Kaindl®
SCHLEIFTECHNIK

OPERATING MANUAL FOR TOOL AND UNIVERSAL GRINDING MACHINE

FSM-CNC

Original operation manual V 1.0.1

Please keep for further use!

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EC-CONFORMITY DECLARATION

The manufacturer:

Kaindl-Schleiftechnik
Reiling GmbH
Remchinger Straße 4

75203 Königsbach-Stein
Germany

declares that the machine described hereafter:

Tool- and
Universal grinding machine
Type: **FSM-CNC**

is conform to the following EC-Instructions:

EC-Machine instruction (2006/42/EC)
EC-Low current requierement (73/23/EC)
EC-Instruction EMV (89/336/EC)

Applied harmonised norms:

EN ISO 12100-1 and EN ISO 12100-2; EN ISO 13857; EN 563; EN 61029-1, EN 60204 Part 1; EN 61000-6-1; EN 61000-6-2; EN 61000-6-3; EN 61000-6-4

Changes in design, which affect the technical data listed in this manual and the directed use, therefore change the machine substancially, make this declaration of conformity invalid!

The documents has been assembled by:

Reinhard Reiling

Kaindl-Schleiftechnik
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Remchinger Straße 4
75203 Königsbach-Stein

Königsbach-Stein, dated 27.08.2012

.....
Reinhard Reiling, General Manager

1. DUTY OF TAKING CARE

The **Tool- and universal grinding machine FSM-CNC** was designed and built taking into consideration a risk analysis and carefully selecting harmonized standards to be complied with as well as other technical specifications. It meets the state of technology and guarantees the highest measure of safety.
However, safety can only be achieved under practical conditions if all measures neccessary for this purpose have been met. It is subject to the machine operator due diligence, to plan these measures and control its execution.

The operator must especially make sure that:

- the machine is only used as intended
  (please refer to the "Technical description" chapter)
- the machine is only operated if in a faultless, functional state and especially the safety devices are checked regulary for proper function
- the operating manual are always kept in a legible state and are available at the machine usage site in its entirety and is stored for future used
- al safety and warning notices attached to the machine are not removed and are legible
- all repair and maintenance instructions are followed are executed

2. DEMANDS OF THE OPERATING PERSONNEL

The **Tool- and universal grinding machine FSM-CNC** may only be operated by personnel who are familiar with the principles of handling CNC machines, who know the operating manual, programming manual and the safety notes contained therein and who act accordingly.

3. TRANSPORT

The **Tool- and universal grinding machine FSM-CNC** is delivered ex works in a wooden box on a palette. The weight of the machine including packing is about 425 Kg. The machine is transported using a hoisting plattform or forklift directly to the set-up location.

Check the machine for transportation damage before commissioning!

Please notify the freight forwarding company if any transport damage has been detected and have the damage record.

Please note: there is only a very brief period for filing complaints!!

4. DIMENSIONS AND WEIGHT

Dimensions L x W x H:	1200 x 880 x 1700 mm
Weight without control system:	345 Kg
Weight of control unit:	37 Kg

5. ENVIRONMENTAL CONDITIONS

The machine may only be set up in dry rooms. Climate requirements ranging from +5° to +50° Celcius, humidity up to 90% not condensing.

6. GENERAL SAFETY ADVISE

The greates caution is required when handling cutting and milling tools, because they may have the sharpness of a **razor blade**. Careless handling can lead to serious cut wounds.

Only start the CNC program, if you are sure that the neutral points are correctly contacted, and saved. Before the first start the CNC program should be subject to a test run with adequate safety distance to the standing disc.

Programming or program parameter errors can seriously damage the machine!

Never insert or remove a USB device (e. g. USB stick) when the CNC software is running! This can destory the JOG-Wheel (digital handwheel on the control system)!

Protect the machine protective covering, the guides beneath it, the spindle and the switch from dirt and coolant. Therefore, when cleaning the machine using the coolant gun, do not flush the protective coverings!

7. DIRECTED USE

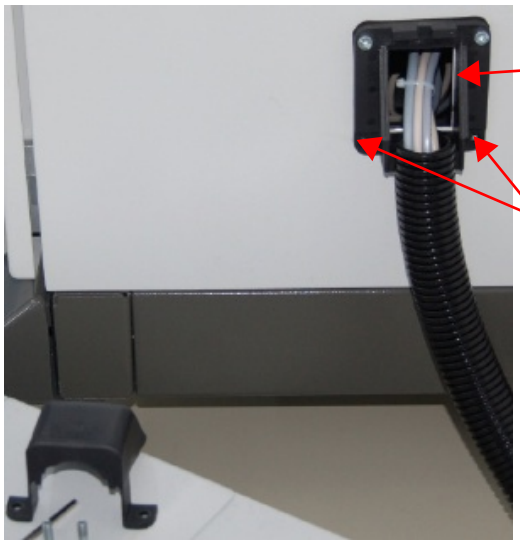
The **Tool- and universal grinding machine FSM-CNC** is exclusively intended for sharpening milling and various cutting tools. The grinding program is created according to DIN 66025 (G-Code) or by the sharpening programs included in the delivery. The tools can be sharpened using the electric spindle for outside grinding or the air spindle for inside grinding.

Reading and understanding the operating and programming instructions are part of the intended use, as well as compliance with all notes contained therein.

The operator is solely responsible for any property damage and personal injury caused by improper use, or by programming or program parameter errors.

8. SET UP OF THE MACHINE AND CONNECTION OF THE CONTROL UNIT

The machine is to be set up using the bases included in the delivery and leveled using a water level. Here it is important that the machine is standing firmly on all four bases, free of any vibration. Now attach the wheel set to the control system frame, make sure that the brake rollers are mounted on the front (operator side).
Next, connect the control system to the machine. For this purpose, open on the right side of the mache the black cable panel.
To open the panel, remove the bottom two screws (M6) using a 4 mm allen key and folding the panel covering up. Now the cables with plugs can be fed through and the black cable hose is fixed in place when closing the panel. By screwing the two screws back in, the panel is screwed tight and the cable hose is firmly mounted and tension relleased.
After opening the front door, the plug connection are produced (see pictures on page 8).

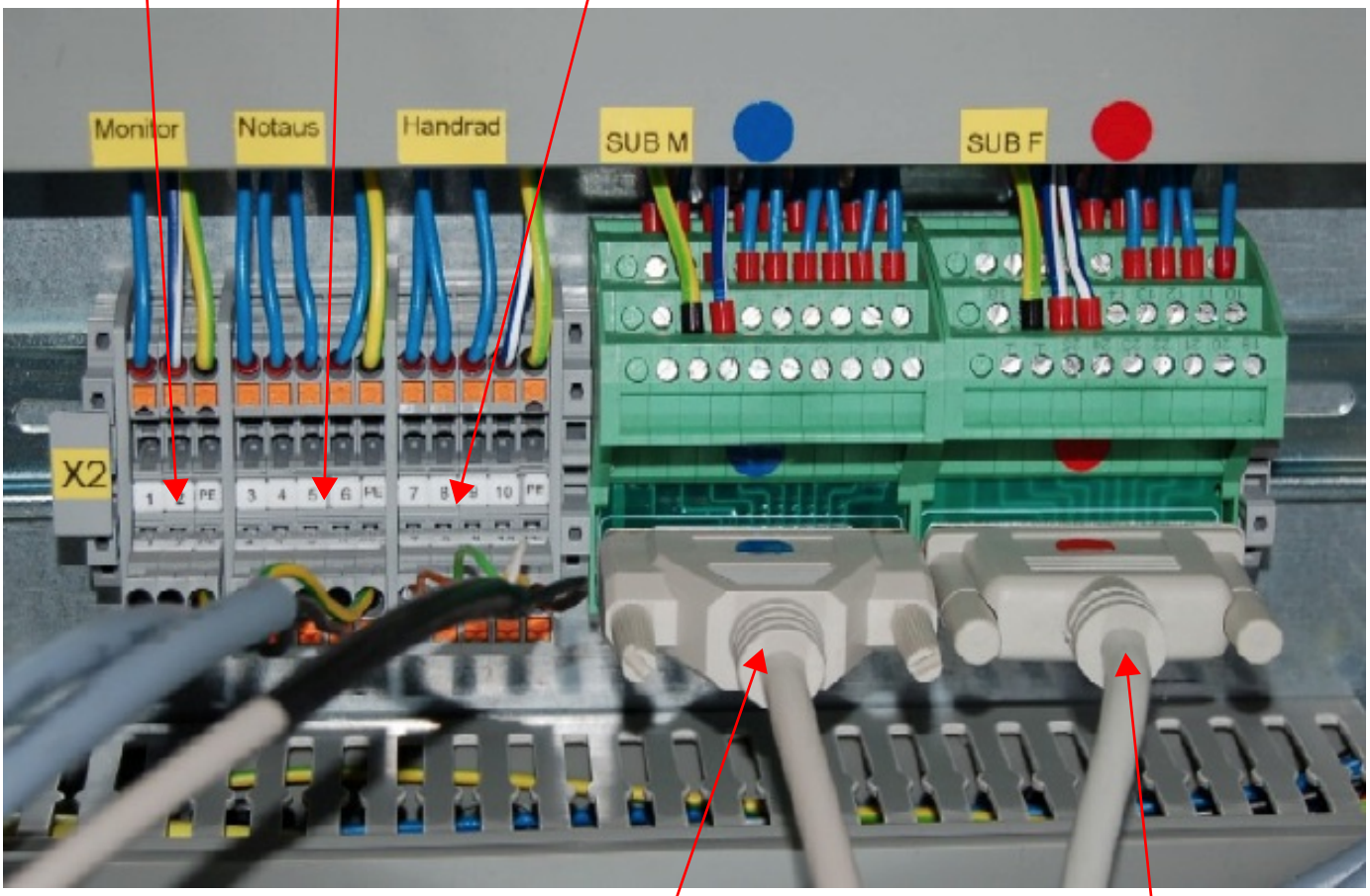


Wheelset on control system frame thereafter tilt the covers open

Plug network

Plug emergency on/off

Plug for jogwheel



25 Pol Sub-D plug with pins

25 Pol Sub-D plug with bushing

NOTE:

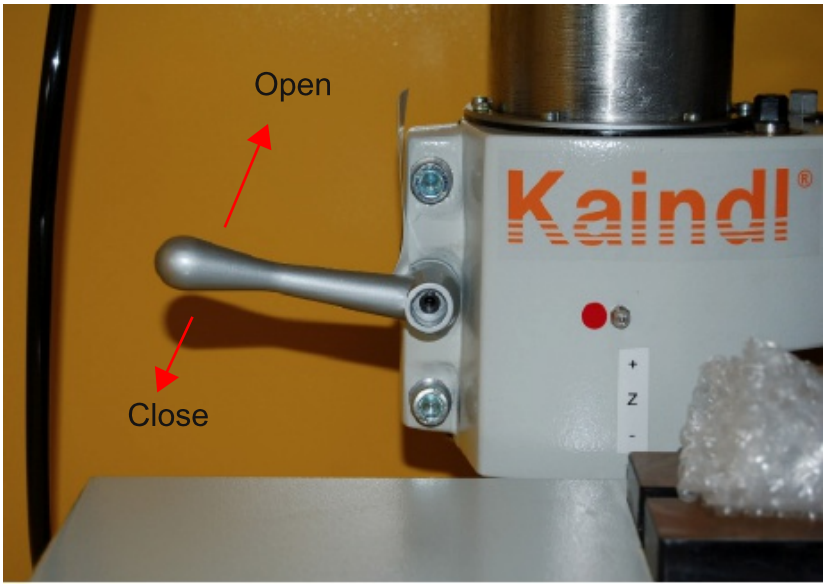
The plug are mechanically coded and cannot be swapped!
Sub-D plugs are color and mechanically coded and cannot be pluged in if swapped!

9. REMOVAL OF THE TRANSPORTATION LOCKS

After the FSM-CNC is firmly positioned on its machine bases and the control system is connected, remove the transportation locks.

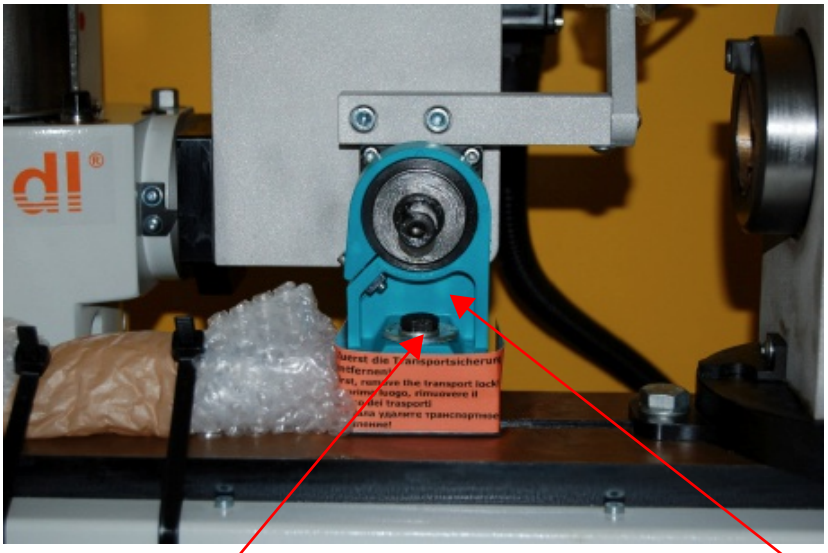
1. Remove the two black cable ties (Picture 2), unpack the clamping lever, mount the clamping lever onto the set screw as seen in picture 1 and open the clamping system.
2. Using a fork wrench SW 13, remove the black 6-hexagonal bolt on the main transportation lock of the axis (Picture 2).
3. Remove the layer of grease on the Z-column and the oil paper in the SK 40 cone of the A-axis. Then turn the machine on and start the CNC software, in order to move in Z-axis in manual operation up.

Picture 1



Remove layer from grease!!

