OPTIMUM
MASCHINEN - GERMANY

Operating instructions

Version 1.0.1

OPTImill®
MH 28V

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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 drilling-milling 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 drilling-milling 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.

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1 Safety

Glossary of symbols

☞	gives additional indications
➜	calls on you to act
❍	enumerations

This part of the operating manual

- ❍ explains the meaning and use of the warning references contained in the operating manual,
- ❍ explains how to use the drilling-milling machine properly,
- ❍ highlights the dangers that might arise for you and others if these instructions are not obeyed,
- ❍ informs you on how to prevent dangers.

In addition to this operating manual please observe

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

Always keep this documentation close to the drilling-milling machine.

INFORMATION

If you are unable to solve a problem using this manual, please contact us for advice:

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1.1 Safety warnings (warning notes)

1.1.1 Classification of hazards

We classify the safety warnings into various levels. The table below gives an overview of the classification of symbols (pictograms) and warnings for the specific danger and its (possible) consequences.

Pictogram	Alarm expression	Definition/Consequences
	**DANGER!**	Imminent danger that will cause serious injury or death to persons.
	WARNING!	Risk: a danger that might cause serious injury or death to persons.
	CAUTION!	Danger or unsafe procedure that might cause injury to persons or damage to property.
	**ATTENTION!**	Situation that could cause damage to the drilling-milling machine and to the product and other types of damage. No risk of injury to persons.
	**INFORMATION**	Application tips and other important/helpful or useful information and notes. No dangerous or harmful consequences for persons or objects.

In the case of specific dangers, we replace the pictogram by


general danger


with a warning of


injuries to hands,


hazardous electrical voltage,

or


rotating parts.

1.1.2 Further pictograms

Activation forbidden!

Read the operating manual before the machine is first used!

Pull the mains plug!

Use protective goggles!

Use protective gloves!

Use protective boots!

Wear a safety suit!

Use ear protection!

Protect the environment!

Contact address

1.2 Proper use

WARNING!

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

- **will endanger the staff,**
- **will endanger the drilling-milling machine and other material property of the operator,**
- **may affect the proper operation of the drilling-milling machine.**

The drilling-milling machine is designed and manufactured to be used for milling and drilling cold metals or other non-flammable 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 authorisation of the company Optimum Maschinen Germany GmbH or operated with different process data, then the drilling-milling machine is being used improperly.

We do not take any liability for damages caused by improper use.

We would like to stress that any modifications to the construction or technical or technological modifications that have not been authorised by the company Optimum Maschinen Germany GmbH will also render the guarantee null and void. It is also part of proper use that

- the maximum values for the drilling-milling machine are complied with,
- the operating manual is observed,
- inspection and maintenance instructions are observed.

☞ “Technical data“ on page 16

WARNING!

Very serious injury due to improper use.

It is forbidden to make any modifications or alterations to the operating values of the drilling-milling machine. These could endanger the staff and cause damage to the drilling-milling machine.

INFORMATION

The drilling-milling machine MH28V is built according to the standard DIN EN 55011 class A.

WARNING!

The class A (machine tools) is not intended to be used in residential facilities, where the power is supplied via a public low voltage supply system. In these areas it may possibly be difficult to guarantee electromagnetic compatibility due to lead bound as well as emitted interferences.

CAUTION!

If the table drilling machine is not used as intended or if the safety directives or the operating instructions are ignored the liability of the manufacturer for any damages to persons or objects resulting hereof is excluded and the claim under guarantee is becoming null and void!

1.3 Reasonably foreseeable misuse

Any other use or any use beyond the use described under "Proper use" is regarded as improper use and is forbidden.

If it is intended to use the device in any other way as described above, it is necessary to consult the manufacturer.

It is only allowed to work metallic, cold and non-flammable material using the milling machine.

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

The operators must be qualified.

1.3.1 Avoiding misuse

- ➜ Using suitable cutting tools.
- ➜ Adapting speed settings and feed on the material and on the workpiece.
- ➜ Clamp the workpiece firmly and vibration-free.

ATTTENTION!

The workpiece must always be fixed in a machine vice, jaw chucks or any other suitable clamping tool such as e.g. clamping claws.

WARNING!

Injuries due to workpieces flying off at high speed

Clamp the workpiece in the machine vice. Make sure that the workpiece is firmly clamped in the machine vice resp. the machine vice is firmly fixed on the machine table.

- ➜ Use of cooling and lubricating agents in order to increase the durability of the tool and to improve the surface quality.
- ➜ Clamp the cutting tools and the workpieces on clean clamping surfaces.
- ➜ Sufficiently lubricate the machine.
- ➜ Correctly set the bearing clearance and guidance.

It is recommended to:

➜ Use the drill in a way that it is exactly located between the three clamping jaws of the quick action chuck.

➜ Clamp the end mill by means of the collet chuck and the corresponding clamping collets.

➜ Clamp the end face mill by means of the end mill arbor.

When drilling, please observe that

➜ It is necessary to set the suitable speed depending on the diameter of the drill,

➜ The press-on must only be as intense that the drill can cut on no-load,

➜ If the press-on is too intense, it might result in early tool wear perhaps even tool fracture resp. jamming in the drill hole. If the tool gets jammed, immediately stop the main drive motor by actuating the emergency-stop button,

➜ For hard materials, e.g. steel, it is necessary to use commercial cooling/lubricating agents,

➜ Generally always back out the tool from the workpiece while the shaft is turning.

ATTENTION!

Do not use the quick action chuck as milling tool. Do not clamp the milling tool in the quick action chuck in no case. Use a collet chuck and the corresponding collets for the end mill.

When milling, make sure that

➜ The suitable cutting speed is selected,

➜ For materials with normal mechanical strength, e.g. steel 18-22 m/min,

➜ For materials with higher mechanical strength 10-14 m/min,

➜ The press-on is selected in a way that the cutting speed remains constant,

commercial cooling/lubricating agents are used for hard materials.

1.4 Possible dangers caused by the drilling-milling machine.

The drilling-milling machine was built using the latest technological advances.

Nonetheless there remains a residual risk, since the drilling-milling machine operates with

❍ high revolutions,
❍ rotating parts and tools,
❍ electrical voltage and currents.

We have used construction resources and safety techniques to minimise the health risk to the staff resulting from these hazards.

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

INFORMATION

All persons involved in assembly, commissioning, operation and maintenance must

❍ be duly qualified,
❍ strictly follow this operating manual.

Disconnect the drilling-milling machine whenever cleaning or maintenance work is being carried out.

WARNING!

The drilling-milling machine may only be used with the safety devices activated.

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

All additional installations carried out by the operator need to incorporate the prescribed safety devices.

This will be your responsibility being the machine operator!

☞ **“Safety devices“ on page 11**

1.5 Qualification of personnel

1.5.1 Target group

This manual is addressed to

- the operator,
- the user,
- the maintenance staff.

The warning notes therefore refer to both operation and maintenance of the drilling-milling machine.

Always disconnect the drilling-milling machine plug from the mains. This will prevent it from being used by unauthorised staff.

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

Operator

The operator is instructed by the operating company about the assigned tasks and possible risks in case of improper behaviour. Any tasks which need to be performed beyond the operation in the standard mode must only be performed by the operator if it is indicated in these instructions and if the operating company expressively commissioned the operator.

Electrical specialist

Due to his professional training, knowledge and experience as well as his knowledge of respective standards and regulations the electrical specialist is able to perform works on the electrical system and to recognise and avoid any possible dangers himself.

The electrical specialist is specially trained for the working environment in which he is working and knows the relevant standards and regulations.

Specialist staff

Due to his professional training, knowledge and experience as well as his knowledge of relevant regulations the specialist staff is able to perform the assigned tasks and to recognise and avoid any possible dangers himself.

Instructed persons

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

INFORMATION

All persons involved in assembly, commissioning, operation and maintenance must

- be duly qualified,
- strictly follow this operating manual.

In the event of improper use

- there may be a risk to the staff,

- there may be a risk to the drilling-milling machine and other material property,
- may affect proper operation of the drilling-milling machine.

1.6 User's position

The user must stand in front of the drilling-milling machine.

1.7 Safety measures during operation

CAUTION!

Risk due to inhaling of health hazardous dusts and mist.

Dependent on the material which need to be processed and the used auxiliaries dusts and mist may be caused which might impair you health.

Make sure that the generated health hazardous dusts and mist are safely sucked off at the point of origin and is dissipated or filtered from the working area. Use an appropriate suction unit.

CAUTION!

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

Take additional preventive measures in order to safely avoid health hazards before processing flammable materials (e.g. aluminum, magnesium) or before using flammable additives (e.g. spirit).

1.8 Safety devices

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

Stop the drilling-milling machine immediately if there is a failure in the safety device or if it is not functioning for any reason.

It is your responsibility!

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

- the cause of the failure has been removed,
- it has been verified that there is no danger resulting for the staff or objects.

WARNING!

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

- **damage as a result of components or parts of components flying off at high speed,**
- **contact with rotating parts,**
- **fatal electrocution.**

The drilling-milling machine includes the following safety devices:

- an EMERGENCY-STOP button,
- a protective cover on the drill-mill head,
- a separating protective equipment on the milling spindle.

WARNING!

The separating protective equipment which is made available and delivered together with the machine is designed to reduce the risk of workpieces or fractions of them which being expelled, but not to remove them completely.

1.8.1 EMERGENCY-STOP button

The EMERGENCY-STOP button switches the drilling-milling machine off.

☞ “Switching on the drilling-milling machine“ on page 26

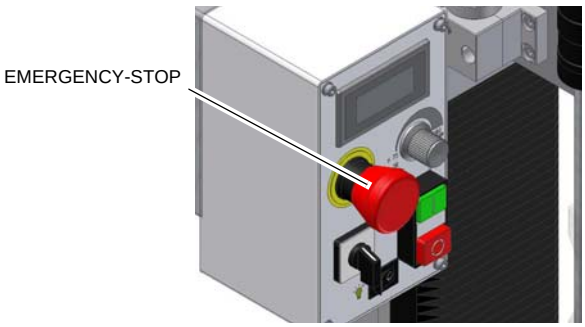


Fig. 1-1: EMERGENCY-STOP button

ATTENTION!

The EMERGENCY-STOP button switches off the drilling-milling machine immediately.

Only press the EMERGENCY-STOP button in case of danger! If the button is actuated in order to stop the drilling-milling machine generally you might damage tools or workpieces.

After actuating the button, turn it to the right, in order to restart the machine.

1.8.2 Protective cover

The drill-mill head is fitted with a protective cover.

WARNING!

Remove the protective cover only after the mains plug has been pulled out of the socket.

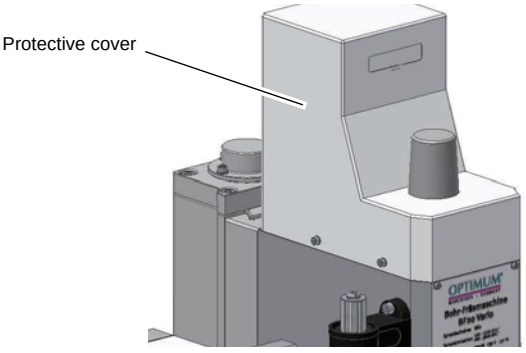


Fig. 1-2: Protective cover

1.8.3 Separating protective equipment

Adjust the protective equipment to the correct height before you start working.

To do so, detach the clamping screw, adjust the required height and retighten the clamping screw.

A switch is integrated in the fixture of the spindle protection which monitors that the cover is closed.

INFORMATION

You cannot start the machine if the drill chuck protection is not closed.

Fig. 1-3: Separating protective equipment

1.9 Safety check

Check the drilling-milling machine regularly.

Check all safety devices

- before starting work,
- once a week (with permanent operation),
- after every maintenance and repair operation.

General check		
Equipment	**Check**	**OK**
Protective covers	Fitted, firmly bolted and not damaged	
Labels, markings	Installed and legible	

Run test		
Equipment	**Check**	**OK**
EMERGENCY-STOP button	When the EMERGENCY-STOP button is activated, the drilling-milling machine should switch off. A restart will not be possible until the EMERGENCY-STOP button has been unlocked and the ON switch has been activated.	
Separating protective equipment around the drilling and milling spindle	Only switch on the drilling-milling machine if the protective equipment is closed.	

1.10 Personnel protective equipment

For certain work peersonnel protective equipment is required.

Protect your face and eyes: During all work and specifically work during which your face and eyes are exposed to hazards, a safety helmet with a face guard should be worn.

Use protective gloves when handling pieces with sharp edges.

Use safety shoes when you position, dismantle or transport heavy components.

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

Before starting work, make sure that the prescribed individual protection gear is available at the workplace.

CAUTION!

Dirty or contaminated personnel protective equipment can cause disease. Clean it each time after it has been used and once a week.

1.11 For your own safety during operation

WARNING!

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

Avoid any unsafe working practises:

Make sure your work does not endanger anyone.

- The instructions in this manual need to be observed during assembly, handling, maintenance and repair.
- Use protective goggles.
- 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 halt.
- Use the prescribed protective equipment. Make sure to wear a well-fitting work suit, when necessary, a hairnet.
- Do not use protective gloves during drilling or milling work.
- Unplug the shockproof plug from the mains, before changing the tool.
- Use suitable devices for removing drilling and milling chips.
- Make sure your work does not endanger anyone.
- Clamp the workpiece tightly before activating the drilling-milling machine.

In the description of work with and on the drilling-milling machine we highlight the dangers specific to that work.

1.12 Disconnecting and securing the drilling-milling machine

Pull out the mains plug before starting maintenance and repair work.

1.13 Using lifting equipment

WARNING!

Use of unstable lifting equipment and load suspension devices that break under load can cause very serious injury or even death.

Check that the lifting equipment and load suspension devices are of sufficient load capacity and in perfect condition.

Observe the rules for preventing accidents issued by your association for the prevention of occupational accidents and safety in the workplace or other inspection authorities.

Hold the loads properly.

