiled. Replace heavily deformed Teflon flat seals.
- The surfaces of the lids and bowls on which the Teflon flat seals lie must be clean!
- Check the rubber disc of the pressure piece for damage! Replace rubber discs that have been pressed flat and are protruding laterally from the pressure piece.

#### Clamping

1. → Position the bracket (a) of the clamping lever vertically!



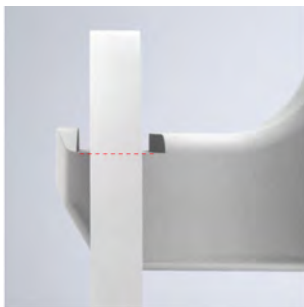
2. → Hang the longer projection of the Safe-Lock tensioning device onto the cut-out of the grinding bowl holder.



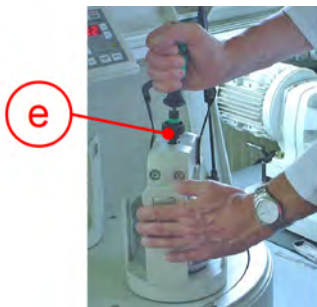
## Using the device



3. ➤ Hang the short projection of the Safe-Lock tensiing device into the other side.



4. ➤ Push the Safe-Lock tensiing device so that the cut-out of the grinding bowl holder sits centrally in the U-shaped cut-out of the longer projection.



5. ➤ Pre-tension the setting screw (e) manually, then place the provided torque spanner on the setting screw (e) and turn until it clicks.



6. ➤ Then press the clamping lever downwards. The Safe-Lock system is now tensioned!



### **DANGER!**

After several minutes of grinding and in the cooling-down phases, check that the tensiing device is firmly connected.



*If the Safe-Lock system is correctly tensioned, the clamping lever is automatically pulled downwards by the eccentric when horizontal.*

## 6.5.2 Clamping the 80 ml grinding bowls

There are two ways of clamping an 80 ml grinding bowl:



1. → Place the reducer (o) (order no. 90.1120.09) into the grinding bowl holder and position the 80ml grinding bowl on it and fasten with the Safe-Lock tensioning device.



2. → Alternatively, clamp two 80 ml grinding bowls on top of one another.



*Tensioning with the Safe-Lock system proceeds as described in ↗ Chapter 6.5.1 'Clamping with the "Safe-Lock" (5) tensioning device' on page 35.*

## 6.6 Mass balance

Load the laboratory planetary mill symmetrically.

Always clamp an equally heavy grinding bowl with lid and seal ring in the opposite grinding bowl holder to balance the weight!

Failing that, select an empty bowl as a counterweight. The empty bowl may be filled with sand as an additional weight.



### NOTICE!

Extra weights, like "GTM" and "additional clamping system", have to be balanced as well.

## 6.7 Grinding duration



### WARNING!

#### Burn hazard!

Grinding bowls can get very hot after long grinding durations. Wear protective gloves for removal after grinding or during the grinding breaks.

## Using the device

Depending on the application, the grinding duration should be adapted to the development of heat in the bowls. The temperature inside the bowls is 20 - 30 °C warmer than the outer casing temperature.



### CAUTION!

The maximum temperature of the grinding bowl outer casing is 100 - 110 °C (agate, max. 70 - 80 °C).

The grinding duration is therefore based on the maximum bowl temperature. The grinding duration at which the temperature is not exceeded depends on the material, ball, and speed. For this reason, the user should determine it through experimentation.

### Reference value

When grinding at high speeds and with large bowls, a grinding duration of one hour (depending on the temperature) should not be exceeded. Then allow the unit to cool down for half an hour to one hour.



### NOTICE!

- Observe the warming up of the grinding stock.
- A longer running time may require pause times for cooling down.
- Check that the tensioning device is firmly connected when switching on again after a cooling-down phase.



### NOTICE!

If bowls are removed during a grinding pause, check that they fit correctly before the device is switched back on.



*The extent to which the heating up of grinding stock needs to be observed depends on the sample used in each individual case. Note → A longer running time may also require a longer pause time for cooling down.*

To reduce the grinding time, you can use a grinding bowl and grinding balls with a higher density, and thus a higher impact energy.

The mill can also run for several hours during low-speed operations for mixing and homogenisation.

Operation with an external time switch is not possible.

## 6.8 Settings on the control panel

### 6.8.1 Setting the speed



- Switch on the main switch (10) on the back side of the device (I).
- The green POWER SUPPLY ready status indicator lights up on the control panel.



