OPTIMUM®
MASCHINEN - GERMANY

Operating Manual

Version 1.1.1

Drilling- milling machine

MB4

OPTImill® MB 4

Part no. 3338450
333845001
333845002
333845003

EN

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Preface

Dear customer,

Thank you very much for purchasing a product made by OPTIMUM.

OPTIMUM metal working machines offer a maximum of quality, technically optimum solutions and convince by an outstanding price performance ratio. Continuous enhancements and product innovations guarantee state-of-the-art products and safety at any time.

Before commissioning the machine please thoroughly read these operating instructions and get familiar with the machine. Please also make sure that all persons operating the machine have read and understood the operating instructions beforehand.
Keep these operating instructions in a safe place nearby the machine.

Information

The operating instructions include indications for safety-relevant and proper installation, operation and maintenance of the machine. The continuous observance of all notes included in this manual guarantee the safety of persons and of the machine.

The manual determines the intended use of the machine and includes all necessary information for its economic operation as well as its long service life.

In the paragraph "Maintenance" all maintenance works and functional tests are described which the operator must perform in regular intervals.

The illustration and information included in the present manual can possibly deviate from the current state of construction of your machine. Being the manufacturer we are continuously seeking for improvements and renewal of the products. Therefore, changes might be performed without prior notice. The illustrations of the machine may be different from the illustrations in these instructions with regard to a few details. However, this does not have any influence on the operability of the machine.
Therefore, no claims may be derived from the indications and descriptions. Changes and errors are reserved!

Your suggestion with regard to these operating instructions are an important contribution to optimising our work which we offer to our customers. For any questions or suggestions for improvement, please do not hesitate to contact our service department.

If you have any further questions after reading these operating instructions and you are not able to solve your problem with a help of these operating instructions, please contact your specialised dealer or directly the company OPTIMUM.

Optimum Maschinen Germany GmbH

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1 Safety

Glossary of symbols

☞	provides further instructions
➜	calls on you to act
❍	listings

This part of the operating instructions

- ❍ explains the meaning and use of the warning notes included in these operating instructions,
- ❍ defines the intended use of the milling machine,
- ❍ points out the dangers that might arise for you or others if these instructions are not observed,
- ❍ informs you about how to avoid dangers.

In addition to these operation instructions, please observe

- ❍ the applicable laws and regulations,
- ❍ the statutory provisions for accident prevention,
- ❍ the prohibition, warning and mandatory signs as well as the warning notes on the milling machine.

When installing, operating, maintaining and repairing the milling machine, the relevant standards must be observed.

If European standards have not yet been incorporated in the national legislation of the country in question, the specific applicable regulations of each country must be observed.

If necessary, relevant measures must be taken to comply with national regulations before commissioning the milling machine.

Always keep this documentation close to the milling machine.

INFORMATION

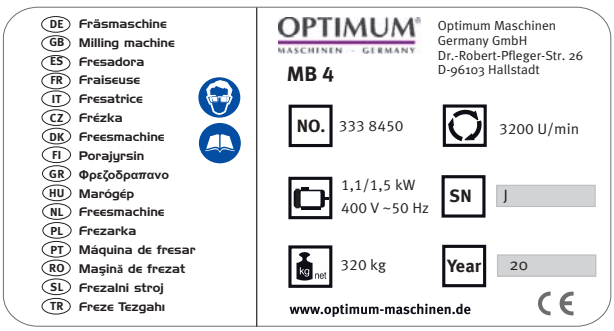
If you are unable to rectify an issue using these operating instructions, please contact us for advice:

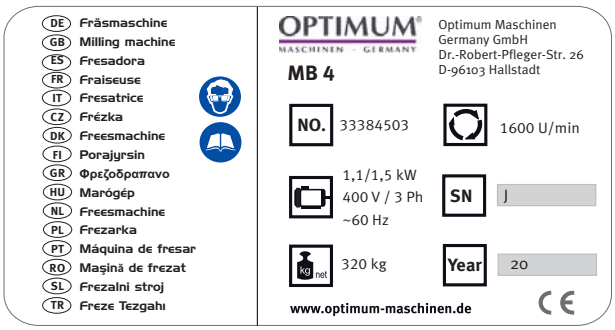
Optimum Maschinen Germany GmbH
Dr. Robert-Pfleger-Str. 26

D-96103 Hallstadt, Germany

Email: info@optimum-maschinen.de

1.1 Rating plates





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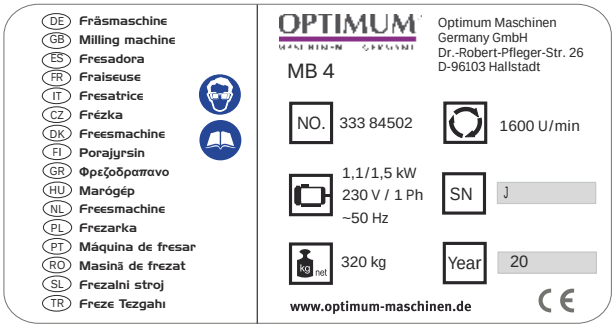

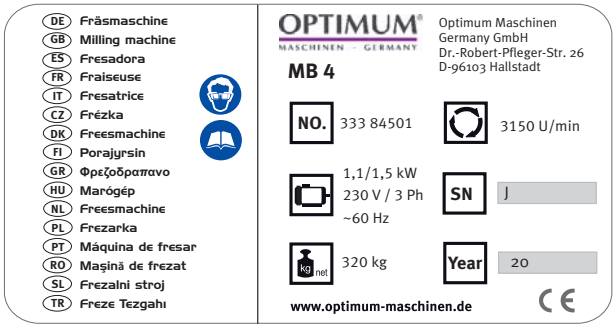

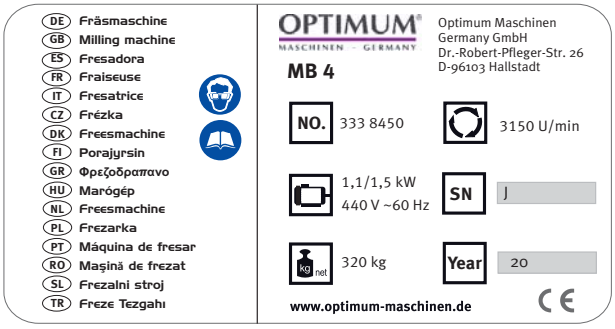

1.2 Safety instructions (warning notes)

1.2.1 Classification of hazards

We classify the safety warnings into different categories. The table below gives an overview of the classification of symbols (ideogram) and the warning signs for each specific danger and its (possible) consequences.

Symbol	Alarm expression	Definition / consequence
	**DANGER!**	Impending danger that will cause serious injury or death to people.
	WARNING!	A danger that can cause serious injury or death.
	CAUTION!	A danger or unsafe procedure that can cause personal injury or damage to property.
	**ATTENTION!**	Situation that could cause damage to the milling machine and product, as well as other types of damage. No risk of injury to persons.
	**INFORMATION**	Practical tips and other important or useful information and notes. No dangerous or harmful consequences for people or objects.

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In case of specific dangers, we replace the pictogram with


general danger


with a warning of


injury to hands,


hazardous electrical voltage,

or


rotating parts.

1.2.2 Other pictograms


Warning: danger of slipping!


Warning: risk of stumbling!


Warning: hot surface!


Warning: biological hazard!


Warning: automatic start-up!


Warning: tilting danger!


Warning: suspended loads!


Caution, danger of explosive substances!


Switching on forbidden!


Read the operating instructions before commissioning!


Pull out the mains plug!


Wear protective glasses!


Wear protective gloves!


Wear safety shoes!


Wear a protective suit!


Use ear protection!


Only switch during standstill!


Protect the environment!


Contact address

1.3 Intended use

WARNING!

In the event of improper use of the drilling- milling machine

- **will endanger personnel,**
- **the drilling- milling machine and other material property of the operating company will be endangered,**
- **the correct function of the drilling- milling machine may be affected.**

The drilling- milling machine is designed and manufactured to be used for milling and drilling cold metals or other non-flammable materials or materials that do not constitute a health hazard by using commercial milling and drilling tools.

The drilling- milling machine must only be installed and operated in a dry and well-ventilated place.

If the drilling- milling machine is used in any way other than described above, modified without the approval of the company Optimum Maschinen Germany GmbH then the CNC machine is being used improperly.

We will not be held liable for any damages resulting from any operation which is not in accordance with the intended use.

We explicitly point out that any construction, technical or process engineering changes that have not been approved by Optimum Maschinen Germany GmbH will render the warranty null and void It is also part of the intended use that you

- observe the limits of the drilling- milling machine,
- the operating manual is observed,
- the inspection and maintenance instructions are observed.

☞ Technical specification on page 18

WARNING!

Severe injuries due to non-intended use.

It is forbidden to make any modifications or alternations to the operation values of the drilling- milling. They could endanger the personnel and cause damage to the drilling-milling machine.

1.4 Reasonably foreseeable misuses

Any use other than that specified under "Intended use" or any use beyond that described will be deemed non-intended use and is not permissible.

Any other use must be discussed with the manufacturer.

It is only allowed to process metal, cold and non-inflammable materials with the drilling- milling machine.

In order to avoid misuse, it is necessary to read and understand the operating instructions before first commissioning.

Operators must be qualified.

1.4.1 Avoiding misuse

➜ Use of suitable cutting tools.

➜ Adapting the speed adjustment and feed to the material and workpiece.

➜ Clamp workpieces firmly and free of vibration.

➜ Risk of fire and explosion due to the use of flammable materials or cooling lubricants. Before processing inflammable materials (e.g. aluminium, magnesium) or using inflammable auxiliary materials (e.g. spirit), you need to take additional preventive measures in order to avoid health risks.

➜ When processing plastics, the machine operator must ensure that static electricity generated during the machining process can be discharged easily.

➜ When processing carbons, graphite and carbon-fibre-reinforced carbons, the machine is no longer being used as intended. This causes the warranty to be null and void. When processing carbons, graphite and carbon-fibre-reinforced carbons and similar materials, the machine can be damaged extremely quickly, even if the dusts generated are completely sucked out during the work process.

ATTENTION!

The workpiece is always to be fixed by a machine vice, jaw chuck or by another appropriate clamping tool such as for the clamping claws.

WARNING!

Risk of injury caused by flying workpieces.

➜ Clamp the workpiece in the machine vice. Make sure that the workpiece is firmly clamped in the machine vice and that the machine vice is firmly clamped onto the machine table.

❍ Use cooling and lubricating agents to increase the durability of the tool and to improve the surface quality.

❍ Clamp the cutting tools and workpieces on clean clamping surfaces.

❍ Sufficiently lubricate the machine.

❍ Set the bearing clearance and guides correctly.

Recommendations:

❍ Insert the drill in a way that it is exactly positioned between the three clamping jaws of the quick action chuck.

❍ Clamp end mills (or shank cutters) in a collet chuck using the corresponding collets.

❍ Clamp end face mills using shell end mill arbors.

When drilling, make sure that

❍ the suitable speed is set depending on the diameter of the drill,

❍ the pressure must only be such that the drill can cut without load,

❍ if there is too much pressure, the drill will wear quickly and may even break or jam in the borehole. If the drill gets jammed immediately stop the main motor by pressing the emergency stop button,

❍ use commercial cooling/lubricating agents for hard materials, e.g. steel and

❍ generally always back the spindle out of the workpiece while it is still turning.

ATTENTION!

Do not use the quick action drill chuck for milling tools. Never clamp a milling cutter into a quick action drill chuck. Use a collet chuck and appropriate collets for end mills.

When milling, ensure that

❍ the right cutting speed is selected;

❍ for workpieces with normal strength values, e.g. steel, 18-22 m/min,

❍ for workpieces with high strength values, 10-14 m/min,

❍ the pressure is selected so that the cutting speed remains constant,

- normal trade coolants/lubricants are used for hard materials.

1.5 Possible dangers caused by the drilling- milling machine

The drilling- milling machine was built using state-of-the-art technology.

Nevertheless, there is a residual risk as the drilling- milling machine operates with

- high speeds,
- circulating parts and tools and
- electrical voltage and currents.

We have used design and safety engineering to minimize the health risk to personnel resulting from these hazards.

If the drilling-milling machine is used and maintained by personnel who are not duly qualified, there may be a risk resulting from incorrect or unsuitable maintenance of the drilling-milling machine.

INFORMATION

Everyone involved in the assembly, commissioning, operation and maintenance must

- be duly qualified,
- and strictly follow these operating instructions.

Always disconnect the drilling- milling machine from the electrical power supply before performing cleaning or maintenance tasks.

WARNING!

The drilling- milling machine may only be operated with functional safety devices.

Disconnect the drilling- milling machine immediately, whenever you detect a failure in the safety devices or when they are not fitted!

All additional devices installed by the operator must be equipped with the stipulated safety devices.

This is your responsibility as the operator!

☞ **Safety devices on page 13**

1.6 Personnel qualification

1.6.1 Target group

This manual is addressed to

- operators,
- users and
- maintenance personnel.

Therefore, the warning notes refer to both, operation and maintenance personnel of the drilling- milling machine.

WARNING!

Always disconnect the drilling- milling machine from the electrical power supply. This will prevent it from being used by unauthorized persons.

The qualifications of the personnel for the different tasks are mentioned below:

Operator

The user must have been instructed by the operator about the assigned tasks and possible risks in case of improper behaviour. The user may only carry out tasks that exceed normal operation if this is stated in these instructions and the operator has explicitly entrusted him with the task.

Qualified electrician

With professional training, knowledge and experience as well as knowledge of respective standards and regulations, qualified electricians are able to perform work on the electrical system and recognise and avoid any possible dangers.

Qualified electricians have been specially trained for the working environment, in which they are working and know the relevant standards and regulations.

Qualified personnel

Due to their professional training, knowledge and experience as well as knowledge of relevant regulations, qualified personnel are able to perform the assigned tasks and to independently recognise and avoid any possible dangers.

Instructed person

Instructed persons were instructed by the operating company regarding the assigned tasks and any possible risks of improper behaviour.

INFORMATION

Everyone involved in the assembly, commissioning, operation and maintenance must

- be duly qualified,
- and strictly follow these operating instructions.

In the event of improper use

- there may be a risk to personnel,
- there may be a risk of damage to the drilling- milling machine and other material values,
- the correct function of the drilling- milling machine may be affected.

1.6.2 Authorized persons

WARNING!

Inappropriate operation and maintenance of the milling machine constitutes a danger to the personnel, objects and the environment.

Only authorized personnel may operate the milling machine !

Authorized operating and maintenance personnel are specialists instructed and trained by the operator and the manufacturer.

1.6.3 Obligations of the operating company

The operator must instruct personnel at least once a year in

- all safety regulations relevant to the machine,
- its operation and
- generally accepted engineering standards.

The operator must also

- check the personnel‘s knowledge level,
- document the training/instruction,
- have attendance at the training/instruction confirmed by signature and
- check whether personnel is working in a manner that shows awareness of safety and risks.
- Define and document the machine inspection deadlines in accordance with section 3 of the Factory Safety Order and perform an operational risk analysis in accordance with section 6 of the Safety at Work Act.

1.6.4 User's obligations

The user must

- ❍ have read and understood the operating instructions,
- ❍ be familiar with all safety devices and regulations and
- ❍ be able to operate the machine.

1.6.5 Additional requirements regarding qualification

The following additional requirements apply for work on electrical components or equipment:

- ❍ They must only be performed by a qualified electrician or person working under the instructions and supervision of a qualified electrician.

Before starting work on electrical parts or operating agents, the following actions must be taken in the order given:

- ➜ disconnect all poles,
- ➜ secure against restarting,
- ➜ check that there is no voltage.

1.7 User positions

The user position is in front of the drilling-milling machine.

Img.1-1: User positions

1.8 Safety measures during operation

CAUTION!

Danger due to inhaling dust and mist that are hazardous to health.

Depending on the materials to be machined and the agents used, dusts and mists can arise that are detrimental to health.

Ensure that the harmful dust and mist generated are safely sucked off at the point of origin and routed away from the working area or filtered. To do so, use a suitable extraction unit.

CAUTION!

Risk of fire and explosion by using flammable materials or cooling lubricants.

Extra precautionary measures must be taken before machining flammable materials (e.g. aluminium, magnesium) or using combustible agents (e.g. spirit) to avert a health hazard.

1.9 Safety devices

Use the drilling- milling machine only with properly functioning safety devices.

Stop the drilling- milling machine immediately, if a safety device fails or is faulty or becomes ineffective.

It is your responsibility!

If a safety device has been activated or has failed, the drilling- milling machine must only be used if you

- the cause of the fault has been eliminated,
- have verified that there is no danger to personnel or objects.

WARNING!

If you bypass, remove or deactivate a safety device in any other way, you are endangering yourself and other personnel working with the drilling- milling machine. The possible consequences are:

- **injuries due to components or workpieces flying off at high speed,**
- **contact with rotating parts and**
- **fatal electrocution.**

The drilling- milling machine features the following safety devices:

- An emergency switching off push button,
- a protective cover on the drilling / milling head.

WARNING!

Although the isolating safety devices provided and delivered with the machine are designed to reduce the risks of workpieces being ejected or parts of tools or workpieces breaking off, they cannot eliminate these risks completely. Always work carefully and observe the limits of the machining process.

1.9.1 Emergency switching off push button

The emergency switching off push button switches off the drilling-milling machine.

Img. 1-2: Emergency switching off push button

ATTENTION!

The emergency switching off push button immediately stops the operation of the drilling- milling machine.

Press the emergency switching off push button only if there is a risk! If this push button is actuated in order to switch off the drilling- milling machine in the standard operation the tool or workpiece might get damaged.

After having actuated the emergency switching off push button, turn the knob to the right in order to restart the machine.

1.9.2 Protective cover

The drilling / milling head is equipped with a protective cover.

WARNING!

Only remove the protective cover when the mains plug of the drilling-milling machine is disconnected.

Img.1-3: Protective cover

1.9.3 Lockable master switch

The lockable master switch can be secured in the "0" position by means of a padlock to guard against the milling machine being switched on accidentally or by an unauthorised person.

The power supply is cut off when the master switch is in the off position.

Except for the areas marked by the pictogram in the margin.

WARNING!

Dangerous voltage even if the main switch is switched off. The areas marked by the pictogram might contain live parts, even if the main switch is switched off.

