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Operating Instructions Ball Mills

Type PM100 / PM200

Retsch®

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Information on these operating instructions

The present operating instructions for the ball mills of type PM100/200 provide all the necessary information on the headings contained in the table of contents.

They act as a guide for the target group(s) of readers defined for each topic for the safe use of the PM100/200 in accordance with its intended purpose. Familiarity with the relevant chapters on the part of each target group(s) of readers is essential for the safe and proper use of the equipment.




The present technical documentation has been designed both as a source of reference and as a learning tool. Each chapter is a self-contained unit.

The operating instructions do not contain any repair instructions. Should repairs ever become necessary, please contact your supplier or talk directly to Retsch GmbH.

<http://www.retsch.de>

Warnings

The following signs are used to warn of hazards:

		Personal injuries
		Material damage

Repairs

These operating instructions do not contain any repair instructions. In the interests of your own safety, repairs should only be performed by Retsch GmbH, an authorised representative or by Retsch service technicians.

In this case, please notify the following:

Your local Retsch representative
Your supplier
Retsch GmbH direct

Your address for service:

Safety

The PM100/200 is a modern, high-performance product manufactured by Retsch GmbH. It incorporates the latest technology. The machine is entirely safe in its operation when used for the intended purpose and in accordance with the present technical documentation.

Safety instructions

You, as the owner/operator, must ensure that the persons who are entrusted to work on the PM100/200:

- have read and understood all the regulations contained in the chapter on safety,
- have made themselves familiar, before starting work, with all the operating instructions and regulations relevant to that particular target group,
- have unrestricted access to the technical documentation for this machine at all times,
- new personnel must have familiarised themselves with the safe use of the PM100/200 and its intended purpose before starting work with the machine, either through verbal instruction by a competent person and / or with the help of the present technical documentation.
- Incorrect operation can result in injuries to persons and damage to property. You bear the responsibility for your own safety and that of your staff.
- Ensure that no unauthorised persons have access to the PM100/200.

As a precaution, have your staff certify in writing that they have received instruction in the operation of the ZM200. A draft for such a form can be found at the end of the chapter on safety.



We reject herewith any and all claims relating to personal injury or material damage that result from the failure to comply with the following safety instructions.

Safety directives summarised, part 1



Safety instructions

We reject herewith any and all claims relating to personal injury or material damage that result from the failure to comply with the following safety instructions.



Intended use

Do not make any modifications to the machine and only use Retsch approved spares and accessories.
The conformity to the European guidelines declared by Retsch otherwise loses its validity.
It furthermore leads to the loss of all warranty claims.



Packaging

Please retain the packaging for the duration of the warranty since, in case of complaint, returning in unsuitable packaging can jeopardize your warranty claims.



Transport

During transportation, do not subject the PM100/PM200 to impacts, jolts or vibrations. The electronic and mechanical components could otherwise be damaged.



Temperature fluctuations

In case of wide temperature fluctuations (during shipment by air, for instance), protect the PM100/PM200 from condensation. The electronic components could otherwise be damaged.



Scope of supply

If the shipment is incomplete and / or has suffered transport damage, you must notify the forwarder and Retsch GmbH immediately (within 24 hours). Under certain circumstances, claims lodged at a later date may not be considered valid.



Ambient temperature :

When the ambient temperature exceeds or falls below that specified, the electronic and mechanical components may be damaged, and performance data changed to an unknown extent.



Air humidity :

At a higher air humidity, electronic and mechanical components may be damaged, and performance data changed to an unknown extent.



Electrical connection / Connecting the power

Failure to observe the values on the data plate can cause damage to electronic and mechanical components.



Inserting and clamping grinding bowls in the PM100

Only use grinding bowls of type "C".

This, in conjunction with the grinding bowl fixture, is a safety component.

Working with old or third-party grinding bowls in the PM100/PM200 risks unforeseeable hazards.



Never allow threaded spindle 3 to lie loose in the grinding bowl fixture without the grinding bowls clamped in.



Danger of being hurled out!

Always ensure that the red sleeve has latched in properly. Otherwise the grinding bowl is not securely clamped.



Inserting and clamping grinding bowls in the PM200

Only use grinding bowl of the type "C".

This, in conjunction with the grinding bowl fixture, is a safety component.

Working with old or third-party grinding bowls in the PM100/PM200 risks unforeseeable hazards.



Never allow threaded spindle 4 to lie loose in the grinding bowl fixture without the grinding bowls clamped in.



Danger of being hurled out!

Always ensure that the red sleeve has latched in properly. Otherwise the grinding bowl is not securely clamped.



Only use grinding bowls of type "C" and only up to a nominal volume of 125ml



The PM200 will otherwise be overloaded and mechanical components could be damaged!

Only ever use 2 grinding bowls with the same gross weight.

Otherwise the PM200 generates unpleasant vibrations!

Safety directives summarised, part 2

Grinding bowl filling level



If the filling level of the grinding bowl is too high or too low, the end result will be impaired and the milling set could become damaged (increased wear and tear).

Stacking 50ml grinding bowls of type "C"



It is not possible to stack 50ml grinding bowls in the PM200.

Heating the grinding bowls



Please take the action necessary - depending on how dangerous the material you are grinding is - to ensure that people are not exposed to danger.



It is essential to wear protective gloves when removing and opening heated grinding bowls.
Danger of burning hands.

Cleaning the grinding bowls



Do not expose grinding bowls with ceramic inserts to temperature fluctuations during rinsing.
The ceramic inserts can crack if subject to sudden changes of temperature.

Wet grinding with easily inflammable materials



Before deploying easily inflammable materials as milling aids, compile explosion protection documentation in accordance with articles 118 and 118a of EC directive 89/391/EEC

Start time



Make certain that the grinding bowls have been securely clamped and balanced before letting the machine start unattended.



Even though it is not possible to start the machine without the cover closed, ensure that the cover is closed before letting the machine start unattended.

Cleaning



Do not clean the **PM100/200** with flowing water.
Mortal danger from electric shock
Only use a cloth dampened with water.
Solvents are not permitted.

Maintenance



The easy running of the threaded spindle and the locking sleeve is essential for secure clamping of the grinding bowl



Locking sleeves which do not move downwards solely by spring power cannot properly prevent the threaded spindle from working loose. The grinding bowls could be hurled out.



The easy running of roller **1** on the locking block is essential for secure closing of the PM100/200 via the automatic closure mechanism.



If the values **D1** and **H1** are undershot, operational safety is no longer assured.
The grinding bowls could be hurled out.

Parts subject to wear and tear



The operating instructions do not contain any repair instructions. In the interests of your own safety, repairs should only be performed by Retsch GmbH, an authorised representative or by Retsch service technicians.

Confirmation

I have read and understood the
chapters Foreword and Safety.

Signature of operator/owner

Signature of service technician

Technical specifications

Machine type designation: PM100/PM200

Intended use

Retsch ball mills are used to grind and mix materials that are soft, medium hard to extremely hard, brittle or fibrous. Dry and wet grinding is possible, grinding with solvents is permissible, although in this case it is essential to observe the supplementary instructions given in the chapter "Wet grinding with easily inflammable materials". **Minerals, ores, alloys, chemicals, glass, ceramics, vegetable matter, soil, slurry, domestic and industrial waste and many other substances** can be comminuted simply, quickly and without loss. The ball mills are successfully deployed in **virtually all fields of industry and research**, particularly where there are high requirements on cleanliness, speed, fineness and reproducibility.

