

# Operating manual

Version 3.0.2

## Drilling-Milling machine

**BF20 Vario**

**BF20 L Vario**



**Keep for future reference!**

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### Preface

We thank you very much that you have decided for the drilling-milling machine made by Optimum Maschinen Germany GmbH.

### Changes

The illustration of the drilling-milling machine might in some details deviate from the illustrations of this operating manual but this will have no influence on the operation of the drilling-milling machine.

Any changes in the construction, equipment and accessories are reserved for reasons of enhancement. Therefore, no claims may be derived from the indications and descriptions. Errors exepcted!

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# 1 Safety

## Glossary of symbols


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 gives additional indications

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 calls on you to act

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 enumerations

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This part of the operating manual

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

In addition to this operating manual please observe

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

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



### INFORMATION

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

Optimum Maschinen Germany GmbH




Dr. Robert-Pfleger-Str. 26

D- 96103 Hallstadt

## 1.1 Safety warnings (warning notes)

### 1.1.1 Classification of hazards

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

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

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



## 1.1.2 Further pictograms



Activation forbidden!



Read the operating manual before the machine is first used!



Pull the mains plug!



Use protective goggles!



Use protective gloves!



Use protective boots!



Wear a safety suit!



Use ear protection!



Protect the environment!



Contact address

## 1.2 Proper use



### WARNING!

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

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

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

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

If the drilling-milling machine is used in any way other than described above, modified without the authorisation of the company Optimum Maschinen Germany GmbH or operated with different process data, then the drilling-milling machine is being used improperly.

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

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

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

☞ "Technical data" on page 13

**WARNING!**

**Very serious injury due to improper use.**

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

**1.3****Possible dangers caused by the drilling-milling machine.**

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

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

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

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

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

**INFORMATION**

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

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

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

**WARNING!**

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

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

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

**This will be your responsibility being the machine operator!**

☞ **“Safety devices“ on page 8**

**1.4****Qualification of the staff****1.4.1****Target group**

This manual is addressed to

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



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

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

**INFORMATION**

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

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

In the event of improper use

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

**1.5 Safety devices**

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

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

It is your responsibility!

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

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

**WARNING!**

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

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

The drilling-milling machine includes the following safety devices:

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

**1.5.1 EMERGENCY-STOP button**

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

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

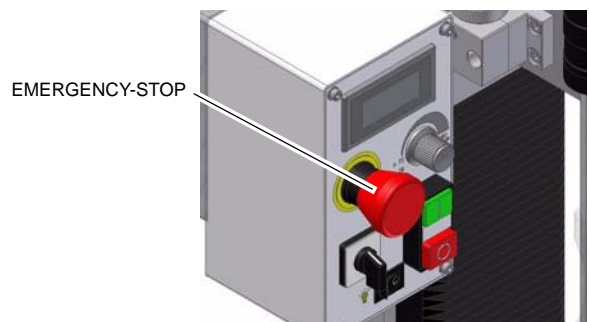


Fig. 1-1: EMERGENCY-STOP button





**ATTENTION!**

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

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

**1.5.2**

**Protective cover**



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



**WARNING!**

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

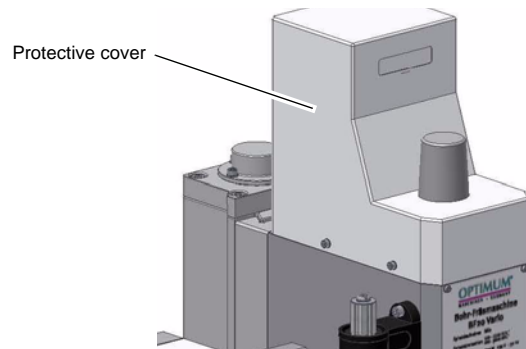


Fig.1-2: Protective cover

**1.5.3**

**Separating protective equipment**

Adjust the correct height of the protective equipment before starting work.

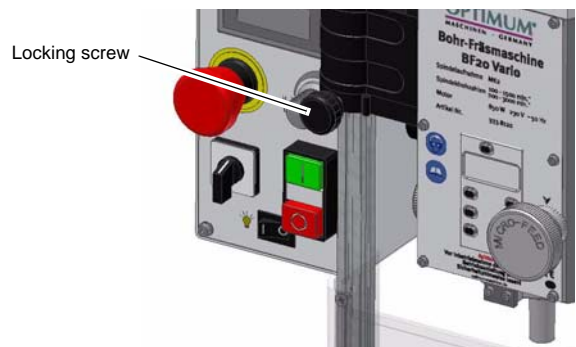


Fig.1-3: Separating protective equipment

## 1.6 Safety check

Check the drilling-milling machine regularly.

Check all safety devices

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

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

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

## 1.7 Personnel protective equipment



For certain work personnel protective equipment is required.

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



Use protective gloves when handling pieces with sharp edges.



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



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

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



### CAUTION!

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

## 1.8 For your own safety during operation



### WARNING!

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

Avoid any unsafe working practises:

Make sure your work does not endanger anyone.

- The instructions in this manual need to be observed during assembly, handling, maintenance and repair.
- Use protective goggles.
- Switch off the drilling-milling machine before measuring the workpiece.
- Do not work on the drilling-milling machine if your concentration is reduced, for example, because you are taking medication.
- Stay on the drilling-milling machine until the working spindle has come to a complete halt.
- Use the prescribed protective equipment. Make sure to wear a well-fitting work suit, when necessary, a hairnet.
- Do not use protective gloves during drilling or milling work.
- Unplug the shockproof plug from the mains, before changing the tool.
- Use suitable devices for removing drilling and milling chips.
- Make sure your work does not endanger anyone.
- Clamp the workpiece tightly before activating the drilling-milling machine.

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

## 1.9 Disconnecting and securing the drilling-milling machine



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

## 1.10 Using lifting equipment



### WARNING!

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

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

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

Hold the loads properly.

Never walk under suspended loads!

## 1.11 Signs on the drilling-milling machine

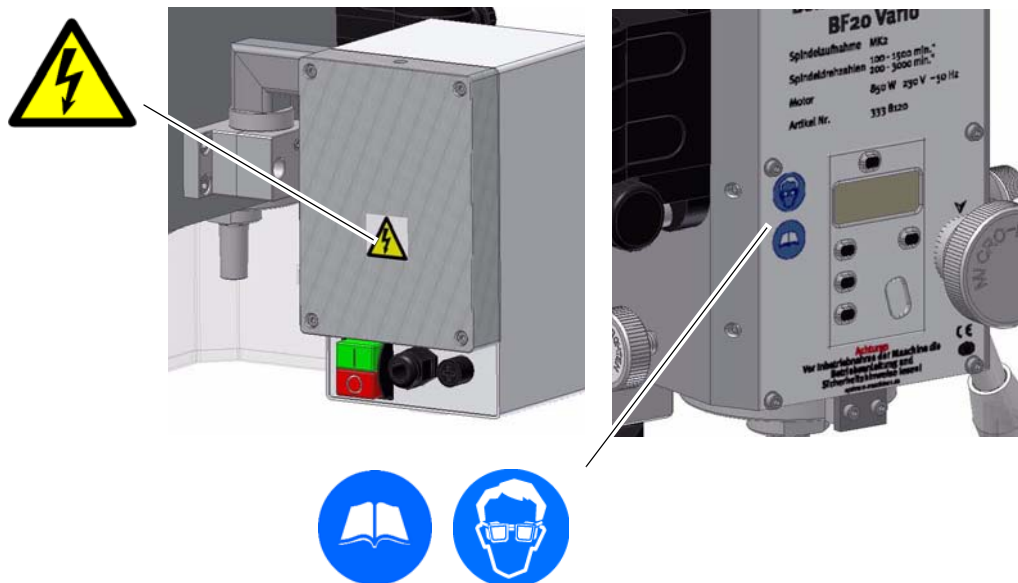


Fig.1-4: BF 20 Vario ; BF 20 L Vario

## 2 Technical data

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

<b>2.1</b>	<b>Power connection</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Engine	230 V / 50Hz / 850 W	
<b>2.2</b>	<b>Drilling-milling capacity</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Drilling capacity [mm]	Ø max. 16	
	Milling capacity of end-mill cutter [mm]	Ø max. 20	
	Milling capacity of inserted tooth cutter [mm]	Ø max. 63mm	
	Working radius [mm]	185	
<b>2.3</b>	<b>Spindle holding fixture</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Spindle holding fixture	MT 2 / M10	
	Sleeve travel [mm]	50 mm	
<b>2.4</b>	<b>Drill-mill head</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Swivelling	+ / - 90°	
	Reduction stages	2	
	Z-axis travel [mm]	370	
<b>2.5</b>	<b>Cross table</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Table length [mm]	500	700
	Table width [mm]	180	
	Y-axis travel [mm]	175	
	X-axis travel [mm]	280	480
	T - slot size / distance [mm]	12 / 63	
<b>2.6</b>	<b>Dimensions</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Height [mm]	860	
	Depth [mm]	670	870
	Width [mm]	550	550
	Total weight [kg]	103	115
<b>2.7</b>	<b>Work area</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Height [mm]	2000	
	Depth [mm]	2200	
	Width [mm]	1500	
<b>2.8</b>	<b>Speeds</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
	Reduction stage slow [min <sup>-1</sup> ]	approx. 50 - 1400	

Reduction stage fast [min <sup>-1</sup> ]		approx. 100 - 2900	
<b>2.9</b>	<b>Environmental conditions</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
Temperature		5-35 °C	
Humidity		25 - 80%	
<b>2.10</b>	<b>Operating material</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
Reduction stage Blank steel parts		Mobilgrease OGL 007 or, Mobilux EP 004, or Mobil XHP acid-free oil, e.g. weapon oil, motor oil	
<b>2.11</b>	<b>Emissions</b>	<b>BF20 Vario</b>	<b>BF20 L Vario</b>
<p>The noise level (emission) of the drilling-milling machine is below 78 dB(A). If the drilling-milling machine is installed in an area where various machines are in operation, the acoustic influence (emission) on the user of the drilling-milling machine may exceed 85 dB(A) at the workplace.</p> <p>We recommended the use of soundproofing ear protection. Remember that the duration of the noise pollution, the type and characteristics of the working area and operation of other machines influence the noise level at the workplace.</p>			

## 3 Unpacking and connecting



### INFORMATION

The drilling-milling machine comes pre-assembled.

### 3.1 Extent of supply

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

Compare the parts supplied with the information on packing list.

### 3.2 Transport

#### WARNING!



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

- centres of gravity
- suspension points
- weights
- means of transport to be used
- prescribed shipping position

#### WARNING!



**Use of unstable lifting equipment and load suspension devices that break under load can cause very serious 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 rules for preventing accidents.**

**Hold the loads properly.**

**Never walk under suspended loads!**

### 3.3 Storage

#### ATTENTION!



**Improper storage may cause important parts to be damaged or destroyed.**

**Store packed or unpacked parts only under the intended environmental conditions.**

☞ **“Environmental conditions“ on page 14**

Consult the company Optimum Maschinen Germany GmbH if the drilling-milling machine or accessories have to be stored for a period of more than three months or under different environmental conditions than those given here.

### 3.4 Installation and assembly

#### 3.4.1 Requirements of the installation site

The working area for operation, maintenance and repair work must not be hindered.

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 with extreme caution when lifting, installing and assembling the machine.

- Secure the load suspension device around the drill-mill head. Use a lifting sling for this purpose.
- Clamp all the clamping levers at the drilling-milling machine before lifting the drilling-milling machine.
- Make sure that no add-on pieces or varnished parts are damaged due to the load suspension.

#### 3.4.3 Installation

- Check the horizontal orientation of the base of the drilling-milling machine with a spirit level.
- Check that the foundation has sufficient floor-load capacity and rigidity. The total weight amounts from 103 to 115 kg.



##### ATTENTION!

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

- Position the drilling-milling machine on the intended foundation.
- Attach the drilling-milling machine using the provided recesses in the machine base.



##### WARNING!

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

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



3.4.4 Installation drawing

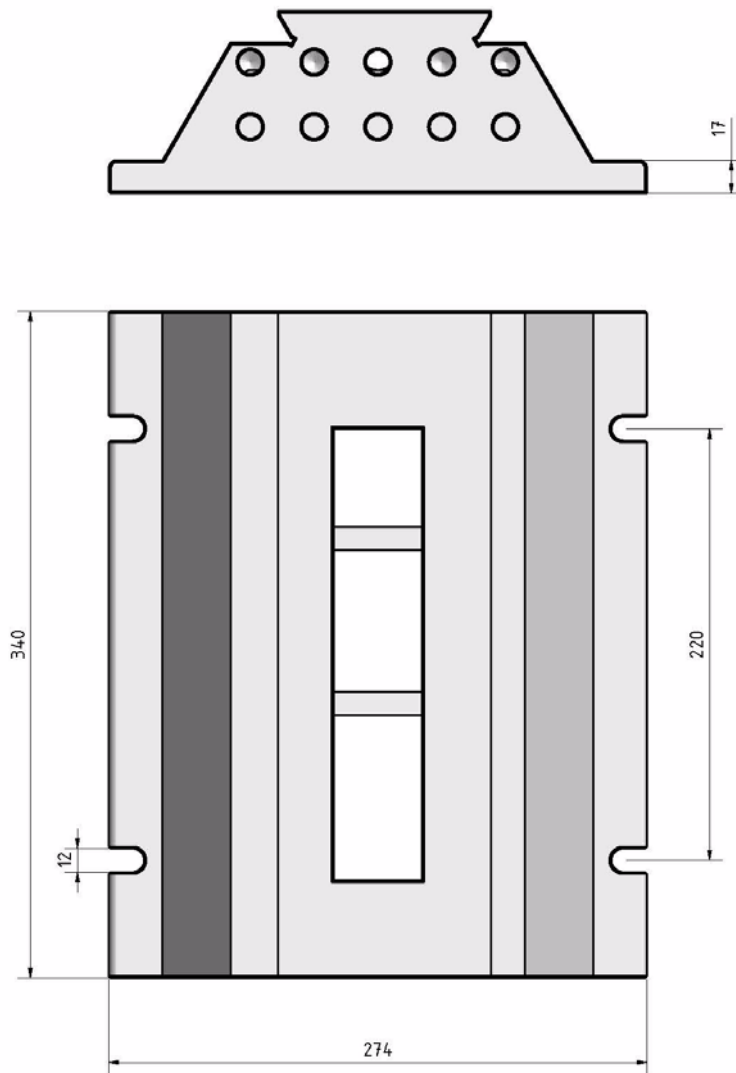
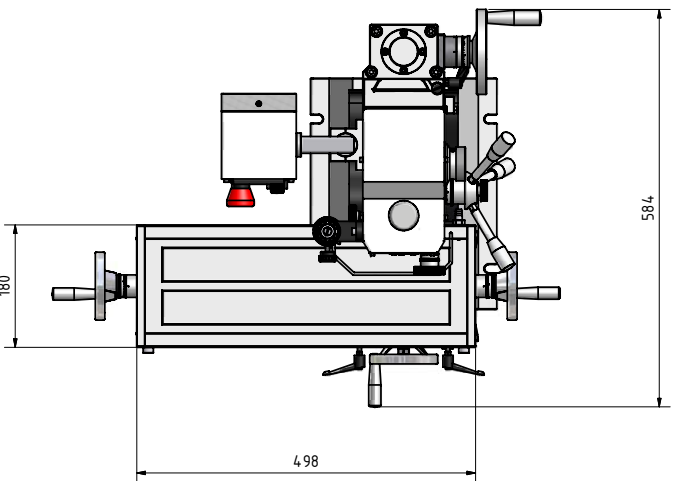
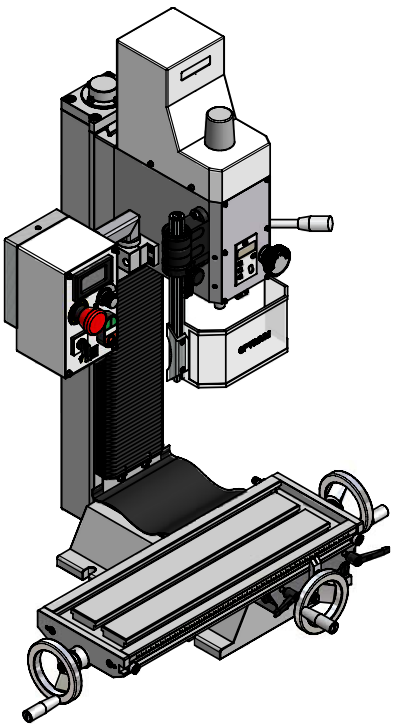
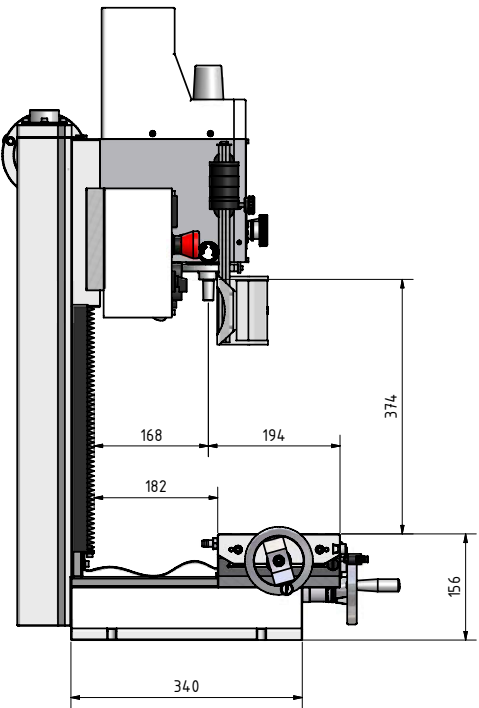
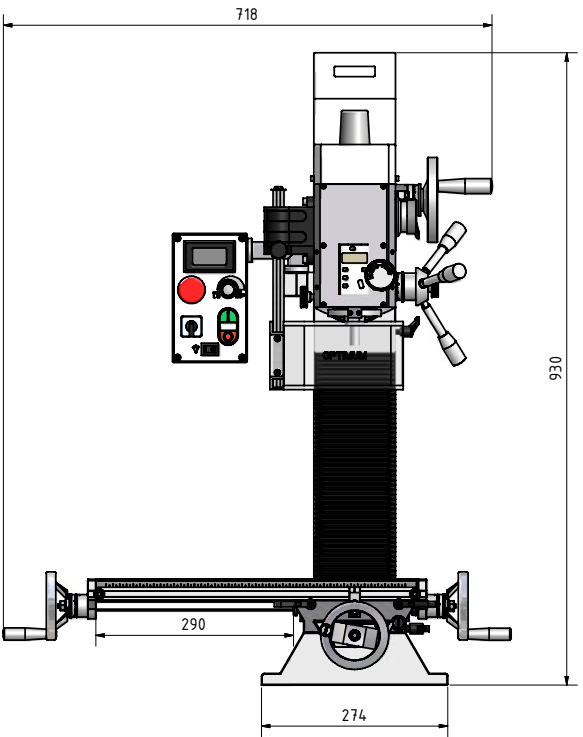


