Operating Instructions for Planetary Ball Mill Type PM400

Retsch®

Notes on these operating instructions

These operating instructions for the ball mill, type PM400, give all the necessary information with regard to the areas mentioned in the contents.
Instructions are given for the definite target group(s) in each area, in order to ensure safe operation of the PM400 for its intended purpose. Knowledge of the relevant section is essential for safe, proper handling in each target group(s).
This technical documentation is intended as a reference and instruction manual. The individual sections are complete in themselves.
These operating instructions do not include repair instructions. If repairs are necessary please contact your supplier or Retsch GmbH direct: **http://www.retsch.com**

Warning instructions

Warnings are given by the following symbols:


Injury to persons

Damage to equipment

Observe instructions for use

Repairs

These operating instructions do not include repair instructions. For your own safety repairs must be carried out only by Retsch GmbH, an authorised agent or by Retsch service technicians.

In this case please contact:

The Retsch agency in your country
Your supplier
Retsch GmbH directly

Your service address:

Safety

The PM400 is an ultra-modern, highly efficeint product of Retsch GmbH, corresponding to state of the art. If the machine is used according to the intended purpose with a knowledge of this technical documentation it is completely safe and reliable to operate.

Safety instructions

As operating authority it is your duty to ensure that all persons charged with working on the PM400:

- have read and understood all the instructions on safety,
- from the beginning of work know all the instructions and regulations for the target group relevant to their work,
- Have access to the technical documentation for this machine at all times without problems.
- New personnel should be familiarized with safe, proper handling of the machine before beginning work on the PM400, either by verbal instruction from a competent person or through this technical documentation.
- Improper operation can cause injury to persons or damage to the equipment. You are responsible for your own safety and that of your employees.
- Ensure that no unauthorised persons have access to the PM400.

  For your own protection have your employees confirm that they have been instructed in operation of the PM400. The draft of a suitable form is given at the end of the section on safety.

We exclude any claims for damages of any kind for injury to persons and damage to equipment arising from non-observance of the following safety instructions.

Safety instructions – summarised, part 1

Safety instructions

We exclude any claims for damages of any kind for injury to persons and damage to equipment arising from non-observance of the following safety instructions.

Use according to the intended purpose

Do not make any alterations to the machine and use only spare parts and accessories approved by Retsch.
Otherwise the Declaration of Conformity to the European Directives will lose its validity.
Furthermore this will lead to loss of any kind of guarantee claims.

Packing

Please keep the packing material for the duration of the guarantee period, since if you have a complaint and the equipment is returned in inadequate packing your guarantee claim is at risk.

Transport

Lifting above head height is not allowed.

The PM400 must not be knocked, shaken or thrown during transport. Otherwise the electronic and mechanical components can be damaged.

Temperature variations

If the PM400 is subjected to high temperature variations (e.g. during air transport) it must be protected against condensed water. Otherwise there may be damage to the electronic components.

Supplied items

If the supplied items are incomplete and/or there is transport damage you must inform the transporter and Retsch GmbH immediately (within 24 hrs). Later complaints may possibly be no longer considered.

Ambient temperature

If the temperature drops below or exceeds ambient temperature the electrical and mechanical components can become damaged and performance data can change to an unknown extent.

Atomospheric humidity

At high atmospheric humidity the elctrical and mechanical components can become damaged and performance data can change to an unknown extent.

Important instructions

If the values on the type plate are not observed electrical and mechanical components can become damaged.

Serial interface

The serial interface cables must not be longer than 2.5 m.
If the cables are longer this can result in disturbances during transmission of data.

Connecting the power supply

If the values on the type plate are not observed electrical and mechanical components can become damaged.

Opening / closing / emergency unlocking the milling chamber

The emergency unlocking device must not be operated when the machine is running. Disconnect the machine from the power supply before emergency unlocking. High danger of injury through long, unbraked after-running of the drive can result. The after-running time of the drive is < 10 secs.

Insertion and clamping of the milling cups in the PM400

Always insert 2 opposite or 4 milling cups. All cups must have the same gross weight.

If loading of the PM400 is unbalanced the machine can generate undesirable vibrations and noises. In this case switch the machine off immediately and check the arrangement and gross weight of the cups.

Before starting the machine make sure that the milling cup is clamped. Milling cups can be ejected – danger of injuries and damage to equipment.

Always insert 2 opposite or 4 milling cups. All cups must have the same gross weight.

Use only milling cups of type „C". This type, in combination with the milling cup holder, is a safety component. **If other types or old milling cups are used in the PM400 this may result in unforeseen danger.**

Never leave the milling cup clamping device (3) loose, without clamped milling cups, in the milling cup holder. **Danger of ejection.**

Safety instructions – summarised, part 2

Check firm fitting of the milling cups, particularly with long-term milling operations, according to the following time schedule: after 3 mins, after 2 hrs, after 5 hrs then every 10-12 hrs. A clamping force of 10 Nm for the milling cup clamping device is optimum. **Danger of ejection of milling cup.**

Always ensure that the red sleeve is properly locked in place. Otherwise the milling cup is not clamped adequately.
Danger of ejection.

Safety instructions when starting the PM400

Before starting the machine ensure that the milling cup is clamped.
Milling cups can be ejected – danger of injuries and damage to equipment.
We recommend that this safety instruction is not faded out.

Always insert 2 opposite or 4 milling cups. All cups must have the same gross weight.

Milling cup filling level

If the filling level of the milling cup is too high or too low this impairs the milling result and can cause damage (increased wear) to the milling fittings.

Handling milling cup type „C"

Please take necessray measures to prevent danger to persons, according to the dangerous nature of your milling material.

When removing and opening hot milling cups it is essential to wear protective gloves.
Danger of burning the hands.

Identification of milling cups

Do not subject milling cups with ceramic inserts to sudden temperature differences when rinsing.
The ceramic inserts can crack through sudden temperature differences.

Tips for ultra-fine milling

When using easily flammable materials it is essential to observe the section „Wet milling of easily flammable materials".
Danger of explosison.

Wet milling of easily flammable materials

Before using easily flammable materials as milling auxiliary agents it is absolutely essential to specifiy in writing explosion protection documentation with supplementary organisational measures, and to make this available to operators. In the EU this procedure is stipulated in directive 89/391/EEG, according to articles 118 and 118a.

For wet milling operations in milling cups with material inserts do not use old closing devices which clamp only the gripping edges of the milling cups. If an internal pressure is developed the material inserts can be pressed out.

Cleaning

Do not clean the PM400 with running water.
Danger to life through current surge.
Use only a cloth moistened with water. Solvents are not permitted.

Maintenance (monthly)

Easy running of the threaded spindle and locking sleeve is essential for reliable clamping of the milling cups.

Locking sleeves which do not slide downwards automatically through spring tension cannot reliably prevent loosening of the threaded spindle. The milling cups can then be ejected.

Easy running of roller **1** on the closing pin is the prequisite for reliable closing of the housing lid of the PM400.

