

Operating Manual



translation of the original



PULVERISETTE 2

FRITSCH Laboratory Mortar Grinder

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Fritsch GmbH, Laboratory Machines was awarded certification on 21 November 2003 by the TÜV-Zertifizierungsgemeinschaft e.V.



Proof of fulfilment of the requirements of DIN EN ISO 9001:2000 by Fritsch GmbH was given by means of an audit.

The enclosed attestation of conformity outlines the standards which the laboratory mortar grinder "pulverisette 2" fulfils in order to carry the CE symbol.



Instrument number 02.2000.00
valid from serial number 0101

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1 General / introduction

1.1 Operating manual instructions

- The copyright of these technical documents belongs to Fritsch GmbH, Laboratory Machines.
- Reprint and reproduction of this operating manual is only allowed with the permission of Fritsch GmbH, Laboratory Machines.
- Study the operating manual carefully.
- Operating personnel must be acquainted with the contents of the operating manual.
- Please follow the safety instructions.
- The mortar grinder was designed with operational safety in mind; however, residual dangers cannot be ruled out. The instructions in this manual must be followed in order to avoid injury to the operators.
- The symbols on the right-hand side indicate the dangers mentioned in the text.
Some symbols can also be found on the machine itself and warn of possible risks.
Warning symbols are indicated by an outlining triangle.
- This operating manual is not a complete technical description. Only elements required for operation and service maintenance are described.



1.2 Explanations of the signs at the instrument and in the operating instructions

<p>Attention! warning against danger spot observe operating instructions</p>	
<p>Attention! mains voltage</p>	
<p>Attention! risk of explosion</p>	

<p>Attention! hot surface</p>	
<p>Wear safety goggles!</p>	
<p>wear protective gloves!</p>	
<p>With water syringes forbade!</p>	

1.3 Short description of the machine

1.3.1 Areas of application

The mortar grinder “pulverisette 2” can be used for universal dry and wet milling to a fineness level suitable for analysis.

It is used during synthesis for mixing or homogenizing dry samples, emulsions or pastes.

It crushes mineral and organic samples for analysis, quality checks or material testing, for example:

Mining / metallurgy	Ores, coal, coke, ashes
Chemistry	Fertilizers, dyes, pesticides, salts ,detergents, synthetic resins
Geology / mineralogy	Minerals (up to and including a Moh´s hardness of 9), calcites, quartz, silicates
Glass	Sand, frits, glass, raw material
Ceramics	Porcelain, fire-clay, Sintered ceramics, Clay
Agriculture	Soil samples, Fertilisers, Organic plant materials
Foodstuffs	Confectionery, gelatine, spices, yeast, pasta, sugar
Metallurgy	Bauxite, slags, additives
Pharmacy	Dragées, drugs, tablets, pastes raw materials

Rocks soils	/	Gypsum, lime, clinker, sand, cement
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1.3.2 Operating procedure

One of the oldest known grinding procedures for food is with hand mortar and pestle. Archaeologists found a mortar bowl with a crushing rock in Jordan and believe it to be approximately 10 000 years old. So it's been around for a while!

Similar to a hand mortar and pestle, the material in the laboratory mortar grinder is crushed with the use of pressure and friction. However, contrary to the hand mortar and pestle, the mortar bowl is driven by a motor in the laboratory mortar grinder – the axle of the rotating pestle can be moved along the horizontal plane. The comparably large pestle ensures quick and even crushing and grinding of the sample.

Sticky or adhesive materials can be ground in suspension by adding liquid. The liquid can be added or topped up during the grinding process.

The ground sample is carried in the rotating mortar bowl, scraped from the sides with a vulkollan scraper, turned over as with a plough, and exposed to the pestle again.

In contrast to the predominately flat hand mortar bowls, the mortar area of the deep mortar bowl in the laboratory mortar grinder is closed and sealed with rubber lips, so that there is basically no loss during crushing.

Adjustable grinding time periods and pestle pressures guarantee consistent grinding conditions – and the grinding process can be observed thanks to a Plexiglas window.

The extremely robust construction of the motor, pestle guidance and all mobile components ensure that the laboratory mortar grinder can be operated for many years.