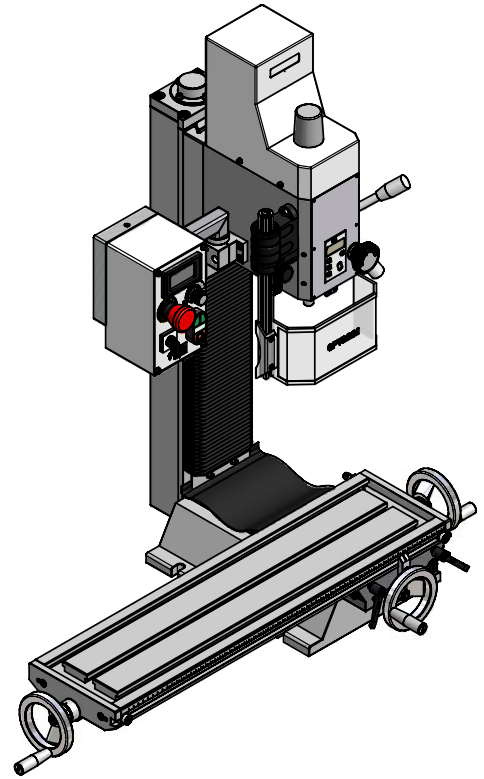
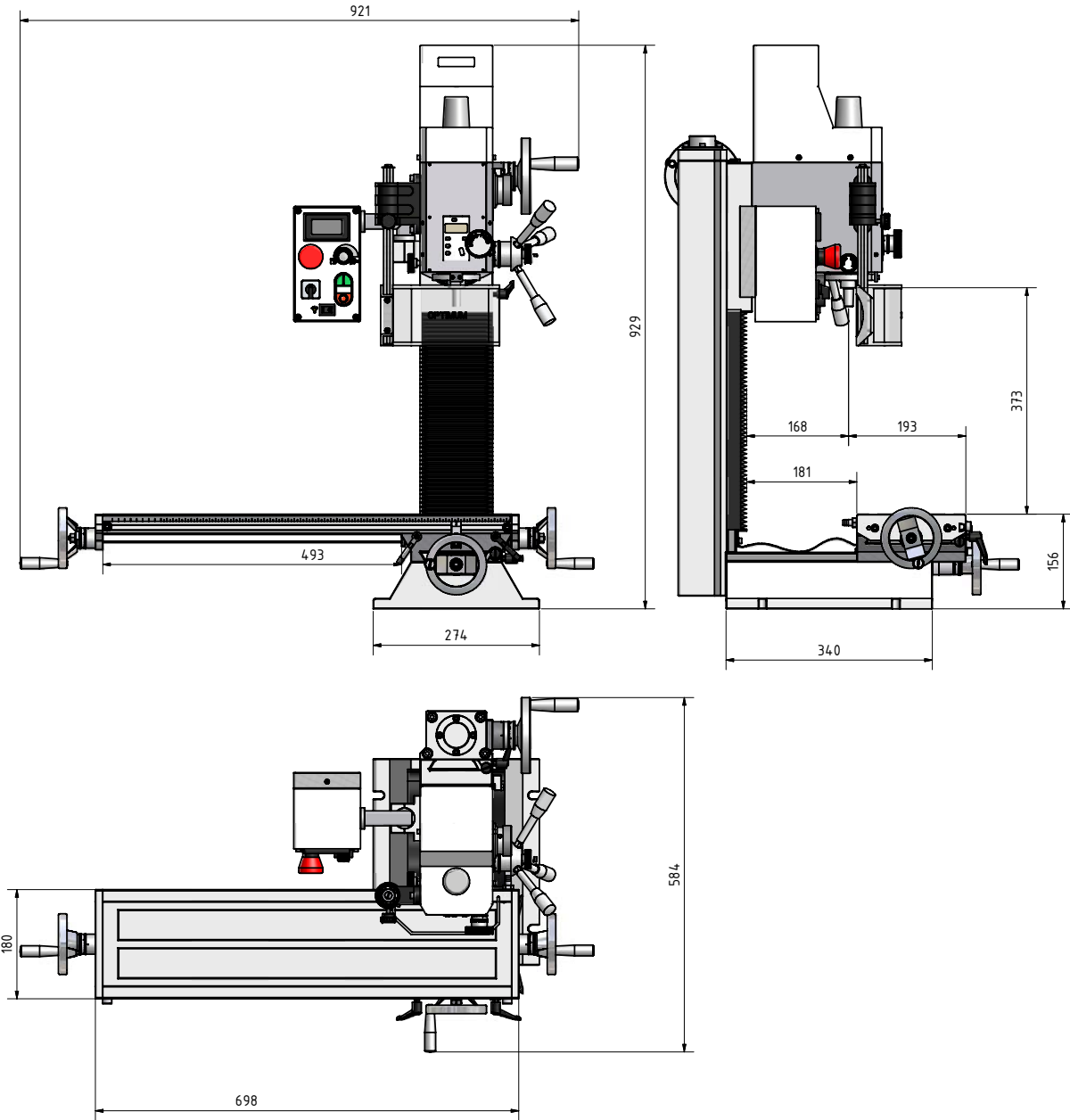
Fig.3-1: Machine base

**3.5 Installation plan BF20 Vario**



		Datum	Name
		Gezeichnet	11.10.2006 Mücke

### 3.6 Installation plan BF20 L Vario



		Datum	Name
		Gezeichnet	16.10.2006
		Müjcke	

## 3.7 Installation plan of optional substructure

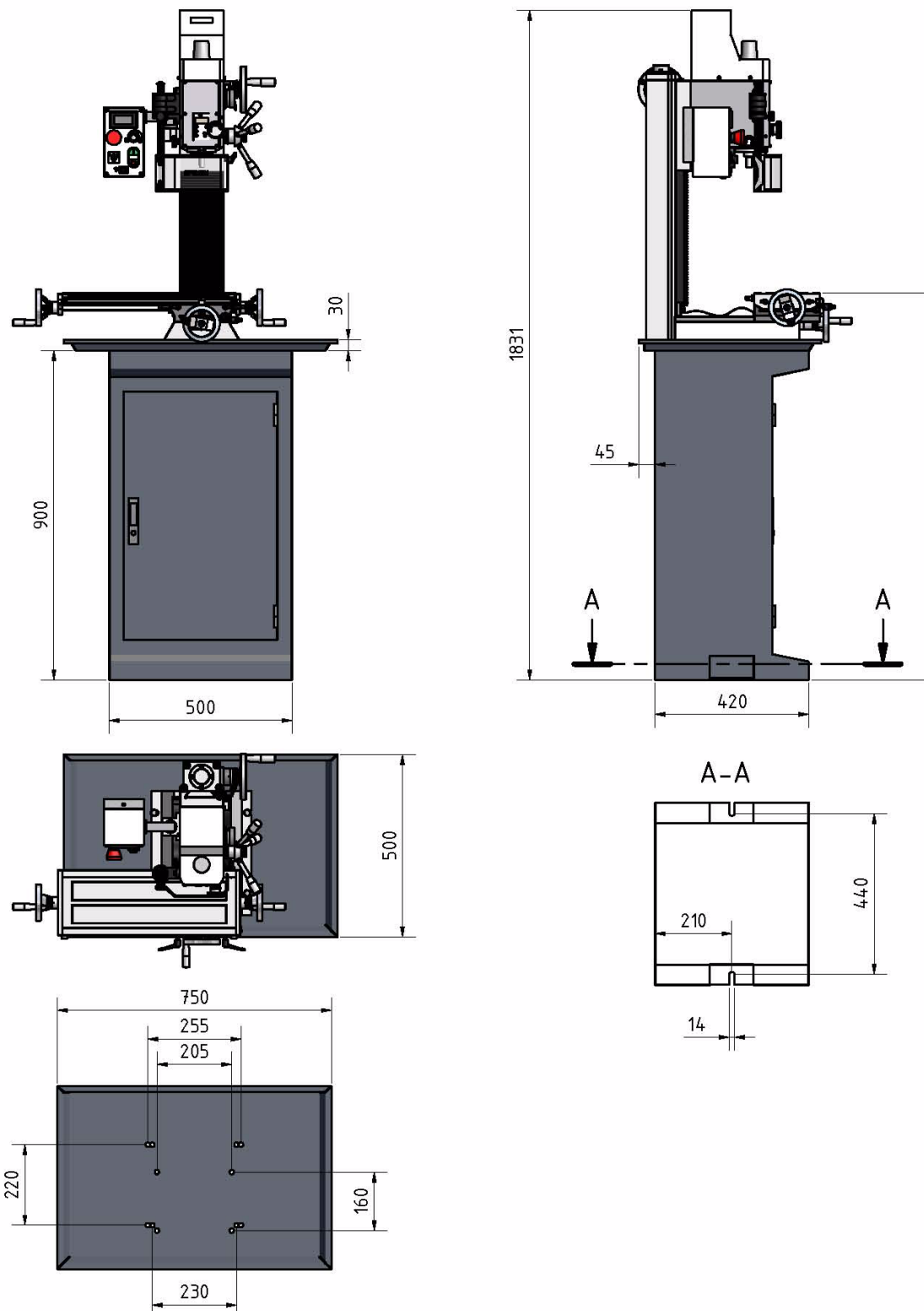




Fig.3-2: Substructure 3353003

### 3.8 First use

#### 3.8.1 Cleaning and lubricating

- Remove the anti-corrosive agent to the drilling-milling machine for transport and storage purposes. We recommend the use of paraffin.
- Do not use any solvents, thinners or other cleaning agents which could corrode the varnish on the drilling-milling machine. Follow the specifications and indications of the manufacturer of the cleaning agent.
- Lubricate all bright machine parts with non-corrosive lubricating oil.
- Grease the drilling-milling machine using the lubrication chart.  
☞ "Inspection and maintenance" on page 37
- Check the smooth running of all spindles. The spindle nuts can be readjusted.
- Disassembly the taper gibs of the cross table and clean the gibs from the anti-corrosive agent. ☞ "Taper gibs" on page 38

### 3.9 Optional accessory

Designation:	Item No	
Machine substructure	335 3002	
Machine substructure	335 3003	
Collet chucks kit 5-pcs MT2 / M10 4 / 6 / 8 / 10 / 12 mm directly clamping	335 1980	
Collet chuck holder MT2 / M10 (ER25)	335 2044	
Collet chucks kit 1-16mm 15-pcs (ER25)	344 1109	
Collet chuck holder MT2 / M10 (ER32)	335 2045	
Collet chucks kit 3-20mm 18-pcs (ER32)	344 1122	
Quick-action drill chuck (0-13mm) B16	305 0623	
Morse taper taper mandrel MT2 / M10 / B16	305 0670	
Mill cutter holding cone MT2 / M10 / id=16mm	335 2102	
Machine vice FMSN 100	335 4110	
Three-axis vice DAS 75 slewable, turnable, tiltable	335 4175	
Two-axis vice ZAS 50 slewable, turnable	335 4170	
Chucking tool kit SPW 10	335 2016	
Milling cutter kit 12-pcs (4-5-6-10-12), each two- and four-edged, TIN-coated	335 2113	
Add-on adapter to the machine bed lathe D240 / D280	335 6572	
Adapter for high speed motor (without high speed motor)	335 6571	
Round cell 1.55V 145mAh (SR44) 11.6 x 5.4mm	338 5480	

## 4 Operation

### 4.1 Safety

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

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



All malfunctions should be eliminated immediately. Stop the drilling-milling machine immediately in the event of any abnormality in operation and make sure it cannot be started up accidentally or without authorisation.