Never walk under suspended loads!

1.14 Signs on the drilling-milling machine

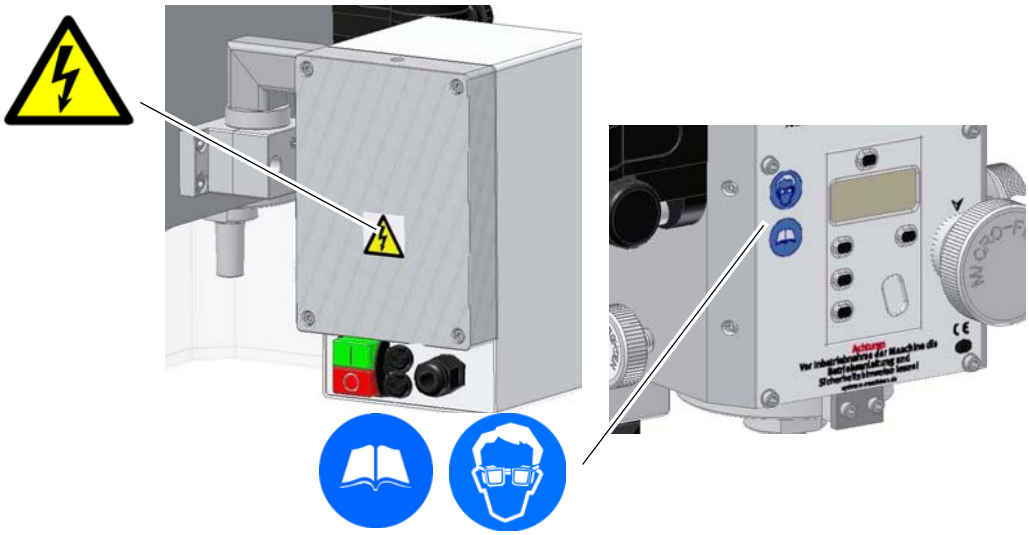


Fig.1-4: MH28V

1.15 Rescuing persons in dangerous situations after the CNC retrofitting

If the machine was subject to a subsequent retrofitting with CNC controlled drives, the following additional dangerous situations such as squeezing and sticking of parts of the body may result hereof.
If the machine had been switched off in a dangerous situation using the Emergency-Stop function, it is no longer possible to actuate the axis by means of the electromotor in order to rescue the squeezed person.
In this case it is necessary to release the machine manually.

This releasing of the X-axis and of the Y-axis is performed using an appropriate tool (e.g. a flat wrench), which is inserted on the hexagon nut at the shaft end which is opposite to the drive.

It is only possible to release the Z-axis using a separate handwheel which is inserted on the free shaft end of the manual crank drive.

WARNING!

It is imperatively necessary that the tools are available to release the machine in case of a dangerous situation.

Therefore, keep the wrench and the handwheel always in close proximity of the CNC controlled machine.

2 Technical data

2.1 Type plate

Fig.2-1: Type plate

The following information gives the dimensions and weight and is the manufacturer's authorised machine data.

2.2 Power connection	
Engine	240 V / 50Hz / 1,1 kW
2.3 Drilling-milling capacity	
Drilling capacity [mm]	Ø max. 28
Milling capacity of end-mill cutter [mm]	Ø max. 28
Milling capacity of inserted tooth cutter [mm]	Ø max. 70
2.4 Spindle holding fixture	
Spindle holding fixture	MK 3 / M12
Sleeve travel [mm]	70 mm
2.5 Drill-mill head	
Swivelling	+ / - 90°
Reduction stages	2
Z-axis travel [mm]	380
2.6 Cross table	
Table length [mm]	730
Table width [mm]	210
Y-axis travel [mm]	440
X-axis travel [mm]	190
T - slot size / distance [mm]	14
2.7 Dimensions	
Height [mm]	1000
Depth [mm]	630

Width [mm]	870
Total weight [kg]	205 to 220
2.8 Work area	
Height [mm]	2000
Depth [mm]	2200
Width [mm]	1500
2.9 Speeds	
Reduction stage slow [min^{-1}]	100 - 830
Reduction stage fast [min^{-1}]	300 - 2500
2.10 Environmental conditions	
Temperatur	5 - 35 °C
Luftfeuchtigkeit	25 - 80%
2.11 Operating material	
Reduction stage Blank steel parts	Mobilgrease OGL 007 or, Mobilux EP 004, or Mobil XHP acid-free oil, e.g. weapon oil, motor oil

2.12 Emissions

The emission of the drilling-milling machine is below 76 dB(A). If the drilling-milling machine is installed in an area where various machines are in operation, the acoustic influence (immission) on the operator of the drilling-milling machine may exceed 85 dB(A).

INFORMATION

This numeric value had been measured on a new machine under conventional operating conditions. Depending on the age or wear of the machine, the noise behavior of the machine might change.

Furthermore, the extent of the noise emission is also depending on manufacturing influence factors, such as speed, material and clamping conditions.

INFORMATION

The mentioned numerical value is an emission level and not necessarily a safe working level.

Unless the degree of noise emission and the degree of noise disturbance are depending on one another it is not possible to use it in order to reliably determine if it is necessary to take further preventive measures or not.

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

- Characteristics of the working chamber, e.g. size or damping behavior**,**
- Other noise sources, e.g. the number of machines,
- Other processes proceeding nearby and the period during which the operator is exposed to the noise.

Furthermore, the admissible pollution level may be different from one country to another due to the national regulations.

This information regarding the noise emission should allow the operator of the machine to perform a better evaluation of the endangerments and risks.

CAUTION!

The machine operator has to wear an appropriate ear protection depending on the overall stress caused by noise and on the basic limit values.

We generally recommend using a sound and ear protection.

3 Unpacking and connecting

INFORMATION

The drilling-milling machine comes pre-assembled.

3.1 Extent of supply

When the drilling-milling machine is delivered, immediately check that the machine has not been damaged during shipping and that all components are included. Also check that no fastening screws have come loose.

Compare the parts supplied with the information on packing list.

3.2 Transport

- Center of gravity

- Attachment positions (marking the positions for the attachment position gear)

- Prescribed transport position (marking the top side)

- Means of transportation to be used
- Weights

WARNING!

Machine parts falling off forklift trucks or other transport vehicles could cause very serious or even fatal injuries. Follow the instructions and information on the transport case.

WARNING!

Use of unstable lifting equipment and load-suspension devices that break under load can cause very serious injury or even death.

Check that the lifting and load-suspension gear has sufficient load capacity and that it is in perfect condition. Observe the rules for preventing accidents issued by your association for the prevention of occupational accidents and safety in the workplace or other inspection authorities.

Hold the loads properly. Never walk under suspended loads!

3.3 Storage

ATTENTION!

Improper storage may cause important parts to be damaged or destroyed.
Store packed or unpacked parts only under the following ambient conditions.
Please follow the instructions and indications on the transportation box.

❍ Fragile goods (goods require careful handling)

❍ Protect against humidity and humid environments

☞ “Environmental conditions“ on page 17.

❍ Prescribed position of the packaging box (marking the top side – arrows pointing upward)

❍ Maximum stacking height

Example: non-stackable – do not pile any further packaging boxes on top of the first packaging box

Consult Optimum Maschinen Germany GmbH if the drilling-milling machine and accessories have to be stored for a period of over three months or under different external conditions than those given here ☞ “Information“ on page 5.

3.4 Installation and assembly

3.4.1 Site requirements

Organize the working space around the drilling-milling machine according to the local safety regulations.

INFORMATION

In order to provide for good functionality and high machining accuracy as well as long durability of the machine the site should fulfill certain criteria.

Observe the following items:

- The device must only be installed and operated in dry ventilated places.
- Avoid places nearby machines generating chips or dust.
- The site has to be vibration-free, i.e. at a distance from presses, planing machines, etc.
- The substructure has to be appropriate for drilling-milling machine. Also make sure that the load bearing capacity and the evenness of the floor are appropriate.
- The substructure has to be prepared in a way that possibly used coolant cannot penetrate into the ground.
- Protruding parts such as stops, handles, etc. need to be secured by measures provided by the customer if necessary in order to avoid dangers for persons.
- Provide sufficient space for assembly and operating staff as well as for material transport.
- Also allow for accessibility for setting and maintenance works.
- Make sure that the mains plug of the turning machine is freely accessible.
- Provide for sufficient illumination (minimum value: 500 lux, measured at the tool tip). In case of little intensity of illumination provide for additional illumination i.e. by a separate workplace illuminator.

INFORMATION

The mains plug of the drilling-milling machine has to be freely accessibl

3.4.2 Load suspension point

WARNING!

Danger of crushing and overturning. Proceed with extreme caution when lifting, installing and assembling the machine.

➜ Secure the load suspension device around the drill-mill head. Use a lifting sling for this purpose.

➜ Clamp all the clamping levers at the drilling-milling machine before lifting the drilling-milling machine.

➜ Make sure that no add-on pieces or varnished parts are damaged due to the load suspension.

3.4.3 Installation

➜ Check the horizontal orientation of the base of the drilling-milling machine with a spirit level.

➜ Check that the foundation has sufficient floor-load capacity and rigidity. The total weight amounts from 205 to 220 kg.

ATTENTION!

Insufficient rigidity of the foundation leads to the superposition of vibrations between the drilling-milling machine and the foundation (natural frequency of components). Insufficient rigidity of the entire milling machine assembly also rapidly causes the machine to reach critical speeds, with unpleasant vibrations, leading to bad milling results.

➜ Position the drilling-milling machine on the intended foundation.

➜ Attach the drilling-milling machine using the provided recesses in the machine base.

WARNING!

The quality of the substructure and the kind of fixture of the machine stand to the substructure has to assimilate the loads of the drilling-milling machine. The substructure needs to be even. Please check the horizontal alignment of the substructure of the drilling-milling machine.

Fix the drilling-milling machine to the substructure at the provided recesses at the stand. When using an optionally available machine substructure, it also needs to be anchored safely and firmly. We recommend the use of shear connector cartridges or heavy-duty bolts.

☞ “We generally recommend using a sound and ear protection.“ on page 18,

☞ “We generally recommend using a sound and ear protection.“ on page 18.

☞ “We generally recommend using a sound and ear protection.“ on page 18.

3.5 First use

ATTENTION!

Before you begin with the commissioning on the machines check that all screws, fasteners and fuses are tight. If necessary they must be tightened.

WARNING!

Risk by using improper workpiece clamping materials or by operating the machine with inadmissible speed.

Only use the clamping materials (e.g. drill chuck) which had been delivered together with the machine or as optional equipment offered by OPTIMUM.

Use the working clamping materials only in the provided admissible speed range.

Workpiece clamping materials must only be modified according to the recommendations of OPTIMUM or of the clamping material manufacturer.

WARNING!

Staff and equipment may be endanged if the drilling-milling machine is first used by unexpert staff.

We do not take responsibility for damage caused by incorrect commissioning.

☞ “Qualification of personnel“ on page 10

3.5.1 Power supply

➜ Connect the electrical feeder.

➜ Check the fuse protection (fuse) of your electrical supply according to the technical specifications for the total connected load of the drilling-milling machine.

3.5.2 Cleaning and lubricating

➜ Remove the anti-corrosive agent to the drilling-milling machine for transport and storage purposes. We recommend the use of paraffin.

- ➜ Do not use any solvents, thinners or other cleaning agents which could corrode the varnish on the drilling-milling machine. Follow the specifications and indications of the manufacturer of the cleaning agent.
- ➜ Lubricate all bright machine parts with non-corrosive lubricating oil.
- ➜ Grease the drilling-milling machine using the lubrication chart.
  ☞ “Inspection and maintenance“ on page 35
- ➜ Check the smooth running of all spindles. The spindle nuts can be readjusted.
- ➜ Disassembly the taper gibs of the cross table and clean the gibs from the anti-corrosive agent. ☞ “Taper gibs“ on page 36

3.5.3 Warming up the machine

ATTENTION!

If the drilling-milling machine and in particular the milling spindle is immediately operated at maximum load when it is cold it may result in damages.

If the machine is cold such as e.g. directly after having transported the machine it should be warmed up at a spindle speed of only 500 1/min for the first 30 minutes.