Picture 2



6-hexagonal bolt SW 13

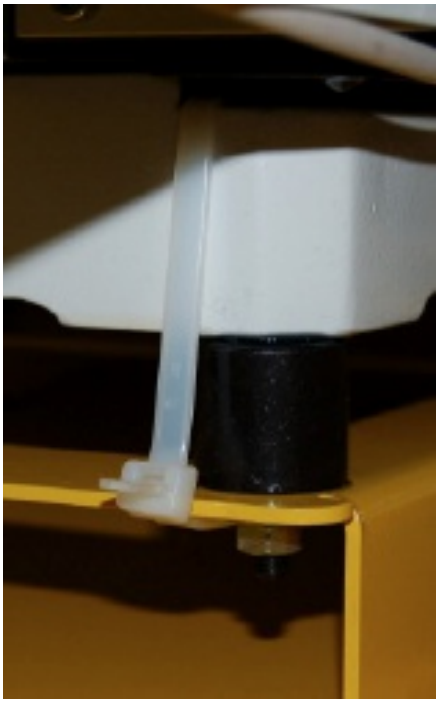
Main transportation lock

10. REMOVAL OF THE TRANSPORTATION LOCKS OF THE BASE

1. Remove all 5 large cable ties form the buttom machine panel, by cutting them using a cutter. (See picture 1 +2)
2. Remove ring around the machine panel the 3 zinc plated allen screws SW 8 (Picture 1).
3. Connect the coolant and fill it with cooling lubricant.

Now all transportation locks have been removed an the FSM-CNC can be put into operation.

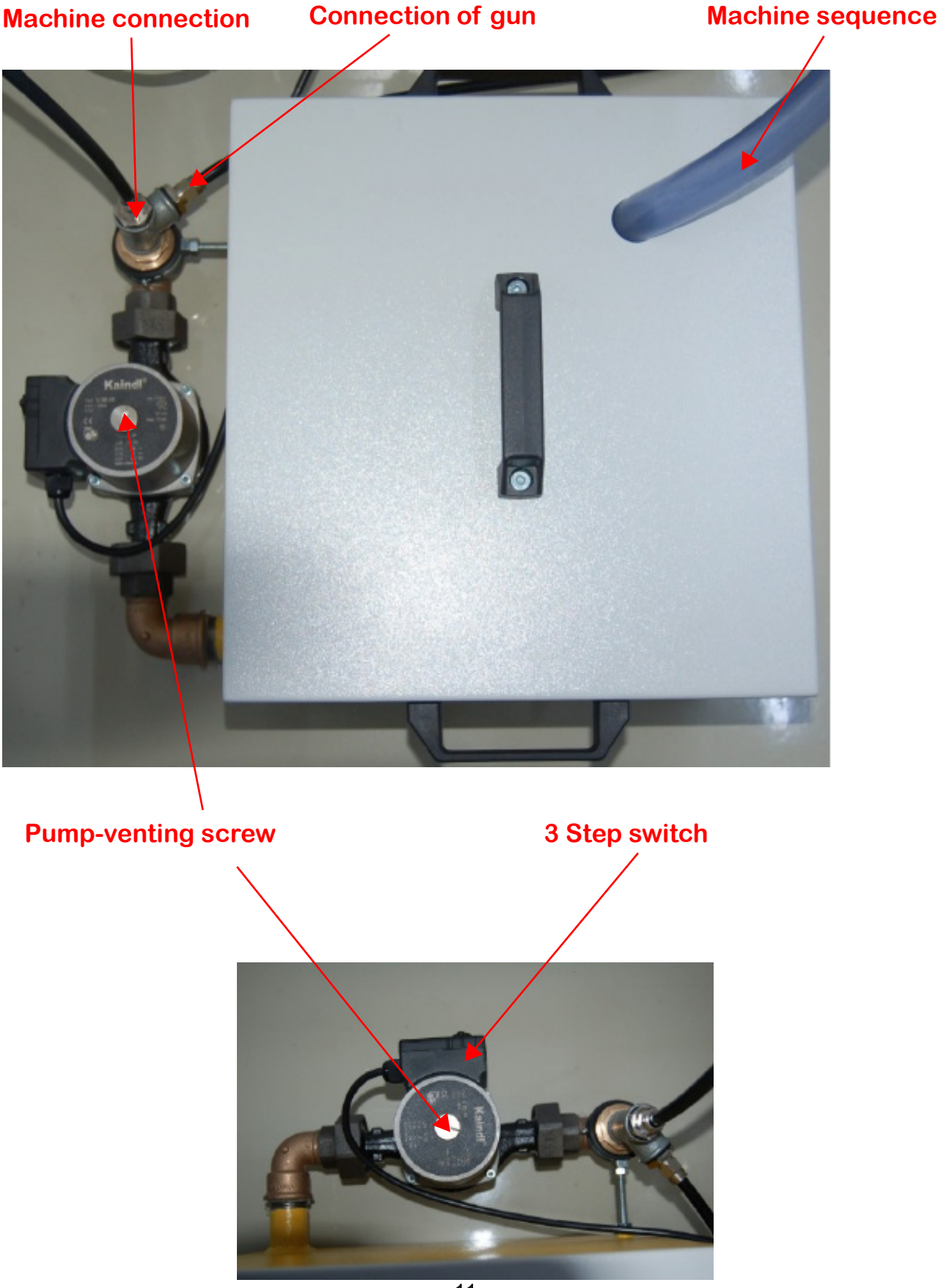
Picture 1



Picture 2

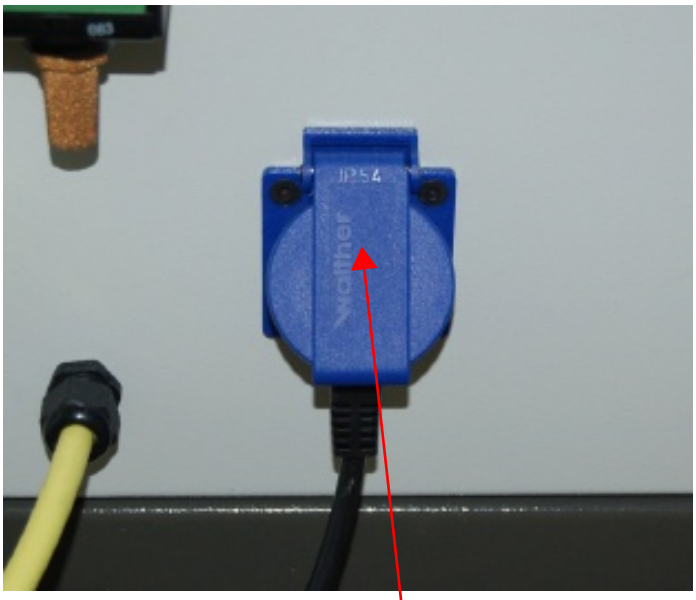
NEUE FOTOS

11. DESCRIPTION OF COOLANT UNNIT



Fill the coolant container with 3/4 of its volume with cooling lubricant an thereafter vent the coolang pumps.

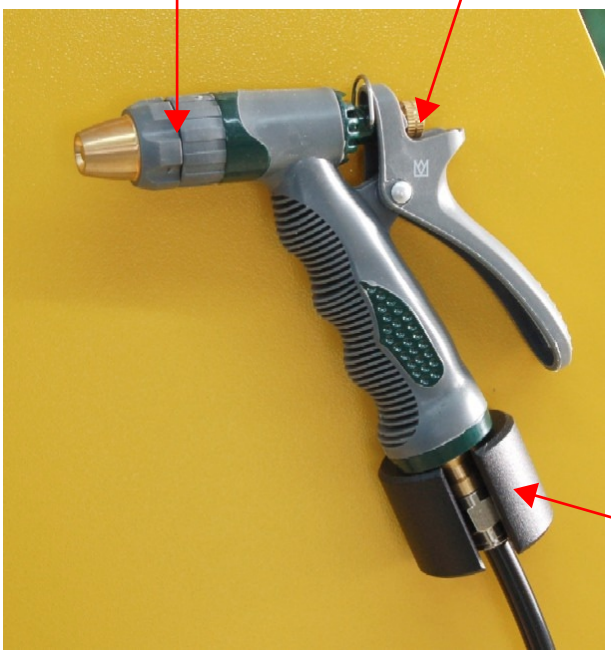
The coolant unit is connected to the **blue socket** of the machine.
To vent the pump, open the **pump-venting screw**.



Socket for coolant unit

The jet is adjustable by twisting

Adjusting the fluid quaranty



Coolant gun holder

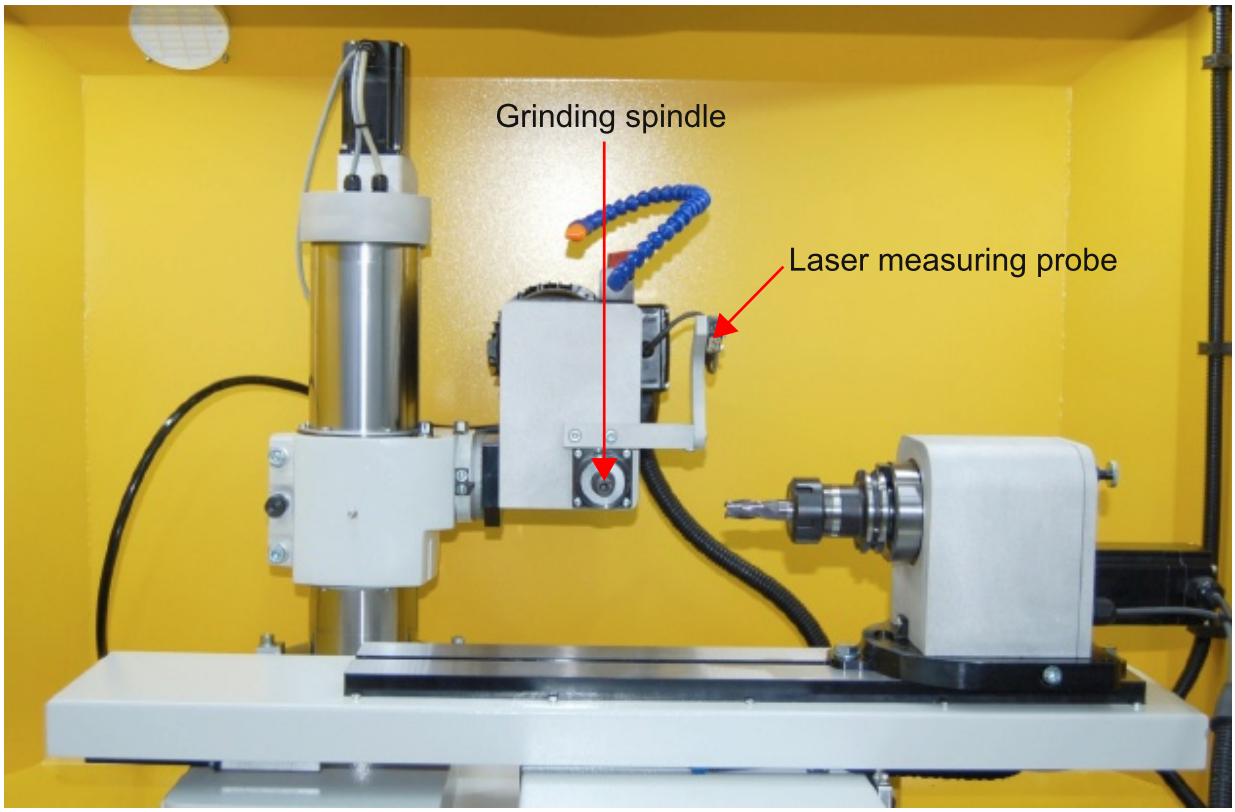
The coolant gun is used to clean the machine and to clean the workpieces. The gun only works if the coolant pump is running. In manual operation, this is turned on using button F8 and the coolant pump can be turned off again using button F8.
When cleaning the machine, the protective covering may not be flushed!

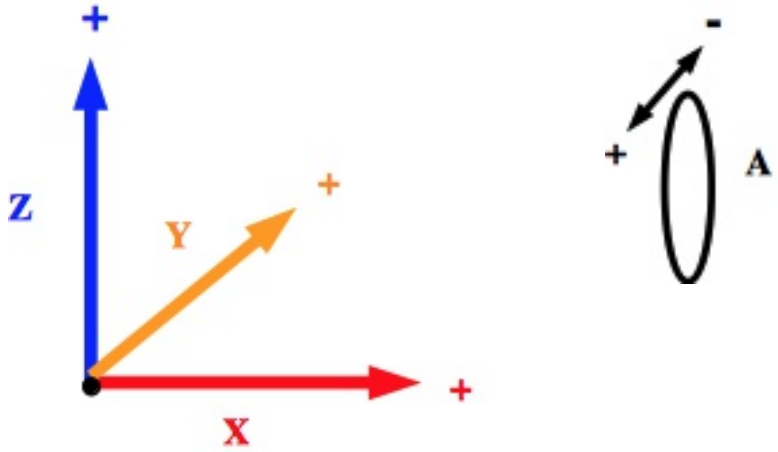
<u>Essentials about the cooling lubricants:</u>
Please only use water mixable emulsions on a mineral oil basis.
For synthetic products, it can significantly damage the paint, various plastic parts and bearing seals; we will not be liable for such damages. When sampling the cooling lubricants, please comply with the guidelines of the resoective lubricant manufacturer.

Please also follow the respective disposal instructions.

12. EXPLANATION OF NUMERIC AXIS

The **FSM-CNC** is equipped with 4 numerical axes. 3 of these are linear axes (**X; Y; Z**) and one is defined as a round axis (**A**). In the buttom figure you can see the allocation of axes, the directional model is always in the visual direction of the grinding spindle (as if the grinding spindle is moving through the room).