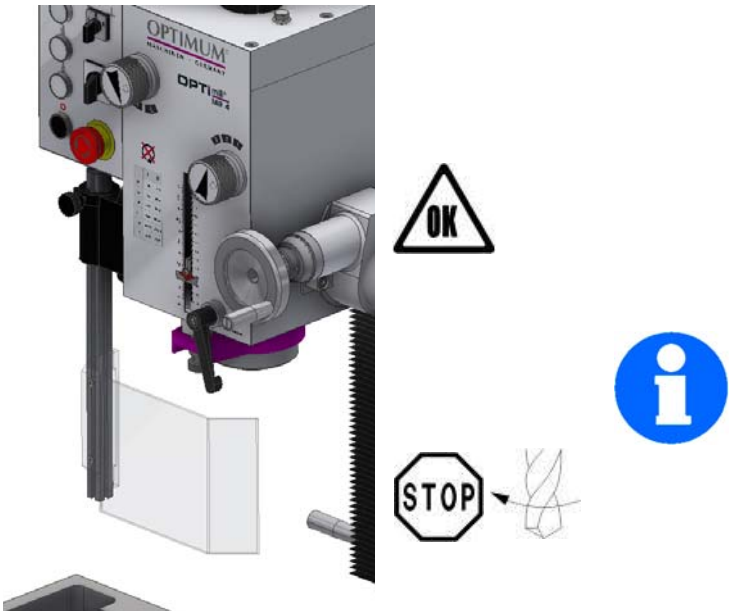
1.9.4 Separation guard

Adjust the guard to the correct height before you start working.
To do so, slacken the clamping screw, set the required height and re-tighten the clamping screw.

There is a switch integrated in the spindle protection mounting which monitors the closed position.

INFORMATION

The machine cannot be started, if the spindle protection is not closed.



Img.1-4: Separation guard

1.10 Safety check

Check the drilling- milling machine regularly.

Check all safety devices

- before starting work,
- once a week (with the machine in operation) and
- after all maintenance and repair work.

General check		
Equipment	**Check**	**OK**
Guards	Mounted, firmly bolted and not damaged	
Signs, Markers	Installed and legible	

Functional check		
Equipment	**Check**	**OK**
Emergency switching off push button	After the emergency switching off push button is pressed, the drilling- milling machine must switch off. It must only be possible to restart the machine, if the emergency switching off push button is unlocked and the ON switch has been pressed.	
Separation guard around the drill and milling spindle	The drilling- milling machine may switch on only when the guard is closed.	

1.11 Personal protective equipment





For certain work, personal protective equipment is required.

Protect your face and your eyes: Wear a safety helmet with facial protection when performing work where your face and eyes are exposed to hazards.

Wear protective gloves when handling pieces with sharp edges.

Wear safety shoes when you assemble, disassemble or transport heavy components.

Use ear protection if the noise level (emission) in the workplace exceeds 80 dB (A).

Before starting work make sure that the required personal protective equipment is available at the work place.

CAUTION!

Dirty or contaminated personnel protective equipment can cause illness. It must be cleaned after each use and at least once a week.

1.12 For your own safety during operation

WARNING!

Before activating the drilling- milling machine, ensure that this will not endanger other persons or cause damage to equipment.

Avoid any unsafe work methods:

Make sure that your operation does not create a safety hazard.

- The rules specified in these operating instructions must be observed during assembly, operation, maintenance and repair.
- Use protective glasses!
- Switch off the drilling- milling machine before measuring the workpiece.
- Do not work on the drilling- milling machine, if your concentration is reduced, for example, because you are taking medication.
- Stay on the drilling- milling machine until the working spindle has come to a complete stand-still.

- Use the specified personal protective equipment. Ensure you wear close-fitting clothing and, if necessary, a hairnet.
- Do not use protective gloves when drilling or milling.
- Disconnect the shock-proof plug from the outlet before replacing the tool.
- Use appropriate agents to remove drilling and milling chips.
- Ensure that your work does not create a safety risk.
- Safely and firmly clamp the workpiece in place, before switching the drilling- milling machine on.

We provide information about the specific dangers when working with and on the drilling- milling machine in the descriptions for these types of work.

1.13 Switching-off and securing the drilling- milling machine

Disconnect the mains plug before starting maintenance and repairs.

1.14 Using lifting equipment

WARNING!

The use of unstable lifting and load suspension equipment that might break under load can cause severe injuries or even death.

Check that the lifting and load suspension equipment are of sufficient load-bearing capability and are in perfect condition.

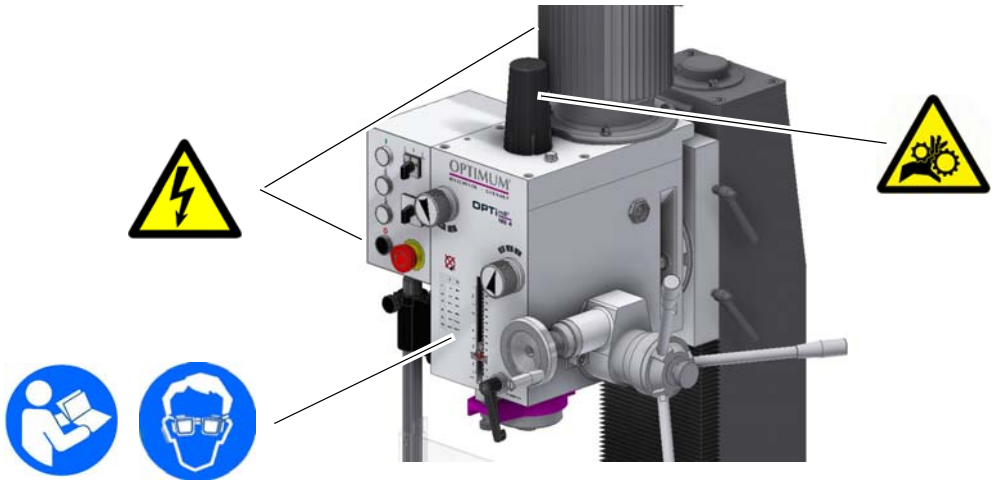
Observe the accident prevention regulations issued by your Employers Liability Insurance Association or other supervisory authorities applicable to your company.

Fasten the loads properly.

Never walk under suspended loads!

1.15 Positions of the symbols on the drilling- milling machine

Make sure that the mandatory and warning symbols are legible.



Img.1-5: Symbols on MB4

1.16 Electronics

Have the machine and/or the electric equipment checked regularly. Immediately eliminate all defects such as loose connections, defective wires, etc.

A second person must be present during work on live components to disconnect the power in the event of an emergency. If there is a fault in the power supply, switch off the milling machine immediately!

Comply with the required inspection intervals in accordance with the factory safety directive, operating equipment inspection.

The operator of the machine must ensure that the electrical systems and operating equipment are inspected with regards to their proper condition, namely,

- by a qualified electrician or under the supervision and direction of a qualified electrician, prior to initial commissioning and after modifications or repairs, prior to recommissioning
- and at certain intervals.

The deadlines must be set so that arising, foreseeable defects can be detected in a timely manner.

The relevant electro-technical rules must be followed during the inspection.

The inspection prior to initial commissioning is not required if the operator receives confirmation from the manufacturer or installer that the electrical systems and operating equipment comply with the accident prevention regulations, see conformity declaration.

Permanently installed electrical systems and operating equipment are considered constantly monitored if they are continually serviced by qualified electricians and inspected by means of measurements in the scope of operation (e.g. monitoring the insulation resistance).

1.17 Inspection deadlines

Define and document the inspection deadlines for the machine in accordance with § 3 of the Factory Safety Act and perform an operational risk analysis in accordance with § 6 of the Work Safety Act. Also use the inspection intervals in the maintenance section as reference values.

2 Technical specification

The following information represents the dimensions and indications of weight and the manufacturer‘s approved machine data.

Electrical connection	
Motor	400V ~ 50Hz / 3Ph. 1,1/ 1,5 kW
optional	400V / 3Ph. ~ 60Hz 1,1/ 1,5 kW 440V / 3 Ph. ~ 60Hz 1,1/ 1,5 kW 230V / 1Ph. ~ 50Hz 1,1 kW 230V / 3Ph. ~ 60Hz 1,1/ 1,5 kW
Drilling-milling capacity	
Drilling capacity in steel [mm]	max. Ø 28
Drilling capacity in cast [mm]	max. Ø 32
Milling capacity end mill [mm]	max. Ø 28
Milling capacity milling head [mm]	max. Ø 63
Throat [mm]	275
Spindle seat	
Spindle seat	MT 4
Draw-in rod	M16
Spindle sleeve stroke [mm]	120 mm
Drill-mill head	
Swivelling	+ / - 60°
Gear stages	2 x 6
Z axis travel [mm]	430
Milling table	
Table length [mm]	800
Table width [mm]	240
Y axis travel [mm]	195
X axis travel [mm]	450
T - slot size / distance [mm]	14 / 63
Max. load [kg]	80
Dimensions	
Height [mm]	☞ Installation plan on page 20
Length [mm]	
Width [mm]	
Total weight [kg]	320

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Work area	
Height [mm]	2500
Length [mm]	2000
Width [mm]	2600
Speeds	
Gear stage slow [min^{-1}]	95 - 1600
Gear stage rapid [min^{-1}]	190 - 3200
Environmental conditions	
Temperature	5-35°C
Humidity	25-80%
Operating material	
Gear	Mobilgear 627, ISO VG 100 Viscosity 100 cSt at 40°C or a comparable oil about 3,5 litres
Bare steel parts	Mobilgrease OGL 007 or, Mobilux EP 004, acid-free oil, e.g. weapon oil, motor oil

Emissions

The generation of noise emitted by the drilling-milling machine is 76 dB(A) at 80% of max. speed without tool.
If the drilling- milling is installed in an area where various machines are in operation, the noise exposure (immission) on the operator of the drilling machine at the working place may exceed 80 dB(A).

INFORMATION

This numerical value was measured on a new machine under the operating conditions specified by the manufacturer. The noise behaviour of the machine might change depending on the age and wear of the machine.

Furthermore, the noise emission also depends on production engineering factors, e.g. speed, material and clamping conditions.

INFORMATION

The specified numerical value represents the emission level and does not necessarily a safe working level.

Though there is a dependency between the degree of the noise emission and the degree of the noise disturbance it is not possible to use it reliably to determine if further precaution measures are required or not.

The following factors influence the actual degree of the noise exposure of the operator:

- **Characteristics of the working area, e.g. size or damping behaviour,**
- **other noise sources, e.g. the number of machines,**
- **other processes taking place in proximity and the period of time, during which the operator is exposed to the noise.**

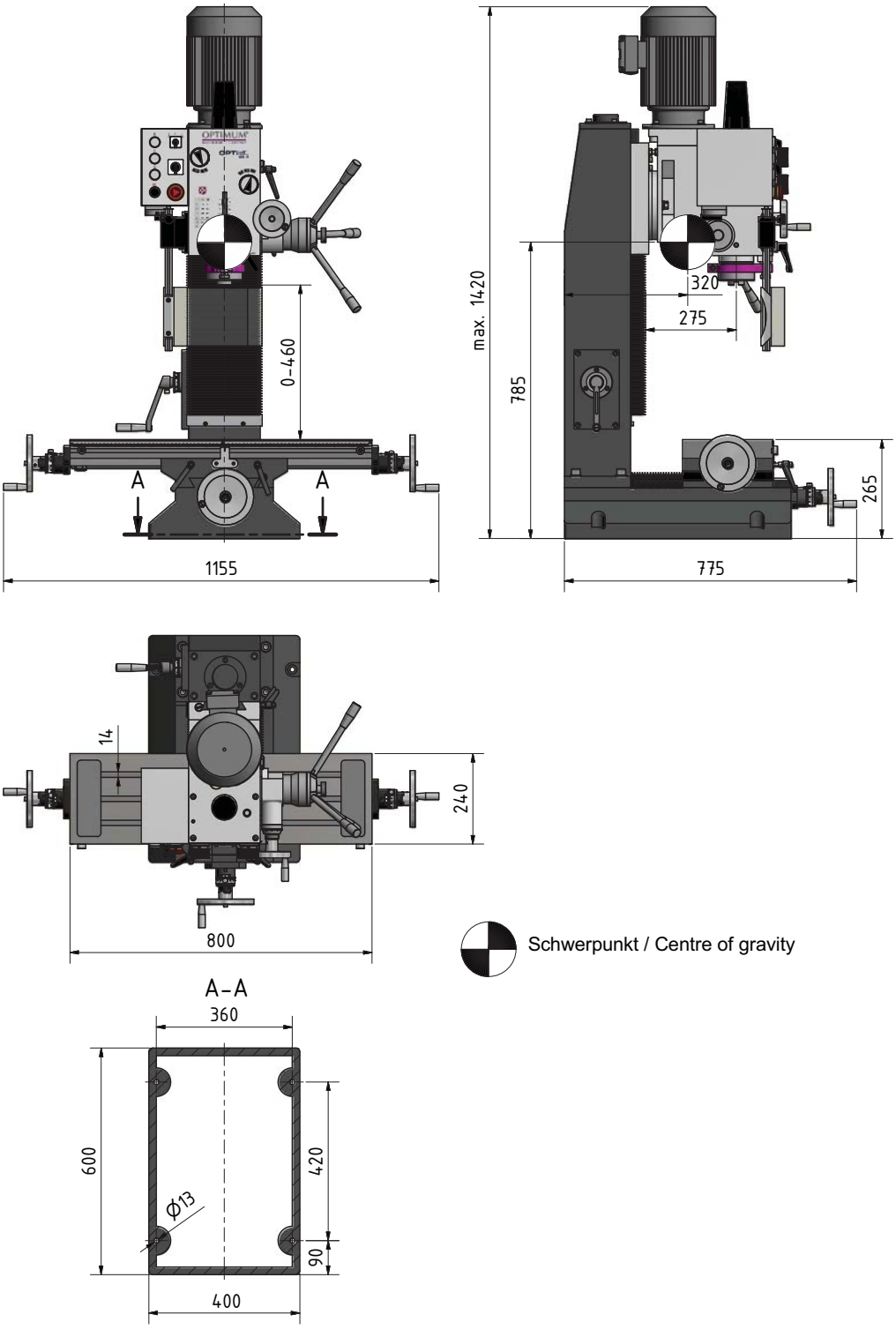
Furthermore, it is possible that the admissible exposure level might be different from country to country due to national regulations.
This information about the noise emission should, however, allow the operator of the machine to more easily evaluate the hazards and risks.

CAUTION!

Depending on the overall noise exposure and the basic threshold values, machine operators must wear appropriate hearing protection.

We generally recommend the use of noise and ear protection.

2.1 Installation plan



Img. 2-1: Installation plan

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3 Delivery, interdepartmental transport, assembly and commissioning

3.1 Notes on transport, installation, commissioning

Improper transport, installation and commissioning is liable to accidents and can cause damage or malfunctions to the machine for which we do not assume any liability or guarantee.

Transport the scope of delivery secured against shifting or tilting with a sufficiently dimensioned industrial truck or a crane to the installation site.

WARNING!

Severe or fatal injuries may occur if parts of the machine tumble or fall down from the forklift truck or from the transport vehicle. Follow the instructions and information on the transport box.

Note the total weight of the machine. The weight of the machine is indicated in the "Technical data" of the machine. When the machine is unpacked, the weight of the machine can also be read on the rating plate.

Only use transport devices and load suspension gear that can hold the total weight of the machine.

WARNING!

The use of unstable lifting and load suspension equipment that might break under load can cause severe injuries or even death. Check that the lifting and load suspension gear has sufficient load-bearing capacity and that it is in perfect condition.

Observe the accident prevention regulations issued by your Employers Liability Insurance Association or other competent supervisory authority, responsible for your company. Fasten the loads properly.

3.1.1 General risks during internal transport

WARNING: TILTING DANGER!

The machine may be lifted unsecured by a maximum of 2 cm.

Employees must be outside the danger zone, i.e. the reach of the load.

Warn employees and advise them of the hazard.

Machines may only be transported by authorized and qualified persons. Act responsibly during transport and always consider the consequences. Refrain from daring and risky actions.

Gradients and descents (e.g. driveways, ramps and the like) are particularly dangerous. If such passages are unavoidable, special caution is required.

Before starting the transport check the transport route for possible danger points, unevenness and faults.

Danger points, unevenness and disturbance points must be inspected before transport. The removal of danger spots, disturbances and unevenness at the time of transport by other employees leads to considerable dangers.

Careful planning of interdepartmental transport is therefore essential.

3.2 Scope of delivery

INFORMATION

The drilling- milling machine is delivered pre-assembled.

Compare the scope of delivery with the attached packing list.

Check the status of the machine immediately upon receipt and claim possible damages at the last carrier also if the packing is not being damaged. In order to ensure claims towards the freight carrier we recommend you to leave the machines, devices and packing material for the time being in the status at which you have determined the damage or to take photos of this status. Please inform us about any other claims within six days after receipt of delivery.

3.3 Set-up and assembly

3.3.1 Installation site requirements

The workplace for operating, maintenance and repair must not be restricted.

The mains plug of the drilling- milling machine must be freely accessible.

The illumination of the workplace must be designed in such a manner that an illumination of 500 Lux is attained at the tool tip.

If this is not guaranteed with the normal installation site lighting, workplace lights (available as an option) must be used.

3.3.2 Load suspension point

WARNING!

Danger of crushing and overturning. Proceed carefully when lifting, installing and assembling the machine.

➜ Lock all clamping levers on the drilling-milling machine before you lift it.

➜ Fix the load lifting gear around the drilling-milling head. Use a lifting sling for this purpose.

➜ Make sure that the attached load does not cause damage to components or paint.

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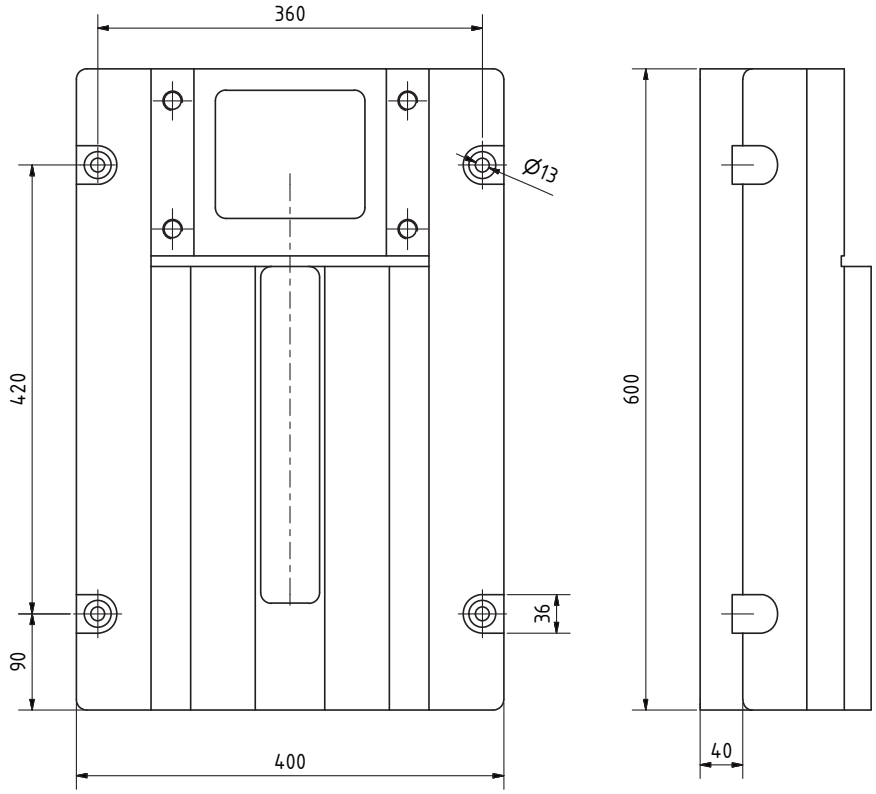
3.3.3 Assembly

➜ Check that the milling machine foundation is horizontal with a spirit level.