4 Operation

4.1 Safety

Use the drilling-milling machine only under the following conditions:

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

All malfunctions should be eliminated immediately. 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 14

4.2 Control and indicating elements

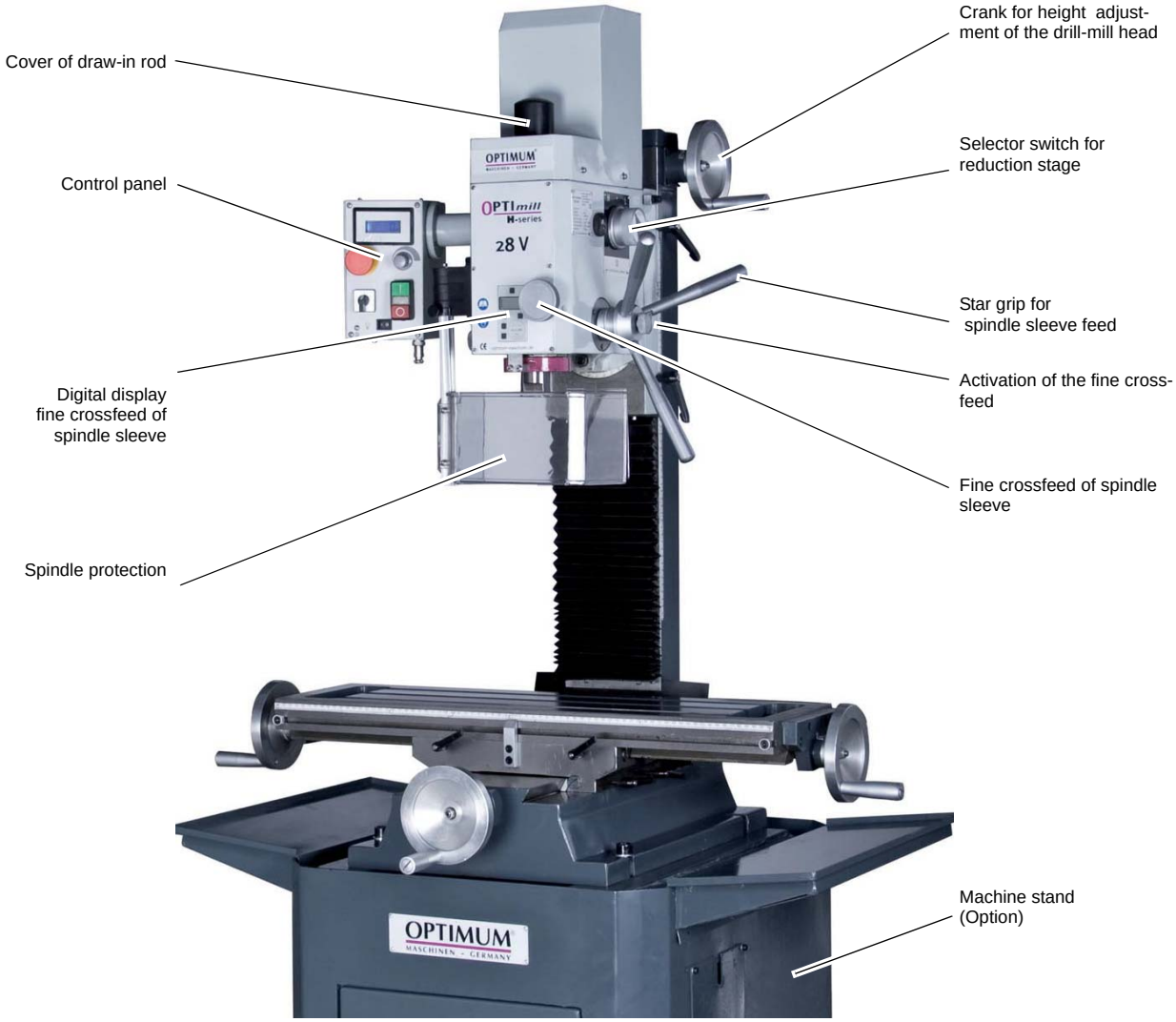


Fig. 4-1: MH28V

4.2.1 Control panel

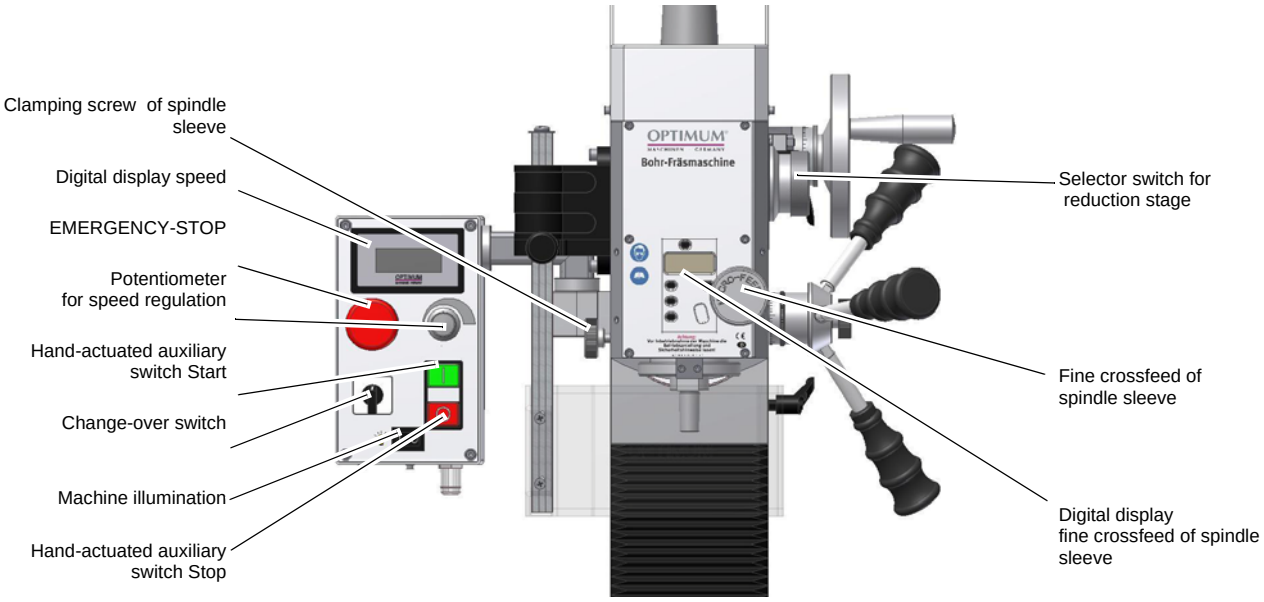


Fig. 4-2: Control panel, front view

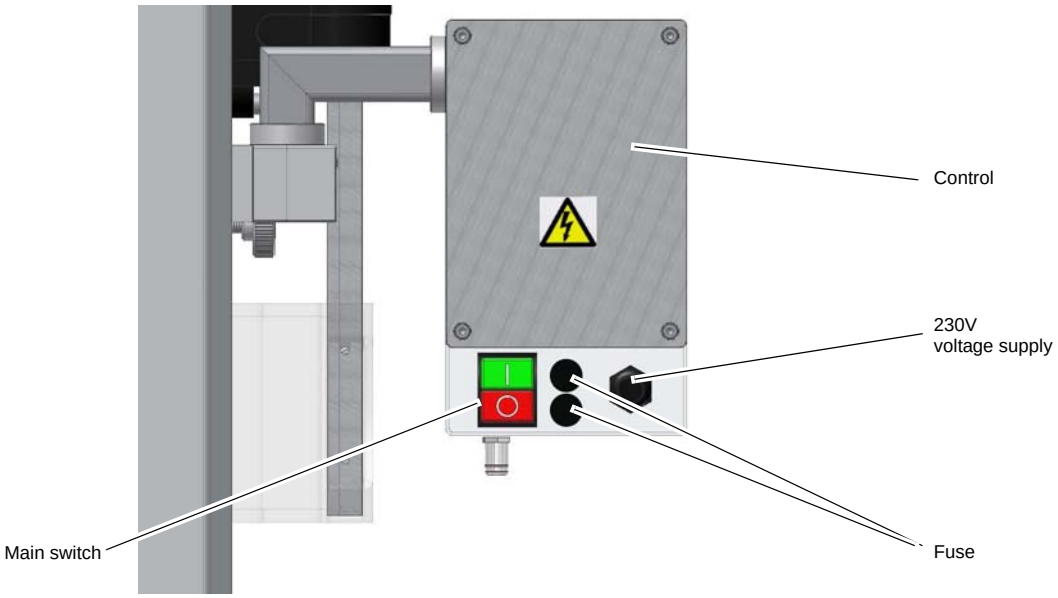


Fig. 4-3: Control panel, back

Main switch

Switches the voltage supply on.
The main switch is at the back of the control panel.

Hand-actuated auxiliary switch Start / Stop

Switches the machine on or off.

Turning direction

Selection left-handed, right-handed rotating or switch-off position. At the left-handed rotation the speed is about 50% less than at the right-handed rotation. First select the turning direction before switching on the machine with the push button.

Speed

Potentiometer to set the required speed. Set the speed at the potentiometer. The speed and thus the cutting speed are depending of the material of the workpiece, of the cutter diameter and of the type of cutter.

The electronics controls the speed slowly to the target value with a ramp. Therefore, please wait a while before you continue milling or drilling with the feed.

Reduction stage

Selection rotary-type switch to select the reduction stage.

CAUTION!

Wait until the drilling-milling machine has come to a complete halt, before performing any changes on the gear switch.

➜ Turn the gear switch to the position "H" for a speed range from approx. 100-830 min^{-1} .

➜ Turn the gear switch to the position "L" for a speed range from approx. 300-2500 min^{-1} .

4.3 Switching on the drilling-milling machine

➜ Switch the main switch on.

➜ Select the reduction stage.

➜ Select the turning direction.

➜ Set the potentiometer to the lowest speed.

➜ Close the spindle protection.

➜ Actuate the hand-actuated auxiliary switch Start.

➜ Set the required speed at the potentiometer.

4.4 Switching off the drilling-milling machine

➜ Press the hand-actuated auxiliary switch Stop. During long-term standstill switch the turning direction switch to the zero position.

4.5 Inserting a tool

4.5.1 Installation

CAUTION!

When milling operations are performed the cone seat has to be fixed always to the draw-in rod. Any cone connections with the taper bore of the work spindle without using the draw-in rod are not allowed for milling operations. The cone connection should be released by the lateral pressure. Injuries may be caused by parts flying off.

The mill head is equipped with a draw-in rod M10.

➜ Remove the cover.

➜ Clean the seat in the milling spindle / spindle sleeve.

➜ Clean the taper of your tool.

➜ Insert the tool into the holding fixture / spindle sleeve.

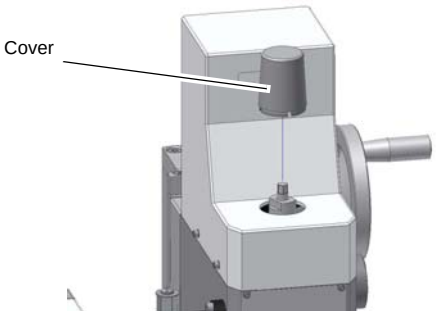


Fig. 4-4: Drill-mill head

➜ Screw the draw-in rod into the tool.

➜ Tighten the tool with the draw-in rod and hold the spindle onto the end support with a key.

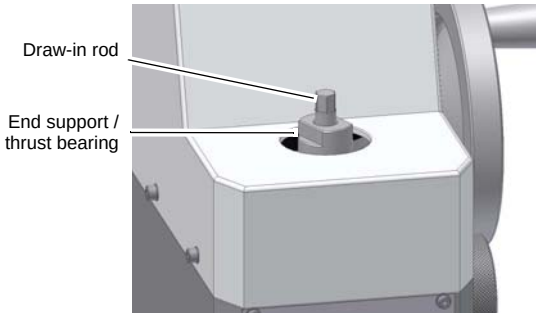


Fig. 4-5: Drill-mill head

4.5.2 Disassembly

➜ Hold the spindle thrust bearing with a wrench and loosen the draw-in rod. Turn the draw-in rod further, so that the tool is squeezed out from the cone admission.

ATTENTION!

When installing a cold morse taper into a heated-up machine those MT seats tend to shrink on the morse taper contrary to the quick-releaser tapers.

4.5.3 Use of collet chucks

When using collet chucks to hold milling tools, a higher operation tolerance can be achieved. The exchange of the collet chucks for a smaller or larger end mill cutter is done in a simple and rapid way and it is not necessary to disassemble the complete tool. The collet chuck is pressed into the ring of the swivel nut and has to rest there by itself. The milling cutter is clamped by fastening the swivel nut on the tool.

Make sure that the correct collet chuck is used for each milling cutter diameter, so that the milling cutter may be fastened securely and firmly.

☞ “If the machine is cold such as e.g. directly after having transported the machine it should be warmed up at a spindle speed of only 500 1/min for the first 30 minutes.“ on page 23

4.6 Clamping the workpieces

CAUTION!

Injury by parts flying off.

The workpiece always needs to be fixed by a machine vice, a jaw chuck or by another appropriate clamping tools such as 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.

➜ Select reduction stage.
H = rapid
L = low

➜ Adjust the speed with the potentiometer. The speed and thus the cutting speed are depending on the material of the workpiece, the milling cutter diameter and the cutter type.

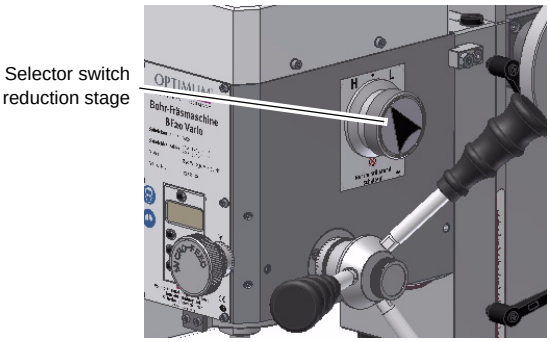


Fig. 4-6: Drill-mill head

4.8 Selecting the speed

For milling operations, the essential factor is the selection of the correct speed. The speed determines the cutting speed of the cutting edges which cut the material. By selecting the correct cutting speed, the service life of the tool is increased and the working result is optimised.

The optimum cutting speed mainly depends on the material and on the material of the tool. With tools (milling cutters) made of hard metal or ceramic insert it is possible to work at higher speeds than with tools made of high-alloyed high-speed steel (HSS). You will achieve the correct cutting speed by selecting the correct speed.

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

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

n = speed in min^{-1} (revolutions per minute)

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

d = tool diameter in m (meters)

4.8.1 Standards values for cutting speeds

[m/min] with high-speed steel and hard metal at conventional milling

Tool	Steel	Grey cast iron	Age-hardened Al alloy
Peripheral and side milling cutters [m/min]	10 - 25	10 - 22	150 - 350
Relieved form cutters [m/min]	15 - 24	10 - 20	150 - 250
Inserted tooth cutter with SS [m/min]	15 - 30	12 - 25	200 - 300
inserted tooth cutter with HM [m/min]	100 - 200	30 - 100	300 - 400

The results are the following standard values for speeds depending on the milling cutter diameter, cutter type and material.