If the values drop below **D1** and **H1** operating reliability is no longer guaranteed.
The milling cups can be ejected.

Wearing parts

These operating instructions do not include repair instructions. For your own safety repairs should be carried out only by Retsch GmbH, an authorised agent or service technicians.

Confirmation

I have taken note of the section “Notes on these operating instructions” and the section on “Safety”.

_____

Signature of operating authority

_____

Signature of service technician

Technical data

Machine type designation: PM400

Use according to the intended purpose

Retsch ball mills are used for milling and mixing soft, medium-hard up to extremely hard, brittle and fibrous matierals. Both dry and wet milling operations can be carried out. **Minerals, ores, alloys, chemicals, glass, ceramics, plant parts, soils, sewage sludge, domestic and industrial waste and many other substances** can be milled, easily, quickly and without losses. These ball mills are used successfully in **practically all areas of industry and research,** particularly where stringent requirements are set on purity, quickness, fineness and reproducibility.

Only milling cups of type "C" from the firm Retsch GmbH may be used.

The mills are not designed as production machines, but as laboratory equipment, intended for 8-hour single shift operation.

Do not make any alterations to the machine and use only spare parts and accessories approved by Retsch.
Otherwise the Declaration of Conformity with the European Directives by Retsch loses its validity.
Furthermore this will result in the loss of any kind of guarantee claims.

Number of milling positions

2 or 4, depending on the type of machine. The milling positions must be operated with identical milling cups and at the same weight for every millling operation.

Maximum charged quantity

PM400 = up to 4 times 300 ml, depending on the machne volume.

Maximum charged grain size

PM400 up to < 10 mm, but depends on material.

Driving power: 1500 W

Emissions

Noise characteristic values PM400 :
Noise measurement according to DIN 45635-31-01-KL3
The noise characteristic values are influenced mainly by the machine speed, milling cup size and diameter of the milling balls used.
Emission value related to workplace L_{pAeq} = up to 85 dB(A)

Conditions for measurement:
Milling set: 4x 500ml special steel each with 5 balls of dia. 30 mm, tungsten carbide
Milling material: quartz sand, 135 g each
Rotary speed: 380 min-1

Materials and analyses of milling tools

See : www.retsch.com/english/docs/grinding_tools.pdf

Systems of protection

IP40

Protective equipment

The PM400 is fitted with an automatic lid shutting device which prevents the machine being started in an unsafe condition. The machine can be started only with the lid closed.

The lid can be opened only when the machine is at a standstill.

Mode of operation

S1
Operation with constant load, the duration of which is sufficient for the thermal steady state condition to be reached. (DIN VDE 0530 T1)

Machine dimensions

Height: up to approx. 1220 mm / width: 836 mm / depth: up to approx. 780 mm
Weight : PM400 net approx. 290 kg

Required floor space

Height (open hood): 1900 mm / width: 1400 mm /
depth: 900 mm;

A safety distance of 100 mm on the rear side is necessary so that the ventilators can fulfil their function.

Transport and installation

Packing

Packing is adapted to the transport route and conforms to the generally applicable packaging guidelines.

Please keep the packing material for the duration of the guarantee period since if there is a complaint and the machine is returned with inadequate packing your guarantee claim will be at risk.

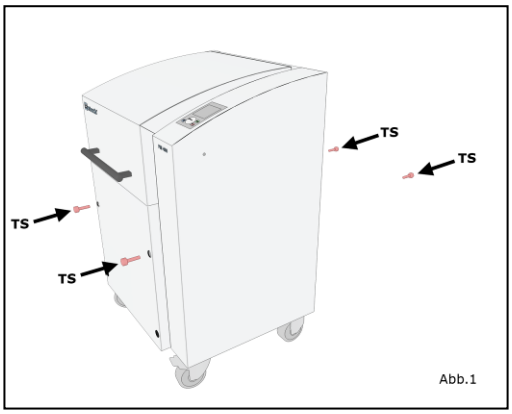


Abb.1

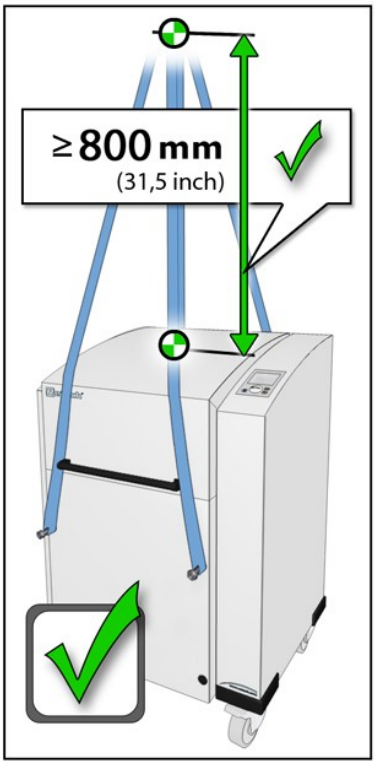
Transport

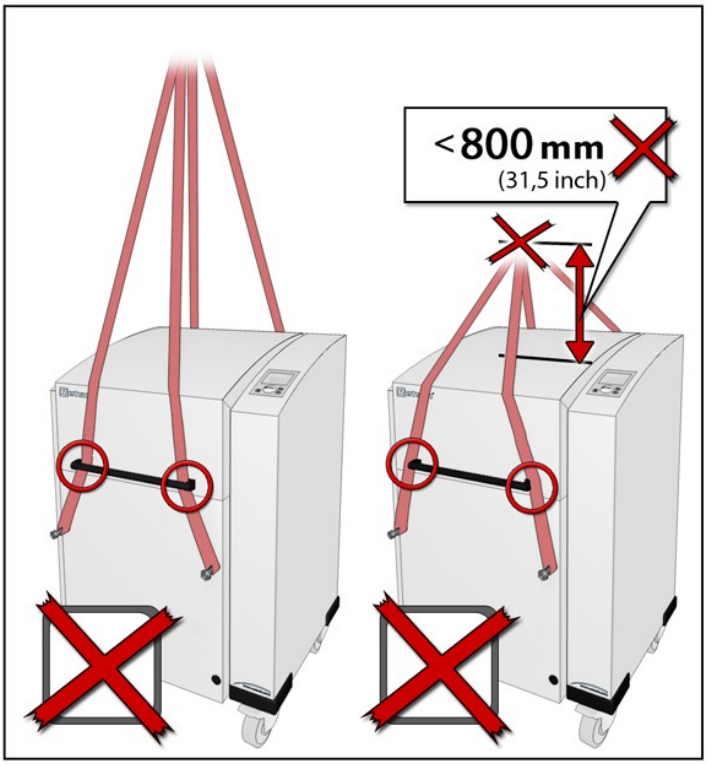
The PM400 is to be lifted and transported only by the transport screws **TS** supplied with the machine.
Fig. 1

Net weight of PM400 = approx. 290 kg

Lifting above head height is not permitted.

The PM400 must not be knocked, shaken or thrown during transport. Otherwise the electronic and mechanical components can become damaged.





