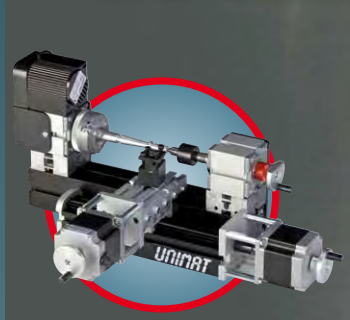
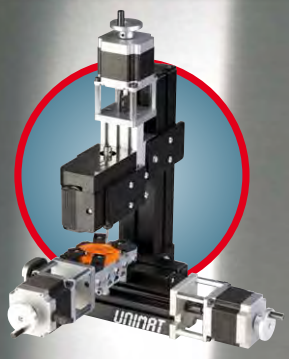
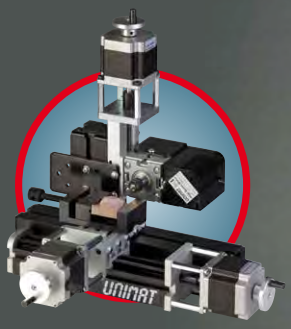
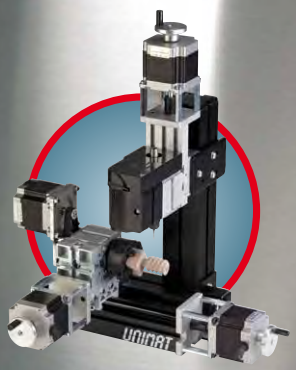
The cool tool est. 1982

Education









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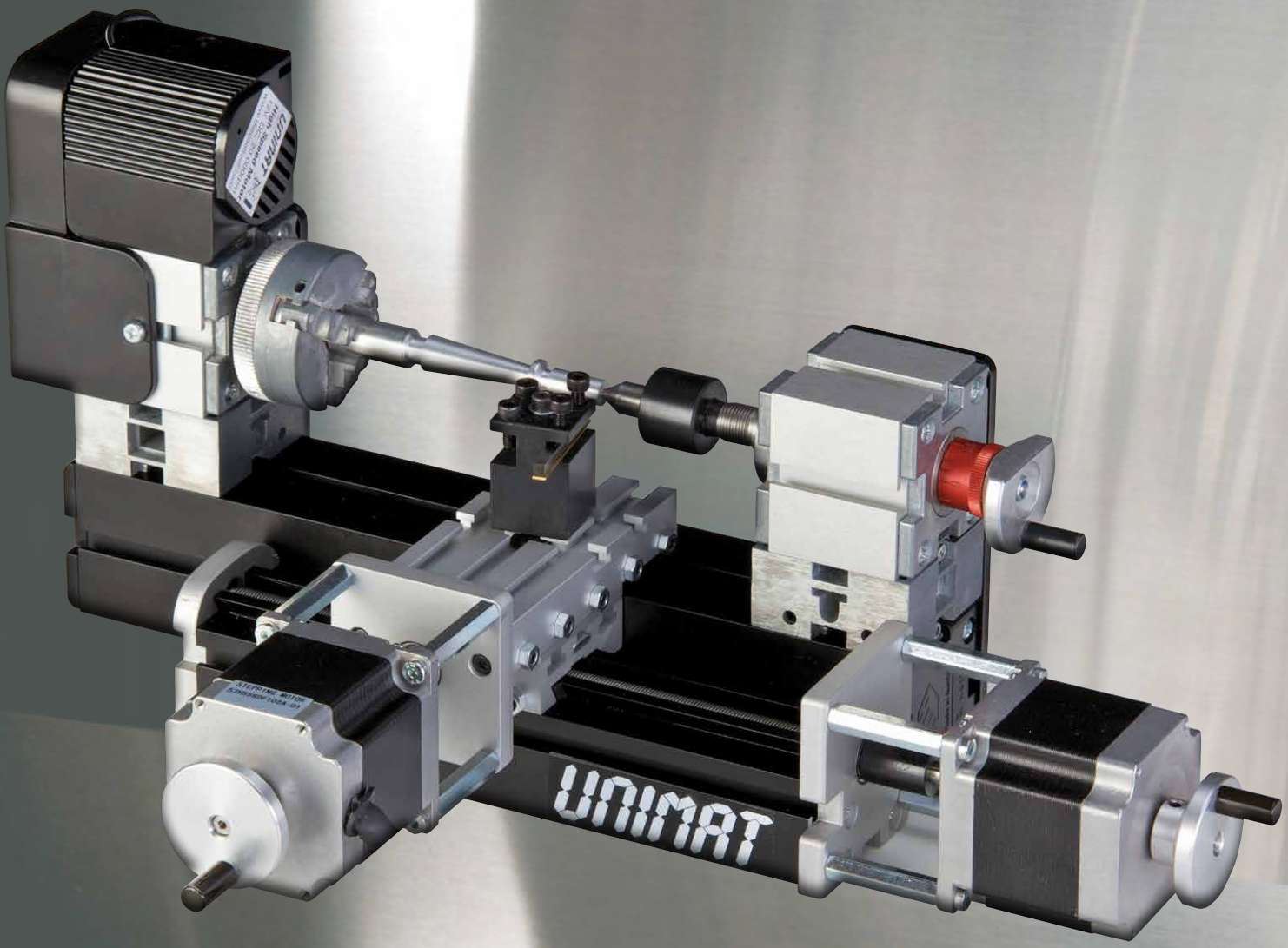
4.3 CNC TURNING MACHINE