Tool diameter [mm] peripheral and side milling cutters	Steel 10 - 25 m/min	Grey cast iron 10 - 22 m/min	Age-hardened Al alloy 150 - 350 m/min
	Speed [min^{-1}]		
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 cutters	**Steel 15 - 24 m/min**	**Grey cast iron 10 - 20 m/min**	**Age-hardened Al alloy 150 - 250 m/min**
	Speed [min^{-1}]		
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 drilling

Material		Cutter 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	
Structural steel, alloyed, quenched and subsequently drawn, 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	
Structural steel, alloyed, quenched and subsequently drawn, 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 r/min											
2): Feed [f] in mm/r											
3): Cooling: E = emulsion; Oil = cutting oil											

- The above mentioned indications are standard values. In some cases it may be advantageous to increase or decrease these values.
- When drilling, a cooling or lubricating agent should be used.
- For stainless materials (e.g. VA – or NIRO steel sheets) do not center since the material would compact and the drill bit will become rapidly blunt.
- The workpieces need to be tensed in flexibly 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 and non-pollutant emulsion as a cooling agent. This can be acquired from authorised distributors.

Make sure that the cooling agent is properly retrieved. Respect the environment when disposing of any lubricants and cooling agents. Follow the manufacturer's instructions for disposal.

4.9 Manual spindle sleeve feed with the fine feed

➜ Turn the handle screw.
The spindle sleeve lever will move towards the drill-mill head and will activate the clutch of the fine feed.

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

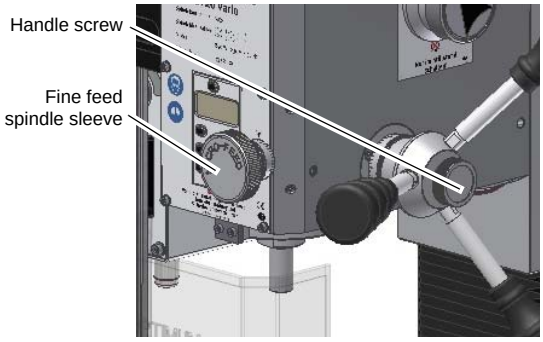


Fig. 4-7: Fine feed

4.10 Digital display for spindle sleeve travel

4.10.1 Technical data

Measuring range	mm	0 - 999.9
	inch	0 - 39.371“
Reading accuracy	mm	0.01
	inch	0.0004“
Power supply		round cell CR2032 3 V ⌀ 20 x 3,2mm

4.10.2 Design

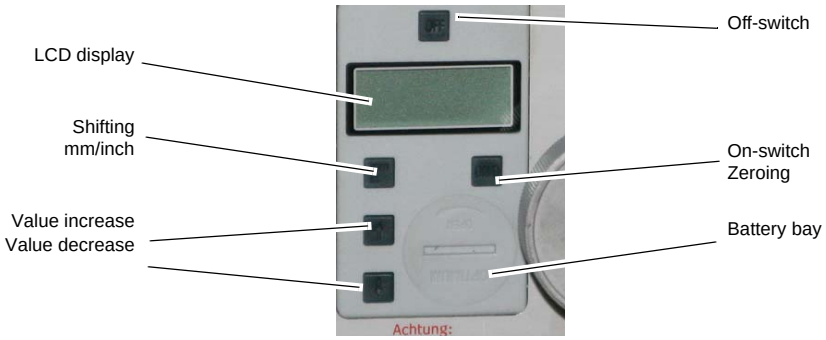


Fig. 4-8: Digital display

- ON / O,
  switches the display on and resets the reading of the display to "0".
- mm/in,
  converts the measuring unit from *millimetres* to *inches* and vice versa.
- OFF,
  switches the display off.
- ↑,
  performs a value increase.
- ↓,
  performs a value decrease.

INFORMATION

Before inserting the new battery, wait about 30 seconds. Please make sure, that the contacts are metallically bright and free from coverings which result from bleeding or gassing batteries. Grip the new batteries only with plastic forceps, if possible not with the hand due to the formation of oxide and never with metal forceps in order to avoid a short circuit. In most cases the round cell will be inserted into the digital display with the marking upside. After inserting the round cell, the battery compartment has to be closed again.

4.10.3 Malfunctions

Malfunction	Cause/ possible consequences	Solution
Flashing of the display	• Voltage too low	• Change battery
Screen doesn't refresh	• Disturbance in the circuit	• Remove the battery, wait 30 seconds and reinsert the battery
No data visible	• No power supply • Battery voltage less than 3V	• Clean battery contacts • Replace battery

4.11 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 (☞ „Fine feed“ on page 31) .
The spindle sleeve lever moves away from the drill-mill head and disengages the clutch of the fine feed.

4.12 Swivelling the drill-mill head

The drill-mill head may be swivelled to the right and to the left. Two screwings need to be loosened.

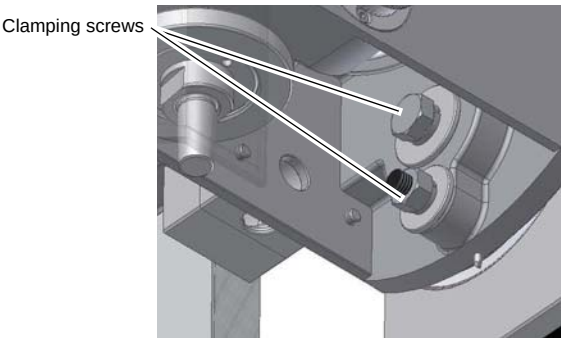


Fig. 4-9: Clamping screws

CAUTION!

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

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

5 Maintenance

In this chapter you will find important information about

- inspection
- maintenance
- repair

of the drilling-milling machine.

The diagram below shows which of these headings each task falls under.

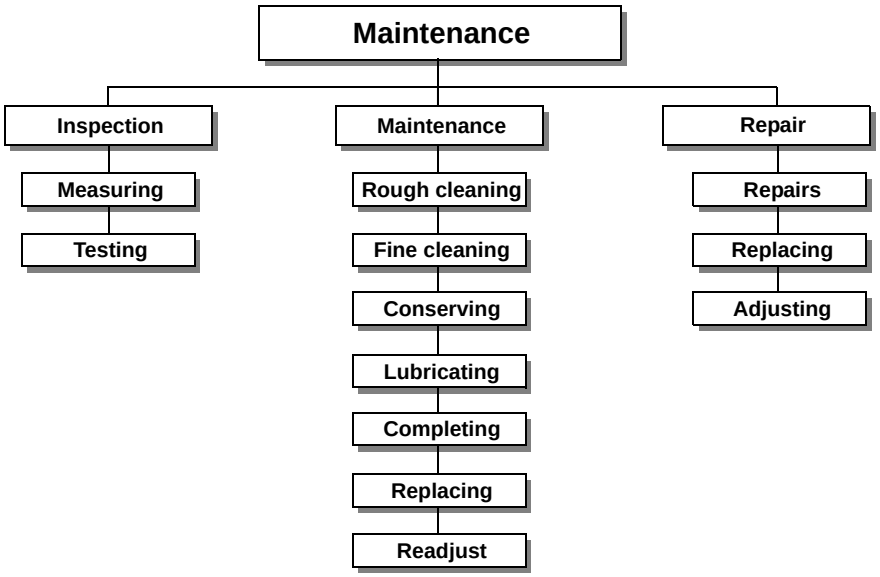


Fig.5-1: Maintenance – definition according to DIN 31051

ATTENTION!

Properly performed regular maintenance is an essential prerequisite for

- **safe operation,**
- **fault-free operation,**
- **long service life of the drilling-milling machine and**
- **the quality of the products you manufacture.**

Installations and equipment of other manufacturer's must also be in optimum condition.

5.1 Safety

WARNING!

The consequences of incorrect maintenance and repair work may include:

- **very serious injury to staff working on the drilling-milling machine,**
- **damage to the drilling-milling machine.**

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

5.1.1 Preparation

WARNING!

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

☞ “Disconnecting and securing the drilling-milling machine“ on page 14

Position a warning sign.

5.1.2 Restarting

Before restarting, run a safety check.

☞ “Safety check“ on page 13

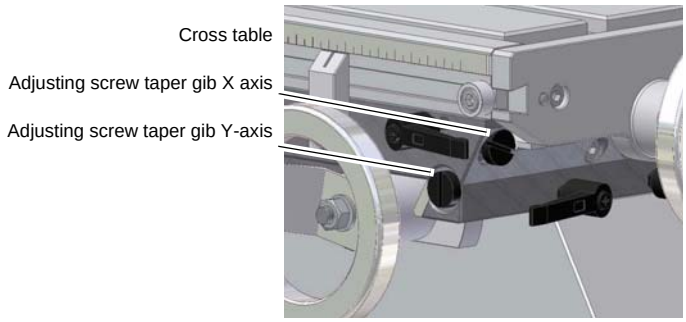
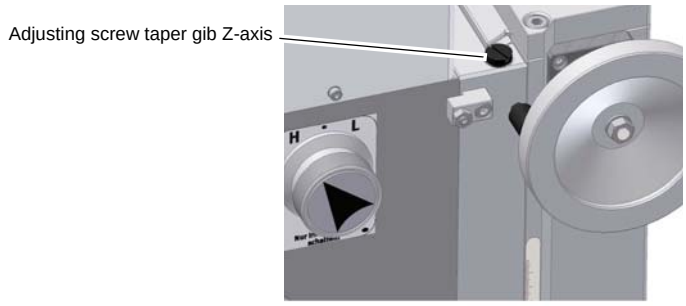
WARNING!

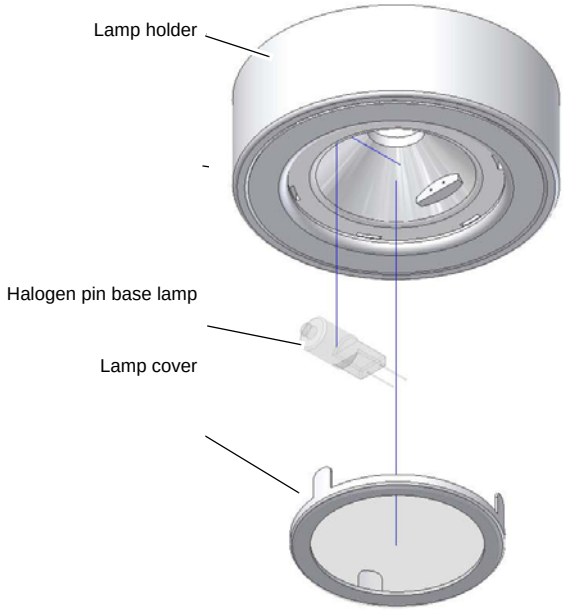
Before starting the drilling-milling machine you have to check that there is no danger for the staff and the drilling-milling machine is undamaged.

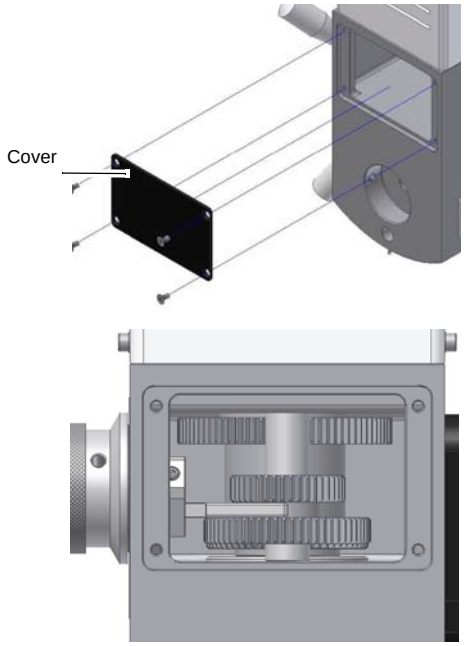
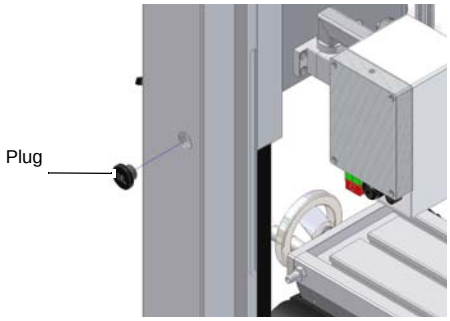
5.2 Inspection and maintenance

The type and extent of wear depends to a large extent on individual usage and service conditions. For this reason, all the intervals are only valid for the authorised conditions.

Interval	Where?	What?	How?
Start of work, after each maintenance or repair operation	Drilling-Milling machine	➜ ☞ “Safety check“ on page 13	
Start of work, after each maintenance or repair operation	Dovetail slideways	Lubricate	➜ Lubricate all slideways.
Weekly	Cross table	Lubricate	➜ Lubricate all blank steel parts. Use acid-free oil, for example weapon oil or engine oil.
As required	Spindle nuts	Readjust	An increased clearance in the spindles of the crosstable can be reduced by readjusting the spindle nuts. Refer to spindle nuts position 66 and 71 The spindle nuts are readjusted by reducing the flank of screw thread of the spindle nut with an adjusting screw. By readjusting a smooth running move over the whole toolpath is to be assured, otherwise the wear by friction between spindle nut /spindle would increase considerably.

Interval	Where?	What?	How?
As required	Taper gibs	Readjust X- and Y- axis	 Fig. 5-2: Cross table ➜ Turn the adjusting screw of the respective taper gib in the clockwise direction. The taper gib is continued to push in and reduced by it the gap in the guideway. ➜ Control your setting. The respective guideway must be still easily mobile from the adjustment, result in however a stable guidance.
As required	Taper gib	Readjust Z-axis	 Fig. 5-3: Mill head ➜ Proceed as described under "Readjust X- and Y-axis".

Interval	Where?	What?	How?
As required	Machine illumination	Replacing the halogen lamp	 Fig. 5-4: Replacing the halogen lamp ➜ Tilt the mill head a little to the right. This way you can easily remove the lamp cover in order to allow replacing of the halogen lamp. ➜ Plug a small screw driver into the recess between the lamp holder and the lamp cover. ➜ By slightly turning the screw driver you can remove the lamp cover. ➜ Pull the halogen pin base lamp with a cloth and replace the halogen lamp. Type: Halogen pin base lamp, Osram 12V - 10W, base G4

Interval	Where?	What?	How?
Every six months	Gear drill-mill head	Greasing	➜ Turn the drill-mill head as described under ☞ “Swivelling the drill-mill head“ on page 33 completely by 90° to the right. ➜ Check if the clamping screws are firmly tightened as described under ☞ “Swivelling the drill-mill head“ on page 33 and that the drill-mill head can not independently tilt. ➜ Disassemble the cover plate at the rear. ➜ Grease the toothed wheels. ☞ “Operating material“ on page 17  Fig. 5-5: Rear
Every six months	Spindle and spindle nut Z-axis	Greasing	➜ Open the plug. ➜ Crank the milling head into the suitable height. ➜ Oil or grease the spindle nut and spindle.  Fig. 5-6: Column

INFORMATION!