1.4 Technical data

Dimensions and weight

Dimensions: 410 x 310 x 460 mm (height x width x depth)

Box: 570 x 400 x 620 mm

Weight: 24 kg (net), 34 kg (gross)

Voltage

The machine can be operated in two voltage ranges:

- Single-phase alternating voltage 100-120V \pm 10% and
- Single-phase alternating voltage 200-240V \pm 10%.

Transient over voltages according to over voltage category II allowed.

Current consumption

The maximum current consumption is appr. 0.8 A at 200-240V, 1.8 A at 100-120V.

Electrical safety devices

Attached to the back of the machine is :

- A fuse in the mains supply unit.
- An overload fuse for the drive motor.

Material

The feed particle size of the material to be ground must not exceed 6-8 mm, nor should the amount of materials exceed approximately 150 ml. (Larger samples should possibly be precrushed.)

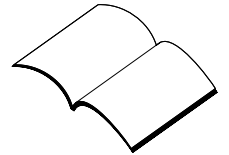
Final fineness

The final fineness is dependent on the duration of the grinding – if the grinding process is given sufficient time, an average grain size of 10 μ m can be achieved.

2 Operational safety

2.1 General safety instructions

- Read the operating manual carefully.
- The mortar grinder may only be used for the purposes described in chapter [1.3.1 Areas of application](#).
- Only use original accessories and original spare parts. The safety of the machine is endangered if this instruction is not followed.
- Do not use damaged accessories.
- Operating personnel must be acquainted with the contents of the operating manual.
For this reason it is essential that – among other things - the operating manual is kept near the machine at all times.
- Do not remove instructive labels or signs.
- Do not deactivate safety devices.
- Unauthorised changes to the machine lead to the loss of Fritch's attestation of conformity to European guidelines as well as the loss of the warranty.
- Operating personnel must always operate the machine with safety in mind.
- All threshold limit values according to current safety requirements must be followed; if necessary, a ventilator must be provided or the machine must be operated under an outlet.
- The machine may only be operated indoors. The surrounding air must not contain any electrically conductive dust particles.
- When grinding oxidable materials (e.g. metals or coal), there is a risk of self-kindling (dust explosion) if the material exceeds a certain fineness. It is therefore necessary to take special safety precautions (e.g. wet milling) when grinding such material and the work must be supervised by a specialised person.
- The mortar grinder is not explosion protected and is not designed to grind explosive materials.



2.2 Operating personnel

- The mortar grinder may only be operated by authorised personnel and maintenance and repairs may only be carried out by trained specialists.
- People with health problems or under the influence of medication, drugs, alcohol or exhaustion must not operate the mortar grinder.

2.3 Electrical safety

Using two conductors, the power switch separates the machine from the power supply.

Overload fuse (see [7 Checklist for rectifying faults](#))

When overloaded, the machine switches off.

3 Installation

Compare your delivery with your order.

3.1 Transportation

Grip under the edge of the housing to carry the machine.

Use transportation packaging when transporting over long distances.

Note:

Please retain the packaging for the duration of your warranty, as your warranty claim is at risk if the unit is returned in insufficient packaging.

3.2 Assembly

Place the laboratory mortar grinder on an even, stable surface. It is not necessary to fix the machine in place.

- Take care that the mortar grinder is easily accessible.
- Operational elements on the back of the machine (mains switch) must be easily accessible.
- The room temperature must be between 10 - 40°C.
- Do not block the exit of air from the ventilator louver. There is a danger of overheating if the louver is blocked.



3.3 Ambience conditions

- Use the instrument only inside.
- The air must not contain any electrical conductive dust.
- The ambient temperature must be between 5 and 40°C.
- Height up to 2000m M.S.L..
- Maximum relative humidity of air 80% temperature up to 31°C, linear decreasing down to 50% relative humidity of air at 40°C.
- Contamination level 2 (IEC 664).



3.4 Electrical connection

Before connection, compare voltage and current indicated on the nameplate and set on the voltage selector with the power supply in question.

Changes or adjustments to the connecting cable and/or line voltage may only be carried out by assigned specialists.

Adjusting the line voltage

Only specialist personnel may change the voltage ranges on the machine:

1. Disconnect the machine from the power supply.
2. Adjust the voltage selector (back of machine) to the voltage of the power supply in question.
3. Connect the machine to the power supply.



