OPTIMUM
MASCHINEN - GERMANY

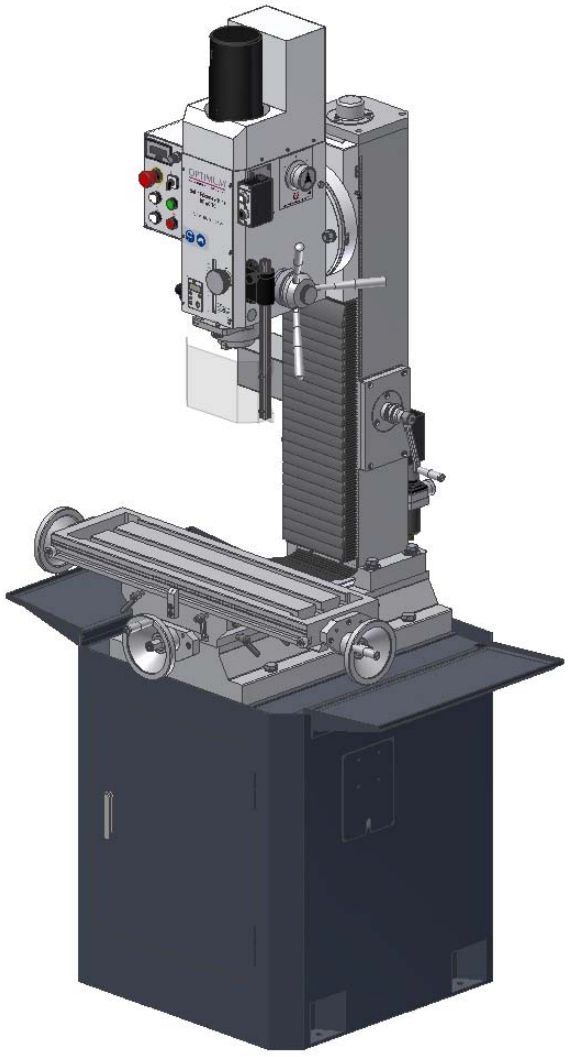
Operating manual

Version 1.1.3

Drilling-milling machine

○ OPTImill® BF 46Vario

○ OPTImill® BF 46TC



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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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D-96103 Hallstadt

Mail: info@optimum-maschinen.de

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1 Safety

Glossary of symbols

☞	gives further advice
➜	calls on you to act
❍	enumerations

This part of the operating instructions

- ❍ explains the meaning and use of the warning notices 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 legal regulations for accident prevention,
- ❍ the prohibition, warning and mandatory signs as well as the warning labels on the milling-machine.

When installing, operating, maintaining and repairing the milling machine it is necessary to observe the European standards.

With regard to relevant national legislation which has not yet been adjusted to the European standards, the applicable national legislation needs to be observed.

If required it is necessary to take the corresponding measures to comply with the country-specific regulations before commissioning the milling-machine.

Always keep this documentation close to the milling-machine.

INFORMATION

If you are unable to solve a problem using these operating instructions, please contact us for advice:

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

D-96103 Hallstadt

Email: info@optimum-maschinen.de

1.1 Safety instructions (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 (ideogram) and the warning signs for each specific danger and its (possible) consequences.

Ideogram	Warning alert	Definition / consequence
	**DANGER!**	Threatening danger that will cause serious injury or death to people.
	WARNING!	A danger that might cause severe injury to the staff or can lead to death.
	CAUTION!	Danger or unsafe procedure that might cause injury to people or damage to property.

Ideogram	Warning alert	Definition / consequence
	**ATTENTION!**	Situation that could cause damage to the milling machine and products and other types of damage. No risk of injury to people.
	**INFORMATION**	Application tips and other important or useful information and notes. No dangerous or harmful consequences for people or objects.

In case of specific dangers, we replace the pictogram by


general danger


by a warning of


injury of hands,


hazardous electrical voltage,

or


rotating parts.

1.1.2 Other pictograms


Warning of danger of slipping!


Warning risk of stumbling!


Warning hot surface!


Warning biological hazard!


Warning of automatic start-up!


Warning tilting danger!


Warning of suspended loads!


Caution, danger of explosive substances!


Activation forbidden!


Read the operating instructions before commissioning!


Disconnect the mains plug!

Use protective glasses!	Use protective gloves!	Use protective boots!	Use protective suit!
			
Use ear protection!	Only switch in standstill!	Protect the environment!	Contact address

1.2 Intended use

WARNING!

In the event of improper use, 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 drilling-milling 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 expressly point out that the guarantee or CE conformity will expire due to any constructive technical or procedural changes which had not been performed by the company Optimum Maschinen Germany GmbH. It is also part of intended use that

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

☞ "Technical data“ on page 17

WARNING!

Heaviest injuries through improper use.

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

INFORMATION

The drilling-milling machine BF46 Vario | BF46TC 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.

ATTENTION!

If the drilling-milling 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 misuses

Any other use as the one determined under the "Intended use" or any use beyond the described use shall be deemed as not in conformity and is forbidden.

Any other use has to be discussed with the manufacturer.

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

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

The operators must be qualified.

1.3.1 Avoiding misuses

➜ Use of suitable cutting tools.

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

➜ Clamp workpieces firmly and vibration-free.

For the drilling-milling machine there are conversion kits.

The attachments are provided as a kit to computer-controlled milling (CNC Computerized numerical control). However, the control of the step motors can also be done manually via a special controller (control, potentiometer). A step motor control is required in each case.

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

The machine BF46 Vario | BF46TC covered by the standard DIN EN 13128 (milling machines, including drilling machines). Therein, the manually controlled machines are divided into two classes with different protection levels, depending on the travel speed of a single power-driven axis. In addition, the requirements for automatically controlled machines listed (highest level of protection).

The one who changed the manually controlled BF46 Vario | BF46TC on CNC control is legally the manufacturer of a new machine due to the significant change in the machine and is therefore responsible for compliance with the requirements of the Machinery Directive and the DIN EN 13128.

The tool follows a path of movement which is normally not predictable by the operator. Because of the additional hazards caused by flying parts the standard defines protective devices. It does not matter what speeds are available on the axes.

We expressly point out that the guarantee will expire due to any constructive technical or procedural changes which had not been performed by the company Optimum Maschinen Germany GmbH.

With the conversion of the machine BF46 Vario | BF46TC an cabinet is required.

A suitable cabinet for these machines you can order:

❍ Cabinet SHC 3 for BF46 Vario | BF46TC, item no. 353 9093

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 workpieces flying off.

Clamp the workpiece in the machine vice. Make sure that the workpiece is firmly clamped in the machine vice resp. that the machine vice is firmly clamped on 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.
- ➜ Correctly adjust the bearing clearance and the guidings.

It is recommended:

- ➜ Insert the drill in a way that it is exactly positioned between the three clamping jaws of the quick action chuck.
- ➜ Clamp and mills by means of the collet chuck and the corresponding collets.
- ➜ Clamp end face mills by means of 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
- ➜ in case of too strong pressure the drill will get worn early or even might break resp. get jammed in the hole. If the drill gets jammed immediately stop the main motor by pressing the emergency stop button,
- ➜ for hard materials, e.g. steel, use commercial cooling / lubricating agents,
- ➜ generally always drive the turning spindle out of the workpiece.

ATTENTION!

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

When milling make sure that

- ➜ the corresponding 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 in a way that the cutting speed remains constant,

for hard materials commercial cooling / lubricating agents are used.

1.4 Possible dangers caused by the drilling-milling machine

The drilling-milling machine is state-of-the-art.

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

- ❍ at high speeds,
- ❍ with rotating parts and tools,
- ❍ with electrical voltages and currents.

We have used construction resources and safety techniques to minimize the health risk to persons 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,
- strictly follow these operating instructions.

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

WARNING!

The drilling-milling machine may only be used 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 have to be equipped with the prescribed safety devices.

This is your responsibility being the operating company!

☞ **"Safety devices“ on page 12**

1.5 Qualification of personnel

1.5.1 Target group

This manual is addressed to

- the operating companies,
- the users,
- the staff for maintenance works.

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

Disconnect the drilling-milling machine always from the electrical power supply. This will prevent it from being used by unauthorized 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 their professional training, knowledge and experience as well as their knowledge of relevant regulations the specialist staff is able to perform the assigned tasks and to recognise and avoid any possible dangers themselves.

Instructed persons

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

INFORMATION

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

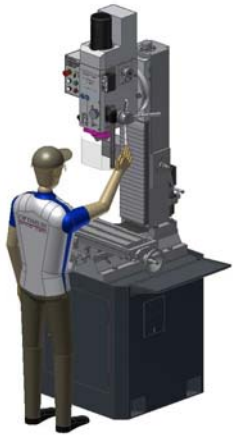
- be duly qualified,
- strictly follow these operating instructions.

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 values,
- the correct function of the drilling-milling machine may be affected.

1.6 Operator positions

The operator's position is in front of the drilling-milling machine.



Img.1-1: Operator positions

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. To do so, use a suitable extraction unit.

CAUTION!

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

Before processing inflammable materials (e.g. aluminium, magnesium) or using inflammable auxiliary materials (e.g. spirit) it is necessary to take additional preventive measures in order to safely avoid health risks.

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 on 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 if you

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

WARNING!

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

- **injuries due to 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:

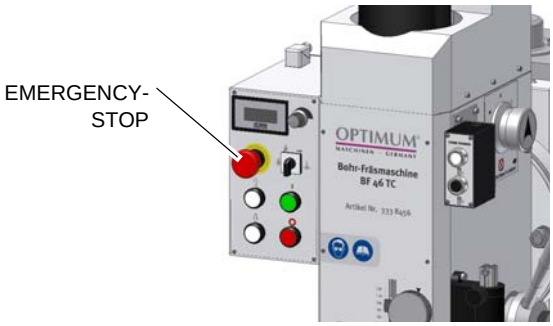
- an EMERGENY-STOP button,
- a protective cover on the drilling / milling head.
- a separating protective device on the milling spindle,

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. Always work carefully and observe the limit values of your chipping process.

1.8.1 EMERGENCY STOP impact switch

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



Img.1-2: EMERGENCY STOP impact switch

ATTENTION!

The EMERGENCY-STOP push button stops the machine the moment it is activated.

Activate the emergency stop impact switch only in case of danger! 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.

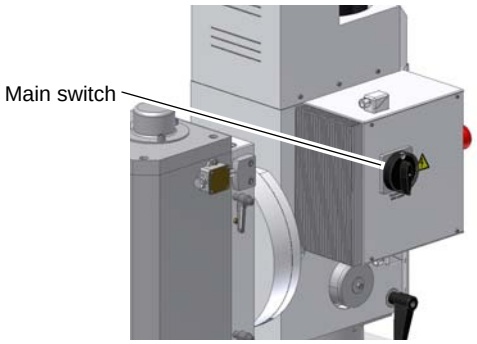
After having actuated the EMERGENCY STOP, turn the knob of the particular push button to the right in order to restart the machine.

1.8.2 Lockable main switch

In the position " 0 " the lockable main switch can be secured against accidental or non-authorized switching-on by means of a padlock.

When the main switch is switched-off, the current supply is interrupted.

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



Img.1-3: Main switch

WARNING!

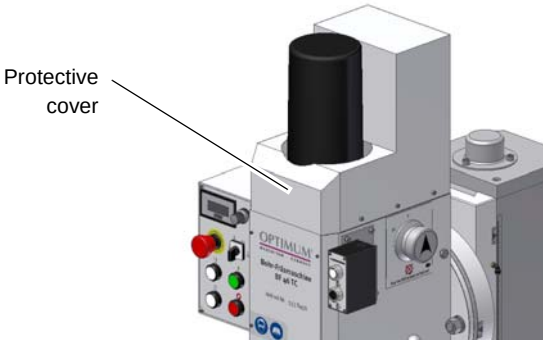
Dangerous voltage even if the main switch is switched-off. In the areas marked by the ideogram in the margin, there might be voltage, even if the main switch is switched off.

1.8.3 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.1-4: Protective cover

1.8.4 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 re-tighten 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 spindle protection is not closed.

Img.1-5: Separating protective equipment

1.9 Safety check

Check the drilling-milling machine in regular intervals.

Check all safety devices

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

General check		
Equipment	**Check**	**OK**
Protective covers	Mounted, firmly bolted and not damaged	
Signs, Markings	Installed and legible	

Functional check		
Equipment	**Check**	**OK**
EMERGENCY STOP impact switch	When the EMERGENCY STOP push button is activated, the drilling-milling machine must switch off. Make sure that it is only possible to restart the machine if the EMERGENCY STOP push button is unlocked and the ON switch was activated.	
Separating safety device around the drilling and milling spindle	The drilling-milling machine may switch on only when the safety device is closed.	

1.10 Personnel 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 works where your face and eyes are exposed to hazards.

Use protective gloves when handling pieces with sharp edges.

Use 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 prescribed personnel protective equipment is available at the working place.

CAUTION!

Dirty or contaminated personnel protective equipment can cause diseases. Clean it each time after use and once a week.

1.11 For your own safety during operation

WARNING!

Before activating the drilling-milling machine assure yourself that this will neither endanger other persons nor cause damage to equipment.

Avoid any unsafe working practices:

Make sure that nobody is endangered by your work.

- The instructions mentioned in these operating instructions have to be strictly observed during assembly, operation, maintenance and repair.
- Wear safety 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 standstill.
- Use the prescribed personnel protective equipment. Make sure to wear a well-fitting work suit 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 auxiliary materials to remove drilling and milling chips.
- Make sure that nobody is endangered by your work.

❍ Safely and firmly clamp the workpiece before switching on the drilling-milling machine.

We specially point out the specific dangers when working with and on the drilling-milling machine.

1.12 Disconnecting and securing the drilling-milling machine

Switch off the drilling-milling machine with the main switch before starting any maintenance and repair works.

1.13 Using lifting equipment

WARNING!

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

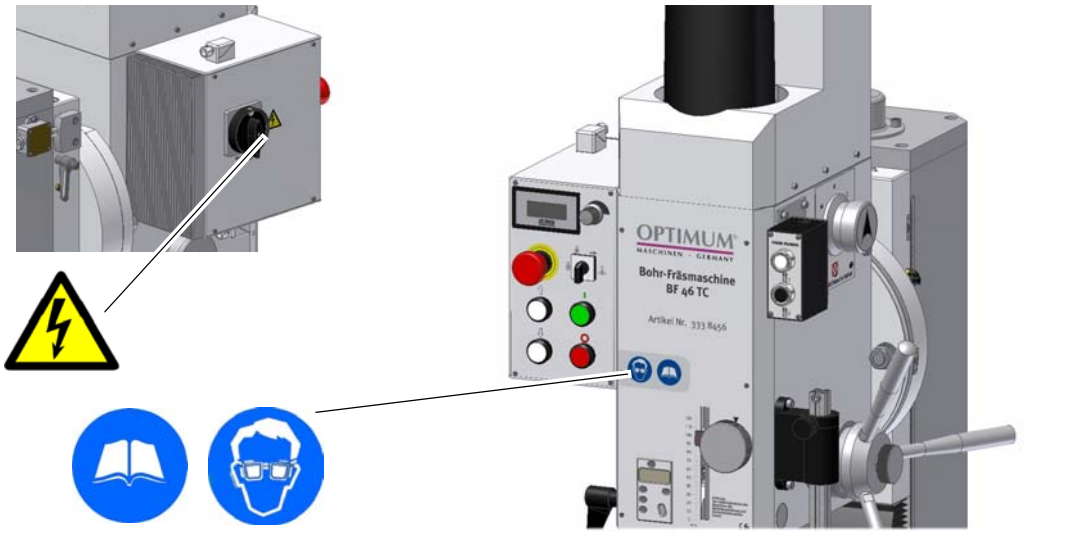
Check that the lifting equipment and load-suspension gears are of sufficient load capacity and are in perfect condition.

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.

Never walk under suspended loads!

1.14 Position of labels on the drilling-milling machine



Img.1-6: BF46 Vario | BF46TC

2 Technical data

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

2.1 Electrical connection	BF46V	BF46TC
Motor	230V / 50Hz / 2.2 kW	
2.2 Drilling-milling capacity	**BF46V**	**BF46TC**
Drilling capacity in steel [mm]	max. Ø 28	
Drilling capacity in cast [mm]	max. Ø 30	
Milling capacity end mill [mm]	max. Ø 32	
Milling capacity milling head [mm]	max. Ø 80	
Throat [mm]	260	
2.3 Spindle seat	**BF46V**	**BF46TC**
Spindle seat	ISO 40 (DIN 2080, DIN 69871) MT4	
Draw-in rod	M16	
Spindle sleeve stroke [mm]	115 mm	
2.4 Drill-Mill head	**BF46V**	**BF46TC**
Swivelling	+ / - 45°	
Gear stages	3	
Travel of Z axis [mm]	541	
2.5 Cross table	**BF46V**	**BF46TC**
Table length [mm]	850	
Table width [mm]	240	
Travel of Y axis [mm]	260	
Travel of X axis [mm]	520	
T - slot size / number / distance [mm]	18 / 80	
Max. load [kg]	175	
2.6 Working area	**BF46V**	**BF46TC**
Height [mm]	2200	
Depth [mm]	2000	
Width [mm]	2600	
2.7 Speeds	**BF46V**	**BF46TC**
Gear stage slow [min^{-1}]	115 - 600	
Gear stage average [min^{-1}]	270 - 1400	
Gear stage rapid [min^{-1}]	590 - 3100	

2.8 Environmental conditions	BF46V	BF46TC
Temperature	5-35 °C	
Humidity	25 - 80%	
2.9 Operating material	**BF46V**	**BF46TC**
Gear	filling quantity 1.65 litres Mobilgear 627, ISO VG 100 Viscosity 100 cSt at 40°C or a comparable oil	
Bare steel parts	Mobilgrease OGL 007 or, Mobilux EP 004, acid-free oil, e.g. weapon oil, motor oil	

2.10 Emissions

The generation of noise emitted by the drilling-milling machine is less than 80 dB(A).
If the drilling-milling machine is installed in an area where various machines are in operation, the noise exposure (immission) on the operator of the drilling-milling machine at the working place may exceed 80dB(A).

INFORMATION

This numerical value was measured on a new machine under proper operating conditions. Depending on the age respectively on the wear of the machine it is possible that the noise behaviour of the machine changes.

Furthermore, the factor of the noise emission is also depending on manufacturing influencing factors, e.g. speed, material and clamping conditions.

INFORMATION

The mentioned numerical value is the emission level and 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 the 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 shall allow the operator of the machine to more easily evaluate the endangering and risks.

CAUTION!

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

We generally recommend to use a noise protection and a hearing protection.

3 Unpacking and connecting

INFORMATION

The drilling-milling machine is delivered pre-assembled.

3.1 Scope of delivery

Check immediately upon delivery of the drilling-milling machine if there are any transport damages or loosened fastening screws.

Compare the scope of delivery with the packing list.

3.2 Transport

- Centres of gravity

- Load suspension points
  (Marking of the positions for the load suspension gear)

- Prescribed transportation position
  (Marking of the top surface)

- Means of transport to be used
- Weights

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 case.

WARNING!

The use of unstable lifting and load suspension gear that might break under load can cause severe injuries or even death. Check that the lifting and load suspension gear has sufficient load 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.

Never walk under suspended loads!

3.3 Storage

ATTENTION!

In case of wrong and improper storage electrical and mechanical machine components might get damaged and destroyed.

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

Follow the instructions and information on the transport case.

- Fragile goods
  (Goods require careful handling)

- Protect against moisture and humid environment

☞ "Environmental conditions“ on page 18.

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

- 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 given here ☞ "Information“ on page 6.

3.4 Installation and assembly

3.4.1 Requirements regarding the installation site

Organize the working area around the drilling machine according to the local safety regulations.

INFORMATION

In order to attain good functionality and a high processing accuracy as well as a long durability of the machine the installation site should fulfil certain criteria.

Please observe the following points:

- The device must only be installed and operated in a dry and well-ventilated place.
- Avoid places nearby machines generating chips or dust.
- The installation site must be free from vibrations also at a distance of presses, planing machines, etc.
- The substructure must be suitable for the drilling-milling machine. Also make sure that the floor has sufficient load bearing capacity and is level.
- The substructure must be prepared in a way that possibly used coolant cannot penetrate into the floor.
- Any parts sticking out such as stops, handles, etc. have to be secured by measures taken by the customer if necessary in order to avoid endangerment of persons.

- Provide sufficient space for the staff preparing and operating the machine and transporting the material.
- Also consider that the machine is accessible for setting and maintenance works.
- Provide for sufficient illumination (Minimum value: 500 lux, measured at the tool tip). At little intensity of illumination an additional illumination has to be ensured e.g. by means of a separate workplace lamp.