Only type "C" grinding bowls may be used.

In the PM100 1x of 50-500ml, 2x50ml, 2x25ml and 2x12ml can be stacked.

In the PM200 the 12ml and 25ml grinding bowls can be stacked but the 50ml and 125ml are not stackable.

They are not designed as production machines, but rather as laboratory devices intended for single-shift, 8-hour operation.



Do not make any modifications to the machine and only use Retsch approved spares and accessories.

The conformity to the European guidelines declared by Retsch will otherwise lose its validity.

It will furthermore lead to the loss of all warranty claims.

Maximum feed volume

PM100 = up to 300ml, depending on the grinding bowl volume.

PM200 = up to 2x50ml, depending on the grinding bowl volume.

Maximum feed grain size

PM100 up to <10 mm, but dependent on the material

PM200 up to <4 mm, but dependent on the material

Drive output

750 W / power draw approx. 1250 W

Emissions

Noise levels PM100:

Noise measured in accordance with DIN 45635-31-01-KL3

The noise levels are basically influenced by the speed of the machine, the size of the grinding bowl and the diameter of the grinding balls used.

Workplace related emission value L_{pAeq} = up to 85 dB(A)

Noise levels PM200:

Noise measured in accordance with DIN 45635-31-01-KL3

The noise levels are basically influenced by the speed of the machine, the size of the grinding bowl and the diameter of the grinding balls used.

Workplace related emission value L_{pAeq} = up to 80 dB(A)

Materials and analyses of the grinding tools

See :

www.retsch.de/english/docs/grinding_tools.pdf

Protection systems

IP20

Protective equipment

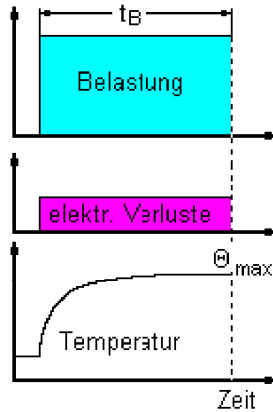
The PM100 and PM200 are equipped with fixtures to automatically close the cover. This prevents the devices being started in an unsafe state.

The machines cannot be started unless the cover is closed. It is only possible to open the cover when the machines are at standstill.

Operating mode

S1

An operating mode with constant loading, the duration of which suffices to reach the state of thermal rigidity. (DIN VDE 0530 T1)



Device dimensions

Height: Up to approx. 835 mm / Width: 630 mm / Depth : Up to approx. 505 mm

Weight : PM100 net approx. 86 kg / PM200 net approx. 80 kg

Base area required

630 mm x 505 mm;

A safe distance of 200mm is required at the rear to allow the fan to fulfil its function.

Transport and assembly

Packaging

The packaging has been adapted to the mode of transport. It corresponds to the generally applicable packaging guidelines.



Please retain the packaging for the duration of the warranty since, in case of complaint, returning in unsuitable packaging can jeopardize your warranty claims.

Transport



During transportation, do not subject the PM100/PM200 to impacts, jolts or vibrations. The electronic and mechanical components could otherwise be damaged.

Temperature fluctuations



In case of wide temperature fluctuations (during shipment by air, for instance), protect the PM100/PM200 from condensation. The electronic components could otherwise be damaged.

Intermediate storage

Likewise for intermediate storage, ensure that the PM100/PM200 are stored in a dry place.

Scope of supply

- PM100 or PM200
- 2 power cables, Europe and USA
- 1 copy of the operating instructions

Check the completeness of the delivery, including any accessories ordered in addition.

Check proper functioning of the PM100/PM200 (see the chapter on operation).



If the shipment is incomplete and / or has suffered transport damage, you must notify the forwarder and Retsch GmbH immediately (within 24 hours). Under certain circumstances, claims lodged at a later date may not be considered valid.

Assembly

If the device is transported with a forklifter or lift truck, it must be placed on the transport pallet.

4 people are required to carry the device.

Only place the PM100 or PM200 on a stable laboratory bench, as they might otherwise be subjected to disagreeable vibrations. The table base must be clean and skid-resistant.

The net weight of the PM100 is approx. 86 kg

The net weight of the PM200 is approx. 80 kg

Requirements for the assembly site

Ambient temperature :

5°C to 40°C



When the ambient temperature exceeds or falls below that specified, the electronic and mechanical components may be damaged, and performance data changed to an unknown extent.

Air humidity :

Maximum relative humidity 80% at temperatures up to 31°C, declining in linear manner down to 50% relative humidity at 40°C



At a higher air humidity, electronic and mechanical components may be damaged, and performance data changed to an unknown extent.

Assembly height :

Max. 2000 m above sea level

Electrical connection

- The voltage and frequency for the PM100 or PM200 are shown on the data plate.
- Ensure that these values agree with the mains power supply.
- Connect the PM100 or PM200 to the mains power supply with the power cable supplied.
- When connecting the power cable to the mains supply, use an external fuse which complies with the regulations applicable to the assembly site.

Important notes :

1. Electrical connections must use PE conductors !
2. A frequency converter is fitted to the drive unit of your PM100 / PM200. In order to fulfil the EMV directive, this is equipped with a mains filter and screened cables to the motor. If your mains power installation for the PM100 / PM200 contains a residual-current protective device, then when the frequency converter switched on (switched on each time the grinding chamber hood is closed), its interference suppression circuit can cause spurious tripping of the residual-current protective device, without this being due to a defect in your PM100 / PM200 or mains power supply.

The state-of-the-art recommends selective, all-current sensitive residual-current protective devices in such cases. The trip current needs to be sufficiently dimensioned because short-lived, capacitive transient currents generated at switch on (screened cables, mains filter) can easily cause spurious tripping.

Under certain conditions, it may be necessary to operate the PM100 / PM200 without a residual-current protective device. It must nevertheless then first be ensured that this does not contradict the regulations of the local electricity supply utility, or those of other institutions or applicable standards.



Failure to observe the values on the data plate can cause damage to electronic and mechanical components.

Serial interfaces



- Interface to update the software
- Inactive interface for optional data communication with an external device. Software update required.



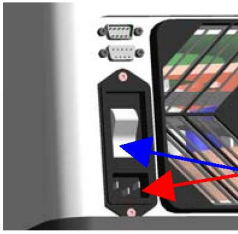
The interface cables may not be longer than 2.5 m.
Longer cables can cause faults in the transmission of data.

Operation

Connect the power

Ensure that the voltage and frequency of your mains power supply agree with the data plate of the PM100 or PM200.

- Plug the power cable into the socket at the rear of the device
- Plug the cable into the mains power socket
- Turn the main switch on



Failure to observe the values on the data plate can cause damage to electronic and mechanical components.


The language menu is displayed the first time the PM100/200 is switched on.

The language required can be selected here by turning operating button **E**. The selection is confirmed by pressing it and the display shows "**Open cover**".

Opening / closing / emergency unlocking of the grinding chamber

Opening

The following are necessary before the grinding bowl(s) can be inserted and clamped.

- Plug the PM100/200 into the mains power supply
- Switch on the main switch at the rear
- Press button **A** - 



A E D Ö S

The safety lock opens and cover **D** can be folded back. The grinding chamber is now freely accessible.



Closing

The grinding chamber cannot be closed unless the PM100 or PM200 is connected to the mains power supply and the main switch at the rear of the device is switched on.

- Close the housing cover

A sensor recognises the locking block on the housing cover and the motorised cover closure is switched on.