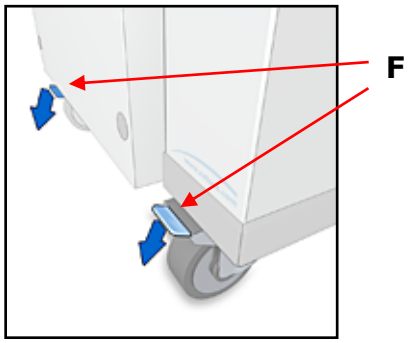
Temperature variations

It temperature variations are high (e.g. during air transport) the PM400 must be protected against condensed water. Otherwise the electronic components can become damaged.

Intermediate storage

Ensure also that the PM400 is stored dry during intermediate storage.

Assembling



Assemble the PM400 on a firm base. Further parameters are given in the section „Technical data".

Net weight of PM400 approx. 290 kg

The machine must be locked in position before starting up. For this purpose press the locking lever **F** of the two front rollers downwards.

Parameters for the place of installation

Ambient temperature:
5°C to 40°C

If the ambient temperature drops below or exceeds these values the electrical and mechanical components can become damaged and performance data are changed to an unknown extent.

Atmospheric humidity:
Maximum relative humidity = 80% at temperatures up to 31°C, decreasing linearly down to 50% relative humidty at 40°C.

At higher atmospheric humidity the electrical and mechanical components can become damaged, and performance data are changed to an unknown extent.

Installation height:
max. 2000 m above sea level

Electrical connection

- Voltage and frequency for the PM400 are given on the type plate.
- Ensure that these values correspond to the available power supply system.
- Connect the PM400 to the power supply system using the supplied connection cable.
- Protection by external fusing is to be carried out when connecting the mains cable to the power supply, according to the regulations at the place of installation.

Important instructions:

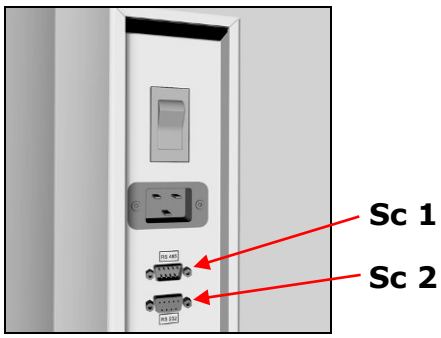
1. Electrical connection without a protective conductor PE is not permissible.
2. The drive of your PM400 is fitted with a frequency converter. To fulfil the EMC directive this is fitted with a line filter and shielded cables to the motor. If your PM400 includes a fault-current protective system, fault throwing may result through the anti-interference wiring of the frequency converter when this is switched on (switching on takes place each time the milling chamber hood is closed). This can occur without there being a fault on your PM400 or your mains installation.

   According to state of the art selective a.c.-d.c. sensitive fault-current protective systems are recommended for such cases. The tripping current must be adequately dimensioned since capacitive compensating currents occuring only for a short time (shielded cables, line filter) when switching on can easily cause fault throwing.

   Under certain circumstances it may be necessary to operate the PM400 without a fault-current protective system. In this case, however, it should be checked whether this is inconsistent with the local regulations of the electricity supply company or other applicable institutions or standards.

If the values on the type plate are not observed this can result in damage to the electrical and mechanical components.

Serial interfaces

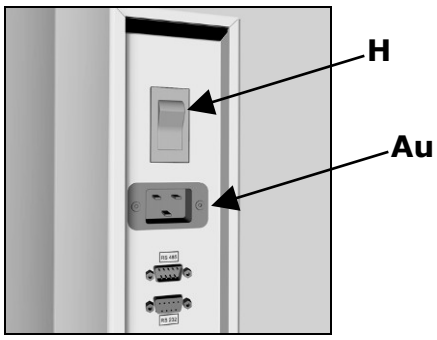


- RS 485 – inactive interface **Sc 1** for optional data communication with an external device. This necessitates updating of the softwear.
- RS 232 - interface **Sc 2** for updating the softwear.

The interface cables must not be longer than 2.5 m.
Longer cables can cause disturbances during transmission of data.

Operation

Connecting the power supply



Ensure that the voltage and frequency of your mains supply correspond to the values on the type plate of the PM400.

- Plug the mains cable in the receiving socket **Au** on the rear side of the equipment.
- Plug the mains plug into the mains socket.
- Switch on the main switch **H**

If the values on the type plate are not observed this can result in damage to the electrical and mechanical components.

When the PM400 is switched on for the first time the language menu is displayed.
The language of your country must now be selected by turning the control knob E. By pressing this knob selection is confirmed and the display shows "Open lid".

Opening / closing / emergency unlocking of milling chamber

Open
The following steps are necessary in order to insert the milling cup or milling cups and to clamp these:

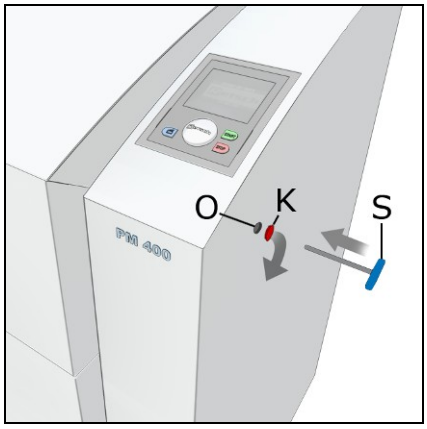
- Connect PM400 to the mains supply
- Switch on the main switch on the rear side
- Press button **A**

The safety closing device opens and the lid **D** can be swung open. The milling chamber is now freely accessible.

Closing
Locking the milling chamber is possible only if the PM400 is connected to the mains supply and the main switch on the rear side of the machine is switched on.

- Close the housing lid **D**

A sensor senses the closing pin of the housing lid and the motor-driven lid closing mechanism is switched on.
The housing lid **D** is automatically closed.



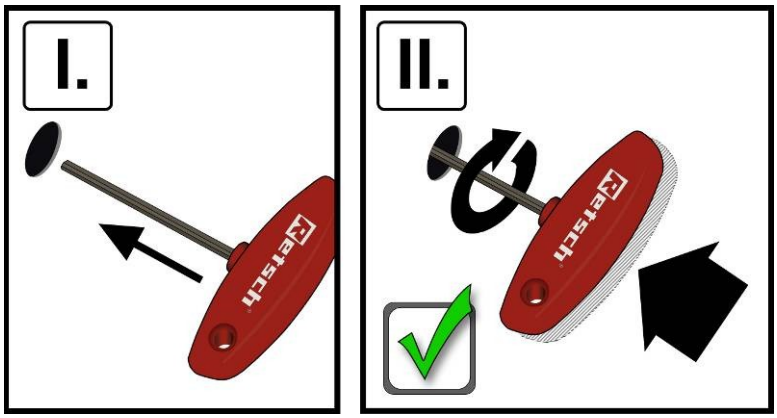
Emergency unlocking

A key for the machine is included in the delivery with which the PM400 can be manually opened if there is a power failure.