➜ Check that the foundation has sufficient load-bearing capacity and rigidity.



Img. 3-1: Machine base

ATTENTION!

Insufficient rigidity of the foundation leads to the superposition of the vibrations of the drilling-milling machine and of the underground (natural frequency of components). If the rigidity of the overall system is insufficient, critical speeds with annoying vibrations will be reached very quickly and lead to bad milling results.

➜ Place the drilling- milling machine on the provided foundation.

➜ Fix the machine base to the substructure through the holes pre-drilled for this purpose. The attachment points are marked by arrows on the machine base.

WARNING!

The nature of the foundation and type of fixings used to secure the machine base to the foundation must be capable of absorbing the loads caused by the drilling- milling machine. The foundation must be level. Check that the drilling- milling machine foundation is horizontal with a spirit level.

Fix the milling machine to its foundation at the recesses provided on the machine base for this purpose. We recommend that you use shear connector cartridges or heavy-duty anchors. ☞ Dimensions on page 18

3.4 First commissioning

WARNING!

First commissioning may only take place after proper installation.

First commissioned of the milling machine by inexperienced personnel constitute a risk to personnel and equipment. ☞ **Personnel qualification on page 10**

We do not accept any liability for damages caused by incorrectly performed commissioning.

ATTENTION!

Before commissioning the machine, all bolts, fastenings and protections must be checked and retightened as necessary!

WARNING!

The use of improper tool holders or their operation at inadmissible speeds constitutes a hazard.

Only use the tool holders (e.g. drill chuck) which were delivered with the machine or which are offered as optional equipment by OPTIMUM.

Only use tool holders in the intended admissible speed range.

Tool holders may only be modified in compliance with the recommendation of OPTIMUM or the clamping device manufacturer.

3.4.1 Power supply

CAUTION!

Install the connection cable of the machine in such a way that people will not stumble over it.

➜Connect the electrical supply cable.

➜ Check the fusing (fuse) of your electrical supply according to the technical instructions regarding the total connected power of the drilling- milling machine.

3.4.2 Cleaning and lubrication

➜ Remove the anti-corrosive agents which has been applied to the drilling- milling machine for transport and storage. We recommend you use paraffin for this purpose.

➜ To clean the drilling- milling machine, do not use any solvents, nitro-cellulose thinner or other cleaning agents that could damage the paintwork. Observe the cleaning agent manufacturer's information and notes.

➜ Grease all exposed machine parts using an acid-free lubricating oil.

➜ Lubricate the drilling- milling machine in accordance with the lubrication schedule.
☞ Inspection and maintenance on page 35

➜ Check that all spindles are running smoothly. All spindle nuts are re-adjustable.

➜ Disassemble the V-ledges of the cross table and clean the ledges from the anti-corrosive agent. ☞ V-ledges on page 37

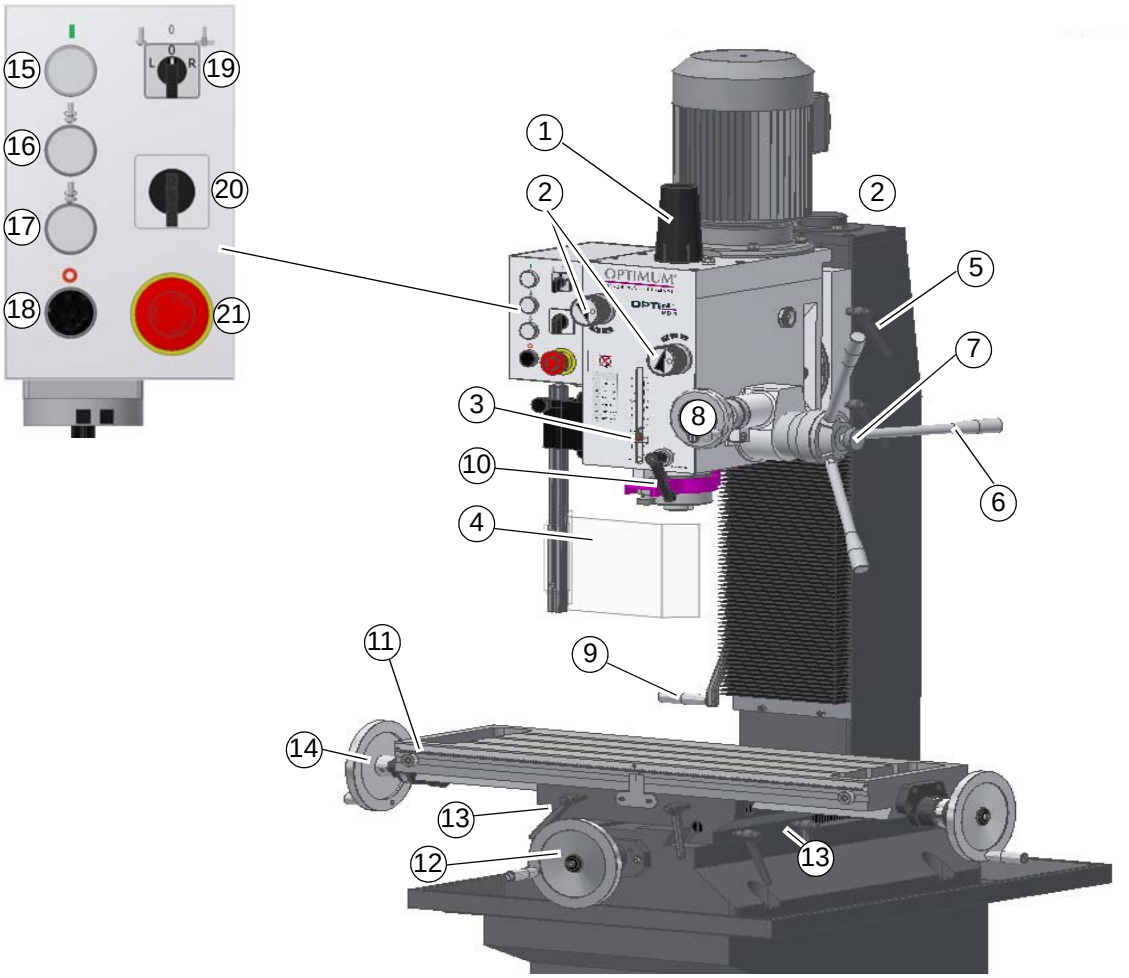
3.4.3 Filling in gear oil

The drilling- milling machine is delivered without gear oil. Fill in gear oil.

☞ Oil change on page 36

4 Operation

4.1 Control and indicating elements



Item	Designation	Item	Designation
1	Draw-in rod cap	2	Rotary selector switch gear stage
3	Meter rule with scale	4	Spindle protection
5	Clamping screw drilling-milling head	6	Star grip for spindle sleeve feed
7	Activation of the fine adjustment	8	Fine adjustment of spindle sleeve
9	Milling head height adjustment hand crank	10	Clamping lever for spindle sleeve
11	Adjustable limit stops	12	Saddle slide Y axis hand crank
13	Clamping lever	14	Cross slide X axis hand crank
15	Operation control light	16	Push button spindle rotation clockwise
17	Push button spindle rotation CCW	18	Push button spindle rotation "OFF"
19	Operating mode selector switch: ❍ Milling ❍ Thread tapping ☞ Thread tapping on page 33	20	Drive step switch (only with three-phase motors)
		21	Emergency switching off

4.2 Safety

The drilling- milling machine must only be operated under the following conditions:

- The drilling- milling machine is in proper working order.
- The drilling- milling machine is used as intended.
- The operating manual is followed.
- All safety devices are installed and activated.

Eliminate or have all malfunctions rectified promptly. Stop the drilling- milling machine immediately in the event of any abnormality in operation and make sure it cannot be started up accidentally or without authorisation.

☞ For your own safety during operation on page 15

4.3 Switching on the drilling-milling machine

ATTENTION!

Wait until the drilling-milling machine has come to a complete halt before changing the rotation direction using the rotation direction switch.

➜ Select the rotation direction of the drilling-milling machine using the rotation direction switch.

Two speed stages are available for each rotation direction.

- The marking "R" means clockwise rotation.
- The marking "L" means anticlockwise rotation.

➜ Press the button "ON".
The drilling-milling machine switches on and turns in the preselected rotation direction.

☞ Changing the speed range on page 28

4.4 Switching off the drilling-milling machine

➜ Press the button "OFF" or switch the rotation direction switch to the neutral position.

4.5 Inserting the tool

4.5.1 Installation

CAUTION!

When milling, the seat cone must always be secured with the draw-in rod. A simple connection with the taper bore of the work spindle without using the draw-in rod is not permissible for milling. The cone connection is released by lateral pressure. Injuries may be caused by parts flying off.

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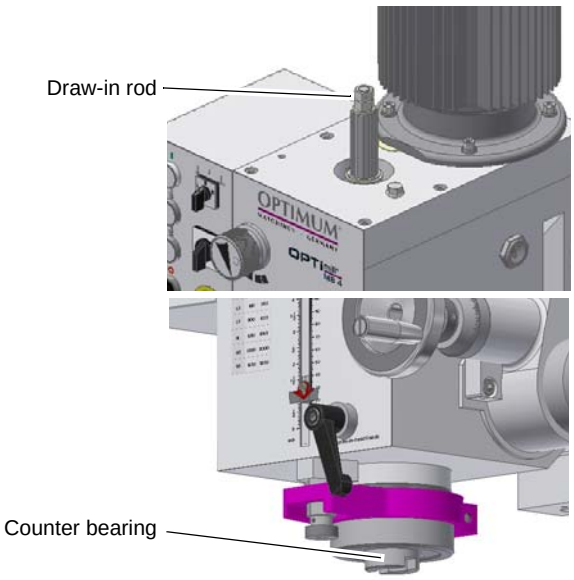
The milling head is fitted with an M12 draw-in rod.

➜ Remove the cap.
➜ Clean the seat in the spindle / quill.
➜ Clean the cone of your tool.
➜ Insert the tool in the spindle / quill.
➜ Screw the draw-in bar in the tool.
➜ Tighten the tool with the draw-in rod and hold the spindle on the counter bearing by means of a wrench.



Img. 4-1: Drilling-milling head without cap

4.5.2 Removal

➜ Hold the spindle counter bearing with a wrench and loosen the draw-in rod. Continue turning the draw-in rod, so that the tool is squeezed out from the conical seat.

ATTENTION!

When using an MT spindle.

When installing a cold Morse taper into a heated-up machine those MT collets are subject to shrinking on the Morse taper contrary to the quick-release tapers.

4.5.3 Use of collets

If collets are used to house milling tools, higher machining tolerance can be achieved. The collet may easily and quickly be changed for a smaller or larger end mill with no need to remove the complete tool. The collet is pressed into the ring of the swivel nut and must rest there by itself. The milling cutter is clamped by fastening the swivel nut on the tool. Make sure that the correct collet is used for each milling cutter diameter, so that the milling cutter may be fastened securely and firmly.

4.6 Clamping the workpieces

CAUTION!

Injuries can be caused by parts flying off.

The workpiece is always to be fixed by a machine vice, jaw chuck or by another appropriate clamping tool such as for the clamping claws.

4.7 Changing the speed range

ATTENTION!

Wait until the drilling-milling machine has come to a complete halt before changing the speed using the gear switch.

There are two levers to switch over the gear to the desired spindle speed at the front side of the machine. The following speeds are available in depending the used electric motor drive stage.

4.7.1 Speed table three-phase drive

	I	II
L1	95	190
L2	180	360
L3	300	600
H1	580	1060
H2	1000	2000
H3	1600	3200

Img. 4-2: Speed table

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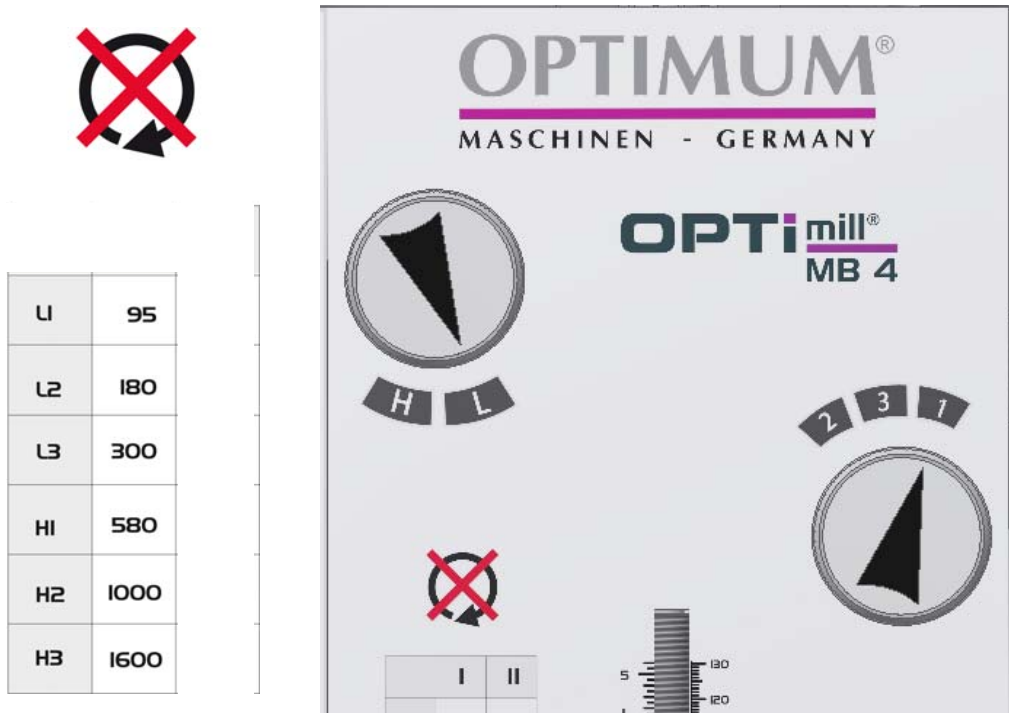
4.7.2 Speed table one-phase drive



Img. 4-3: Speed table

4.8 Selecting the speed

The correct speed is an important factor for milling. The speed determines the cutting speed by which the cutting edges cut the material. The service life of the tool can be increased and the working result optimized by selecting the correct cutting speed.

The ideal cutting speed basically depends on the workpiece and the tool material. Higher speeds are possible with tools (mills) made from hard metal or cutting ceramics than with tools made from high-alloy high speed steel (HSS). You will achieve the ideal cutting speed by selecting the correct rotation speed.

Please refer to the following standard values or a table reference book (e.g. Tabellenbuch Metall, Europa Lehrmittel, ISBN 3808517220) to determine the correct cutting speed for your tool and the material to be cut.
The required speed is calculated as follows:

$$n = \frac{V}{\pi \times d}$$

n = speed in rpm(revolutions per minute)

V = cutting speed in m/min (metres per minute)

d = tool diameter in m (metres)

4.8.1 Standard values for cutting speeds

[m/min] with high-speed steel and hard metal for upcut milling.

Tool	Steel	Grey cast iron	Al alloy case-hardened
Plain milling cutters and shell end mills [m/min]	10 - 25	10 - 22	150 - 350
Relieved milling cutters [m/min]	15 - 24	10 - 20	150 - 250
Cutter head with SS [m/min]	15 - 30	12 - 25	200 - 300
Cutter head with HM [m/min]	100 - 200	30 - 100	300 - 400

This results in the following standard speeds, dependent on mill diameter, mill type and material.

Tool diameter [mm] plain milling cutters and shell end mills	Steel 10 - 25 m/min	Grey cast iron 10 - 22 m/min	Al alloy case-hardened 150 - 350 m/min
	Speed [rpm]		
35	91 - 227	91 - 200	1365 - 3185
40	80 - 199	80 - 175	1195 - 2790
45	71 - 177	71 - 156	1062 - 2470
50	64 - 159	64 - 140	955 - 2230
55	58 - 145	58 - 127	870 - 2027
60	53 - 133	53 - 117	795 - 1860
65	49 - 122	49 - 108	735 - 1715

Tool diameter [mm] Form mills	Steel 15 - 24 m/min	Grey cast iron 10 - 20 m/min	Al alloy case-hard-ened 150 - 250 m/min
	Speed [rpm]		
4	1194 - 1911	796 - 1592	11900 - 19000
5	955 - 1529	637 - 1274	9550 - 15900
6	796 - 1274	531 - 1062	7900 - 13200
8	597 - 955	398 - 796	5900 - 9900
10	478 - 764	318 - 637	4700 - 7900
12	398 - 637	265 - 531	3900 - 6600
14	341 - 546	227 - 455	3400 - 5600
16	299 - 478	199 - 398	2900 - 4900

4.8.2 Standard values for speeds with HSS – Eco – twist drills

Material		Drill diameter									Cooling 3)
		2	3	4	5	6	7	8	9	10	
Steel, unalloyed, up to 600 N/mm²	n 1)	5600	3550	2800	2240	2000	1600	1400	1250	1120	E
	f 2)	0.04	0.063	0.08	0.10	0.125	0.125	0.16	0.16	0.20	
Mild steel, alloyed, tempered, up to 900N/mm²	n	3150	2000	1600	1250	1000	900	800	710	630	E/oil
	f	0.032	0.05	0.063	0.08	0.10	0.10	0.125	0.125	0.16	
Mild steel, alloyed, tempered, up to 1200 N/mm²	n	2500	1600	1250	1000	800	710	630	560	500	Oil
	f"	0.032	0.04	0.05	0.063	0.08	0.10	0.10	0.125	0.125	
Stainless steels up to 900 N/mm² e.g. X5CrNi18 10	n	2000	1250	1000	800	630	500	500	400	400	Oil
	f	0.032	0.05	0.063	0.08	0.10	0.10	0.125	0.125	0.16	
1): Speed [n] in rpm											
2): Feed [f] in mm/rev											
3): Cooling: E = Emulsion; oil = cutting oil											

- The above data are standard values. In some cases it may be advantageous to increase or decrease these values.
- A cooling or lubricating agent should be used when drilling.
- For stainless materials (e.g. VA – or NIRO steel sheets) do not centre, as this will result in the material compacting and the drill bit rapidly becoming blunt.
- The workpieces need to be tensed inflexibly and stably (vice, screw clamp).

INFORMATION

Friction during the cutting process causes high temperatures at the cutting edge of the tool. The tool should be cooled during the milling process. Cooling the tool with a suitable cooling lubricant ensures better working results and a longer edge life of the cutting tool.

INFORMATION

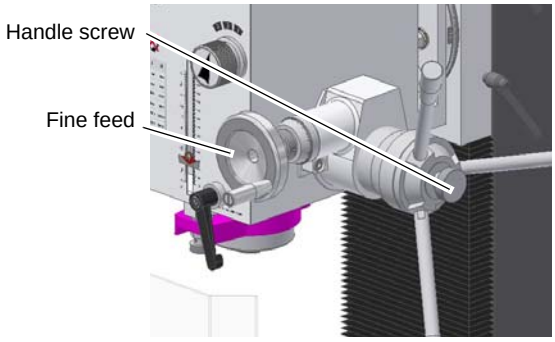
Use a water-soluble environmentally friendly emulsion as cooling lubricant procured from a specialist retailer.