- The housing cover is locked automatically

Emergency unlocking

A key is fixed underneath the unit. This can be used to open the PM100 or PM200 manually in case of a power failure.

- Lift the unit
- Remove key **S**
- Insert the key into opening **Ö** in the right side
- Turn the key clockwise up to the stop

The cover can now be opened.



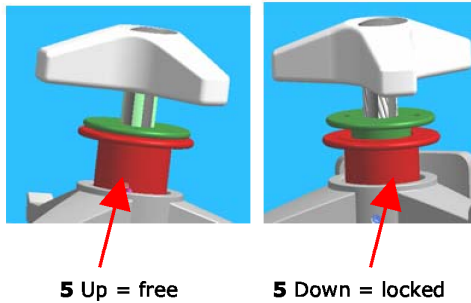
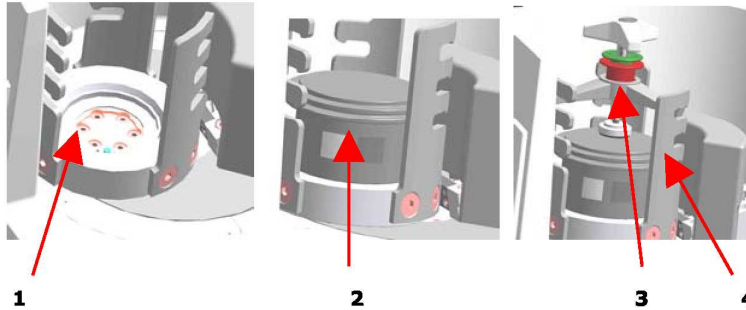
S



Never actuate the emergency unlocking feature whilst the machine is running, only do so with the machine at standstill and the mains power disconnected.

Considerable danger of injuries from a long drive run-on time without braking.

Inserting and clamping grinding bowls in the PM100



- Clean the grinding bowl disk with torsion lock pin **1**
- Turn the label on the grinding bowl **2** to the same side as the torsion lock pin, the borehole in the grinding bowl is located here.

- Insert the grinding bowl into the grinding bowl fixture

Pay attention to the torsion lock in 250 and 500 ml grinding bowls. The borehole in the base of the grinding bowl to take up the torsion lock pin is located on the side of the marking areas.

- Insert grinding bowl clamping arrangement **3** into latching brackets **4**
- Pull red sleeve **5** upwards and clamp the grinding bowl by turning the three-point grip to the right
- Let red sleeve **5** latch audibly downwards, if necessary, retighten gently from the three-point grip
- The three-point grip should now not be able to be turned

Should the red locking sleeve not move completely downwards when released (audible clacking), briefly retighten from the three-point grip.

The red locking sleeve, which is now in the locked position, prevents the threaded spindle from working loose.

Removing the grinding bowl fastening device in the PM100



- Pull the red sleeve **5** upwards and unscrew the grinding bowl by turning the three star grip to the left.
- Continue to turn the three star grip to the left until the grinding bowl fastening device can be removed.

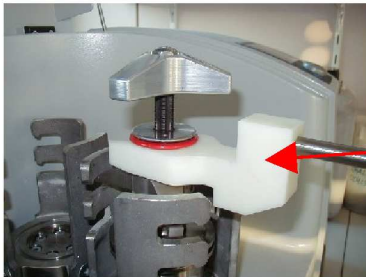
Tightening and unscrewing the grinding bowl fastening device using a counter spanner

Using a counter spanner prevents the drive from turning, which can otherwise easily occur when tightening or loosening the grinding bowl.



- Insert the counter spanner **6** under the red sleeve **5**. The spindle is now unlocked.

- Turn the three star grip to the right (clockwise) for tightening and to the left (anticlockwise) for loosening. The drive now turns only until a latched bracket **4** is in contact with the counter spanner **6**. Easy tightening or loosening is then possible.



- For the PM200 the counter spanner **6** must be turned 180° and inserted when the grinding bowl fastening device is in the highest lock-in position.



Only use type "C" grinding bowls. This, in conjunction with the grinding bowl fixture, is a safety component.

Unforeseen risks may arise if third-party or old grinding bowls are used in the PM100.

Never allow grinding bowl clamping arrangement **3** to lie loose in the grinding bowl fixture without the grinding bowls being clamped in.

Danger of being hurled out!

Especially in cases of lengthy grinding periods, check at the intervals in the following schedule that the grinding bowl is sitting securely: after 3 mins, after 1h, after 5h and then every 10-12h. A gripping force of 10Nm is the optimum for the grinding bowl clamping fixture.

Risk of being hurled out!

Safety Instructions for starting the PM 100

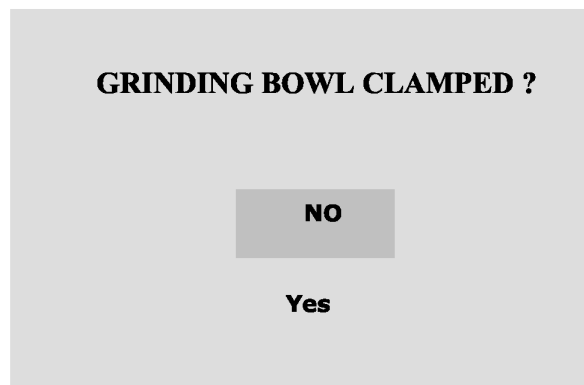
The grinding bowl clamping fixture has proven its worth over many years as an easy-to-manage and reliable appliance. A precondition here both for the operator's safety and also to ensure that the components have a long service life is that the grinding bowl must be clamped conscientiously.

Please bear in mind that the PM 100/200 is a grinder that inputs a very high level of energy into the material being ground and the grinding bowl must therefore be clamped conscientiously.

To avoid operating errors, the correct grinding bowl clamping is queried each time before the machine starts.

Personnel who are particularly well trained and very familiar with how the PM is operated may hide this safety instruction permanently. However, we particularly advise against this if the operating personnel vary!

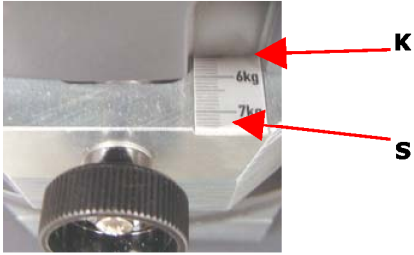
The software for the PM 100/200 is set up in such a way that each time before the machine starts up, when the starting button is activated, it is necessary to confirm in the following display that the grinding bowl has been clamped.



The grinding process starts after this confirmation.
This safety instruction can be hidden in the "settings" menu.



Make sure the grinding bowl is clamped before you start the machine.



Balancing – only required for the PM100

In order to ensure that the machine runs smoothly, the PM100 must be balanced after the grinding bowl has been inserted and clamped in.

- Weight the grinding bowl with cover, ball filling and the material to be ground
- Move the balancing weight using the knob until edge **K** on scale **S** shows the determined weight.

Balancing – only for PM 100 with additional balance weight



Additional balance weight 1kg

Caution:

When using the following grinding bowls with safety locking device an additional balance weight of 1 kg is necessary.

Combination 1:

- 250 ml grinding bowl of tungsten carbide 01.462.0222
- Safety locking device 22.867.0004
- Grinding bowl lid for gassing 22.107.0006

Combination 2:

- 500 ml grinding bowl of zirconium oxide 01.462.0227
- Safety locking device 22.867.0005

When the additional balance weight is used please note that the scale no longer shows the correct weight. (See below)

Order number for additional weight: 22.221.0002

In order to fix the additional weight both protective caps on the top side of the counterweight must be removed.