- Remove cap **K**
- (I) Insert the (S) key into the O opening on the right-hand side.
- (II) To unlock the gear, the key must be pushed in further with some degree of force. While pushing the key in, turn it in a clockwise direction as far as it will go.
- The lid can now be opened.

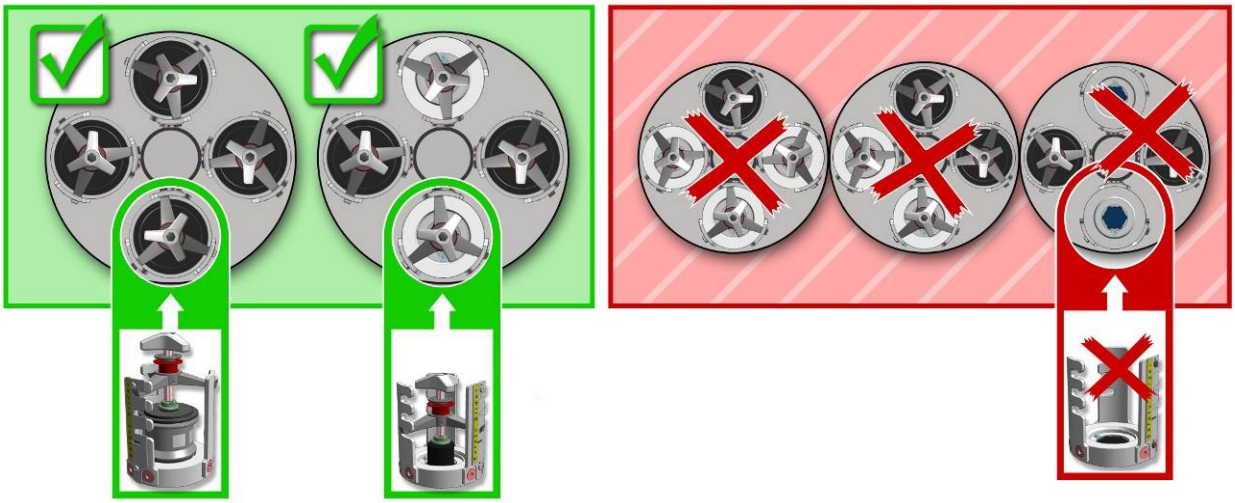
The emergency unlocking device must not be operated while the machine is running. Disconnect the machine from the mains supply before emergency unlocking.

Considerable danger of injury through long, unbraked after-running of the drive. The after-running time of the drive is < 10 sec.



Insertion and clamping of the milling cups in the PM400

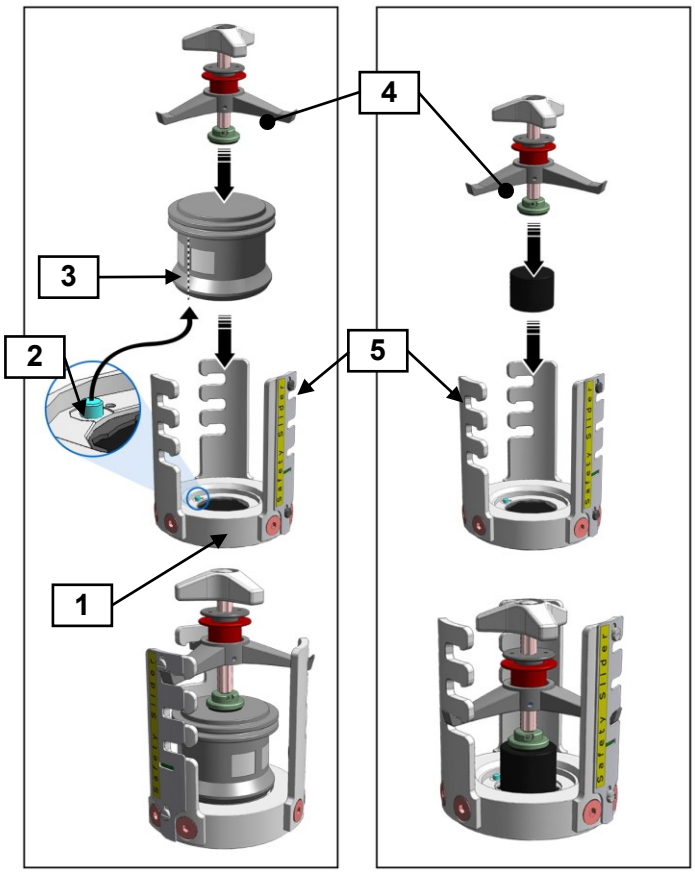
Always insert either 4 grinding jars or 2 jars opposite each other. All jars must have the same gross weight. When 2 grinding jars are used, each of the two grinding stations must be secured with a clamping pin and a spider.



When grinding with 2 grinding jars, the two must be placed opposite each other. Each of the two unoccupied grinding stations must be secured with a clamping pin and a spider (see illustration). The safety slider function will otherwise prevent the device from starting.

A high level of vibration by the mill indicates wrong taring or incorrectly clamped grinding jars!

If unevenly loaded, the PM400 can generate undesirable vibrations and noises! Turn the mill off immediately and check the jars' positioning and gross weight!



- If necessary, clean the grinding jar turntable **1** and torsion lock pin **2**.
- Turn the grinding jar label **3** to the same side as the torsion lock pin, where the grinding jar's borehole is.
- Insert the grinding jar into the grinding jar holder.

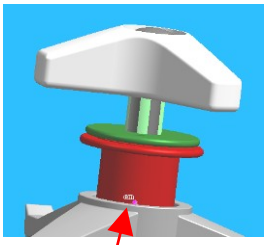
Pay attention to the torsion lock when using 250-ml and 500-ml grinding jars. The borehole in the bottom of the grinding jar into which the torsion lock pin **2** fits is on the side of the labelling panels **3**.

- Insert the spider **4** into the three brackets **5**.
- When using two grinding jars, insert a clamping pin and the spider into each of the two opposite unoccupied grinding stations.

Inserting and clamping the spider presses the safety slider **6** upwards and activates it. Once the mill has been started, the PM100 checks this safety function for up to approx. 15 seconds long. If you

- have not clamped the spider,
- not inserted any spider or
- the grinding jar is missing,

the PM100 will stop the starting procedure and emit the error message F10.



6 up = free

6 down = closed

- Pull the red sleeve **6** upwards and clamp the grinding jar by turning the three-point grip to the right.
- Let the red sleeve **6** move downwards and lock audibly in place; if necessary, tighten a bit more by means of the three-point grip.
- It must not be possible to turn the three-point grip any further.