#### ROTATIONAL SPEED control panel area

Press and hold the + or - button.

The speed can be selected in steps of 10 between 50 and 400 1/min.

The actual speed is displayed during operation. The nominal speed is briefly displayed when the + or - button is pressed.

### 6.8.2 Setting the running time



#### TIMER control panel area

##### Setting the grinding time

1. ➤ Press the "MILLING" button.
  - ⇒ The "MILLING" button lights up
2. ➤ Press the + or - buttons to set the running time in hours (0...99) and minutes (0...59)!

##### Set the pause time

1. ➤ Press the "PAUSE" button.
  - ⇒ The "PAUSE" button lights up.
2. ➤ Press the + or - buttons to set the pause time in hours (0...99) and minutes (0...59)!

If no pause time is required, set the pause time to 0.

## Using the device



- If the combination minutes/seconds is set in setup mode instead of hours/minutes (see Chapter 6.8.2.1 'Changing the time unit in setup mode' on page 40), the numbers at **h** indicate the minutes and at **min**, the seconds!
- The **factory setting** of the time unit is minutes and seconds. (Display: 1)
- The remaining running times and the pause times are displayed during operation.
- Operation with an external time switch is not possible.
- For running times see Chapter 6.4.1 'Running time (grinding duration)' on page 33.
- Interrupt grinding by pressing the STOP button. Continue grinding by pressing the START button. This takes into account the previous grinding duration and the number of repetitions.

### 6.8.2.1 Changing the time unit in setup mode



1. When the device has been switched off, press and hold the STOP button on the front control panel.



2. Switch on the device with the main switch (10) on the back side of the device.
3. If POWER SUPPLY is flashing, the device is in setup mode. If POWER SUPPLY is not flashing, repeat the procedure.





4. ➔ To perform changes, press the right "+" button (y) in the TIMER field:  
 Time unit, hours and minutes → Display: -  
 Time unit, hours and minutes → Display: 1 (factory setting)
5. ➔ To save and end setup mode, press the STOP button.

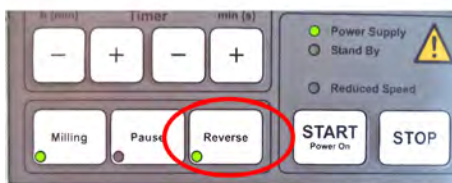
### 6.9 Repetition of grinding / pause cycles



#### REPETITIONS control panel area

Press + or - button; select the number of repetitions (0..99). The number of remaining cycles is displayed during operation.

### 6.10 Reverse mode

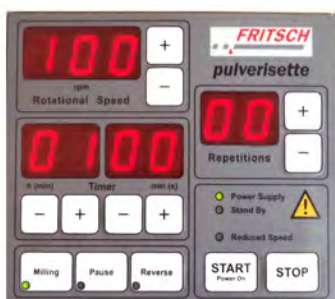


→ Press the REVERSE button. The button lights up.

After the selected running time expires, the mill will change its direction of rotation. For this, REPETITIONS has to indicate at least 1.

"Reverse" is selected when mixing dry samples, for example.

### 6.11 Conducting a grinding operation



- After all the preparations described in [Chapter 6.1 'Choice of grinding bowls and grinding balls'](#) on page 29 to [Chapter 6.10 'Reverse mode'](#) on page 41 have been carried out, close the hood (3).
- Press the START button on the control panel.
- The hood is locked and the mill starts up.
- The mill turns at the set speed (nominal speed). If the load is too great, for example due to heavy grinding bowls, the speed is reduced (actual speed) so that the machine is not overloaded.  
 → The "REDUCED SPEED" lamp is lit!

## Using the device



If the mill does not start, see [↪ Chapter 10 'Repairs'](#) on page 55



While in operation, the hood (3) remains locked, even during pause times, and the fan cools the interior.

### 6.11.1 Overload

If the mill is overloaded, the speed is reduced and the REDUCED SPEED light flashes.

The mill switches off if the overload continues for too long; see [↪ Chapter 10.1 'Checklist for troubleshooting'](#) on page 55.

### 6.11.2 Switching off

- Press STOP on the control panel.
- When the drive comes to a standstill, the hood is unlocked and can be opened.
- If the device is not in operation for a long time, switch off the main switch (10) on the back side.