Make sure that the cooling lubricant is properly absorbed. Respect the environment when disposing of lubricants and coolants. Follow the manufacturer's disposal instructions.

4.9 Manual spindle sleeve feed with the fine feed

➜ Turn the handle screw.
The spindle sleeve lever moves in direction of the drilling-milling head and activates the coupling of the fine feed.

➜ Turn the spindle sleeve fine feed in order to move the spindle sleeve.



Img. 4-4: Handle screw

4.10 Manual spindle sleeve feed with the spindle sleeve lever

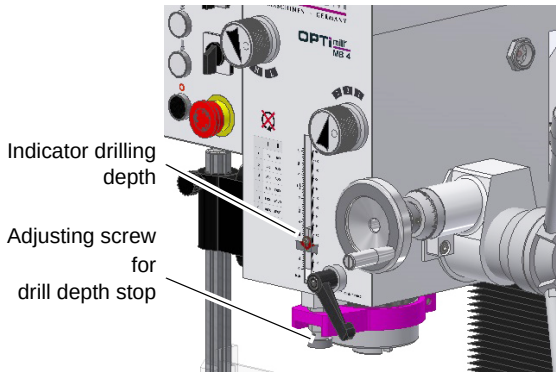
ATTENTION!

The clutch of the fine feed has to be disengaged before the spindle sleeve lever can be used. Activating the spindle sleeve lever when the fine feed is engaged may damage the clutch.

➜ Loosen the handle screw ☞ „Img. 4-4: Handle screw“ on page 31. The sleeve lever moves away from the drilling head and deactivates the coupler of the fine feed.

4.10.1 Drill depth stop

Use the drilling depth stop when drilling several holes of the same depth.



Img. 4-5: Drill depth stop

4.11 Swivelling the drill-mill head

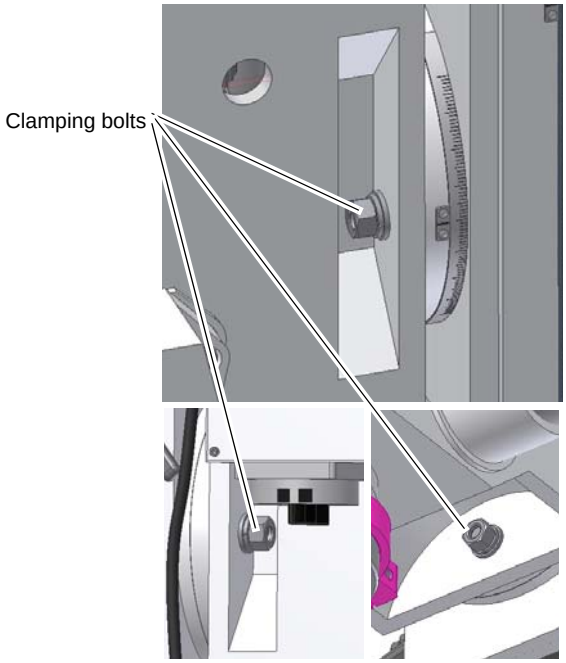
The drill-mill head may be swivelled to the right and to the left. There three screws are to loosen.

➜ Turn the drill-mill head to the desired position.

➜ Retighten the fastening screws.

ATTENTION!

It is possible to slew the drill mill head much further. By continuing to swing gear oil can leak.



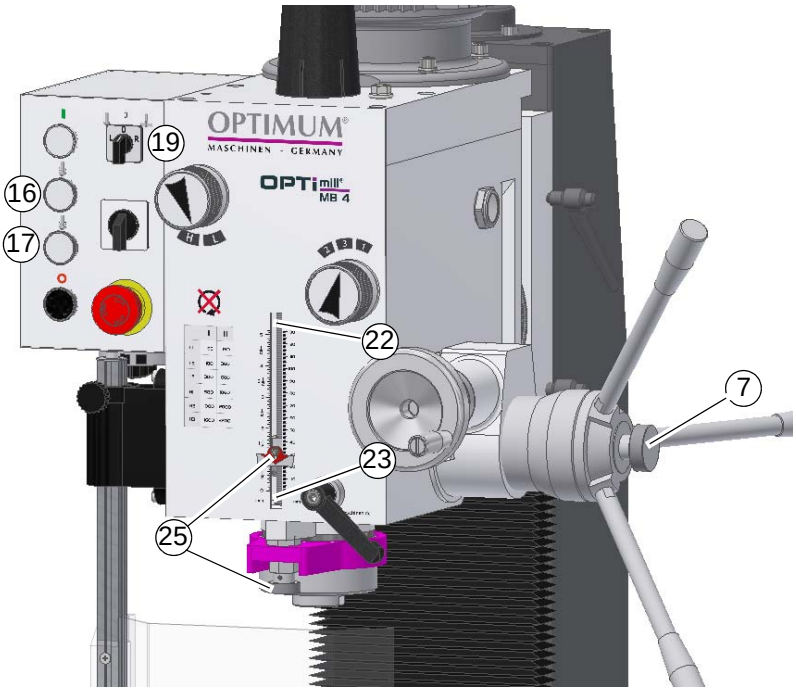
Img. 4-6: Clamping bolts

CAUTION!

If the screws are completely unfastened, the drill mill head might fall down.

When slewing the working head, only unfasten the screws as far as necessary to be ableto perform the settings. After having set the slewing angle, retighten the fixing screws.

4.12 Thread tapping



Img. 4-7: Thread tapping

Item	Designation	Item	Designation
22	Cycle end limit switch	19	Operating mode selector switch
23	Turning direction reversal switch	16	Spindle rotation direction push button
25	Depth stop	17	
7	Activation of fine adjustment of spindle sleeve		

➜ Set the operating mode selector switch (19) to threading.

➜ Set the depth stop (25) to the desired depth.

➜ Select the lowest speed. ☞ Changing the speed range on page 28

➜ Switch the rotation of the spindle on. Note the correct direction of rotation (16) or (17).

➜ Move the sleeve downward with the sleeve lever until the machine tap cams in the workpiece.

The machine tap turns into the workpiece. As soon as the preset depth is attained, the spindle reverses the direction of rotation at the switch point (23). The machine tap turns out of the workpiece. When the sleeve is completely entered up to the switch point (22) the rotation of the spindle is stopped. Then it is possible to proceed another threading operation.

ATTENTION!

Before proceeding another threading cycle, the sleeve must be completely entered in order to trigger the switch point (22).

The activation of fine adjustment of spindle sleeve (7) must be disabled.

5 Maintenance

In this chapter you will find important information about

- Inspection
- Maintenance
- Repair

of the drilling- milling machine.

ATTENTION!

Properly performed regular maintenance is an essential prerequisite for

- **operational safety,**
- **failure-free operation,**
- **long service life of the drilling- milling machine and**
- **the quality of the products which you manufacture.**

Installations and equipment from other manufacturers must also be in good order and condition.

5.1 Safety

WARNING!

The consequences of incorrect maintenance and repair work may include:

- **extremely serious injuries to those working on the drilling- milling machine and**
- **damage to the drilling- milling machine.**

Only qualified personnel should carry out maintenance and repair work on the drilling-milling machine.

5.1.1 Preparation

WARNING!

Only work on the drilling- milling machine if it has been disconnected from the power supply.

☞ Switching-off and securing the drilling- milling machine on page 16

Attach a warning label.

5.1.2 Restarting

Before restarting, run a safety check.

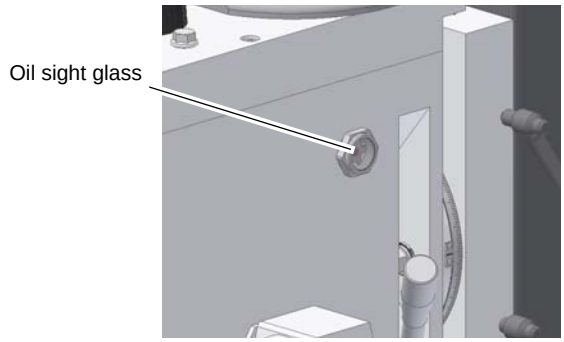
☞ Safety check on page 14

WARNING!

Before starting the drilling- milling machine, you must check that there is no danger for persons and that the drilling- milling machine is not damaged.

5.2 Inspection and maintenance

The type and level of wear depends to a large extent on the individual usage and operating conditions. Any indicated intervals therefore are only valid for the corresponding approved conditions.

Interval	Where?	What?	How?
Start of work, after every maintenance or repair work	**Drilling- milling machine**	➜ ☞ Safety check on page 14	
Start of work, after every maintenance or repair work	**Dovetail guides**	Oiling	➜ Oil all guide rails.
Every week	**Milling table**	Oiling	➜ Oil all bare steel surfaces. Use an acid-free oil, e.g. weapon oil or motor oil.
Weekly	**Gear of milling head**	Oil level	➜ Check the oil level of the gear. The oil level must be in the middle of the sight glass.  Abb. 5-1: Oil sight glass speed gear

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Interval	Where?	What?	How?
First after 200 operating hours, then every 2000 operating hours	**Gear of milling head**	Oil change	➜ For oil change use an appropriate collecting tray of sufficient capacity. ➜ Have the drilling-milling machine run for a few minutes, the oil will heat up and will slightly penetrate from the opening. ➜ Remove the oil drain plug. ☞ Operating material on page 19
Weekly	**Drilling- milling machine**	Oiling	➜ Lubricate all oiler cups with machine oil, do not use grease guns or the like. ☞ Operating material on page 19
Every month	**Oiler cup**	Oiling	➜ Lubricate all oiler cups with machine oil, do not use grease guns or the like.

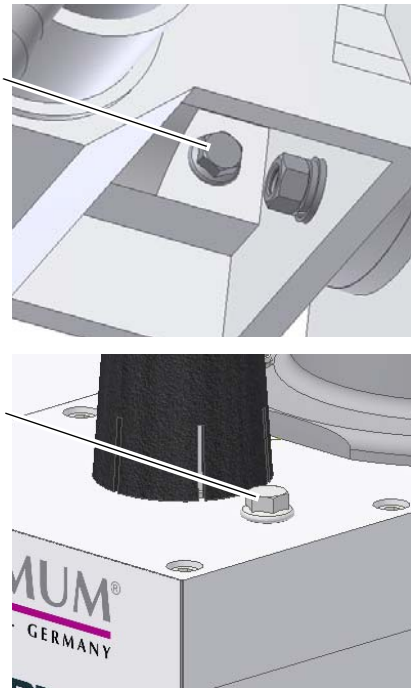
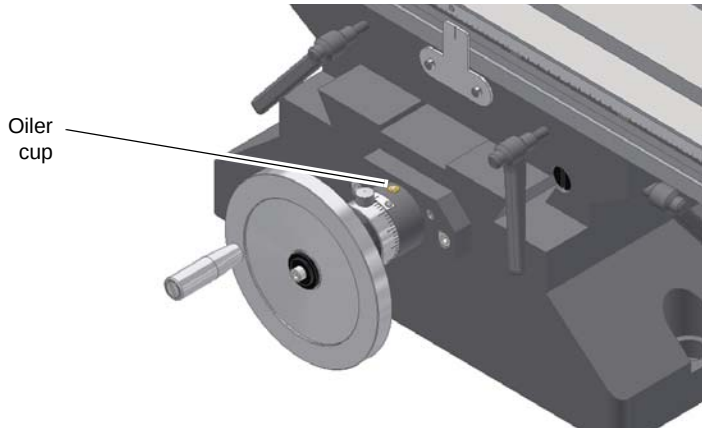


Abb.5-2: Milling head



Img.5-3: Oiler cup

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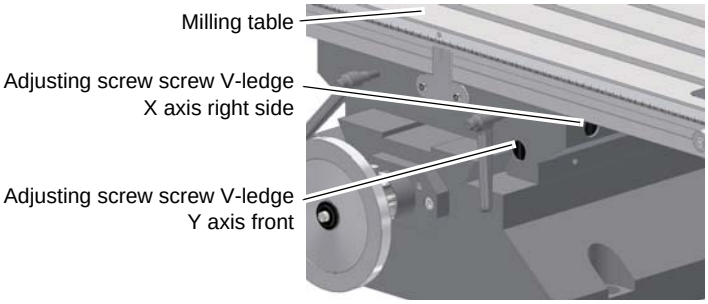
Interval	Where?	What?	How?
Every six months	**Adjustment Z axis**	Lubricate	➜ Clamp the milling head. ➜ Remove the service cover from the column. ➜ Lubricate the gearwheels.
When necessary	**Spindle nut cross table**	Readjusting	Increased gap in the milling table spindles can be reduced by resetting the spindle nuts. The spindle nuts are reset by reducing the thread flanks of the spindle nut by means of a take-up screw. After the reset, it is necessary to check if there is still smooth movement over the entire path, otherwise wear is considerably increased due to friction between the spindle nut and the spindle. The regulating screw of the spindle nut of the Y axis is accessible from the rear side, the regulating screw of the spindle nut of the x axis is accessible from the right or left side of the milling table.
When necessary	**V-ledges**	Readjusting X and Y axis	 Abb. 5-4: Milling table ➜ Turn the adjusting screw of the corresponding V-ledge clockwise. The V-ledge is pushed further inward thus reducing the play in the guide rail. ➜ Check the settings. The corresponding guide rail must be more easily movable but ensure stable guidance.
When necessary	**V-ledges**	Readjusting Z axis	➜ Proceed as described under "Readjusting X and Y axis".

INFORMATION

The spindle bearing is lifetime-lubricated. It is not necessary to lubricate it again.

5.3 Repair

5.3.1 Customer service technician

For any repair work request the assistance of an authorised customer service technician. Contact your specialist dealer if you do not have customer service's information or contact Stürmer Maschinen GmbH in Germany who can provide you with a specialist dealer's contact information. Optionally, the

Stürmer Maschinen GmbH

Dr.-Robert-Pfleger-Str. 26

D- 96103 Hallstadt

can provide a customer service technician, however, the request for a customer service technician can only be made via your specialist dealer.

If the repairs are carried out by qualified technical personnel, they must follow the indications given in these operating instructions.

Optimum Maschinen Germany GmbH accepts no liability nor does it guarantee against damage and operating malfunctions resulting from failure to observe these operating instructions.

For repairs, only use

- faultless and suitable tools,
- original parts or parts from series expressly authorised by Optimum Maschinen Germany GmbH.

6 Ersatzteile - Spare parts

6.1 Ersatzteilbestellung - *Ordering spare parts*

Bitte geben Sie folgendes an - *Please indicate the following :*

- Seriennummer - *Serial No.*
- Maschinenbezeichnung - *Machines name*
- Herstellungsdatum - *Date of manufacture*
- Artikelnummer - *Article no.*

Die Artikelnummer befindet sich in der Ersatzteilliste. *The article no. is located in the spare parts list.* Die Seriennummer befindet sich am Typschild. *The serial no. is on the rating plate.*

6.1.1 Wichtiger Hinweis - Important note

INFORMATION

Um Ihnen eine erfolgreiche Ersatzteilversorgung zu ermöglichen, ist es zwingend erforderlich die Seriennummer Ihrer Fräsmaschine zu erhalten. Ihre MB4 Fräsmaschine kann sich erheblich in diversen Teilen und deren Kompatibilität zu anderen MB4 Fräsmaschinen unterscheiden. Bitte haben Sie Verständnis dafür, dass ansonsten eine erfolgreiche Ersatzteilversorgung für Ihre MB4 Fräsmaschine nicht möglich ist.

In order to enable a successful spare parts supply, it is absolutely necessary to obtain the serial number of your milling machine. Your MB4 milling machine can differ considerably in various parts and their compatibility with other MB4 milling machines. Please understand that otherwise a successful spare parts supply for your MB4 milling machine is not possible.