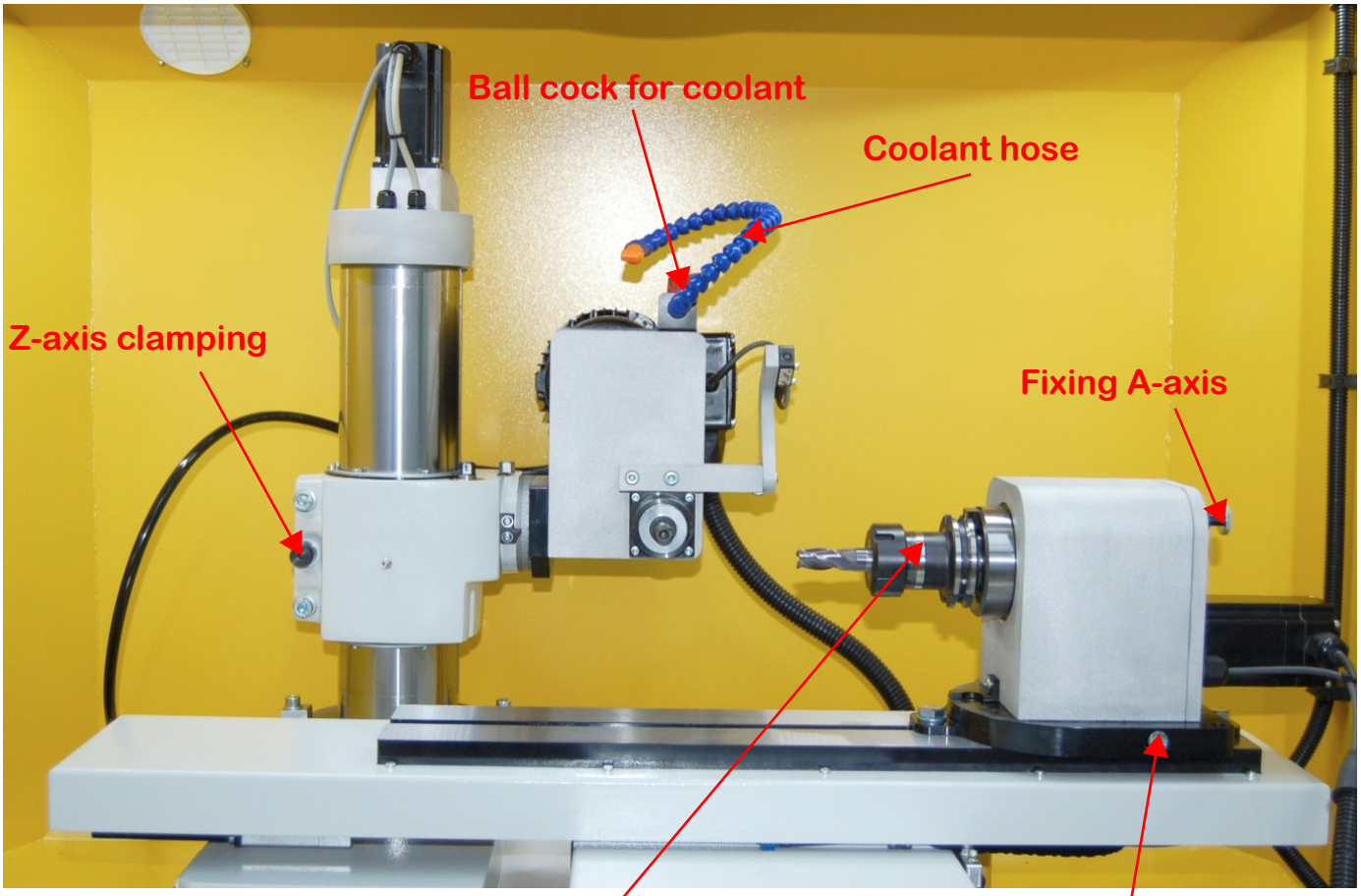




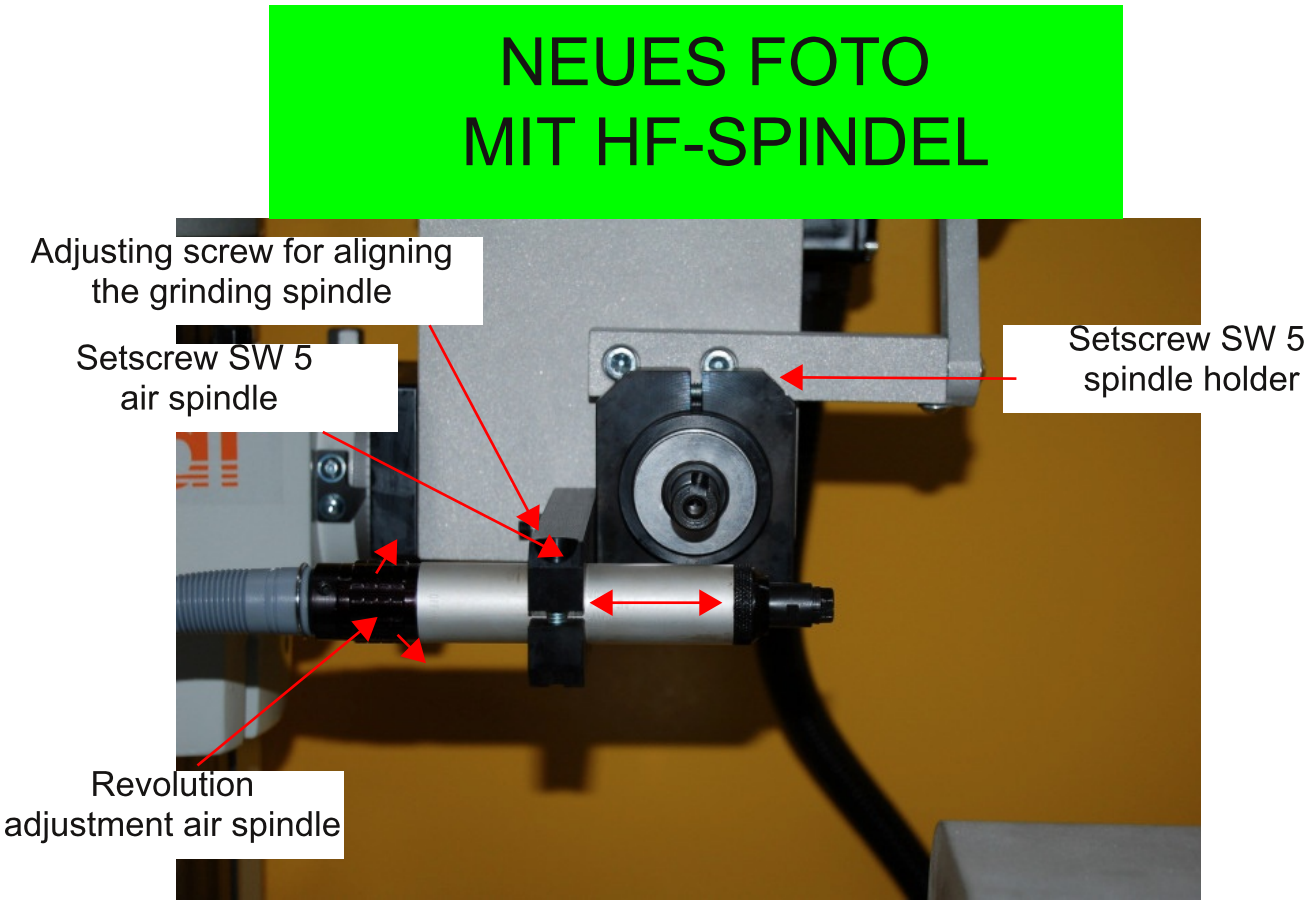
Procedure model in visual direction of the grinding spindle

NOTE:
The axis X; Y; and Z are defined in the "mm" unit of measurement. The A-axis is defined in degree, i.e. one rotation is 360°, the decimal places are decimally. The feed information are therefore "mm/min" and " °/mm".

13. SETUP OF THE FSM-CNC

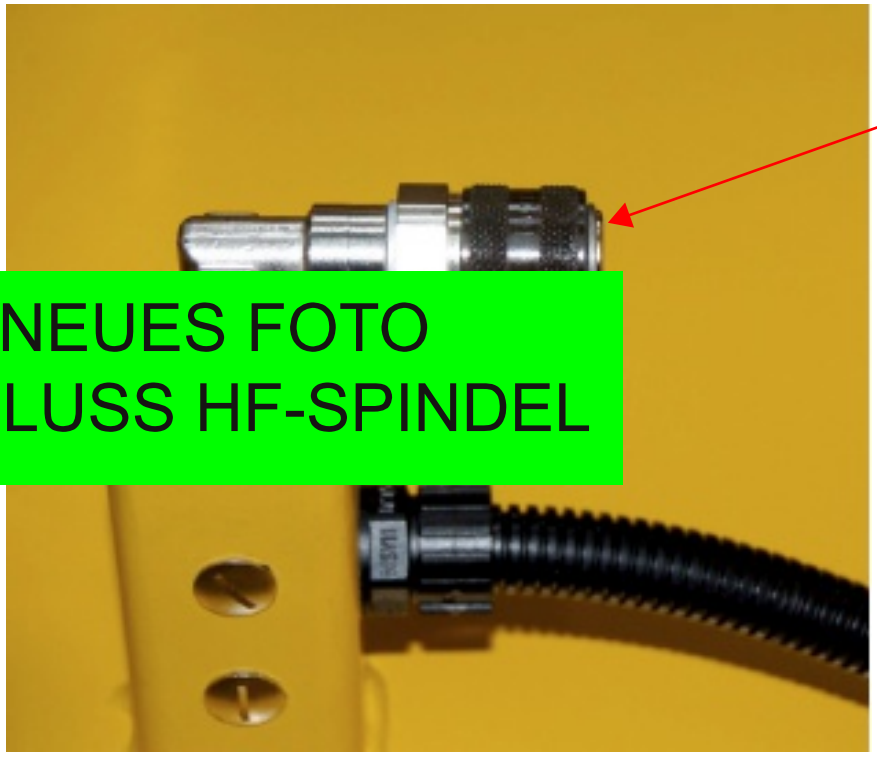


14. INSTALL THE AIR ACTUATOR (OPTION)



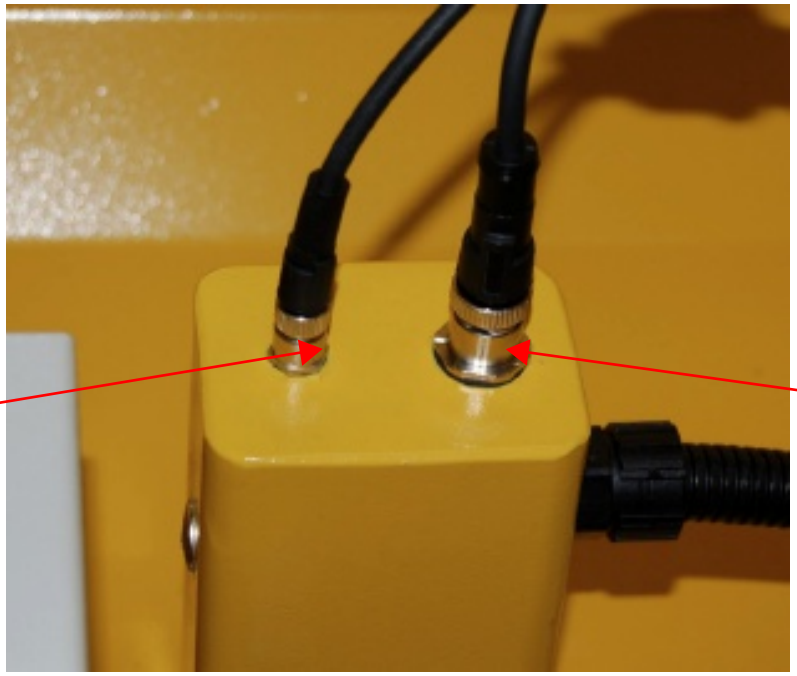
With the adjusting screw allen key SW 3 the air spindle is mounted axis parallel to **X** and is secured with the counter nut SW 10. Only then it is tightended using the setscrew on the spindle holder. The air spindle can be adjusted in the longitudinal direction by loosening the setscrew on the air spindle clamping.

15. CONNECTION FOR AIR ACTUATOR AND A-AXIS



Air connection for air spindle

NEUES FOTO
ANSCHLUSS HF-SPINDEL



Connection for reference point switch

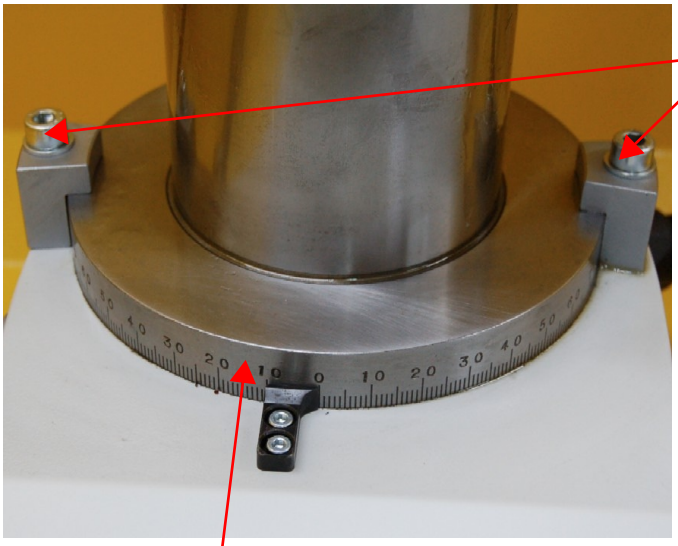
Motor connection A-axis

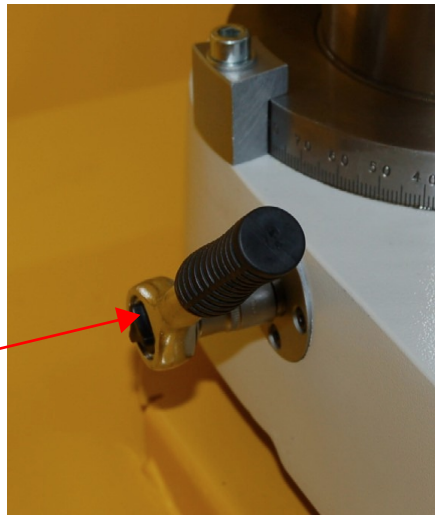
16. MANUAL ADJUSTMENT OPTIONS

The **FSM-CNC** has additional manual adjustment options that make thid machine a very grinding machine. The **Z**-axis can be adjusted in 2 more levels, which creates numerous options for reaching certain tool using the sanding disc.