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

Before starting the machine ensure that the milling cup is clamped. Milling cup can be ejected, danger of injury and damage to equipment.
Always insert 2 opposite or 4 milling cups. All cups must have the same gross weight.
Use milling cups only of type „C". This, in combination with the milling cup holder, is a safety component. **If other or old milling cups are used in the PM400 this can result in unforeseen danger.**
Never leave the milling cup clamping device **3** loose, without clamped milling cups, in the milling cup holder. **Danger of ejection.**
Check firm fitting of the milling cups, particularly with long-term milling operations, according to the following time schedule: after 3 min, after 1 hr, after 5 hrs then every 10-12 hrs. A clamping force of 10 Nm for the milling cup clamping device is optimum. **Danger of ejection.**
Always ensure that the red sleeve is locked in place properly. Otherwise the milling cup will not be clamped adequately. **Danger of ejection.**

Unclamping the milling cup clamping device in the PM400

- Pull the red sleeve **5** upwards and unclamp the milling cup by turning the 3-star handle to the left.
- Continue to turn the 3-star handle to the left until the milling cup clamping device can be removed.

Safety instructions when starting the PM400

The milling cup clamping device is easy and reliable to handle and has proved itself for many years. The basic precondition both for safety of the operator and for long service life of the machine components is conscientious clamping of the milling cups.

Please consider that the PM400 is a milling machine with a very high power input into the milling material. For this reason the milling cups must be fixed conscientiously.

In order to avoid operating faults correct milling cup fixing is interrogated before starting the machine.
Personnel who have been particularly well trained and are familiar with operation of the PM can permanently fade out this safety instruction. However, if operating personnel are changed frequently we do not recommend this procedure.

The software of the PM400 is set up in such a way that when operating the start button the following display appears, in which clamping of the milling cups has to be confirmed before every machine start up.

After confirmation the milling process is started.
This safety instruction can be faded out in the "Settings" menu.

Ensure that the milling cup is clamped before starting the machine.

Milling cups can be ejected – danger of injury and damage to equipment.

We recommend that this safety instruction is not faded out.

Always insert 2 opposite milling cups or 4 milling cups. All cups must have the same gross weight.

Power failure during milling

Display 1

PROCESS INTERRUPTED
POWER FAILURE

START = CONTINUE

STOP = DISCONTINUE

If the mains supply fails during the milling process the milling operation is interrupted. All parameters are retained and the residual running time is stored. After switching on the machine again the instructions shown on the left appear in the display (display 1).

You can continue the process by pressing the **START** button. Through automatic storage of the residual running time the milling process is continued up to the end of the originally set milling period.

For safety reasons the PM400 must be opened and the milling chamber checked. After closing the lid milling is continued automatically (display 2).

Display 2

1. OPEN MACHINE

2. CHECK MILLING CHAMBER

3. CLOSE MACHINE

By pressing the **STOP** button the process is stopped.

Suitable milling cups in the PM400

The PM400 is suitable only for milling cups f rom the firm Retsch GmbH, of type "Comfort", with a nominal volume of 12 ml – 500 ml.

These are available in the following materials:

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

The „Comfort" milling cup range has been developed specially for extreme test conditions, such as long-term trials, high mechanical loading and maximum rotary speeds – and also for mechanical alloying.

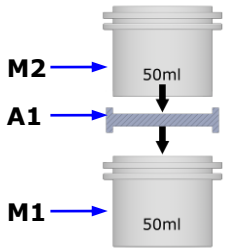
Milling cup filling level

Guide values for material quantity and balls

Nominal volume	Useful volume	Max. charging grain size	Recommended ball filling			
			dia. 10mm	dia. 20mm	dia. 30mm	dia. 40mm
12 ml	- 5 ml	1 mm	5 balls	-	-	-
25 ml	- 10 ml	1 mm	8 balls	-	-	-
50 ml	5 – 20 ml	3 mm	10 balls	3 balls	-	-
80 ml	10 – 35 ml	4 mm	25 balls	5 balls	-	-
125 ml	15 – 50 ml	4 mm	30 balls	7 balls	-	-
250 ml	25 – 120 ml	6 mm	50 balls	15 balls	6 balls	-
500 ml	75 – 220 ml	10 mm	100 balls	25 balls	8 balls	4 balls

If the filling level of the milling cup is too high or too low the milling result will be impaired and damage (wear increase) to the milling equipment can result.

Stacking of 50 ml milling cups of type "C"



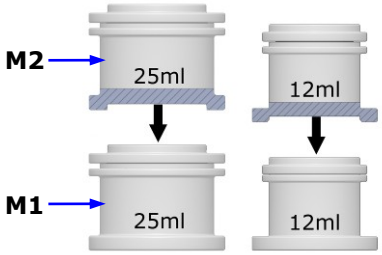
It is possible to stack two 50 ml milling cups one on top of the other.
For stacking an adapter is required, which is available as an accessory.

Stacking procedure

- Place milling cup **M1** in the milling cup plate
- Place the adapter **A1** on the lid of **M1**
- Place milling cup **M2** in position

Clamp the milling cups as described in the section "Clamping the milling cups".

Stacking of milling cups less than 50 ml



It is also possible to stack milling cups with a capacity of less than 50 ml one on top of the other.

Stacking procedure

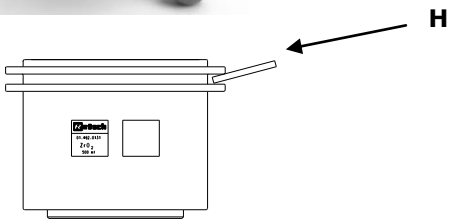
- Place milling cup **M2** on milling cup **M1**

Clamp milling cups as described in the section "Clamping the milling cups".

Handling milling cups of type "C"

Carrying and gripping
The gripping edges **X** on the milling cup lid and on the milling cup facilitate safe handling.

Protection against twisting
All 250 and 500 ml milling cups of type „C" have a drill hole in the underside of the cup in which the pin for protection against twisting is inserted. This drill hole is used only in the PM400 and is located on the side of the milling cup casing with labelling.

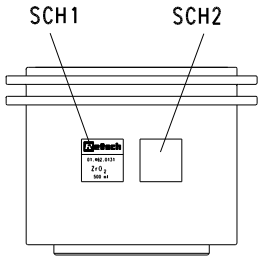


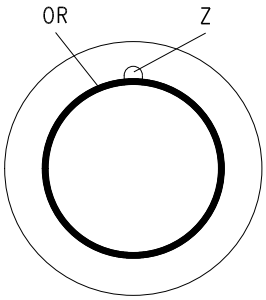
Heating up of the milling cups
The milling cups can become heated up to 150°C during milling, depending on the milling time and the filling level.

This temperature change causes a pressure increase in the interior of the milling cup. When removing the lid please note that this increased pressure is reduced through the suddenly escaping air. At the same time particles of the material being milled can also be carried off.

A vacuum is produced in the interior of milling cups which have been left to cool, and this can cause difficulty in opening the milling cup. Therefore milling cups of type „C" can be prised open by inserting, e.g. a wooden pin **H** between the gripping edges of the lid and the milling cup.

Please take the necessary measures, depending on the dangerous nature of your milling material, so that danger to persons is excluded.
When removing and opening hot milling cups it is essential to wear protective gloves. **Danger of burning the hands.**





Milling cup identification

All milling cups of type „C" are easy to identify through the labelling area **SCH1** which shows the article no. and material.