3.5 Initial switch-on / performance check

The machine may be switched on only after all work described in chapter 3 Installation has been carried out.



3.5.1 To switch on

1. Connect the machine to the power supply.
2. Switch the machine on using the power switch (back of machine).
3. Segmented displays of the digital timer light up in red.
4. As soon as you press the -START- switch and close the hood, the laboratory mortar grinder starts operating.

3.5.2 To switch off

1. Press -STOP- switch.
2. Disconnect the machine from the power supply using the power switch (in the back).

4 Working with the mortar grinder

The laboratory mortar grinder only functions / starts when the lid is closed. If the lid is opened during operation, the machine switches itself off. The machine **cannot** be switched on when the lid is open.

4.1 Timer

After the machine has been switched on (main switch on the back of the machine), the timer will show the time setting for the previous grinding procedure.

You can preselect a grinding period from 1 second up to 10 hours using the installed timer. Permanent operation is not provided for.

Basically, the grinder can function in two operating modes:

- Hour mode (display of hours and minutes)
- Minute mode (display of minutes and seconds).



4.1.1 Displaying / changing the operating mode

Keep the -STOP- switch pressed while you switch on the machine at the main switch (back of machine).

The right-hand segmented display will indicate if the machine is set to hour mode (-) or minute mode (|).

You can alternate between hour mode (-) and minute mode (|) by pressing the right-hand button “+” (several times).

4.1.2 Switching to normal operation

When the STOP button is pressed, the machine switches to normal operation; the currently preselected operating mode is then assumed.

4.1.3 Preselecting the grinding time

The desired grinding time can be pre-set using the buttons “ + ” and “ - “. Depending on the selected operating mode, the display will show **hours / minutes** or **minutes / seconds**.

4.1.4 Grinding operation / interruption

The START button starts the grinding process (only when the lid is closed). The segmented display shows the remaining grinding time. After the grinding process is completed, the preselected time is once again displayed.

If the grinding process is interrupted by the STOP button or by opening the hood, the segmented display shows the remaining time required for the grinding process. The grinding time resumes when START is reactivated.

The mortar bowl comes to a standstill after the time has been completed.

Remember that the temperature of the ground material will rise.

Please note that the ground material increases in temperature during the grinding process. The grinding parameters must be chosen according to the permissible treatment of the ground material.

4.2 Choosing the mortar bowl and pestle

When choosing the material for the grinding tools, take the hardness of the material to be ground into consideration as well as the permissible contamination of your sample caused by friction of the grinding tools, even if this is only minimal.

You can use mortar bowls and pestles manufactured from the following materials:

Material (Mortar and pestle)		Order no. (Grinding set)	Abrasion resistance
---------------------------------	--	-----------------------------	------------------------

Mineral materials

Hard porcelain		46.2110.00	adequate
Sintered corundum	99.7% Al ₂ O ₃	46.2060.00	fairly good
Agate	99.9% SiO ₂	46.2050.00	good
Zirconium oxide	94.8% ZrO ₂	46.2120.00	very good

Metallic materials

Stainless steel	17-19% Cr + 8-10% Ni	46.2100.00	fairly good
Tempered steel	11-12% Cr + 1.9-2.2% C	46.2090.00	good
Stainless steel, mono- lithic	17-19% Cr + 8-10% Ni	46.2140.00	fairly good
Hard metal tungsten carbide	93.5% WC + 6% Co	46.2080.00	very good

Caution:

If it is necessary to add liquid nitrogen during the grinding process, only stainless steel, monolithic may be used. When using mineral materials, there is a risk of destroying the grinding tools by adding liquid nitrogen.

The warranty is negated if mineral grinding tools are used for grinding processes with liquid nitrogen.

4.3 Inserting / removing the grinding set

The grinding components used in the laboratory mortar grinder fit into each other exactly. For this reason, always use the mortar bowl, pestle and scraper together.

You might have to readjust the pestle and scraper as the grinding tools are subject to some wear, the intensity of which depends on the amount of use.

The grinding components are easily accessible when the lid of the mill is opened.

4.3.1 Inserting / removing the mortar bowl

The mortar bowl is fixed to its supporting base with the help of a bayonet joint.