16.1 HORIZONTAL ADJUSTMENT

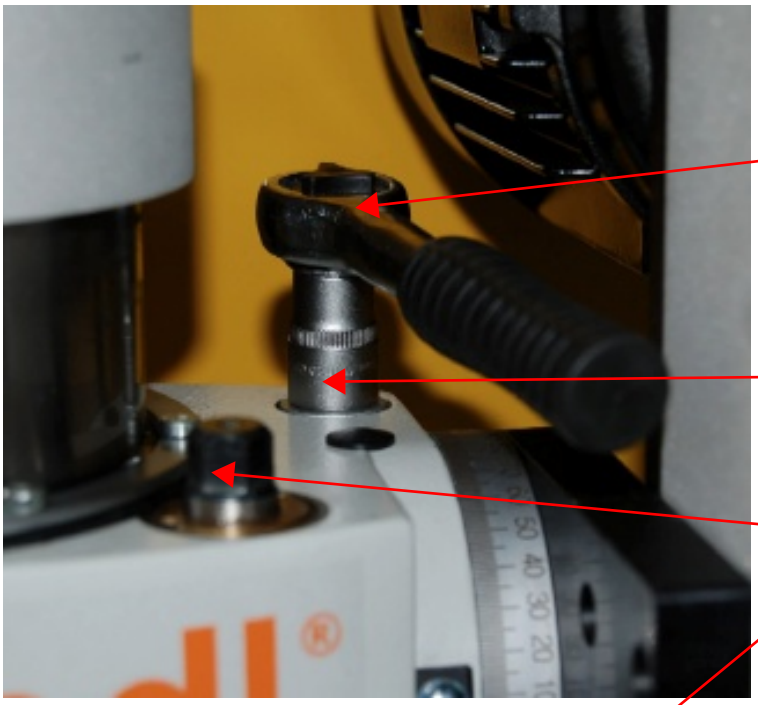
the entire **Z**-axis tower is turned, after the two fastening screws are opened and the adjusting screw is rotated using a ratchet.

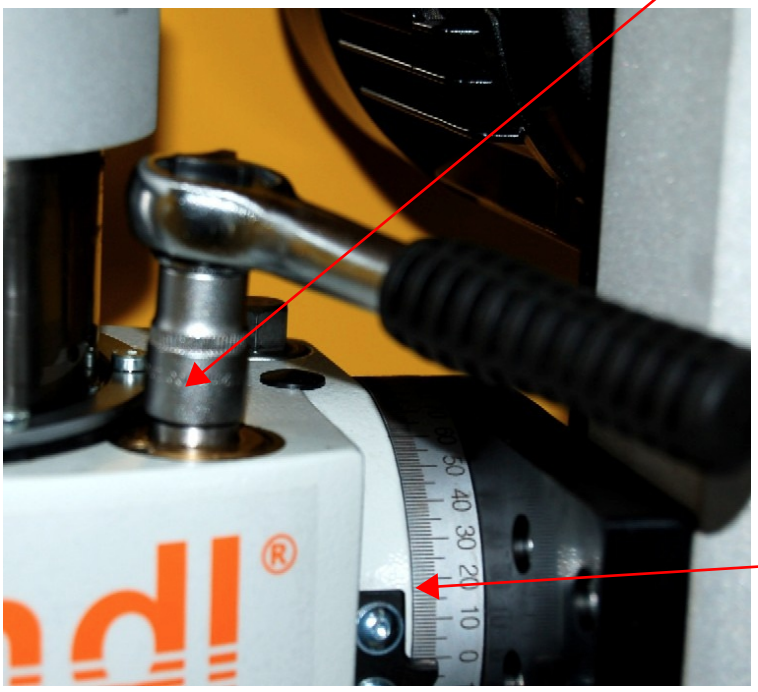




16.2 VERTICAL ANGLE ADJUSTMENT

Using the ratchet open the rear hexagonal screw of the tensioning round. Now adjust the vertical angle on the adjustment screw of the vertical adjusting. If the adjustment cannot be made, lightly knock from the top using the ratchet handle onto the screw of the tensioning round to that they become loose.





After adjusting to the requestet angle, tighten the tensioning round or fastening screws again.

17. CONSTRUCTION OF THE CNC CONTROL SYSTEM

The IPC control is equipped with a touch screen; the buttons are triggered by touching the user interface. The IPC control has a touchpad keyboard that replaces a mouse. The USB 2.0 interface can be used as an additional data backup of your CNC programs on a USB stick.

CAUTION!!!

Never insert or remove a USB device (e. g. USB stick) when the CNC software is running, it could destory the JOG-Wheel!

18. TECHNICAL DATA

Traversing range in X:	300 mm
Traversing range in Y:	130 mm
Traversing range in Z:	190 mm
Grinding motor (E-Spindle):	1~230V/50-60 Hz, 0.25 KW, 2790 r/pm
Grinding motor with control unit:	1~230V/50-60 Hz, 1.2 KW
Number of numerical axes:	4 (X; Y; Z; A)
Suction connection:	Preoared with housing bore ø 100 mm
Dimensions L x W x H:	1200 x 880 x 1700 mm
Machine weight without control:	345 Kg
Calculated noise level:	< 70 dB/A

Control unit:	IPC control unit with 15" touchscreen
Operating system:	Ubuntu 6.06 LTS "Drapper Drake" mit RT Kernel
CNC-Software:	EMC2 Version 2.3.5
Weight of control system, net:	37 Kg

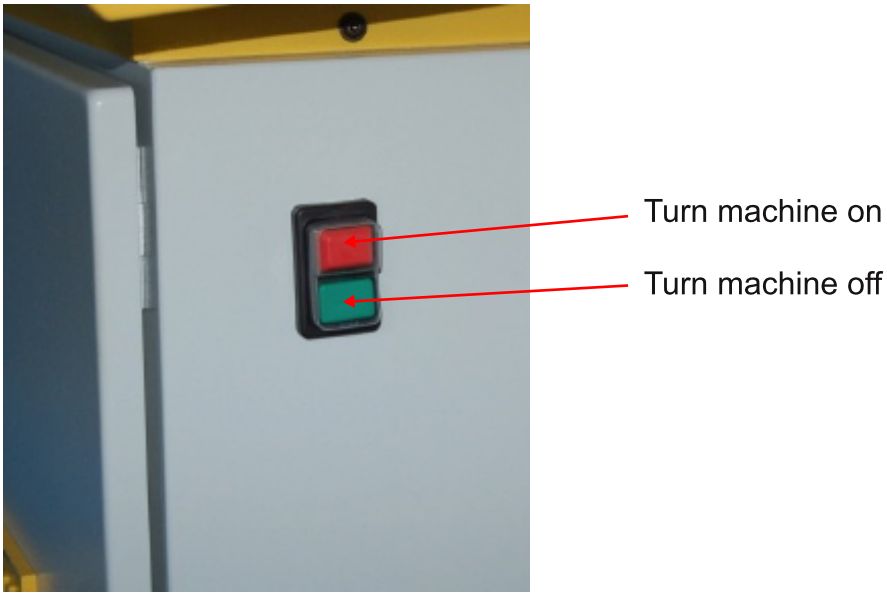
Coolant pump:

Motor:	1~230V / 50 Hz
Power level 1:	0.028 KW
Power level 2:	0.045 KW
Power level 3:	0.063 KW
Protection type:	IP65
Delivery rate:	16 to 35 l/min

Subject to technical changes!

19. TURNING ON THE MACHINE

Turn on the machine by operating the green button on the right at the bottom of the panel.The machine illumination is lit and the control system boots up the operating system.

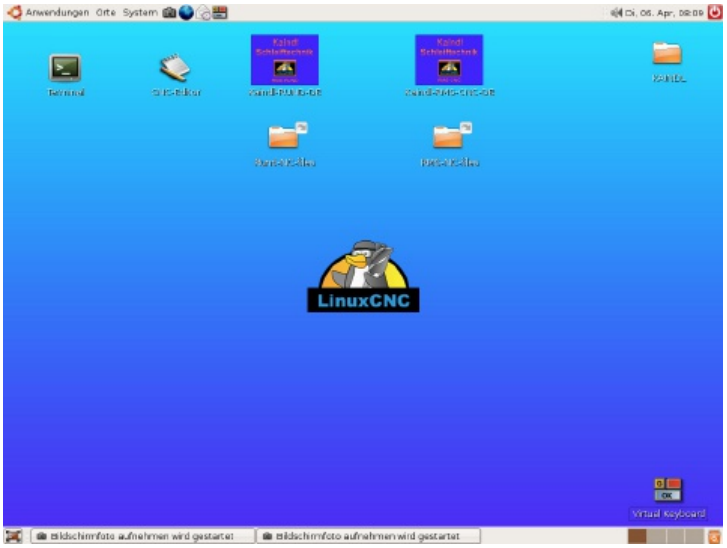


NOTE: Always properly exit the control before turning off the machine!

After booting up the control system, you will see the start-up display, there are 2 machine configurations available:

1. Kaindl-FSM-Rund is a 3 axis configuration for circular or interior circular grinding. (**A**-axis is cinfigured as a spindle)
2. Kaindl-FSM-CNC is a 4 axis configuration for grinding milling and cutting tools.

NOTE: Every configuration has its own independent program folder.
By lightly touching the respective image, the CNC software EMC2 is started.



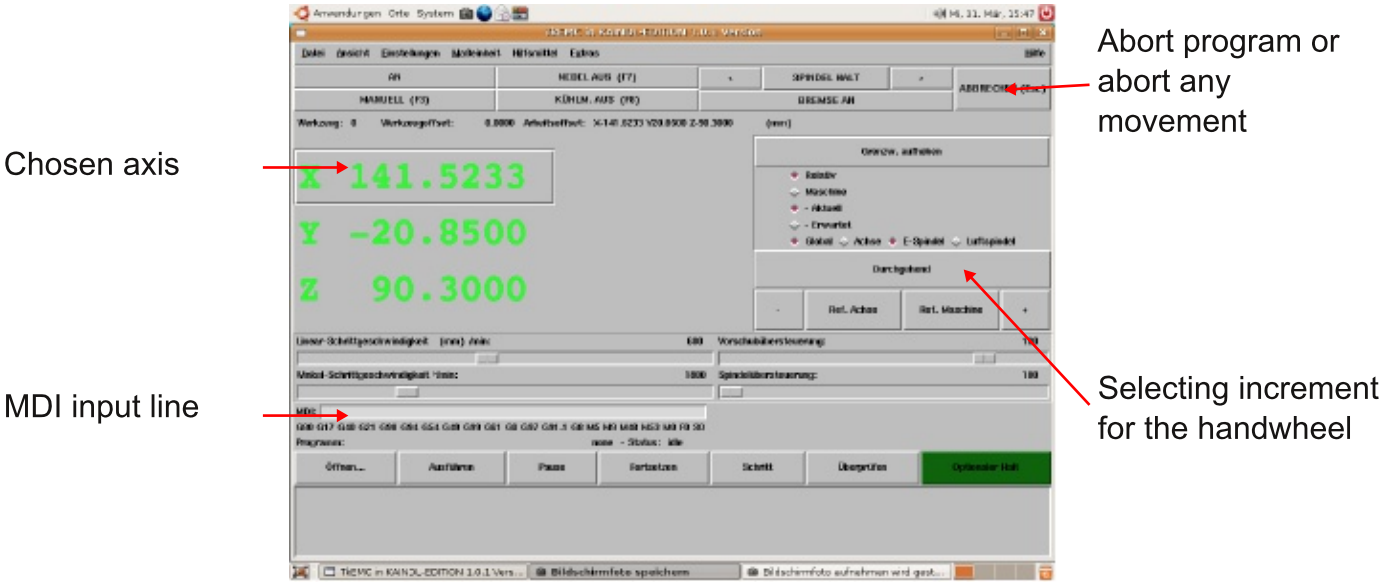
20. THE GRAPHIC COMMAND USER INTERFACE TKEMC

We adjust TKEMC to the machine accordingly. In the following the menus and functions are described. The **help menu -> help** provides a brief introduction on the keyboard functions, the individual menus and the G- and M-codes.

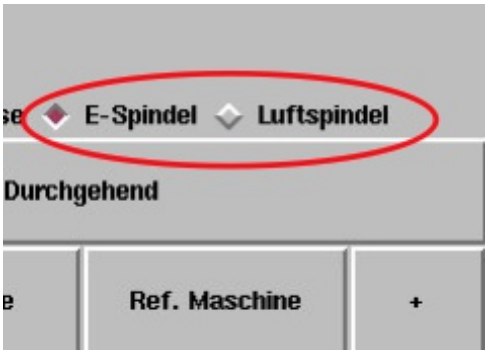
After starting the software, the machine must be turned on using the F2 button. The axis designation and presentation of actual values are presented in yellow, which points out the missing reference of the axis.

REFERENCING THE MACHINE

The machine is referenced by pressing the "**Ref.Maschine**" button. This issues the message "**homing sequenz already in progress**", which is acknowledged with **OK**. After the reference run, the axis label and actual values are displayed in green. Without a valid reference point, it is not possible to work in the automatic mode or in MDI.



In the option group it can be switched between electric spindle and air spindle. (**E-Spindle** = electric motor for exterior grinding; **air spindle** = for interior grinding). The pre-selection must be completed in maual operation (by pressing the font).
In the automatic operation the spindle switch is realized with the M101 (air spindle) and M102 (E-spindle).



21. DESCRIPTION OF MENUS

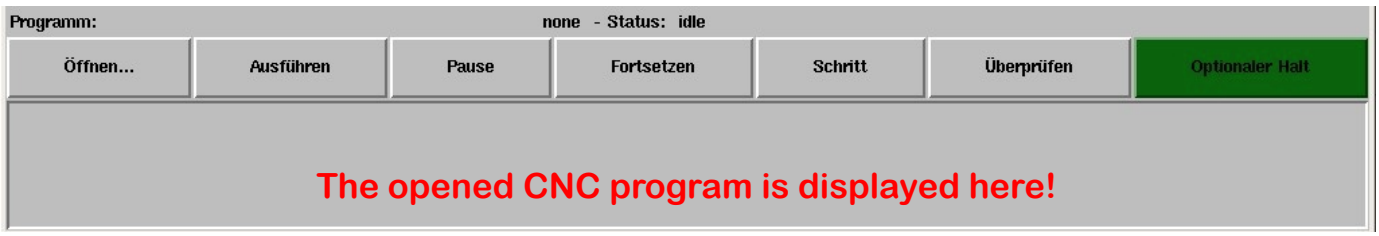
The TKEMC menus contain many useful functions are resources, which make working or diagnosing errors much easier; the functions relevant for you are describted:

Menu File	
File > open	Opens a CNC program
File > edit	Opens the TKEMC internal editing the CNC program
File > reset	Resets the open CNC program (Program reset)
File > end	Ends TKEMC
Menu View	
Ansicht > tool table	Opens the food table for viewing or editing
View > parameter file	Opens the EMC.VAR for viewing or editing
View > diagnosis	Opens a diagnosis window (only for manufacturer)
View > backplot	Opens the backplot view that present the motion sequences in the room however the displays are only linear, no display of round axes.
Menu Settings	
Settings > calibration	Not for users
Settings > debug	Not for users
Settings > font	Is used for customizing the font type
Menu Measuring unit	
Measuring unit > auto	The measuring unit of the machine configuration is valid
Measuring unit > inch	All dimensions are in inches
Measuring unit > cm	All dimensions are in cm
Measuring unit > mm	All dimensions are in mm (default)
Menu Resources	
Recources > HAL scope	Is used to review the RT function (RT = Real Time)
Recources > HAL meter	Is used to review various signals
Menu Extras	
Extras > set coordinates	Opens a dialog window to set the NPV (G54 - G59.3)
Extras > display HAL	Not for users
Extras > configure HAL	Not for users

22. FUNCTIONS FOR THE CNC PROGRAM FLOW

The program flow function is nearly self-explanatory.