INFORMATION

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

3.4.2 Load suspension point

WARNING!

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

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

➜ Firmly clamp all clamping levers on the drilling-milling machine before lifting the drilling-milling machine.

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

3.4.3 Assembly

➜ Check if the underground of the drilling-milling machine is level using a spirit level.

➜ Check if the underground is sufficiently stable and rigid. The total weight amounts to 480 kg.

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). Critical speeds and moves in the axis with displeasing vibrations are rapidly achieved in case of insufficient rigidity of the whole system and will lead to bad milling results.

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

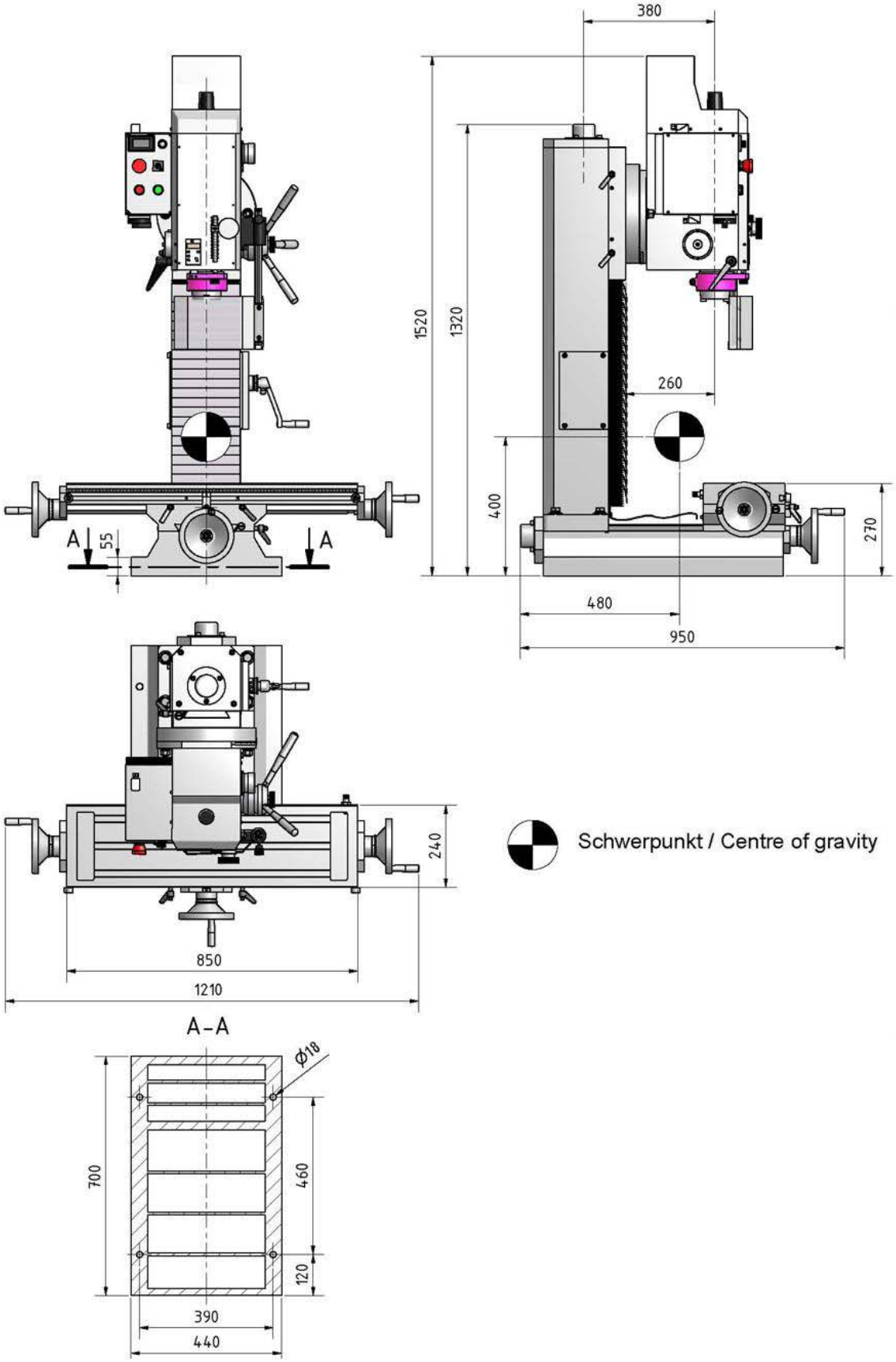
➜ Fix the drilling-milling machine in the provided through-holes on the machine foot.
The attachment points are marked by arrows on the machine foot.

WARNING!

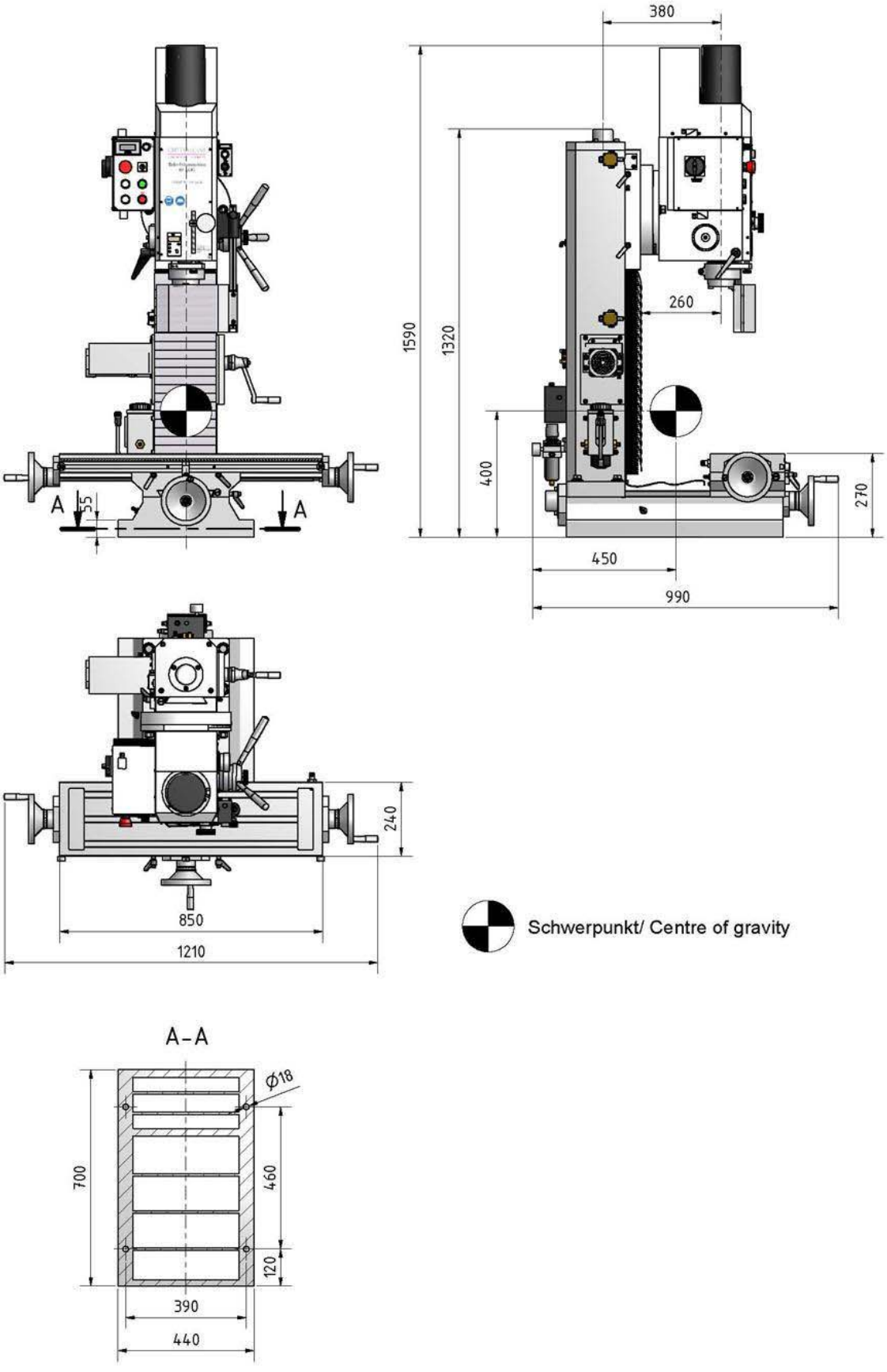
The condition of the underground and the fixing type of the machine foot to the underground must be in a way that it can bear the loads of the drilling-milling machine. The underground must be level. Check if the underground of the drilling-milling machine is level using a spirit level.

Fix the foot of the drilling-milling machine to the substructure with the provided through-holes. We recommend you to use shear connector cartridges resp. heavy-duty anchors.

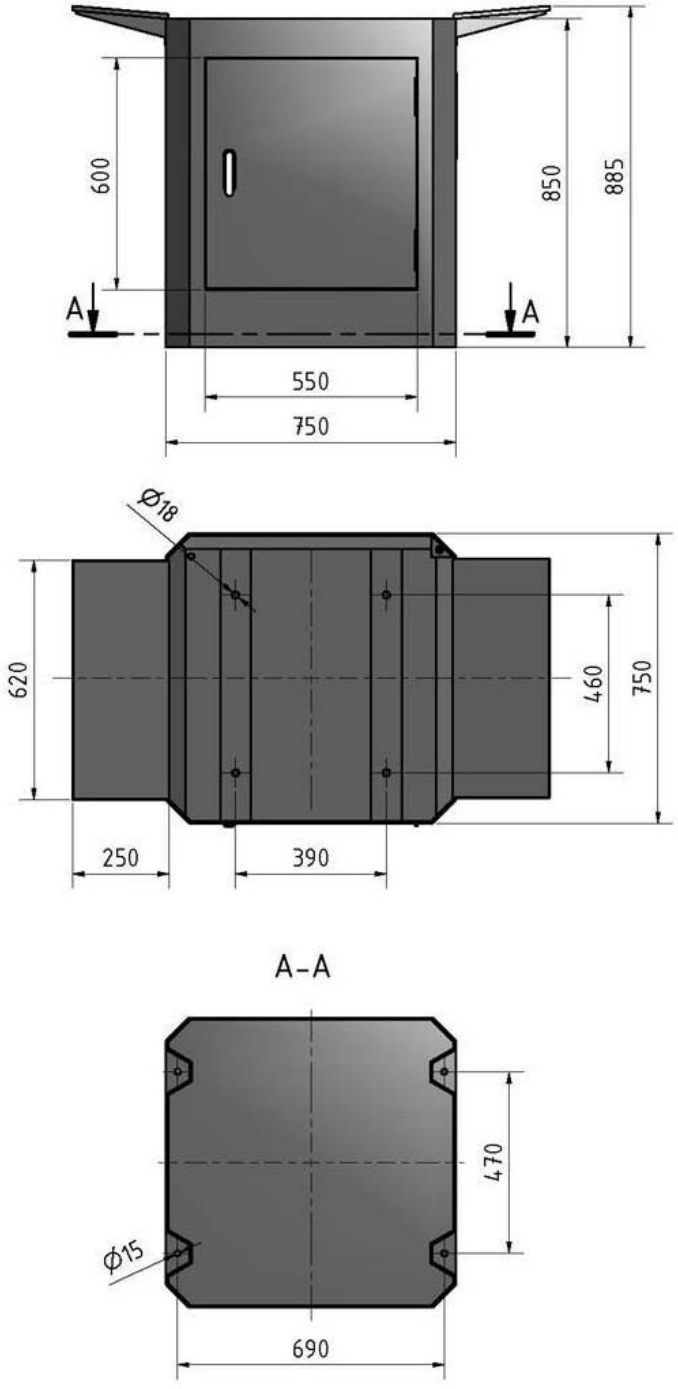
3.5 Dimensions, installation plan BF46V



3.6 Dimensions, installation plan BF46TC



3.7 Installation plan of optional substructure



3.8 First commissioning

ATTENTION!

Before commissioning the machine check all screws, fixtures resp. safety devices and tighten up the screws if necessary!

WARNING!

Risk by using improper tool holders or operating them at inadmissible speeds.

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 of the manufacturer of the clamping devices.

WARNING!

When first commissioning the drilling-milling machine by inexperienced staff you endanger people and the machine.

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

☞ "Qualification of personnel“ on page 11

3.8.1 Power supply

➜ 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.

3.8.2 Cleaning and lubricating

➜ Remove the anti-corrosive agents on the drilling-milling machine which had been applied for transportation and storage. Therefore, we recommend you to use paraffin.

➜ Do not use any solvents, cellulose thinner or any other cleaning agents which might affect the coating of the drilling-milling machine when cleaning the machine. Observe the indications and notes of the manufacturer for cleaning agents.

➜ Oil all blank machine parts using an acid-free lubricating oil.

➜ Lubricate the drilling-milling machine according to the lubricating plan.
☞ "Inspection and maintenance“ on page 46

➜ Check if all spindles are running smoothly. The 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 48

3.8.3 Filling in gear oil

The drilling-milling machine is delivered without oil filling. Fill in gear lubricant oil into the drill-mill head and the central lubrication unit.

☞ "Oil change“ on page 47

3.8.4 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.

3.8.5 Compressed air supply on BF46TC

➜ Connect the compressed air supply with at least 6 bars to the quick-action coupling of the compressed air maintenance unit.

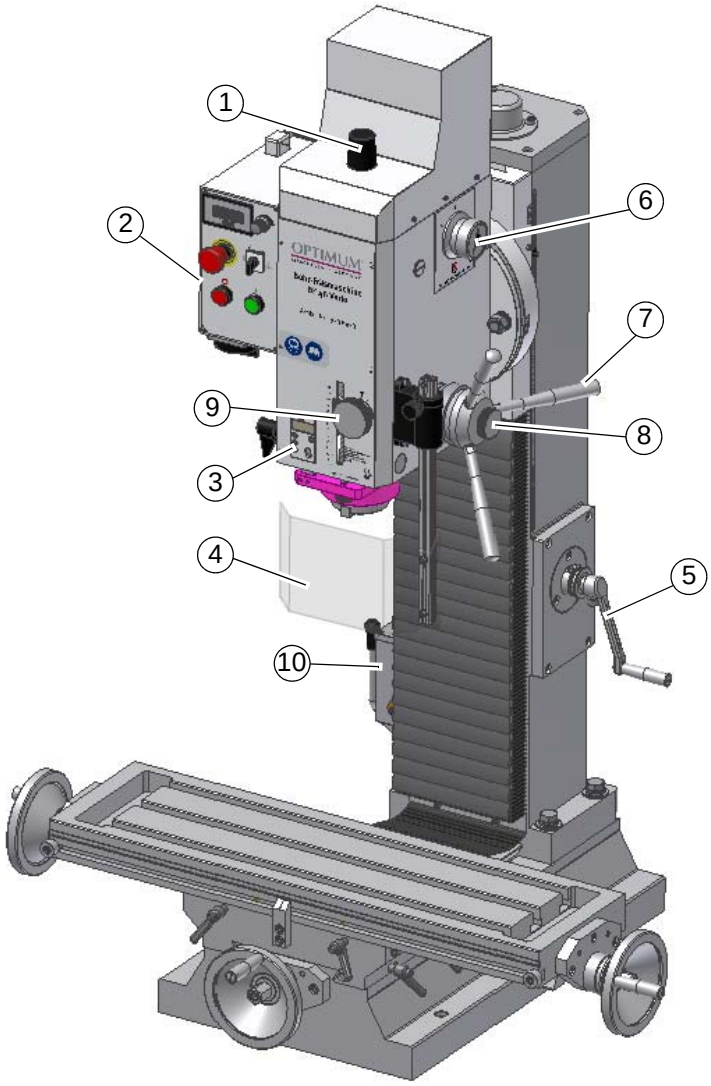
ATTENTION!

In order to ensure a failure-free operation of the machine it is necessary that the required air pressure is continuously applied on the machine at constant quality.

Img. 3-1: Compressed air supply

4 Operation

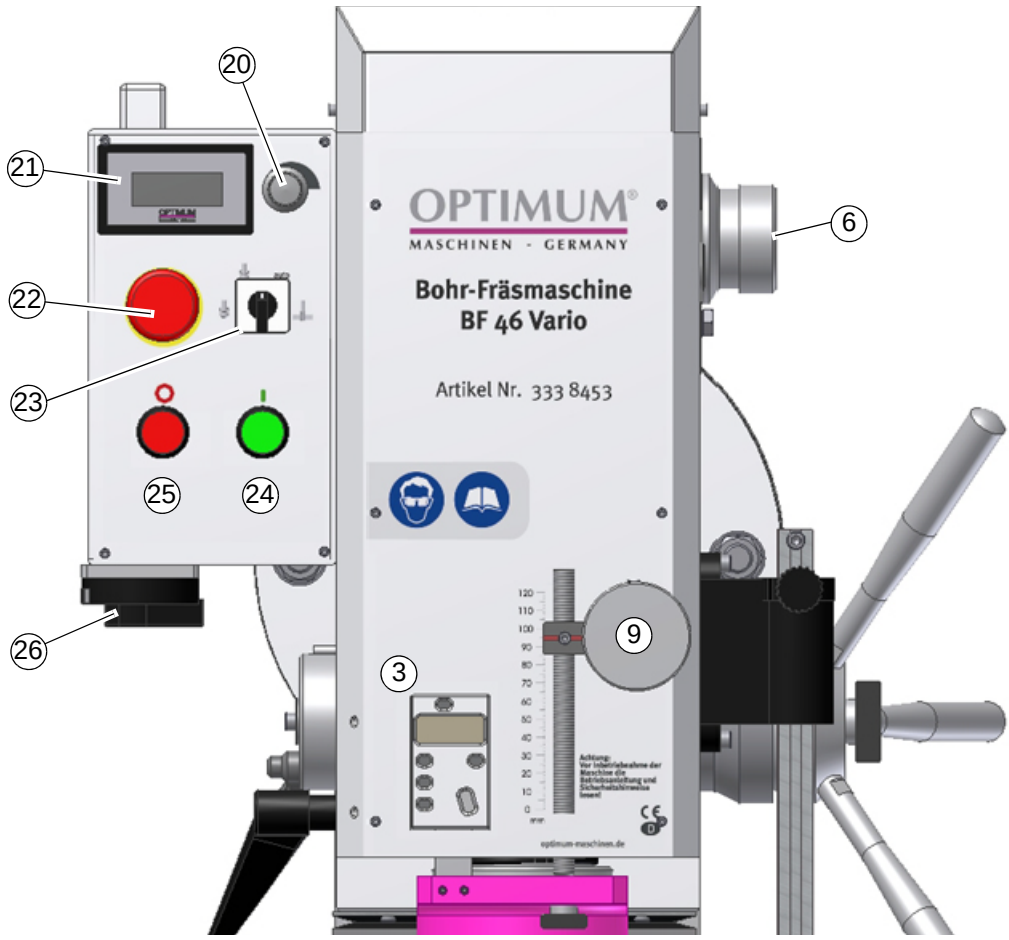
4.1 Control and indicating elements BF46V



Img. 4-1: BF46 Vario | BF46TC

Pos.	Designation	Pos.	Designation
1	Cover of draw-in rod	2	Control panel
3	Digital display fine crossfeed of spindle sleeve	4	Spindle protection
5	Crank for height adjustment of the drill-mill head	6	Selector switch for reduction stage
7	Star grip for spindle sleeve feed	8	Activation of the fine adjustment
9	Fine adjustment of spindle sleeve	10	Central lubrication

4.1.1 Control panel



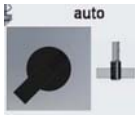
Img.4-2: Control panel

Pos.	Designation	Pos.	Designation
20	Speed control	21	Digital display speed
22	EMERGENCY-STOP	23	Selection switch operating mode ❍ Automatic ❍ Threading ❍ turning direction
24	Push button spindle rotation "ON"	25	Push button spindle rotation "OFF"
26	Main switch	6	Selector switch for reduction stage
3	Digital display fine crossfeed of spindle sleeve	9	Fine adjustment of spindle sleeve

Selection switch for operating mode

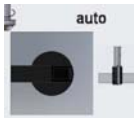
With the selector switch the operating mode „automatic, threading or right-hand respectively left-hand run“ is being selected.

Operation mode automatic



In the automatic mode the engine starts up according to a predefined path over the drilling depth limit of the spindle sleeve and stop at the end position. This way for, the push button Start and Stop does not have to be actuated for repetitive drilling tasks.

Operation mode thread cutting



In the thread cutting mode the engine automatically starts up according to a predefined path over the drilling depth stop and automatically changes the turning direction as soon as the predefined depth had been achieved. The screw-tap is drawn out of the workpiece.

Rotation direction switch

Standard operation, selection left-handed or right-handed rotation.