## 6.12 Cooling the grinding bowl



### **WARNING!** **Burn hazard!**

Grinding bowls can get very hot after long grinding durations. Wear protective gloves for removal after grinding or during the grinding breaks.

- When the hood is open (3), or
- In the programmed pause times with closed (locked) hood and the fan running.

### 6.13 Stand-by

If the mill is not in operation and the hood (3) is open, it switches to the energy-saving stand-by mode after one hour. The STAND-BY lamp lights.

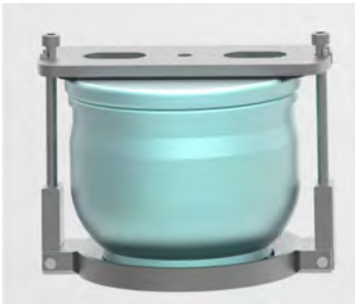
The stand-by function is not possible when the hood is closed.

## 7 Accessories

### 7.1 Additional clamping system for grinding harmful substances or in a gas atmosphere.

The additional clamping system is used to transport a grinding bowl filled with inert gas or harmful substances from a glove box to the planetary mill and back again. This ensures that no harmful substances can be inhaled.

**There are two ways of gassing the grinding bowls:**

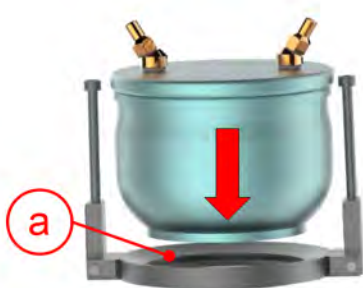


1. ➤ Grinding bowls with standard lids have to be filled in a glove box with an inert gas atmosphere and closed using the additional clamping system. Using this procedure you can even grind hazardous substances!

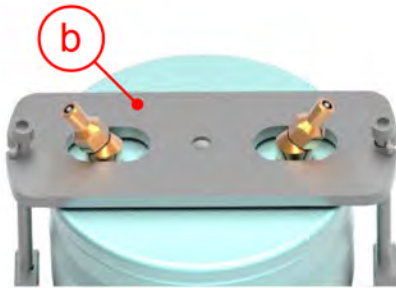


2. ➤ Grinding bowls with gassing lids can also be closed and gassed outside the device using the additional clamping system.

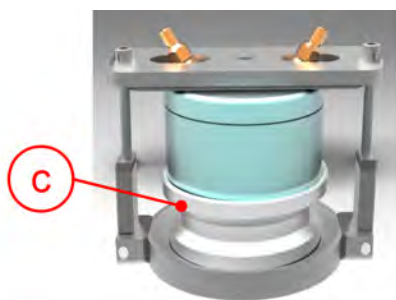
#### 7.1.1 Locking the additional clamping system into place



1. ➤ Place the grinding bowl in the grinding bowl adapter (a) of the additional clamping system.



2. → Position the pressure plate (b) with the rubber disc on the bowl as shown in the picture.



3. → When using grinding bowls with a volume of 80 ml, the adapter piece (c) (90.1120.09) has to be used as well.



**NOTICE!**

Under no circumstances may 80 ml bowls be clamped on top of one another. This can lead to damage to the bowl and its component seals.



4. → Then tighten both socket-head screws (d) shown in the diagram equally with a hex key and thereby clamp the pressure plate tightly. Ensure that the pressure plate is lying evenly on the bowl lid.



5. → Place the additional clamping system with clamped bowl in the grinding bowl holder.

## Accessories



6. ➤ The pressure piece has to be removed in order to use the Safe-Lock system for tensioning.



7. ➤ Position the bracket (d) vertically!



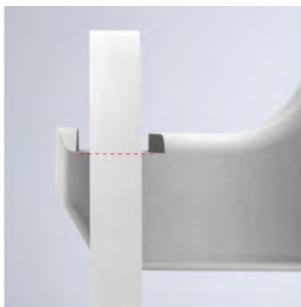
8. ➤ Hang the longer projection of the Safe-Lock tensioning device onto one side of the mounting of the grinding bowl holder.



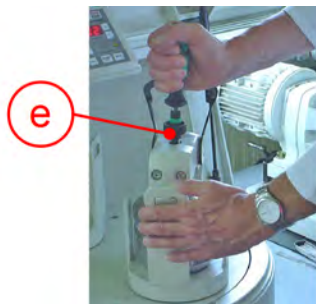
9. ➤ Hang the short projection of the Safe-Lock tensioning device onto the other side.