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QUALITY PRODUCT MADE IN AUSTRIA

General information on CNC turning machines 4.3.1

CNC turning machines are in general turning machines (lathe) with axes (slide X,Z and the headstock spindle C) that are moved by a servo or stepper motors and controlled via storable programs.

Most of the CNC lathes are built differently than the manual ones. Two examples:

1) The tool resp. the tool-slide is mostly behind the turning axis, to give better access to the work piece.
2) The machine bed is inclined (inclined-bed turning machine) to remove the chips easier. This construction is only found on controlled machines, because it would be too complicated to access the hand-wheels on manual ones.

In production mainly multi-spindle turning machines are used (lathes with powered tools and powered tailstock). As tool holder, a turret tool post, movable in X- and Y direction, is used. The powered tools allow for the complete finishing of a work piece in one go. If the tools can be moved in Y-axis as well, milling and engraving tasks at the work piece are possible too.

But CNC-milling machines cannot be replaced by such multi-axes lathes (size of the work piece, etc.). See more details in chapter 4.4. CNC milling machines.

A short summary – Turning:

• Turning: chipping process in which the WORK PIECE makes the cutting movement (rotation). The feed and the depth of cut are done with the tool.

• Samples of turning machines: horizontal and vertical lathes, multi-spindle lathes, screw machines, chucking machines, watch-maker lathes, combination lathes, centering lathes, wheel lathes, etc.