6.2 Hotline Ersatzteile - Spare parts Hotline

+49 (0) 951-96555 -118

ersatzteile@stuermer-maschinen.de

6.3 Service Hotline

+49 (0) 951-96555 -100

service@stuermer-maschinen.de

6.4 Fräskopf 1 von 6 - Milling head 1 of 6

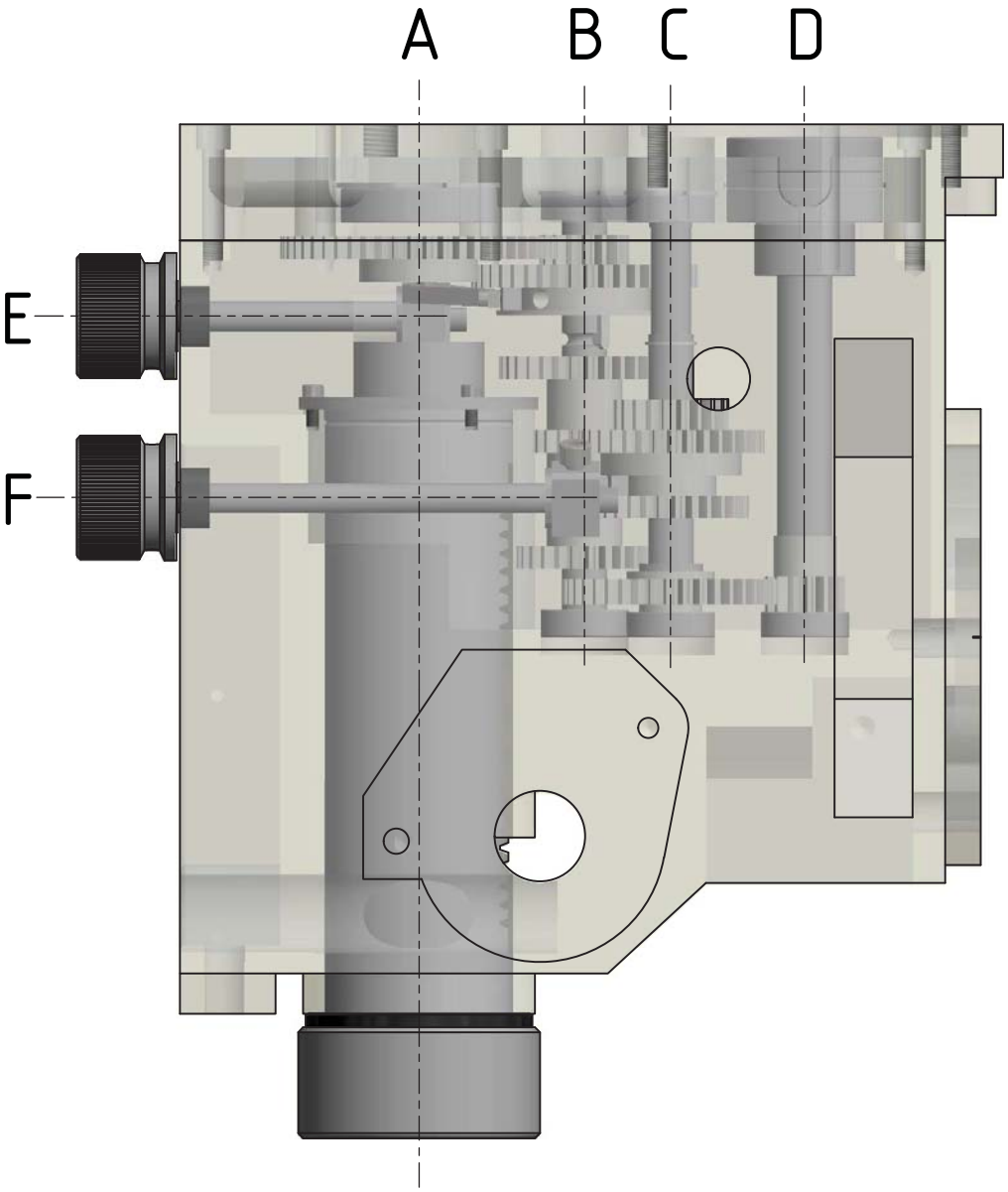


Abb.6-1: Fräskopf 1 von 6 - Milling head 1 von 6

MB4_parts.fm

6.5 Fräskopf 2 von 6 - Milling head 2 of 6

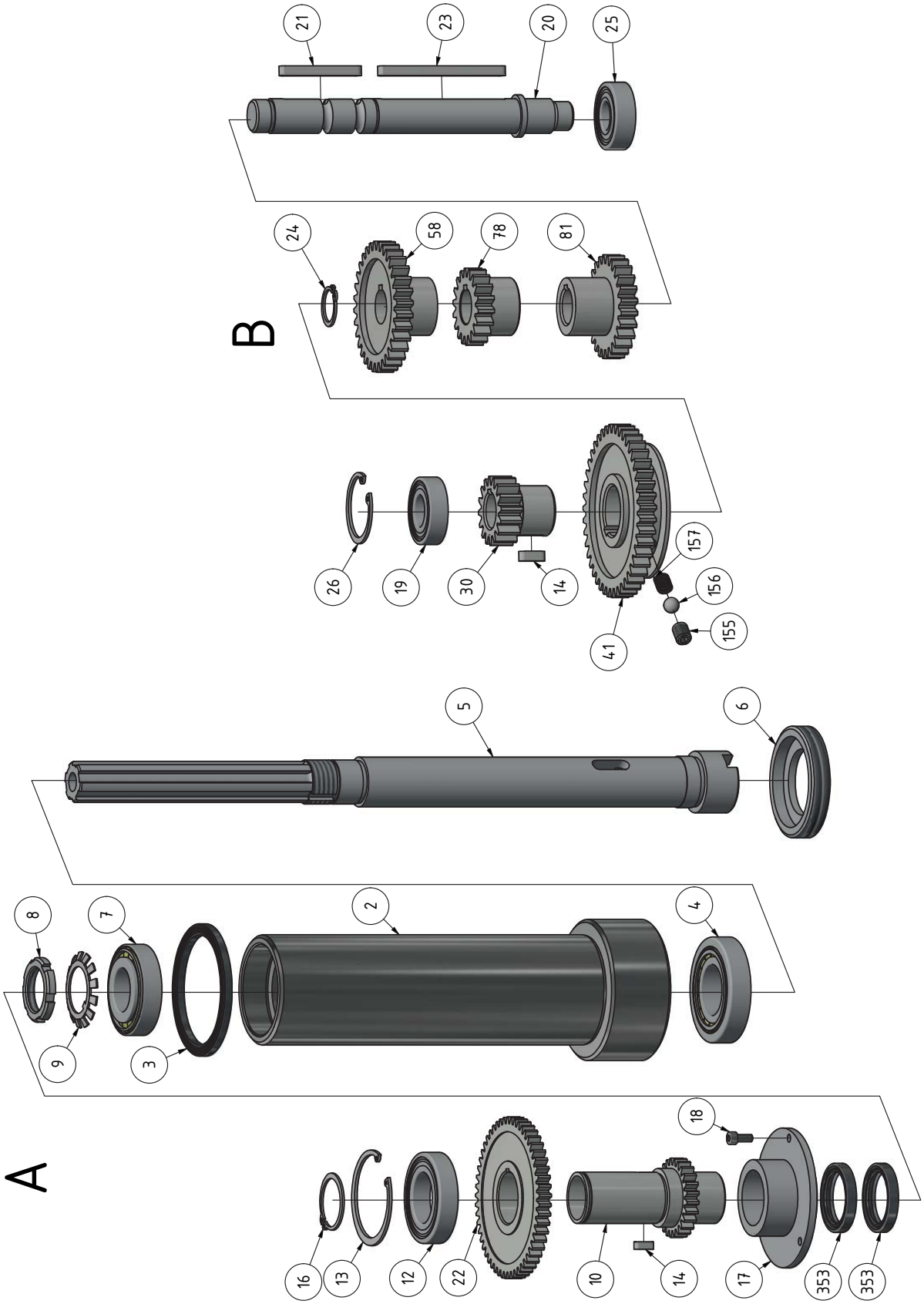


Abb. 6-2: Fräskopf 2 von 6 - Milling head 2 von 6

MB4_parts.fm

6.6 Fräskopf 3 von 6 - Milling head 3 of 6

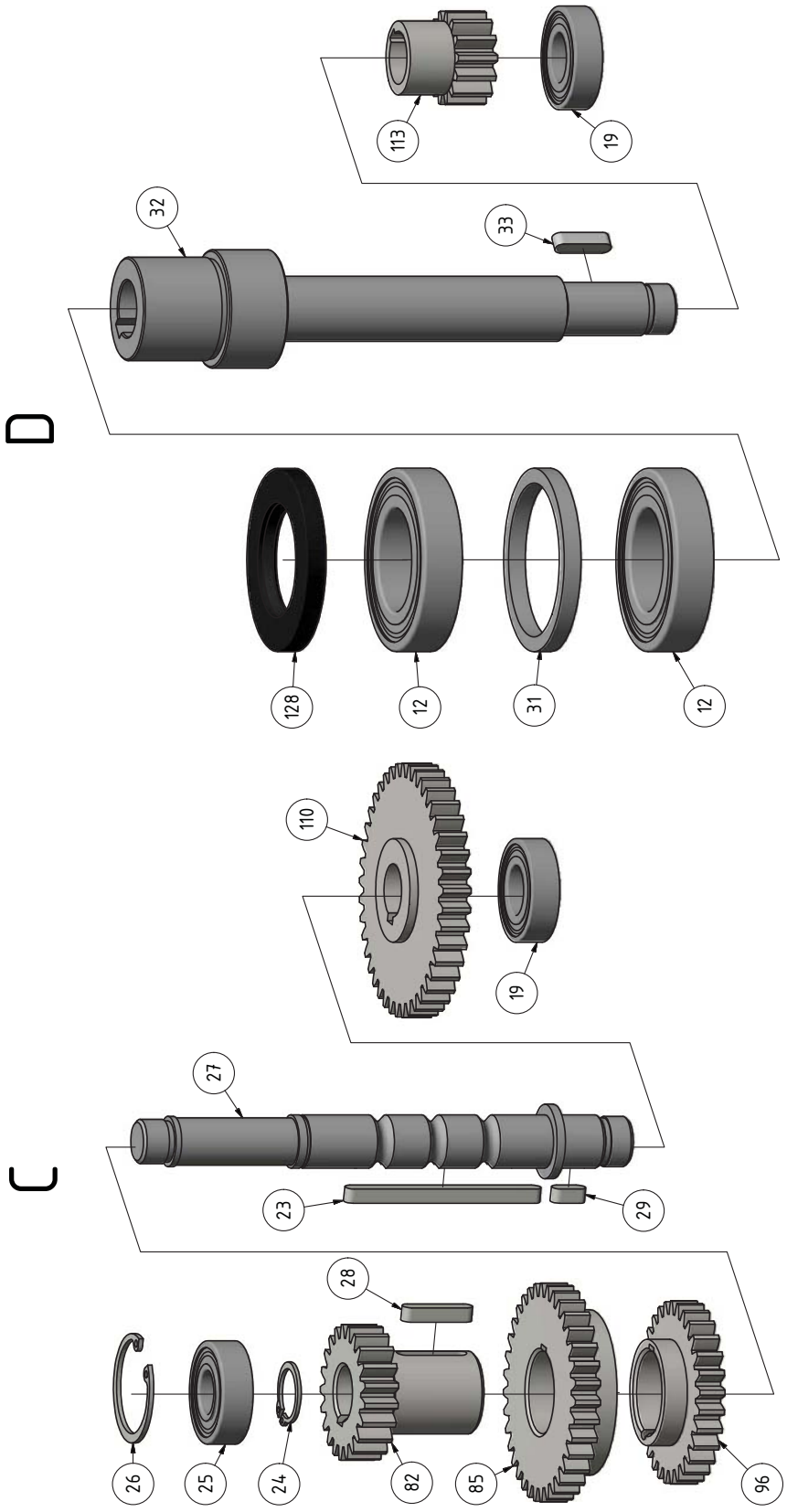


Abb. 6-3: Fräskopf 3 von 6 - Milling head 3 von 6

MB4_parts.fm

6.7 Fräskopf 4 von 6 - Milling head 4 of 6

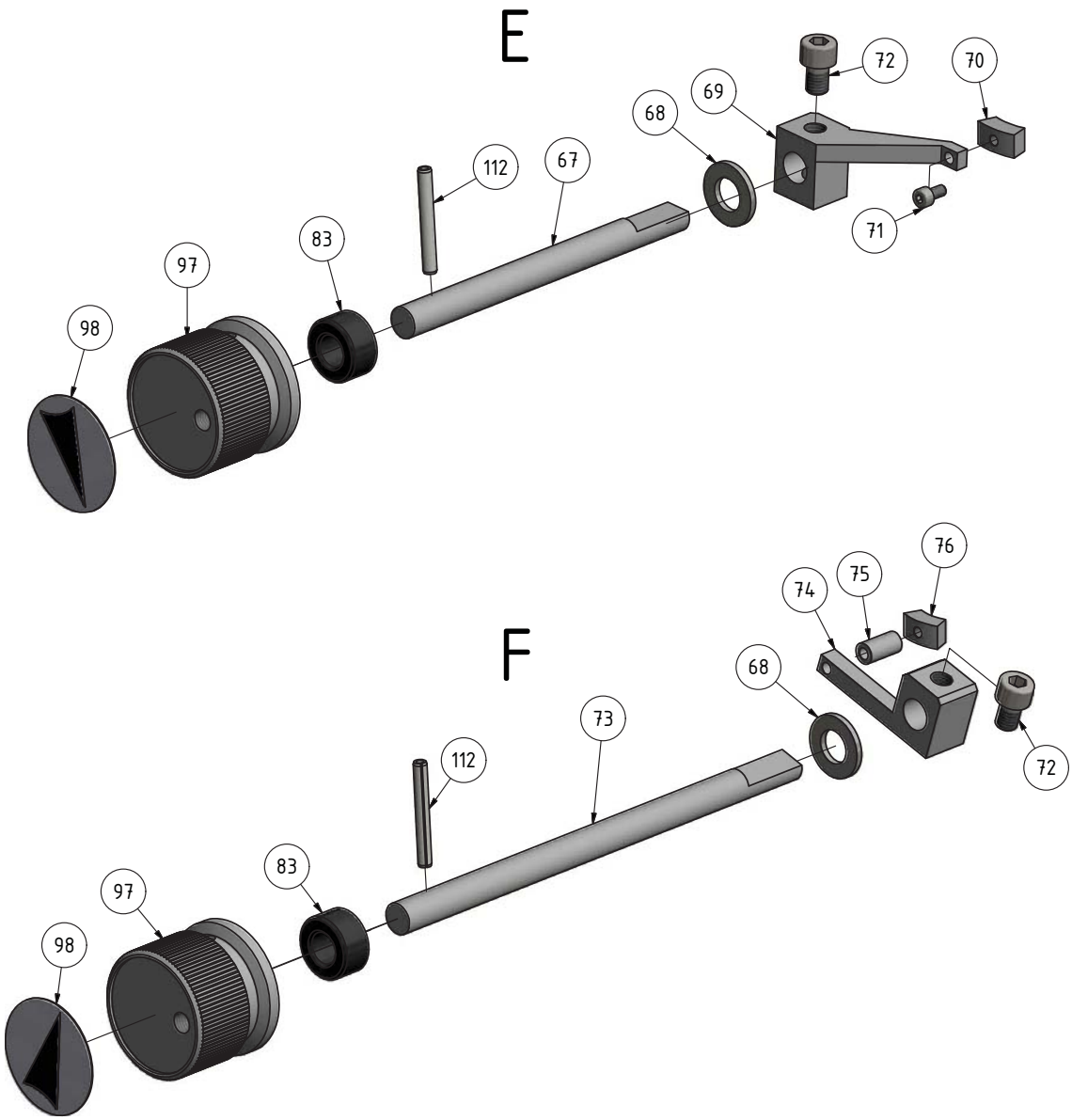


Abb. 6-4: Fräskopf 4 von 6 - Milling head 4 von 6

MB4_parts.fm

6.8 Fräskopf 5 von 6 - Milling head 5 of 6

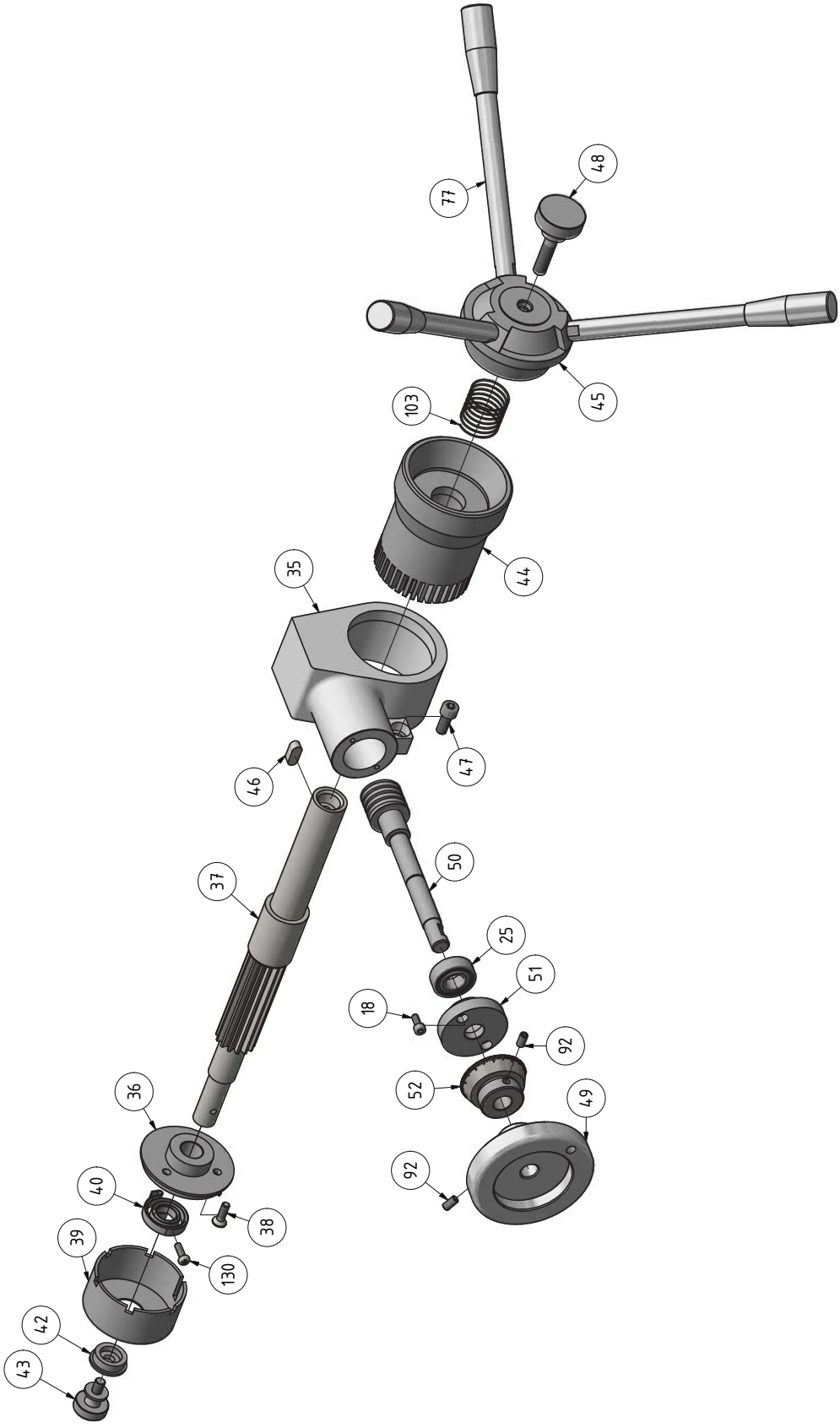


Abb. 6-5: Fräskopf 5 von 6 - Milling head 5 von 6

MB4_parts.fm

6.9 Fräskopf 6 von 6 - Milling head 6 of 6

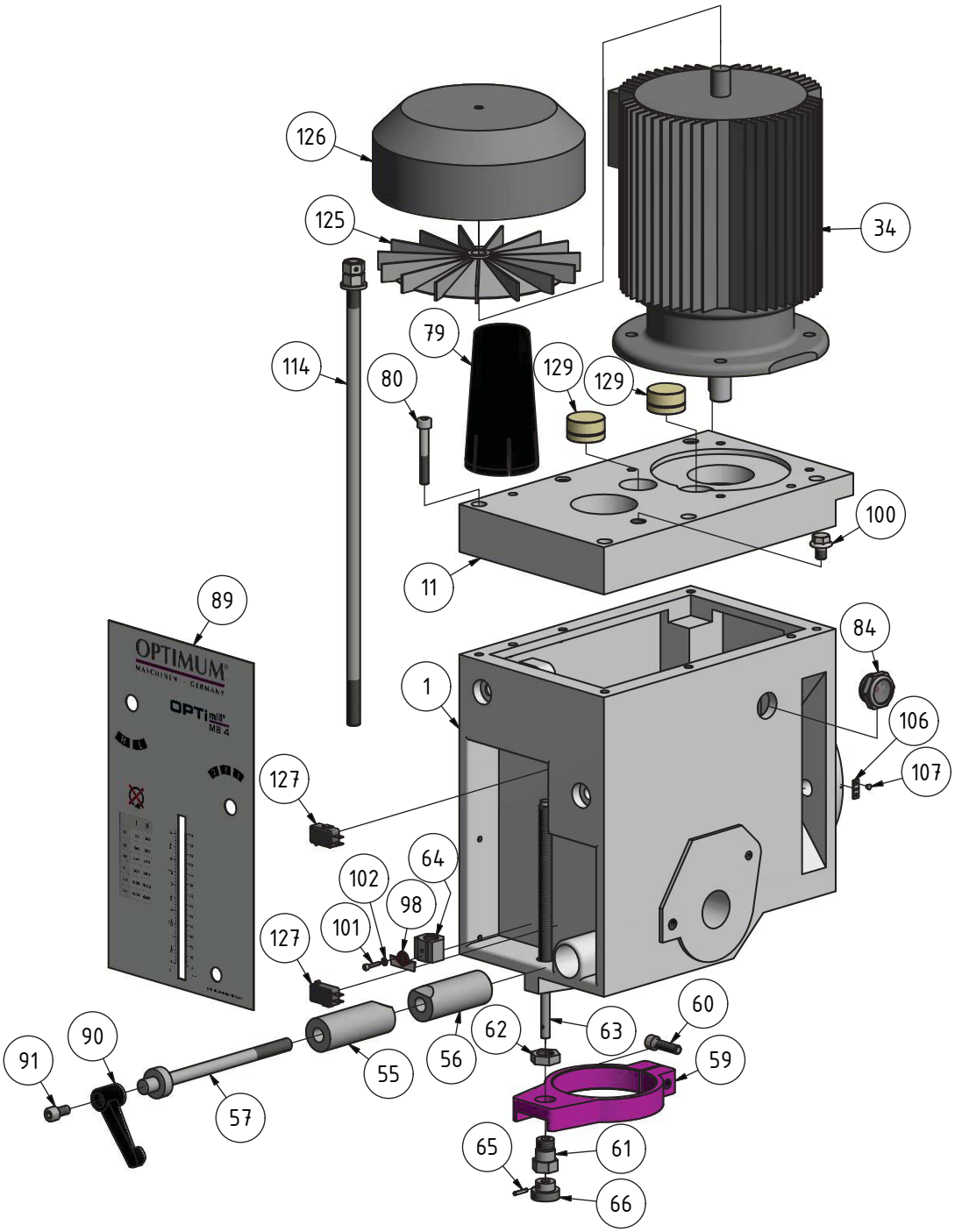


Abb. 6-6: Fräskopf 6 von 6 - Milling head 6 von 6

MB4_parts.fm

6.10 Fräsfutterschutz - Milling chuck protection

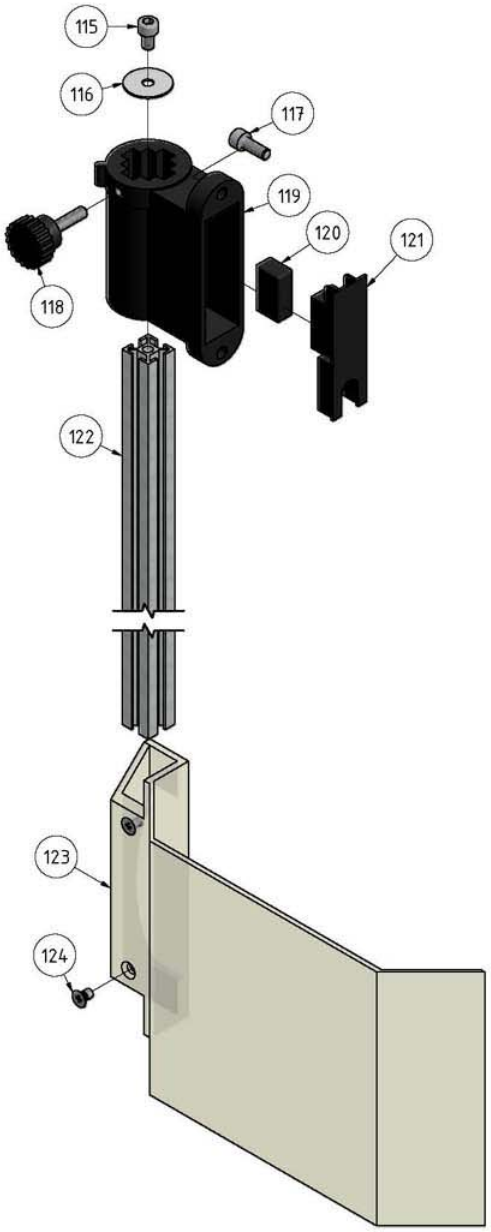


Abb. 6-7: Fräsfutterschutz - Milling chuck protection

MB4_parts.fm

6.11 Schaltbox - Switch box

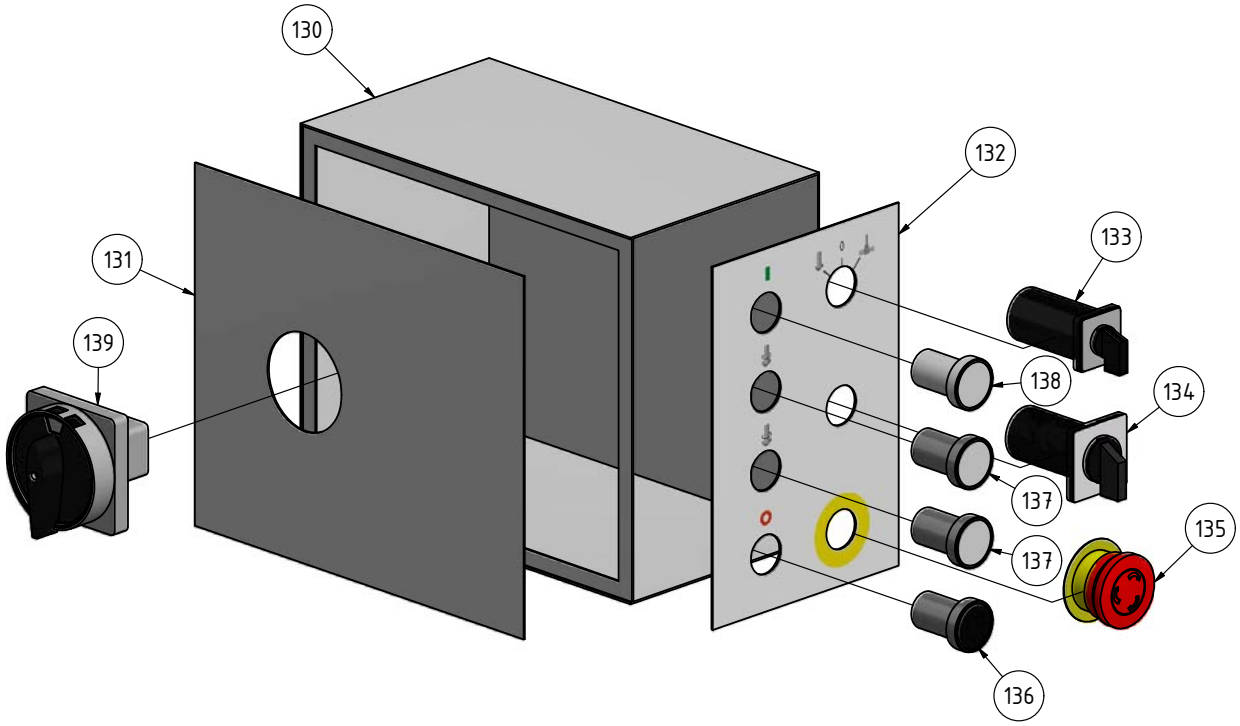


Abb. 6-8: Schaltbox - Switch box

MB4 - Teileliste Fräskopf - Parts list milling head					
Pos.	Bezeichnung	Designation	Menge	Grösse	Artikelnummer
			Qty.	Size	Item no.
1	Gehäuse	Housing	1		
2	Pinole	Sleeve	1		0303434002
CPL	Pinole komplett	Sleeve complete	1		0303434002CPL
3	Dichtung	Seal	1		0303434003
4	Kegelrollenlager	Taper roller bearing	1	30207 J2Q	04033009
5	Frässpindel	Milling spindle	1		0303434005
6	Klemmmutter	Clamping nut	1		0303434006
7	Kegelrollenlager	Taper roller bearing	1	30206 J2_Q	04033007
8	Nutmutter	Grooved nut	1		
9	Sicherungsscheibe	Safety washer	1	DIN 981 - MB6.4	
10	Zahnrad	Gear	1		0303434010

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11	Platte	Plate	1		0303434011
12	Kugellager	Ball bearing	3	6007-2Z	0406007R
13	Sicherungsring	Retaining ring	1	DIN 472 - 62 x 2	042SR62I
14	Passfeder	Fitting key	2	DIN 6885/5x5x14	042P5516
16	Sicherungsring	Retaining ring	1	DIN 471 - 35x1,5	042SR35I
18	Innensechskantschraube	Hexagon socket screw	5	ISO 4762 - M5x12	
19	Kugellager	Ball bearing	3	6202-2Z	0406202R
20	Welle	Shaft	1		0303434020
21	Passfeder	Fitting key	1	DIN 6885 - 5x5x45	042P5550
22	Zahnrad	Gear	1		0303434022
23	Passfeder	Fitting key	2	DIN 6885/5x 5x50	042P5550
24	Sicherungsring	Retaining ring	2	DIN 471 - 18x1,2	042SR18W
25	Kugellager	Ball bearing	3	6003	0406003R
26	Sicherungsring	Retaining ring	2	DIN 472 - 35 x 1,5	042SR35W
27	Welle	Shaft	1		0303434027
28	Passfeder	Fitting key	1	DIN 6885 - 5 x 5 x 25	
29	Passfeder	Fitting key	1	DIN 6885 - 5 x 5 x 12	042P5512
30	Zahnrad	Gear	1		0303434030
31	Abstandring	Spacer ring	1		0303434031
32	Welle	Shaft	1		0303434032
33	Passfeder	Fitting key	1	DIN 6885 - 5 x 5 x 20	042P5520
34	Motor	Motor	1		0303434034
35	Gehäuse	Housing	1		0303434035
36	Flansch	Flange	1		0303434036
37	Welle	Shaft	1		0303434037
38	Schraube	Screw	3	ISO 10642 - M6x20	
39	Gehäuse	Housing	1		0303434039
40	Feder	Spring	1		0303434040
41	Zahnrad	Gear	1		0303434041
42	Buchse	Bush	1		0303434042
43	Schraube	Screw	1		0303434043
44	Schneckenrad	Worm gear	1		0303434044
45	Nabe	Handle base	1		0303434045
46	Passfeder	Fitting key	1	DIN 6885 - 8 x 7 x 20	042P8720