- 10.** ➤ Ensure that the tenon joint of the threaded spindle (where the pressure piece was previously affixed) is sitting in the bore hole provided in the pressure plate (b).



- 11.** ➤ Push the Safe-Lock tensing device so that the mounting of the grinding bowl holder sits centrally in the U-shaped cut-out of the longer projection.



- 12.** ➤ Pre-tension the setting screw (e) manually, and screw it tight using the provided torque spanner. Place the torque spanner provided on the setting screw (b) and turn until it clicks.



- 13.** ➤ Then press the clamping lever downwards.  
**14.** ➤ Re-tighten the screws in the additional clamping system with a hex key. The additional clamping system may be loosened due to the clamping of the Safe-Lock using the clamping lever.



**DANGER!**

After several minutes of grinding and in the cooling-down phases, check that the tensing devices are still firmly connected.



*If the Safe-Lock system is correctly tensioned, the clamping lever is automatically pulled downwards by the eccentric when horizontal.*

## 7.2 Grinding in inert gas with gassing lid



### NOTICE!

Observe imbalance offsetting! (See [↪ Chapter 6.6 'Mass balance'](#) on page 37).



We carry out a worker water bath test on all gassing lids. The part to be tested is sealed, a pressure of 5.5 bar is applied and it is immersed in a water bath. If there is a leak, bubbles will develop. The air bubbles that develop within a specific interval are evaluated by the worker/tester.

Only gassing lids with a leak rate of  $<10^{-4}$  [mbar l/s] are approved.

When grinding in inert gas, the same conditions apply regarding clamping and composition of grinding set and balls, as apply for standard grinding.

Two valves are screwed onto the gassing lid through which you can feed in inert gas (e.g. nitrogen) before switching on the mill. A Viton flat seal is used instead of a Teflon one.

### 7.2.1 Preparation for gassing



- a Gassing hose
- b Hose clamp
- c Coupling
- d Valves
- e Ventilation attachment


- Fill the grinding bowl with grinding balls and grinding stock. (See [↪ Chapter 6.3 'Filling the grinding bowl'](#) on page 33)
- Attach the Viton seal and lid.
- Insert the grinding bowl into the grinding bowl holder (8).
- Clamp the grinding bowl in the device (See [↪ Chapter 6.5.1 'Clamping with the "Safe-Lock" \(5\) tensioning device'](#) on page 35)

**Using the additional clamping system, the following steps can also be completed in the glove box and subsequently clamped in the Planetary Mill:**

- Connect the gassing hose (a) to the inert gas supply using the provided hose clamp (b).
- Screw the ventilation attachment (e) onto one of the two valves (d).
- Place the coupling (c) of the gassing hose on the free valve. When doing so, press the lever of the coupling and push the coupling along the neck of the valve until it goes no further. Release the lever.





Using the additional clamping system, the closed grinding bowl can also be tensioned and gassed outside of the device. (See  Chapter 7.1.1 'Locking the additional clamping system into place' on page 44)

## 7.2.2 Gassing

- Slowly open the inert gas supply.
- Press a thin object (e.g. hex key) onto the top of the ventilation attachment (e) so that the air can escape from the grinding bowl.
- The inert gas now purges the air from the grinding bowl.
- The duration of purging has to be determined through experimentation.  
It depends on grinding bowl size, filling, and gas supply, among other factors.
- To end purging, close the inert gas supply and release the ventilation attachment.
- Screw off the ventilation attachment.
- Remove the gassing hose. To do so, press the lever.



### CAUTION!

Only switch on the device when both coupling and ventilation attachment have been removed.

Overpressure may occur during grinding!

## 7.2.3 Ventilate after grinding



### CAUTION!

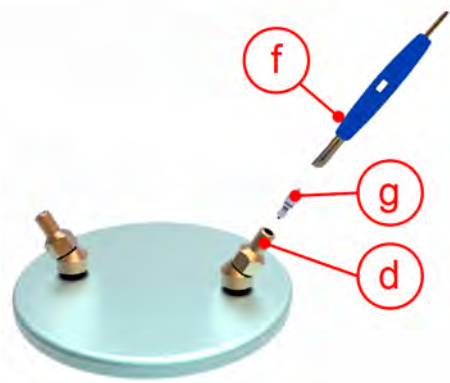
Always let the bowl cool down before ventilation. Hot gases and sample material may escape from the bowl during pressure equalisation, leading to serious burns.

→ Use protective gloves when ventilating!