**A left-hand turn of the mortar bowl opens the bayonet.
A right-hand turn of the mortar bowl closes the bayonet.**

When the bayonet is open, the bowl can be lifted out of the mill.

When inserting the mortar, the bowl is placed in the centre of the receptacle. The bayonet locks into place by turning the bowl. If the bayonet is locked into place (the bowl no longer "wobbles"), then the bayonet joint is closed by turning the mortar bowl to the right.

Note:

Right-hand turn = Clockwise turn

Left-hand turn = Anti-clockwise turn

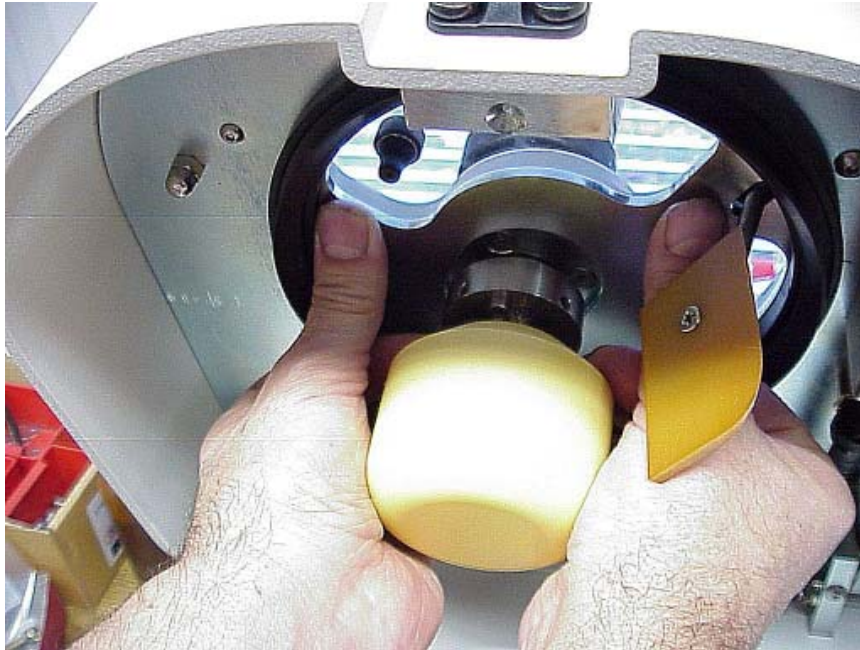
An arrow on the mortar bowl indicates the mill's turning direction. The bayonet joint must be opened in the direction of the arrow.



4.3.2 Inserting / removing the pestle

The pestle is held in its bearings with a catch and can be easily removed without any tools.

The pestle is removed from the catch device by pulling it in the direction of the axle. It is helpful to press your fingers (thumb) against the lid (see photo).



The pestle shaft must be cleaned before putting the pestle into place.

The pestle is locked into its operating position by sliding the pestle shaft into the bearings. When sliding the pestle shaft into place you must take care that one of the cut key surfaces (1) is positioned next to the clinging screw (2).



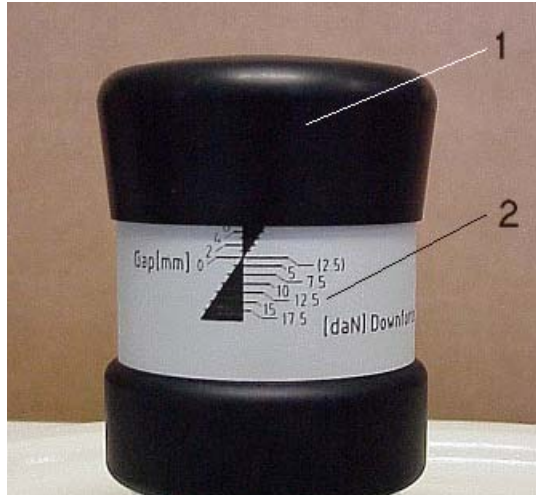
4.4 Setting the grinding pressure

The pressure of the pestle against the walls and base of the mortar can be adjusted in two directions.

The pressure is adjusted when the lid and seal are closed.