👉 "For your own safety during operation" on page 11

### 4.2 Control and indicating elements

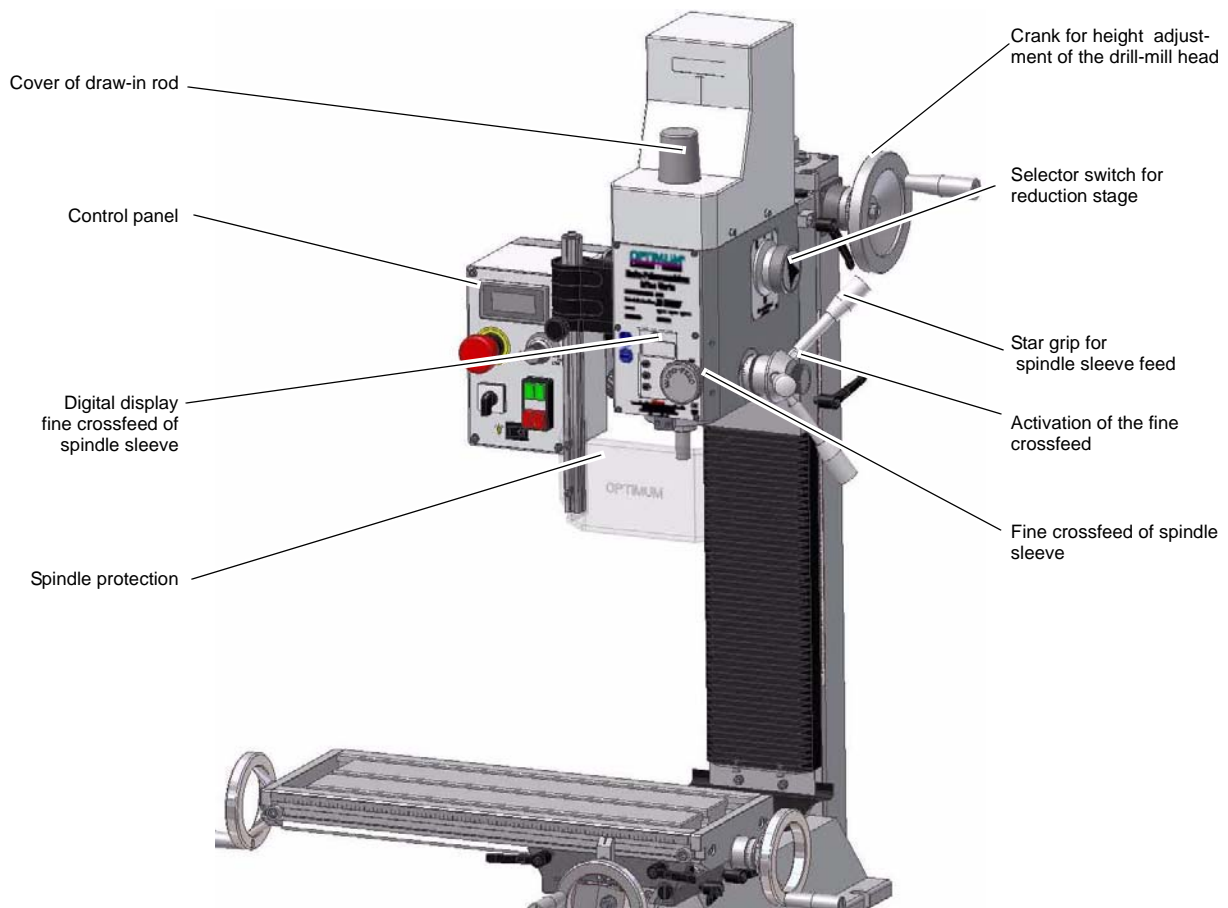


Fig.4-1: BF 20 Vario ; BF 20 L Vario

### 4.2.1 Control panel

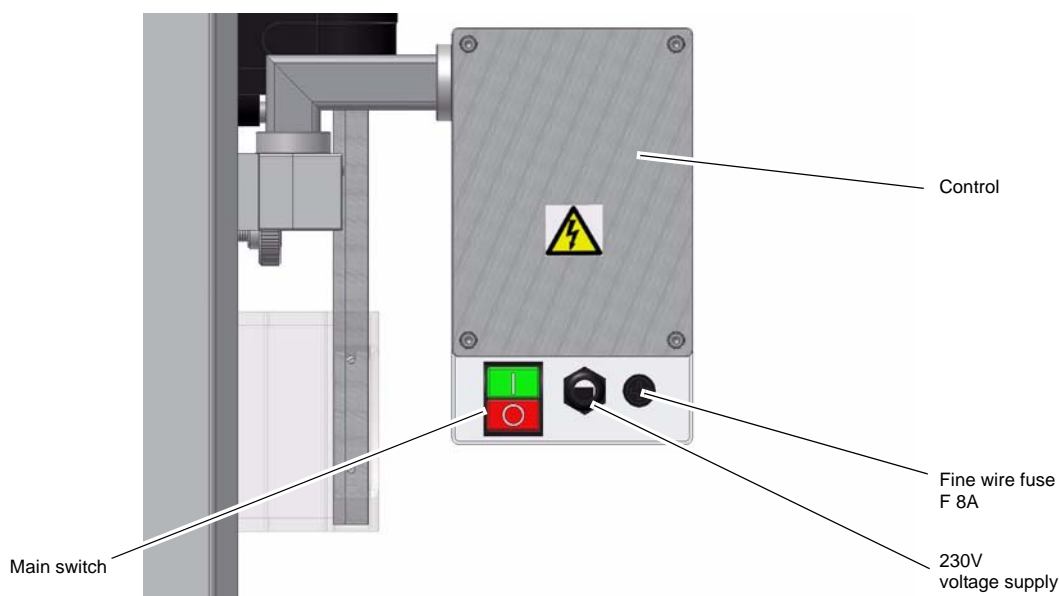
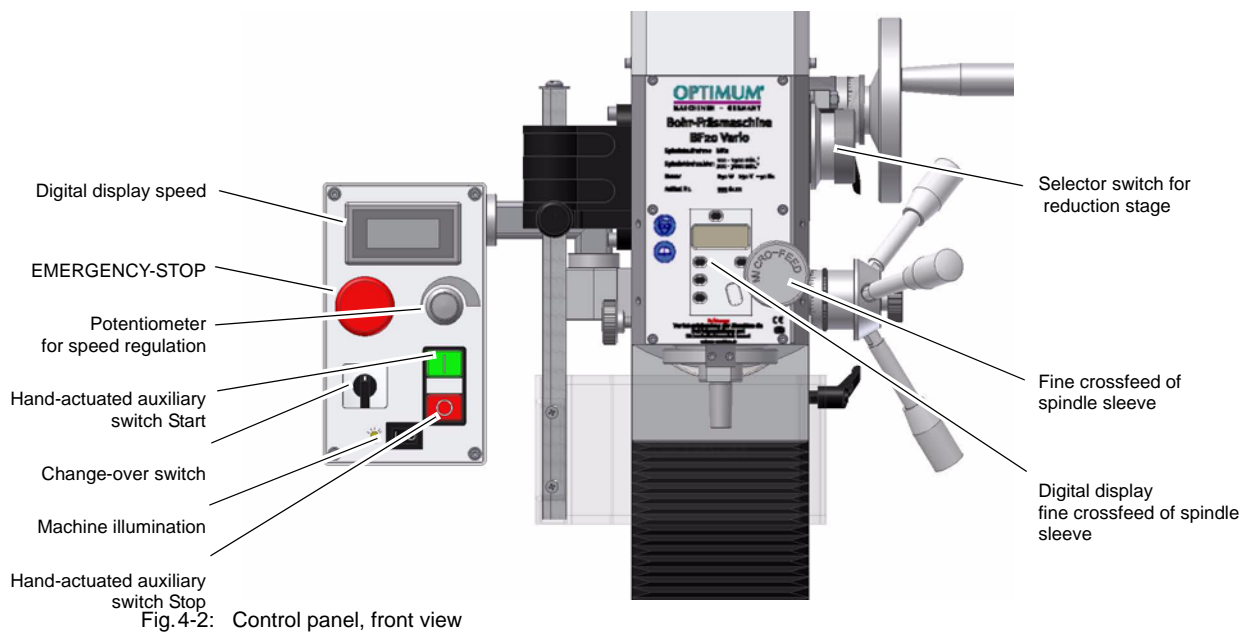


Fig. 4-3: Control panel, back





**Main switch**

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



**Hand-actuated auxiliary switch Start / Stop**

Switches the machine on or off.



**Turning direction**

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



**Speed**

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

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



**Reduction stage**

Selection rotary-type switch to select the reduction stage.

**CAUTION!**



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

- Turn the gear switch to the position "H" for a speed range from approx. approx. 100 - 2900 min<sup>-1</sup>.
- Turn the gear switch to the position "L" for a speed range from approx. approx. 50 - 1400 min<sup>-1</sup>.

## 4.3 Switching on the drilling-milling machine

- Switch the main switch on.
- Select the reduction stage.
- Select the turning direction.
- Set the potentiometer to the lowest speed.
- Close the spindle protection.
- Actuate the hand-actuated auxiliary switch Start.
- Set the required speed at the potentiometer.

## 4.4 Switching off the drilling-milling machine

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

## 4.5 Inserting a tool

### 4.5.1 Installation



#### CAUTION!

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

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

- Remove the cover.
- Clean the seat in the milling spindle / spindle sleeve.
- Clean the taper of your tool.
- Insert the tool into the holding fixture / spindle sleeve.

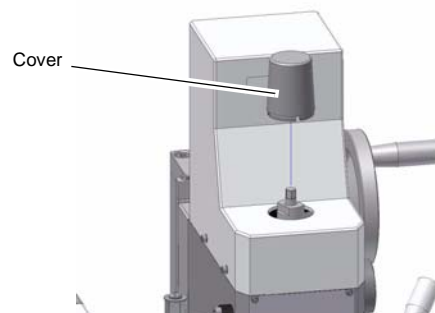


Fig.4-4: Drill-mill head

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

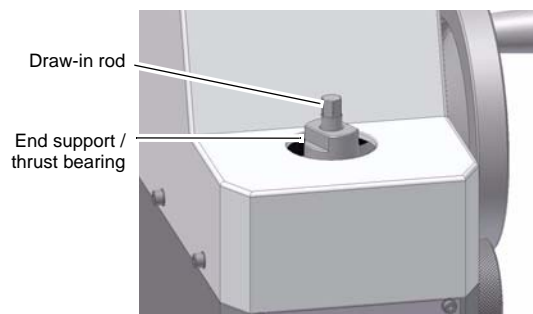


Fig.4-5: Drill-mill head

### 4.5.2 Disassembly

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

**ATTENTION!**

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

**4.5.3****Use of collet chucks**

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

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

☞ "Optional accessory" on page 22

**4.6****Clamping the workpieces****CAUTION!**

Injury by parts flying off.

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

**4.7****Changing the speed range****ATTENTION!**

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

- Select reduction stage.  
H = rapid  
L = low
- Adjust the speed with the potentiometer. The speed and thus the cutting speed are depending on the material of the workpiece, the milling cutter diameter and the cutter type.

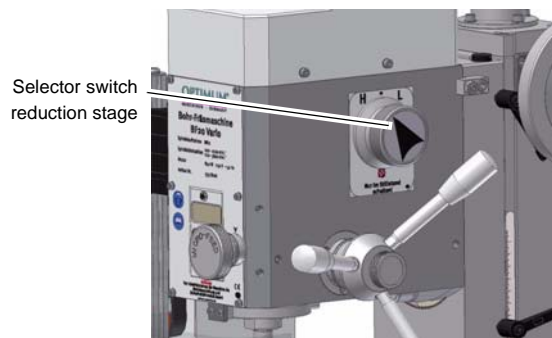


Fig. 4-6: Drill-mill head

### 4.8 Selecting the speed

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

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

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

The required speed is calculated as follows:

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

n = speed in min<sup>-1</sup> (revolutions per minute)

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

d = tool diameter in m (meters)

#### 4.8.1 Standards values for cutting speeds

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

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

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

Tool diameter [ mm ] peripheral and side milling cutters	Steel 10 - 25 m/min	Grey cast iron 10 - 22 m/min	Age-hardened Al alloy 150 - 350 m/min
	Speed [ min <sup>-1</sup> ]		
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
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Tool diameter [ mm ] form cutters	Steel 15 - 24 m/min	Grey cast iron 10 - 20 m/min	Age- hardened Al alloy 150 - 250 m/min
	Speed [ min <sup>-1</sup> ]		
4	1194 - 1911	796 - 1592	11900 - 19000
5	955 - 1529	637 - 1274	9550 - 15900
6	796 - 1274	531 - 1062	7900 - 13200
8	597 - 955	398 - 796	5900 - 9900
10	478 - 764	318 - 637	4700 - 7900
12	398 - 637	265 - 531	3900 - 6600
14	341 - 546	227 - 455	3400 - 5600
16	299 - 478	199 - 398	2900 - 4900

**4.8.2 Standard values for speeds with HSS – Eco – twist drilling**

Material	Cutter diameter										Cooling 3)
		2	3	4	5	6	7	8	9	10	
Steel, unalloyed, up to 600 N/mm <sup>2</sup>	n <sup>1)</sup>	5600	3550	2800	2240	2000	1600	1400	1250	1120	E
	f <sup>2)</sup>	0.04	0.063	0.08	0.10	0.125	0.125	0.16	0.16	0.20	
Structural steel, alloyed, quenched and subse- quently drawn, up to 900N/ mm <sup>2</sup>	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 subse- quently drawn, up to 1200 N/mm <sup>2</sup>	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 <sup>2</sup> e.g. X5CrNi18 10	n	2000	1250	1000	800	630	500	500	400	400	Oil
	f	0.032	0.05	0.063	0.08	0.10	0.10	0.125	0.125	0.16	
1): Speed [ n ] in r/min											
2): Feed [ f ] in mm/r											
3): Cooling: E = emulsion; Oil = cutting oil											

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



**INFORMATION**

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



**INFORMATION**

Use a water-soluble and non-pollutant emulsion as a cooling agent. This can be acquired from authorised distributors.



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

**4.9 Manual spindle sleeve feed with the fine feed**

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

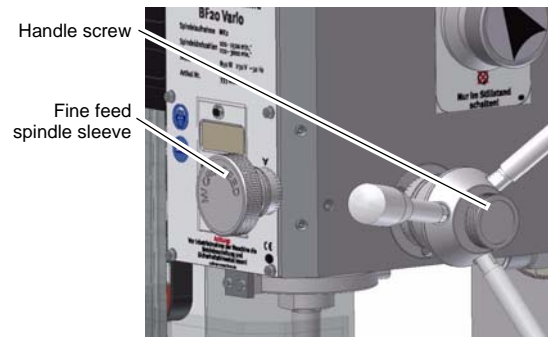


Fig.4-7: Fine feed

**4.10 Digital display for spindle sleeve travel**

**4.10.1 Technical data**

Measuring range	mm	0 - 999.9
	inch	0 - 39.371"
Reading accuracy	mm	0.01
	inch	0.0004"
Power supply		round cell CR2032 3 V Ø20 x 3,2mm

## 4.10.2 Design

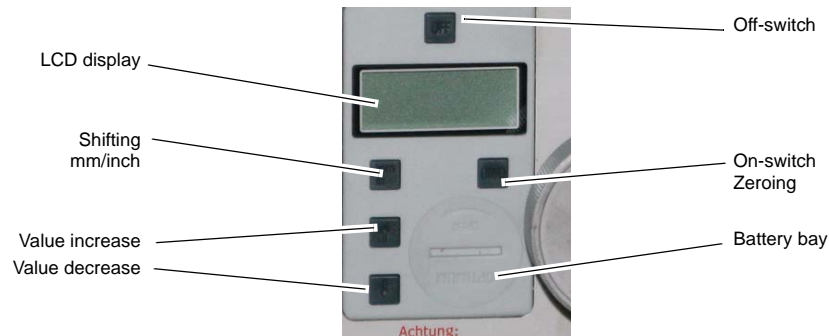


Fig.4-8: Digital display

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



### INFORMATION

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

## 4.10.3 Malfunctions

Malfunction	Cause/ possible consequences	Solution
Flashing of the display	<ul style="list-style-type: none"> <li>• Voltage too low</li> </ul>	<ul style="list-style-type: none"> <li>• Change battery</li> </ul>
Screen doesn't refresh	<ul style="list-style-type: none"> <li>• Disturbance in the circuit</li> </ul>	<ul style="list-style-type: none"> <li>• Remove the battery, wait 30 seconds and reinsert the battery</li> </ul>
No data visible	<ul style="list-style-type: none"> <li>• No power supply</li> <li>• Battery voltage less than 3V</li> </ul>	<ul style="list-style-type: none"> <li>• Clean battery contacts</li> <li>• Replace battery</li> </ul>

## 4.11 Manual spindle sleeve feed with the spindle sleeve lever



### ATTENTION!

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

- Loosen the handle screw (☞ Fig. 4-7: „Fine feed“ on page 30) .  
The spindle sleeve lever moves away from the drill-mill head and disengages the clutch of the fine feed.