Screw the additional weight onto the counterweight with the two cheese-head screws. Tightening torque for the cheese-head screws = 20 Nm.

After mounting the additional weight the extra weight of 1.0 kg must be taken into account when reading the scale.

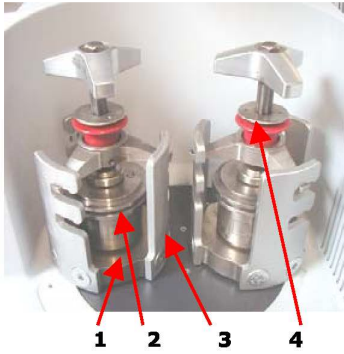
Example:

If the grinding bowl weighs 8.2 kg the counterweight must be set to a scale reading of 7.2 kg.

Note:

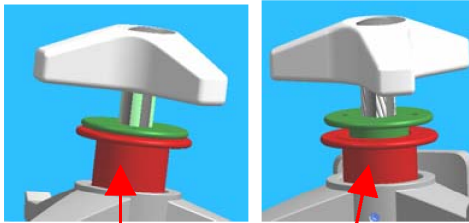
When using light (small) grinding bowls the additional weight must be removed again.

Inserting and clamping grinding bowls in the PM200



Only operate the PM200 with grinding bowls up to a maximum nominal volume of 125ml. In order to avoid unpleasant vibrations, 2 grinding bowls with the same gross weight must always be inserted.

- Clean grinding bowl disk **1**
- Insert grinding bowl **2** into the grinding bowl fixture
- Insert threaded spindle **4** with pressure piece into the latching brackets **3**
- Pull red sleeve **5** upwards and clamp the grinding bowl by turning the three-point grip to the right
- Let red sleeve **5** latch audibly downwards, if necessary, retighten gently
- It should now be impossible to turn the three-point grip.



5 Up = free

5 Down = locked

Should the red locking sleeve not move completely downwards when released (audible clacking), briefly retighten threaded spindle **4**.

The red locking sleeve, which is now in the locked position, prevents the threaded spindle becoming loose.

Tightening and loosening the grinding bowl clamping fixture using the counter spanner

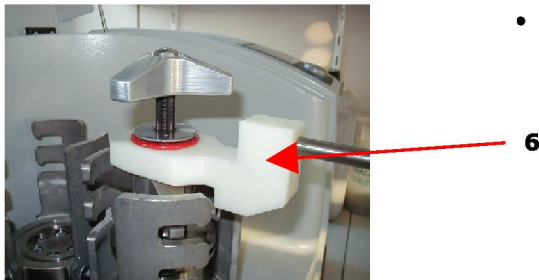
The counter spanner prevents the drive turning while the grinding bowl clamping fixture is being tightened or loosened!



- Push the counter spanner **6** under the red sleeve **5**, the spindle is now released



- To clamp, pull the three-point grip to the right (clockwise direction) and to loosen, pull to the left (anticlockwise). The drive now turns only as far as till a latching bracket **4** rests against the counter spanner **6**. Easy tightening or loosening is then possible.



- For the PM200 the counter spanner **6** must be turned 180° and inserted when the grinding bowl fastening device is in the highest lock-in position.

Safety instructions for starting the PM 200

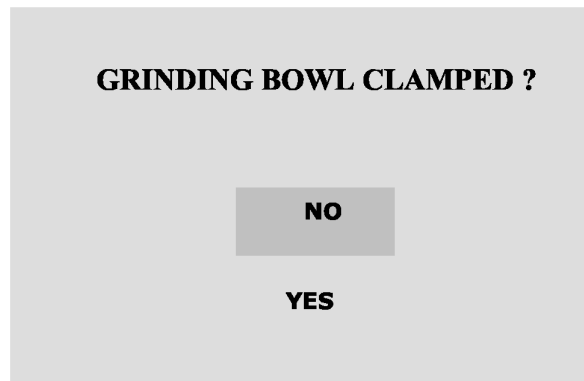
The grinding bowl clamping fixture has proven its worth over many years as an easy-to-manage and reliable appliance. A precondition here both for the operator's safety and also to ensure that the components have a long service life is that the grinding bowl must be clamped conscientiously.

Please bear in mind that the PM 100/200 is a grinder that inputs a very high level of energy into the material being ground and the grinding bowl must therefore be clamped conscientiously.

To avoid operating errors, the correct grinding bowl clamping is queried each time before the machine starts.

Personnel who are particularly well trained and very familiar with how the PM is operated may hide this safety instruction permanently. However, we particularly advise against this if the operating personnel vary!

The software for the PM 100/200 is set up in such a way that each time before the machine starts up, when the starting button is activated, it is necessary to confirm in the following display that the grinding bowl has been clamped.



The grinding process starts after this confirmation.
This safety instruction can be hidden in the "settings" menu.



Make sure the grinding bowl is clamped before you start the machine.



Only use "C" type grinding bowls.
This, in conjunction with the grinding bowl fixture, is a safety component.

Unforeseen risks may arise if third-party or old grinding bowls are used in the PM200.



Never allow threaded spindle 4 to lie loose in the grinding bowl fixture without the grinding bowls clamped in.

Danger of being hurled out!



Only use grinding bowls of type "C" and only up to a nominal volume of 125ml

The PM200 will otherwise be overloaded and mechanical components could be damaged!



Suitable grinding bowls for the PM100

The PM100 is only suitable for grinding bowls of the type "Comfort" with a nominal volume of 50-500 ml.

They are available in the following materials:

- Agate
- Sintered corundum
- Zirconium oxide
- Stainless steel
- Special steel
- Tungsten carbide

The "Comfort" grinding bowl program was developed especially for extreme test conditions, such as long-term trials, high mechanical loadings, maximum speeds and for mechanical alloying.

Grinding bowl filling level Guide values for material volumes and balls

Nominal volume	Utility volume	Max. feed grain size	Recommended ball filling			
			Ø 10mm	Ø 20mm	Ø 30mm	Ø 40mm
12 ml	1- 5 ml	<1 mm	5 pieces	-	-	-
25 ml	3- 10 ml	<1 mm	8 pieces	-	-	-
50 ml	5- 30 ml	<3 mm	10 pieces	3 pieces	-	-
125 ml	15- 80 ml	<4 mm	25 pieces	6 pieces	-	-
250 ml	25- 150 ml	<6 mm	50 pieces	12 pieces	5 pieces	-
500 ml	75- 300 ml	<10 mm	100 pieces	20 pieces	8 pieces	4 pieces



If the filling level of the grinding bowl is too high or too low, the end result will be impaired and the milling set could become damaged (increased wear and tear).

Stacking 50ml grinding bowls of type "C"

This option is only possible in the PM100.

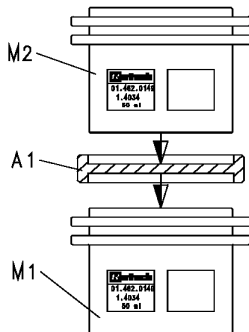
There is also the option of stacking two 50ml grinding bowl one over the other.

An adapter available as an accessory is required for stacking.

Stacking operation

- Place grinding bowl **M1** into the grinding bowl disk
- Install adapter **A1** onto the cover of **M1**
- Install grinding bowl **M2**

Clamp the grinding bowl as described in the chapter "Clamping the grinding bowl".