- Screw the ventilation attachment onto the valve.  
Each valve can be used for aerating or ventilating.
- For pressure equalisation (of the overpressure occurring because of grinding), carefully press on the ventilation attachment with a thin object (e.g. hex key).
- Only now may the grinding bowl tensioning be released.

## Accessories

### 7.2.4 Cleaning the valves



- f Valve screwdriver
- g Valve insert
- d Valves

Both valves (d) should be cleaned after every grinding!

- Insert the thin end of the valve screwdriver (f) from above into the valve (d) and turn anti-clockwise.
- Screw out the valve insert (g).
- Depending on the soiling, clean the valve insert (g) with compressed air, or place it in a small glass container filled with alcohol and clean in an ultrasonic cleaner (LABORETTE 17) and then dry carefully.
- After the two valve inserts have been removed, the two valve holders can be cleaned with compressed air from above the lid.

### 7.2.5 Installing valve inserts

- Insert the valve insert (g) into the valve (d) with the spring pointing upwards.
- With the valve screwdriver (f), screw the valve insert clockwise.

The following gassing lids for the grinding sets are available, each with two valves and a soft sealing ring:

Material	Order number
Hardmetal tungsten carbide 250 ml	50.8600.00
Tempered chrome steel 80 ml	50.8700.00
Tempered chrome steel 250 ml	50.8500.00
Tempered chrome steel 500 ml	50.8400.00
Stainless steel 80 ml	50.8800.00
Stainless steel 250 ml	50.8300.00
Stainless steel 500 ml	50.8200.00
Agate 250 ml	50.8100.00
Agate 500 ml	50.8000.00



#### NOTICE!

The soft black sealing rings made of "Viton" can endure temperatures of approx. 200 °C.

The valves (d) can endure temperatures of approx. 180 °C for one hour at most.

**NOTICE!**

The grinding parts made of agate are only designed for temperatures of up to 100 °C. After this point, they need to be slowly and carefully cooled down.

**7.3 GTM - system**

The GTM system is available as an accessory for recording pressure and temperatures in the grinding bowl during grinding.

Instructions are included with the GTM system.

## 8 Cleaning



### DANGER!

#### Mains voltage!

- Before beginning with cleaning work, disconnect the mains plug and protect the device against being unintentionally switched back on!
- Do not allow any liquids to flow into the device.
- Indicate cleaning work with warning signs.
- Put safety equipment back into operation after cleaning work.



*When cleaning the entire device, adhere to the guidelines of the Accident Prevention Regulation (BGV A3) - especially when the device has been set up in a dusty environment or when the grinding stock processed produces dust.*

### 8.1 Grinding elements



### NOTICE!

Cool grinding elements made of agate, sintered corundum, zirconium oxide and silicon nitride slowly and carefully.

Do not heat agate elements in a microwave under any circumstances (heating is too fast).

They must never be exposed to thermal shocks as this could cause irreparable damage to the parts → They will burst apart like in an explosion.

- Clean the grinding bowl and grinding balls each time after using them: Clean them, e.g., under running water using a brush and a commercially available cleaning agent.
- Half fill the grinding bowl with grinding balls, sand and water, and run for 2 to 3 minutes (correctly tensioned) in the Planetary Mill.
- Cleaning with an ultrasonic cleaner is permitted.
- For sterilisation in the heat cabinet, only heat the grinding elements up to 100 °C.

### 8.2 Mill

- The planetary mill can be wiped down with a damp cloth when it is switched off.

## 9 Maintenance



### DANGER!

#### Mains voltage

- Before beginning with maintenance work, unplug the mains plug and protect the device against being unintentionally switched back on again!
- Indicate maintenance work with warning signs.
- Maintenance work may only be performed by specialised personnel.
- Put safety equipment back into operation after maintenance or repair work.



We recommend keeping a safety logbook ↗ Chapter 15 'Safety logbook' on page 64, where all work (maintenance, repairs.....) performed on the device is entered.



- The most important element of maintenance is regular cleaning:
- When cleaning the complete device, adhere to the guidelines of the Accident Prevention Regulation (BGV A3) - especially if the device has been set up in a dusty environment or if the processed source material produces dust.



### NOTICE!

Safe-lock - clamping systems might lose their tension force over time of usage. To watch the right tension force of each Safe-lock - clamping system Fritsch GmbH stipulates a scheduled maintenance interval of one year. Please send back all Safe-lock - clamping systems for regular checks to Fritsch GmbH. This service is liable to pay the costs.