## 4.12 Swivelling the drill-mill head

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

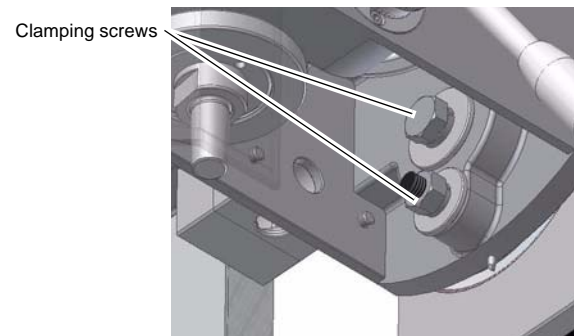


Fig.4-9: Clamping screws

### 4.12.1 Shifting the drill-mill head

The column of the drill-mill head can be shifted each to the left or to the right.

Use the option of shifting if you need to swivel the drill-mill head to the left or to the right for working.

## 4.13 Assembly of the optional adapter for a high speed motor



### CAUTION!

Two persons are needed to disassemble the milling head since the milling head needs to be held in its position when disassembling the screws.

- Remove spindle protection.  
Remove the screw and pull the aluminium profile with blinds from the guiding.

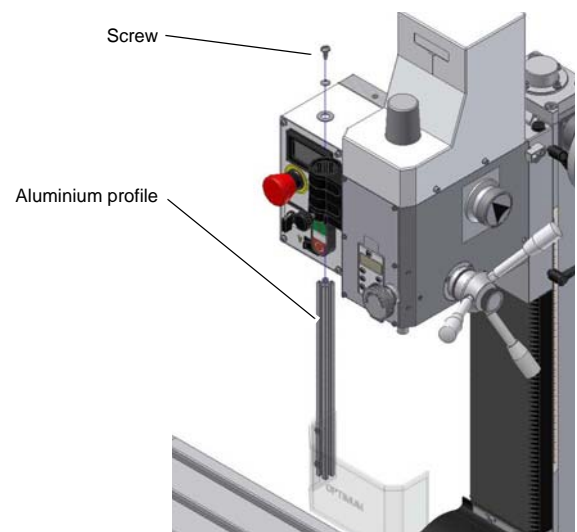


Fig.4-10: Spindle protection



→ Disassemble clamping screw and nut.

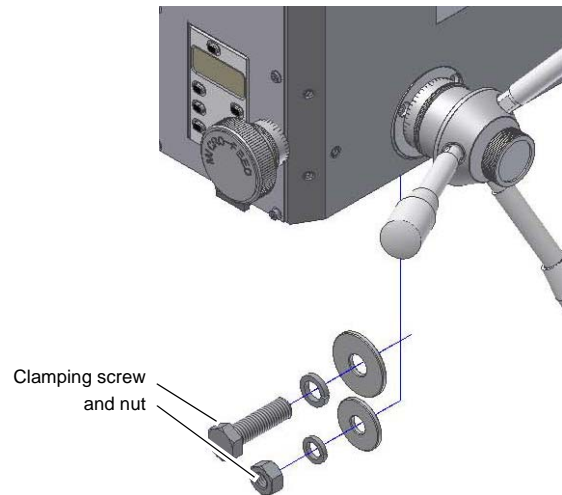


Fig.4-11: Fixing screws

- Loosen or completely unscrew the screw.
- Remove the mill head to the front.

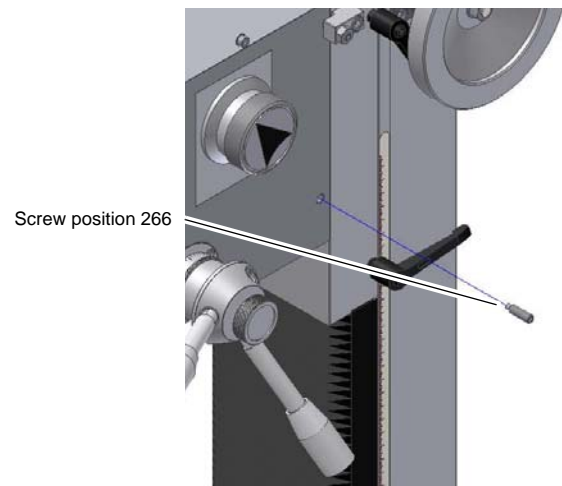


Fig.4-12: Screw

→ The high speed adapter will be aligned and fixed with the same fixing screws as the mill head on the turning bearing block.

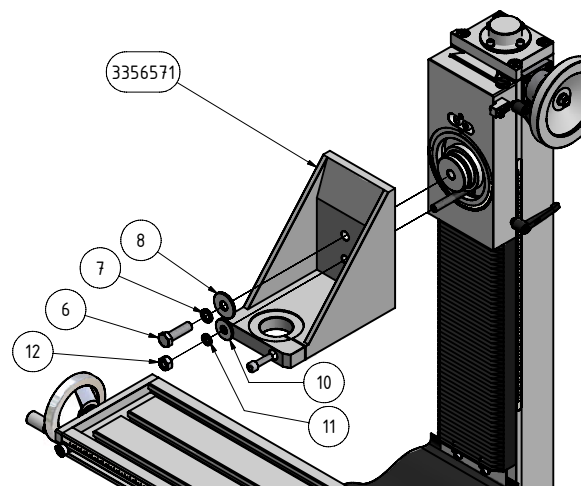


Fig.4-13: High speed adapter

## 4.13.1 Drawing adapter for a high speed motor

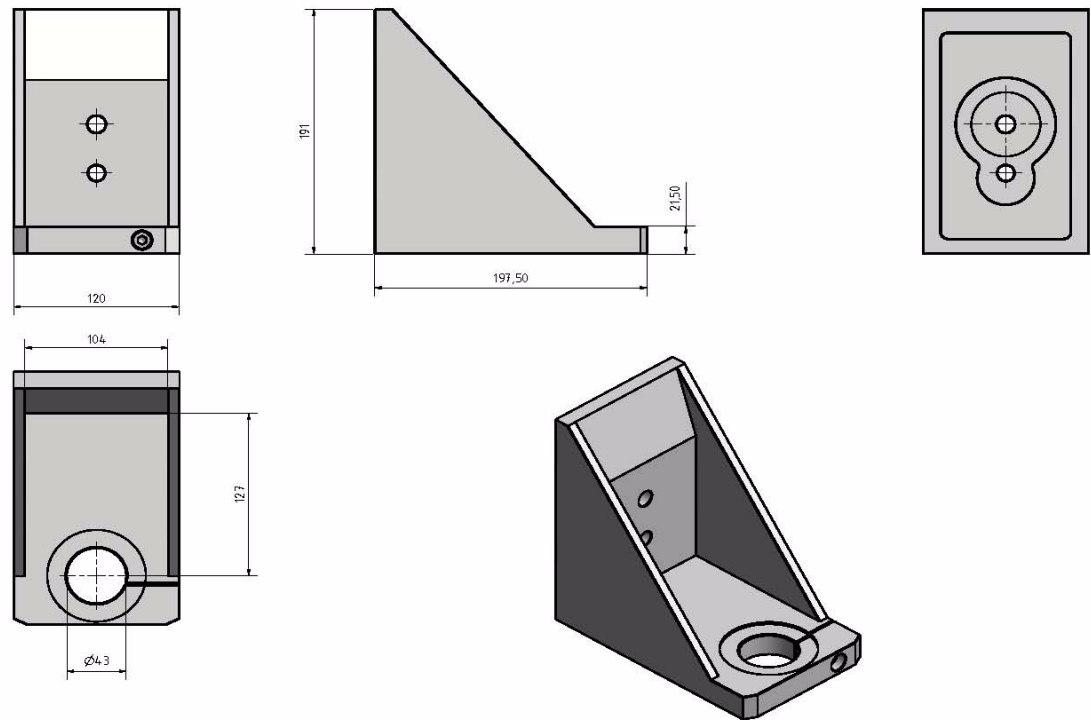


Fig.4-14: High speed adapter 3356571

## 4.14 Assembly of the column on the lathe

The mill head with column can be mounted on the lathe bed of the D240 and D280. An adapter is required to fix it. It is not possible to fix it on the lathe saddle. The adapter is dimensioned in a way that the center of the lathe chuck can be reached with the centre of the milling spindle (line tailstock - lathe chuck).

☞ “Optional accessory“ on page 22

Due to the manufacturing tolerances of cast parts and the manufacturing tolerances of two different machines, it is however not possible to exactly reach the centre. The adapter might be too short or too long.

If required, the adapter has to be milled or provided with dummy sheets. When using dummy sheets, the complete surface needs to be filled.

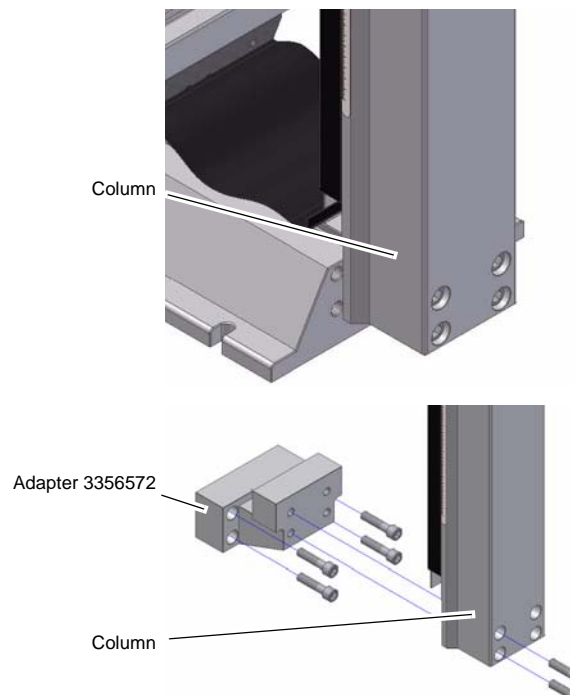


Fig.4-15: Adapter

When aligning the column with the mill head mounted onto it, we recommend to disassemble the mill head from the column in order to reduce the holding force of the column. Unscrew the

stud screw (screw) position 266. Disassemble the mill head from the column by completely loosening the clamping screw and the guide screw and pull off the mill head.

Check the alignment (right angle horizontal and vertical) of the column regarding the reference level at the lathe bed.



### INFORMATION

In order to avoid the efforts of alignment when retrofitting it at a later time, we recommend you to provide the column and the adapter as well as the adapter and the lathe bed with aligning pins. If required, also pin the column to the cross table before disassembling the column. It is most suitable to use hardened straight pins of 8mm or 10mm according to DIN 6325 and an adjustment tolerance field m6 (e.g. DIN 6325-8 m6 x 30). These straight pins have a round cap on one side which simplifies to stick the parts together. The holes have to be predrilled imperatively about 0,2mm smaller in the assembled status and have to be grinded with a reamer also in the assembled status. Therefore, make sure to use a new spiral drill with a diameter of 7.8mm for the straight pins of 8mm.

#### 4.14.1 Drawing adapter

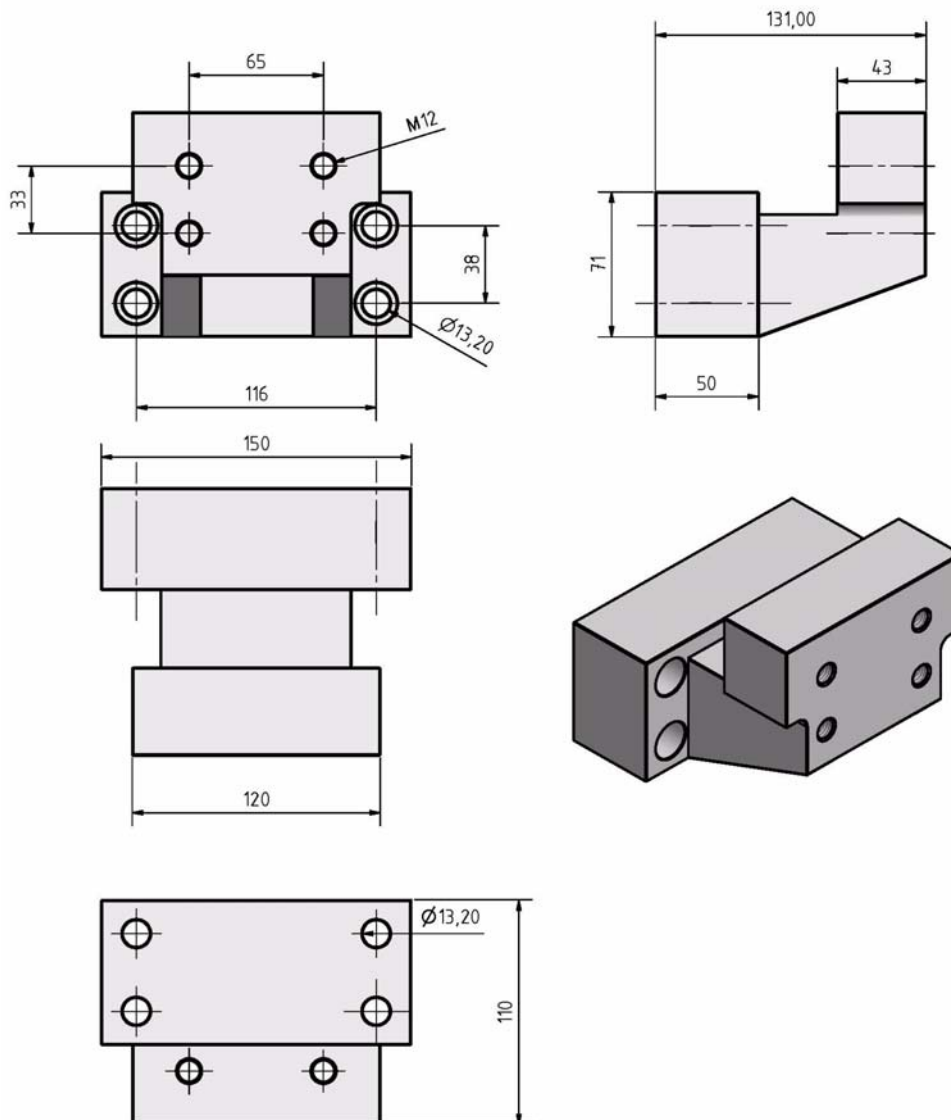


Fig.4-16: Adapter 3356572

## 5 Maintenance

In this chapter you will find important information about

- inspection
- maintenance
- repair

of the drilling-milling machine.