Open	Opens a dialog to selected an existing CNC program
Execute	Starts the selected CNC program
Pause	Stops the running CNC program which ...
Continue	Starts a stopped CNC program
Step	The CNC program is processed line by line and stops after each line until starting the next line of the program by clicking continue.
Check	Check the syntax of an opened CNC program
Optional stop	By operating this button it is determined if a program start occurs with M1 or not



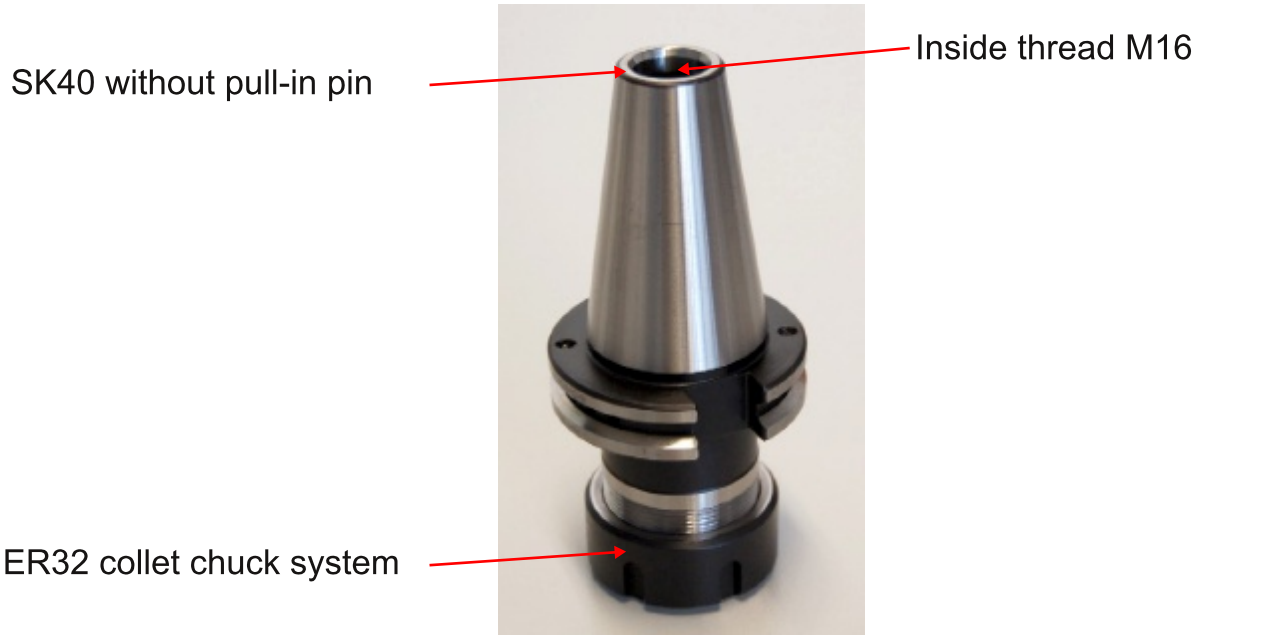
NOTE:

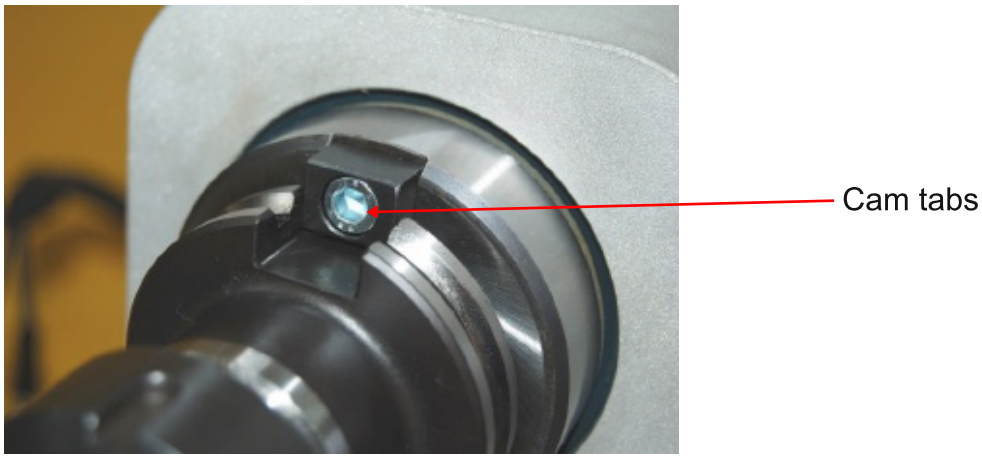
When the machine door is opened it is not possible to switch to an automatic operating mode (auto or MDI)!

23. MOUNTING THE MILLING TOOLS

FSM-CNC mounts milling tools for sharpening by way of a standard tool fitting with SK40 cone, the **A**-axis can fit this pin precisely. Generally every SK40 tool fitting occurs without pull-in pin (see picture), there are differences of cource, also in the concentricity precision, we recommend using the "better" tool fittings.

Picture: Standard fitting SK40 with collet chuck system ER32





The SK40 mount is inserted with the clamped milling cutter from the front into the inside cone of the **A**-axis, please make sure that the inside cone and the SK40 mount are clean an without dirt. From the rear side of the **A**-axis the SK40 mount is tighten using the SW8 allen key included in the delivery.

NOTE: After each clamping onto the A-axis, a reference point run of the A-axis must be completed!

The SK40 tool mount is tightened from the back using the SW8 allen key and for resistance the clamp is pushed.

<u>NOTE:</u> In the 3 axis configuration (FSM circular), the A-axis becomes a supplemental spindle and does not have an oriented hold on the locking point!

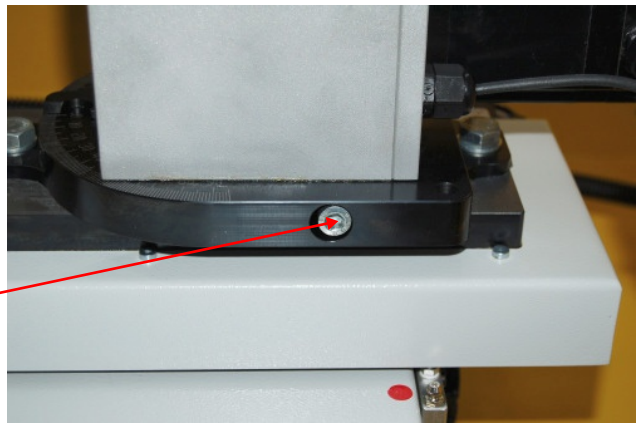
Picture: Rear A-axis with lock and fastening screw

24. ANGLE ADJUSTMENT ON THE A-AXIS

The A-axis has an additional angle adjustment that allows grinding conical workpieces without interpolation, or is also used to sharpen milling cutters on the inside.

Angle scale in °

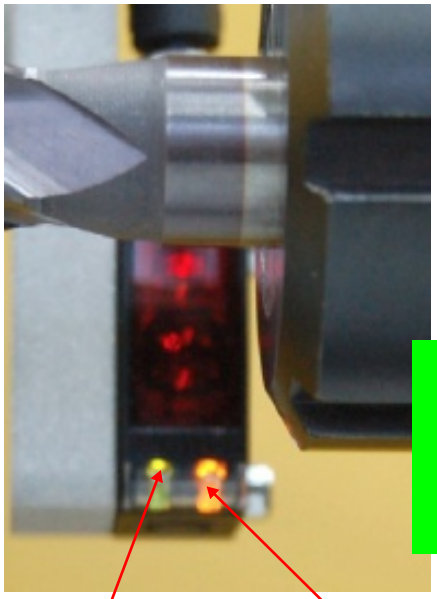
Clamping the angle adjustment



25. INSTALLING THE LASER MEASURING PROBE

Before measuring the angle spiral slope of your milling cutter, using the simple measuring program included in your delivery. It must be established accordingly to the measuring program The NPV (**N**ull **P**oint **D**isplacement) used here is G57.

- Camp milling cutter with mount to the **A**-axis
- Close the machine door and switch to the MDI operating mode
- Move **Z**-axis to the degree for centering the **A**-axis to the laser measuring probe. Take the exact measurement, refer to the machine measuring protocol in section 5 (is saved to the control system or is available in the circuit diagram pocket in the switch cabinet).
- Turn the measuring probe in by writing **M103** in the command line and execute with "**Enter**".
- Switch to the manual operating mode (button F3) and fold the laser measuring probe down to the measuring position and change the increments for manual feed to "**Continuous**"
- Move the **X**-axis until the laser mesuring probe is on the level of the milling cutter shaft (Picture)
- Move the **Y**-axis via **+** or **-** button on the monitor to the milling cutter shaft until the machine stops itself. (**Machine should come to a standstill at a distance of about 35 mm of the milling cutter shaft to the laser probe. If the distance falls short significantly, stop the process, there is a crash danger!**)



Laser probe On (M103); LED is lit

Laser captured the object; LED is lit

Measuring position on the milling cutter shaft

NEUES FOTO

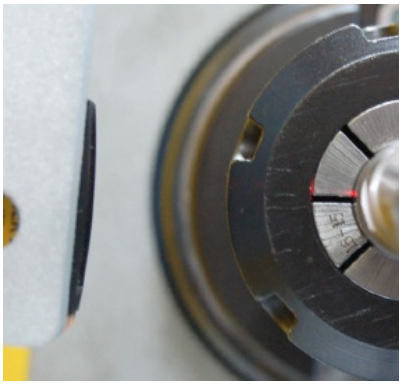
<u>NOTE:</u> If the laser probe has captured the object (yellow LED is lit), and the laser continues to be moved on the recording range, the axis will not stop automatically!

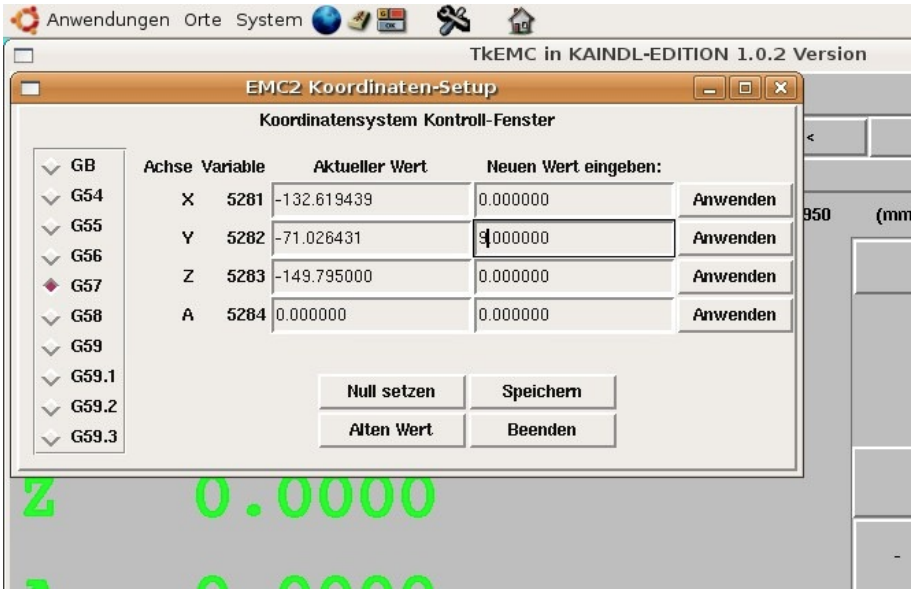
- If the **Y**-axis stops during the milling cutter shaft measuring, because the laser probe recognized the milling cutter shaft. the milling cutter shaft measuring on the collet chuck is completed thereafter.
- Now move the **X**-axis using the button (+) on the monitor in the direction of the collet chuck until the axis stops automatically (see picture 1+2). Observe note on page 25!
- After the laser measuring probe stops the **X**-axis, move the laser measuring probe back using the button (-) on the monitor until the **X**-axis stops automatically (see picture 3). The stop position should now be identical with picture 3.
- Access the "**Extras**" menu to set the NPV "**Set_Coordinates**" and click on G57 to select the NPV for G57.
- Click in line **X** on the button "**Apply**" to zero out the NPV for **X**.
- Enter in the line **Y** in the column "**New value**" the result from **milling cutter shaft Ø/2 +1mm** and click on the button "**Apply**" directly behind the recorded value. In our example it is a milling cutter shaft Ø of 16mm/2=8mm; 8mm+1mm = **9.00000** mm input value.
- Click in line **Z** on button "**Apply**" to zero out the NPV for **Z**.
- Click the button "**Save**" and then "**Exit**". The laser measuring probe is now ready for the measuring program.