Milling cup labelling by the customer
In addition to the above mentioned labelling area you can stick one of the labels supplied with the machine or available as accessories on the area **SCH2** marked on the milling cup – for labelling e.g. milling cup contents etc.
The label is heat resistant up to 150°C and your inscription can be cleaned with e.g. alcohol, petrol or acetone.

Cleaning the milling cups
For cleaning the milling cups the O-ring on the groove **Z** on the underside of the lid can be easily prised off.
Milling cups, including also those with stuck-in ceramic inserts, can be cleaned with alcohol, petrol or normal domestic detergents.

Do not subject milling cups with ceramic inserts to sudden temperature differences when rinsing.
The ceramic inserts can crack through sudden temperature differences.

Drying the milling cups
After cleaning the milling cups can be dried at any time in a drying oven at the temperatures given below.

Milling cup 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 milling

In many cases high finenesses can be achieved only by wet milling.

In dry milling processes an improved fineness of milling can be achieved by the addition of a few drops of stearic or acetic acid, and use of milling balls with a diameter < 10 mm and a filling level of 70-80% of the milling cup volume.

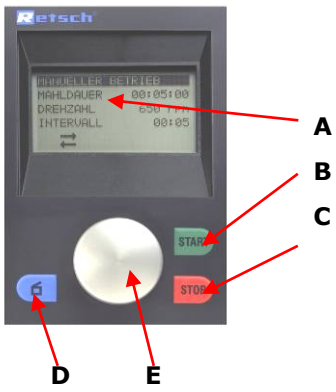
Use of the closing device for milling cups

- After filling the milling cups these must be closed with closing devices available as accessories.
- For milling cups with material inserts, ceramics or tungsten carbide use only closing devices which support the material insert of the milling cup lid. This is absolutely essential owing to the anticipated internal pressure.
- Use of agate milling cups for wet milling with solvents should be particularly carefully considered owing to the internal pressures produced and the non-homogeneous material properties of this natural product.
- Tighten the clamping screws of the closing device with a torque of 2.5 Nm. Internal pressures of up to max. 5 bar are permissible only with this preliminary tension.
- Please note that the milling cups can easily be heated to above 100°C, depending on the milling cup size, ball filling, speed and milling time.
- The PM400 is fitted with a ventilator which sucks the waste heat produced during milling directly out of the milling chamber.The suction volume per hour is greater than 20 times the milling chamber volume. The ventilator has a standstill monitor with signalling.
- If necessary the air stream of the ventilator should be carried off into a duct during milling.
- Check firm fitting of the closing device before removing the milling cups.
- Remove the milling cups only with closing device and open **only** in a safe position (extraction unit) **after** cooling.

For wet milling in milling cups with material inserts do not use old closing devices which clamp only the gripping edges of the milling cups. The material inserts can be pressed out by possible internal pressure.

Operation via the display unit of the PM400

The mills have a new, very comfortable operator control system. All relevant data can be entered or called via a graphic display with one knob operation.
The menu system is multlingual.



	Name	Function
A	**Display**	Displays the menu, parameter settings, operating instructions and fault signalling.
B	**START button**	Starts the milling process
C	**STOP button**	Stops the milling process
D	**Button**	Opens the milling chamber hood
E	**Setting knob**	By turning and pressing, all menu points can be selected and parameters set. **Turning 1** By turning, the various menu points can be selected. Selected menu points are displayed inversely. **Turning 2** Setting of parameters in the opened menu points (see Pressing 1) **Pressing 1** Selected menu points are opened. **Pressing 2** Short pressing confirms setting of parameters. **Pressing 3** Continuous pressing: jump back to the 1st menu level.

Symbols in the display unit

Reversal of direction of rotation switched on

Programme mode – take over parameters

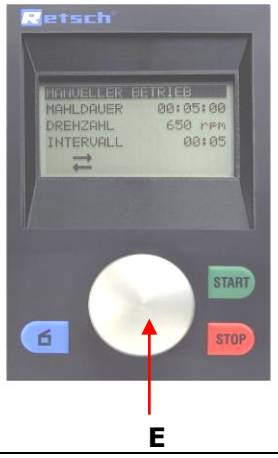
Programme mode – change programme

Programme mode – delete programme

Opening automatic control off

Warning sound off

°C Motor or frequency converter too hot



By turning and pressing the setting knob **E** all menu points can be selected and parameters set.

Turning 1
By turning, the various menu points can be selected. Selected menu points are displayed inversely.

Turning 2
Setting of parameters in the opened menu points (see Pressing 1).

Pressing 1
Selected menu points are opened.

Pressing 2
Short pressing confirms setting of parameters.

Pressing 3
Continuous pressing: jump back to the 1st menu level.

Setting possibilities via the display menu

For the setting possibilities on the display described below please observe the menu structure on this page. The selection bar in the display should be operated as follows:

- Vertical manoeuvering through the structure by **turning** the setting knob
- Horizontal manoeuvering through the menu structure by **pressing** the setting knob
- Setting of numerical values or decisions by **turning** the setting knob
- Confirmation of settings by **pressing** the setting knob
- With "RETURN" you go to the previous menu structure level
- By **continuous pressing** the setting knob you return to the basic screen

Languages		
Menu	**Display**	**Languages**

You can select the language here. After selection and pressing the setting knob the complete menu structure is shown in this language.

False language selection
If the wrong language is accidentally selected switch off the unit at the main switch.

Keep the buttons 

pressed simultaneously and switch on the unit again.
After selecting the correct language switch off the equipment and immediately on again.
Confirm your selection by pressing the setting knob.
The unit is now set permanently in your language and you are in the main menu.

Manual operation	If this function is set you can call and change all parameters and functions at any time. This is also possible during milling.

Milling programme	• To get to the „milling programme" function press the setting knob with "manual operation" set. Milling programme 1 appears, flashing, in the display. Furthermore data which may already have been stored in milling programme 1 are also displayed. • By turning the setting knob to the right you can select other milling programmes 2-10. Any parameters which may have been stored are displayed each time. • You can start the machine directly with the selected milling programme. • To return to „manual operation" turn the setting knob completely to the left and confirm with the setting knob.

Milling time	00:00:01 up to 99:59:59 Hours:Minutes:Seconds
START	The PM400 is started with the preselected milling time and the speed last used. Reversal of direction of rotation with pause time is not switched on.

Speed	30 to 400 rpm
START	The PM400 is started with the preselected milling time and the preselected speed. Reversal of the direction of rotation with pause time is not switched on.

Interval	00:00:01 to 99:59:59 Hours:Minutes:Seconds	The interval time can be set here, depending on the milling time. If interval is not set then reversal of direction of rotation cannot be set.
	Reversal of direction of rotation **YES** **NO**	
START	The PM400 is started with the preselected milling time, speed and reversal of direction of rotation. The machine rotates in one direction with the set interval time, comes to a stop and starts immediately after standstill in the other direction without a pause time.	