The spindle bearing arrangement is continuously lubricated. It is not required to relubricate it.

5.3 Repair

For any repair work, get assistance from an employee of the company Optimum Maschinen Germany GmbH's technical service or send us the drilling-milling machine.

If the repairs are carried out by qualified technical staff, they have to follow the indications given in this manual.

The company Optimum Maschinen Germany GmbH does not take responsibility nor does it guarantee against damage and operating anomalies resulting from failure to observe this operating manual.

For repairs only use

- faultless and suitable tools,
- original spare parts or serial expressly authorised by the company Optimum Maschinen Germany GmbH.

5.4 Setting instructions control

Please find below a description to set the operating parameters, if required after replacement of the control and of the motor.

Vmax

This is the potentiometer to set the maximum possible speed of the motor.

The speed of 3000 min^{-1} must not be exceeded since the spindle bearings and your tools might get damaged.

Vmin

This is the potentiometer to set the minimum possible speed of the motor. Make sure that the speed does not fall below 50 min^{-1}.

With reduced speed also the torque (power of the motor) and the cooling will reduce!

Torque

This is the potentiometer to set the torque when readjusting the motor. Depending on the application set the value by which the the control will readjust. If you require less readjustment, turn the potentiometer one to two turns in direction "minus". For a larger readjustment, turn the potentiometer in direction "plus". For thread cutting we recommend little torque.

Slope

This is the potentiometer to set the acceleration time of the motor at the moment when it starts turning. If you require a smoother ramp, turn the potentiometer in direction "plus". In order to achieve a steeper ramp, turn the potentiometer in direction "minus".

CL

This is the potentiometer to set the current limiting as an overload protection for the motor. The current limiting is set by the manufacturer and must not be changed in any way.

General information

The control is charged with high constant-voltage currencies. Please make imperatively sure that the housing will only be opened up in the idle status. Furthermore, make sure that any settings are only being performed when the housing is closed.

The spindle trimmers of the potentiometer are designed with 12 gears. This means in order to achieve the corresponding minimum or maximum value, the spindle trimmer needs to be turned 12 times. Due to this high number of gears of the spindle trimmer it is possible to perform a very sensitive setting over the corresponding potentiometer.