Picture 1: approximate stop position in X

Picture 2: Stop position in X

Picture 3: stop directly on the collet chuck





26. CONTACTING A WORKPIECE AND SETTING THE WORKPIECE ZERO POINT

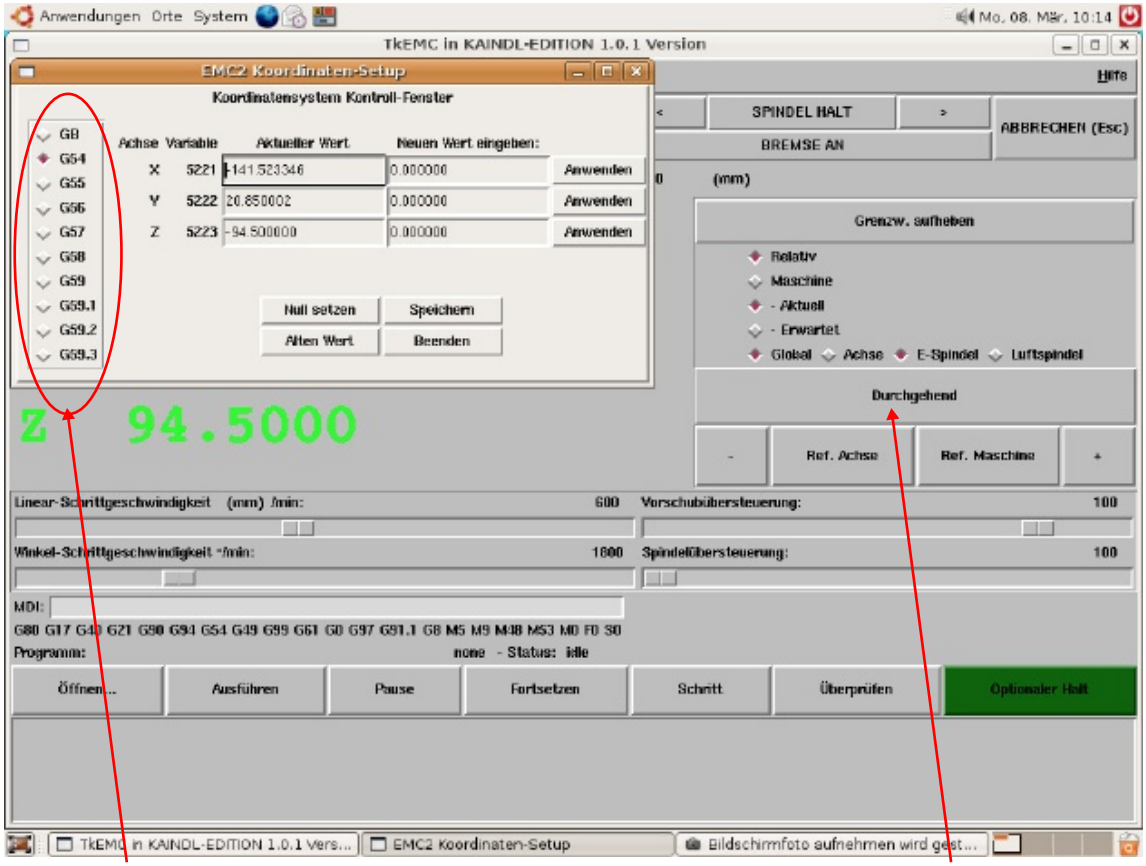
The workpiece is contacted in all 4 (3) axes, in manual operation using the digital handwheel. The axis selection for adjusting using the handwheel is completed by contacting the respective axis display on the touchscreen. The axes are zeroed out using the function "**Set_Coordinates**" from the "**Extras**" menu, by clicking the button "**Apply**". Thereafter, press the button "**Save**" and "**Exit**". Your workpiece is zeroed out.

The following NPV are planned for the fixed use in the Kaindl programs:

- **G54** workpiece NPV for E spindle
- **G55** workpiece NPV for air spindle (option)
- **G56** grinding wheel NPV for dressing device (E spindle and air spindle)
- **G57** laser measuring probe NPV for measuring program

G58 to **G59.3** are freely available to the user.

<u>NOTE:</u> The digital handwheel can be occupied with different increments and is out of order if on "Continuous". Available increments: 0.001; 0.01; 0.03 mm for each lock-in position handwheel or each click on the buttons + or - .



Select NPV

Increment selection, click here

27. MEASURE MILLING CUTTER

Before we are contacting or grinding a milling cutter, measure the milling cutter spiral and align the front clearance. The measuring program "**Fraeser-messem_Dia.ngc**" (milling cutter measurement dialogue.ngc) is a simple measuring program which uses the laser probe to measure the gradient of the spiral cutter, an documents in the file **Fraeser.txt** (milling cutter.txt). (On the desktop, the file is connected via link, by lightly touching in the file opens). The basic requirement for working with a measuring program is that the laser probe is installed in G57 as described previously.
After clamping the milling cutter in the mount and installing the mount in the A-axis, the program is opened using the editor and supplied with the respective information in the dialog field. Measure the milling cutter Ø and the programming length of the milling cutter to the collet, then enter the values in #1 for the milling cutter radius and in #2 for the programming length of the milling cutter and save these changes.
The probing feed should not exceed 400 mm/min since it directly depends upon the measurment precision.

```
(Dialog measuring program for milling cutter increase)
(NPV note X collet edge, Y milling cutter shaft radius +1mm, Z laser dimension in the acceptance protocol)
(Before starting the measuring program, record the milling cutter radius and the milling cutter length) (Dialog)
#1=7.3 (Milling cutter radius)
#2=52 (Milling cutter length in mm collet for cutting)
#3=300 (Probing feed in mm/min)
(#############################################################)
```

Open the measuring program in **Linux-CNC** and execute it by pressing the "**Execute**"-button. The machine now positions to measure and stops with the following message: **Please bring laser probe into measuring position and click "Continue" program**.
Fold the laser measuring probe down into the measuring position and continue the program by clicking the button **"Continue"**. The milling cutter is now measuring and the front cutter is aligned, another message appears: **Please fold measuring probe up and "Continue" program**.
Fold the laser measuring probe up again and press the button **"Continue"**. Now the machine will move to the zero point of NPV G54... If you do not wish this, abort the program by clicking **ESC**.
You csn now view the file **Fraeser.txt** with the measuring results.

PLEASE NOTE: The milling cutter is measured using a laser which is a light, reflecting surfaced, grease sheen and dirt can lead to faulty results, especially HSS milling cutters are susceptible to such faulty measuring caused by reflections, prior cleaning and degreasing can counteract this.
For HSS milling cutters, marking the measuring surfaces (spiral and front cutters) e. g. by using a white Edding pen (Edding 750) may be of help.

28. CONTACTING THE MILLING CUTTER

The following example explains how and at which surfaces a milling cutter must be contacted, to sharpen a milling cutter using our standard program.
Please note that our programs included in the delivery can sharpen regular standard milling cutters, without special features such as:

- different cutting separation
- asynchronous spiral angle
- cutting though center

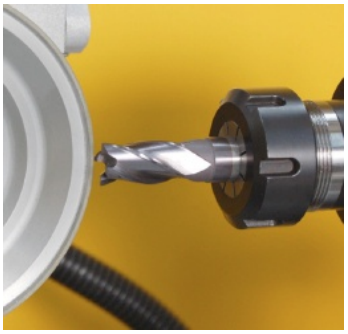
If you need these features, you can creatre these programs in G-Code, or adjust the existing ones and equip these of cource with all the functions that you require for your special cutting and milling tools. The measuring program "**Fraeser-messen_dia.ngc**" determines the gradient values for the milling cutter spiral and aligns the front cutter.

The **Z**-axis must be moved into the position of the **A**-axis center (the specific dimension is found in the measuring protocol of the machine, under section 4). In the menu "**Extras**" select "**Set_Coordinates**" to zero out the **Z**-axis in **G54**.
Then accept with "**Save**" and "**Exit**". In the **Manual** (button F3) operating mode, you turn the grinding spindle on with button F10 and lightly touchwith the handwheel in **X** to the aligned milling cutter. (see picture below)

From the menu "**Extras**" select "**Set_Coordinates**" to zero out the **X**-axis in **G54**. Then accept with "**Save**" and "**Exit**". With the handwheel slowly contact in **Y** the slide cutter of the milling cutter. (see picture)
From the menu "**Extras**" select "**Set_Coordinates**" to zero out **Y**-axis in **G54**. Then accept with "**Save**" and "**Exit**".

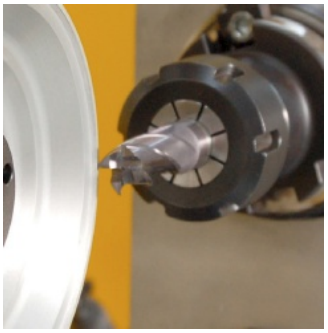
Move the milling cutter using the handwheel in **Y**, a few mm away from the grinding wheel and move the **A**-axis to angle vlaue of the 2 cutting phase, then contact the milling cutter again in **Y** and record the value of the **Y**-display, this values must be entered in the grinding program under **#34 "Contact value 2 Phase"**.

Now using the handwheel move the milling cutter in **Y** and then in **X** about 3-4 mm away from the girnding disc. The milling cutter has now been zeroed out for cutting.



Contacting using the X-axis

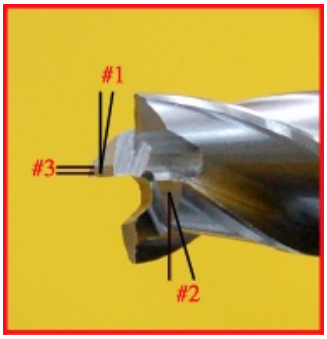
Contacting using the Y-axis

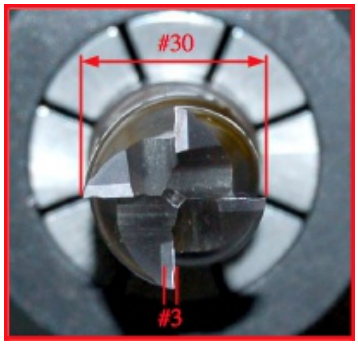


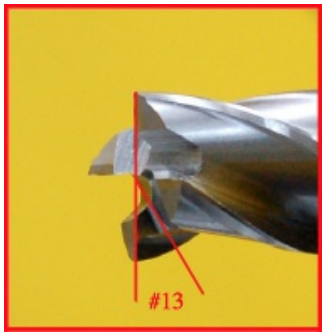
29. GRINDING OF A STANDARD MILLING CUTTER

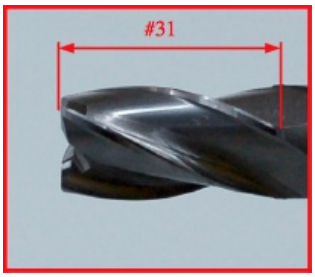
If you do not have a specific milling cutter you can use the dialog CNC program included in your delivery, which is very easy to use. Only the red area directly behind the **=** must be filled out.

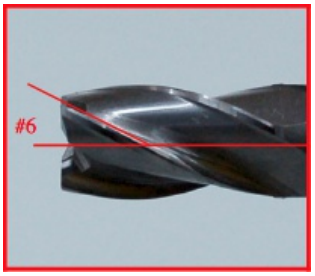
```
((Grinding program for standard milling cutters, complete version)
(Dialog)
#1=8 (Clearance angle front cutters in °)
#2=20 (Clearance angle open space in °)
#3=1 (Phase width front cutter)
#5=0.05(Hollow cut front cutter)
#6=3.95 (Greadient in ° Sside cutter each mm cutting length)
#7=4 (Number of blades)
#8=7 (Withdrawal level in mm/min)
#9=80 (Grinding rate mm/min for front cutters)
#10=0.1 (Total wear front cutter)
#11=0.02(Delivery front cutter)
#12=125 (Grinding disc diameter)
#13=45 (Grinding out for corner for front cutters in °)
#30=14 (Milling cutter diameter)
#31=25 (Length of blades)
#32=-8 (1 angle of the sid cutters)
#33=-30 (2 angle of the sid cutters)
#34=-0.45 (Contact dimension 2 phase)
#35=500 (Feed rate rough cuts side cutters)
#36=200 (Feed rate finishing process side cutters)
#37=7 (Total wear in mm side cutters)
#38=0.01 (Wear for each delivery side cutters)
#39=2 (Delivery steps)
#40=1 (Delivery pause)
#41=1 (Radio steps)
(#########################################################################################)
```











The CNC program described previously "**Fraeser_Dia_Komplett.ngc**" is also available in the split version as "**Stirnseite.ngc**" (front cutter) and "**Fraeserspirale_Dia.ngc**" (milling cutter spiral). This allows sharpening the milling cutter in partial areas, for example only the spiral cutters or only the front cutters. The variables are exactly the same as for "**Fraeser_Dia_Komplett.ngc**".

You can reserve the dialogs with other dimension and then save it under every name you want to provide it (up to 256 characters). The ending for CNC programs must be **.ngc**.

NOTE: Linux generally differentiates between upper and lower case!

More about the topic programming (DIN 66025 G-Code) is found in the **programming instruction**.