4.4.1 Main feed motion direction in the pestle axle direction:

The desired pressure is set by turning the feed motion nut (1) and it is read on scale (2).



4.4.2 Pestle feed motion against the mortar wall :

(radial to the main rotation of the mortar):

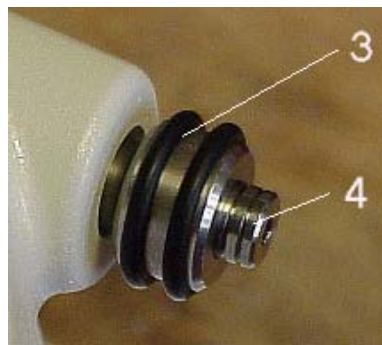
The desired pressure is built up by turning the feed motion screw (3).

For this motion screw (3) turn clockwise until the indicator cylinder (4) looks out of the motion screw (3).

The pressure is read on indicator cylinder (4).

The grinding pressures can be read as follows:

1. ring visible ~ 16.5 daN (kg)
2. ring visible ~ 20 daN (kg)
3. ring visible ~ 23.8 daN (kg)
4. ring visible ~ 27.3 daN (kg)



4.4.3 Preliminary comminution setting for coarse samples

For the preliminary comminution of coarse particles up to 8 mm, the adjusting nut (1) can be raised above the “zero position” so that coarse samples can enter beneath the pestle and be ground. For the subsequent fine grinding, the pestle is lowered back to the desired setting.

4.5 Calibrating the feed motion scale

The scale is already calibrated on the grinding tools in new machines that are delivered with a mortar bowl and pestle and does not have to be readjusted after operation.

The scale must be readjusted when different or new grinding tools are installed.

4.5.1 Calibrating

1. The mortar bowl is empty (no ground material).
2. The mortar bowl and pestle are (or will be) installed.
3. Feed motion nut (1) is pulled out fully (the pestle is lifted off the base of the mortar bowl).



4. Feed motion screw (3) is fully unscrewed (pestle is removed from the mortar walls):



The “zero position” on the pressure scale can be determined in two ways:

- The lid and its seal are closed. The machine is started (START). The pestle is slowly lowered using feed motion nut (1) until it reaches the base of the rotating mortar bowl. Observation of the pestle reveals that the pestle is moved by the contact with the mortar



bowl. The scale is now released and shifted so that the pestle's "zero position" is displayed.

- A small piece of paper is moistened and pressed flat against the base of the mortar bowl (do not place the paper in centre position, but off-centre). The lid and its seal are closed. The machine is started (START). While observing the rotating paper, the pestle is slowly lowered using feed motion nut 1 until the paper is held back by the pestle. The pestle has then reached the base of the rotating mortar bowl.

The scale is now released and shifted so that the pestle's "zero position" is displayed.

4.6 Scraper

The scraper is adjusted when the lid and seal are closed.

Ideally, the scraper is adjusted during the grinding process as the correct scraper setting is recognised with the help of the grinding motion.

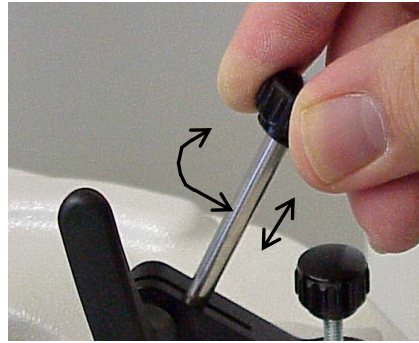
The fixture of scraper fin 5 (recessed head screw 6) should not be tightened too much, so that the fin can still rotate around the recessed head screw.



4.6.1 adjustment of the scraper



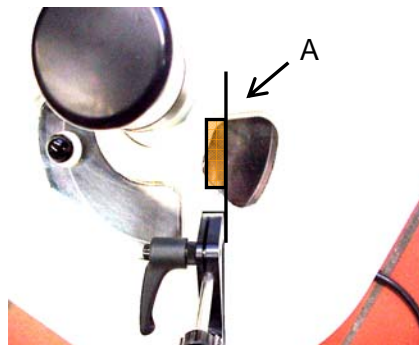
1. turn screw (7) anti-clockwise



5. adjust scraper



2. loosen lever



6. scraper (A) approx. parallel



3. grab rod



7. tighten lever



4. tip the rod



8. turn screw to reduce force

4.6.2 notes to the adjustment of the scraper

- **see above fig. 6**

The angle can be adapted to different ground materials.