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

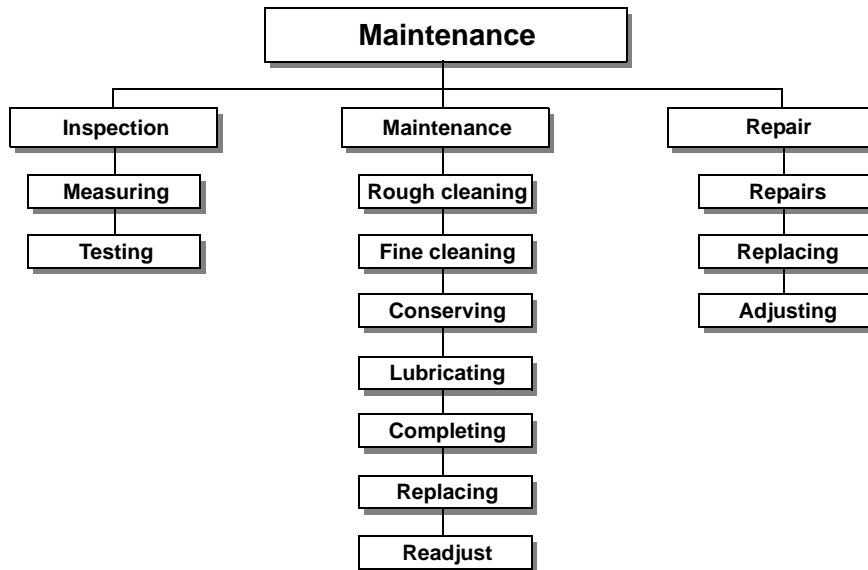


Fig.5-1: Maintenance – definition according to DIN 31051



### ATTENTION!

Properly performed regular maintenance is an essential prerequisite for

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

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

### 5.1 Safety



#### WARNING!

The consequences of incorrect maintenance and repair work may include:

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

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

#### 5.1.1 Preparation



#### WARNING!

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



☞ “Disconnecting and securing the drilling-milling machine“ on page 12

Position a warning sign.

**5.1.2 Restarting**

Before restarting, run a safety check.

☞ “Safety check“ on page 10



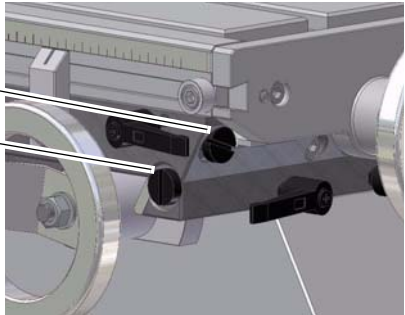
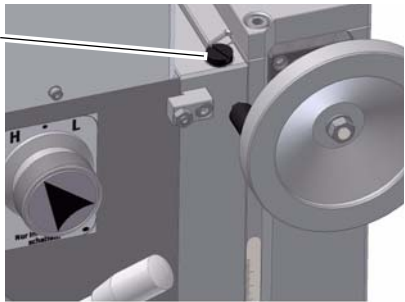
**WARNING!**

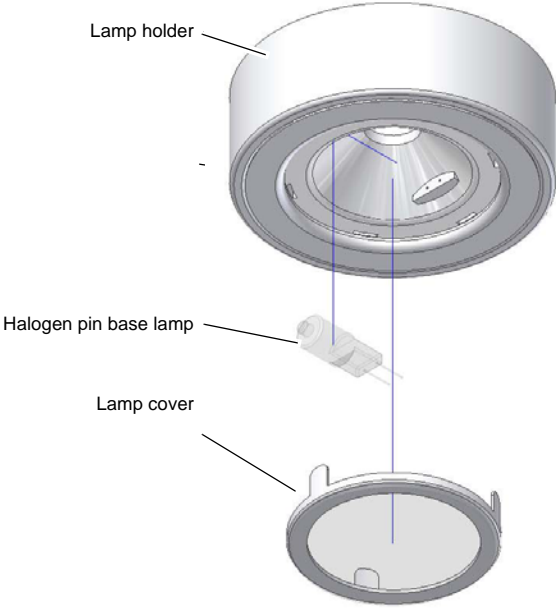
**Before starting the drilling-milling machine you have to check that there is no danger for the staff and the drilling-milling machine is undamaged.**




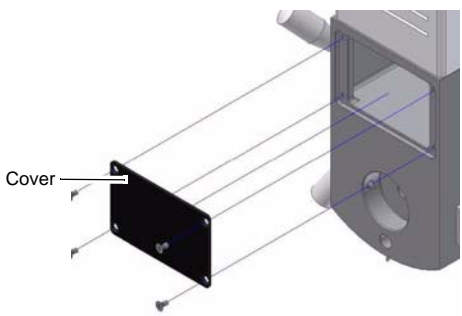
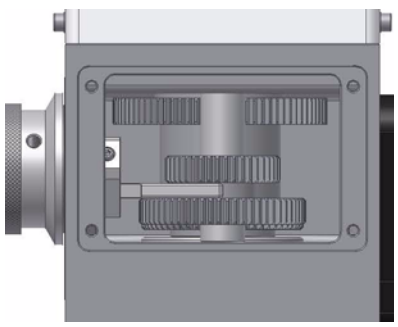
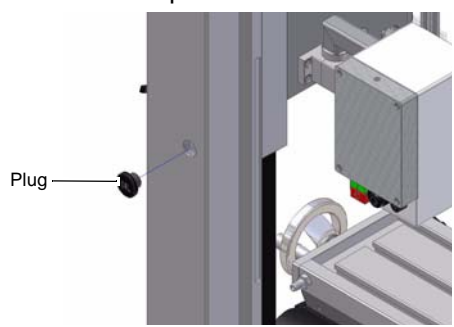
**5.2 Inspection and maintenance**

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

Interval	Where?	What?	How?
Start of work, after each maintenance or repair operation	Drilling-Milling machine		→ ☞ “Safety check“ on page 10
Start of work, after each maintenance or repair operation	Dovetail slideways	Lubricate	→ Lubricate all slideways.
Weekly	Cross table	Lubricate	→ Lubricate all blank steel parts. Use acid-free oil, for example weapon oil or engine oil.
As required	Spindle nuts	Readjust	An increased clearance in the spindles of the crosstable can be reduced by readjusting the spindle nuts. Refer to spindle nuts position 66 and 71  The spindle nuts are readjusted by reducing the flank of screw thread of the spindle nut with an adjusting screw. By readjusting a smooth running move over the whole toolpath is to be assured, otherwise the wear by friction between spindle nut /spindle would increase considerably.

Interval	Where?	What?	How?
As required	Taper gibbs	Readjust X- and Y- axis	 <p>Fig.5-2: Cross table</p> <ul style="list-style-type: none"> <li>→ Turn the adjusting screw of the respective taper gib in the clockwise direction. The taper gib is continued to push in and reduced by it the gap in the guideway.</li> <li>→ Control your setting. The respective guideway must be still easily mobile from the adjustment, result in however a stable guidance.</li> </ul>
As required	Taper gib	Readjust Z-axis	 <p>Fig.5-3: Mill head</p> <ul style="list-style-type: none"> <li>→ Proceed as described under "Readjust X- and Y-axis".</li> </ul>

Interval	Where?	What?	How?
As required	Machine illumination	Replacing the halogen lamp	 <p data-bbox="895 987 1257 1014">Fig.5-4: Replacing the halogen lamp</p> <ul style="list-style-type: none"> <li data-bbox="708 1025 1433 1122">→ Tilt the mill head a little to the right. This way you can easily remove the lamp cover in order to allow replacing of the halogen lamp.</li> <li data-bbox="708 1133 1378 1196">→ Plug a small screw driver into the recess between the lamp holder and the lamp cover.</li> <li data-bbox="708 1207 1396 1270">→ By slightly turning the screw driver you can remove the lamp cover.</li> <li data-bbox="708 1281 1402 1344">→ Pull the halogen pin base lamp with a cloth and replace the halogen lamp.</li> </ul> <p data-bbox="743 1355 1366 1417">Type: Halogen pin base lamp, Osram 12V - 10W, base G4</p>

Interval	Where?	What?	How?
Every six months	Gear drill-mill head	Greasing	<ul style="list-style-type: none"> <li>→ Turn the drill-mill head as described under  "Swivelling the drill-mill head" on page 32 completely by 90° to the right.</li> <li>→ Check if the clamping screws are firmly tightened as described under  "Swivelling the drill-mill head" on page 32 and that the drill-mill head can not independently tilt.</li> <li>→ Disassemble the cover plate at the rear.</li> <li>→ Grease the toothed wheels.  "Operating material" on page 14</li> </ul> <div style="text-align: right;">  </div> <div style="text-align: center; margin-top: 20px;">  </div> <p style="text-align: right;">Fig.5-5: Rear</p>
Every six months	Spindle and spindle nut Z-axis	Greasing	<ul style="list-style-type: none"> <li>→ Open the plug.</li> <li>→ Crank the milling head into the suitable height.</li> <li>→ Oil or grease the spindle nut and spindle.</li> </ul> <div style="text-align: right;">  </div> <p style="text-align: right;">Fig.5-6: Column</p>