Suitable grinding bowls for the PM200

The PM200 is only suitable for grinding bowls of type "Comfort" with a nominal volume of 50-125 ml.

Grinding bowl filling level Guide values for material volumes and balls

Nominal volume	Utility volume	Max. feed grain size	Recommended ball filling			
			Ø 10mm	Ø 20mm	Ø 30mm	Ø 40mm
12 ml	1- 5 ml	<1 mm	5 pieces	-	-	-
25 ml	3- 10 ml	<1 mm	8 pieces	-	-	-
50 ml	5- 30 ml	<3 mm	10 pieces	3 pieces	-	-
125 ml	15- 80 ml	<4 mm	25 pieces	6 pieces	-	-



If the filling level of the grinding bowl is too high or too low, the end result will be impaired and the milling set could become damaged (increased wear and tear).



Stacking 50ml grinding bowls of type "C"

It is not possible to stack 50ml grinding bowls in the PM200.



X

Handling grinding bowls of type "C"

Carrying and holding

The gripping edges **X** on the grinding bowl itself and its cover provide secure handling.

Torsion lock

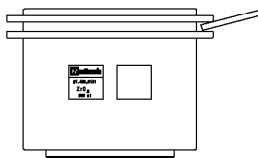
All 250 and 500ml grinding bowls of type "C" also have a torsion lock borehole to the steel shell in the bottom of the grinding bowl. This is only deployed in the PM100 and is located on the labelled side of the grinding bowl shell.

Heating the grinding bowls

Depending on the grinding time and the filling level, the grinding bowl can be heated up to 150°C during comminution.

When the fixture is undone, the pressure which builds up in the bowl during grinding escapes, and can also take powered ground material with it.

When the grinding bowls are put to one side to cool, a vacuum develops inside the bowl, which can make it difficult to open. Grinding bowls of type "C" can therefore be levered open by inserting a wooden bar **H**, for example, between the gripping edges of the cover and the bowl.



H



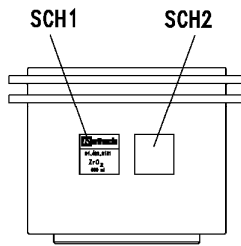
Please take the action necessary - depending on how dangerous the material you are grinding is - to ensure that people are not exposed to danger.



It is essential to wear protective gloves when removing and opening heated grinding bowls.
Danger of burning hands.

Grinding bowl identification

All grinding bowls of type "C" are easily identified by a marking area **SCH1**, including the article No. and material.

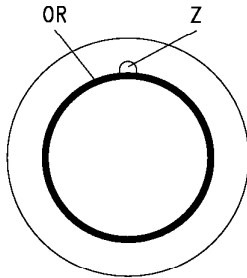


Customer marking of grinding bowls

In addition to the aforesaid marking area, you can affix one of the labels supplied (or available as accessories) to an area **SCH2** on the grinding bowl; this makes it possible to apply extra markings, such as grinding bowl capacity etc. The label is heat-resistant up to 150°C and the markings you apply can be removed using alcohol, benzene or acetone, for example.

Cleaning the grinding bowls

To clean the grinding bowls, the O-ring can be easily levered out of groove **Z** on the underside of the cover. Grinding bowls, including those with adhered ceramic inserts, can be cleaned with alcohol, benzene or with normal household washing-up liquid.



Do not expose grinding bowls with ceramic inserts to temperature fluctuations during rinsing.
The ceramic inserts can crack if subject to sudden changes of temperature.

Drying the grinding bowls

Grinding bowls can be dried at any time after cleaning in the drying cabinet at the temperature indicated below.

Grinding bowl material	Temperature
Special steel	Up to 200°C
Stainless steel	Up to 200°C
Tungsten carbide	Up to 150°C
Sintered corundum	Up to 120°C
Agate	Up to 120°C
Zirconium oxide	Up to 120°C
Silicon nitride	Up to 120°C

Tips for ultra-fine grinding

In many cases, a high fineness can only be achieved by wet grinding; alcohol (e.g. ethanol, isopropanol) or benzenes (e.g. hexane, heptane or the like) have proven useful as liquid additives for this purpose.

With dry grinding, it is possible to achieve an improved grinding result by adding a few drops of stearic or acetic acid, using grinding balls with a $\varnothing < 10\text{mm}$ and filling level the grinding bowl to 70-80% of its capacity.



When working with easily inflammable materials, it is essential to observe the chapter on "Wet grinding with easily inflammable materials".
Explosion hazard!

Wet grinding with easily inflammable materials

Wet grinding using easily inflammable material is admissible in the PM100/200 providing certain precautionary action is taken.

When deploying easily inflammable materials as milling aids, such as hexane, isopropanol, ethanol, benzene and the like, it must be assumed that an explosive atmosphere is always present inside the grinding bowl, which should be classified in zone 0.

It must therefore be ensured that explosive vapours cannot escape from the clamped grinding bowls during the grinding process, and particularly during the heating phase which takes place here, and can never reach areas in which sources of ignition exist.

We therefore urgently recommend that, before using such solvents, the operator (employer) of the planetary ball mill assesses the existing hazards in a comprehensive explosion protection concept. This should take account of the local conditions and, if necessary, lay down supplementary organisational action in a written explosion protection document.

In the EU, this procedure is regulated by articles 118 and 118a of the EC directive 89/391/EEC.

Please observe comparable regulations in other countries outside the EU.

For this purpose, assume the following prerequisites for the PM100/200.

- Only grinding bowls of type "C" are admissible for wet grinding with easily inflammable materials.
- If ceramic or agate material inserts are used, the resistance of the adhesive used needs to be considered when selecting the solvent. Admissible solvents are therefore: alcohol (except methanol and ethanol), isopropanol, isopropylether.
- The O-ring seals used are made of viton (FPM) and are only fully resistant against isobutylalcohol (isobutanol), isopropylalcohol (isopropanol), butylalcohol (butanol), hexane, cyclohexane, ethylenglycol (glycol) and glycerine (glycerol, vegetable oil, E422). Other solvents are not permissible.
- Once the grinding bowls have been filled, seal these with the locking arrangements which are available as accessories.
- In the case of grinding bowls with material inserts, ceramics or WC, only use locking arrangements which support the material insert of the grinding bowl cover. This is essential because of the interior pressure which can be expected.
- Careful consideration needs to be given to using agate grinding bowls for wet grinding with solvents because of the interior pressures this creates and the non-homogenous material characteristics of a natural product.
- Tighten the clamping screws in the locking arrangement to 2.5 Nm. Interior pressures of up to a max. 5 bar are only admissible at this pretension figure.
- Please note that it is quite possible that grinding bowls can be heated up to over 100° C in dependence on the size of the grinding bowl, the ball filling, the speed and the duration of milling.

- The PM100 and PM200 are fitted with a fan which solely extracts air directly from the grinding chamber. The extraction volume per hour is more than 20 times the volume of the grinding chamber. The fan is equipped with a stand still monitoring feature with signalling.
- Feed the air stream produced by the fan during grinding into a lead-off extractor.
- Before removing the grinding bowl, ensure that the locking arrangement is sitting properly.
- Only remove the grinding bowl with the locking arrangement and **only** open in a safe position (suction equipment) after it has cooled down.