Functional part	Task or description	Test	Maintenance interval
Safety lock	Hood lock (7)	Is the closed hood (3) locked in place when the main switch is off?  If this test is failed, do not continue to work until the fault has been rectified.	Before each use
Rotating bearings	Permanent lubrication	Bearing clearance	Every 2,000 h or annually

## Maintenance

Functional part	Task or description	Test	Maintenance interval
Drive motor	Permanent lubrication	Bearing clearance	Every 4,000 h or annually
V-belt	Motor planetary disc	Check belt tension  Disconnect the device from the mains. Screw off the top rear cover plate. The belt must not slacken by more than 10 mm when pushed with your thumb.	Once a year
Fan, ventilation slots (13)	Grinding chamber cooling and electronics	Clean functional parts when soiled (right and left side of the device, as in the interior)	Twice a year
Grinding bowl tensioning device, Safe-Lock (5) (Fig. 1)	Rubber of the pressure piece and rubber disc in the grinding bowl holder	Signs of use; replace if pressed flat and no longer elastic	After every 1,000 h
	Indicated surfaces of Safe-Lock are round Original height, 12.5 mm Minimum height, 12 mm (y)	Safe-Lock has frequently been tensioned too loosely	After every 200 h If the height is under the minimum height, the corresponding part has to be replaced.
Seal the grinding bowl	Grinding bowl lid seal	Replace seal if dirt has penetrated	After every 100 h
Grinding bowl holder (8) (Fig. 2)	Keep tension Original height, 14 mm	Minimum measurement at grinding bowl holder, 11 mm (x)	Twice a year; this minimum measurement may have to be checked more often depending on use.  If the height is under the minimum height, the corresponding part has to be replaced.

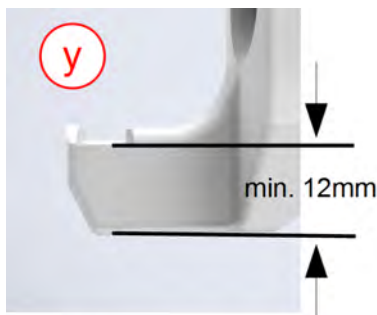


Fig. 1

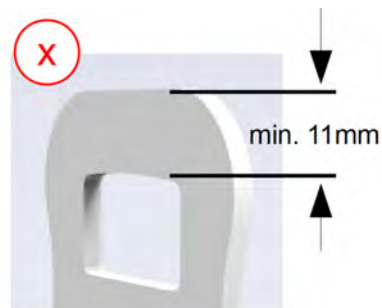


Fig. 2

## 10 Repairs


**DANGER!**
**Mains voltage!**

- Before beginning with repair work, unplug the mains plug and protect the device against being unintentionally switched back on.
- Indicate repair work with warning signs.
- Repair work may only be performed by specialised personnel.
- Put safety equipment back into operation after maintenance work.

### 10.1 Checklist for troubleshooting

Fault description	Cause	Remedy
The POWER SUPPLY ready status indicator doesn't light up	No mains connection	Plug in mains plug.
	Main switch (10) at 0 (OFF)	Switch on main switch.
	Excess current protection switch has been triggered	Press the excess current protection switch (9) on the back of the device.
"START" button is pressed but mill does not start up	POWER SUPPLY does not light up	see above
	Pause time active	Wait for end of pause or press "STOP".
	Safety lock was opened manually	Reactivate the safety lock, see <a href="#">Chapter 2.6 'Protective equipment' on page 14</a>
Mill reduces speed automatically	If REDUCED SPEED is lit: Overload	Reduce load or accept automatically set speed.
Mill stops running	Switched off due to thermal overload of the drive	Allow device to cool down and select a lower speed.
	Imbalance of machine too high	Improve mass balance. (See <a href="#">Chapter 6.6 'Mass balance' on page 37</a> ).
	Drive was blocked	Rectify malfunction in grinding chamber.
	Motor's V-belt loose or ripped	Check V-belt, replace if necessary.
	Speed sensor is defective	Contact customer service.
The hood cannot be opened.	The hood handle (1) was not properly operated during opening.	Unlock the hood handle by pressing!