47	Innensechskantschraube	Hexagon socket screw	6	ISO 4762 - M8 x 20	
48	Griffschraube	Screw	1		0303434048
49	Handrad	Handle	1		0303434049
50	Welle	Shaft	1		0303434050
51	Flansch	Flange	1		0303434051
52	Skalenring	Scale ring	1		0303434052
53	Griff	Grip	1		0303434053
54	Griffschraube	Grip screw	1		
55	Klemmbolzen	Clamping bolt	1		0303434055
56	Klemmbolzen	Clamping bolt	1		0303434056
57	Schraube	Screw	1		

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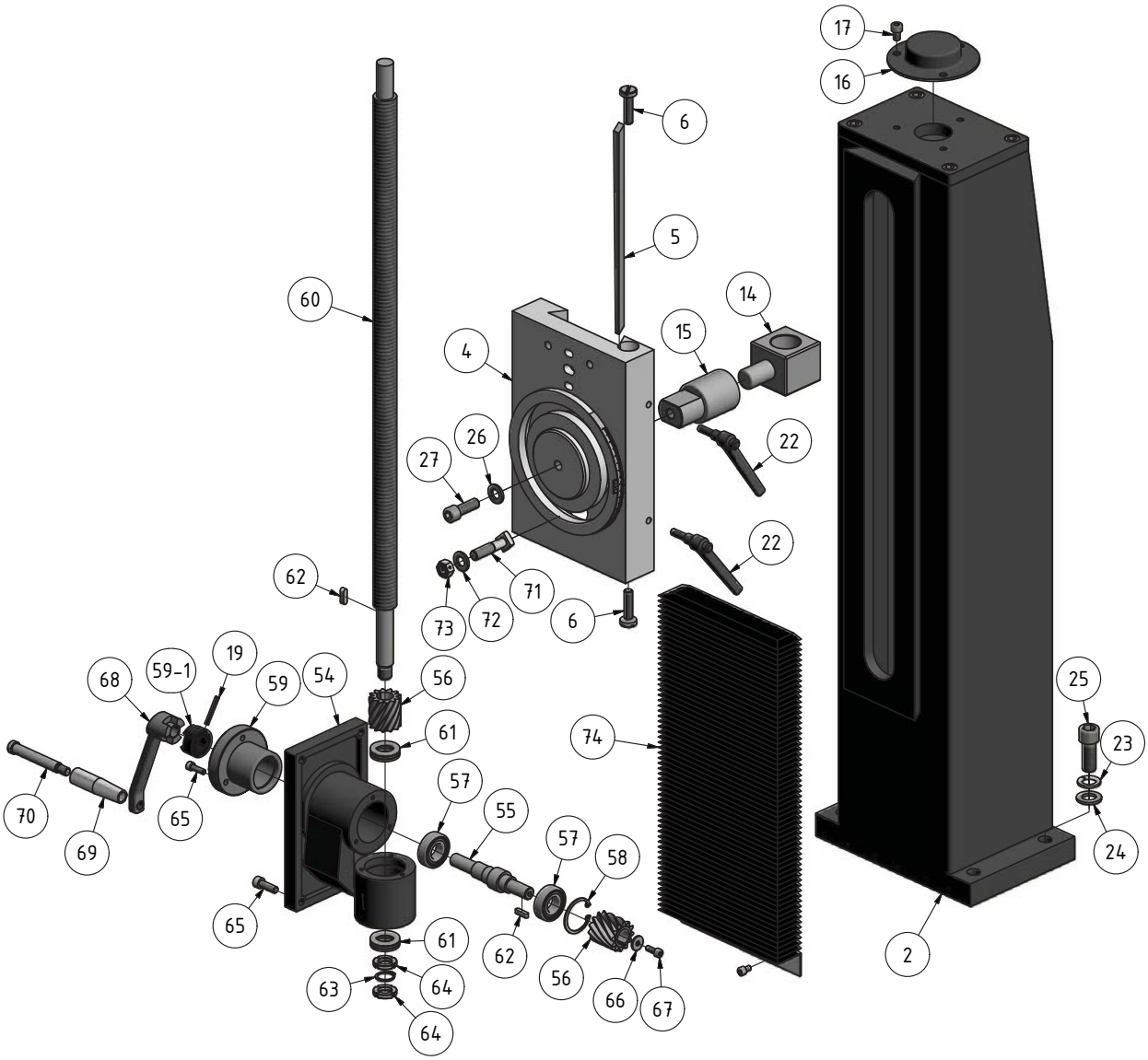
58	Zahnrad	Gear	1		0303434058
59	Halter	Holder	1		0303434059
60	Innensechskantschraube	Hexahon socket screw	1	ISO 4762 - M8 x 30	
61	Buchse	Bushing	1		0303434061
62	Sechskantmutter	Hexagon screw	1		
63	Gewindestange	Graduated rod	1		0303434063
64	Endanschlag	Limited block	1		0303434064
65	Spannstift	Spring pin	1	3 X 16	
66	Schraube	Screw	1		0303434066
67	Welle	Shaft	1		0303434067
68	Scheibe	Washer	4	DIN 125 - A 13	
69	Schalthebel	Control lever	1		0303434069
70	Platte	Plate	1		0303434070
71	Innensechskantschraube	Hexagon socket screw	1	ISO 4762 - M4 x 8	
72	Innensechskantschraube	Hexagon socket screw	2	ISO 4762 - M8 x 12	
73	Welle	Shaft	1		0303434073
74	Schalthebel	Control lever	1		0303434074
75	Hülse	Sleeve	1		0303434075
76	Platte	Plate	1		0303434076
77	Hebel	Lever	3		03338430227
78	Zahnrad	Gear	1		0303434078
79	Abdeckung	Cover cap	1		0303434079
80	Innensechskantschraube	Hexagon screw	6	ISO 4762 - M8 x 55	
81	Zahnrad	Gear	1		0303434081
82	Zahnrad	Gear	1		0303434082
83	Dichtung	Seal	2	12x22x7	04112227
84	Ölschauglas	Oil glass	1		0343143
85	Zahnrad	Gear	1		0303434085
89	Label	Label	1		0333845089
90	Hebel	Lever	1		0303434090
91	Innensechskantschraube	Hexagon socket screw	1	ISO 4762 - M8 x 16	
92	Gewindestift	Grub screw	2	ISO 4026 - M6 x 12	
96	Zahnrad	Gear	1		
97	Schaltknopf	Control knob	2		0303434097
98	Zeiger	Indicator	3		034009231113
100	Sechskantschraube	Hexagon screw	1		03034340100
101	Innensechskantschraube	Hexahon socket screw	1	ISO 4762 - M3 x 16	
102	Scheibe	Washer	1	DIN 125 - A 3,2	
103	Feder	Spring	1		03034340103
106	Zeiger	Indicator	2		03034340106
107	Niet	Rivet	4		
110	Zahnrad	Gear	1		03034340110
112	Spannstift	Spring pin	2	ISO 8752 - 5 x 40	
113	Zahnrad	Gear	1		03034340113
114	Anzugstange	Drawin bar	1		03034340114
115	Innensechskantschraube	Socket head screw	1	GB 70-85 - M6 x 10	

116	Scheibe	Washer	1		
117	Innensechskantschraube	Socket head screw	2	GB 70-85 - M6 x 16	
118	Rändelschraube	Knurled screw	1		
119	Halterung	Fixture	1		0302024149CPL
120	Mikroschalter	Microswitch	1		030031712018
121	Platte	Plate	1		
122	Alu- Profil	Aluminium profile	1		
123	Bohrfutterschutz	Drill chuck protection	1		0302024153CPL
124	Schraube	Screw	2	GB819-85/M5x8	
125	Lüfter	Fan	1		
126	Deckel	Cover	1		
127	Mikroschalter	Micro switch	2	JUCHE LXW16-16/ 51C	
128	Dichtung	Seal	2	35x45x10	041354510
129	Stopfen	Plug	2		03338450129
130	Schaltbox	Switch box	1		03338450130
131	Abdeckung	Cover	1		03338450131
132	Frontabdeckung	Front cover	1		03338450132
133	Wahlschalter	Mode switch	1		03338450133
134	Drehrichtungsschalter	Change over switch	1		03338450134
135	Not-Halt-Schalter	Emergency stop button	1		03338450135
136	Taster Aus	Button Off	1		03338450136
137	Taster Drehrichtung	Button of rotation	2		03338450137
138	Taster Steuerung Ein	Button control On	1		03338450138
139	Hauptschalter	Main switch	1		03338450139
155	Gewindestift	Grub screw	1		03338450155
156	Stahlkugel	Steel ball	1		03338450126
157	Feder	Spring	1		03338450157