### INFORMATION!

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



### 5.3 Repair

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

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

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

For repairs only use

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

## 5.4 Setting instructions control

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

### Vmax

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

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

### Vmin

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

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

### Torque

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

### Slope

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

### CL

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

### General information

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

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

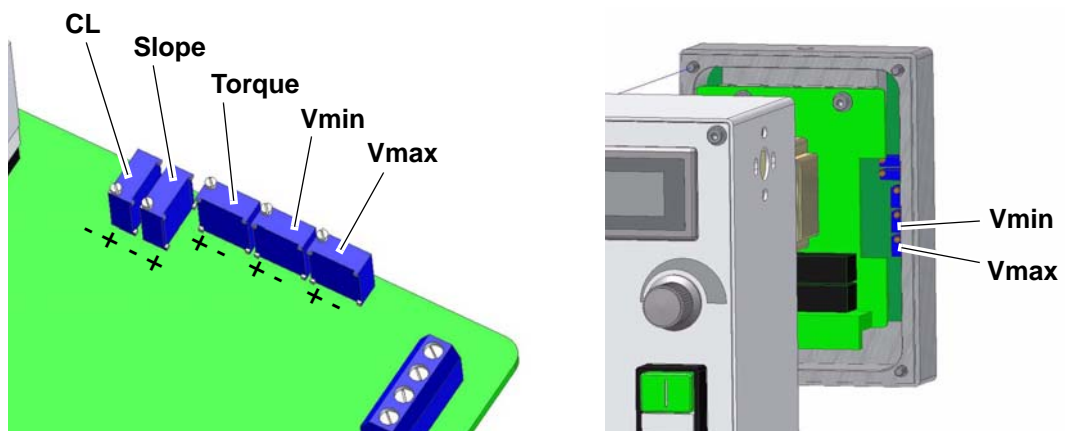


Fig.5-7: Control board 0320297

## 6 Ersatzteile - Spare parts BF20 Vario

### 6.1 Kreuztisch - Cross table

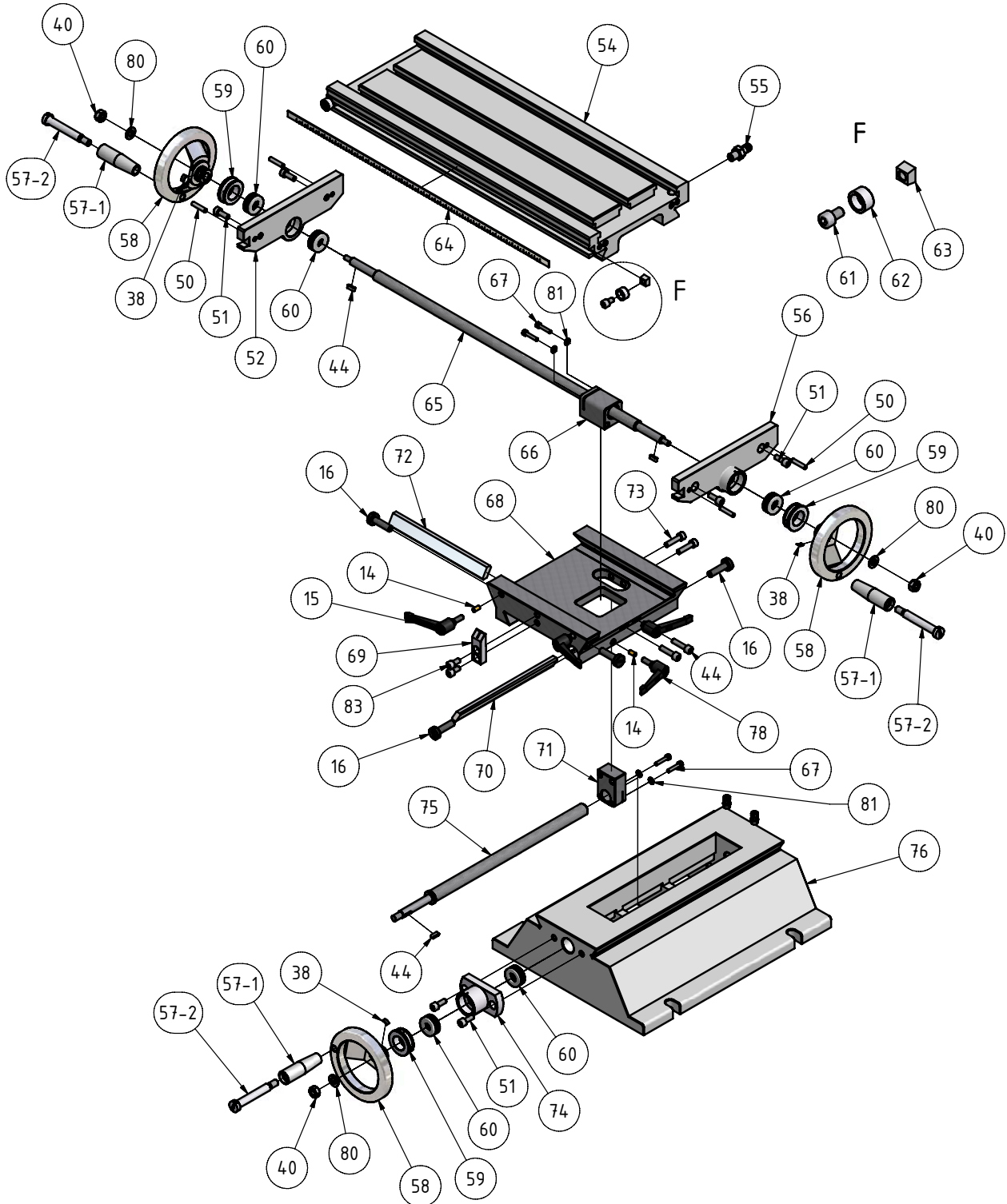


Abb.6-1: Kreuztisch - Cross table

## 6.2 Säule 1 von 2 - Column 1 of 2

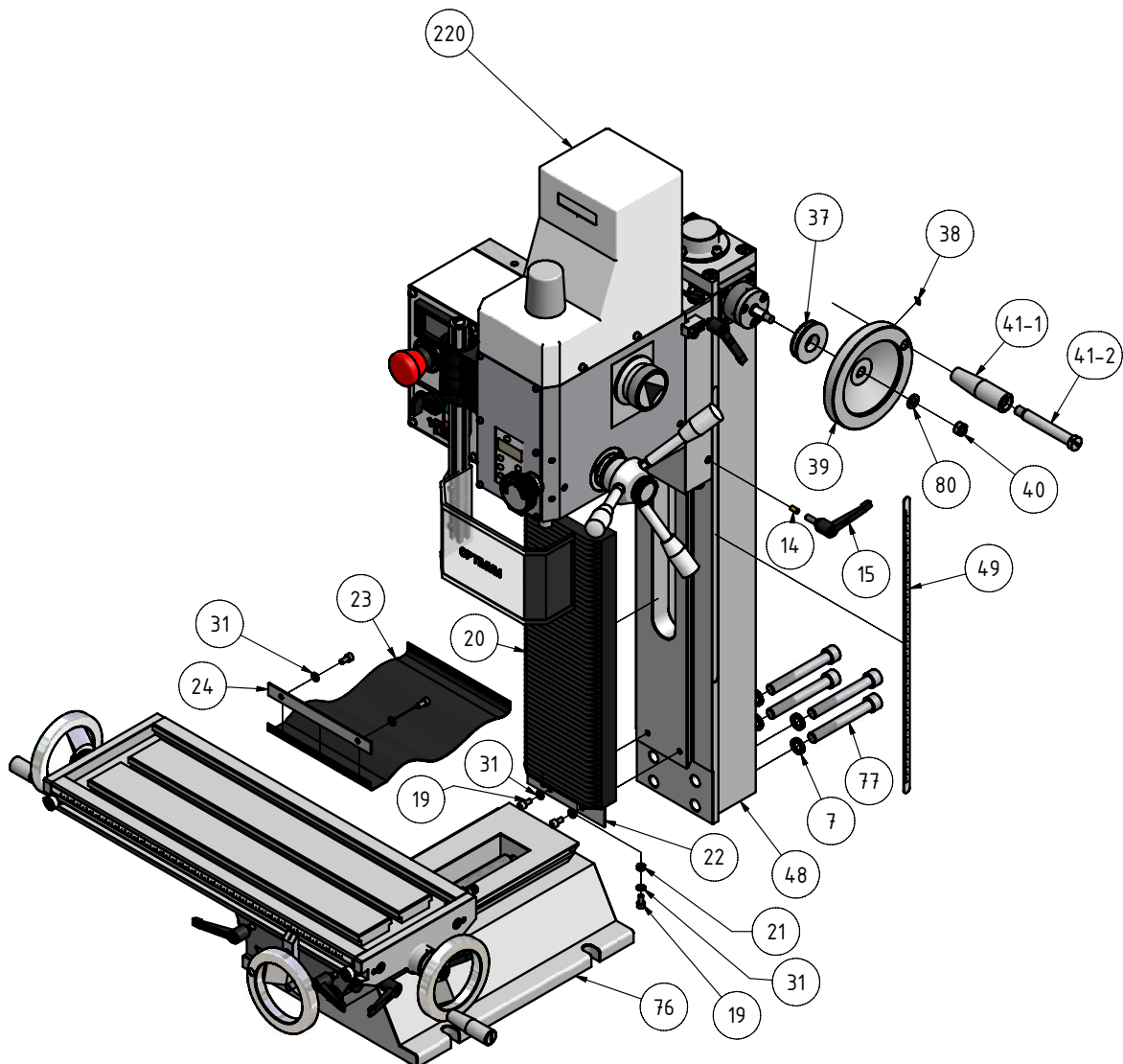


Abb.6-2: Säule - Column

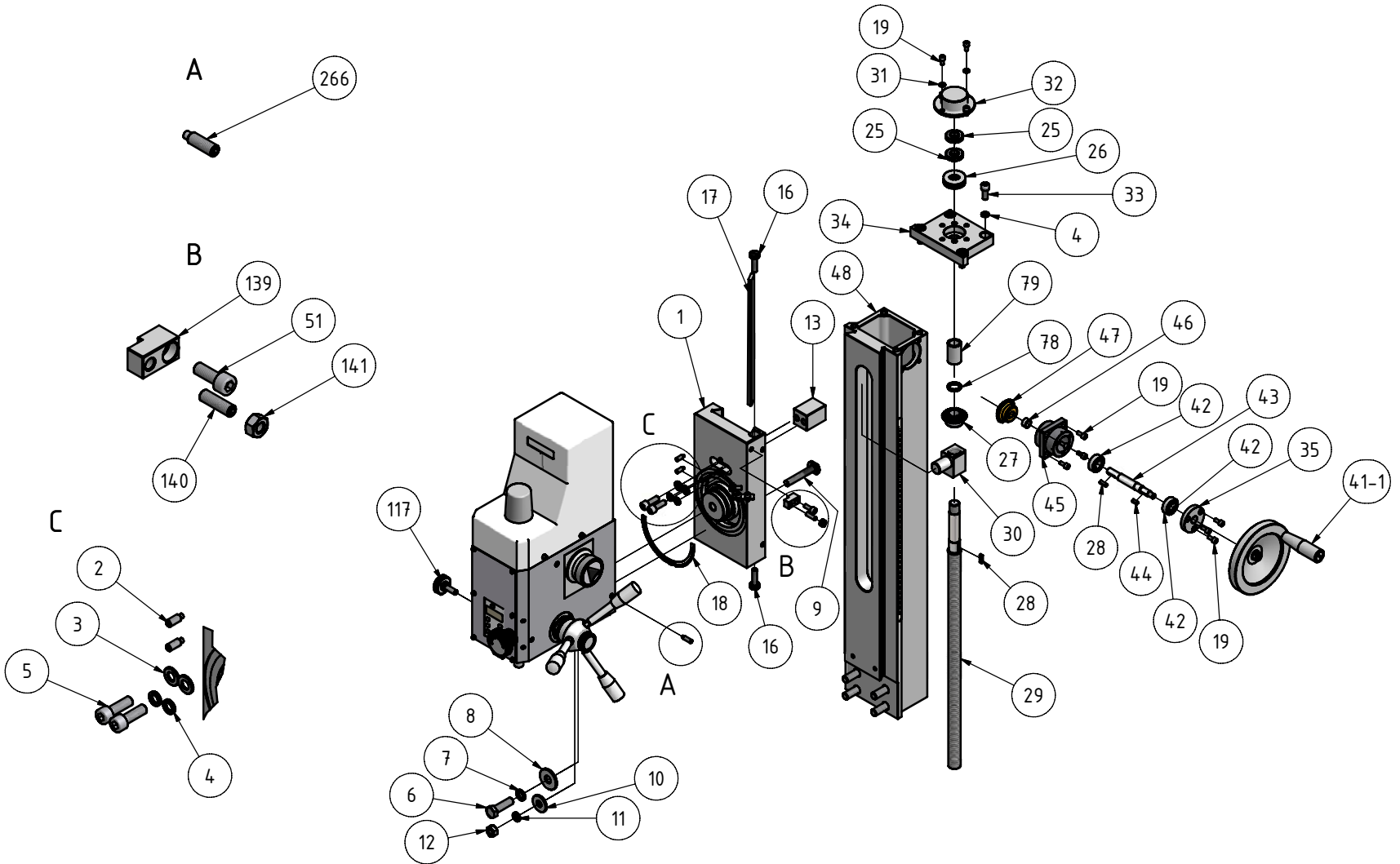


Abb.6-3: Säule - Column

6.3

Säule 2 von 2 - Column 2 of 2

28.11.06

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## 6.4 Fräskopf 1 von 2 - Milling head 1 of 2

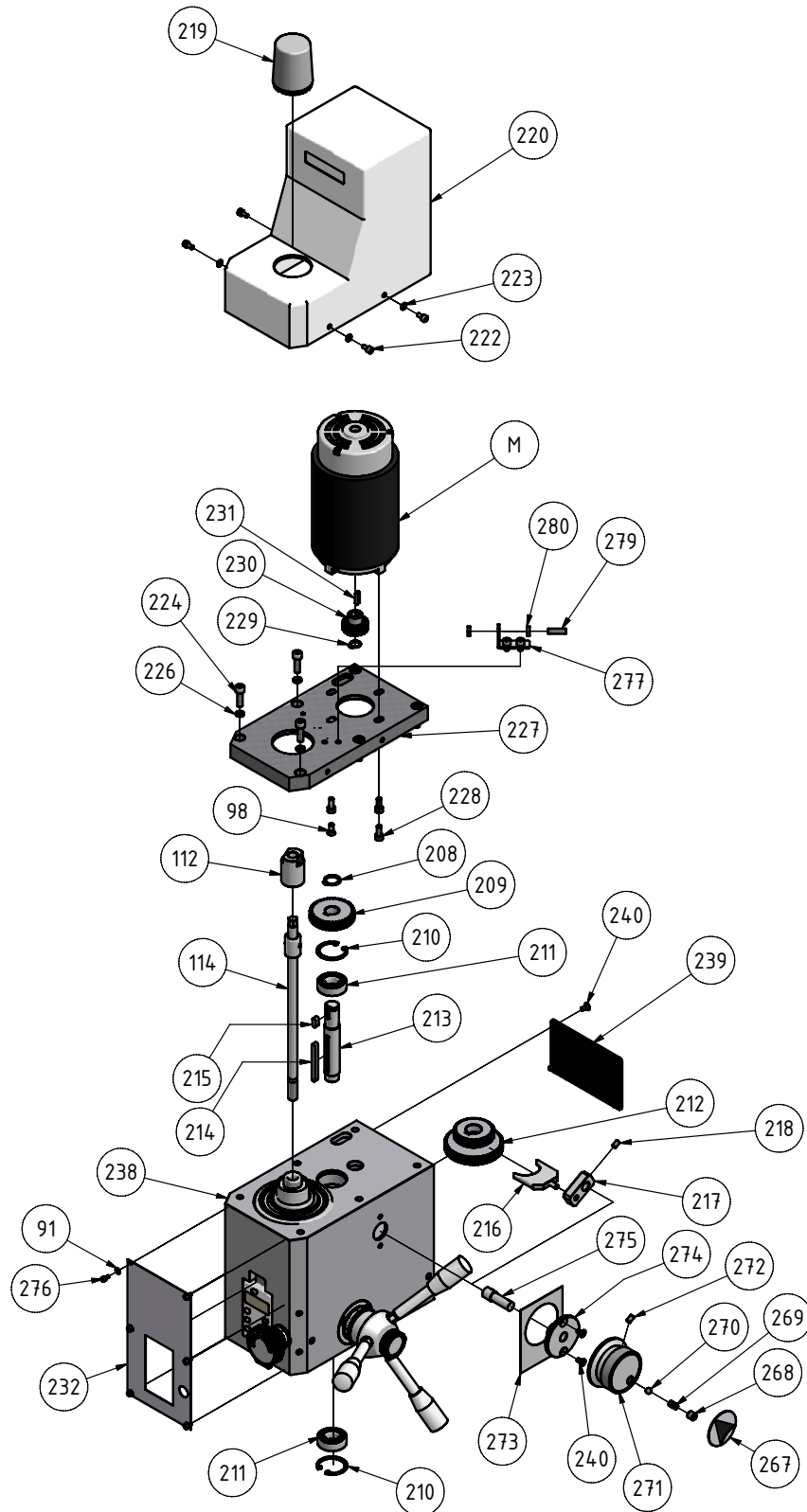
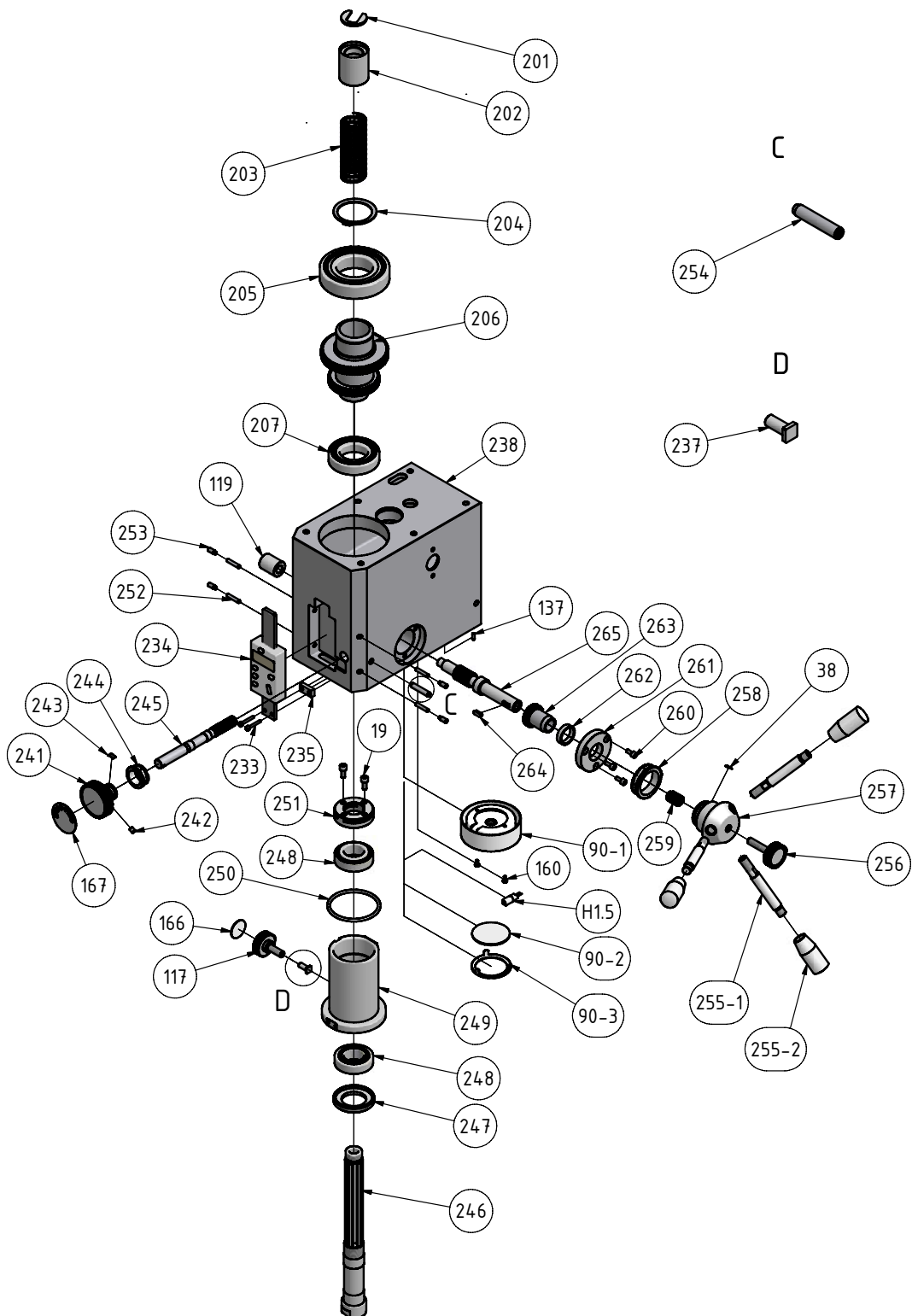