## Repairs

Fault description	Cause	Remedy
	No mains connection	Plug in mains plug.
	Main switch at 0 (OFF)	Switch on main switch (I).
	Excess current protection switch has been triggered	Press the excess current protection switch (9) on the back of the device
Grinding stock escapes	Tensioning device (5) loose	Check and re-tension if necessary.
	Seal ring between the bowl and lid is soiled or defective	Clean or replace seal ring.
Runs unevenly with strong vibrations	Bowls are imbalanced	Align the bowls symmetrically (equal masses in the opposing position)



## 11 Examples of comminution tasks

<b>Material</b>			
<b>Feeding amount</b>	<b>Material of grinding bowl and balls</b>	<b>Grinding balls, St. x diameter</b>	<b>Result</b>
<b>Feed size</b>	<b>Grinding bowl size</b>	<b>Grinding duration</b>	<b>Final fineness</b>
<b>Ruby (stone)</b>			
140 g	Cr-Ni steel	6 x 30 mm	100%
12 mm	250 ml	3 min	< 250 µm
<b>Titanium dioxide TiO<sub>2</sub> (dry and wet grinding in water)</b>			
40 g	Cr-Ni steel	6 x 30 mm	100%
2 mm	250 ml	30 min	< 40 µm
<b>Titanium dioxide TiO<sub>2</sub> (wet grinding in water)</b>			
40 g / 50 ml water	Cr-Ni steel	6 x 30 mm	100%
2 mm	250 ml	60 min	< 10 µm
<b>Coal (dry and wet grinding in water)</b>			
5 g	Zirconium oxide	5 x 20 mm	100%
0.5 mm	80 ml	120 min	< 15 µm
<b>Aluminium oxide / silicon oxide</b>			
100 g	WC + Co	15 x 20 mm	90%
0.1 mm	250 ml	90 min	< 20 µm
<b>Ferrovandium</b>			
70 g	WC + Co	5 x 30 mm	70%
3 mm	250 ml	20 min	< 100 µm
<b>Glass</b>			
50 g	Agate	15 x 20 mm	100%
4 mm	250 ml	15 min	< 90 µm
<b>Silicon carbide (dry and wet grinding in water)</b>			
15 g	WC + Co	5 x 20 mm	100%
3 mm	80 ml	30 min	< 150 µm
<b>Silicon carbide (dry and wet grinding in water)</b>			
15 g / 5 ml water	WC + Co	5 x 20 mm	100%
3 mm	80 ml	45 min	< 71 µm

## Examples of comminution tasks

<b>Raw phosphate</b>			
40 g	Cr steel	15 x 20 mm	100%
3 mm	250 ml	2 min	< 250 µm
<b>Manganese dioxide MnO<sub>2</sub> (wet grinding in water)</b>			
50 g / 40 ml water	WC + Co	15 x 20 mm	100%
0.1 mm	250 ml	60 min	< 20 µm
<b>Sludge (dry)</b>			
180 g	Al <sub>2</sub> O <sub>3</sub>	10 x 30 mm	100%
8 mm	500 ml	30 min	< 250 µm
<b>Active carbon (wet grinding in water)</b>			
150 ml	Cr-Ni steel	15 x 20 mm	100%
0.025 mm	250 ml	30 min	< 5 µm
<b>Plaster</b>			
300 g	Cr steel	10 x 30 mm	100%
10 mm	500 ml	20 min	< 200 µm
<b>Protein</b>			
50 g	Sintered corundum 1	6 x 30 mm	90%
20 mm	250 ml	90 min	< 50 µm
<b>Grains (barley)</b>			
100 g	Sintered corundum 1	3 x 40 mm	100%
3 mm	500 ml	20 min	< 150 µm
<b>Dough products</b>			
100 g	Sintered corundum 1	10 x 30 mm	100%
5 mm	500 ml	3 min	< 250 µm
<b>Sugar (wet grinding in alcohol)</b>			
200 g	Agate	10 x 30 mm	100%
1 mm	500 ml	45 min	< 10 µm

## 12 Disposal

It is hereby confirmed that FRITSCH has implemented the directive 2002/95/EC of the European Parliament and Council from 27th January 2003 for the limitation of the use of certain dangerous substances in electrical and electronic devices.

FRITSCH has registered the following categories according to the German electrical and electronic equipment act, section 6, paragraph 1, clause 1 and section 17, paragraphs 1 and 2:

**Mills and devices for the preparation of samples have been registered under category 6 for electrical and electronic tools (except for large stationary industrial tools).**

**Analytical devices have been registered under category 9, monitoring and control instruments.**

It has been accepted that FRITSCH is operating only in the business-to-business area. The German registration number for FRITSCH is WEEE reg. no. DE 60198769

### **FRITSCH WEEE coverage**

Since the registration of FRITSCH is classified for bilateral transactions, no legal recycling or disposal process is described. FRITSCH is not obliged to take back used FRITSCH devices.