Potentiometer

Speed setting "VARIO"

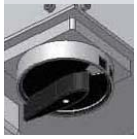
Push button ON

The push button "ON" switches on the rotation of the spindle.

Push button OFF

The push button "OFF“ switches off the rotation of the spindle.

Main switch



Interrupts or connects the power supply.

4.2 Switching on the drilling-milling machine

- ➜ Switch on the main switch.
- ➜ Close the protective equipment.
- ➜ Select the operating mode.
- ➜ Select the gear level.
- ➜ Set the potentiometer to the lowest speed.
- ➜ Actuate push button "Start".
- ➜ Set the required speed on the potentiometer.

ATTENTION!

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

INFORMATION

At a cold drilling-milling machine it is possible that with switching on the machine an overload of the drive occur.

Therefore, allow the drilling-milling machine at low speeds depending on environmental conditions to warm up for 10 to 20 minutes before you go to maximum speed.

Also with a quick on and off, this overload occur. Therefore wait for about 3 seconds before you switch on the drilling-milling machine again, the capacitors in the controller must first discharged.

4.3 Switching off the drilling-milling machine

- ➜ Press the push button spindle rotation "OFF". For a long-term standstill of the drilling-milling machine switch it off at the main switch.

4.4 Inserting a tool on BF46V

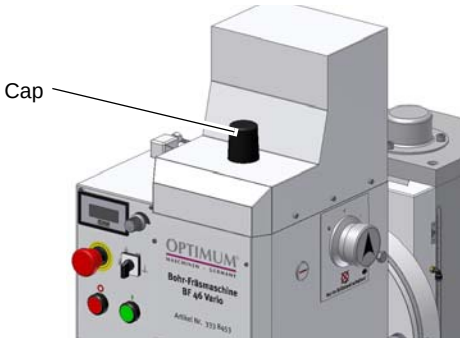
4.4.1 Installation

CAUTION!

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

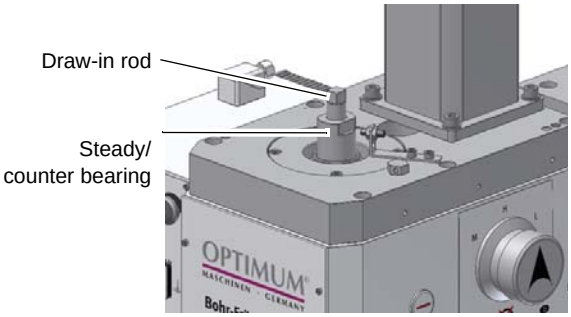
The milling head is equipped with a draw-in rod M16.

➜ Remove the cap.
➜ Clean the seat in the spindle / quill.
➜ Clean the taper of your tool.
➜ Insert the tool in the spindle / quill.



Img.4-3: Drilling and milling head

➜ 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.4-4: Drilling-milling head without cap

4.4.2 Unfitting

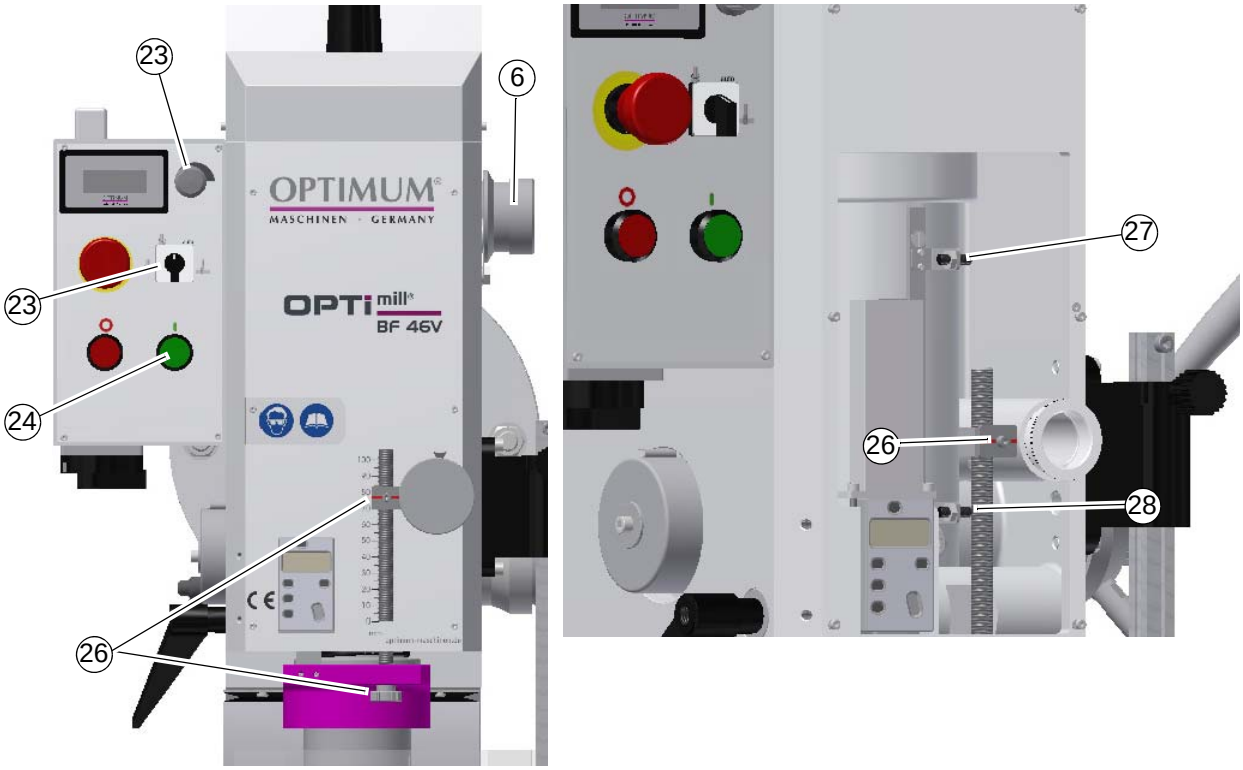
➜ Hold the spindle counter bearing with a wrench and loosen the draw-in rod. Continue turning the draw -in rod, so that the tool is squeezed out from the conical collet.

ATTENTION!

When using an optional MT4 spindle.

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 Threading



Img. 4-5: Operation mode thread cutting

Pos.	Designation	Pos.	Designation
6	Selector switch for reduction stage	20	Speed control
23	Selection switch operating mode ❍ automatic ❍ threading ❍ turning direction	24	Push button spindle rotation "ON"
26	Depth stop	27	Adjustable stop cycle end
28	End position switch turning direction reversal		

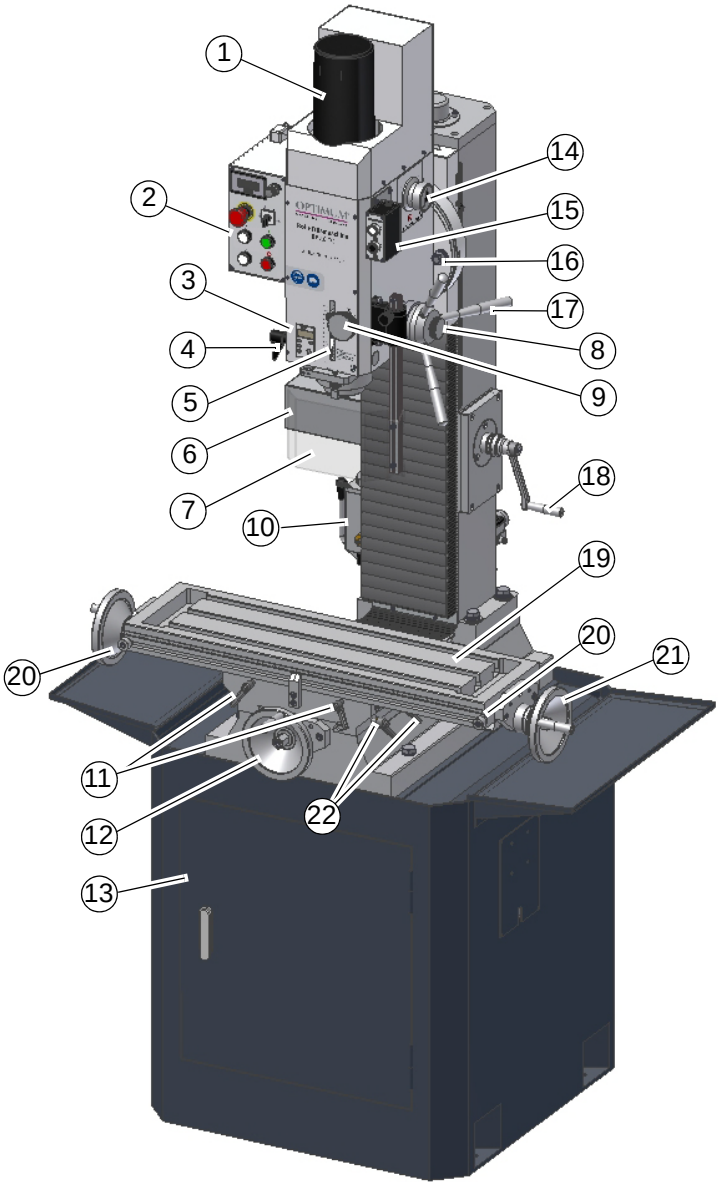
➜ Set the selection switch mode (23) to "threading" or "automatic".
➜ Set the depth stop (26) to the desired depth.
➜ Select the smallest speed.
➜ Close spindle protection system.
➜ Start the rotation of spindle (24).
➜ Move the sleeve downward with the sleeve lever until the machine tap cams in the 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 (28). The machine tap turns out of the workpiece. When the spindle sleeve is completely entered up to the switch point (27) in operation mode "automatic" the rotation of the spindle is stopped. Then it is possible to proceed another threading operation.

ATTENTION!

The spindle sleeve must be completely retracted in order to trigger the switch point (27).

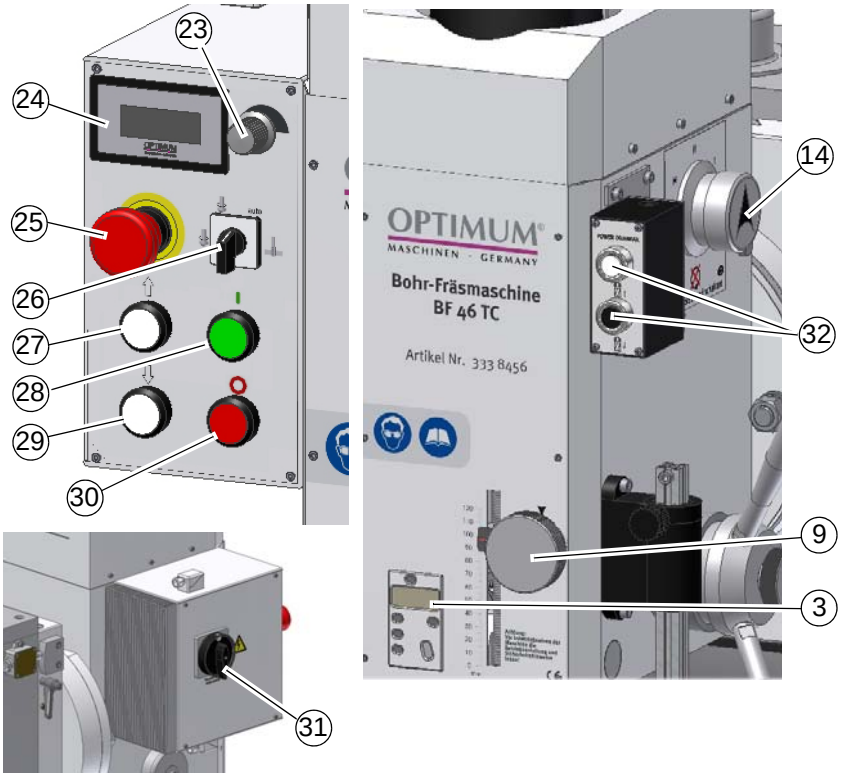
4.6 Control and indicating elements BF46TC



Pos.	Designation	Pos.	Designation
1	Pneumatic tool changer	2	Control panel
3	Digital display fine crossfeed of spindle sleeve	4	Clamping lever for spindle sleeve
5	Meter rule with scale	6	Motor Z-axis feed
7	Spindle protection	8	Activation of the fine adjustment
9	Fine adjustment of spindle sleeve	10	Central lubrication
11	Clamping lever for X-axis	12	Crank handle for saddle slide Y axis
13	Machine base (optionally)	14	Selector switch for reduction stage
15	Control panel tool change "CLAMPING" / "RELEASING"	16	Clamping screw drilling-milling head right

Pos.	Designation	Pos.	Designation
17	Star grip for spindle sleeve feed	18	Crank handle for manual height adjustment of the drilling milling head
19	Cross table	20	Adjustable limit stops
21	Handle of cross slide for X-axis	22	Clamping lever for Y-axis

4.6.1 Control panel BF46TC

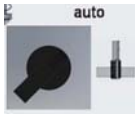


Pos.	Designation	Pos.	Designation
23	Potentiometer speed control	24	Digital display speed
32	Control panel tool change: ❍ Pushbutton "CLAMPING" ❍ Pushbutton "RELEASING"	26	Selection switch operating mode ❍ automatic ❍ threading ❍ turning direction
27	Push button Z feed (travelling drilling milling head upward)	28	Push button spindle rotation "ON"
29	Push button Z feed (travelling drilling milling head downward)	30	Push button spindle rotation "OFF"
31	Main switch	14	Selector switch for reduction stage
3	Digital display fine crossfeed of spindle sleeve	9	Fine adjustment of spindle sleeve
25	EMERGENCY-STOP		

Selection switch for operating mode

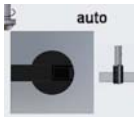
With the selector switch the operating mode „automatic, threading or right-hand respectively left-hand run“ is being selected.

Operation mode automatic



In the automatic mode the engine starts up according to a predefined path over the drilling depth limit of the spindle sleeve and stop at the end position. This way for, the push button Start and Stop does not have to be actuated for repetitive drilling tasks.

Operation mode thread cutting



In the thread cutting mode the engine automatically starts up according to a predefined path over the drilling depth stop and automatically changes the turning direction as soon as the pre-defined depth had been achieved. The screw-tap is drawn out of the workpiece.

Rotation direction switch

Standard operation, selection left-handed or right-handed rotation.

Potentiometer

Speed setting "VARIO"

Push button ON

The push button "ON" switches on the rotation of the spindle.

Push button OFF

The push button "OFF“ switches off the rotation of the spindle.

Main switch

Interrupts or connects the power supply.

4.7 Switching on the drilling-milling machine

➜ Switch on the main switch.
➜ Close the protective equipment.
➜ Select the operating mode.
➜ Select the gear level.
➜ Set the potentiometer to the lowest speed.
➜ Actuate push button "Start".
➜ Set the required speed on the potentiometer.

ATTENTION!

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

INFORMATION

At a cold drilling-milling machine it is possible that with switching on the machine an overload of the drive occur.

Therefore, allow the drilling-milling machine at low speeds depending on environmental conditions to warm up for 10 to 20 minutes before you go to maximum speed.

Also with a quick on and off, this overload occur. Therefore wait for about 3 seconds before you switch on the drilling-milling machine again, the capacitors in the controller must first discharged.

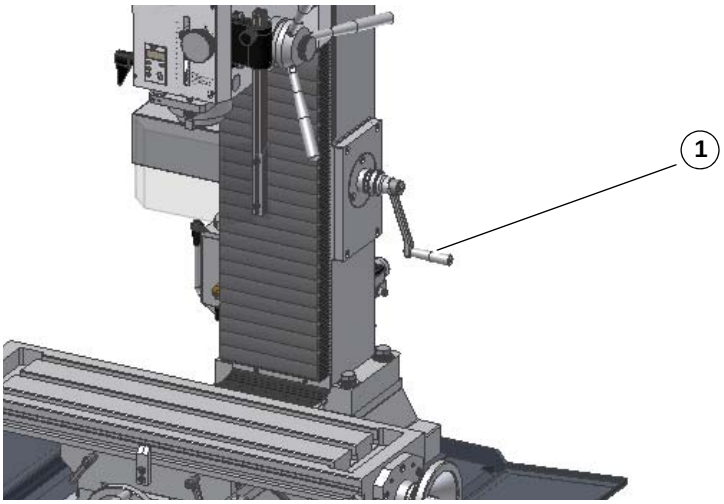
4.8 Switching off the drilling-milling machine

➜ Press the push button "OFF". For a long-term standstill of the drilling-milling machine switch it off at the main switch.

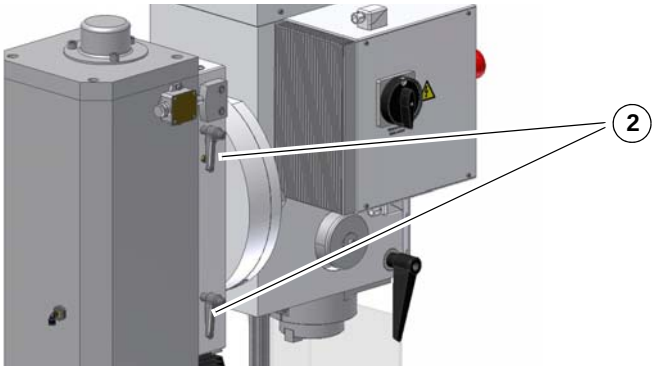
4.9 Traveling the drilling milling head (Z-axis) upward respectively downward

It is possible to perform the height adjustment of the drilling milling head by actuating the crank handle or the control panel

4.9.1 Traveling the drill-mill head upward respectively downward by actuating the crank handle



Img.4-6: Drilling milling head - height adjustment



Img.4-7: Clamping lever

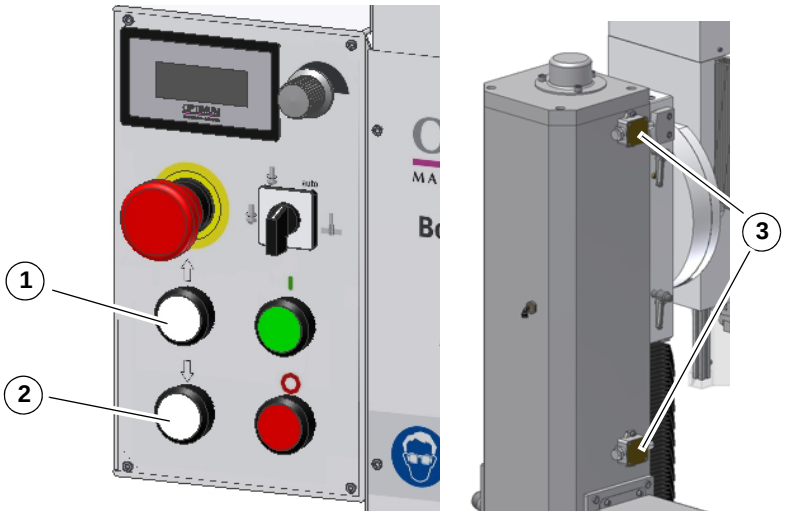
1	Crank handle
2	Clamping lever

➜ Release clamping lever (2).
➜ Engage the handle (1) by pushing it towards the teeth.
➜ Crank the drilling milling head to the required position.
➜ Clamp if needed.

4.10 Threading

as described under ☞ "Threading“ on page 31

4.10.1 Traveling the drill-mill head upward respectively downward using the control panel



Img.4-8: Traveling the drilling milling head upward respectively downward using the control panel

1	Traveling the drilling milling head upward
2	Traveling the drilling milling head downward
3	End switch

➜ Press the button (1) in order to travel the drilling milling head upward.
➜ Press the button (2) in order to travel the drilling milling head downward.

The end switch (3) limits the vertical movement of the drilling milling head upward respectively downward.

4.11 Inserting a tool on BF46TC

4.11.1 Installation

CAUTION!

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

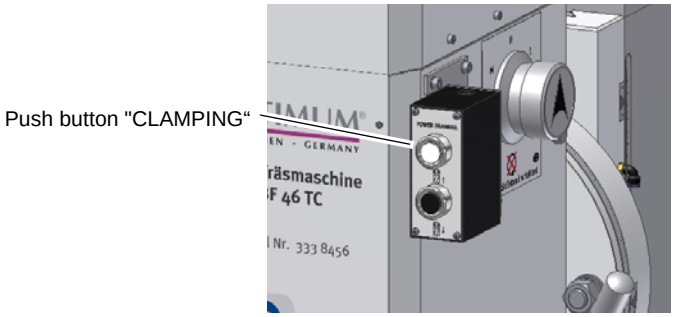
The milling head is equipped with a pneumatic tool changer and a M16 draw in bar.

➜ Clean the seat in the spindle / quill.
➜ Clean the taper of your tool.
➜ Insert the tool in the spindle / quill.