Abb.6-4: Fräskopf - Milling head

6.5 Fräskopf 2 von 2 - Milling head 2 of 2







6.7 Optionaler unterbau - Optional sub structure

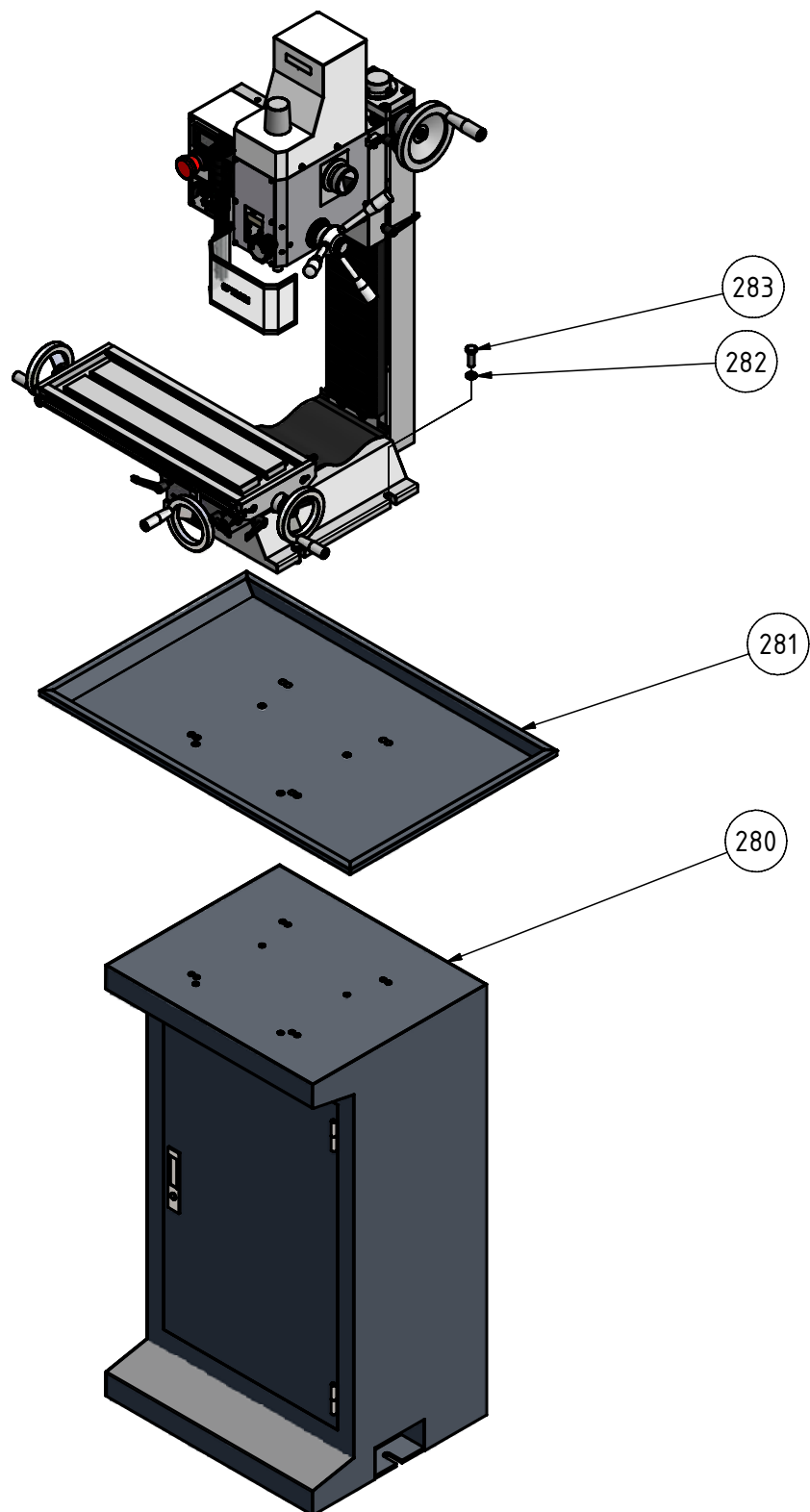


Abb.6-6: Unterbau - Sub structure

## 6.7.1 Ersatzteilliste - Spare part list

Pos.	Bezeichnung	Designation	Menge	Zeichnungsnummer	Grösse	Artikelnummer
			Qty.	Drawing no.	Size	Item no.
1	Drehlagerbock Fräskopf	Connect board	1	DM14-01-14		0320201
2	Gewindestift	Socket head set screw	2	GB 79-85	M6 x 16	033381202
4	Federring	Spring washer	6	GB 93-87	M8	033381203
5	Innensechskantschraube	Hexagon head cap screw	2	ISO 4762	M8 x 25	033381204
6	Sechskantschraube	Hexagon head screw	1	GB 5783-86	M12 x 40	033381205
7	Federring	Spring washer	5	GB 93-87	M12	033381206
8	Unterlegscheibe	Washer	1	DM14-01-39		033381207
9	Schraube	Screw	1			033381208
10	Unterlegscheibe	Washer	1	DM14-01-40		0340295
11	Federring	Spring washer	1	GB 93-87	M10	0333812011
12	Sechskantmutter	Hexagon nut	1	GB 6170-86	M10	0333812012
13	Führungsstück	Connect collar	1	DM14-01-13		0320202
14	Messingstift	Brass pin	6	DM14-00-05		0320203
15	Klemmhebel	Adjust locating handle	4	JBT 7270.12-1994	DM6 x 16	0320204
16	Schraube Keilleiste	Gib screw	6	DM14-02-20		0320205
17	Keilleiste Z-Achse	Taper gib z axis	1	DM14-00-01		0320206
18	Winkelskala	Angle plate	1	DM14-00-03		0320207
19	Innensechskantschraube	Hexagon head cap screw	20	GB 70-85	M5 x 10	0333812019
20	Faltenbalg	Bellows	1	DM14-00-06		0320208
21	Mutter	Hexagon nut	2	DIN EN 24 032	M5	0333812021
22	Halterung Faltenbalg	Bellows bracket	1	DM14-00-06		0320209
23	Gummi - Späneabdeckung	Rubber splash guard	1	DM14-00-08		0320210
24	Leiste	Plate	1	DM14-00-09		0320211
25	Nutmutter	Groove nut	2	GB 810-88	M16x1.5	0320212
26	Axial Rillenkugellager, einseitig wirkend	Axially grooved ball bearing, on one side working	1	51203	51203	0320213
27	Kegelzahnrad	Taper gear	1	DM14-03-06	26 Z ; m 1,5	0320214
28	Paßfeder	Key	3	DIN 6885	A 4 x 4 x 16	0333812028
29	Spindel Z-Achse	Lift lead screw	1	DM14-03-04		0320215
30	Spindelmutter Z-Achse	Lift lead screw nut	1	DM14-03-05		0320216
31	Scheibe	Washer	8	GB 97.1-85	5	0333812031
32	Abdeckkappe	Nut collar	1	DM14-03-01		0320217
33	Innensechskantschraube	Hexagon head cap screw	4	GB 70-85	M8 x 20	0333812033
34	Abdeckplatte Säule	Column cover	1	DM14-03-02		0320218
35	Lagerabdeckung	Bearing cover	1	DM14-03-10		0320219
37	Skalering Z-Achse	Lift dial z axis	1	DM14-03-11		0320220
38	Federstück	Spring piece	4			0320221
39	Handrad Z Achse	Handwheel z axis	1	DM14-03-13		0320222
40	Sechskantmutter	Hexagon nut	4	ISO 4033	M8	0320223
41	Griff komplett	Handle complete	1			0320224
41-1	Griffhülse	Handle sleeve	1	JB7270.5-1994-80	80	03202241
41-2	Schraube	Screw	1	JB7270.5-1994-M10	M10 x 80	03202242
42	Rillenkugellager einreihig	Grooved ball bearing single-row	2	6001-2RZ		0320225
43	Welle Handrad Z Achse	Lift shaft z axis	1	DM14-03-12		0320226
44	Paßfeder	Key	5	DIN 6885	A 4 x 4 x 12	0333812044
45	Lagerbock	Lift bearing base	1	DM14-03-09		0320227
46	Buchse	Collar	1	DM14-03-08		0320228
47	Kegelzahnrad	Taper gear	1	DM14-03-07		0320229
48	Säule	Column	1	DM14-03-03		0320230
49	Skala Z-Achse	Lift plate	1	DM14-00-04		0320231
50	Zylinderstift	Cylindrical pin	4	GB 119-86	A 5 x 24	0333812050
51	Innensechskantschraube	Hexagon head cap screw	11	GB 70-85	M6 x 16	0333812051
52	Lagerbock Kreuztisch links X-Achse	Table dial support x axis left	2	DM14-02-06		0320232
54	Frästisch	Cross table	1	DM14-02-03	BF20	0320234
54	Frästisch	Cross table	1	DM14-02-03L	BF20 L	0333812054
55	Eiinschraubverschraubung Schlauchanschluss	Screwing in screw connection hose connector	1	DM14-02-18	M10 x 1	0333812055
56	Lagerbock Kreuztisch rechts X-Achse	Table dial support x axis	1	DM14-02-02		0320235
57	Griff komplett	Handle complete	3			0320236
57-1	Griffhülse	Handle sleeve	3	JB7270.5-1994-63	63	03202361
57-2	Schraube	Screw	3	JB7270.5-1994-M8	M8 x 63	03202362
58	Handrad Kreuztisch	Handwheel cross table	3	DM14-02-01		0320237
59	Skalering	Dial	3	DM14-02-19		0320238
60	Axial-Rillenkugellager, einseitig wirkend	Axially grooved ball bearing, on one side working	5	51200		0320239



Pos.	Bezeichnung	Designation	Menge	Zeichnungsnummer	Grösse	Artikelnummer
			Qty.	Drawing no.	Size	Item no.
61	Innensechskantschraube	Hexagon head cap screw	2	GB 70-85	M6 x 10	0333812061
62	Hülse Endlagenanschlag X-Achse	Stopper x axis	2	DM14-02-04		0320240
63	Rechteckmutter (Nutenstein)	Wedgy nut	2	DM14-02-05		0333812063
64	Skala X-Achse BF20	Table plate x axisBF20	1	DM14-00-02	BF20	0320241
64	Skala X-Achse BF20 L	Table plate x axisBF20 L	1	DM14-00-02L	BF20 L	0333812064
65	Spindel X-Achse BF20	Table lead screw x axis BF20	1	DM14-02-11	BF20	0320242
65	Spindel X-Achse BF20 L	Table lead screw x axis BF20 L	1	DM14-02-11L	BF20 L	0333812065
66	Spindelmutter X-Achse	Table lead screw nut x axis	1	DM14-02-09		0320243
67	Innensechskantschraube	Hexagon head cap screw	4	GB 70-85	M4 x 20	0333812067
68	Kreuztischführung	Saddle	1	DM14-02-08	BF20	0320244
69	Anschlag Endlage X-Achse	Limit plate x axis	1	DM14-02-07		0320245
70	Keilleiste Y-Achse	Taper gib y axis	1	DM14-02-10		0320246
71	Spindelmutter Y-Achse	Lead screw nut y axis	1	DM14-02-16		0320247
72	Keilleiste X-Achse	Taper gib x axis	1	DM14-02-17	BF20	0320248
73	Innensechskantschraube	Hexagon head cap screw	2	GB 70-85	M6 x 25	0333812073
74	Lagerbock	Saddle dial support	1	DM14-02-13		0320249
75	Spindel Y-Achse	Lead screw y axis	1	DM14-02-14		0320250
76	Maschinenfuss	Base	1	DM14-02-15	BF20	0333812076
77	Innensechskantschraube	Hexagon head cap screw	4	GB 70-85	M12 x 90	0333812077
78	Klemmhebel	Clamping lever	4	JBT7270.12-1994	DM6x16	0333812078
78	Distanzring für Spindel Z-Achse	Spacer ring for spindle z axis	1	DM14-03-15		0333812078
79	Hülse für Z-Achse	Case for z axis	1	DM14-03-14		0333812079
80	Scheibe	Washer	6	GB 97.1-85	8	0333812080
81	Scheibe	Washer	2	GB 97.1-85	4	0333812081
83	Innensechskantschraube	Hexagon head cap screw	6	GB 70-85	M6 x 12	0333812083
90	Maschinenleuchte komplett	Machine lightning complete	1			0333812090
90-1	Gehäuse Maschinenleuchte	Housing machine lightning	1			03338120901
90-2	Schutzglas	Protection glas	1			03338120902
90-3	Deckel Maschinenleuchte	Cover machine lightning	1			03338120903
H 1.5	Halogen-Stiftsockellampe 12V , 10 W, Sockel G4	Halogen lamp 12V , 10 W, Sockel G4	1			03338120H15
91	Scheibe		6	GB 97.1-85	3	0333812091
98	Senkschraube mit Kreuzschlitz	Countersunk screw	1	BS 4183	M5 x 12	0333812098
112	Gegenhalter Anzugsstange	Holder screw rod	1	DM14-01-42		03338120112
114	Anzugsstange	Screw rod	1	DM14-20-02		03338120114
117	Klemmschraube Pinole	Clamping screw collar	1	DM14-01-43		03338120117
119	Verschlussstück	Endplate	1	DM14-01-25		03338120118
126	Schutzeinrichtung komplett	Protection device complete	1	BF20-XHZMX		03338120126
126-1	Gehäuse	Housing	1	BF20-XHZMX		033381201261
126-2	Aluminium Profilaufnahme	Aluminium profile admission	1	BF20-XHZMX		033381201262
126-3	Klemmschraube	Clamping scwew	1	BF20-XHZMX		033381201263
126-4	Aluminiumprofil	Aluminium profile	1	B15-04-02	L=290mm	033381201264
126-5	Schutz	Protection	1	BF20-XHZMX		033381201265
126-6	Schraube	Screw	2	BF20-XHZMX		033381201266
126-7	Stahlkugel	Steel ball	1	BF20-XHZMX		033381201267
126-8	Federblech	Spring plate	1	BF20-XHZMX		033381201268
126-9	Schraube	Screw	2	BF20-XHZMX		033381201269
126-10	Mikroschalter	Micro switch	1	BF20-XHZMX		0333812012610
126-11	Deckel	Cover	1	BF20-XHZMX		0333812012611
127	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	1	GB 78-85	M5 x 6	03338120127
137	Zeiger Winkelskala	Scale-pin	1			03338120137
139	Anschlagstück	Stopper	1	DM14-00-10		03338120139
140	Innensechskant-Gewindestift mit flachem Ende	Hexagon head cap thread pin screw with flat end	1	GB 77-85	M6 x 20	03338120140
141	Sechskantmutter	Hexagon nut	1	GB 6170-86	M6	03338120141
160	Flachkopfschraube mit Kreuzschlitz	Cheese head screw	2	ISO 7045	M3 x 6 - 4.8 - H	03338120160
164-3	Gehäuse Steuerung	Housing control boards	1	DM14-10-04		033381201643
165-1	Panel Gehäuse	Panel housing	1	DM14-10-02A		033381201651
165-2	Blende	Cover	1	DM14-10-01A		033381201652
165-12	Innensechskantschraube	Innensechskantschraube	4	GB 70-85	M4 x 30	0333812016512
166	Label lösen / spannen	Label loose / tighten	1			03338120166
167	Label Feinvorschub	Label Micro feed	1			03338120167
168	Morsekonus MK2 - B16	Morse taper MK2 - B16	1	DM14-MS2W-B16		03338120168
169	Halterung Panel	Mounting plate panel	1	DM14-10-07		03338120169
170	Halterung Panel	Mounting plate panel	1	DM14-10-08		03338120170
171	Innensechskant-Gewindestift mit Ringschneide	Innensechskant-Gewindestift with cup point	1	GB 80-85	M5 x 12	03338120171