6.12 Säule - Column



MB4_parts.fm

Abb. 6-9: Säule - Column

6.13 Kreuztisch - Cross table

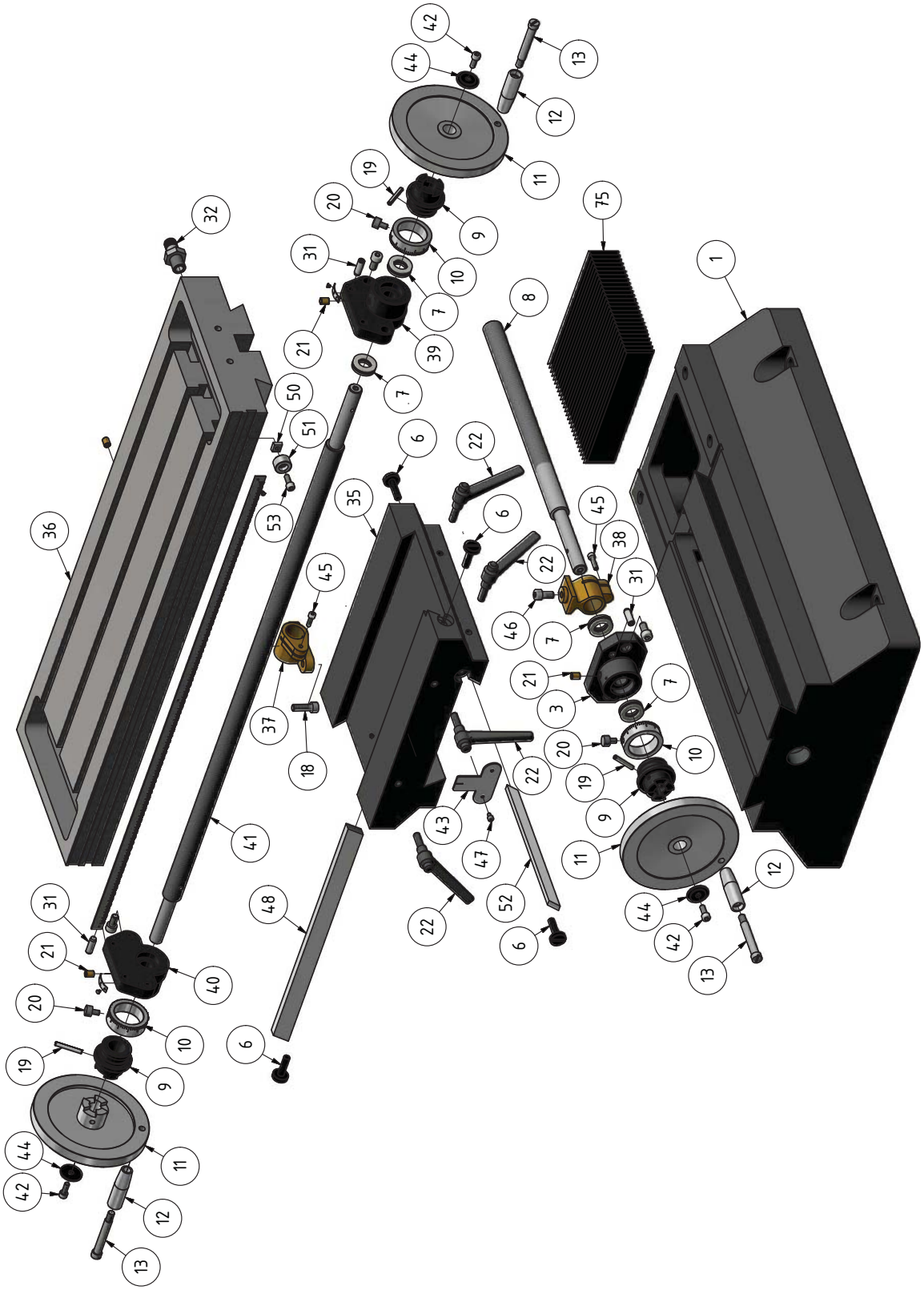


Abb. 6-10: Kreuztisch - Cross table

MB4 - Ersatzteilliste Kreuztisch - Spare parts list cross table					
Pos.	Bezeichnung	Designation	Menge	Grösse	Artikelnummer
			Qty.	Size	Item no.
1	Maschinenfuss	base	1		
2	Säule	column	1		
3	Flansch	square flange	1		
4	Führung	Guide	1		
5	Keilleiste	gib strip	1		03338460305
6	Schaube	screw	3		
7	Kugellager	bearing	4		
8	Spindel	table screw	1		03338460308
9	Kupplung	dial clutch	2		
10	Skalenring	Skale ring	2		
11	Handrad	wheel	3		03338460311
12	Handhebel	Hanadle lever	3		03338460312
13	Schraube	screw	3		0333812057-1
14	Spindelmiutter	Spindle nut	1		
15	Halter	nut bracket	1		
16	Abdeckung	cover	1		
17	Schraube	screw	3	M8x20	
18	Schraube	screw	4	M8x25	
19	Stift	pin	3	5x35	
20	Schraube	screw	2		
21	Schmiernippel	oil cup	3	8	0340114
22	Klemmhebel	fixed handle	6		03338460322
23	Scheibe	washer	4	16	
24	Scheibe	washer	4	16	
25	Schraube	Screw	4	M16x60	
26	Scheibe	washer	1		
27	Schraube	screw	1	M12x35	
31	Stift	pin	6	8x30	
32	Anschluss	Plug	1		
33	Platte	Plate	1		
35	Schlitten	Slide	1		
36	Frästisch	table	1		
37	Spindelmutter	table nut	1		03338460337
38	Spindelmutter	table base nut	1		03338460338
39	Flansch	right flange	1		
40	Flansch	left flange	1		
41	Spindel	table screw	1		03338460341
42	Schraube	Screw	1	M6x16	
43	Anzeige	Dial clutch	1		
44	Scheibe	washer	2	6	
45	Schraube	screw	2	M5x20	

46	Schraube	screw	1	M8x45	
47	Schraube	screw	2	M8x15	
48	Keilleiste	gib strip	1		03338460348
50	Block	movable fixed block	2		0333812013
51	Anschlag	fixed block support	2		0333812062
52	Keilleiste	gib strip	1		03338460352
53	Schraube	screw	2	M6x16	
54	Lagerbock	Lagerbock	1		
55	Welle	shaft	1		03338460355
56	Zahnrad	gear	2		03338460356
57	Kugellager	bearing	2	6004.2Z	0406004ZZ
58	Sicherungsring	retaining ring	1		
59	Flansch	flange	1		
59-1	Kupplung	Clutch	1		
60	Spindel	Spindle	1		03338460360
61	Kugellager	bearing	2	51104	04051104
62	Passfeder	key	2	6x20	042P6620
63	Sicherungsring	lock washer	1	20	042SR20W
64	Klemmmutter	lock nut	1	M20x1,5	
65	Schraube	screw	7	M6x20	
66	Scheibe	Washer	2		
67	Schraube	Screw	1	M6x16	
68	Schraube	screw	1		03338460368
69	Handhebel	turn handle	1		
70	Schraube	Screw	1		
71	Schraube	Screw	3	M14x55	
72	Scheibe	Washer	3	14	
73	Sechskantmutter	Hexagon nut	3	M14	
74	Faltenbalg	Bellow	1		03338450640
75	Faltenbalg	Bellow	1	oder / or	03338450641
	Gummiabdeckung	Rubber cover	1	oder / or	03338165346

6.14 Maschinenschilder - Machine labels

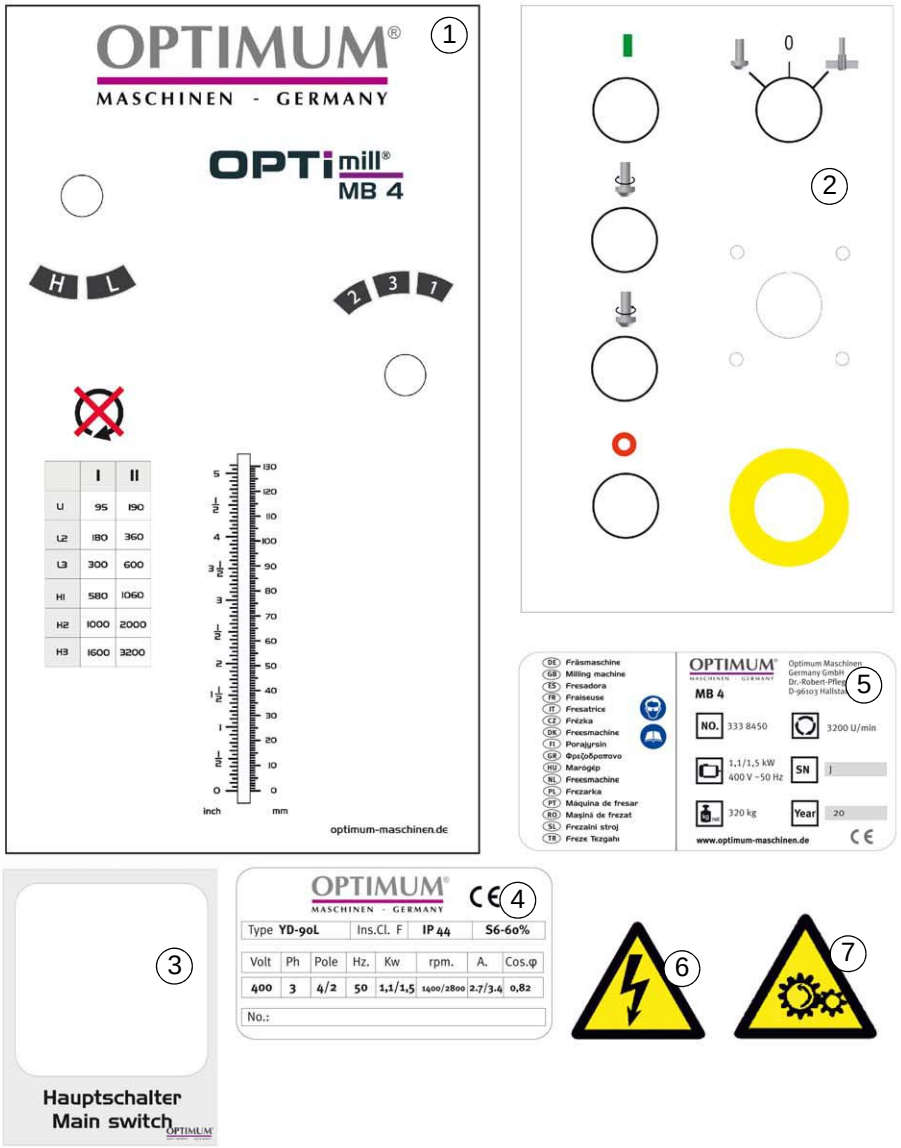
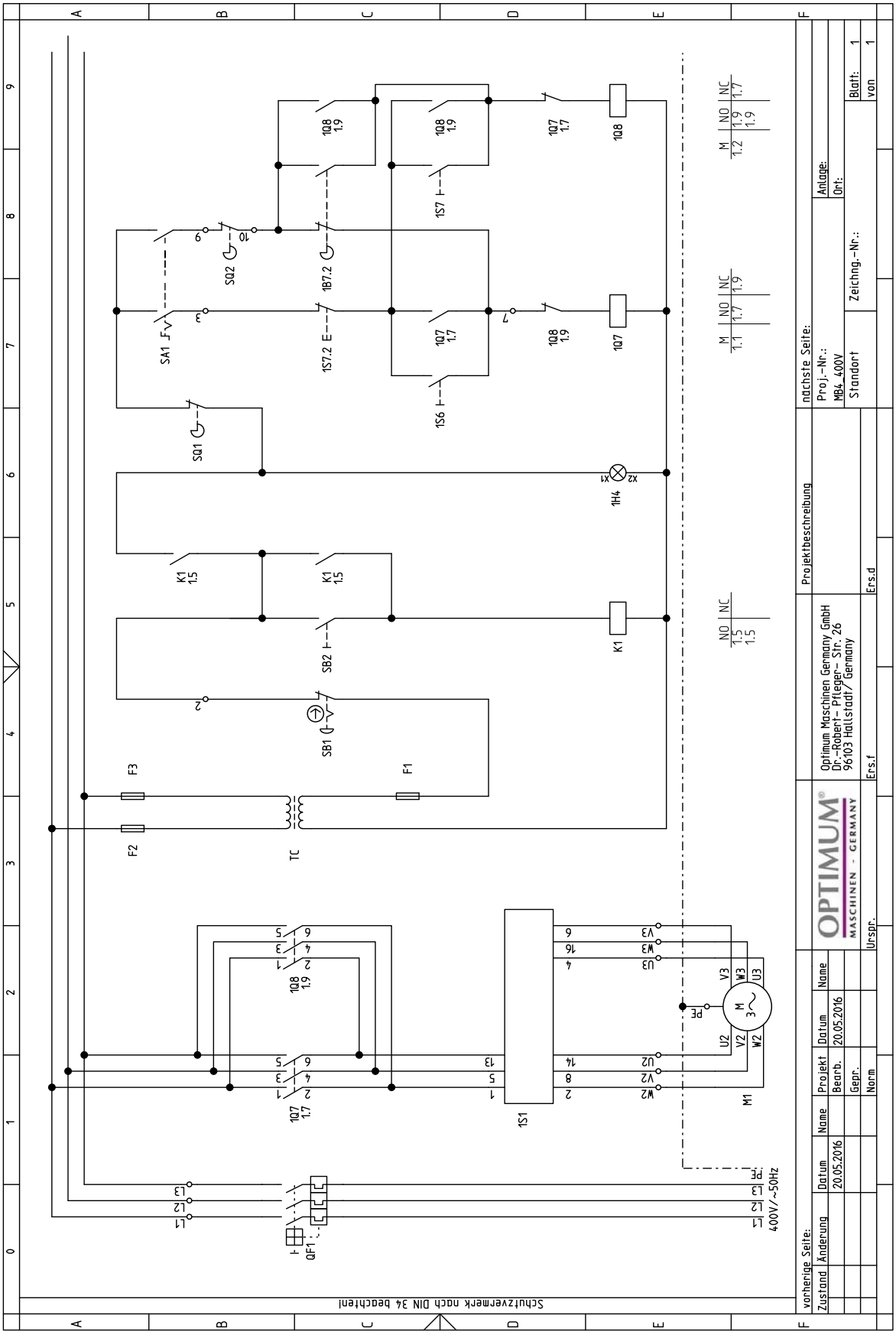


Abb. 6-11: Maschinenschilder - Machine labels

Ersatzteilliste Maschinenschilder - Spare part list machine labels					
Pos.	Bezeichnung	Designation	Menge	Grösse	Artikelnummer
			Qty.	Size	Article no.
1	Schild Frontabdeckung	Front cover lable	1		
2	Schild Steuerbox	Control box cover	1		
3	Schild Hauptschalter	Main switch lable	1		
4	Schild Motor	Motor Lable	1		
5	Maschinenschild	Machine lable	1		
6	Schild Sicherheit	Safety lable	1		
7	Schild Sicherheit	Safety lable	1		

MB4_parts.fm

6.15 Schaltplan Drehstromantrieb - Wiring diagram three-phase drive

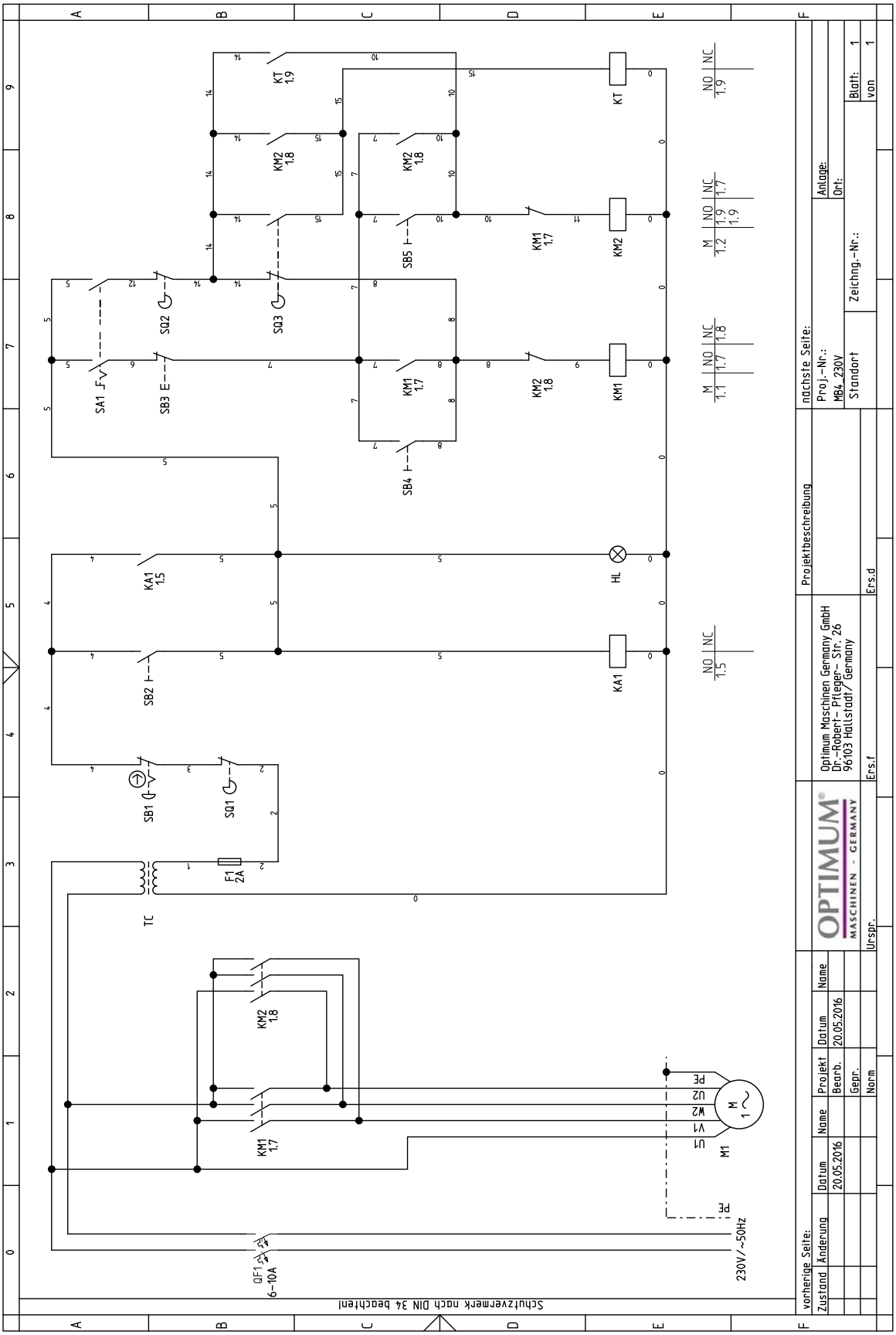


MB4_parts.fm

6.15.1 Teileliste Elektrik - Parts list electrical components - 400V

MB4 - Elektrik - Electrical components - 400V					
Pos.	Bezeichnung	Designation	Menge	Grösse	Artikelnummer
			Qty.	Size	Item no.
1B5	Sicherheitschalter Fräsown	Mill chuck safety switch	1		
1B7.1	Endschalter oben	Top end switch	1		
1B7.2	Endschalter unten	Below end switch	1		
1F0	Schutzschalter	Safety switch	1		
1F3	Sicherung	Fuse	1		
1F4.1	Sicherung	Fuse	1		
1F4.2	Sicherung	Fuse	1		
1H4	Lampe Betriebsleuchte	Work light lamp	1		
1M1	Motor	Motor	1		
1Q7	Motorschütz	Motor contactor	1		
1Q8	Motorschütz	Motor contactor	1		
1S1	Drehrichtungsschalter	Rotation switch	1		
1S4	NOT-Halt Schalter	Emergency stop button	1		
1S5	Taster Ein	Button ON	1		
1S6	Taster Vorwärts	Button forward	1		
1S7	Taster Rückwärts	Buton reverse	1		
1S7.1	Funktionsschalter	Mode switch	1		
1S7.2	Taster Aus	Button OFF	1		
1T3	Transformator	Transformer	1		
K1	Steuerrelais	Control relay	1		