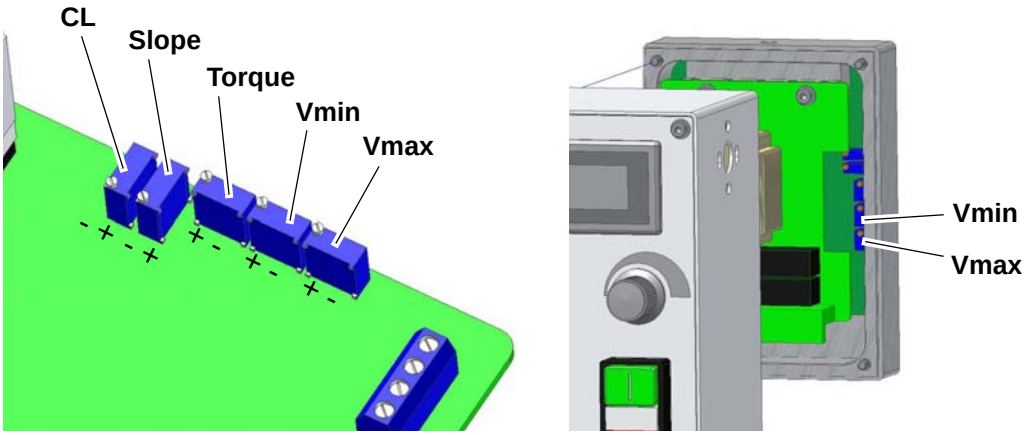


Fig. 5-7: Control board 0320297

6 Ersatzteile - Spare parts

6.1 Kreuztisch - Cross table

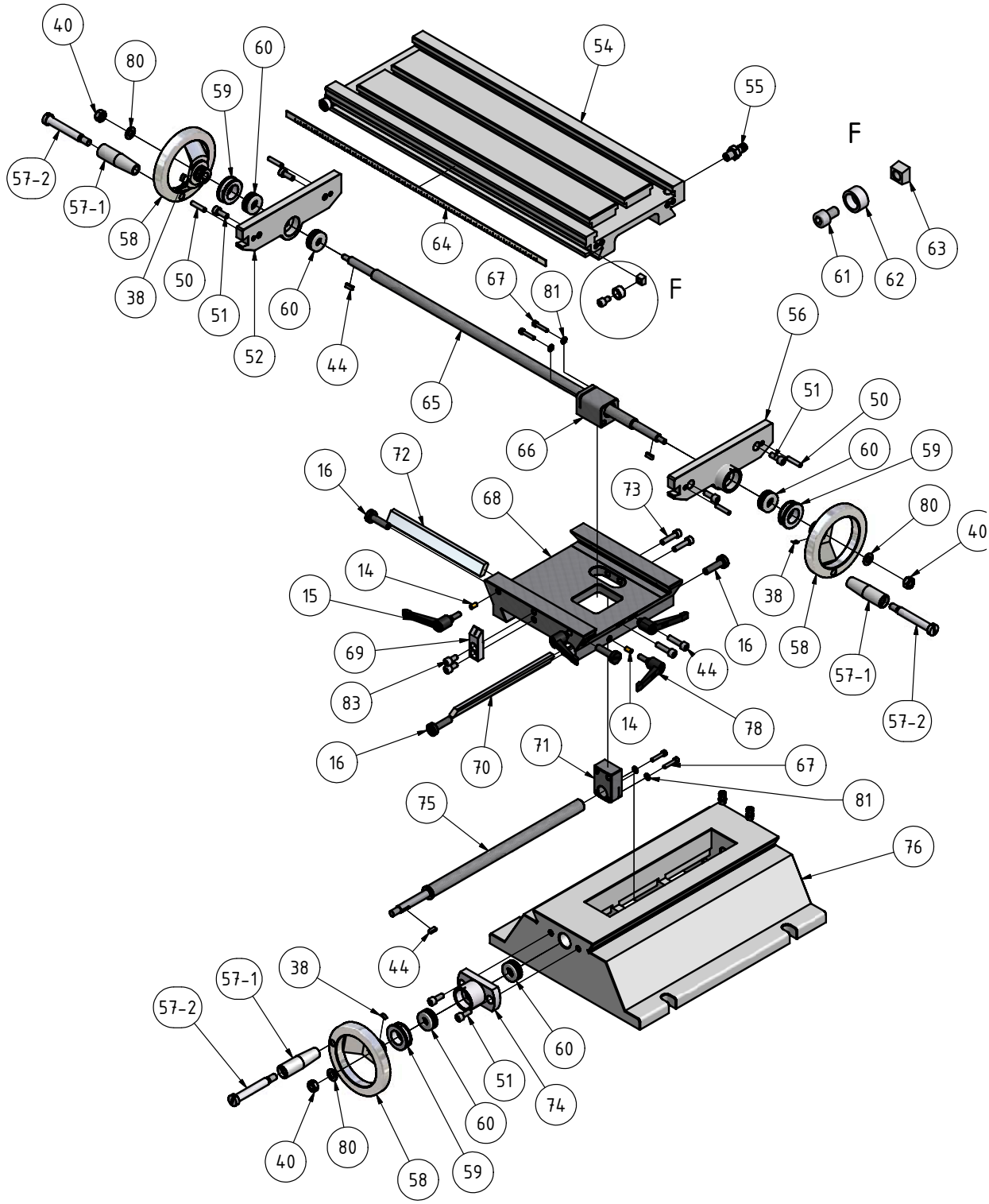


Abb. 6-1: Kreuztisch - Cross table

6.2 Säule 1 von 2 - Column 1 of 2

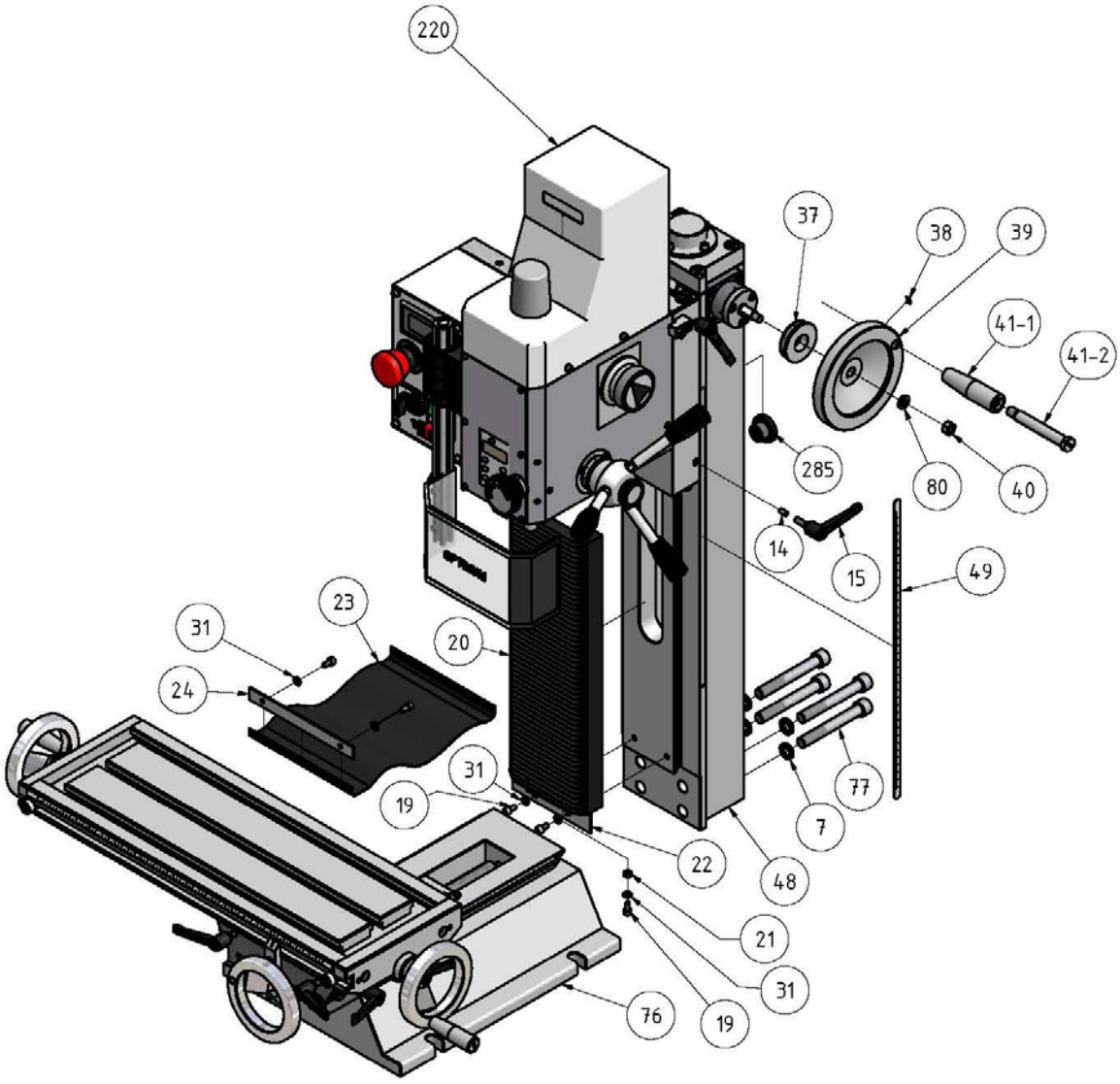


Abb.6-2: Säule 1 von 2 - Column 1 of 2

6.3 Säule 2 von 2 - Column 2 of 2

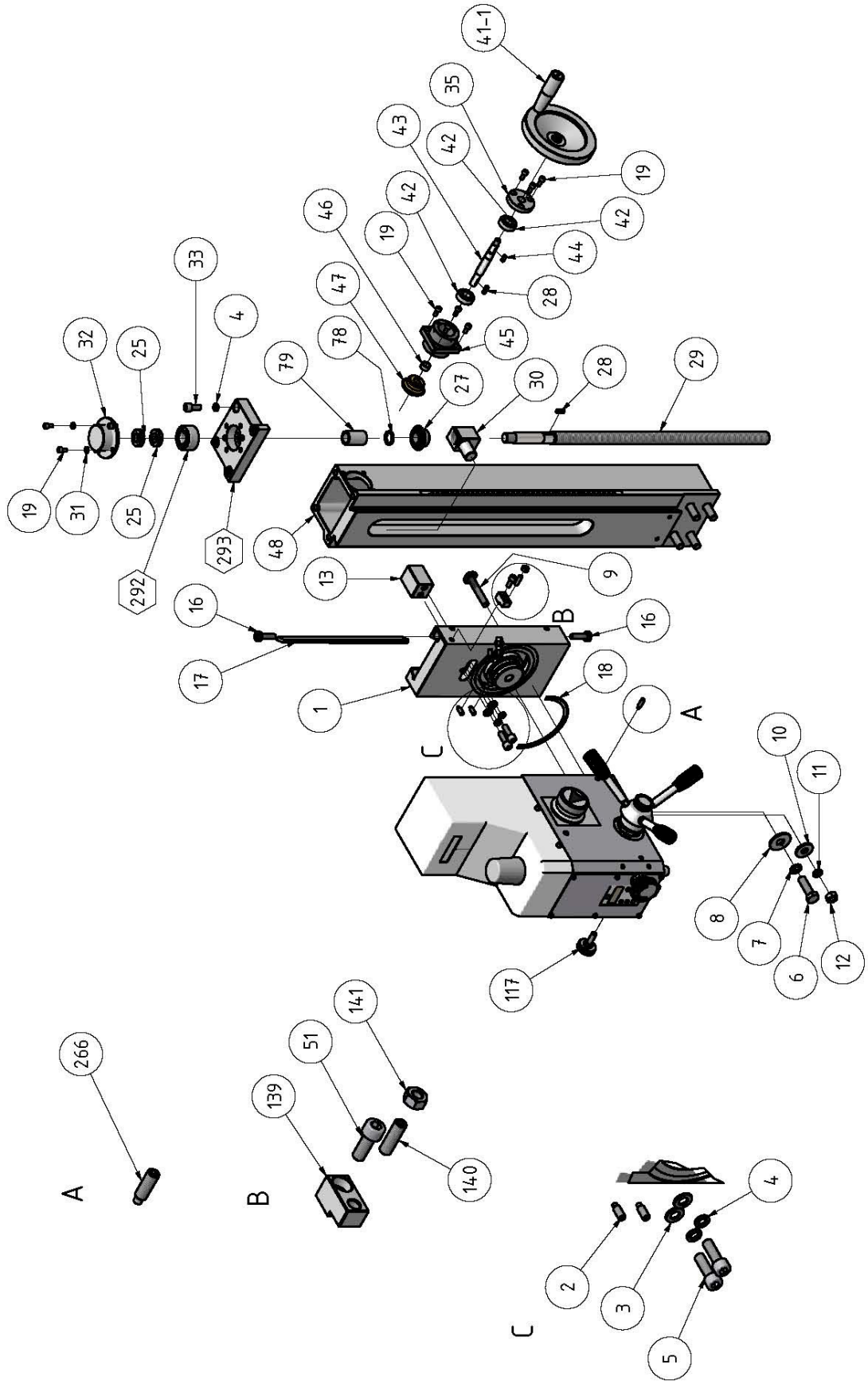


Abb. 6-3: Säule 2 von 2 - Column 2 of 2

6.4 Fräskopf 1 von 2 - Milling head 1 of 2

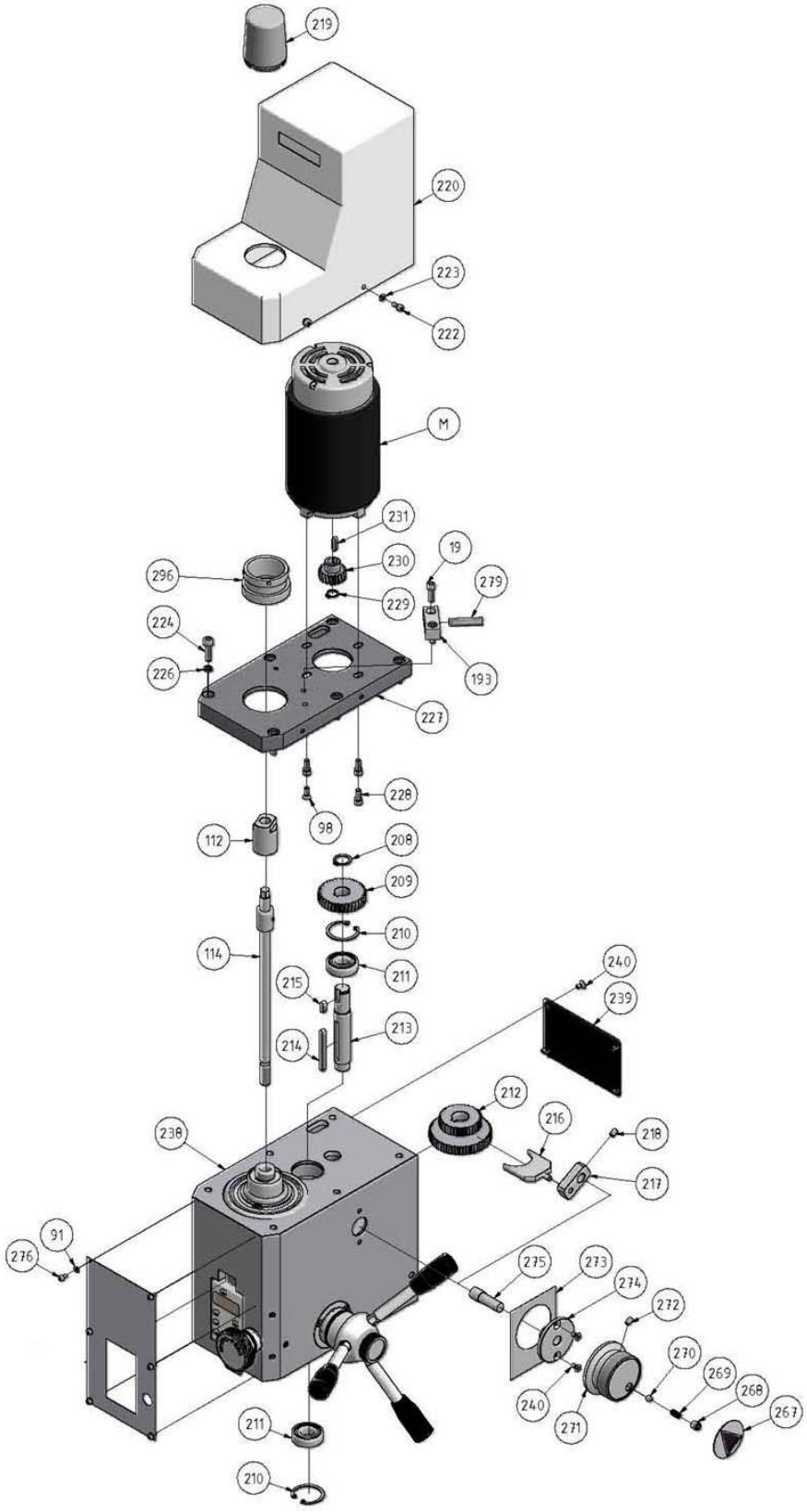


Abb. 6-4: Fräskopf 1 von 2 - Milling head 1 of 2

6.5 Fräskopf 2 von 2 - Milling head 2 of 2

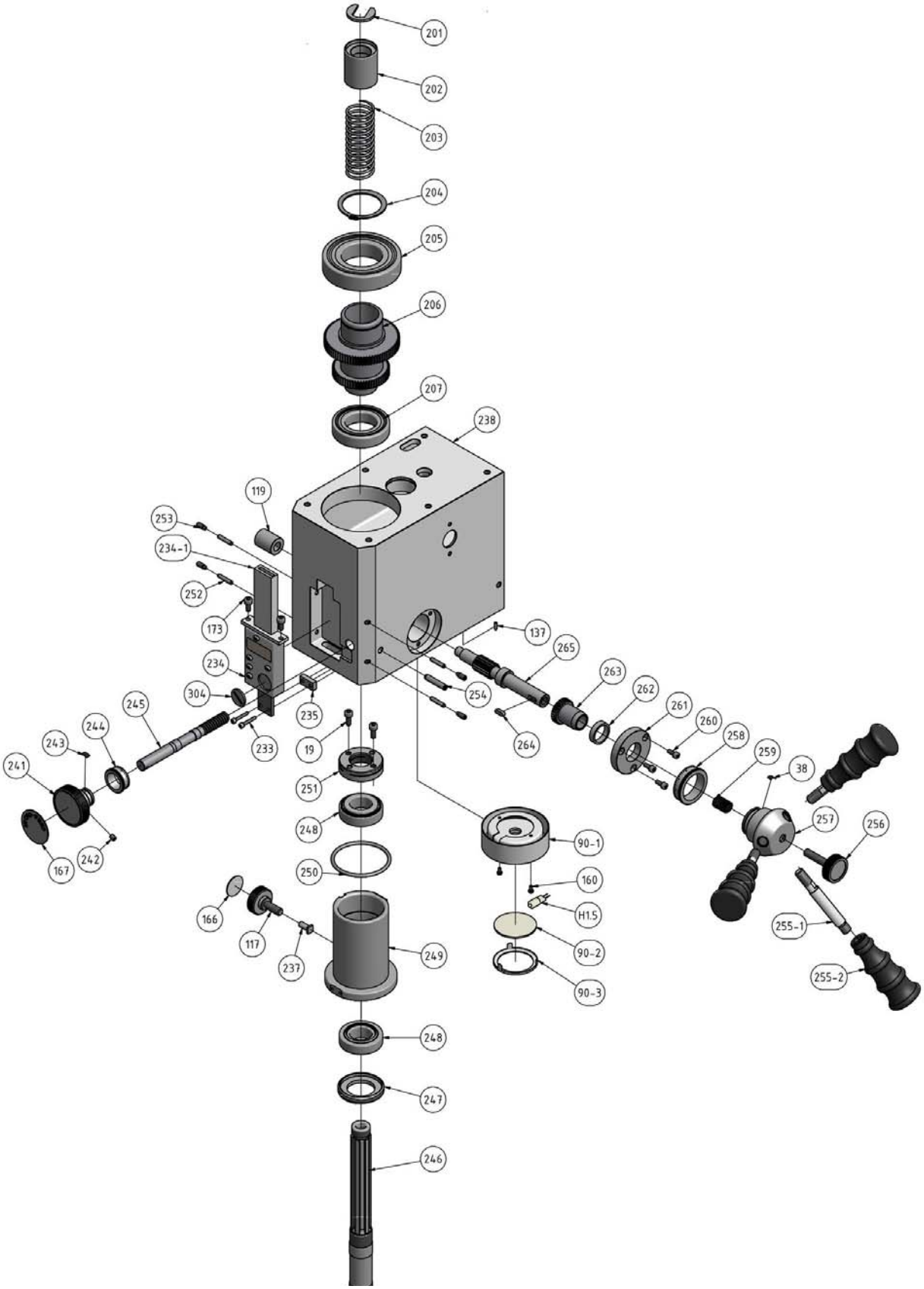


Abb. 6-5: Fräskopf 2 von 2 - Milling head 2 of 2

6.6 Bedienkonsole /Schutzeinrichtung - Operation panel/ protection device

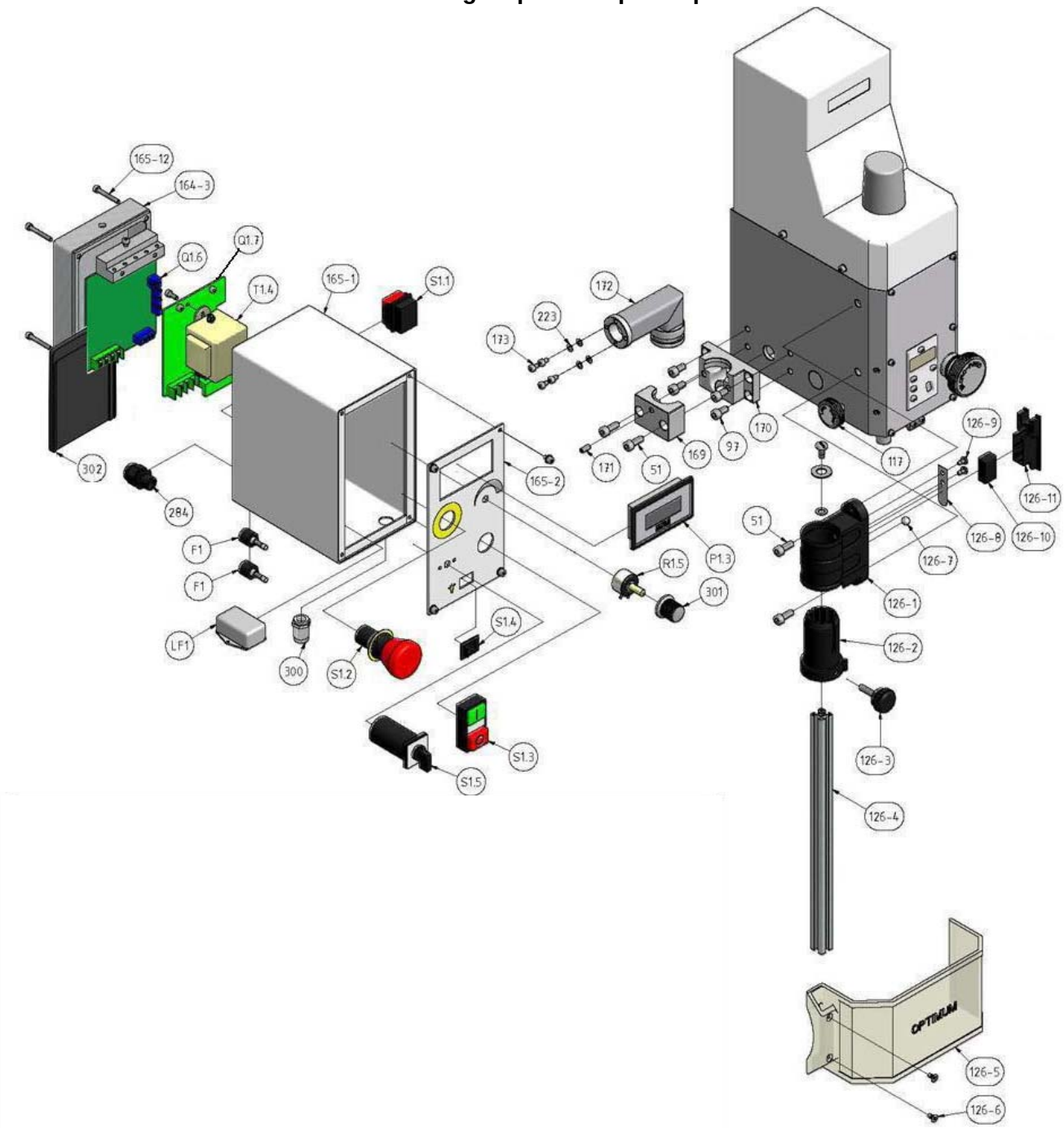


Abb.6-6: Panel und Schutzeinrichtung - Operation panel and protection device

6.7 Schaltplan - Wiring diagram

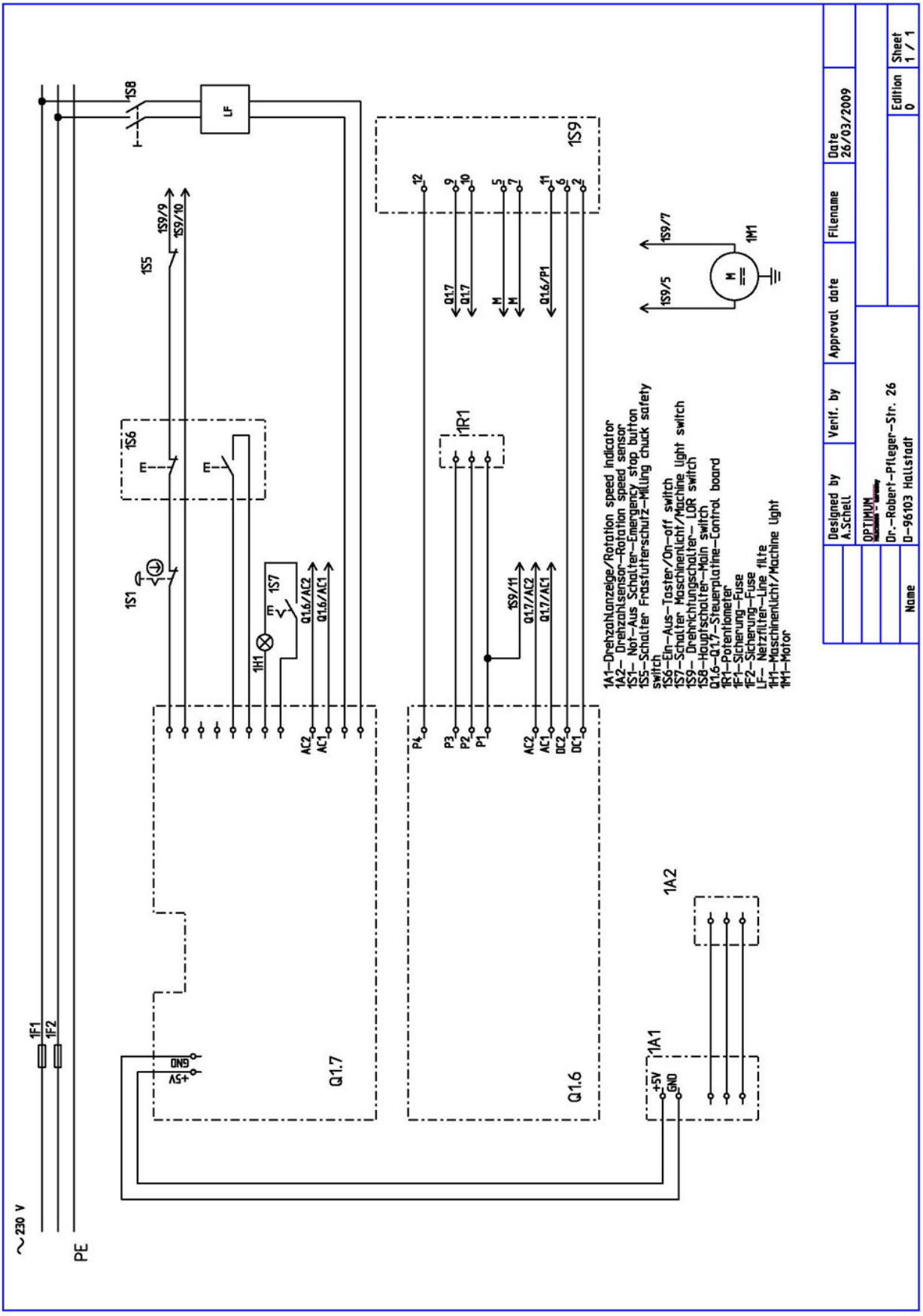


Abb.6-7: Schaltplan-Wiring diagram

6.7.1 Ersatzteilliste - Spare part list

Pos.	Bezeichnung	Designation	Menge Qty.	Artikel-nummer Item no.
1	Drehlagerbock Fräskopf	Connect board	1	0333813001
2	Gewindestift	Socket head set screw	2	
4	Federring	Spring washer	6	
5	Innensechskantschraube	Hexagon head cap screw	2	
6	Sechskantschraube	Hexagon head screw	1	
7	Federring	Spring washer	5	
8	Unterlegscheibe	Washer	1	0333813008
9	Schraube	Screw	1	0333813009
10	Unterlegscheibe	Washer	1	0333813010
11	Federring	Spring washer	1	
12	Sechskantmutter	Hexagon nut	1	
13	Führungsstück	Connect collar	1	0333813013
14	Messingstift	Brass pin	6	0333813014
15	Klemmhebel	Adjust locating handle	4	0333813015
16	Schraube Keilleiste	Gib screw	6	0333813016
17	Keilleiste Z-Achse	Taper gib z axis	1	0333813017
18	Winkelskala	Angle plate	1	0333813018
19	Innensechskantschraube	Hexagon head cap screw	20	
20	Faltenbalg	Bellows	1	0333813020
21	Mutter	Hexagon nut	2	
22	Halterung Faltenbalg	Bellows bracket	1	0333813022
23	Gummi - Späneabdeckung	Rubber splash guard	1	0333813023
24	Leiste	Plate	1	0333813024
25	Nutmutter	Groove nut	2	0333813025
26	Axiallager	Axially grooved ball bearing	1	04051203
27	Kegelzahnrad	Taper gear	1	0333813027
28	Paßfeder	Key	3	0333813028
29	Spindel Z-Achse	Lift lead screw	1	0333813029
30	Spindelmutter Z-Achse	Lift lead screw nut	1	0333813030
31	Scheibe	Washer	8	
32	Abdeckkappe	Nut collar	1	0333813032
33	Innensechskantschraube	Hexagon head cap screw	4	
34	Abdeckplatte Säule	Column cover	1	0320218
35	Lagerabdeckung	Bearing cover	1	0333813035
37	Skalenring Z-Achse	Lift dial z axis	1	0333813037
38	Federstück	Spring piece	4	0333813038
39	Handrad Z Achse	Handwheel z axis	1	0333813039
40	Sechskantmutter	Hexagon nut	4	
41	Griff komplett	Handle complete	1	0333813041
41-1	Griffhülse	Handle sleeve	1	0333813041-1
41-2	Schraube	Screw	1	0333813041-2
42	Rillenkugellager einreihig	Grooved ball bearing single-row	2	0406001.2R
43	Welle Handrad Z Achse	Lift shaft z axis	1	0333813043
44	Paßfeder	Key	5	0333813044
45	Lagerbock	Lift bearing base	1	0333813045
46	Buchse	Collar	1	0333813046
47	Kegelzahnrad	Taper gear	1	0333813047
48	Säule	Column	1	0333813048
49	Skala Z-Achse	Lift plate	1	0333813049
50	Zylinderstift	Cylindrical pin	4	
51	Innensechskantschraube	Hexagon head cap screw	11	
52	Lagerbock Kreuztisch links X-Achse	Table dial support x axis left	1	0320232
54	Frästisch	Cross table	1	0333813054
54	Frästisch	Cross table	1	0333812254
55	Eiinschraubverschraubung Schlauchanschluss	Screwing in screw connection hose connector	1	0333813055
56	Lagerbock Kreuztisch rechts X-Achse	Table dial support x axis	1	0320235
57	Griff komplett	Handle complete	3	0333813057
57-1	Griffhülse	Handle sleeve	3	0333813057-1
57-2	Schraube	Screw	3	0333813057-2
58	Handrad Kreuztisch	Handwheel cross table	3	0333813058