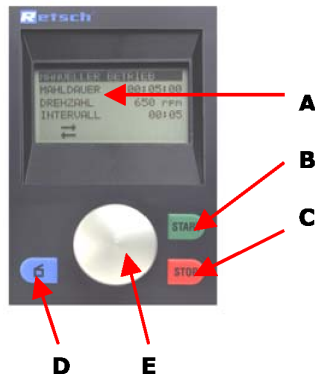
Before deploying easily inflammable materials as milling aids, it is essential that explosion protection documentation is compiled in writing with supplementary organisational action and make this accessible to the operatives. In the EU, this procedure is laid down by articles 118 and 118a of the EC directive 89/391/EEC.



Do not use older locking arrangements which only clamp the gripping edges of the grinding bowl during wet grinding in the grinding bowls with material inserts. The material inserts could be forced out by internal pressure.









Operation via the PM100/200 display unit

The mills offer new, very user-friendly operating functions. All relevant data can be entered or called up from a graphic display operated with a single button. The menu is multi-lingual.




	Designation	Function
A	Display	Displays the menu, the parameter settings, operating information and error messages.
B	START key	Starts the grinding process
C	STOP key	Stops the grinding process
D	Key	Opens the grinding chamber hood
E	Setting button	<p>All menu items can be selected and parameters adjusted by turning and pressing this button.</p> <p>Turn 1 The different menu items can be selected by turning. Selected menu items are shown inversely.</p> <p>Turn 2 Adjust parameters in opened menu items (see Press 1)</p> <p>Press 1 Selected menu items are opened</p> <p>Press 2 A short press confirms the adjustment of the parameters</p> <p>Press 3 Return to the 1st level menu by continuously pressing the button.</p>

Symbols in the display unit

- 
 - Reverse rotation switched on
- 
 - Program mode – Store parameters
- 
 - Program mode – Edit program
- 
 - Program mode – Delete program
- 
 - Opening mechanism off
- 
 - Alarm off
- 
 - Service due
- 
 - Motor or frequency converter too hot

Menu structure of the display unit

1. Level	2. Level	3. Level	4. Level	5. Level
1	MANUAL OPERATION GRINDING PROGRAM 01 bis 09			
2	TIME			
3	SPEED			
4	INTERVAL	REVERSE ROTATION YES / NO INTERVAL BREAK 00:00		
5	PROGAM MODE	STORE PARAMETERS EDIT PROGRAM DELETE PROGRAM		
6	SET START TIME	START IN XXX h		
7	MENU	SETTINGS	OPENING MECHANISM YES / NO	
		ENERGY	DETERMINE IDLING NERGY INSERT JAR START=MACHINE START STOP=CANCEL	
			PREPARE JAR BALANCED ? CLOSE COVER PRESS START TO CONTINUE	
			ENERGY INPUT MEASURE SET	
		ALARM		
		SERVICE	SERVICE HELP	DETAILS IN MANUAL CLEAN SREW CHECK RUBBER DISK UNDER CLAMPING SYSTEM CHECK CLOAMPING ARMS AND FASTENING BRACKET FOR WEAR AND TEAR CLEAN LUBRICATE LOCK WHEEL
			SERVICE INTERVAL	SET SERVICE INTERVAL SET TIME xx h REMANING TIMET xx h
			TOTAL OPERATION HOURS	TOTAL GRINDING TIME: xxx h
			SOFTWARE VERSION	SOFTWARE VERSION: V 1.03 SOFTWAREUPDATE? YES/NO
			BACK	
		BACK		
	DISPLAY	CONTRAST	LOW - HIGH	
		BRIGHTNESS	LOW - HIGH	
		LANGUAGES	SET	
		BACK		
	DATE	01.04.03	SET	
	TIME	12:05:00	SET	
	BACK			



E

All menu items can be selected and parameters adjusted by turning and pressing setting button E.

Turn 1
The different menu items can be selected by turning. Selected menu items are shown inversely.

Turn 2
Adjust parameters in opened menu items (see Press 1)

Press 1
Selected menu items are opened

Press 2
A short press confirms the adjustment of the parameters

Press 3
Return to the 1st level menu by continuously pressing the button.

Adjustment options via the display menu

Please consult the menu structure on this page for the setting options on the display explained below. The selection bar in the display is operated as follows:




- Move vertically through the structure by turning the setting button
- Move horizontally through the menu structure by pressing the setting button
- Adjust numeric values / options by turning the setting button
- Confirm settings by pressing the setting button
- Return to the previous level of the menu structure with "BACK"
- Return to the start screen by prolonged pressing of the setting button

Languages		
Menu	Display	Languages

This allows you to select your language. After making the selection and pressing the setting button the complete menu structure will be displayed in your language.

Incorrect language selection

If the wrong language has been selected, switch the device off at the main switch.

Hold down the keys    simultaneously and switch the device back on. Once the correct language has been selected, switch the device off and immediately back on again. Confirm your selection by pressing the setting button.

The device is now permanently set to your language and you should see the main menu

Manual mode

If this function is set, all parameters and functions can be called up and changed at any time. This is also possible during comminution.

Grinding program 01

- In order to access the "Grinding program" function, press the setting button whilst in "Manual mode". The display flashes showing grinding program 1. Any data already stored in grinding program 1 are also displayed.
- Turn the setting button to the right to select the further grinding programs 2-10, any parameters stored in these are likewise displayed.
- The machine can be started directly with the selected grinding program.
- Return to "Manual mode" by turning the setting button fully to the left and confirm with the setting button.

Grinding time

00:00:01 to 99:99:99
Hours:Minutes:Seconds

 START

The PM100/200 is started at the pre-selected grinding time and a speed of 100 rpm. Reverse rotation with interval break is not switched on


Speed


100 to 650 rpm


 START





The PM100/200 is started at the pre-selected grinding time and speed. Reverse rotation with interval break is not switched on

Interval	00:01 to 99:99 Minutes:Seconds	Reverse rotation cannot be set until an interval is set.
	Reverse rotation YES NO	
START	The PM100/200 is started at the pre-selected grinding time, speed and reverse rotation. The machine rotates with the specified interval time in one direction, runs down and then starts immediately after coming to a stand still, without interval break, in the other direction.	
	Interval break BACK	
	00:01 to 99:99 Minutes:Seconds	The interval break can be set here from 00:01 to 99:99 Minutes:Seconds. An interval break cannot be set until an interval is set.
START	The PM100/200 is started at the pre-selected grinding time, speed, reverse rotation and specified interval break. The machine rotates with the specified interval time in one direction, runs down, after coming to a stand still the previously specified interval break is displayed in the interval and counted down to 00:00. Once the interval break has expired, the machine starts in the other direction.	

Program mode		
	Store parameters	All previously specified parameters, such as grinding time, speed, interval and pause can be stored to memory here.
	<ul style="list-style-type: none"> Set the desired parameters. In the menu, change to "Program mode", press the setting button and confirm "Store parameters" again, the menu shows "Grinding program" and the storage place number on the right. Turn the setting button to the right until you find a grinding program with free storage places or one which you want to overwrite. Press the setting button to reserve the selected storage place. You can now choose between "Save parameters?" or "Cancel". You are then returned to the "Program mode" level. 	

Program mode		
	Edit program	All previously specified parameters, such as grinding time, speed, interval and pause can be edited here. It is likewise possible to enter new parameters.
	<ul style="list-style-type: none"> Select "Program mode", "Edit program" and confirm with the setting button, the display shows grinding program again with the storage place number. Select the "Grinding program" to be edited by pressing the setting button, only the storage place figures are inverted, change the grinding program by turning the setting button. Confirm the grinding program to be edited by pressing the button, the parameters can now be edited. You can subsequently choose between "Save parameters" or "Cancel" You are then returned to the program mode level. 	