6.16 Schaltplan einphasiger Antrieb - Wiring diagram one-phase drive



6.16.1 Teileliste Elektrik - Parts list electrical components - 230V

MB4 - Elektrik - Electrical components - 230V					
Pos.	Bezeichnung	Designation	Menge	Grösse	Artikelnummer
			Qty.	Size	Item no.
SQ1	Sicherheitschalter Frässchutz	Mill chuck safety switch	1		
SQ2	Endschalter oben	Top end switch	1		
SQ3	Endschalter unten	Below end switch	1		
1F0	Schutzschalter	Safety switch	1		
F1	Sicherung	Fuse	1	2A	
HL	Lampe Betriebsleuchte	Work light lamp	1		
M1	Motor	Motor	1		
KM1	Motorschütz	Motor contactor	1		
KM2	Motorschütz	Motor contactor	1		
SB1	NOT-Halt Schalter	Emergency stop button	1		
SB2	Taster Ein	Button ON	1		
SB4	Taster Vorwärts	Button forward	1		
SB5	Taster Rückwärts	Buton reverse	1		
SA1	Funktionsschalter	Mode switch	1		
SB3	Taster Aus	Button OFF	1		
TC	Transformator	Transformer	1		
KA1	Steuerrelais	Control relay	1		
KT	Zeitrelais	Time relay	1		

7 Malfunctions

7.1 Milling machine malfunctions

Malfunction	Cause/ possible effects	Solution
Milling machine cannot be switched on	• Power-on sequence not observed.	• ☞ Switching on the drilling-milling machine on page 26 • Have it checked by qualified personnel.
Tool "burnt".	• Incorrect speed. • Chips are not coming out of the drilled hole. • Blunt tool. • Operating without cooling agent.	• Choose a different speed, excessive feed. • Withdraw the tool more frequently. • Sharpen or replace tool. • Use coolant.
Taper cannot be inserted in quill.	• Remove any dirt, grease or oil from the internal conical surface of the spindle sleeve or the taper.	• Clean surfaces well. Keep surfaces free from grease.
The taper cannot be pushed out.	• MT4 taper is shrinked on the Morse taper.	• Let the machine run at highest speed for two minutes to warm it up and attempt to remove the taper again.
Motor does not start.	• Defective fuse.	• Have it checked by qualified personnel.
Rattle the spindle if the workpiece surface is rough.	• Upcut mill machining not possible under the current operating conditions. • Clamping lever of the movement axes not tightened. • Loose collet, loose drill chuck, draw-in rod loose. • Tool is blunt. • The workpiece is not fastened. • Excessive slack in bearing. • Spindle moves up and down.	• Perform conventional milling. • Tighten the clamping lever. • Check, re-tighten. • Sharpen or renew the tool. • Clamp the workpiece firmly. • Readjust the bearing slack or replace the bearing. • Readjust the bearing slack or replace the bearing.
Fine feed of the spindle sleeve does not work	• Fine feed is not correctly activated. • Coupling of the fine feed does not cam-in, is soiled, blurred, worn, defective	• ☞ Manual spindle sleeve feed with the fine feed on page 31 • Clean, replace.

8 Appendix

8.1 Copyright

8.2 Terminology/Glossary

Term	Explanation
Milling table	Supporting surface, clamping surface for the workpiece with traverse in X and Y directions
Taper mandrel	Tool housing taper, drill taper, drill chuck taper.
Workpiece	piece to be milled, drilled or machined.
Draw-in rod	Threaded rod to fix the taper mandrel in the quill.
Drill chuck	Drill bit adapter
Collet	Holder for end mill
Drill-mill head	Upper part of the milling machine
Spindle sleeve	Hollow shaft in which the milling spindle turns.
Milling spindle	Shaft activated by the motor
Drilling table	Supporting surface, clamping surface
Taper mandrel	Cone of the drill or of the drill chuck
Quill lever	Manual operation for the drill feed
Quick action - drill chuck	Drill bit adapter can be fixed by hand.
Workpiece	Part to be drilled, part to be machined.
Tool	Milling cutter, drill bit, etc.

8.3 Liability claims/warranty

Besides the legal liability claims for defects of the customer towards the seller, the manufacturer of the product, OPTIMUM GmbH, Robert-Pfleger-Straße 26, D-96103 Hallstadt, does not grant any further warranties unless they are listed below or were promised as part of a single contractual provision.

Liability or warranty claims are processed at OPTIMUM GmbH's discretion either directly or through one of its dealers.
Any defective products or components of such products will either be repaired or replaced by components which are free from defects. Ownership of replaced products or components is transferred to OPTIMUM Maschinen Germany GmbH.

The automatically generated original proof of purchase which shows the date of purchase, the type of machine and the serial number, if applicable, is the precondition in order to assert liability or warranty claims. If the original proof of purchase is not presented, we are not able to perform any services.

Defects resulting from the following circumstances are excluded from liability and warranty claims:

- Using the product beyond the technical options and proper use, in particular due to overstraining of the machine.
- Damage caused personally through incorrect use or failure to observe our operating instructions,
- negligent or incorrect handling and use of improper operating materials.
- Unauthorized modifications and repairs.
- Insufficient installation and safeguarding of the machine.
- Disregarding the installation requirements and conditions of use.
- Atmospheric discharges, overvoltage and lightning strokes as well as chemical influences.

The following items are also not subject to liability or warranty claims:

- Wearing parts and components which are subject to a standard wear as intended such as e.g. V-belts, ball bearings, illuminants, filters, sealings, etc.
- Non reproducible software errors

Any services, which OPTIMUM GmbH or one of its agents performs in order to fulfil any additional warranty are neither an acceptance of the defects nor an acceptance of its obligation to compensate. These services neither delay nor interrupt the warranty period.

The court of jurisdiction for legal disputes between businessmen is Bamberg.

If any of the aforementioned agreements is totally or partially inoperative and/or invalid, a provision which nearest approaches the intent of the guarantor and remains within the framework of the limits of liability and warranty which are specified by this contract is deemed agreed.

8.4 Storage

ATTENTION!

Incorrect and improper storage might result in damage or destruction of electrical and mechanical machine components.

Store packed and unpacked parts only under the intended environmental conditions.

Follow the instructions and information on the transport box:

- Fragile goods
  (Goods require careful handling)

- Protect against moisture and humid environment

☞ Environmental conditions on page 19

- Prescribed position of the packing case
  (Marking the top surface - arrows pointing up)

- Maximum stacking height

  Example: not stackable - do not stack a second packing case on top of the first one.

Consult Optimum Maschinen Germany GmbH if the machine and accessories are stored for more than three months or are stored under different environmental conditions than those specified here. ☞ Environmental conditions on page 19

8.5 Advice for disposal / Options of reuse

Please dispose of your equipment in an environmentally friendly manner, by not placing waste in the environment but in a professional manner.

Please do not simply throw away the packaging and later the disused machine, but dispose of both in accordance with the guidelines laid down by your city council/local authority or by an authorised disposal company.

8.5.1 Decommissioning

CAUTION!

Immediately decommission used machines in order to avoid later misuse and endangering of the environment or of persons.

- **Unplug the power cord.**
- **Cut the connection cable.**
- **Remove all operating materials from the used device which are harmful to the environment.**
- **If applicable remove batteries and accumulators.**
- **Disassemble the machine if required into easy-to-handle and reusable assemblies and component parts.**
- **Dispose of machine components and operating fluids using the intended disposal methods.**

8.5.2 Disposal of new device packaging

All used packaging materials and packaging aids from the machine are recyclable and generally need to be supplied to the material reuse.

The packaging wood can be supplied to the disposal or the reuse.

Any packaging components made of cardboard box can be chopped up and supplied to the waste paper collection.

The films are made of polyethylene (PE) and the cushion parts are made of polystyrene (PS). These materials can be reused after reconditioning if they are passed to a collection station or to the appropriate waste management enterprise.

Only forward the packaging materials correctly sorted to allow direct reuse.

8.5.3 Disposal of the old device

INFORMATION

Please take care in your interest and in the interest of the environment that all component parts of the machine are only disposed of in the intended and admitted way.

Please note that the electrical devices comprise a variety of reusable materials as well as environmentally hazardous components. Please ensure that these components are disposed of separately and professionally. In case of doubt, please contact your municipal waste management. If appropriate, call on the help of a specialist waste disposal company for the treatment of the material.

8.5.4 Disposal of electrical and electronic components

Please make sure that the electrical components are disposed of professionally and according to the statutory provisions.

The device is composed of electrical and electronic components and must not be disposed of as household waste. According to the European Directive regarding electrical and electronic used devices and the implementation of national legislation, used power tools and electrical machines need to be collected separately and supplied to an environmentally friendly recycling centre.

As the machine operator, you should obtain information regarding the authorised collection or disposal system which applies for your company.

Please make sure that the electrical components are disposed of professionally and according to the legal regulations. Please only throw depleted batteries in the collection boxes in shops or at municipal waste management companies.

8.5.5 Disposal of lubricants and coolants

ATTENTION!

Please imperatively make sure to dispose of the used coolant and lubricants in an environmentally compatible manner. Observe the disposal instructions of your municipal waste management companies.

INFORMATION

Used coolant emulsions and oils should not be mixed since it is only possible to reuse oils without pre-treatment when they have not been mixed.

The disposal instructions for used lubricants are made available by the manufacturer of the lubricants. If necessary, request the product-specific data sheets.

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8.6 Disposal via municipal collection facilities

Disposal of used electrical and electronic components
(Applicable in the countries of the European Union and other European countries with a separate collecting system for those devices).

The sign on the product or on its packing indicates that the product must not be handled as common household waste, but that is needs to be disposed of at a central collection point for recycling. Your contribution to the correct disposal of this product will protect the environment and the public health. Incorrect disposal constitutes a risk to the environment and public health. Recycling of material will help reduce the consumption of raw materials. For further information about the recycling of this product, please consult your District Office, municipal waste collection station or the shop where you have purchased the product.

8.7 Change information operating manual

Chapter	Short summary	new version number
EC declaration	modified standard, DIN EN 12100:2010	1.0.2
Control panel	new images	1.0.2
Spare parts	Added wiring diagram	1.0.3
4	Description of threading mode	1.0.4
1 + 2 + 4	Type plates, variants added	1.0.5
Spare parts	Update of spare parts drawing	1.0.6
Spare parts	Update of spare parts drawing	1.0.7
Spare parts	Update of spare parts drawing, column	1.0.8
2.2 + 2.4 + 4.11	tech. data	1.0.9
Spare parts 8.1.1	Important notes of spare part supply	1.1.0
3	Interdepartmental transport	1.1.1

8.8 Product follow-up

We are required to perform a follow-up service for our products which extends beyond shipment.

We would be grateful if you could send us the following information:

- Modified settings
- Any experiences with the drilling- milling machine which might be important for other users
- Recurring malfunctions

Optimum Maschinen Germany GmbH
Dr.-Robert-Pfleger-Str. 26

D-96103 Hallstadt

email: info@optimum-maschinen.de

OPTIMUM®
MASCHINEN - GERMANY

EC Declaration of Conformity

according to Machinery directive 2006/42/EC, Annex II 1.A

The manufacturer / distributor Optimum Maschinen Germany GmbH
Dr.-Robert-Pfleger-Str. 26
D - 96103 Hallstadt, Germany

hereby declares that the following product

Product designation: Hand-controlled drilling and milling machine

Type designation: MB4

fulfills all the relevant provisions of the directive specified above and the additionally applied directives (in the following) - including the changes which applied at the time of the declaration.

Description:

Hand-controlled drilling and milling machine

The following additional EU Directives have been applied:

EMC Directive 2014/30/EU ; Restriction of the use of certain hazardous substances in electrical and electronic equipment 2015/863/EU

The following harmonized standards were applied:

EN 13128:2001+A2:2009/AC:2010 Safety of machine tools - Milling machines (including boring machines)

EN 60204-1:2014 - Safety of machinery - Electrical equipment of machines - Part 1: General requirements

EN 13849-1:2015 - Safety of machinery - Safety related parts of controls - Part 1: General design principles

EN 13849-2:2012 - Safety of machinery - Safety related parts of controls - Part 2: Validation

EN ISO 12100:2013 - Safety of machinery - General principles for design - Risk assessment and risk reduction

Name and address of the person authorized to compile the technical file:

Kilian Stürmer, phone: +49 (0) 951 96555 - 800

Kilian Stürmer (CEO, General Manager)
Hallstadt, 2019-12-11

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Schmierstoffe Lubricant Lubrifiant	Viskosität Viskosity Viscosité ISO VG DIN 51519 mm²/s (cSt)	Kennzeich-nung nach DIN 51502	ARAL	BP	Esso	Klüber Lubrication	Mobil	Shell	Texaco
Getriebeöl Gear oil Huile de réducteur	VG 680	CLP 680	Aral Degol BG 680	BP Energol GR-XP 680	SPARTAN EP 680	Klüberoil GEM 1-680	Mobilgear 636	Shell Omala 680	Meropa 680
	VG 460	CLP 460	Aral Degol BG 460	BP Energol GR-XP 460	SPARTAN EP 460	Klüberoil GEM 1-460	Mobilgear 634	Shell Omala 460	Meropa 460
	VG 320	CLP 320	Aral Degol BG 320	BP Energol GR-XP 320	SPARTAN EP 320	Klüberoil GEM 1-320	Mobilgear 632	Shell Omala 320	Meropa 320
	VG 220	CLP 220	Aral Degol BG 220	BP Energol GR-XP 220	SPARTAN EP 220	Klüberoil GEM 1-220	Mobilgear 630	Shell Omala 220	Meropa 220
	VG 150	CLP 150	Aral Degol BG 150	BP Energol GR-XP 150	SPARTAN EP 150	Klüberoil GEM 1-150	Mobilgear 629	Shell Omala 150	Meropa 150
	VG 100	CLP 100	Aral Degol BG 100	BP Energol GR-XP 100	SPARTAN EP 100	Klüberoil GEM 1-100	Mobilgear 627	Shell Omala 100	Meropa 100
	VG 68	CLP 68	Aral Degol BG 68	BP Energol GR-XP 68	SPARTAN EP 68	Klüberoil GEM 1-68	Mobilgear 626	Shell Omala 68	Meropa 68
	VG 46	CLP 46	Aral Degol BG 46	BP Bartran 46	NUTO H 46 (HLP 46)	Klüberoil GEM 1-46	Mobil DTE 25	Shell Tellus S 46	Anubia EP 46
	VG 32	CLP 32	Aral Degol BG 32	BP Bartran 32	NUTO H 32 (HLP 32)	Klübersynth GEM 4- 32 N	Mobil DTE 24	Shell Tellus S 32	Anubia EP 32
Hydrauliköl Hydraulic oil Huile hydraulique	VG 32	CLP 32	Aral Vitam GF 32	BP Energol HLP HM 32	NUTO H 32 (HLP 32)	LAMORA HLP 32	Mobil Nuto HLP 32	Shell Tellus S2 M 32	Rando HD HLP 32
	VG 46	CLP 46	Aral Vitam GF 46	BP Energol HLP HM 46	NUTO H 46 (HLP 46)	LAMORA HLP 46	Mobil Nuto HLP 46	Shell Tellus S2 M 46	Rando HD HLP 46
Getriebefett Gear grease Graisse de réducteur		G 00 H-20	Aral FDP 00 (Na-ve rseift) Aralub MFL 00 (Li-verseift)	BP Energrease PR-EP 00	FIBRAX EP 370 (Na-verseift)	MICRO-LUBE GB 00	Mobilux EP 004	Shell Alva-nia GL 00 (Li-verseift)	Marfak 00

Spezialfette, wasserabweisend Special greases, water resistant Graisses spéciales, déperlant			Aral Aralub	Energrease PR 9143		ALTEMP Q NB 50 Klüberpaste ME 31-52	Mobilux EP 0 Mobil Greaserex 47		
Wälzlagerfett Bearing grease Graisse de roulement		K 3 K-20 (Li-verseift)	Aralub HL 3	BP Energrease LS 3	BEACON 3	CENTO-PLEX 3	Mobilux 3	Shell Alvania R 3 Alvania G 3	Multifak Premium 3
Öle für Gleitbahnen Oils for slideways Huiles pour glissières	VG 68	CGLP 68	Aral Deganit BWX 68	BP Maccurat D68	ESSO Febis K68	LAMORA D 68	Mobil Vactra Oil No.2	Shell Tonna S2 M 68	Way lubricant X 68
Öle für Hochfrequenzspindeln Oils for Built-in spindles Huiles pour broches à haute vitesse	VG 68		Deol BG 68	Emergol HLP-D68	Spartan EP 68		Drucköl KLP 68-C	Shell Omala 68	
Fett für Zentralschmierung (Fließfett) Grease for central lubrication Graisse pour lubrification centrale	NLGI Klasse 000 NLGI class 000		ARALUB BAB 000	Grease EP 000	Shell Gadus S4 V45AC	CENTO-PLEX GLP 500	Mobilux EP 023		Multifak 264 EP 000
Fett für Hochfrequenzspindeln Grease for Built-in spindles Graisse pour broches à haute vitesse	METAFLUX-Fett-Paste (Grease paste) Nr. 70-8508 METAFLUX-Moly-Spray Nr. 70-82 Techno Service GmbH ; Detmolder Strasse 515 ; D-33605 Bielefeld ; (++49) 0521- 924440 ; www.metaflux-ts.de								
Kühlschmiermittel Cooling lubricants Lubrifiants de refroidissement	Schneidöl Aquacut C1, 10 L Gebinde, Artikel Nr. 3530030 EG Sicherheitsdatenblatt http://www.optimum-daten.de/data-sheets/Optimum-Aquacut_C1-EC-datasheet_3530030_DE.pdf		Aral Emusol	BP Sevora	Esso Kutwell		Mobilcut	Shell Adrana	Chevron Soluble Oil B

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Quellenverzeichnis von Ihrem Fachhändler Metallbau Mehner

Optimum Fräsmaschinen und CNC Fräsmaschinen:
Optimum MB4 Übersicht

- OPTImill MB4
  - OPTImill MB4 Ersatzteile
  - OPTImill MB4 Zubehör

- OPTImill Zubehör

Ihr Ersatzteil nicht in den Listen?
Direkt zum >>**Formular Download**<<. Tragen sie Ihr Maschinenmodell, samt Bauteil und Artikelnr. ein und wir unterbreiten Ihnen ein Angebot.

Allgemeine Betriebsmittel

- Öle und Schmiermittel
- Minimalmengenschmierung

Weitere interessante Verweise

- Bohrmaschinen / CNC Steuerungen
- Drehmaschinen / CNC Drehmaschinen
- Drucklufttechnik / Kompressoren