Img. 4-9: Installation tool

➜ Clamp the tool fixture by actuating the pressure switch "Clamping" on the control panel. The fixture will be drawn into the spindle. Press the push button switch until the tool is securely clamped.

ATTENTION!



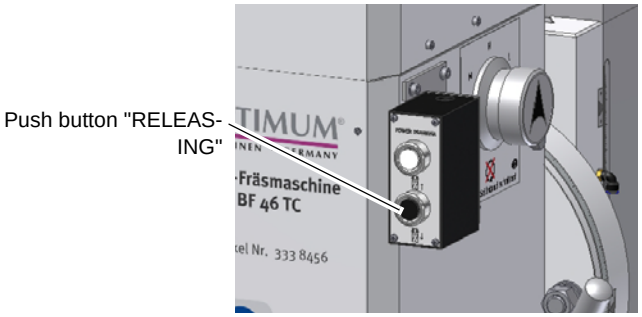
Img. 4-10: Installation tool

Make sure that the tool seat is correctly positioned (ISO 40).

The tool clamping system must not be activated when the machine is operated.

4.11.2 Unfitting

➜ Release the tool by actuating the switch "Release“. The fixture comes out of the spindle.
➜ Press the push button switch until the tool is completely detached.



Img. 4-11: Extraction tool

ATTENTION!

Hold the tool fixture tight when you detach it. The tool fixture is pressed out of the spindle.

ATTENTION!

The tool clamping system must not be activated when the machine is operated.

Img.4-12: Extraction tool

ATTENTION!

When using an optional MT4 spindle.

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.

4.12 Safety

Commission 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 intended.
- The operating manual is followed.
- All safety devices are installed and activated.

All failures 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 15

4.13 Use of collet chucks

When using collet chucks for the reception of milling tools, a higher operation tolerance can be achieved. The exchange of the collet chucks for a smaller or larger end mill cutter is performed simply and rapidly and it is not necessary to disassemble the complete tool. The collet chuck 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 chuck is used for each milling cutter diameter, so that the milling cutter may be fastened securely and firmly.

☞ "Compressed air supply on BF46TC“ on page 26

4.14 Clamping the workpieces

CAUTION!

Injury by flying off parts.

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.

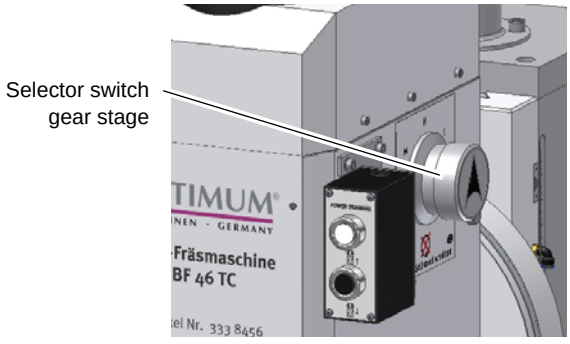
4.15 Changing the speed range

ATTENTION!

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

➜ Select gear level
H = rapid (590 min-1 - 3100 min-1)
M = middle (270 min-1 - 1400 min-1)
L = low (115 min-1 - 600 min-1)

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

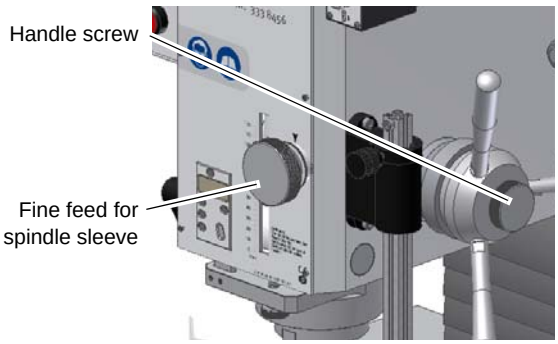


Img. 4-13: Drill-Mill head

4.16 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.

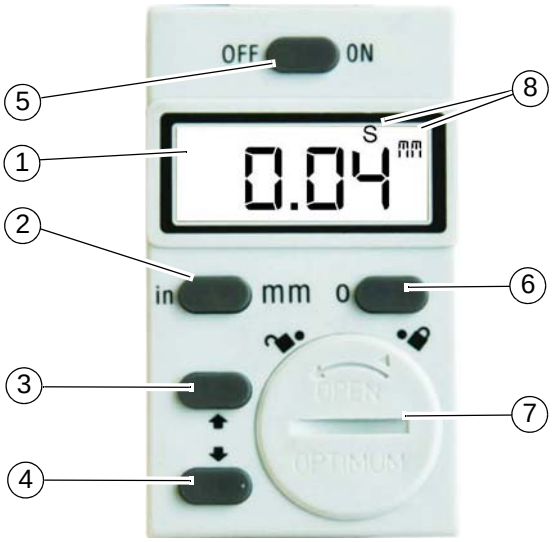
➜ Turn the spindle sleeve fine feed in order to move the spindle sleeve.



Img. 4-14: Handle screw

4.17 Digital display for spindle sleeve travel

Measuring range	0 - 999.99mm
	0 - 39.371“inch
Reading precision	0.01mm
	0.0004“inch
Power supply	round cell CR2032 , 3 V 20 x 3,2mm



Pos.	Designation
1	LCD display
2	Shifting mm/inch
3	Performs a value increase in operating mode "S" (Setting)
4	Performs a value decrease in operating mode "S" (Setting)
5	ON/OFF switch
6	Zero position and activation of operation mode "S"
7	Battery bay
8	Display of operation mode "S" and selected unit "mm / inch"

Operation mode "S"

The operation mode "S" is used to enter and to compensate the mechanical play (backlash) of quill mechanism.

- (1) Display which shows the operating modes "S", "inch" or "mm"
- (2) converts the measuring unit from *millimetres* to *inches* and vice versa.
- (3) ▲, Value increase in operation mode "S"
- (4) ▼, Value decrease in operation mode "S"
- (5) Switches the display ON or OFF.
- Resets the display to the set compensation value "S".

Enter the offset value of the quill mechanism

➜ Press the button (6) for about 2-3 seconds. The operation mode (8) "S" is activated and displayed.

➜ Enter the offset value of a quill mechanism, based on your experience with the keys (3) or (4).

➜ Stop the operation mode "S" by pressing the button (6) again.

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.

4.17.1 Malfunctions

Malfunction	Cause / possible effects	Solution
Flashing of the display	• Voltage too low	• Change battery
Screen doesn't refresh	• Operation mode "S" is active • Disturbance in the circuit	• Disable the operation mode "S". • 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

4.18 Manual spindle sleeve feed with the spindle sleeve lever

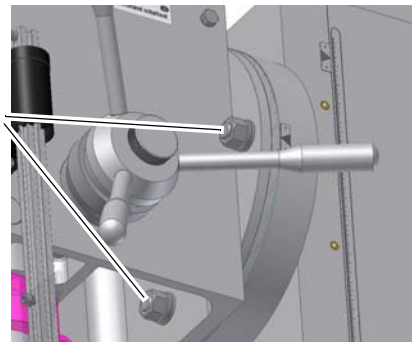
ATTENTION!

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. The sleeve lever moves away from the drilling head and deactivates the coupler of the fine feed.

4.19 Swivelling the drill-mill head

The drill-mill head may be swivelled 45° to the right and to the left. There are to loosen three screws.



Img.4-15: Clamping screws

CAUTION!

If the screws are completely unfastened, the drilling-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.

ATTENTION!

The drill-mill head can be rotated much further. When slewing it further on gear oil might escape.

4.20 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. By selecting the correct cutting speed, the service life of the tool is increased and the working result is optimized.

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 with higher speeds than with tools made of high-alloy 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 (meter per minute)

d = tool diameter in m (Meter)

4.20.1 Standard values for cutting speeds

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

Tool	Steel	Grey cast iron	Al alloy age-hardened
Plain mill 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 in dependence of 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	Al alloy cured 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	Al alloy cured 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

4.20.2 Standard values for speeds with HSS – Eco – twist drilling

Material		Drill diameter									Cooling 3)
		2	3	4	5	6	7	8	9	10	
Steel, unalloyed, up to 600 N/mm^2	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/mm^2	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/mm^2	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/mm^2 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 as 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

High temperatures are generated at the tip of the tool by the occurring friction heat. 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 coolants. Follow the manufacturer's disposal instructions.

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:

- **Very serious injury to personnel working on the,**
- **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 16

Attach a warning sign.

5.1.2 Restarting

Before restarting run a safety check.

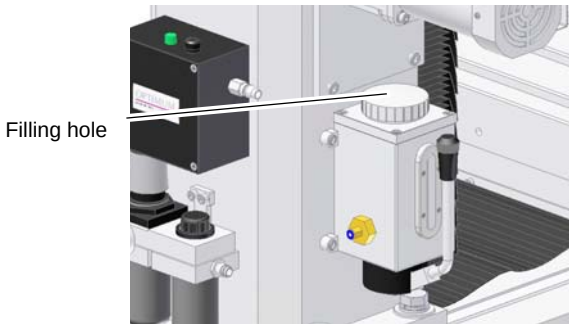
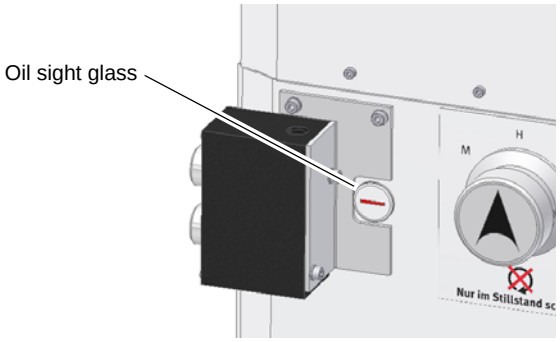
☞ "Safety check“ on page 14

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. For this reason, all the intervals are only valid for the authorised 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	**Cross table / drill-mill head**	Oiling	➜ Actuate the central lubrication of the cross table and of the drill-mill head with five pump strokes. If required refill acid-free oil in the tank of the central lubrication.  Img.5-1: Central lubrication
Every week	**Cross table**	Oiling	➜ Oil all bare steel surfaces. Use an acid-free oil, e.g. weapon oil or motor oil.
Every week	**Gear milling head**	Oil level	➜ Check the oil level of the gear. The oil level must be in the middle of the sight glass.  Abb.5-2: Oil sight glass gear

Interval	Where?	What?	How?
First after 200 operatingm hours, then every 2000 operating hours	**Gear 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 ventilation screw from the gear. ➜ Remove the oil drain plug. ➜ Refill the oil over the removed ventilation screw. Quantity and type of oil☞ "Operating material“ on page 18

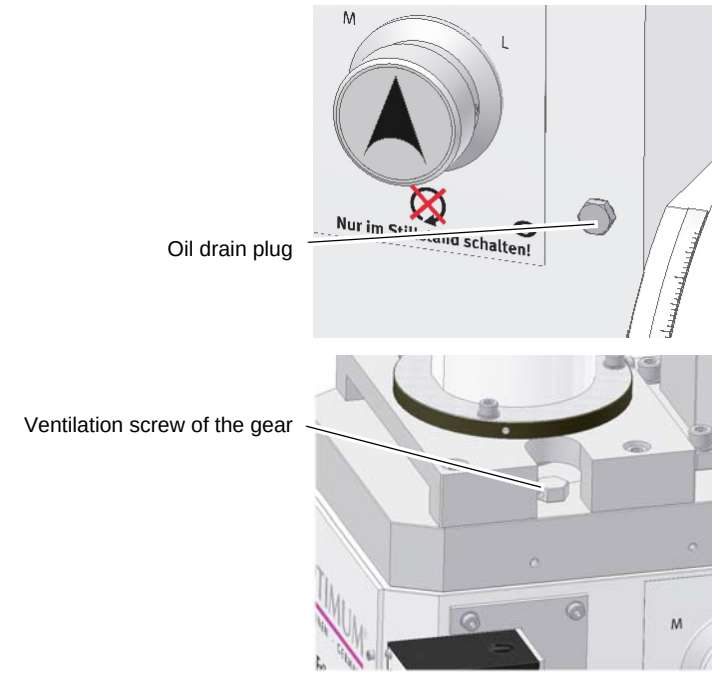
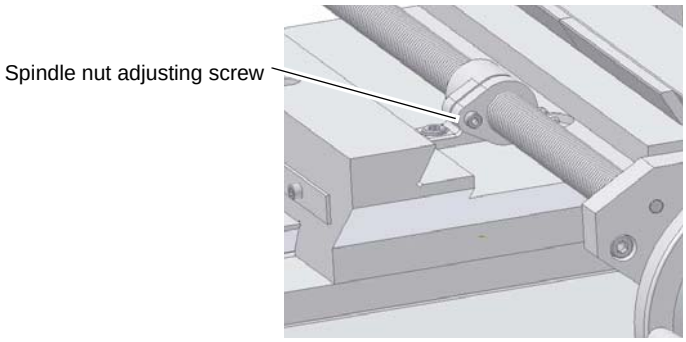
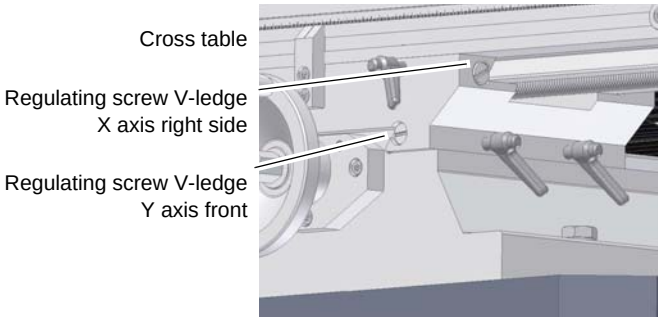
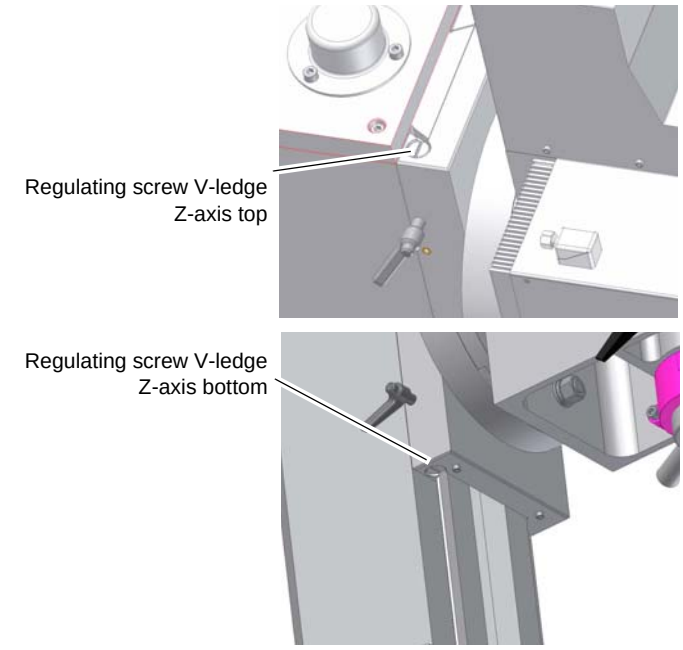


Abb.5-3: Milling head

Interval	Where?	What?	How?
As required	**Spindle nut cross table**	Readjusting	An extended clearance in the spindles of the cross table can be reduced by readjusting the spindle nuts.  Abb.5-4: Spindle nut X - axis (milling table faded out) The spindle nuts are readjusted by reducing the thread flanks of the spindle nut by means of a regulating screw. Due to the readjustment it is necessary to check if a smooth movement over the whole travel is still given, otherwise the wear is considerably increased due to the 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.
As required	**V-ledges**	Readjusting X and Y axis	 Img.5-5: Cross table ➜ Turn the adjusting screw of the respective taper gib frontand rear, or left and right in the clockwise direction. The taper gib is continued to push in and reduced by it the gap in the guide way. ➜ Check the settings. The corresponding guideway must be more easily moveable but ensure a stable guiding.

Interval	Where?	What?	How?
As required	V-ledges	Readjusting Z axis:	 Img.5-6: Column and mill head ➜ 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

Request for a service technician of the company Optimum Maschinen Germany GmbH for all repairs.

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

The company Optimum Maschinen Germany GmbH does not take responsibility nor does it guarantee for damages and failures resulting of non-observance of this operating manual.