A recommended standard value: The scraper should be in approx. alignment with the holding device.

A good position means that the ground material will be guided away from the mortar wall and towards the pestle without a "ground material jam" developing in front of the scraper.

- **see above fig. 8**

Adjust the pressure of the scraper with the screw.

An unnecessary high pressure would lead to excessive wear of the scraper!

4.7 Feeding the material to be ground / starting the grinding process

1. Open the lid's clamping seal. Open the laboratory mortar grinder.
2. Fill the mortar bowl with a maximum of 150 ml of material to be ground (grain size < 6-8mm).
3. Close the lid of the mill. Secure the lid by closing the clamping seal.
4. Set the desired grinding time.
5. Start the laboratory mortar grinder by pressing START.
6. If necessary, adjust the grinding settings while the grinder is in operation (see [4.4 Setting the grinding pressure](#)).

4.8 Removing the ground material

1. Stop the grinding process by pressing STOP; alternatively, wait until the pre-set grinding time has been completed.
2. Open the lid's clamping seal. Open the lid of the laboratory mortar grinder.
3. Remove the mortar bowl from the mill (see [4.3 Inserting / removing the grinding set](#)).
Take the required samples out of the mortar bowl.

4.9 Grinding with forced air cooling

When grinding certain materials, the comminution can be positively influenced through the use of cooling agents. For example, various plastics or animal body parts can be made brittle with liquid nitrogen (N₂) or by freezing in a deep freezer before grinding. However, you should protect the grinding material from condensing water (from the room air). For instance, a plastic bag can keep the material dry while it is cooling and up until grinding.

When using liquid nitrogen, always wear safety glasses and appropriate gloves!

In this application, the grinding set is at “room temperature” and only the material being ground is pre-cooled. Grinding sets of tungsten carbide, stainless steel, zirconium oxide or sintered corundum may be used *since no direct cooling of the grinding set takes place!*

For grinding materials that are very sensitive to temperature or for non-brittle, elastic materials, we recommend additional cooling with liquid nitrogen. This can be added directly to the grinding material through the lid opening in the inspection window of the mortar mill of *stainless steel*.

A grinding time of 5 minutes requires roughly 2-3 l of liquid nitrogen (N₂), which is added in portions through the opening in the lid. The sample is always constantly bathed in liquid N₂ during the grinding.

We recommend that a maximum grinding time of 10-15 minutes not be exceeded since the cooling effect extends to the bearings and drives, causing the bearing grease to harden and possibly blocking the pestle, for example. The grinding parts should also be removed from the instrument after grinding so that the bearings can return to room temperature. Remove any condensation from the grinding chamber.

Important:

If you wish to add liquid nitrogen during grinding, this is *only possible when using the stainless steel grinding set (part number 46.2140.00)* because the grinding bowl is made of solid material (monolithic)!

All other grinding sets are set in a plastic dish that would be destroyed by the addition of liquid nitrogen.

You can also use so-called dry ice (solid carbon dioxide) for cooling. However, take into consideration that dry ice often contains frozen condensed water on its surface, which could add water to your materials to be ground, which could lubricate them.



4.10 Cleaning the laboratory mortar grinder

When switched off, the mortar grinder can be wiped off with a damp cloth.

Do not allow any liquids to drip into the machine.

You can take the mortar bowl and the pestle out of the machine in order to clean them. (see [4.3 Inserting / removing the grinding set](#)) The grinding set components can be washed off under running water. It is especially important that there are no ground materials on the top edge of the bowl; the pestle axle should be wiped off every time before it is inserted into the machine.



In time, residual ground materials will destroy the lip seal.

The amount of cleaning required depends on the individual demands (purity of the sample, risk of carry-over).

Attention:

Agate bowls contain water of crystallisation and may therefore not be dried in a microwave. In addition, the bowls may not be subjected to any large temperature fluctuations as this would damage them.