Program mode		
	Delete program	All previously stored parameters can be deleted here.
	<ul style="list-style-type: none"> Select "Program mode", press the setting button, and confirm "Delete program" again. Select the grinding program to be deleted by turning the setting button and confirm by pressing. You can now choose between "Delete program" or "Cancel" You are then returned to the program mode level. 	

Start time		
	Start in Cancel	xx h The start can be pre-selected from 01 to 99 h here.
	The PM100/200 is started at the pre-selected grinding time, speed and reverse rotation after the specified start time has expired.	
		Make certain that the grinding bowls have been securely clamped and balanced before letting the machine start unattended.
		Even though it is not possible to start the machine without the cover closed, ensure that the cover is closed before letting the machine start unattended.
	Once running, the start time can be interrupted at any time with the STOP button and from the main switch at the rear of the machine. The start time must then subsequently be re-programmed.	

Opening mechanism

MENU	SETTINGS	OPENING MECHANISM
-------------	-----------------	--------------------------

This allows you to pre-select whether the grinding chamber cover should be raised automatically after grinding has ended or may only be opened after pressing the button. If the function is switched off the

pictogram  appears on the display for confirmation.

Energy

MENU	SETTINGS	ENERGY
-------------	-----------------	---------------

This function enables the total energy input into the grinding bowl (comminution energy + loss energy) to be determined.

This total energy input into the grinding bowl is defined as the difference between the energy drawn from the machine's drive unit when the grinding bowl is empty and when it is filled with material to be ground and grinding balls.

Thus it is first necessary to determine the idling energy drawn by the machine when the grinding bowl is empty.

The idling energy level is established over a relatively short period and is taken as the zero point by the electronics, in a similar way to taring scales.

During subsequent grinding with material, the only energy input taken into account is that which exceeds the level of idling energy. This difference can be regarded as equal to the energy input into the grinding bowl(s) by the grinding media and the material being ground.

For the purpose of comparing different combinations of parameters, the energy input can be specified instead of the grinding time (only the volume of the material being ground and the feed grains need to be the same to allow a proper comparison to be made). In this case, the grinding process is not ended after a specified time, but rather after the input of the pre-set energy.

The energy menu is divided into three sub-menus:

DETERMINE IDLING ENERGY
MEASURE
SET

In order to determine the energy input into the grinding bowl during the grinding process, please proceed as follows:

- Specify all the parameters - speed, grinding time, interval - required for the intended grinding process.
- Determine the weight of the grinding bowl intended for the subsequent grinding process but still without the material to be ground and the grinding media.
- Set the balancing weight accordingly.
- Then change to the sub-menu:
- **DETERMINE IDLING ENERGY**
- Clamp the grinding bowl securely into the machine, but still without the material to be ground and the grinding media.

- Start the machine. The process now started takes about 45 seconds. During this time the PM 100 / PM 200 determines the idling energy with the grinding bowl empty at the later operating speed.
- The PM 100 stops automatically after the idling energy has been recorded and you are requested to fill it with the material to be ground and grinding balls.
- Determine the increased weight of the grinding bowl filled with material and grinding media.
- Please note that the balancing of the PM 100 must be corrected accordingly.
- After pressing the start button again, you are requested to choose between "MEASURE" and "SET" the energy.
- **MEASURE**
Once the idling energy has been determined, only that energy is determined which is additionally input into the grinding bowl by the movement of balls and material during the grinding time.
- **SET**
Enter the energy to be input into the grinding bowl in kJ. It is not yet possible to stipulate the grinding time at the same time. The machine stops once the specified energy has been input.

Alarm

MENU	SETTINGS	Alarm
-------------	-----------------	--------------

The error messages generated by false operation can be acoustically supported by an alarm.

If the function is switched off, the appropriate pictogram appears



Service

MENU	SETTINGS	SERVICE
-------------	-----------------	----------------

The service menu is sub-divided into four sub-menus:

- **SERVICE HELP**
Service help is stored here in the form of a check list. This is intended to make effective and regular service work easier and increase the operational reliability of the unit. Also refer to the chapter General/Maintenance!
- **SERVICE INTERVAL**
An individual service interval – after which the operator is informed that service work is required - can be set here to take account of the prevailing conditions. The time set refers to the sum of the grinding times (times between START and STOP) and can be set between 1-99 hours. The default setting is 20 hours. If the ambient conditions are particularly rough, we recommend reducing the default setting.
- **TOTAL OPERATION HOURS**
This counts the number of grinding hours, thus the sum of the times between START and STOP. The times cannot be manipulated.
- **SOFTWARE VERSION**
The version of the operating software can be called up and updated as required. If necessary, get in touch with your Retsch distributor.
Should you have reached this menu by mistake and cannot return to the previous menu, switch the device off at the main switch and re-start it.

Contrast / brightness

MENU	DISPLAY	CONTRAST
		BRIGHTNESS

The contrast and brightness can be adapted to the particular user or ambient conditions (sunlight, glare etc.). If the contrast or brightness has been incorrectly set (the display can no longer be read), switch the device off at the main switch, simultaneously hold down the START, STOP and COVER OPEN keys and switch it on again. You will now see the language menu and the values for CONTRAST and BRIGHTNESS have returned to the default settings.

Date / Time

MENU	DATE
	TIME

The current data and time can be entered here.

The time then appears on the stand-by monitor.

The power to the device can be turned off for up to 30 days without losing the settings.

Stand-by monitor

The stand-by monitor switches on automatically after the device has been inactive for 15 minutes (timed from a STOP command).

The stand-by monitor disappears after a key is pressed or the setting button activated without executing the command issued.

Should you be in a sub-menu when the stand-by monitor is activated, you will be returned automatically to this selection window.

The stand-by monitor cannot be adjusted, it therefore cannot be switched off.

Error messages on the display

F01 to F12

	F02
The display shows F01	
Lock indicator	
Close cover	
The error appears when the cover has not been fully closed, or if the trannion magnets have not been recognised. <ul style="list-style-type: none"> Close the cover 	•

The display shows F03	The display shows F04
Problem in the safety circuit of the interlock	Close or open cover, should problem remain then interlock faulty
Service required!	Service required!
The error appears when the interlock is defective. <ul style="list-style-type: none"> Turn the device off at the main switch, there is a safety problem. 	The error appears when the interlock is defective. <ul style="list-style-type: none"> Turn the device off at the main switch, there is a safety problem.

F05	F06

The display shows F07	The display shows F08
Faulty motor control	Please select grinding time
Service required!	

The display shows F09	The display shows F10
Cooling fan is off	Sun wheel does not rotate
Service required!	Service required!

	F12
The display shows F11	
Sun wheel rotate to slow	
Service required!	