For repairs only use

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

6 Ersatzteile - Spare parts

6.1 Fräskopf - Milling head 1 - 3

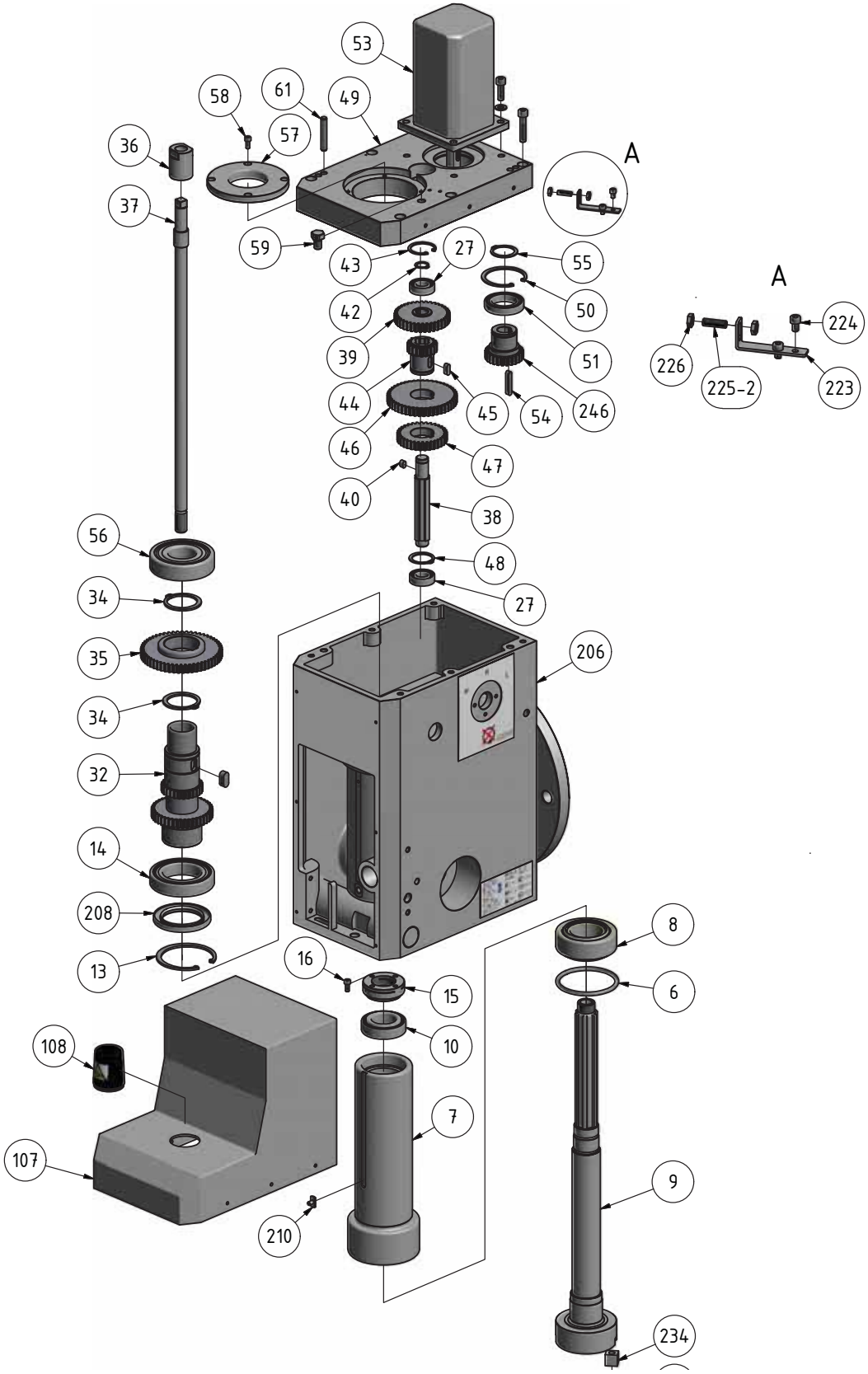


Abb.6-1: Fräskopf - Milling head 1 - 3

6.2 Fräskopf- Milling head BF 46 TC Vario

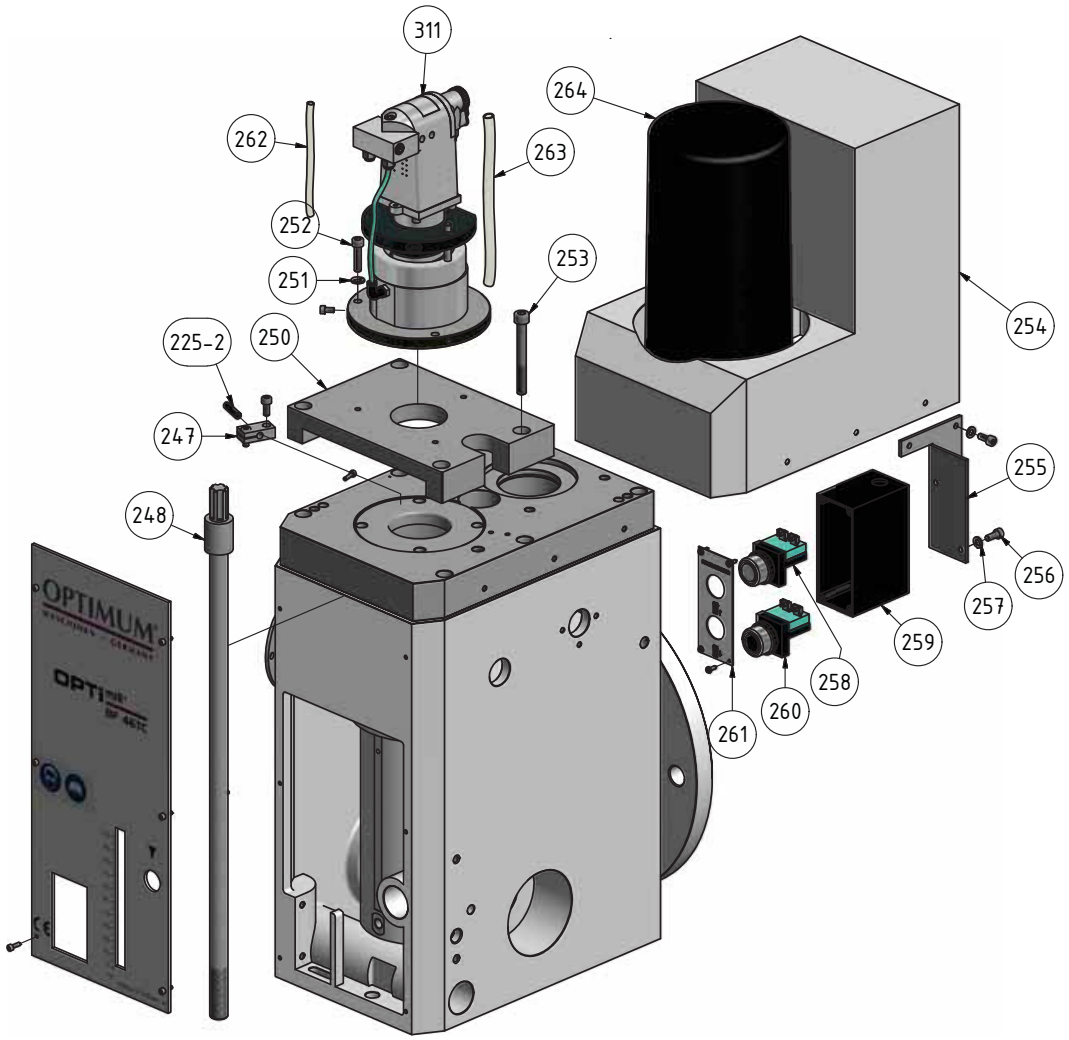


Abb. 6-2: Fräskopf - Milling head BF46 TC Vario

6.3 Fräskopf - Milling head 2 - 3

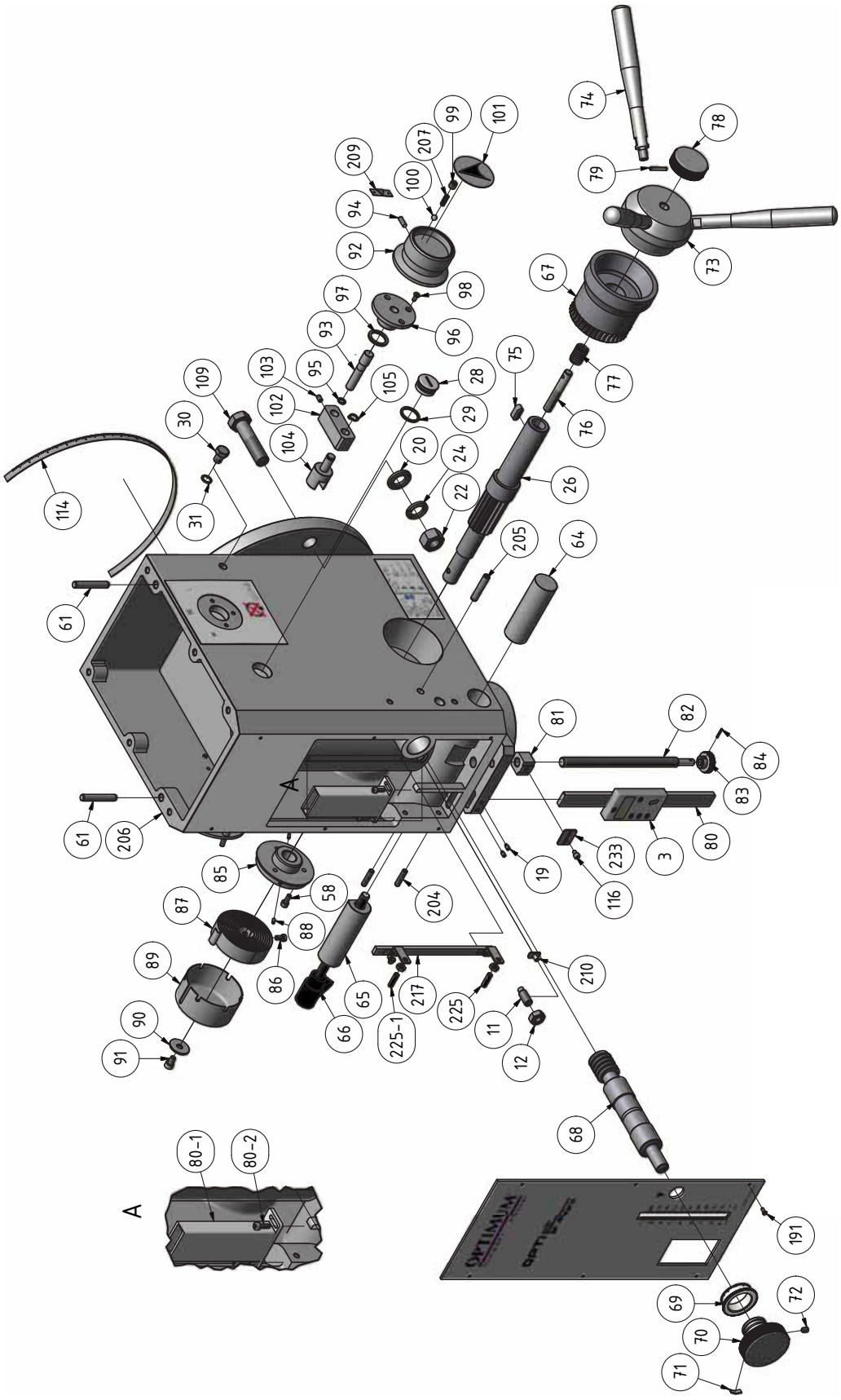


Abb.6-3: Fräskopf - Milling head 2 - 3

6.4 Fräskopf - Milling head 3 - 3

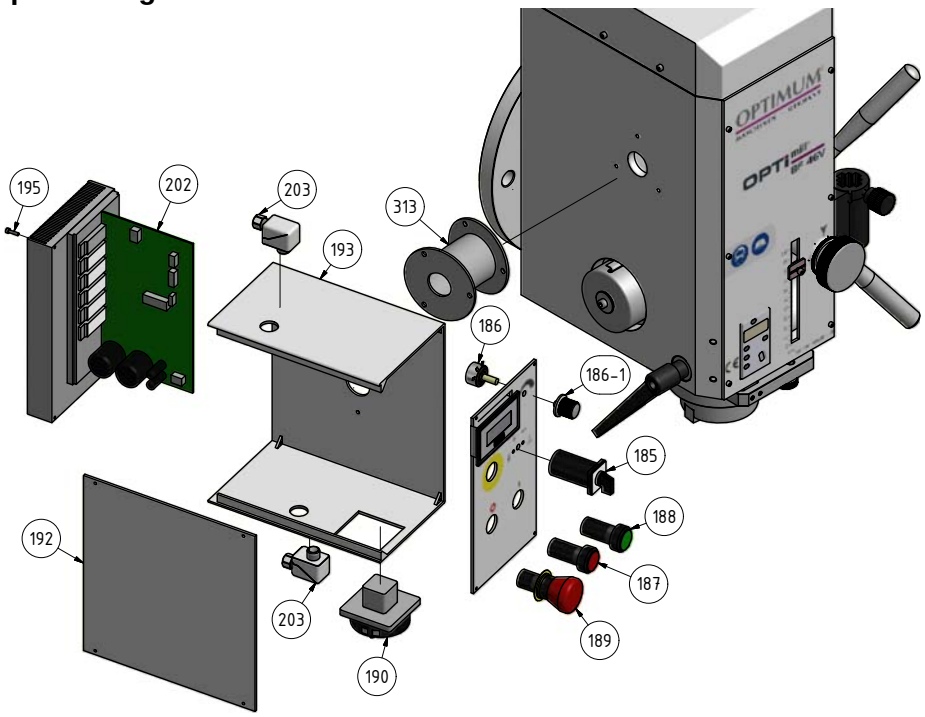


Abb. 6-4: Fräskopf - Milling head 3 - 3

6.5 Fräskopf - Milling head BF46TC

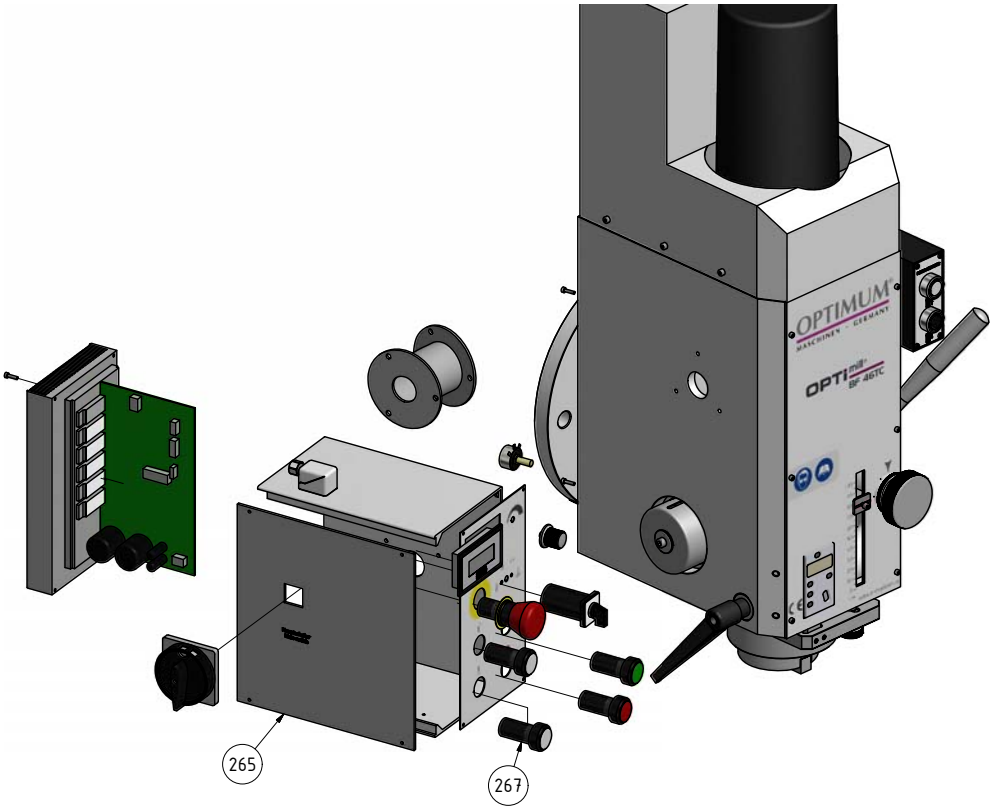


Abb. 6-5: Fräskopf - Milling head BF46 TC Vario

6.6 Säule - Column

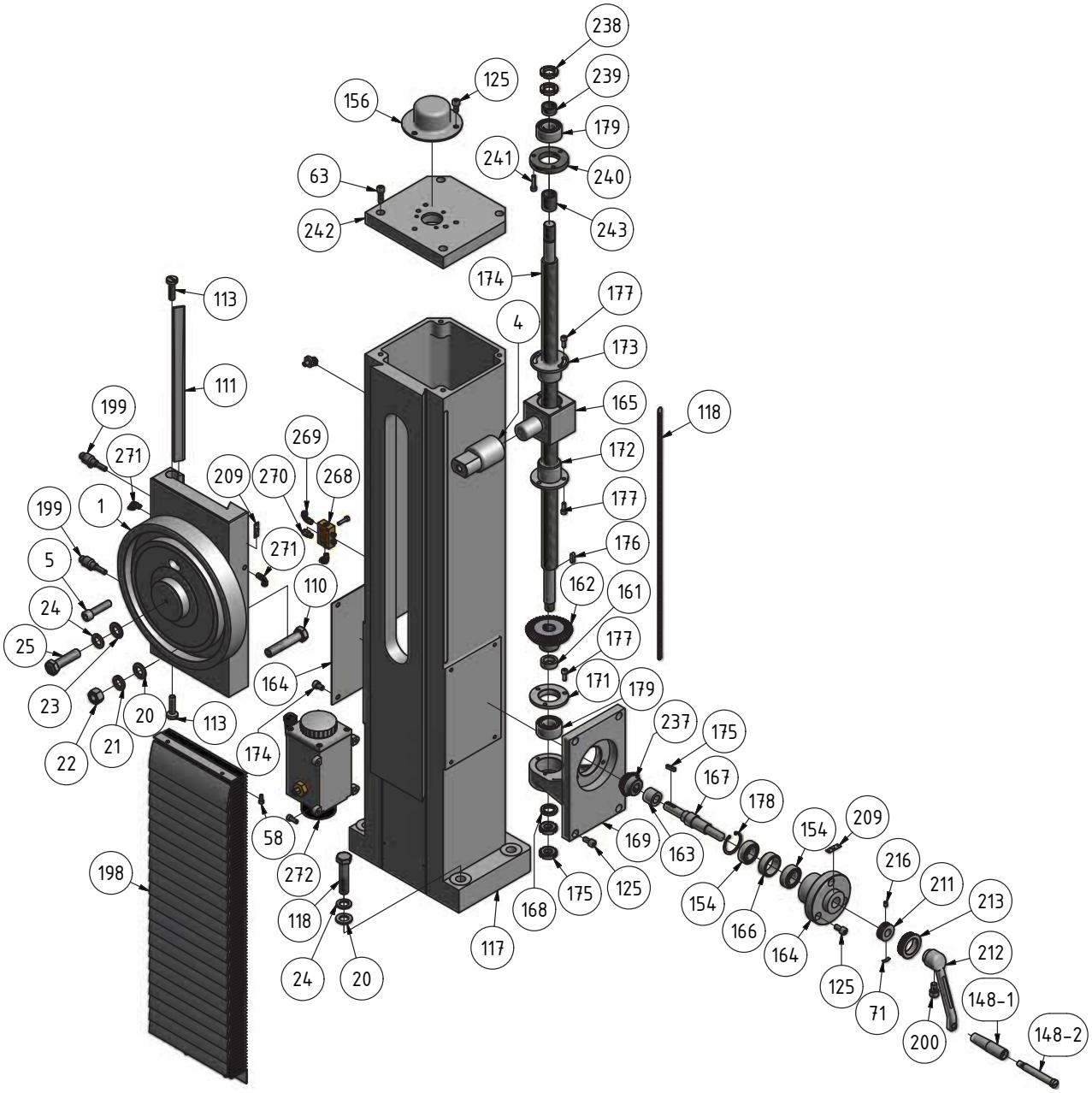
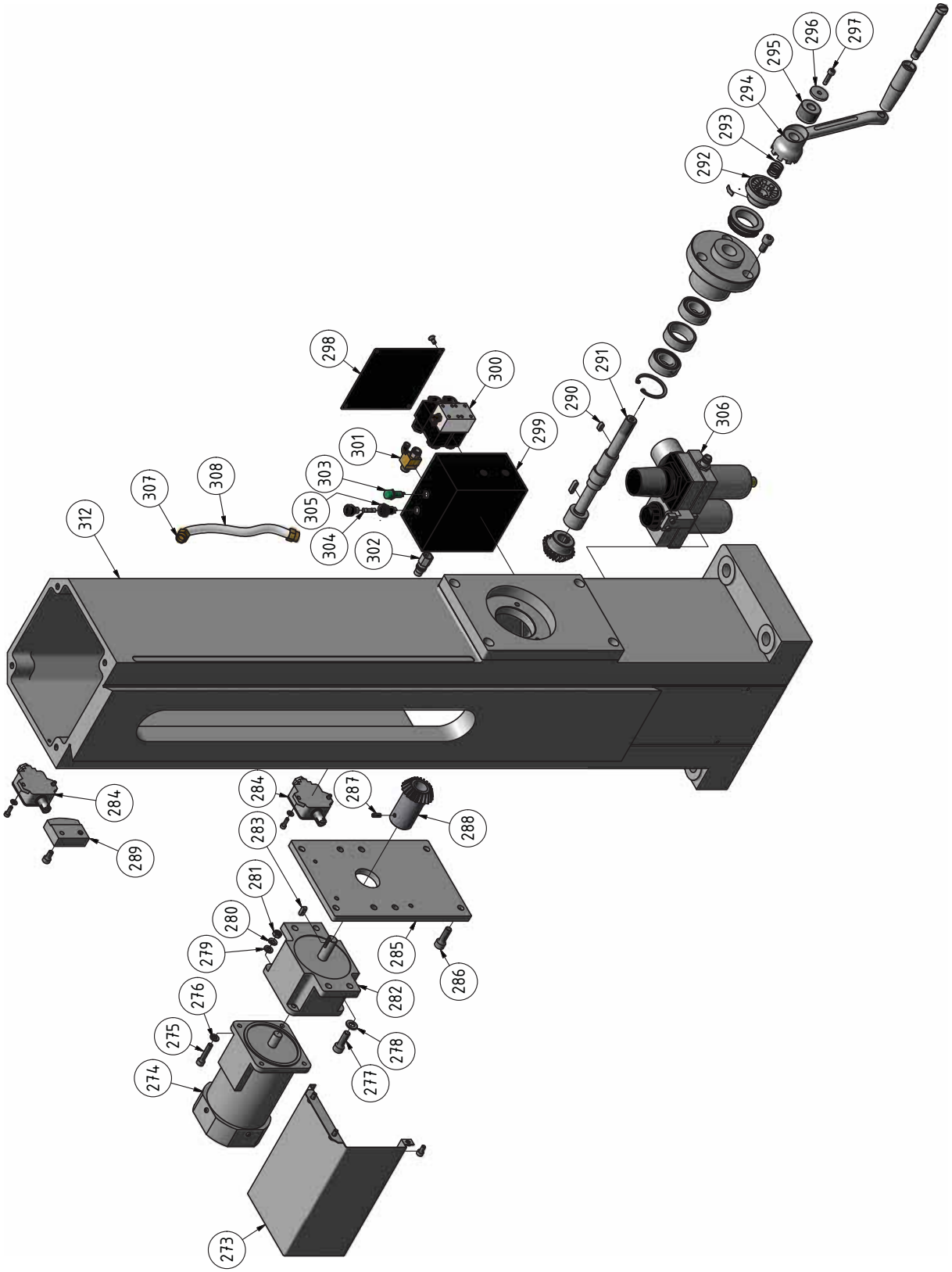