	Pause time	
	00:00:01 to 99:59:59 Hours:Minutes:Seconds	The pause time can be set here between the intervals from 00:00:01 to 99:59:59 Hours:Minutes:Seconds. If no interval is set then a pause time cannot be set.
START	The PM400 is started with the preselected milling time, speed, reversal of direction of rotation and the set pause time. The machine rotates with the set interval time in one direction, comes to a stop and after standstill the previously set pause time is displayed in the interval and counted down to 00:00:00. After the pause time has elapsed the machine starts in the other direction.	

Programme mode		
	Take over parameters	Here all the previously set parameters, such as milling time, speed, interval and pause can be stored in a store.
	• Set the required parameter. • Change to „Programme mode" in the menu, press the setting knob and confirm „Take over parameters" again. The menu shows „Milling programme" and on the right the storage location number. • Turn the setting knob to the right until you have found a milling programme with empty storage locations or one which you wish to overwrite. • By pressing the setting knob you can reserve the selected storage location. • You can now choose between "Store parameter ?" or "Cancel". • You will then be returned again into the "Programme mode" level.	

Programme mode		
	Change programme	Here all previously stored parameters, such as milling time, speed, interval and pause can be changed. It is also possible to enter new parameters.
	• Select „Programme mode", „Change programme" and confirm with the setting knob. The display shows the milling programme with storage location number again. • To select the „Milling programme" to be changed press the setting knob;only the storage location numbers are inverse; the milling programme is changed by turning the setting knob. • Confirm the milling programme to be changed by pressing; you can now change the parameters. • After this you can „Store (the changed) Parameters" or "Cancel" • You will then be returned again to the "Programme mode" level.	

Programme mode		
	Delete programme	Here all the previously stored parameters can be deleted.
	• Select „Programme mode", press the setting knob and confirm „Delete programme" again. • Select the milling programme to be deleted by turning the setting knob and confirm by	

	pressing. • You can now "Delete programme" or "Cancel", • You will then be returned again to the programme mode level.

Starting time

	Start in xx h **Cancel**	Starting the milling process can be preselected here, in steps of 01 to 99 hrs.
START	The PM400 is started with the preselected milling time, speed and reversal of direction of rotation after the set starting time has elapsed. The countdown up to starting the machine is shown in the display.	
		Ensure that the milling cups are properly clamped and balanced before you start the machine unattended.
		Even though starting without the lid closed is not possible, make sure that the lid is closed before you start the machine unattended.
STOP	You can interrupt running of the starting time at any time with the STOP button and with the main switch on the rear side of the unit. You then have to reprogramme the starting time.	

Opening automatic

MENU	SETTINGS	OPENING AUTOMATIC

Here you can preselect whether the milling chamber lid is to be automatically lifted at the end of milling or is to be opened only by pressing the knob. If the function is switched off the pictogram

 appears in the display to confirm this.

Power

MENU	SETTINGS	POWER

With this function you can determine the total power (milling power + power loss) put into the milling cups. This total power input into the milling cups is defined as the difference between the power consumed by the drive of the machine with the milling cups filled with milling material and milling medium compared with empty milling cups.

First of all the no-load power consumed by the machine with empty milling cups must be determined. The level of no-load power is determined only over a relatively short period and is considered as zero point from the electronics – in a similar way to the taring of weighing scales.

During subsequent milling of the material only the power input which extends beyond the level of no-load power is considered. This difference is equivalent to the power which is put into the milling cup(s) through the milling medium and milling material.

For comparison purposes of various parameter combinations the power input can also be specified instead of the milling time. (For comparability only the milling material quantity and the charged grain size must be the same). In this case the milling process is ended not after a specified time but after input of the specified power.

The power menu is divided into three further sub-menus:

DETERMINE NO-LOAD POWER
MEASURE
SPECIFY

In order to determine the power input into the milling cups during your milling process please proceed as follows:

- Preset all the parameters – speed, milling time, interval, necessary for the intended milling process.
- Determine the weight of the milling cup intended for the subsquent milling process – still without milling material and milling medium.
- Set the balancing weight accordingly.

- and then change into the sub-menu:
- **DETERMINE NO-LOAD POWER**
- Clamp the milling cup – still without milling material and milling medium – firmly in the machine.
- Start the machine. The process now following lasts approx. 45 sec. During this time the PM400 determines the no-load power with empty milling cups at the subsequent operating speed.
- After determining the no-load power the PM400 stops automatically and you are asked to fill in the milling material and milling balls.
- Determine the increased weight of the milling cup filled with milling material and milling medium.
- Please note that balancing of the PM400 must be corrected accordingly.
- After pressing the Start button again you are asked to decide on "MEASURE" or "SPECIFY" the power.
- **MEASURE**
  After determining the no-load power only the additional power put into the milling cup through movement of the balls and milling material during the milling time is determined.
- **SPECIFY**
  Enter the power in kJ to be put into the milling cup. Simultaneous pressing of the milling time is now no longer possible. The machine stops when the preset power has been put in.

Warning sound

MENU	SETTINGS	WARNING SOUND

Fault signals through incorrect operation can be supported acoustically by a warning sound.

With the function switched off the corresponding pictogram appears 

Service

MENU	SETTINGS	SERVICE

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

- **OPERATING HOURS**
  The milling hours are counted, i.e. the total sum of the times between START and STOP. These times cannot be manipulated.
- **OPERATING SOFTWARE**
  The operating software version can be interrogated and if necessary updated. When required please contact your Retsch distributor.
  If you have accidentally got into the menu and jumping back into the previous menu is not possible, switch off the unit at the main switch and restart.

Contrast / Brightness		
MENU	**DISPLAY**	**CONTRAST**
		BRIGHTNESS

Contrast and brightness can be adapted to each user or to the environment (sunlight, dazzling etc).
If you have accidentally selected the wrong contrast or brightness (the display can no longer be seen), switch off the unit at the main switch, keep the buttons START, STOP and LID OPEN pressed simultaneously and switch on again. You are now in the language selection and the setting values CONTRAST and BRIGHTNESS have the works presettings again.

Date / Time	
MENU	**DATE**
	TIME

The date format can be changed by turning the setting knob. The actual date and time can be entered here. The time then appears in the stand-by monitor.
The unit can be disconnected fromt the mains for up to 30 days without the settings being lost.

Stand-by monitor

After 15 minutes inactivity of the unit (times after a STOP command) the stand-by monitor switches on automatically.
By pressing one of the buttons or touching the setting knob the stand-by monitor disappears without carrying out the command which has been made.
If you were in a sub-menu when the stand-by monitor was activated, you return to this selection window automatically.
The stand-by monitor cannot be set and cannot therefore be switched off.

Residual running time		
RESIDUAL RUNNING TIME		

After START(ing) the milling process the display of the residual running time appears after a few minutes have elapsed. By turning or pressing the rotating knob the normal display with milling time, speed, interval etc is shown again. After one minute the residual running time is displayed again.