59	Skalenring	Dial	3	0333813059
60	Axiallager	Axially grooved ball bearing	5	04051200
61	Innensechskantschraube	Hexagon head cap screw	2	
62	Hülse Endlagenanschlag X-Achse	Stopper x axis	2	0333813062
63	Rechteckmutter (Nutenstein)	Wedgy nut	2	0333813063

Pos.	Bezeichnung	Designation	Menge Qty.	Artikel-nummer Item no.
64	Skala X-Achse MH 28 V	Table plate x axisMH 28 V	1	0333813064
65	Spindel X-Achse MH 28 V	Table lead screw x axis MH 28 V	1	0333813065
66	Spindelmutter X-Achse	Table lead screw nut x axis	1	0333813066
67	Innensechskantschraube	Hexagon head cap screw	4	
68	Kreuztischführung	Saddle	1	0333813068
69	Anschlag Endlage X-Achse	Limit plate x axis	1	0333813069
70	Keilleiste Y-Achse	Taper gib y axis	1	0333813070
71	Spindelmutter Y-Achse	Lead screw nut y axis	1	0333813071
72	Keilleiste X-Achse	Taper gib x axis	1	0333813072
73	Innensechskantschraube	Hexagon head cap screw	2	
74	Lagerbock	Saddle dial support	1	0320249
75	Spindel Y-Achse	Lead screw y axis	1	0333813075
76	Maschinenfuss	Base	1	0333813076
77	Innensechskantschraube	Hexagon head cap screw	4	
78	Klemmhebel	Clamping lever	4	0333813078
78	Distanzring für Spindel Z-Achse	Spacer ring for spindle z axis	1	0333813078
79	Hülse für Z-Achse	Case for z axis	1	0333813079
80	Scheibe	Washer	6	
81	Scheibe	Washer	2	
83	Innensechskantschraube	Hexagon head cap screw	6	
90	Maschinenleuchte komplett	Machine lightning complete	1	0333813090
90-1	Gehäuse Maschinenleuchte	Housing machine lightning	1	0333813090-1
90-2	Schutzglas	Protection glas	1	0333813090-2
90-3	Deckel Maschinenleuchte	Cover machine lightning	1	0333813090-3
H 1.5	Halogen-Stiftsockellampe 12V , 10 W, Sockel G4	Halogen lamp 12V , 10 W, Sockel G4	1	03338130H15
91	Scheibe		6	
98	Senkschraube mit Kreuzschlitz	Countersunk screw	1	
112	Gegenhalter Anzugsstange	Holder screw rod	1	03338130112
114	Anzugsstange	Screw rod	1	03338130114
117	Klemmschraube Pinole	Clamping screw collar	1	03338130117
119	Verschlußstück	Endplate	1	03338130119
126	Schutzeinrichtung komplett	Protection device complete	1	03338130126
126-1	Gehäuse	Housing	1	03338130126-1
126-2	Aluminium Profilaufnahme	Aluminium profile admission	1	03338130126-2
126-3	Klemmschraube	Clamping scew	1	03338130126-3
126-4	Aluminiumprofil	Aluminium profile	1	03338130126-4
126-5	Schutz	Protection	1	03338130126-5
126-6	Schraube	Screw	2	03338130126-6
126-7	Stahlkugel	Steel ball	1	03338130126-7
126-8	Federblech	Spring plate	1	03338130126-8
126-9	Schraube	Screw	2	03338130126-9
126-10	Mikroschalter Spindelschutz	Micro switch spindle protection	1	03338130126-10
126-11	Deckel	Cover	1	03338130126-11
127	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	1	03338130127
137	Zeiger Winkelskala	Scale-pin	1	03338130137
139	Anschlagstück	Stopper	1	03338130139
140	Innensechskant-Gewindestift mit flachem Ende	Hexagon head cap thread pin screw with flat end	1	
141	Sechskantmutter	Hexagon nut	1	
160	Flachkopfschraube mit Kreuzschlitz	Cheese head screw	2	
164-3	Gehäuse Steuerung	Housing control boards	1	03338130164-3
165-1	Panel Gehäuse	Panel housing	1	03338130165-1
165-2	Blende	Cover	1	03338130165-2
165-3	Blende	Cover	1	03338130165-3
165-12	Innensechskantschraube	Innensechskantschraube	4	
166	Label lösen / spannen	Label loose / tighten	1	03338130166
167	Label Feinvorschub	Label Micro feed	1	03338130167
168	Morsekonus MK2 - B16	Morse taper MK2 - B16	1	03338130168
169	Halterung Panel	Mounting plate panel	1	03338130169
170	Halterung Panel	Mounting plate panel	1	03338130170
171	Innensechskant-Gewindestift mit Ringschneide	Innensechskant-Gewindestift with cup point	1	03338130171
172	Haltearm Panel	Holding arm panel	1	03338130172
173	Innensechskantschraube	Hexagon head cap screw	4	
201	Positionsscheibe	Position washer	1	03338130201
202	Buchse	Spring sleeve	1	03338130202