Abb.6-6: Säule - Column

6.7 Säule - Column BF46TC



Säule - Column BF46 TC Vario

6.8 Kreuztisch - Cross table 1 - 2

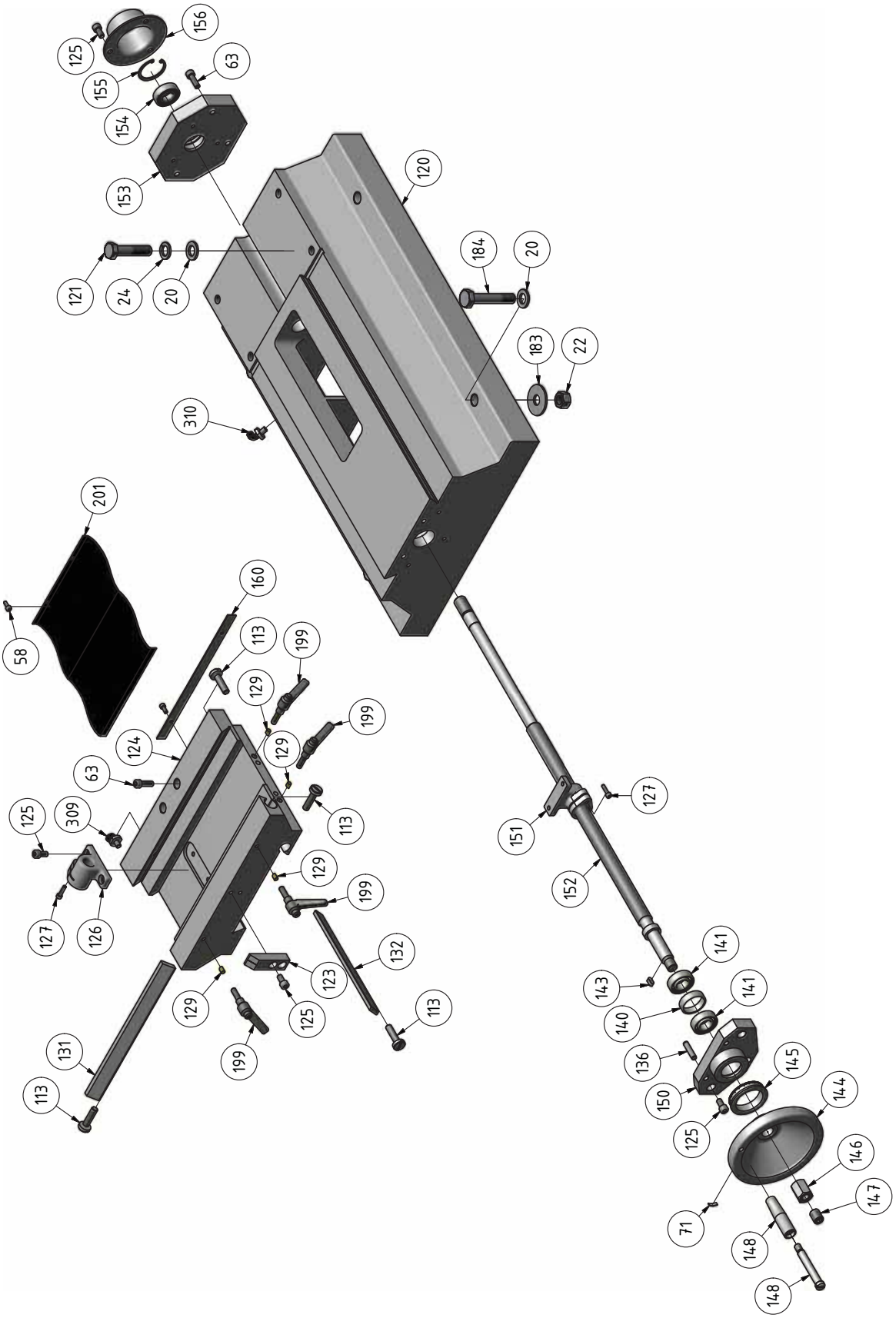


Abb.6-7: Kreuztisch - Cross table 1 - 2

6.9 Kreuztisch - Cross table 2 - 2

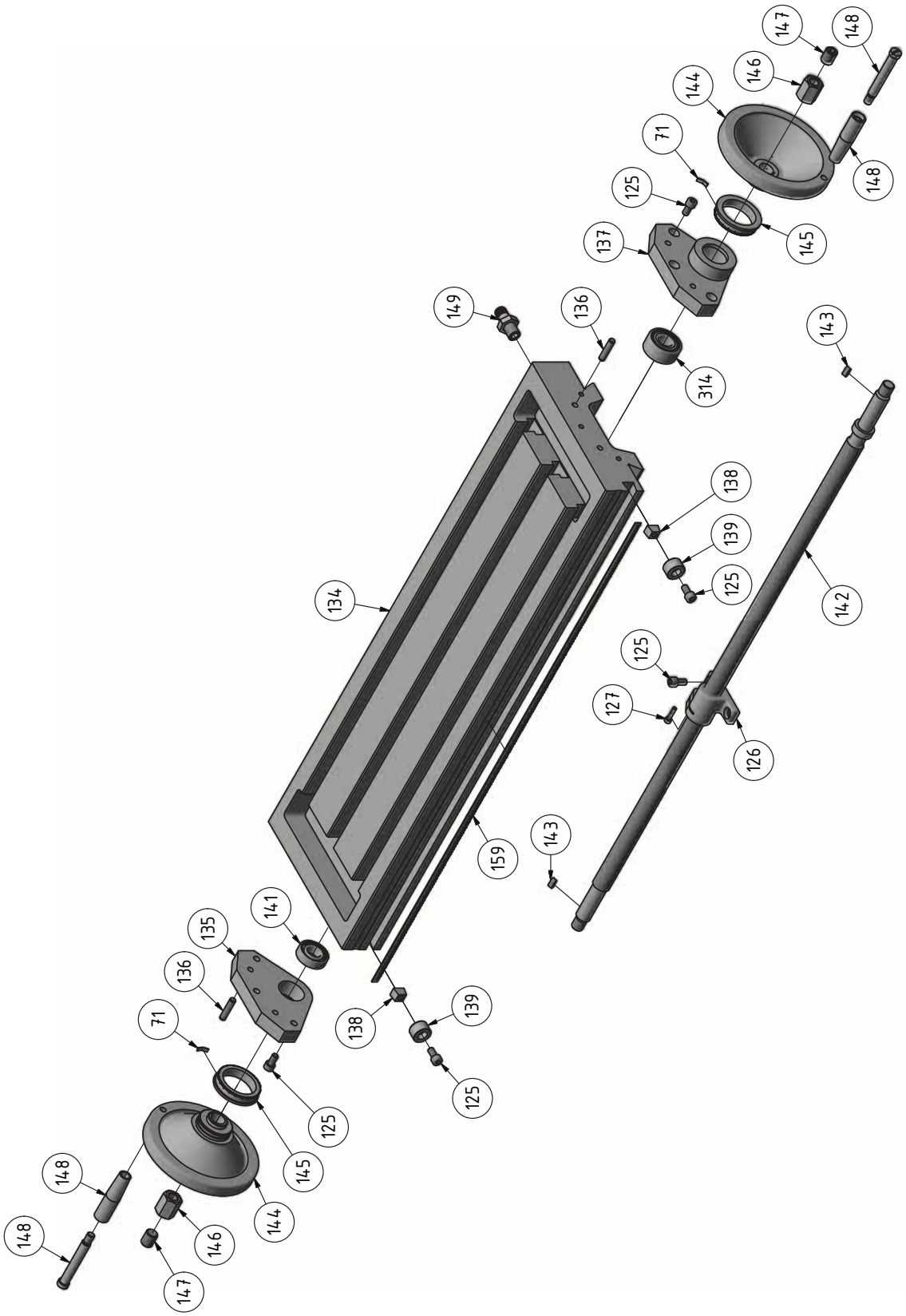


Abb. 6-8: Kreuztisch - Cross table 1 - 2

6.10 Schutzeinrichtung - Protection device

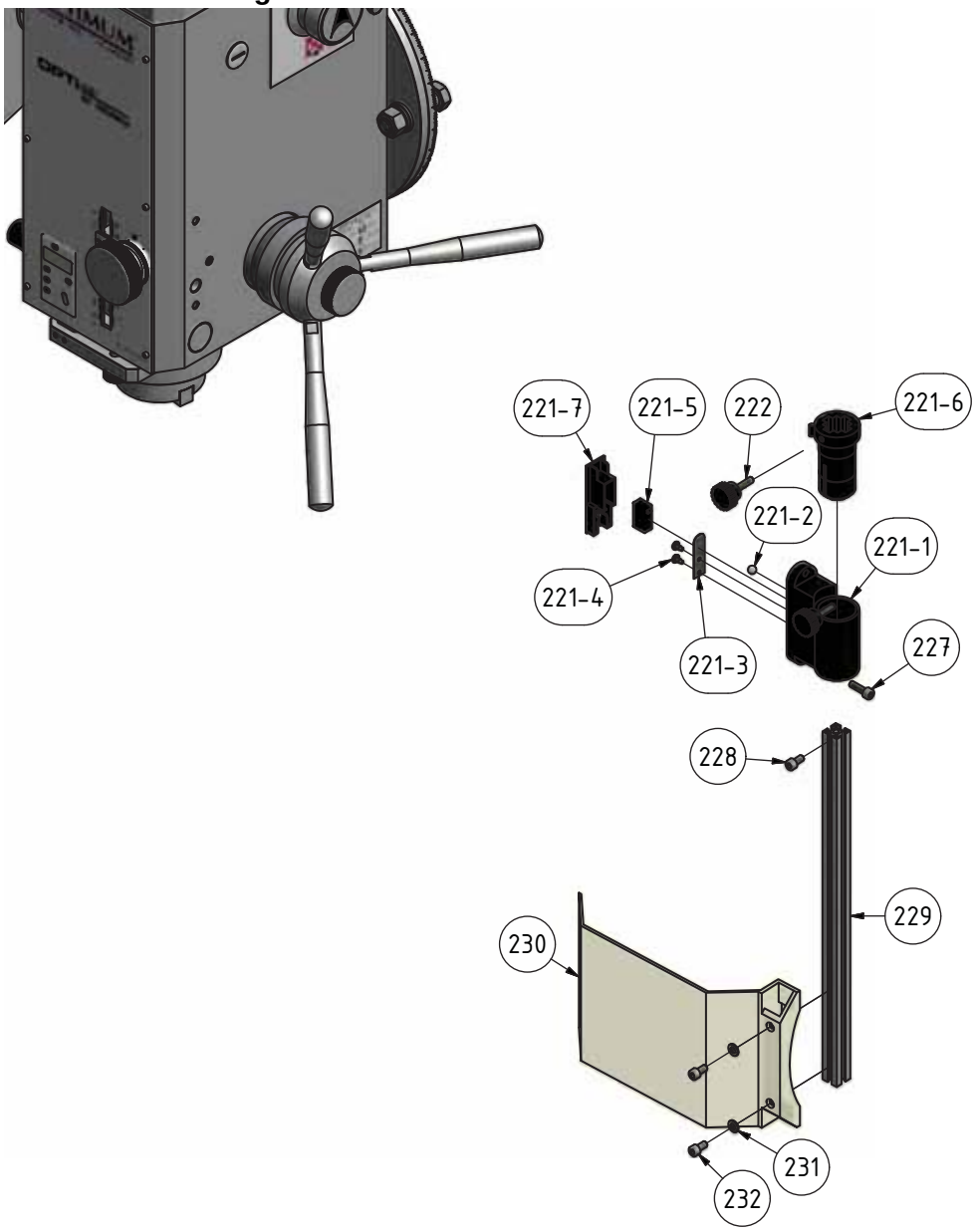


Abb. 6-9: Schutzeinrichtung - Protection device

6.11 Maschinenunterbau (Optional) - Machine stand (option)

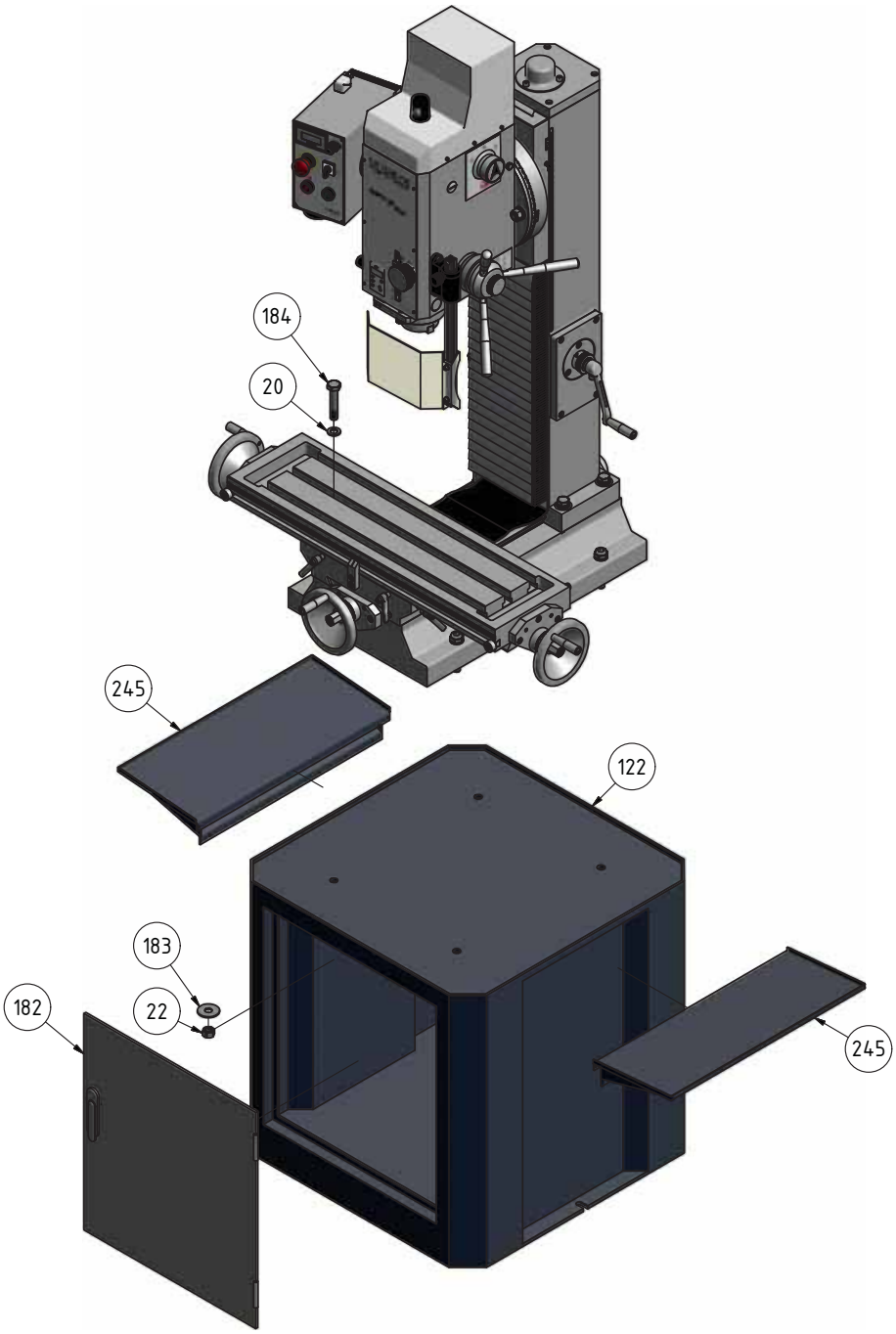


Abb. 6-10: Maschinenunterbau (Optional) - Machine stand (option)

6.12 Maschinenschilder - Machine labels

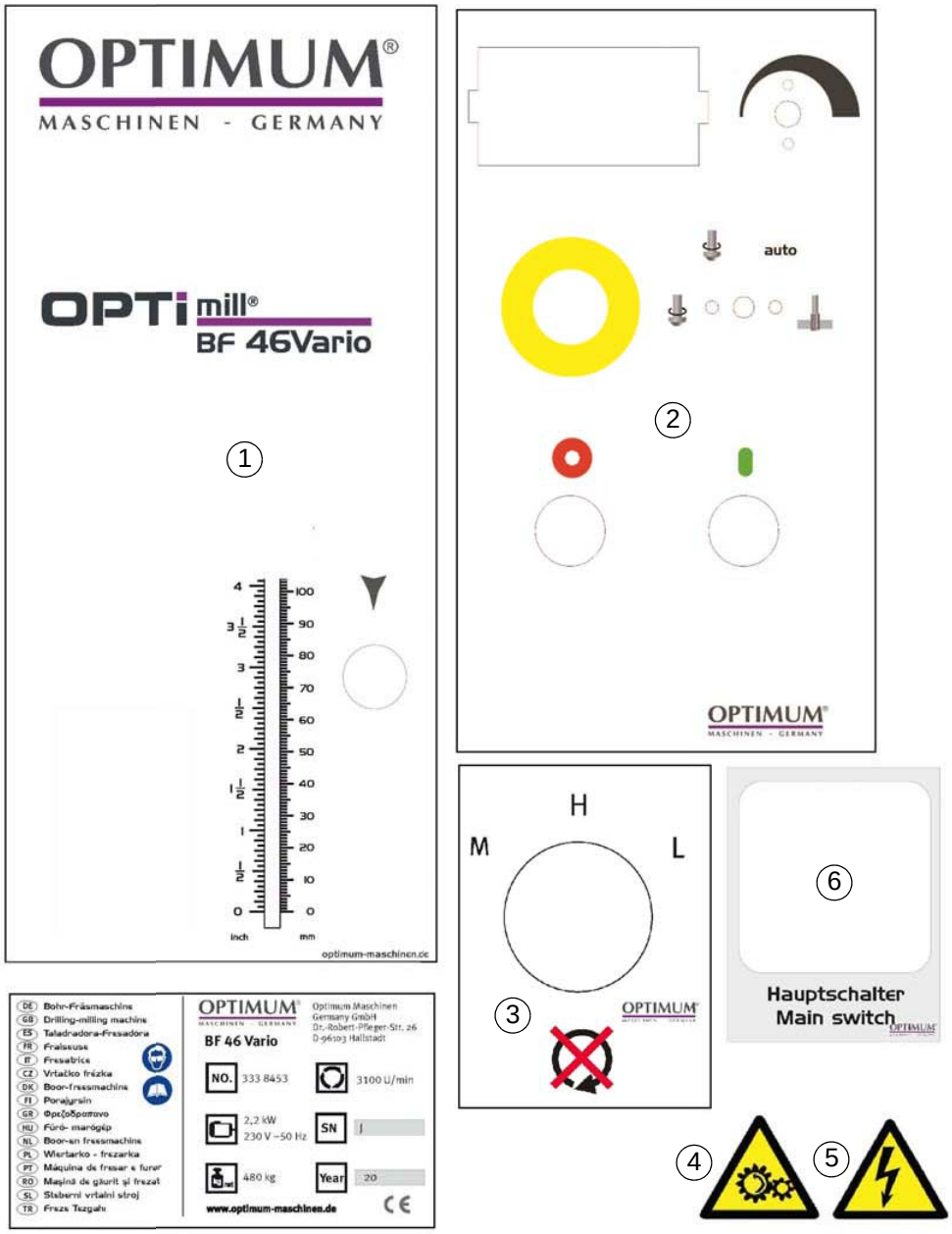


Abb. 6-11: Maschinenschilder - Machine labels

6.12.1 Maschinenschilder - Machine labels

Pos.	Bezeichnung	Designation	Menge Quan-tity	Grösse Size	Artikelnummer Article no.
1	Frontschild	Front label	1	BF46 Vario	03338456L01
				BF TC Vario	03338456L01
2	Schild Schaltkasten	Switch box label	1	BF46 Vario	03338456L02
				BF TC Vario	03338456L02
3	Getriebeschild	Gear box label	1		03338456L03
4	Sicherheitsschild	Safety label	1		03338456L04
5	Sicherheitsschild	Safety label	1		03338456L05
6	Label Hauptschalter	Label main switch	1		03338456L06