FRITSCH declares it is prepared to take back used FRITSCH devices for recycling or disposal free of charge whenever a new device is purchased. The used FRITSCH device must be delivered free of charge to a FRITSCH establishment.

In all other cases FRITSCH takes back used FRITSCH devices for recycling or disposal only against payment.

## 13 Guarantee terms

### Guarantee period

As manufacturer, FRITSCH GmbH provides – above and beyond any guarantee claims against the seller – a guaranty valid for the duration of two years from the date of issue of the guarantee certificate supplied with the device.

Within this guarantee period, we shall remedy all deficiencies due to material or manufacturing defects free of charge. Rectification may take the form of either repair or replacement of the device, at our sole discretion. The guarantee may be redeemed in all countries in which this FRITSCH device is sold with our authorisation.

### Conditions for claims against the guarantee

This guarantee is subject to the condition that the device is operated according to the instructions for use / operating manual and its intended use.

Claims against the guarantee must include presentation of the original receipt, stating the date of purchase and name of the dealer, together with the complete device type and serial number.

**For this guarantee to take effect, the answer card entitled "Securing of Guarantee" (enclosed with the device) must be properly filled out and despatched without delay after receipt of the device and be received by us within three weeks or alternatively, online registration must be carried out with the above-mentioned information.**

### Reasons for loss of the guarantee

#### The guarantee will not be granted in cases where:

- Damage has arisen due to normal wear and tear, especially for wear parts, such as: Crushing jaws, support walls, grinding bowls, grinding balls, sieve plates, brush strips, grinding sets, grinding disks, rotors, sieve rings, pin inserts, conversion kits, sieve inserts, bottom sieves, grinding inserts, cutting tools, sieve cassettes, sieve and measuring cell glasses.
- Repairs, adaptations or modifications were made to the device by unauthorized persons or companies.
- The device was not used in a laboratory environment and/or has been used in continuous operation.
- Damage is present due to external factors (lightning, water, fire or similar) or improper handling.
- Damage is present that only insubstantially affects the value or proper functioning of the device.
- The device type or serial number on the device has been changed, deleted, removed or in any other way rendered illegible
- The above-mentioned documents have been changed in any way or rendered illegible.

**Costs not covered by the guarantee**

This guarantee excludes any costs for transport, packaging or travel that accrue in the event the product must be sent to us or in the event that one of our specialist technicians is required to come to your site. Any servicing done by persons not authorised by us and any use of parts that are not original FRITSCH accessories and spare parts will void the guarantee.

**Further information about the guarantee**

The guarantee period will neither extend nor will a new period of guarantee begin in the event that a claim is placed against the guarantee.

Please provide a detailed description of the type of error or the complaint. If no error description is enclosed, we shall interpret the shipment as an assignment to remedy all recognisable errors or faults, including those not covered by the guarantee. Errors or faults not covered by the guarantee shall in this case be rectified at cost.

We recommend reading the operating manual before contacting us or your dealer, in order to avoid unnecessary inconvenience.

Ownership of defective parts is transferred to us with the delivery of the replacement part; the defective part shall be returned to us at buyer's expense.

**NOTICE!**

Please note that in the event that the device must be returned, the device must be shipped in the original Fritsch packaging. Fritsch GmbH denies all liability for any damage due to improper packaging (packaging not from Fritsch).

Any enquiries must include a reference to the serial number imprinted on the type plate.

## 14 Exclusion of liability

Before using the product, be sure to have read and understood this operating manual.

The use of the product requires technical knowledge; only commercial use is permitted.

The product may be used exclusively within the scope of applications set down in this operating manual and within the framework of guidelines put forth in this operating manual and must be subject to regular maintenance. In case of non-compliance, improper use or improper maintenance, the customer assumes full liability for the functional capability of the product and for damage or injury arising from violating these obligations.

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Neither compliance with this operating manual nor the conditions and methods used during installation, operation, use and maintenance of the product can be monitored by Fritsch GmbH. Improper execution of the installation can result in property damage and thus endanger persons. Therefore, we assume absolutely no responsibility or liability for loss, damage or costs that result from errors at installation, improper operation or improper use or improper maintenance or are in any way connected to these.





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