Pos.	Bezeichnung	Designation	Menge Qty.	Artikel-nummer Item no.
203	Druckfeder	Spring	1	03338130203
204	Sicherungsring	Retainer ring	1	03338130204
205	Rillenkugellager	Grooved ball bearing	1	0406209.2R
206	Zahnradkombination	Gear combination	1	03338130206
207	Rillenkugellager	Grooved ball bearing	1	0406007.2R
208	Sicherungsring	Retainer ring	1	03338130208
209	Zahnrad schrägverzahnt	Gear diagonally-toothed	1	03338130209
210	Sicherungsring	Retainer ring	2	03338130210
211	Rillenkugellager	Grooved ball bearing	2	0406002.2R
212	Zahnradkombination	Gear combination	1	03338130212
213	Zwischenwelle	Intermediate shaft	1	03338130213
214	Paßfeder	Key	1	03338130214
215	Paßfeder	Key	1	03338130215
216	Schaltgabel	Fork	1	03338130216
217	Arm Schaltgabel	Fork arm	1	03338130217
219	Abdeckkappe Anzugsstange	Cover	1	03338130219
220	Motorhaube	Motor cover	1	03338130220
222	Innensechskantschraube	Hexagon head cap screw	4	
223	Scheibe	Washer	8	
224	Innensechskantschraube	Hexagon head cap screw	6	
226	Federring	Spring washer	6	
227	Fräskopf Gehäusedeckel	Fixed cover	1	03338130227
229	Sicherungsring	Retainer ring	1	
230	Zahnrad schrägverzahnt	Gear diagonally-toothed	1	03338130230
233	Innensechskantschraube	Hexagon head cap screw	2	
234	Digitalanzeige	Digital slide guage	1	03338130234
234-1	Schutzabdeckung	Prodective cover	1	03338130235
235	Linealbefestigung Digitalanzeige	Base for ruler digital display	1	03338130237
237	Klemm- und Führungsstift	Clamping and guide pin	1	03338130238
238	Gehäuse Fräskopf	Housing milling head	1	03338130239
239	Abdeckung	Cover	1	
240	Senkschraube mit Kreuzschlitz	Countersunk screw	6	
241	Drehknopf Feinzustellung	Micro feed knob	1	03338130241
242	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	1	
243	Federstück	Spring piece	1	03338130243
244	Skalenring Feinzustellung	Micro feed dial	1	03338130244
245	Schneckenwelle	Worm shaft	1	03338130245
246	Spindel	Spindle	1	03338130246
247	Spindelmutter	Nut	1	03338130247
248	Kegelrollenlager einreihig	Taper roller bearing single-row	2	04032005
249	Pinole	Collar	1	03338130249
250	O-Ring	O-ring	1	03338130250
251	Klemmmutter	Clamp nut	1	03338130251
252	Zylinderstift	Cylindrical pin	4	
253	Gewindestift geschlitzt mit langem Zapfen	Thread pin slit with long tap	4	
254	Zylinderstift	Cylindrical pin	1	
255	Griffhebel komplett	Handle complete	3	03338130255
255-1	Gewindestange	Threaded rod	3	03338130255-1
255-2	Griff	Handle	3	03338130255-2
256	Griffschraube	Locking knob	1	03338130256
257	Nabe Sterngriff Pinolenvorschub	Feed handle disc	1	03338130257
258	Skalenring Sterngriff	Feed dial	1	03338130258
259	Feder	Compression spring	1	03338130259
260	Innensechskantschraube	Hexagon head cap screw	3	
261	Abdeckscheibe	Cover	1	03338130261
262	Klemmring	Adjust collar	1	03338130262
263	Kupplung mit Verzahnung	Clutch with gear	1	03338130263
264	Passfeder	Key	1	03338130264
265	Verzahnte Welle	Toothed shaft	1	03338130265
266	Gewindestift geschlitzt mit langem Zapfen	Thread pin slit with long tap	1	
267	Indikator	Plate	1	03338130267
268	Innensechskant-Gewindestift mit flachem Ende	Hexagon head cap thread pin screw with flat end	1	
269	Feder	Compression Spring	1	03338130269
270	Stahlkugel	Steel ball	1	03338130270

Pos.	Bezeichnung	Designation	Menge Qty.	Artikel-nummer Item no.
271	WahldrehschalterGetriebe	Locating knob	1	03338130271
272	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	2	
273	Drehzahllabel	Shifting plate	1	03338130273
274	Aufnahmescheibe	Locating base	1	03338130274
275	Schaltwelle	Shifting shaft	1	03338130275
276	Innensechskantschraube	Hexagon head cap srew	6	
277	Winkel Messfuehler	Angle sensor	1	03338130277
278	Innensechskantschraube	Hexagon head cap screw	2	
279	Drehzahlsensor	Sensor, number of revolutions	1	03338130279
280	Optionaler Unterbau	Optional sub structure	1	03338130280
281	Optionale Wanne Unterbau	Optional pan sub structure	1	03338130281
282	Scheibe	Washer	4	
283	Sechskantschraube	Hexagon head screw	4	
284	Zugentlastung Ansclusskabel	Strain relief connection cable	1	03338130284
285	Schmierverschluß	Lubrication catch	1	03338130285
286	Lagerbock Kreuztisch links X-Achse	Table dial support x axis left	2	03338130286
287	Rillenkugellager, einreihig	Grooved ball bearing, single-row	1	0406000.2R
288	Sicherungsring	Snap ring	1	03338130288
289	Distanzhülse	Distance case	1	03338130289
290	Distanzhülse	Distance case	1	03338130290
291	Lagerbock Kreuztisch rechts X-Achse	Table dial support x axis	1	03338130291
292	Schrägkugellager, zweireihig	Skew-angle roller bearing, double-row	1	0403203
293	Abdeckplatte Säule	Column cover	1	03338130293
294	Schrägkugellager, zweireihig	Skew-angle roller bearing, double-row	2	0403200
295	Lagerbock	Saddle dial support	1	03338130295
296	Sensorring	Sensor ring	1	03338130296
299	Distanzhülse	Distance case	1	03338130299
300	Start- Stop Verbindung für CNC Con-roller	Start- Stop connection for CNC cont-roller	1	03338130300
301	Drehknopf	Knob	1	03338130301
302	Kunststoffplatte	Plastic plate	1	03338130302
S1.1	Hauptschalter	Main switch	1	03338130S1.1
S1.2	NOT-AUS-Schlagschalter	Emergency push button	1	03338130S1.2
S1.3	Ein - Aus Drucktaster	On- Off push button	1	03338130S1.3
S1.4	Ein - Aus Schalter Halogenlampe	On- Off switch halogen lamp	1	03338130S14
S1.5	Drehrichtungsschalter ZH-A	Change over switch ZH-A	1	03338130996
S1.6	Mikroschalter Spindelschutz	Micro switch spindle protection	1	0333813012610
R1.5	Potentiometer 4,7 KΩ	Potentiometer 4,7 KΩ	1	0320298
T1.4	Transformator 230V / 12V	Transformer 230V / 12V	1	03338130T1.4
P1.3	Digitale Drehzahlanzeige	Digital speed indicator	1	03338130P1.3
Q 1.6	Steuerkarte	Control board	1	0320297
Q1.7	Relaiskarte	Relay board	1	03338130Q1.7
T1.4	Transformator 230V / 12V , alter Typ	Transformer 230V / 12V , old type	1	0340292
H 1.5	Halogen-Stiftsockellampe 12V , 10 W, Sockel G4	Halogen lamp 12V , 10 W, Sockel G4	1	03338130H15
M	Motor	Motor	1	03338130221
M - 1	Motorkohle / carbon brush motor	Carbon brush motor	2	03338130994
X1	Schutzkontaktstecker	Cable	1	03338130998
F1/ F1.2	Sicherung	Fuse	2	03338130F1
LF1	Netzfilter	Line filter	1	03338130LF1
LF2	Netzfilter	Line filter	1	03338130LF2

7 Malfunctions

7.1 Malfunctions on the drilling-milling machine

Malfunction	Cause/ possible consequences	Solution
The drilling-milling machine does not start	• Start sequence not followed.	• ☞ “Switching on the drilling-milling machine“ on page 26 • Have it checked by authorised staff.
Tool "burnt“.	• Incorrect speed. • The chips have not been removed from the bore hole. • Tool blunt. • Operating without cooling agent.	• Select another speed, feed too high. • Retract tool more often • Sharpen and replace tool. • Use coolant.
Impossible to insert holding taper into the spindle sleeve.	• Remove any dirt, grease or oil from the internal conical surface of the spindle sleeve or the holding taper.	• Clean surfaces well. Keep surfaces free of grease.
Taper cannot be squeezed out	• Optional MT3 taper seat shrinked on morse cone.	• Have the machine heat-up at highest speed for about two minutes and then try again to disassemble the taper.
Motor does not start	• Defective fuse	• Have it checked by authorised staff.
Working spindle rattling on rough workpiece surface	• Climb milling machining not possible under the current operating conditions. • Clamping lever of the movement axes not tightened. • Loose collet chuck, loose drill chuck, loose draw-in rod. • Tool blunt. • Workpiece is not fixed. • Excessive slack in bearing. • Working spindle goes up and down.	• Perform conventional milling. • Tighten clamping lever • Check, retighten. • Sharpen or replace tool • Secure the workpiece properly. • Readjust bearing slack or replace bearing. • Readjust bearing slack or replace bearing.
Fine feed of spindle sleeve does not work	• Fine feed is not correctly activated • Clutch of the fine feed does not engage, is dirty, smeared, worn or 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
Cross table	Bearing surface, clamping surface for the workpiece with X- and Y-direction
Taper mandrel	Taper of the tool holding, taper of the bit or the drill chuck.
Workpiece	Piece to be milled, drilled or machined.
Draw-in rod	Threaded bar for fastening the taper mandrel in the spindle sleeve.
Drill chuck	Device for holding the bit
Collet chuck	Holding fixture for end mill cutters
Drill-mill head	Upper part of the drilling-milling machine
Spindle sleeve	Hollow shaft in which the milling spindle turns.
Milling spindle	Shaft activated by the motor
Drilling table	Bearing surface, clamping surface
Taper mandrel	Cone of the bit or drill chuck
Spindle sleeve lever	Manual control to advance the bit
Quick-action drill chuck	Bit holding fixture can be tightened manually.
Workpiece	Piece to be drilled or machined.
Tool	Milling cutter, drill bit, countersink, etc.

8.3 Liability claims for defects / warranty

Beside 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 had been promised in the frame of a single contractual agreement.

- The processing of the liability claims or of the warranty is performed as chosen by OPTIMUM GmbH 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. The property of replaced products or components passes on to OPTIMUM 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 of 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
  - Any defects arising by one's own fault due to faulty operations or if the operating manual is disregarded
  - Inattentive or incorrect handling and use of improper equipment
  - Non-authorized 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 as well not subject to the 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 fulfill in the frame of an additional guarantee are neither an acceptance of the defects nor an acceptance of its obligation to compensate. Such services do neither delay nor interrupt the warranty period.
- Place of jurisdiction among traders is Bamberg.
- If one of the above mentioned agreements is totally or partially inefficient and/or null, it is considered as agreed what is closest to the will of the warrantor and which remains in the framework of the limits of liability and warranty which are predefined by this contract.

8.4 Note regarding disposal / options to reuse:

Please dispose of your device environmentally friendly by disposing of scrap in a professional way.

Please neither throw away the packaging nor the used machine later on, but dispose of them according to the guidelines established by your city council/municipality or by the corresponding waste management enterprise.

8.4.1 Decommissioning

CAUTION

Used devices need to be decommissioned in a professional way in order to avoid later misuses and endangerment of the environment or persons

- Pull off the mains plug.
- Disconnect the connection cable.
- Remove all environmentally hazardous operating fluids from the used device.
- If applicable remove batteries and accumulators.
- Disassemble the machine if required into easy-to-handle and reusable assemblies and component parts.
- Supply the machine components and operating fluids to the provided disposal routes.

8.4.2 Disposal of the packaging of new devices

All used packaging materials and packaging aids of 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 forwarded to a collection station or to the appropriate waste management enterprise.

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

8.4.3 Disposing of the old device

INFORMATION

Please make sure in your own interest and in the interest of the environment that all component parts of the machine will be disposed of in the provided and admitted ways.

Please note that the electrical devices include lots of reusable materials as well as environmentally hazardous components. Account for separate and professional disposal of the component parts. 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.

8.4.4 Disposal of electrical and electronic components

Please make sure that electrical components are disposed of in a professional way according to the legal requirements.

The device includes electric and electronic components and must not be disposed of with the rubbish. According to the European directive 2002/96/EG regarding electrical and electronic used devices and the execution of national rights used electrical tools and electrical machines need to be collected separately and be supplied to an environmentally compatible reuse.

Being the machine operator you should obtain information regarding the authorized collection or disposal system which applies for your company.

Please make sure that the batteries and/or accumulators are disposed of in a professional way according to the legal regulations. Please only throw discharged batteries in the collection boxes in shops or at municipal waste management companies.

8.4.5 Disposal of lubricants and coolants

ATTENTION

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

INFORMATION

Used coolant emulsions and oils should not be mixed up since it is only possible to reuse used oils which had not been mixed up without pre-treatment.

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

8.5 Disposal

Disposal of used electric and electronic machines
(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 handles as common household waist, but that is needs to be delivered to a central collection point for recycling. Your contribution to the correct disposal of this product will protect the environment and the health of your fellow men. The environment and the health are endangered by incorrect disposal. Recycling of material will help to reduce the consumption of raw materials. Your District Office, the municipal waste collection station or the shop where you have bought the product will inform you about the recycling of this product.

8.6 RoHS , 2002/95/CE

The sign on the product or on its packing indicates that this product complies with the European guideline 2002/95/EC .

8.7 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
- Experiences with the drilling-milling machine, which could be important to other users
- Recurring failures

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

D-96103 Hallstadt

Fax +49 (0) 951 - 96 555 - 888
E-Mail: info@optimum-maschinen.de

8.8 EC - Declaration of Conformity

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

hereby declares that the following product,

Type of machine:	BF20 Vario; BF20 L Vario
Designation of the machine:	Drilling-Milling machine
Serial number:	J __ __ __ __
Year of manufacture:	20__

all relevant provisions of the **Machinery Directive (2006/42/EC)** corresponds.

The machnine continues to comply with all provisions of the **Directives Electrical equipment (2006/95/EC)** and **electromagnetic compatibility (2004/108/EC)**.

The following harmonized standards were applied:

DIN EN 12100-1:2003/ A1:2009	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
DIN EN 12100-2:2003/ A1:2009	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
DIN EN 60204-1	Safety of machinery - Electrical equipment of machines - General requirements
DIN EN 55011 class A 2003-08	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

The following technical standards were applied:

EN 13128: 2001	Safety of machine tools: Milling and drilling machines

Responsible for documentation: Kilian Stürmer, Tel.: +49 (0) 951 96822-0

Address:	Dr.-Robert-Pfleger-Str. 26 D - 96103 Hallstadt

Kilian Stürmer
(Manager)

Hallstadt, 01.03.2012

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