6.12.2 Ersatzteileliste - Spare parts list

Pos.	Bezeichnung	Designation	Menge	Zeichnungs-nummer	Grösse	Artikel-nummer
			Qty.	Drawing no.	Size	Item no.
1	Drehlagerbock	Connect board	1	1015119		0333845301
2	Innensechskantschraube	Socket head screw	1	ISO 4762	M3 x 10	
3	Digitale Anzeige	Digital indicator	1	DQ-02A		0333845303
5	Sechskantschraube	Hexagon screw	1	DIN 912	M12 x 50	
6	O-Ring	O-ring	1	DIN 3771	77.5 x 5.3	0333845306
7	Pinole ISO 40	Pinole	1	1015105b		0333845307
	Pinole für MK4 optional	Pinole	1	1015105		
8	Kegelrollenlager ISO 40 Pinole	Taper roller bearing ISO40	1		33209_Q	04033209
	Kegelrollenlager MK4 Pinole, Optional	Taper roller bearing MT4, option	1		33208_Q	
9	Spindel ISO 40	Spindle ISO 40	1	1015101_SK40	SK40	0333845309
	Spindel MK4, Optional	Spindle MT4, option	1	1015101_MK4	MK4	
10	Kegelrollenlager	Taper roller bearing	1		33007	04033007
11	Gewindestift	Set screw	1	DIN 915	M10 x 25	
12	Sechskantmutter	Hexagon nut	1	DIN 934	M10	
13	Sicherungsring	Snap ring	1	DIN 472	80 x 2.5	0333845313
14	Rillenkugellager	Grooved ball bearing	1		6011-2RZ	0406011.2R
15	Klemmmutter	Clamping nut	1	1015106		0333845315
16	Sechskantschraube	Hexagon screw	2	DIN 912	M5 x 12	
17	Halter	Support	1	1015103b		0333845317
18	Sechskantschraube	Hexagon screw	1	DIN 912	M8 x 20	
19	Gewindestift	Set screw	2	DIN 915	M4 x 8	
20	Scheibe	Washer	11	DIN125	A 16	
21	Federring	Lock washer	1	DIN 127	A 16	0333845321
22	Sechskantmutter	Hexagon nut	7	ISO 4032	M16	
23	Scheibe	Washer	1	DIN 125-2	17	
24	Federring	Lock washer	7	DIN 128	A16	0333845324
25	Sechskantschraube	Hexagon screw	1	ISO 4017	M16 x 60	
26	Schaftritzel	Pinion shaft	1	1015135		0333845326
27	Rillenkugellager	Grooved ball bearing	2		6003	0406003.2R
28	Ölschauglas	Oil sight glas	1			0333845328
29	O-Ring	O-ring	1	DIN 3771	20 x 2.65 - N - NBR 70	0333845329
30	Sechskantschraube	Hexagon screw	1	AS 2465	3/8 x 1/2 UNC	0333845330
31	Kupferscheibe	Copper washer	1		10	0333845331
32	Verzahnte Antriebswelle	Toothed drive shaft	1	1015107		0333845332
33	Paßfeder	Key	1	DIN 6885	A10 × 6 × 18	0333845333
34	Sicherungsring	Snap ring	2	DIN 471	48	0333845334
35	Zahnrad 55Z	Gear 55	1	1015108		0333845335
36	Gegenhalter Anzugsstange	Holder drawin bar	1	1015141		0333845336
37	Anzugsstange ISO 40	Drawin bar	1	1015701b		0333845337
	Anzugsstange MK4	Screw rod MT4 drawin bar	1	1015701		0333845337MK4
38a	Welle, Baujahr bis 2011	Shaft, year of manufacture to 2011	1	1015113		0333845338a
38	Welle, Baujahr ab 2011	Shaft, year of manufacture from 2011	1			0333845338
39	Zahnrad 37Z	Gear 37T	1	Baujahr bis/Year to 2006	gerade verzahnt/ straight teeth	0333845339A
39	Zahnrad 37Z	Gear 37T	1	Baujahr ab/Year from 2006	schräg verzahnt/ helical teeth	0333845339
40	Paßfeder	Key	1	DIN 6885	A 6 x 6 x 10	0333845340
41	Paßfeder	Key	1	DIN 6885	A 6 x 6 x 70	0333845341
42	Sicherungsring	Snap ring	1	DIN 471	17	0333845342
43	Sicherungsring	Snap ring	1	DIN472	35	0333845343
44a	Zahnrad, Baujahr bis 2011	Gear, year of manufacture to 2011	1	1015114		0333845344a
44	Zahnrad, Baujahr ab 2011	Gear, year of manufacture from 2011	1			0333845344
45	Paßfeder	Key	1	DIN 6885	A 6 x 6 x 16	0333845345
46	Zahnrad 47Z	Gear 47	1	1015115		0333845346
47	Zahnrad 3Z	Gear 33	1	1015116		0333845347
48	Sicherungsring	Snap ring	1	DIN 471	32	0333845348
49	Fräskopf Gehäusedeckel	Milling head housing cover	1	1015109		0333845349
50	Sicherungsring	Snap ring	1	DIN 472	55	0333845350
51	Rillenkugellager	Grooved ball bearing	2		6307.2R	0406307R
52	Zahnrad	Gear wheel	1	1015117	1015117	0333845352
53	Motor	Motor	1		Motor 2,2 KW	0333845353
54	Paßfeder	Key	1	DIN 6885	A 6 x 6 x 36	0333845354
55	Sicherungsring	Snap ring	1	DIN 471	32 x 1.5	0333845355
56	Rillenkugellager	Grooved ball bearing	1		6308-2RZ	0406308.2R
57	Lagerdeckel	Bearing cover	1	1015110		0333845357
58	Innensechskantschraube	Socket head screw	13	ISO 4762	M5 x 12	
59	Belüftungsschraube	Vent screw	1	1015142		0333845359
60	Innensechskantschraube	Socket head screw	6	ISO 4762	M8 x 40	
61	Zylinderstift	Cylindrical pin	2	ISO 8734	8 x 50 - A	0333845361

Pos.	Bezeichnung	Designation	Menge	Zeichnungs-nummer	Grösse	Artikel-nummer
			Qty.	Drawing no.	Size	Item no.
62	Scheibe	Washer	7	DIN 125	8	
63	Innensechskantschraube	Socket head screw	27	ISO 4762	M8 x 25	
64	Klemmbolzen	Clamping bolt	1	1015138		0333845364
65	Klemmbolzen	Clamping bolt	1	1015139		0333845365
66	Klemmhebel	Clamping lever	1			0333845366
67	Schneckenrad 35Z	Taper gear wheel 35	1	1015133		0333845367
68	Schneckenwelle	Worm shaft	1	1015129		0333845368
69	Skalenring	Scale ring	1	1015130		0333845369
70	Rändelscheibe	Knurling tool	1	1015131		0333845370
71	Federblech	Spring plate	4	D140-04-09		0333845371
72	Gewindestift	Set screw	1	DIN 916	M6 x 8	
73	Nabe	Hub	1	1015134		0333845373
74	Griffhebel	Lever	3			0333845374
74	Griffhebel ab Baujahr 05/2009	Lever year of manufacture 05/2009	3			03338430227
75	Paßfeder	Key	1	DIN 6885	A 8 x 7 x 20	0333845375
76	Gewindestange	Threaded rod	1	1015128-2		0333845376
77	Druckfeder	Compression spring	1	2×14×30-3	2×14×30-3	0333845377
78	Rändelscheibe	Knurling tool	1	1015128-1		0333845378
79	Spannstift	Spring pin	1	ISO 13337	3 × 25	
80	Meßlineal Digitalanzeige	Measuring ruler digital display	1			0333845380
80-1	Schutzabdeckung	Protective cover	1			03338453801
80-2	Innensechskantschraube	Socket head screw	!			
81	Bohrtiefenanschlag	Drilling depth stop	1	1015122		0333845381
82	Gewindestange	Threaded rod	1	1015121		0333845382
83	Rändelscheibe	Knurling tool	1	1015123		0333845383
84	Spannstift	Spring pin	1	ISO13337	3 × 14	
85	Mitnehmerscheibe	Driving disk	1	1015136		0333845385
86	Sechskantschraube mit Schlitz	Hexagonal screw with slot	1	ISO 1207	M5 x 10	
87	Rückholfeder	Return spring	1	1015137		0333845387
88	Schraube	Screw	2	DIN427	M3 × 10	
89	Rückholfederabdeckung	Return spring housing	1	1015120		0333845389
90	Scheibe	Disk	1	1015140		0333845390
91	Innensechskantschraube	Socket head screw	1	ISO 4762	M6 x 10	
92	Wahldrehschalter Getriebe	Choice rotary switch transmission	1	1015132		0333845392
93	Welle	Shaft	1	1015127		0333845393
94	Gewindestift	Set screw	1	DIN 914	M5 x 16	
95	O-Ring	O-ring	1	DIN 3771	6.9 × 1.8 G	0333845395
96	Aufnahmescheibe Schaltgabel	Support shift fork	1	1015126		0333845396
97	O-Ring	O-ring	1	DIN 3771	20 x 3.55 - N - NBR 70	0333845397
98	Schraube	Screw	3	ISO 10642	M5 × 10	
99	Gewindestift	Set screw	1	DIN 913	M8 x 8	
100	Stahlkugel	Steel ball	1	GB-T308-1994	6.5	03338453100
101	Positionsdeckel Wahldrehschalter	Position cover choice rotary switch	1	1015506		03338453101
102	Arm Schaltgabel	Arm shift fork	1	1015125		03338453102
103	Gewindestift	Set screw	1	DIN 913	M5 x 8	
104	Schaltgabel	Shift fork	1	1015124		03338453104
105	Sicherungsring	Snap ring	1	DIN 471	10 × 1	03338453105
106	Innensechskantschraube	Socket head screw	6	ISO 4762	M4 x 8	
107	Motorhaube	Motor cover	1	1015111		03338453107
108	Abdeckkappe	Cover cap	1	DM14-01-09		03338453108
109	Sechskantschraube	Hexagon screw	2	ISO 4014	M16 x 65	
110	Sechskantschraube	Hexagon screw	1	ISO 4014	M16 x 80	
111	Keilleiste	Taper gib	1	1015119		03338453112
113	Stellschraube	Adjusting screw	6	1015002		03338453113
114	Winkelskala	Angle scale	1	1015502		03338453114
116	Innensechskantschraube	Socket head screw	1	ISO 4762	4762-M4 × 8	
117	Säule	Column	1	1015301		03338453117
118	Winkelskala	Angle scale	1	1015503		03338453118
120	Maschinenfuss	Machine base	1	1015202		03338453120
121	Sechskantschraube	Hexagon screw	4	ISO 4014	M16 x 70	
122	Maschinenunterbau, optional	Machine stand, option	1	1015702		3353005
123	Marke Längenmessung Kreuztisch	Zero point - linear measurement cross table	1	1015204		03338453123
124	Kreuztischführung	Cross table guidance	1	1015210		03338453124
125	Innensechskantschraube	Socket head screw	28	ISO 4762	M8 x 16	
126	Spindelmutter X-Achse	Spindle nut x-axis	1	1015208		03338453126
127	Innensechskantschraube	Socket head screw	2	ISO 4762	M5 x 20	
128	Schmiernippel	Grease nipple	8			0340114
129	Messingstift	Brass pin	6			03338453129
131	Keilleiste X-Achse	Taper gib x-axis	1	1015207		03338453131
132	Keilleiste Y-Achse	Taper gib y-axis	1	1015215		03338453132

Pos.	Bezeichnung	Designation	Menge	Zeichnungs-nummer	Grösse	Artikel-nummer
			Qty.	Drawing no.	Size	Item no.
134	Frästisch	Milling table	1	1015209		03338453134
135	Lagerbock X-Achse	Bearing block x-axis	1	1015219		03338453135
136	Zylinderstift	Cylindrical pin	6	ISO 2338	8 h8 x 35	03338453136
137	Lagerbock X-Achse	Bearing block x-axis	1	1015218		03338453137
138	Nutenstein Endanschlag X-Achse	Slots stone end stop x-axis	2	1015206		03338453138
139	Hülse Endanschlag X-Achse	Bushing end stop x-axis	2	1015205		03338453139
140	Distanzring	Spacer ring	2	1015220		03338453140
141	Rillenkugellager	Grooved ball bearing	5	6004	6004	0406004.2R
142	Spindel X-Achse	Spindle x-axis	1	1015216		03338453142
143	Paßfeder	Key	3	DIN 6885	A 6 x 6 x 14	03338453143
144	Handrad	Handwheel	3	1015211		03338453144
145	Skalenring	Scale ring	3	1015213		03338453145
146	Klemmmutter	Clamping nut	3	1015212		03338453146
147	Gewindestift	Set screw	3	DIN 913	M16 x 20	
148	Griff komplett	Handle complete	4	JB-T7270.4-1994		03338453148
148-1	Hülse	Bushing	4			033384531481
148-2	Schraube	Screw	4			033384531482
149	Einschraubanschluss Kühlmittel-abfluss	Screwing in connection coolant drainage	1	1015217		03338453149
150	Lagerbock Y-Achse	Bearing block y-axis	1	1015201		03338453150
151	Spindelmutter Y-Achse	Spindle nut y-axis	1	1015214		03338453151
152	Spindel Y-Achse	Spindle y-axis	1	1015203		03338453152
153	Lagerbock Y-Achse	Bearing block y-axis	1	1015221		03338453153
154	Rillenkugellager	Grooved ball bearing	4	6004-2Z	6004-2Z	0406004.2R
155	Sicherungsring	Snap ring	1	DIN 472	45 x 1.75	03338453155
156	Spindelabdeckung	Spindle cover	2	1015222		03338453156
158	Lagerbock	Bearing block	1	1015308		03338453158
159	Skala X-Achse	Scale x-axis	1	1015504		03338453159
160	Leiste	Plate	1			03338453160
161	Distanzhülse	Spacer	1	1015302		03338453161
162	Kegelzahnrad 42	Taper gear 42	1	1015303		03338453162
163	Distanzhülse	Spacer	1	1015305		03338453163
164	Flansch	Flange	1	1015306		03338453164
165	Spindelmutter Z-Achse	Spindle nut z-axis	1	1015307		03338453165
166	Distanzring	Spacer	1	1015310		03338453166
167	Welle	Shaft	1	1015311		03338453167
168	Scheibe	Disk	1	1015312		03338453168
169	Lagerbock Z-Achse	Bearing block z-axis	1	1015313		03338453169
170	Abdeckblech Säule	Cover plate column	1	1015314		03338453170
171	Lagerdeckel	Bearing cover	1	1015315		03338453171
172	Spindelmutter Z-Achse	Spindle nut z-axis	1	1015316		03338453172
173	Spindelmutter Z-Achse	Spindle nut z-axis	1	1015317		03338453173
174	Innensechskantschraube	Socket head screw	4	ISO 4762	M8 x 12	
175	Paßfeder	Key	1	DIN 6885	A 5 x 5 x 20	03338453175
176	Paßfeder	Key	1	DIN 6885	A 6 x 6 x 20	03338453176
177	Innensechskantschraube	Socket head screw	8	ISO 4762	M6 x 16	
178	Sicherungsring	Snap ring	2	DIN 472	42 x 1.75	03338453178
179	Schrägkugellager	Skew-angle roller bearing	1		3204 A	0403204A.2R
180	Spindel Z-Achse	Spindle z - axis	1	1015309		03338453180
181	Nutmutter	Groove nut	2	DIN 1804	M16	03338453181
182	Tür Maschinenunterbau	Door machine stand	1	1015702_1		03338453182
183	Scheibe	Washer	4	DIN 9021	17	
184	Sechskantschraube	Hexagonal screw	4	DIN 6914	M16 x 85	
185	Schalter Drehrichtung	Switch R/L	1			03338453185
186	Potentiometer	Potentiometer	1			03338453186
186-1	Knopf	Knob	1			033384531861
187	Drucktaster Aus	Push button off	1			03338453187
188	Drucktaster Ein	Push button on	1			03338453188
189	Not Aus Schlagschalter	Emergency OFF push button	1			03338453189
190	Hauptschalter	Main switch	1			03338453190
191	Innensechskantschraube mit Senkkopf	Socket head screw with countersunk head	14	ISO 10642	M4 × 6	
192	Schaltkasten - Deckel	Electric box - cover	1	1015402		03338453192
193	Schaltkasten - Gehäuse	Electric box - housing	1	1015401		03338453193
194	Schaltkasten - Abdeckung	Electric box - cover	1	BF46-FL223-003		03338453194
195	Innensechskantschraube	Socket head screw	4	ISO 4762	M3 x 12	
198	Faltenbalg	Bellows	1	1015004		03338453198
199	Klemmhebel	Clamping lever	6			03338453199
200	Innensechskantschraube	Socket head screw	1	ISO 4762	M10 x 16	
201	Gummiabdeckung	Rubber cover	1			03338453201
202	Steuerplatine	Control board	1	03338453700		03021303201

Pos.	Bezeichnung	Designation	Menge	Zeichnungs-nummer	Grösse	Artikel-nummer
			Qty.	Drawing no.	Size	Item no.
203	Zugentlastung Anschlusskabel Schaltkasten	Strain relief lead switchbox	2			03338453203
204	Gewindestift	Set screw	2	DIN 913	M6 x 25	
205	Zylinderstift	Cylindrical pin	1	ISO 8733	8 x 40	
206	Gehäuse Fräskopf	Housing milling head	1	1015104		03338453206
207	Druckfeder	Compression spring	1		0.8×5×25-3	03338453207
208	Radial-Wellendichtring	Radial rotary shaft seal	1		CR 55x80x8 HMS4 R	03338453208
209	Marke Winkelskala	Zero point - scale	1	B26-02-27		03338453209
210	Zentrierstück Pinole	Centerring piece pinole	1	B26-02-04		03338453210
211	Laufring Skala	Center ring scale	1	1015319		03338453211
212	Handkurbel	Crank	1	B26-01-09		03338453212
213	Skala	Scale	1	1015318		03338453213
215	Elektronische Anzeige	Electronic display	1			03338453215
214	Schaltkasten - Schaltertafel	Electric box - switch plate	1	1015403		03338453214
216	Innensechskant - Stiftschraube	Threaded pin	1	M6 x 8	M6 x 8	
217	Befestigungswinkel	Attaching bracket	1			03338453217
221	Halter	Support	1			03338453221
221-1	Gehäuse	Housing	1			033384532211
221-2	Stahlkugel	Steel ball	1			033384532212
221-3	Federblech	Spring plate	1			033384532213
221-4	Schraube	Screw	2			033384532214
221-5	Mikroschalter	Micro switch	1			033384532215
221-6	Aluminium Profilaufnahme	Aluminium profile admission	1			033384532216
221-7	Deckel	Cover	1			033384532217
222	Klemmschraube	Clamping scew	1			03338453222
223	Befestigungswinkel	Attaching bracket	1			03338453223
224	Innensechskantschraube	Socket head screw	2			03338453224
225	Sensor Endlage unten	Sensor end position below	1			03338453225
225-1	Sensor Endlage oben	Sensor end position top	1			033384532251
225-2	Drehzahlsensor	Rotation speed sensor	1			033384562252
226	Mutter	Nut	4			03338453226
227	Innensechskantschraube	Socket head screw	2			03338453227
228	Innensechskantschraube	Socket head screw	1			03338453228
229	Aluminiumprofil	Aluminium profile	1			03338453229
230	Schutz	Protection	1			03338453230
231	Scheibe	Washer	2			03338453231
232	Innensechskantschraube	Socket head screw	2			03338453232
233	Anzeiger Bohrtiefenanschlag	indicator drilling depth stop	1			03338453233
234	Mitnehmer Fräswerkzeug	Socket piece milling tool	2			03338453234
235	Innensechskantschraube	Socket head screw	2	GB 70 - 85	M8 x 16	
237	Kegelzahnrad 21 Zähne	Taper gear wheel 21 teeths	1	1015304		03338453236
238	Nutmutter	Groove nut	2	1015323		03338453238
239	Distanzhülse	Spacer	1	1015322		03338453239
240	Lagerdeckel	Bearing cover	1	1015320		03338453240
241	Innensechskantschraube	Socket head screw	3	GB 70 - 85	M6x25	
242	Lagerbock	Bearing block	1	1015308b		03338453242
243	Distanzhülse	Spacer	1	101531		03338453243
245	Spänewanne	Chip tray	2			03338453245
246	Zahnrad	Gear	1			03338453246
247	Halter Sensor	Holder sensor	1			03338456247
248	Anzugsstange	Drawin bar	1			03338456248
250	Platte	Plate	1			03338456250
251	Scheibe	Washer	1		DIN 125/6	
252	Innensechskantschraube	Hexagon socket screw	3		DIN 4762-M6x25	
253	Innensechskantschraube	Hexagon socket screw	4		DIN 4762-M8x70	
254	Abdeckung	Cover	1			03338456254
255	Winkel	Angle	1			03338456255
256	Innensechskantschraube	Hexagon socket screw	3		DIN 4762-M5x12	
257	Scheibe	Washer	3		DIN 125/6	
258	Drucktaster Ein	Button On	1			03352394125
259	Schaltergehäuse	Switch box	1			03352394123
260	Taster Aus	Button Off	1			03352394126
261	Deckel Schaltergehäuse	Cover switch box	1			03352394127
262	Luftschlauch	Air tube			4 mm	03338453262
263	Luftschlauch	Air tube			8 mm	03338456263
264	Abdeckung	Cover	1			03338456264
265	Abdeckung	Cover	1			03338456265
267	Taster	Button	2			03338456267
268	3-Wege Ventil	3-way distributor	1			03338456410
269	Anschluss	Plug	2			03338453269