30. MACHINE RELATED SPECIAL FUNCTIONS (M-FUNCTION IN THE G-CODE)

M101 Switching from the E-spindle to the air spindle (option)

M102 Switching from theair spindle to the E-spindle (option)

M103 Turning on the laser measuring probe

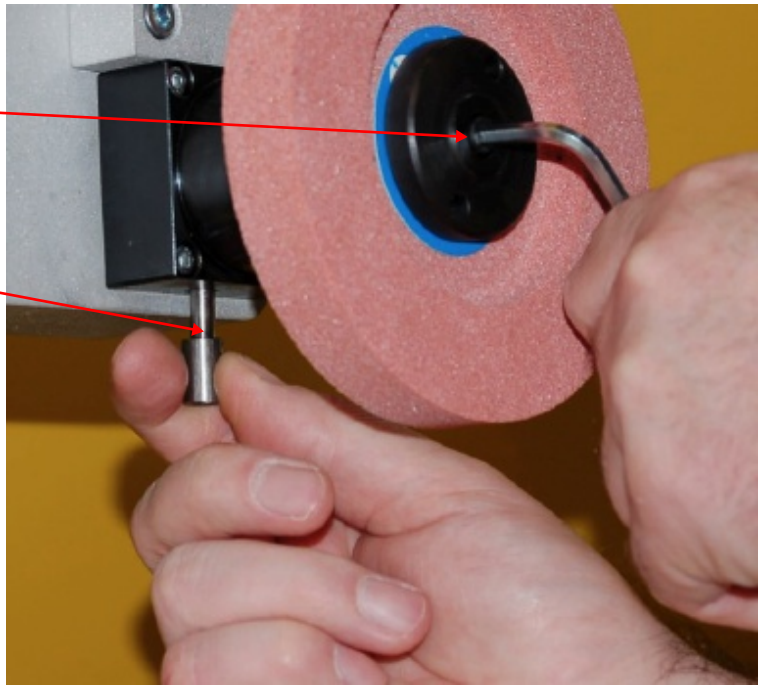
M104 Turning on the laser measuring probe

31. CHANGE OF THE GRINDING WHEEL

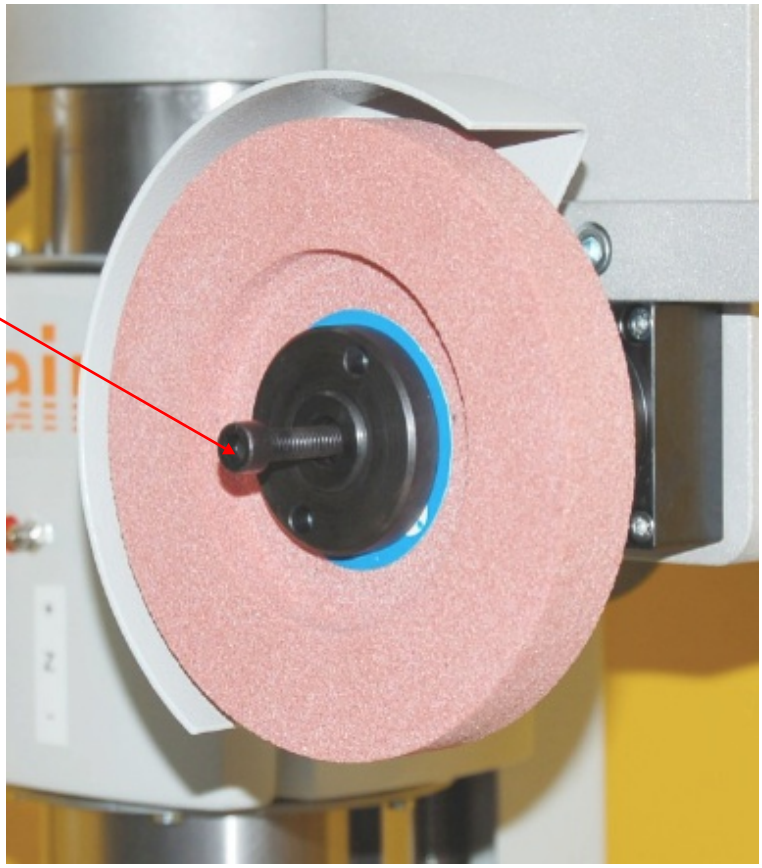
Before changing the grinsind wheel, move the **Z**-axis all the way up. Clamp the grinding spindle using the Ø 6 mm pin included in the delivery and loosen the fastening screw SW 4 in the center of the grinding wheel flange (see picture).

Grinding wheel fixing screw
SW 4

Clamping pin
Ø 6 mm



Focing screw
M8 with SW 6



Use only the included forcing screw M8 with SW 6 and push with it the grinding disc including grinding disc flange from the grinding spindle.

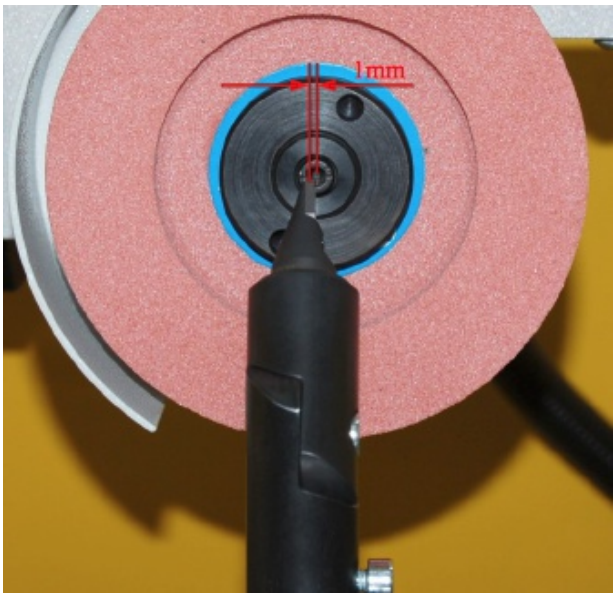
Place the new grinding disc on the grinding spindle and make sure that the driving pins of the grinding disc mount is placed correctly in slot of the grinding spindle. Now fasten the grinding disc using the allen screw, in the center and tighten it.

32. DRESSING THE CORUNDUM GRINDING WHEEL

You can also use corundum grinding wheels on the **FSM-CNC**. These grinding wheels must be dressed before use, in order to achieve optimum circular run of the grinding wheel and to guarantee the best possible grinding results. The grinding wheel is dressed using the device to which a PKD dess diamond is attached. Using the respective dressing program, it is possible to also include forms in the grinding wheels, such as radii, prism forms, etc.
The delivery includes a sub program (1000.ngc) for range dressing, which can also be used as a programming examble for own dressing programs. After dressing according to the delivery, this sub program will update the NPV for the workpiece and NPV of the grinding wheel in **Z**. The dressing diamond should be positioned, as the picture setting about 1 mm behind the center in **X** and in NPV G56, the position should be zeroed out.

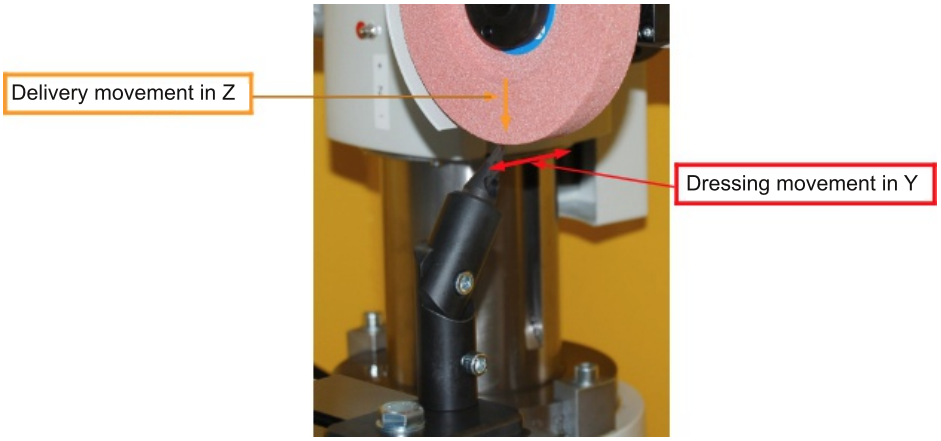
Contact the grinding wheel in **Y** from the side and zero out in NPV G56, thereafter the same in the **Z**-direction and also zero out for **Z** in G56. See pictures.

Setting: Dressing diamong about 1 mm behind the center



Contacting the grinding wheel in Y

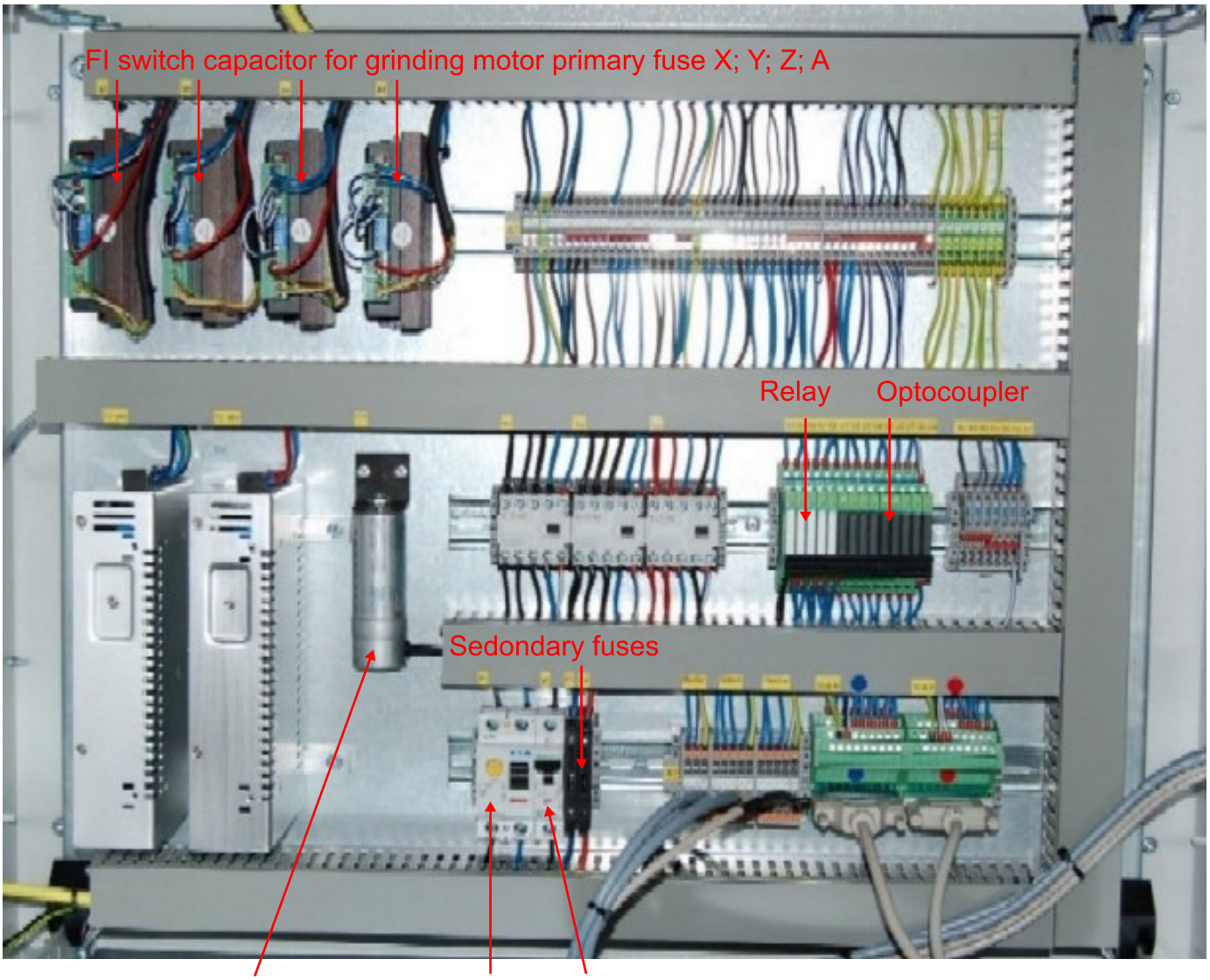
Contacting the grinding wheel in Z



As the corundum grinding wheels of the E spindle can be dressed, the corundum grinding wheels of the inside grinding wheel can also be dressed.
For this purpose, the dressing device must be attached as shown on the picture below and be contacted using "**Set_Coordinates**" from the menu "**Extras**" the **NPV G56** and saved.
Please also note in "**Set_Coordinates**" the top function "**GB**" (grind body). Here you can enter in the parameters **#3000** for E spindle grind body and in **#3001** for air spindle grind body, the maximum dressing dimension, which is also monitored in the dressing program included in the delivery.

Example:
A corundum grinding pin has a Ø of 20 mm and shaft of 6 mm, the smallest possible Ø are 10 mm, which means that from the corundum pin 10 mm in diameter can be used. 10/2 = 5 mm, accordingly the parameter #3001 = 5 is recorded. Every time the dressing program is accessed the delivery is deducted from this measurements, and when contacting the last mm a message is issued on the monitor that the grind body must be replaced.

33. FSM ELECTRIC



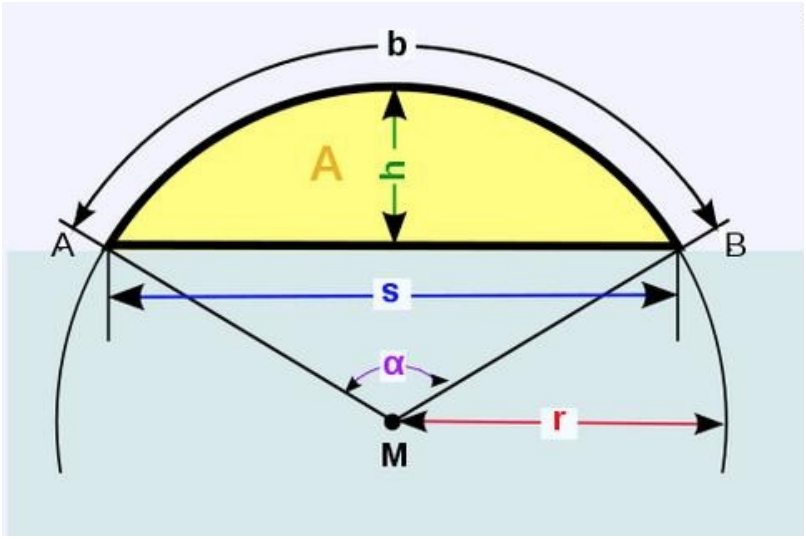
CAUTION:

The FSM-CNC is equipped with FI switch, if this switch is triggered or the triggered FI switch cannot be turned anymore, then there is a serious electrical problem. As a result it is not permitted to work on the machine until the electrical fault has been repaired by an electrical engineer.
There is mortal danger be electric shock!

Please disconnect the electric plug!

34. TIPS AND TRICKS

Since the front cutting angles are generated by the radius of the cutting disc, we would like to briefly explain the mathematics behind it.



α = Center angle
b = Circular arc
h = Height segment
r = Radius
s = Circular chord
A = Segmetn area
M = Center of circle

Connection A-M-B = isosceles triangle

Calculating the clearance angle:

Formula for calculating the **Z** height **S/2 = r x (SIN α)**

EXAMPLE:
Grinding wheels Ø = 125 mm; clearance angle of the front cutter = 10°

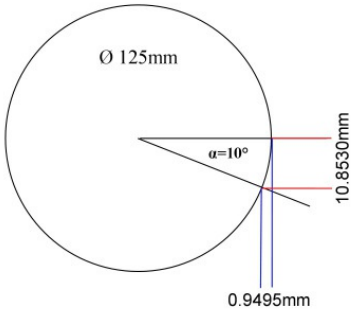
125 mm/2 = r=62,5 mm; α=10°
S/2= 62,5x(SIN 10°) = 10,8530 mm

This means that at the milling front cutter the **Z**-axis must move with the grinding wheel **10,8530 mm** from the center upward. The clearance angle has mow been calculated. However, this has little value of we do not know the new position to the cutting disc. As a next step we must update our zero point to the new grinding wheel position and this value is calculated by solving for **h**.

Calculating the zero point update:

Formula for calculating the **X** update **h=S/2 x TAN(α/2)**
S/2 = 10,8530 mm x TAN 5° = 0,9495 mm

The difference to the zero point in **X** is **0,9495 mm**.