Display after power failure		
POWER FAILURE		

After a power failure an instruction concerning this is displayed. The locking device is opened. After START you go to the standard screen in order to continue. All parameter values are stored in seconds and are available for continuing. Open and close the lid. Then press START. After STOP you return to the screen before the start and all parameters are reset to the starting values.

Fault signals in the display

F03 to F23

Appearing in display	Appearing in display
F03 **Problem in safety circuit of lid lock** **Service required!**	**F04** **Open or close lid, otherwise lid lock defective** **Service required!**
Fault appears if the lid lock has a fault. • Switch off machine at main switch – this is a safety problem.	Fault appears if the lid lock hs a fault. • Switch off machine at main switch – this is a safety problem.

Appearing in display	Appearing in display
F07 **Motor speed control is defective**	**F08** **Please enter milling time**

Appearing in display	Appearing in display
F09 **Housing ventilator stopped** **Service required!**	**F10** **Sun wheel does not rotate** **Service required!**

Appearing in display	Appearing in display
F11 **Sun wheel rotates too slowly** **Service required!**	**F14** **Speed sensor defective** **Service required!**

Appearing in display	Appearing in display
F15 **Problem in safety circuit of frequency converter** **Service required!**	**F16** **Motor is overheated** **No START possible** **Please allow to cool**

Appearing in display	Appearing in display
F17 **Motor is overheated** **Has been switched off** **Please allow to cool** **Continue with STOP**	**F18** **Problem in safety circuit of transformer** **Service required!**

F24 to F26

Appearing in display	Appearing in display
F25 **Parameters OK?** **START = Start machine** **STOP = Check**	**F26** **Frequency converter is overheated** **No START possible** **Please allow to cool**

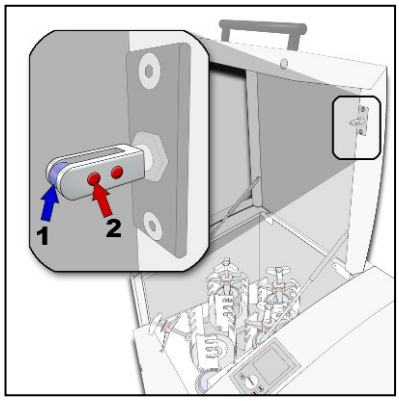
General

Cleaning

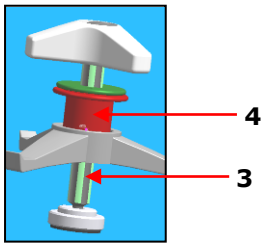
Do not clean the PM400 with running water. **Danger to life through current surge.** Use only a cloth moistened with water. Solvents are not permitted.

Maintenance (monthly)

In order to guarantee operating reliability of your PM400 the following maintenance work should be carried out from time to time, however at the latest monthly:

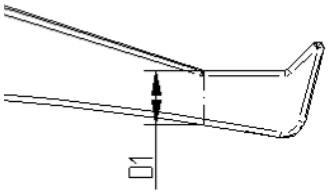


- Check roller **1** of the closing pin for easy running and oil if necessary, e.g. with sewing machine oil.
- Clean magnets **2** on closing pin.



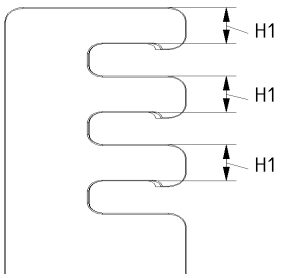
- Check threaded spindle **3** and locking sleeve **4** for easy running. A drop of oil usually helps.

Easy running of the threaded spindle and locking sleeve is necessary for reliable clamping of the milling cups.
Locking sleeves which do not automatically slide downwards through spring tension cannot reliably prevent the threaded spindle from becoming loose. The milling cups can then be ejected.
Easy running of roller **1** on the closing pin is necessary for reliable closing of the housing lid of the PM400.



- The thickness **D1** of the three spider supports should be checked for wear from time to time, at the latest monthly.

This should not drop below 7.5 mm for the PM400.



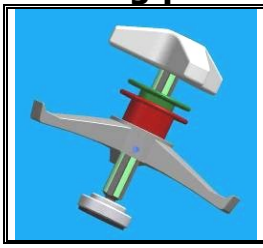
- The height **H1** of the locking strips should be checked for wear from time to time, at the latest monthly.

This should not drop below 17 mm.

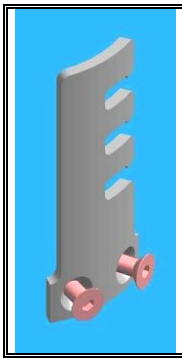
- Check the rubber gasket **5** in the thrust piece for wear and firm seating (adhesion). Up to 120°C use temperature resistant quick-acting adhesive DELO 2256.

If the values drop below **D1** and **H1** operating reliability is no longer guaranteed. The milling cups can be ejected.

Wearing parts

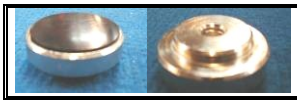


Spider with thrust piece PM400
Art. No. 22.661.0002



For PM400
3x locking strip
Art. No. 03.623.0002

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



For PM400 PM400
1x thrust piece with rubber gasket
Art. No. 02.108.0046

These operating instructions do not include repair instructions. For your own safety repairs should be carried out only by Retsch GmbH, an authorised agent or service technicians.

Copyright

Alterations

Subject to technical alterations without notice.

CERTIFICATE OF CE-CONFORMITY

Translation

PLANETARY BALL MILL

PM 400

Certificate of CE-Conformity according to:

EC Mechanical Engineering Directive 2006/42/EC

Applied harmonized standards, in particular:

DIN EN ISO 12100	Security of machines

EC Directive Electromagnetic Compatibility 2004/108/EC

Applied standards, in particular:

EN 61000-3-2/-3	Electromagnetic compatibility (EMC)
EN 61236	Electrical measuring, operating, controlling and laboratory equipment – EMC-requirements in conjunction with EN 61000
EN 55011	Limit values and measuring procedures for noise suppression of industrial, scientific and medical high frequency devices

Additional applied standards, in particular

DIN EN 61010	Safety prescriptions concerning measuring-, operating-, controlling- and laboratory equipment

Authorized person for the compilation of technical documents:
J. Bunke (technical documentation)

The following records are held by Retsch GmbH in the form of Technical Documentation:
Detailed records of engineering development, construction plans, study (analysis) of the measures required for conformity assurance, analysis of the residual risks involved and operating instructions in due form according to the approved regulations for preparation of user information data.

The CE-conformity of the Retsch Planetary Ball Mill Type PM 400 is assured herewith.

In case of a modification to the machine not previously agreed with us as well as the use of not licensed spare parts and accessories this certificate will lose its validity.

Retsch GmbH

Haan, January 2010

Dr. Stefan Mähler
Manager technical services

CE

Retsch GmbH • Retsch-Allee 1-5 • 42781 Haan • Germany • www.retsch.com