Pos.	Bezeichnung	Designation	Menge	Zeichnungs-nummer	Grösse	Artikel-nummer
			Qty.	Drawing no.	Size	Item no.
270	Adapter	Adapter	1			03338453270
271	Anschluss	Plug	1			03338453271
272	Öler	Oiler	1			03336020001
273	Abdeckung	Cover	1			03338456273
274	Motor	Motor	1			03338456274
275	Innensechskantschraube	Hexagon socket screw	4		DIN 4762-M6x30	
276	Scheibe	Washer	4		DIN 125/6	
277	Innensechskantschraube	Hexagon socket screw	4		DIN 4762-M8x25	
278	Scheibe	Washer	4		DIN 125/8	
279	Scheibe	Washer	4		DIN 125/6	
280	Federring	Spring washer	4		DIN 129/6	
281	Sechskantmutter	Hexagon nut	4		DIN 4032/M6	
282	Getriebe	Gear box	1			03338456282
283	Passfeder	Fitting key	1		DIN 6885/5x5x14	
284	Endschalter	Endswitch	2			03338456284
285	Flansch	Flange	1			03338456285
286	Innensechskantschraube	Hexagon socket screw	4		DIN 4762-M8x25	
287	Gewindestift	Grub screw	2		DIN 4026/M5x12	
288	Endanschlag	End stop	1			03338456288
289	Endanschlag	End stop	2			03338456
290	Passfeder	Fitting key	1		DIN 6885/5x5x12	
291	Welle	Shaft	1			03338456291
292	Zahnkranz	Crown gear	1			03338456292
293	Feder	Spring	1			03338456293
294	Handkurbel	Crank	1			03338456294
295	Buchse	Sleeve	1			03338456295
296	Scheibe	Washer	1			03338453296
297	Innensechskantschraube	Hexagon socket screw	1		DIN 4762-M5x20	
298	Deckel Steuerungskasten	Cover control box	1			0335239488
299	Steuerungskasten	Control box	1			0335239490
300	Magnetventil	Electric valve	1			0335239492
301	T-Stück mit Schnellanschlüssen	T-fiting with quick connector	1			0335239497
302	Schnellanschluss	Quick connector	1			03352394122
303	Signallampe	Signal lamp	1			03352394114
304	Sicherung	Fuse	1		4A	03352394116
305	Sicherungsgehäuse kpl.	Fuse housing cpl.	1			03338453305
306	Wartungseinheit	Maintenance unit	1			03352394138
307	Schnellanschluss	Quick connector	2			03352394137
308	Luftschlauch	Air tube			13 mm	03352394135
309	Anschluss	Plug	1			03338453309
310	Anschluss	Plug	1			03338453310
311	Pneumatikzylinder	Pneumatic cylinder	1			0335239481
312	Säule BF46TC Vario	Column BF46TC Vario	1			03338456312
313	Halterung Bedienpanel	Holder control panel	1			03338430377
314	Kugellager	Ball bearing	1	3204A		0403204

6.13 Schaltplan 1 von 2 - Wiring diagram 1 of 2/ BF46, BF46TC

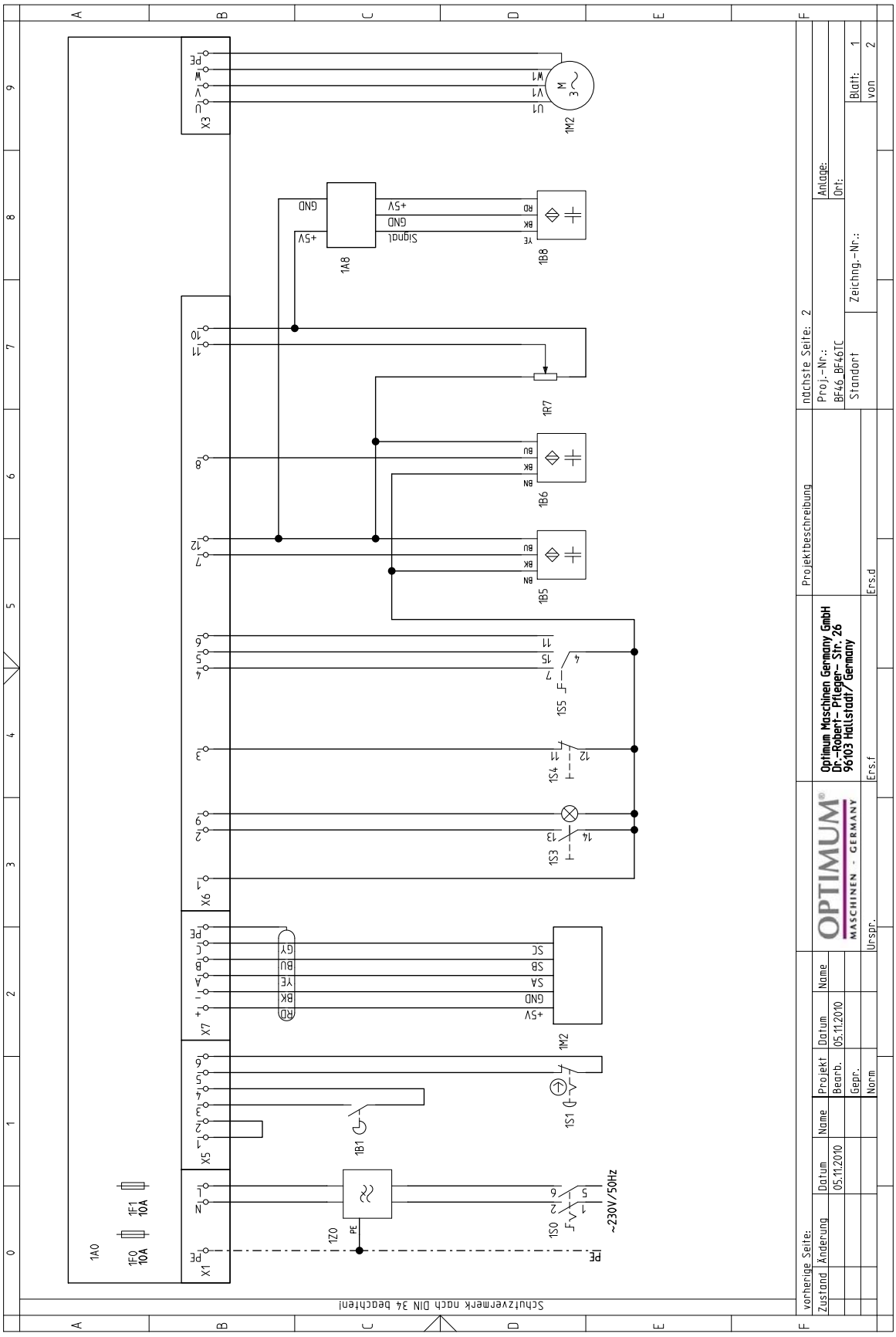


Abb.6-12: Schaltplan 1 von 2 - Wiring diagram 2 of 2/ BF46, BF46TC

6.14 Schaltplan 2 von 2 - Wiring diagram 2 of 2/ BF46TC

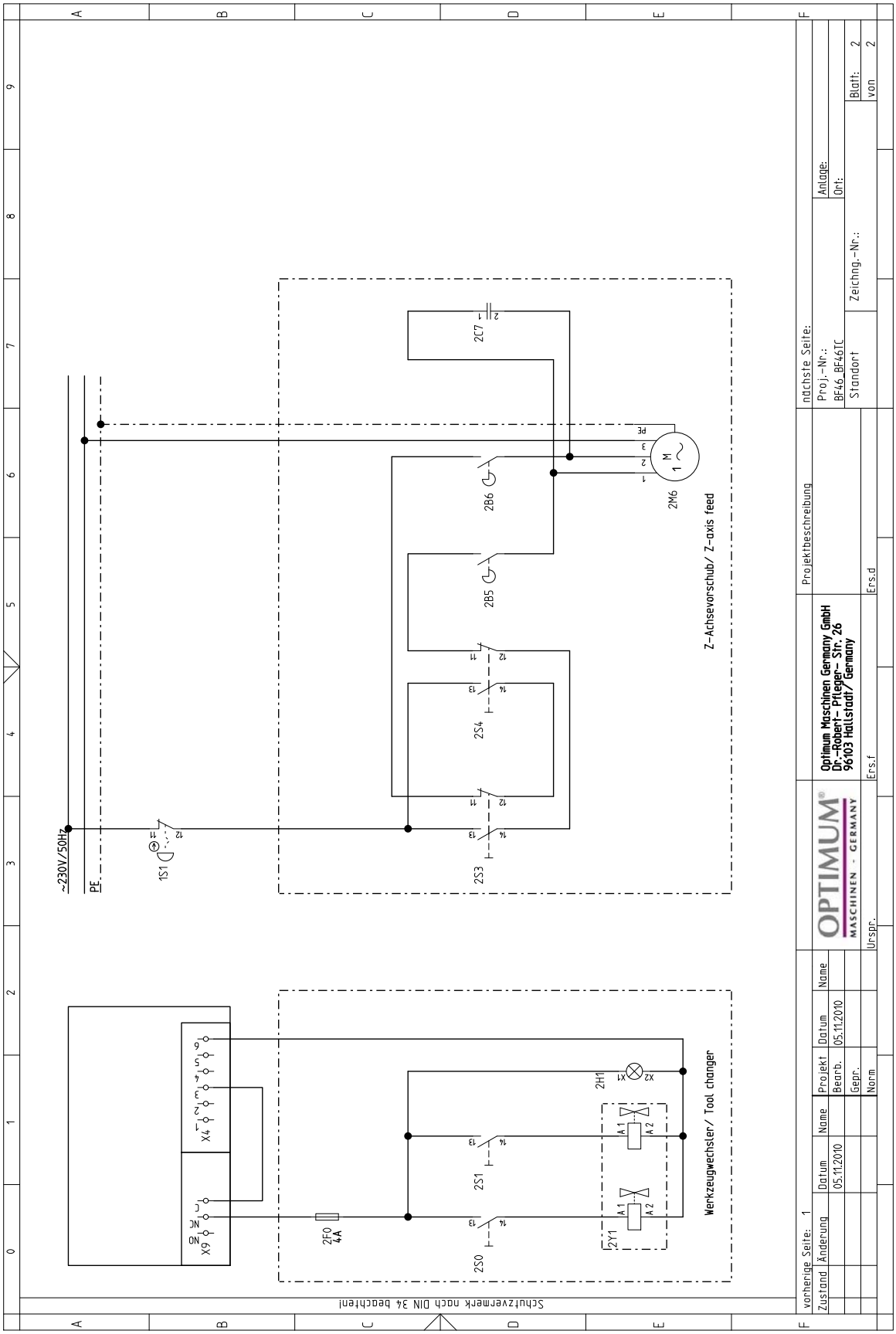


Abb. 6-13: Schaltplan 2 von 2 - Wiring diagram 2 of 2/ BF46TC

6.14.1 Teileliste Elektrik - Parts list electrical components BF46 Vario, BF46TC Vario

Pos.	Bezeichnung	Designation	Menge Qty.	Grösse Size	Artikelnummer Item no.
Teilliste Elektrik für BF46 Vario, BF46TC Vario/ Parts list electrical komponents for BF46 Vario, BF46TC Vario					
1S0	Hauptschalter	Main switch	1	LW8GS-20104-2/660V,20A	03338453190
1A0	Brushlesscontroller	Brushlesscontroller	1	Type V3	03034303156V3M
1F0	Sicherung	Fuse	1	10A	033384531F0
1Z0	Netzfilter	Line filter	1		033384531Z0
1B1	Sicherheitsschalter Fräsfutterschutz	Milling chuck safety switch	1		0302024153-4
1S1	Not-Aus-Schalter	Emergency-Stop button	1	LA103/10A, 660V	03338453189
1F1	Sicherung	Fuse	1	10A	033384531F0
1M2	Antriebsmotor	Drive motor	1		0333845353
1S3	Taster Ein	Button On	1	LA103XD-22/36V,10A	03338430386
1S4	Taster Aus	Button Off	1	LA103	03338453187
1S5	Funktionsschalter	Functional switch	1	Kraus&Naimer/ F89580/ 001	03338453185
1B5	Sensor obere Endstellung	Upper end position sensor	1		03021303225
1B6	Sensor untere Endstellung	Lower end position sensor	1		03021303230
1R7	Potentiometer	Potentiometer	1	WX14-12/4K7	03338120R1.5
1B8	Drehzahlsensor	Speed sensor	1		033384532252
1A8	Drehzahlanzeige	Rotation speed indicator	1	SN100304	03338120P1.3
Teilliste Elektrik nur für BF46TC Vario/ Parts list electrical komponents only for BF46TC Vario					
2S0	Taster Werkzeugwechsler	Button tool changer	1	SHAN-HO/ 6A, 250V AC	03352394125
2F0	Sicherung	Fuse	1	4A	03352394116
2S1	Taster Werkzeugwechsler	Button tool changer	1	SHAN-HO/ 6A, 250V AC	03352394126
2H1	Signalleuchte	Work light	1	24V	03352394114
2Y1	Magnetventil	Solenoid valve	1	Amisco 24V, 5A	0335239492
2S3	Taster Vorschub Z-Achse	Button feed z-axis	1	LA130/ 400V, 12A	03338453267
2S4	Taster Vorschub Z-Achse	Button feed z-axis	1	LA130/ 400V, 12A	03338453267
2B5	Endschalter	Endswitch	1	Delixi 220V/3A	03338453284
2M6	Motor Vorschub Z-Achse	Z-axis feed motor	1	220V, 120W, 0,95A, 1350 U/min	03338453274
2B6	Endschalter	Endswitch	1	Delixi 220V/3A	03338453284
2C7	Kondensator	Capacitor	1	7µF/150V	033384562C7

6.15 Schmierplan - Lubrication diagram

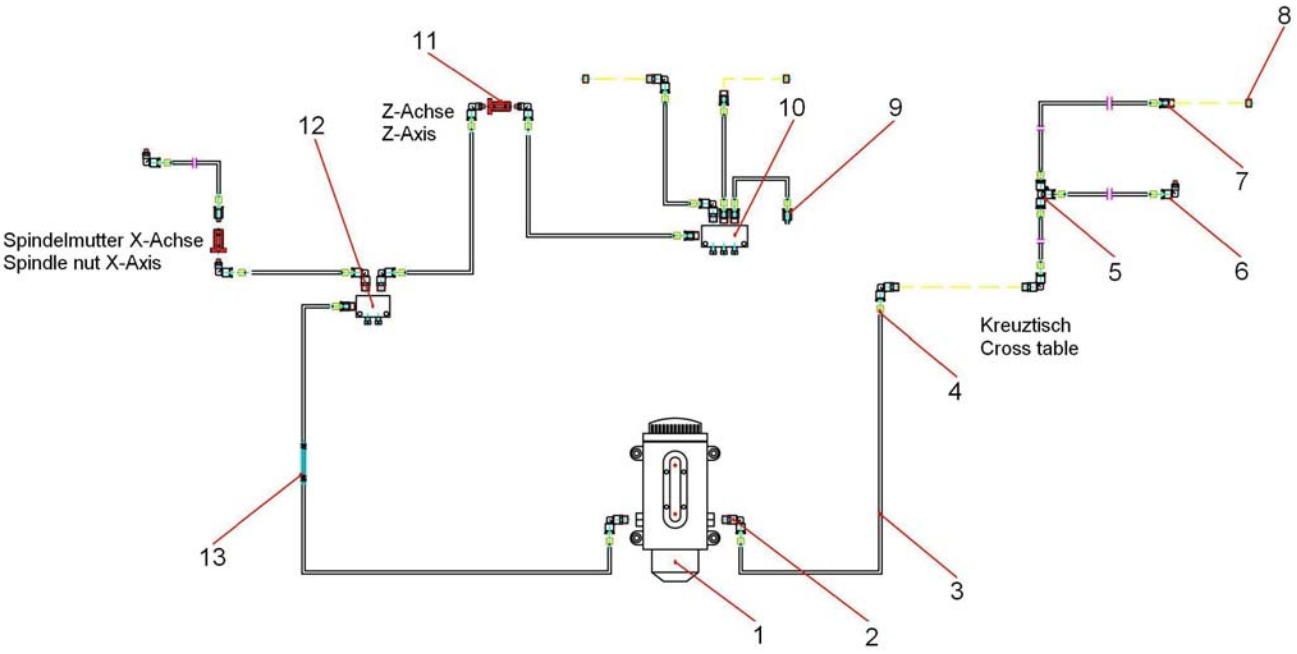


Abb. 6-14: Schmierplan - Lubrication diagram

6.15.1 Teileliste Schmiervorrichtung - Lubricating unit

Pos.	Bezeichnung	Designation	Menge Qty.	Grösse Size	Artikelnummer Item no.
1	Öler	Oiler	1		03336020001
2	L- Anschluss	L- Connector	8	M10x1	03338456402
3	Ölleitung	Oil tube		4mm	03338456403
4	Schutzkappe	Protecting cap	14		03338456404
5	T- Anschluss	T- Connector	1		03338456405
6	L- Anschluss	L- Connector	2		03338456406
7	Reihenanschluss	Series connection	2	M10x1	03338456407
8	Verschraubung	Screwing	3	M10x1	03338456408
9	Reihenanschluss	Series connection	1		03338456409
10	Verteiler	Manifold	1		03338456410
11	Anschlussschraube	Connector screw	1		03338456411
12	Verteiler	Manifold	1		03338456412
13	Schlauchschutz	Tube protection			03338456413

7 Malfunctions

7.1 Damage to the drilling-milling machine.

Malfunction	Cause / possible effects	Solution
The drilling-milling machine does not start	• Power-on sequence ignored.	• ☞ "Switching on the drilling-milling machine“ on page 29 and ☞ "Switching on the drilling-milling machine“ on page 34 • Have it checked by authorised personnel.
Tool "burnt".	• Incorrect speed. • Chips do not come out of the bore hole • Tool blunt. • Operating without cooling agent.	• Select another rate, feed too high. • Pull out tool more often. • Sharpen or replace tool. • Use cooling agent
Impossible to insert grip cone into the spindle sleeve.	• Remove any dirt, grease or oil from the internal conical surface of the spindle sleeve or the grip cone.	• Clean surfaces well Keep surfaces free of grease.
It is not possible to push-out the taper.	• Optional MT4 taper is shrinked on the Morse taper.	• Let the machine run at highest speed for two minutes in order to warm it up and then retry to disassemble the taper.
Motor does not start	• Defective fuse.	• Have it checked by authorised personnel.
Working spindle rattling on rough piece surfaces	• 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 is blunt. • The workpiece is not fastened. • Excessive slack in bearing. • Working spindle goes up and down.	• Perform conventional milling. • Tighten clamping lever • Check, re-tighten. • Sharpen or replace tool • Clamp the workpiece firmly. • Readjust bearing slack or replace bearing • Readjust bearing slack or replace 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 40 • 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-axis travel
Taper mandrel	Cone of the drill or of the drill chuck
Workpiece	Piece to be milled, drilled or machined.
Draw-in rod	Threaded rod to fix the taper mandrel in the spindle sleeve.
Drill chuck	Drill bit chuck
Collet chuck	Holder for end mill
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	Supporting surface, clamping surface
Taper mandrel	Cone of the drill or of the drill chuck
Spindle sleeve lever	Manual operation for the drill feed
Quick action - drill chuck	Drill chuck can be fixed by hand.
Workpiece	Piece to be drilled or machined.
Tool	Milling cutter, drill bit, etc.

8.3 Change information manual

Chapter	Short note	new version number
4.3	Warming up of the drilling-milling machine Fast on and off.	1.1.1
	CE declaration	1.1.2
4.17	New digital display for spindle sleeve travel	1.1.3

8.4 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 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 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.

8.5 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.

8.5.1 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.

- **Dsconnect the plug from the power supply.**
- **Cut 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.**

8.5.2 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.

8.5.3 Disposing 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 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.

8.5.4 Disposal of electrical and electronic components

Please make sure that the electrical components are disposed of professionally and according to the legal regulations.

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.

8.5.5 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.

8.6 Disposal via municipal collection

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 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.

8.7 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 .

8.8 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
- 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
Email: info@optimum-maschinen.de

EC - Declaration of Conformity

Machinery Directive 2006/42/EC Annex II 1.A

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

hereby declares that the following product,

Type of machine:	Drilling-milling machine
Type designation:	BF46V ; BF46TC
Serial number:	_ __ __ __ __
Year of manufacture:	20__

Manual geared drill with with frequency converter for speed control for private persons as well as for craft and industrial plants which meets all the relevant provisions of the above mentioned Directive 2006/42/EC as well as the other directives applied (below) including their amendments in force at the time of declaration. The following other EU Directives have been applied: EMC Directive 2014/30/EC, Low Voltage Directive 2014/35/EC

The safety objective meet the requirement of EC Directive 2006/42/EC

The following harmonized standards were applied:

EN 1037:1995+A1:2008 Safety of machinery - Prevention of unexpected start-up

EN ISO 14119 Safety of machinery - Interlocking devices associated with guards - Principles for design and selection

EN 61800-5-1 Adjustable speed electrical power drive systems 2008-04 + correction 2

EN 61800-3:2012-09 Adjustable speed electrical power drive systems + correction 1

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

EN 50581:2012 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

EN 60204-1:2006/AC: 2010 Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2005 (modified))

DIN EN 55011 class A: 2003-08 Industrial, scientific radio-frequency equipment

EN ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)

EN ISO 13857:2008 Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs

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

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

Kilian Stürmer
(CEO, General manager)

Hallstadt, 2015-01-16

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