Pos.	Bezeichnung	Designation	Menge	Zeichnungsnummer	Grösse	Artikelnummer
			Qty.	Drawing no.	Size	Item no.
172	Haltearm Panel	Holding arm panel	1	DM14-10-06		03338120172
173	Innensechskantschraube	Hexagon head cap screw	4	GB 70-85	M4 x 6	03338120173
201	Positionsscheibe	Position washer	1	DM14-01-08		0320251
202	Buchse	Spring sleeve	1	DM14-01-07		0320252
203	Druckfeder	Spring	1	GB2089-94	2.5x28x110-3	0320253
204	Sicherungsring	Retainer ring	1	GB 894.1 - 45		03338120204
205	Rillenkugellager einreihig	Grooved ball bearing single-row	1	6209-2Z	6209-2Z	0320254
206	Zahnradkombination	Gear combination	1	DM14-01-06	Z 60 / Z 80, m 1	0320255
207	Rillenkugellager einreihig	Grooved ball bearing single-row	1	6007-2Z	6007-2Z	0320256
208	Sicherungsring	Retainer ring	1	DIN 471	15 x 1	03338120208
209	Zahnrad schrägverzahnt	Gear diagonally-toothed	1	DM14-01-10	Z 37, m 1,25, 9°	03338120209
210	Sicherungsring	Retainer ring	2	DIN 472	32 x 1.2	03338120210
211	Rillenkugellager einreihig	Grooved ball bearing single-row	2	6002-2Z	6002-2Z	0320258
212	Zahnradkombination	Gear combination	1	DM14-01-05	Z 62 / Z 42, m 1	0320259
213	Zwischenwelle	Intermediate shaft	1	DM14-01-04		0320260
214	Paßfeder	Key	1	DIN 6885	A 5 x 5 x 50	03338120214
215	Paßfeder	Key	1	DIN 6885	A 5 x 5 x 12	03338120215
216	Schaltgabel	Fork	1	DM14-01-17		0320261
217	Arm Schaltgabel	Fork arm	1	DM14-01-16		0320262
219	Abdeckkappe Anzugsstange	Cover	1	DM14-01-09		0320263
220	Motorhaube	Motor cover	1	DM14-01-35A		0320264
222	Innensechskantschraube	Hexagon head cap screw	4	GB 70-85	M4 x 8	03338120222
223	Scheibe	Washer	8	GB 848-85	4	03338120223
224	Innensechskantschraube	Hexagon head cap screw	6	GB 70-85	M6 x 20	03338120224
226	Federring	Spring washer	6	GB 93-87	M6	03338120226
227	Fräskopf Gehäusedeckel	Fixed cover	1	DM14-01-20		0320266
229	Sicherungsring	Retainer ring	1	GB 894.1	10	03338120229
230	Zahnrad schrägverzahnt	Gear diagonally-toothed	1	DM14-01-11	Z 20, m 1,25, 9°	03338120230
232	Blende	Screen	1			0320268
233	Innensechskantschraube	Hexagon head cap screw	2	GB 70-85	M3 x 20	03338120233
234	Digitalanzeige	Digital slide guage	1	DQ1		0320269
235	Linealfestigung Digitalanzeige	Base for ruler digital display	1	DM14-01-31		0320270
237	Klemm- und Führungsstift	Clamping and guide pin	1	DM14-01-34		0320272
238	Gehäuse Fräskopf	Housing milling head	1	DM14-01-19		0320273
239	Abdeckung	Cover	1	DM14-01-12		0320274
240	Senkschraube mit Kreuzschlitz	Countersunk screw	6	GB 819-85	M4x8	03338120240
241	Drehknopf Feinzustellung	Micro feed knob	1	DM14-01-30		0320275
242	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	1	GB 78-85	M5 x 6	03338120242
243	Federstück	Spring piece	1			03338120243
244	Skalenring Feinzustellung	Micro feed dial	1	DM14-01-28		0320276
245	Schneckenwelle	Worm shaft	1	DM14-01-27		0320277
246	Spindel	Spindle	1	DM14-01-03		0320278
247	Spindelmutter	Nut	1	DM14-01-01		0320279
248	Kegelrollenlager einreihig	Taper roller bearing single-row	2	32005 X/Q		0320280
249	Pinole	Collar	1	DM14-01-02		0320281
250	O-Ring	O-ring	1	GB 3452-1	58x2.65	03338120250
251	Klemmmutter	Clamp nut	1	DM14-01-41		0320282
252	Zylinderstift	Cylindrical pin	4	GB 119-86	B4x20	03338120252
253	Gewindestift geschlitzt mit langem Zapfen	Thread pin slit with long tap	4	GB 79-85	M5 x 12	03338120253
254	Gewindestift	Pin with thread	1	GB 120-86-A	6x30	03338120254
255	Griffhebel komplett	Handle complete	3			0320283
255-1	Gewindestange	Threaded rod	3	JB_T7271.6-1994	BM10x80	033381202551
255-2	Griff	Handle	3	JBT7271.5-1994		033381202552
256	Griffschraube	Locking knob	1	DM14-01-21		0320284
257	Nabe Sterngriff Pinolenvorschub	Feed handle disc	1	DM14-01-22		0320285
258	Skalenring Sterngriff	Feed dial	1	DM14-01-36		0320286
259	Feder	Compression spring	1	GB2089-94	1.2x12x25-3	0320287
260	Innensechskantschraube	Hexagon head cap screw	3	GB 70-85	M4 x 10	03338120260
261	Abdeckscheibe	Cover	1	DM14-01-26		0320288
262	Klemmring	Adjust collar	1	DM14-01-37		0320289
263	Kupplung mit Verzahnung	Clutch with gear	1	DM14-01-23		0320290
264	Passfeder	Key	1	DIN 6885 A	4 x 4 x 12	03338120264
265	Verzahnte Welle	Toothed shaft	1	DM14-01-24		0320291
266	Gewindestift geschlitzt mit langem Zapfen	Thread pin slit with long tap	1	GB 79-85	M6 x 20	03338120266
267	Indikator	Plate	1	DM14-BP-03		0320292

Pos.	Bezeichnung	Designation	Menge	Zeichnungsnummer	Grösse	Artikelnummer
			Qty.	Drawing no.	Size	Item no.
268	Innensechskant-Gewindestift mit flachem Ende	Hexagon head cap thread pin screw with flat end	1	GB 77-85	M8 x 8	03338120268
269	Feder	Compression Spring	1	GBT2089-94	0.8x5x25-3	03338120269
270	Stahlkugel	Steel ball	1	GBT308-1994	6,5	03338120270
271	WahldrehschalterGetriebe	Locating knob	1	DM14-01-33		0320293
272	Innensechskant-Gewindestift mit Spitze	Hexagon head cap thread pin screw with point	2	GB 78-85	M5 x 8	03338120272
273	Drehzahllabel	Shifting plate	1	DM14		0320294
274	Aufnahmescheibe	Locating base	1	DM14-01-38		0320295
275	Schaltwelle	Shifting shaft	1	DM14-01-15		0320296
276	Innensechskantschraube	Hexagon head cap srew	6	GB 70-85	M3 x 6	03338120276
277	Winkel Messfühler	Angle sensor	1			03338120277
278	Innensechskantschraube	Hexagon head cap screw	2	GB 70-85	M5 x 8	03338120278
279	Drehzahlsensor	Sensor, number of revolutions	1			03338120279
280	Optionaler Unterbau	Optional sub structure	1			
281	Optionale Wanne Unterbau	Optional pan sub structure	1			
282	Scheibe	Washer	4	GB 848-85	10	03338120282
283	Sechskantschraube	Hexagon head screw	4	GB 5783-86	M10 x 30	03338120283
284	Zugentlastung Anschlusskabel	Strain relief connection cable	1			03338120284
S1.1	Hauptschalter	Main switch	1			03338120S1.1
S1.2	Not-Aus Schlagschalter	Emergency push button	1			03338120S1.2
S1.3	Ein - Aus Drucktaster	On- Off push button	1			03338120S1.3
S1.4	Ein - Aus Schalter Halogenlampe	On- Off switch halogen lamp	1			03338120S14
S 1.5	Drehrichtungsschalter ZH-A	Change over switch ZH-A	1			03338120996
R 1.5	Potentiometer 4,7 K $\Omega$	Potentiometer 4,7 K $\Omega$	1			0320298
T1.4	Transformator 230V / 12V	Transformer 230V / 12V	1			0340292
F1.4	Feinsicherung F 8A / Micro fuse	Fine wire fuse	1			03338120997
P1.3	Digitale Drehzahlanzeige	Digital speed indicator	1			03338120P1.3
Q 1.6	Steuerkarte	Control board	1			0320297
Q1.7	Relaiskarte	Relay board	1			03338120Q1.7
T1.4	Transformator 230V / 12V	Transformer 230V / 12V	1			0340292
H 1.5	Halogen-Stiftsockellampe 12V , 10 W, Sockel G4	Halogen lamp 12V , 10 W, Sockel G4	1			03338120H15
M	Motor	Motor	1			03338120221
M - 1	Motorkohle / carbon brush motor	Carbon brush motor	2			03338120994
X1	Schutzkontaktstecker	Cable	1			03338120998

## 7 Malfunctions

### 7.1 Malfunctions on the drilling-milling machine

Malfunction	Cause/ possible consequences	Solution
The drilling-milling machine does not start	<ul style="list-style-type: none"> <li>Start sequence not followed.</li> </ul>	<ul style="list-style-type: none"> <li> "Switching on the drilling-milling machine" on page 26</li> <li>Have it checked by authorised staff.</li> </ul>
Tool "burnt".	<ul style="list-style-type: none"> <li>Incorrect speed.</li> <li>The chips have not been removed from the bore hole.</li> <li>Tool blunt.</li> <li>Operating without cooling agent.</li> </ul>	<ul style="list-style-type: none"> <li>Select another speed, feed too high.</li> <li>Retract tool more often</li> <li>Sharpen and replace tool.</li> <li>Use coolant.</li> </ul>
Impossible to insert holding taper into the spindle sleeve.	<ul style="list-style-type: none"> <li>Remove any dirt, grease or oil from the internal conical surface of the spindle sleeve or the holding taper.</li> </ul>	<ul style="list-style-type: none"> <li>Clean surfaces well. Keep surfaces free of grease.</li> </ul>
Taper cannot be squeezed out	<ul style="list-style-type: none"> <li>Optional MT3 taper seat shrunk on morse cone.</li> </ul>	<ul style="list-style-type: none"> <li>Have the machine heat-up at highest speed for about two minutes and then try again to disassemble the taper.</li> </ul>
Motor does not start	<ul style="list-style-type: none"> <li>Defective fuse</li> </ul>	<ul style="list-style-type: none"> <li>Have it checked by authorised staff.</li> </ul>
Working spindle rattling on rough workpiece surface	<ul style="list-style-type: none"> <li>Climb milling machining not possible under the current operating conditions.</li> <li>Clamping lever of the movement axes not tightened.</li> <li>Loose collet chuck, loose drill chuck, loose draw-in rod.</li> <li>Tool blunt.</li> <li>Workpiece is not fixed.</li> <li>Excessive slack in bearing.</li> <li>Working spindle goes up and down.</li> </ul>	<ul style="list-style-type: none"> <li>Perform conventional milling.</li> <li>Tighten clamping lever</li> <li>Check, retighten.</li> <li>Sharpen or replace tool</li> <li>Secure the workpiece properly.</li> <li>Readjust bearing slack or replace bearing.</li> <li>Readjust bearing slack or replace bearing.</li> </ul>
Fine feed of spindle sleeve does not work	<ul style="list-style-type: none"> <li>Fine feed is not correctly activated</li> <li>Clutch of the fine feed does not engage, is dirty, smeared, worn or defective</li> </ul>	<ul style="list-style-type: none"> <li> "Manual spindle sleeve feed with the fine feed" on page 30</li> <li>Clean, replace</li> </ul>

## 8 Appendix

### 8.1 Copyright

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The company reserves the right to make technical alterations without prior notice.

### 8.2 Terminology/Glossary

Term	Explanation
Cross table	Bearing surface, clamping surface for the workpiece with X- and Y-direction
Taper mandrel	Taper of the tool holding, taper of the bit or the drill chuck.
Workpiece	Piece to be milled, drilled or machined.
Draw-in rod	Threaded bar for fastening the taper mandrel in the spindle sleeve.
Drill chuck	Device for holding the bit
Collet chuck	Holding fixture for end mill cutters
Drill-mill head	Upper part of the drilling-milling machine
Spindle sleeve	Hollow shaft in which the milling spindle turns.
Milling spindle	Shaft activated by the motor
Drilling table	Bearing surface, clamping surface
Taper mandrel	Cone of the bit or drill chuck
Spindle sleeve lever	Manual control to advance the bit
Quick-action drill chuck	Bit holding fixture can be tightened manually.
Workpiece	Piece to be drilled or machined.
Tool	Milling cutter, drill bit, countersink, etc.



### 8.3 Warranty

Within the terms of warranty, the company Optimum warrants for a perfect quality of its products and will reimburse any cost for overhaul or exchange of defective parts in case of construction error, fault in material and / or defect of fabrication.

The term of warranty for commercial use is 12 months and for use as an amateur it is 24 months. Condition for a warranty claim due to construction errors, faults in material, and / or defects of fabrication is:

- Proof of purchase and that the instructions for use had been followed.  
In order to assert the claim of warranty, you have to present a typescript original receipt of purchase. It must comprise the complete address, date of purchase and type designation of the product.  
The instruction for use for the corresponding device as well as the safety information need to be observed. Damages due to operator's mistakes may not be accepted as warranty claims.
- Correct use of the devices.  
The products of the company Optimum had been designed and built for certain purposes. They are listed in the operation manual.  
The warranty claim may not be accepted if the operating manual is not being followed or if it is used for a purpose which has not been intended or with improper accessory.
- Maintenance work and cleaning.  
It is absolutely necessary to maintain and clean the machine in regular intervals according to the prescriptions of the instruction for use.  
By intervention of a third party, any warranty claim will expire. Maintenance work and cleaning are usually not part of the claim of warranty.
- Original spare parts  
Make sure to use only original spare parts and original accessory. This can be acquired from authorised distributors of the machine.  
When other than original parts are being used, consequential damages may occur and dangerous accidents will increase. Disassembled or partially disassembled devices and devices which are repaired with foreign parts are excluded from warranty claims.
- Wearing parts  
Certain components are subject to wear out by time respectively a standard wear by use on the corresponding machine.  
Among these components are e.g. V-belts, ball bearings, switches, mains cables, gaskets, and washers, etc. These wearing parts are not part of the warranty.

### 8.4 Disposal



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

The sign on the product or on its packing indicates that the product must not be handled as common household waste, but that it 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.

### 8.5 RoHS , 2002/95/EC



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



**8.6 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

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Optimum Maschinen Germany GmbH  
 Dr.-Robert-Pfleger-Str. 26  
 D-96103 Hallstadt  
 Fax +49 (0) 951 - 96 822 - 22  
 E-Mail: [info@optimum-maschinen.de](mailto:info@optimum-maschinen.de)

**8.7 EC - Declaration of Conformity**

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

**hereby declares that the following product,**

**Type of machine:** Drilling-Milling machine

**Name of machine:** BF20 Vario  
BF20 L Vario

**Relevant EU directives:**

**Machinery directive** 98/37/EG, Annex II A

**EMC directive** 89/336/EWG

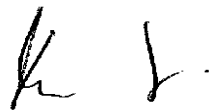
**Low voltage directive** 73/23/EWG

**meets the provisions of the aforementioned directive, including any amendments valid at the time of this statement.**

**In order to ensure conformity, the following harmonised standards in particular have been applied:**

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

EN 62079 Preparing of instructions - structuring, content and presentation  
(IEC 62079:2001)



Thomas Collrep  
(Manager)



Kilian Stürmer  
(Manager)

Hallstadt, 28 / 11 / 2006

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