F13 to F26

F13	
	The display shows F14 Fault speed sensor Service required!
The display shows F15 Problem in the safety circuit of the frequency converter Service required!	The display shows F16 Motor has overheated No START possible Let motor cool down
The display shows F17 Motor has overheated Was switched off Let motor cool down Continue with STOP	The display shows F18 Problem in the safety circuit of the transformer Service required!
F19	F20
	The display shows Overload 110%
F21	
The display shows Overload 120 % Please reduce to ??? rpm	The display shows F22 Due to overload speed automatically reduced to ??? rpm
The display shows F23 Problem in the safety circuit of balance control Service required!	The display shows F24 Balance control is out of tolerance Please rebalance
F25	
The display shows Parameters OK? START = Machine START STOP = Check	The display shows F26 Frequency converter has overheated No START possible Allow to cool down

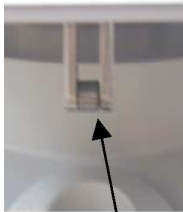
General points

Cleaning

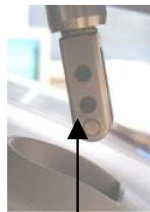


Do not clean the **PM100/200** with flowing water.
Mortal danger from electric shock
 Only use a cloth dampened with water.
 Solvents are not permitted.

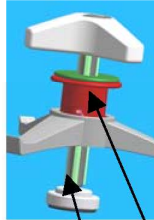
Maintenance



1

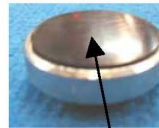


2



3

4



5

The following service work should be performed from time to time, although at the latest once per month, in order to guarantee the operational reliability of your PM100/200:

- Check roller **1** of the locking trannion for easy running and oil, if necessary, e.g. with sewing machine oil
- Clean magnets **2** on the locking trannion
- Check threaded spindle **3** and locking sleeve **4** for easy running. A drop of oil helps in most cases.



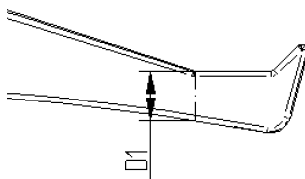
The easy running of the threaded spindle and the locking sleeve is essential for secure clamping of the grinding bowl



Locking sleeves which do not move downwards solely by spring power cannot properly prevent the threaded spindle from working loose. The grinding bowls could be hurled out.

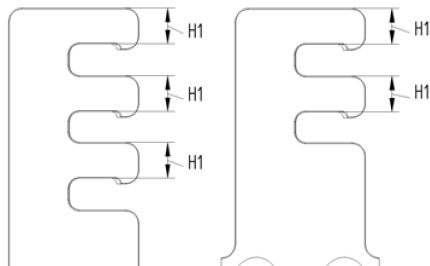


The easy running of roller **1** on the locking trannion is essential for secure closing of the housing cover of the PM100/200.



- The thickness **D1** of the three spider feet should be checked for wear from time to time, although at the latest every month.

It may not be less than 7.5 mm for the PM100.
 It may not be less than 5.5 mm for the PM200.



- The heights **H1** of the latching brackets should be checked for wear from time to time, although at the latest every month.

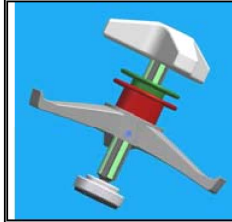
They may not be less than 17mm.

- Check rubber washer 5 in the pressure piece for wear and ensure that it is securely in place (sticking). At temperatures up to 120°C use temperature-resistant rapidly-acting adhesive DELO 2256.

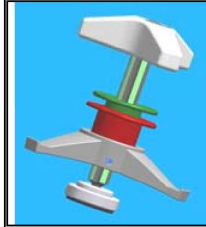


If the values **D1** and **H1** are undershot, operational safety is no longer assured.
 The grinding bowls could be hurled out.

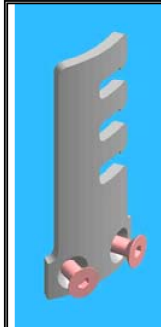
Parts subject to wear and tear



Spider with pressure piece PM100
Art. No. 22.661.0002
Only deployable for PM100.

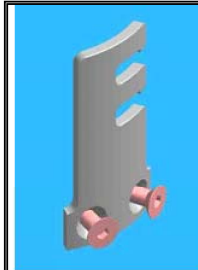


Spider with pressure piece PM200
Art. No. 22.661.0003
Only deployable for PM200.



For PM100
3x latching brackets
Art.No. 03.623.0002

6x countersunk screws
Art.No. 08.643.0108
M12x25 DIN7991-10.9-A2K



For PM200
6x latching brackets
Art.No. 03.623.0003

12x countersunk screws
Art.No. 08.643.0110
M12x20 DIN7991-10.9-A2K



For PM100 and PM200
1x pressure piece with rubber washer
Art. No. 02.108.0046



The operating instructions do not contain any repair instructions. In the interests of your own safety, repairs should only be performed by Retsch GmbH, an authorised representative or by Retsch service technicians.

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Changes

Technical changes are reserved.

Warranty Conditions

1. If legitimate claims are made we shall remedy the defect or replace the goods free of charge.

The purchaser shall only have a right to rescind the contract or reduce the purchase price if we have decided that it is not possible to remedy the defect and a replacement delivery cannot be made or the time limit therefore cannot be complied with or if a reasonable additional time limit of six weeks granted by the customer has not been complied with due to our fault.

If the remedy or replacement delivery in fact fails the customer shall have the right to reduce the price or rescind the contract at his discretion. Further claims, in particular for damages in relation to damage not caused to the goods themselves, such as lost production, are excluded in so far as we have not acted wilfully or negligently. For goods produced by third parties we pass on the liability of the manufacturer.

2. We shall bear the costs directly incurred through the remedying of defects or the replacement delivery on the condition that claim is found to be legitimate. This also applies to the freight costs as well as the reasonable costs of removal and installation. The customer, however, undertakes to bear the reasonable costs of providing his own technicians and assistants on site.

If our customer carries on business overseas, however, we shall be entitled to pay the costs, in particular costs of transport, tolls, wages and materials, ex German border.

3. The warranty term for newly manufactured goods is two years, for used it is one year.

The guarantee refers to deployment in a laboratory in 1-shift operation. In case of multi-shift operation or other areas of application, the guarantee term is shortened accordingly.

No warranty is given for parts subject to wear and tear.

4. We warrant that our goods are free from manufacturing defects. The suitability, classification and function of our goods are determined exclusively on the basis of the performance descriptions contained in the order confirmation even if these differ from the order. In the latter event the customer may, within two weeks after receipt of the order confirmation, draw any possible difference from the order to our attention and come to an agreement on these with us. If the customer does not object to the specifications in the order confirmation then these shall be deemed to have been accepted.

Unless an agreement to the contrary has been reached, we shall not be held liable for the suitability of the goods delivered for the use to which the customer intends to put them. The same applies to performance figures expected by the customer unless we have been able to carry out appropriate preliminary practical experiments and have, in our order confirmation, declared in writing that these performance figures shall be binding.

5. Our warranty shall also become invalid if persons other than those employed by us carry out repairs or in any other way interfere with or make alterations to the goods delivered by us or do not use suitable parts to the extent that the defect is causally connected thereto. In addition, it is a condition of our warranty that our directions for use and operation be followed.

6. If, without a release having first been obtained from us, the goods are installed in and /or connected to, attached to or incorporated in other systems or production plants then our guarantee is limited exclusively to the parts delivered by us.

7. The remedying of defects or replacement of defective parts shall, at our discretion, be carried out on site or at the seat of our company. If the repair is carried out on site, the customer shall ensure that our employee has access, unlimited in either time or space, to the purchased item. In addition, the customer may only demand that work necessary in order to fulfil warranty obligations be carried out during the normal local business hours. If such work is carried out outside our normal business hours on request, the customer shall bear the additional costs. If he wishes to have other particular work performed which goes beyond the work warranted then these costs shall be payable at the actual valid price.

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