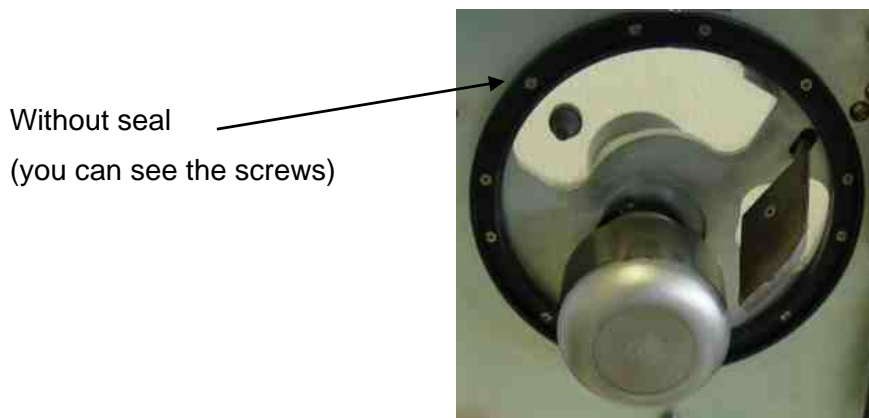
4.11 Cover sealing

The seal in the cover separates the „working chamber“ from the rest of the instrument. The seal is detachable



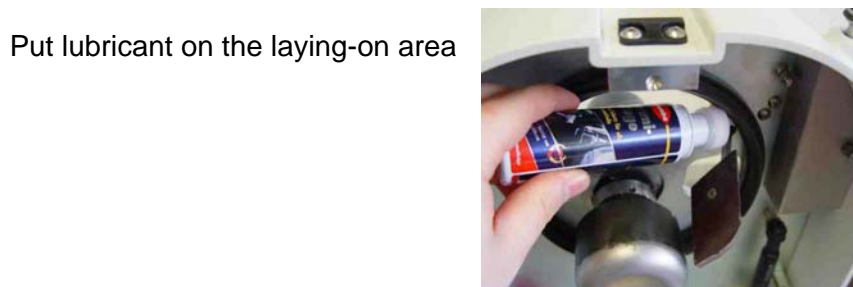
Attention:

When you are working with high dusty samples or samples which leaps off the bowl it is absolutely necessary to use the seal to avoid soiling or possible damaging. If you work with samples which do not leap off the bowl (e.g. pasty samples), the seal needs not to be used.



Attention:

Should you need the seal but get problems with the abrasion of the seal (which may happen e.g. with hot samples), we recommend to use a lubricant.



5 Maintenance

**Before any maintenance work, always unplug the mains plug and secure the machine to prevent it being switched on accidentally.
Signalise maintenance works with a notice.**



Regular cleaning is the most important part of maintenance of the mortar grinder.

5.1 Calibrating the feed motion scale

We recommend that you adjust the scale from time to time, depending on the wear of the grinding tools.

5.2 Instrument

The instrument itself does not require any maintenance. The bearings of the rotating components are equipped with permanent lubrication.

Functional part	Task / Description	Test	Maintenance interval
security switch	safety for the user	Comes the mill to standstill after opening the hood?	before each use
Ventiduct	Cooling the electronics	Operation; clean when dirty	2 x annually

5.3 Resharpener the grinding set

Scratches and dents to the surface of the mortar bowl and pestle can occur over time; ground materials can be detained in these uneven places.

You can sharpen the grinding set by placing approximately 20 g of carborundum (silicon carbide emery 0,5mm with a grain of 60) in the mortar bowl; then switch the laboratory mortar grinder on to a grinding setting of approximately ½ hour.

6 Warranty

The warranty card accompanying this delivery must be completely filled in and returned to the supplier in order for the warranty to come into force.

The company Fritsch GmbH, Idar-Oberstein and its "Application Technology Laboratory" or the corresponding state representatives will gladly offer help and advice.

It is necessary to name the serial number imprinted on the nameplate with any enquiries.

7 Checklist for rectifying faults

Fault	Possible cause	To correct failure
Grinder at a standstill	Switch-off as a result of overloading / blocking of drive	Remove cause, press safety button (back of machine) again
Grinder will not run after pressing [START]	Hood is not closed	Close hood
No functions after switching on the mains switch	Lines safety fuse in the mains plug is defective	Replace safety fuses