NOTE: Please note that these formulas are slightly different from formulas you can find in different formula collections. The reason is that we are always mathematically below the grinding wheel center.

35. SPARE PARTS LIST

An up to date spare parts list can be found under **www.kaindl.de**

36. WIRING DIAGRAM

The wiring diagram of your machine is located in the switch cabinet on the inside right side

37. ACCESSORIES

Item No.	Description
10895	High grade corundum grinding wheel grit 60 (rough) 125 x 20 x 20 mm
10890	High grade corundum grinding wheel grit 80 (medium) 125 x 20 x 20 mm
10891	High grade corundum grinding wheel grit 180 125 x 20 x 20 mm
10893	High grade corundum grinding wheel grit 100 125 x 5 x 20 mm
11103	High grade corundum grinding wheel grit 100 125 x 10 x 20 mm
15422	Grinding wheel support FSM for corundum-, diamond- and CBN grinding wheels
15856	Diamond dressing wheel D356 100 x 20 x 20 mm for resin bonded CBN grinding wheels
15857	Silicon carbide dressing wheel grit 80 100 x 30 x 20 mm for resin bonded diamond grinding wheels
15855	Sharpening stone 100 x 40 x 15 mm for sharpening resin bonded grinding wheels after dressing
11315	CBN grinding wheel B126
11317	Diamond grinding wheel D126
99999	PKD dressing diamond for dressing corundum grinding wheels

39. MAINTENANCE

The **tool grinding machine FSM-CNC** does not require special maintenance.
Clean your machine at regular intervals and it will provide you much joy. To guarantee the machines' precision as long as possible, please adhere to the lubricating instructions.
Only use the specifically mentoined oil types (Page 41).

Ocassionally check the network cable and electric plug for damage and the coolant system for tightness.

The cooling lubricant must be checked according to the guidelines of the coolant manufacturer.

Do not use any aggresive cooling lubricants or cleaning agents!

40. CLEANING THE MACHINE

To guarantee the full functionality of the **FSM-CNC tool grinding machine**, it should be cleaned regularly (depending on the type and scope of use).

Remove grind dust using coolant and brush from the machine, clean stubborn dirt using customer machine cleaner (**do not use any aggresive media**).

When cleaning the machine using the coolant gun, the protective covers may not be flushed!

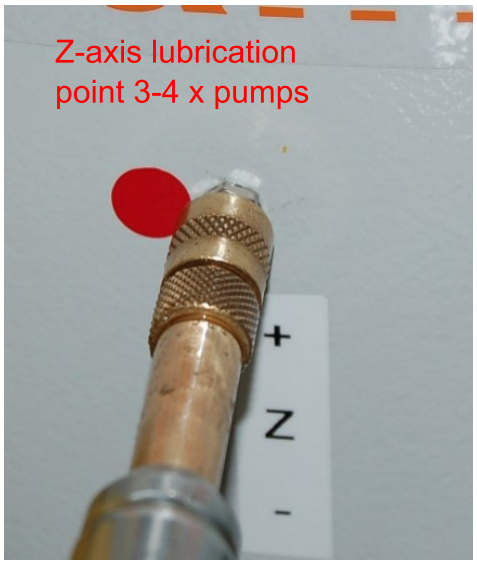
41. GREASING THE MACHINE

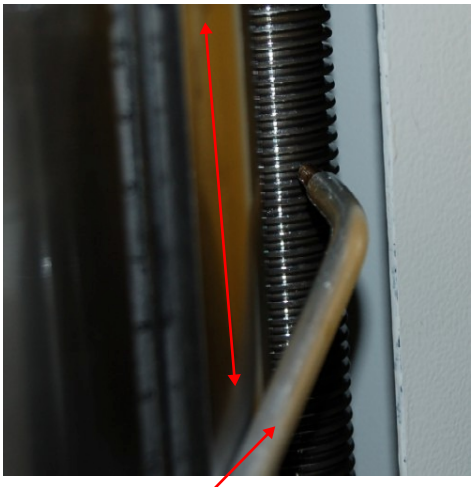
Depending on the use of the machine, it should be lubricate as least 2x a week, if using more frequently at least 1x daily by only using **lubricating and track oils GGLP 68 (specification according to DIN 51 502)**.

All positions furnished with grease nipples (red point). The thread spindle of the **Z**-axis must be lubricated directly using a customary hand pump oiler.

The oil container of the maintenance unit is only to be filled with the oil brand HLP-10. The oils **lubricating and track oil GGLP 68** and **HLP-10** can be obtained from nearly any lubricant manufacturer.

XY-axis lubrication point
4-6 x pumps





Z-thread spindle
lubrication using
hand pump oiler

42. REPAIR

Repairs to the FSM-CNC and its mechanical components may only be completed by Kaindl or by persons authorized by us. The replacement does not affect wear parts.

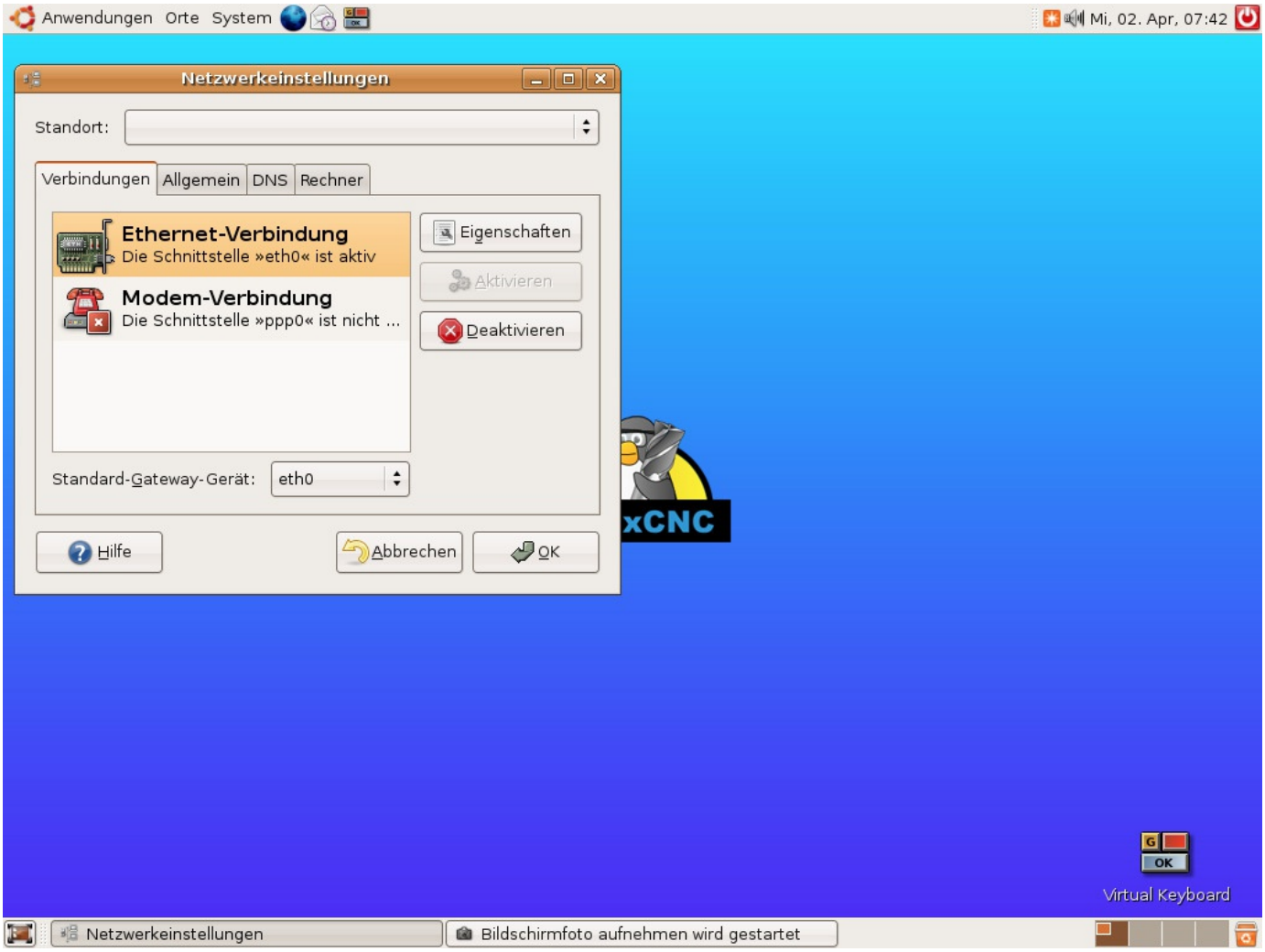
Only electrical engineers may replace electrical spare parts!

43. MACHINE DISPOSAL WITHIN THE EU

Upon free delivery at our factory, Kaindl-Schleiftechnik Reiling GmbH will assume responsibility for prober disposal of old machines according to the respective directives of the European electric old devices regulation.

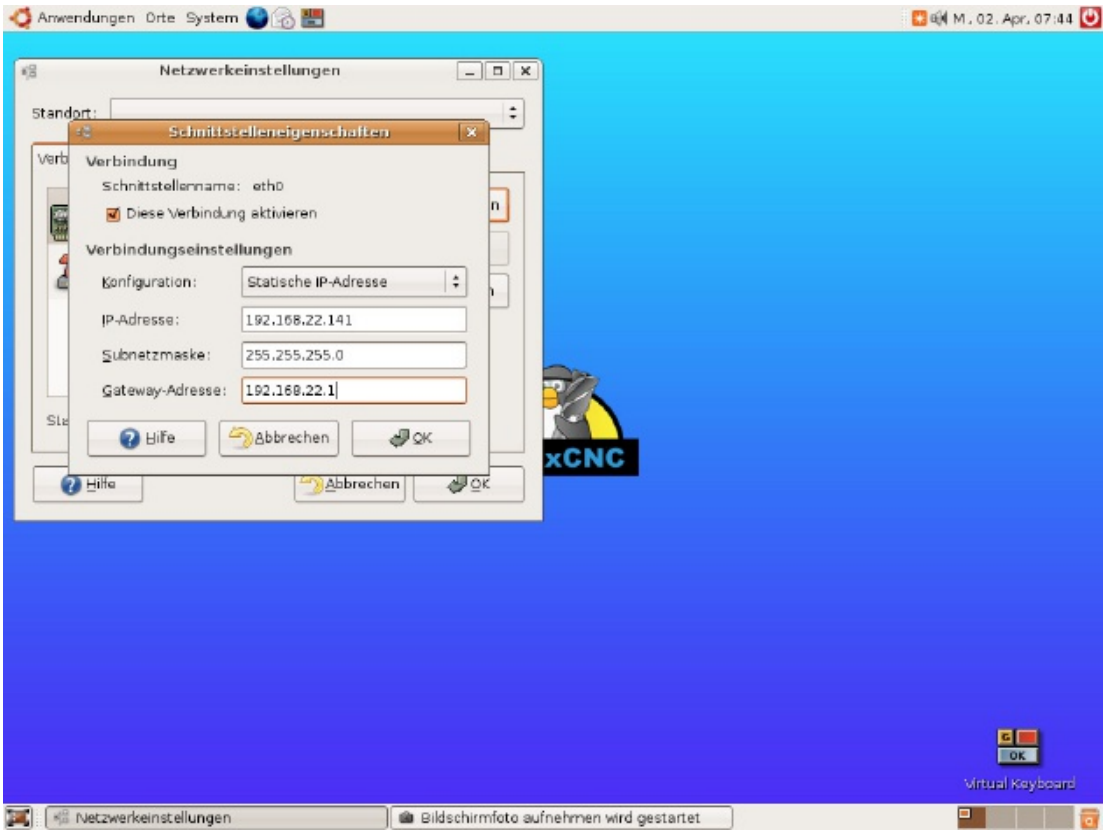
44. NETWORK SETTINGS

The standard setting is **DHCP**.
A DHCP server (usually a router that provides this function) found in the network will obtain the IP address.
Of course you can allocate a fixed IP address to the control system, by assingning it manually. Up top in the menus of the operating system, click on **"System > Administration > Network"** to reach the below displayed monitor:



Via the button **"Properties"** you can access the network connection settings (**Ethernet-connection**).
Here you can enter the setting for the IP address, gateway (router address), etc.

The picture below shows the screen for entering the fixed IP address in your network.



If your request a fixed allocation of the IP address via the DHCP server, you must find out the MAC address. You find out the Mac address of your control system via the menu "**Applications > Accessories > Terminal**". By entering the command **ifconfig** and confirm with "**Enter**". Now you will receive all network settings in text format, including the MAC address.

45. REMOTE MAINTENANCE VIA INTERNET

The IPC control system has an option remote maintenance via internet. For this purpose your control system must be included in your network as descirbed previously, which has internet access.
You will require a fixed IP address of the control system (fixed IP via DHCP or assigned manually). You must configure your router accordingly, so that we can access the control system. In your router the **port 5000** must be released for the IP address of the control system, in order to realize the connection via internet and VNC.

NOTE: A remote maintenance can only occur if you are present at the machine, because these cinnection requests must be confirmed manually by you at the control system.

Before a remote maintenance, your IP address you have in the internet will be requested by telephone, your current IP address of your router in the internet is on your router. Via remot maintenance we can quickly and without any administrative delay help solve operating system, EMC2 configuration, data back up, etc. problems.

46. WARRANTY

The warranry is **12 months** as of delivery date and refers to **one shift work**, for **multiple shift operations** the warranty period is **6 months** as of delivery date with the general requirement of proper use of the machine and compliance with the operator due diligence.

The warranty service includes the costs for replacing defect parts and components (this can be repaired, used parts and components), including the necessary labor.

Excluded from any warranty are:

- Wear parts during course of normal operation
- Transportation damages
- Damages caused by improber use of the machine
- Damages caused by programming errors or program parameter errors
- Damages caused external forces
- Damages and subsequent damages created by the operator violating due diligence or disregarding the proof of safety
- Damages caused by using aggresive media such as sharp or caustic cleaning agents, solvents etc., or aggresive cooling lubricants

For warranty claims, please notify us immediately by stating the machine type, serial number and contruction year of the machine.

If not providing the construction year and machine number, out office is not able to process your request!

Machine returns required our prior approval.
We reserve the right to charge for transportation costs of unauthorized returns.

Parts replaced or exchanged on warranty are our unlimited property.

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