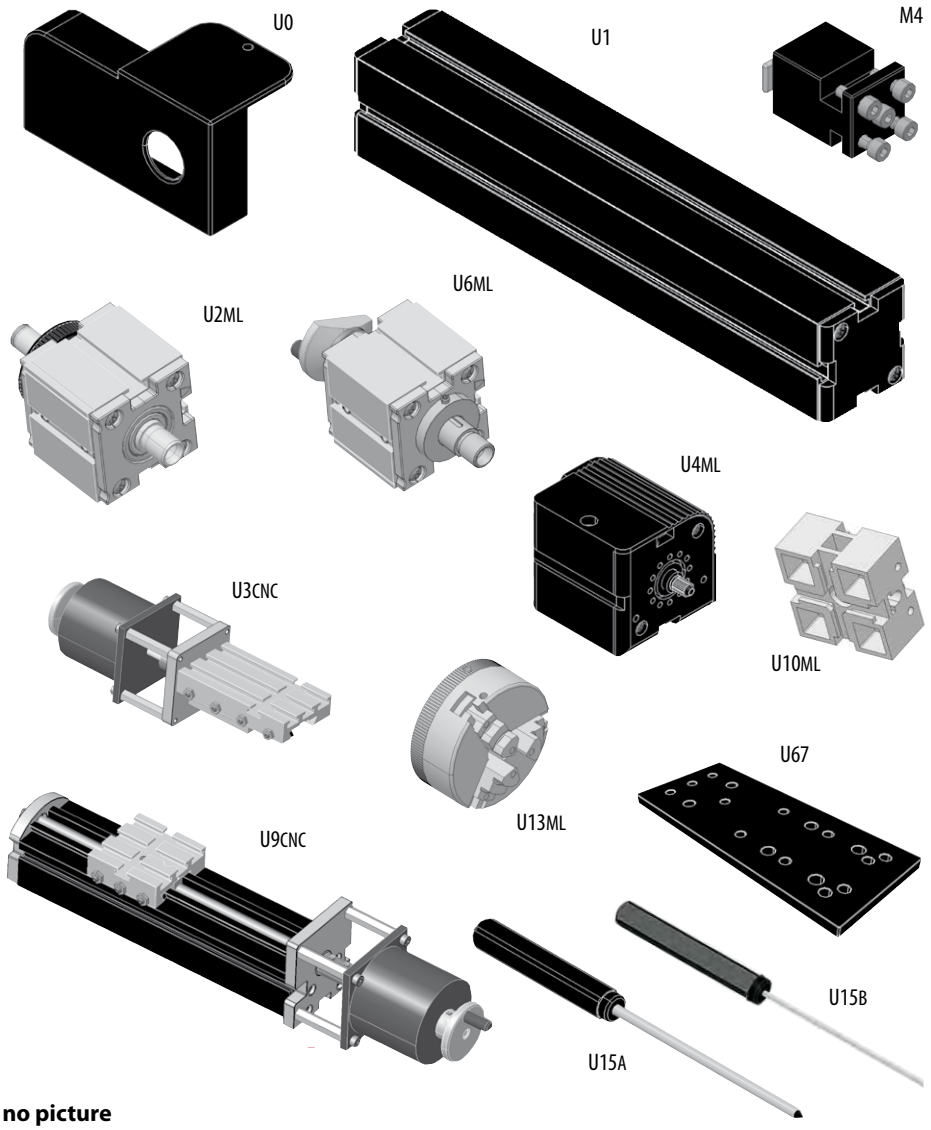
• Way of processing: profile cutting, taper turning, thread cutting, cut-off turning, center drilling lathes, etc.

For more details, see chapter 3.1. Metal turning

Part list and setup of CNC turning machine

www.youtube.com/thecooltool09

U0	1	Drivebeltcover	A1A 000 010
U1	1	Machine bed, long	A1A 020 000 SW
U2ML	1	Countershaft	A1M 035 000
U3CNC	1	Cross slide CNC	164 060 CNC
U4ML	1	Motor	162 420 MH S
U6ML	1	Tailstock	A1M 040 000
U9CNC	1	Longitudinal slide CNC	164 480 CNC
U10ML	2	Intermediate piece	A1M 000 101
U12ML	1	Collet 3.5 mm	164 460 35
U13ML	1	3 jaw chuck	164 430
U15A	1	Screw driver #2	ZWZ 980 010
U15B	1	Screw driver allen key	ZWZ 980 075
U31	8	Screw M4x10	ZSR M40 410
U37	4	Screw M4x8	ZSR M40 408
U38	3	Screw M4x6	ZSR M40 406
U40	2	Small part 0,1mm	A1A 000 170
U41	2	Small part 0,4mm	A1A 000 190
U42	2	Small part 1,0mm	A1A 000 180
U46	8	Slot nut	A1A 060 040
U47	2	Clamping plate	A1A 010 020
U48ML	1	Collet holder	A1A 000 072
U51	1	Allen key 2mm	ZWZ 110 200
U52	2	Rod	ZST 110 345
U53	1	Tool for outside turning	A1A 000 080
U54	1	center	A1A 000 130
U54RO	1	Live center	164 450
U57	1	Drive belt (87)	ZRM 730 087
U65	1	Allen key 2,5mm	ZWZ 110 250
U66	7	Connection piece	A1A 000 ZIN SK
U67	2	Stabilizing plates	A1Z 470 010
U71	1	7/14 mm straddle wrench	ZWZ 400 700
U74	9	Plain washer	ZSB 250 430
U75	1	Allen key 3,0mm	ZWZ 110 300
M4	1	2 position tool post	A1M 000 091
	1	Wood mounting plate *	164 400
	4	Rubber buffer *	
	1	Unimat power supply *	161 312



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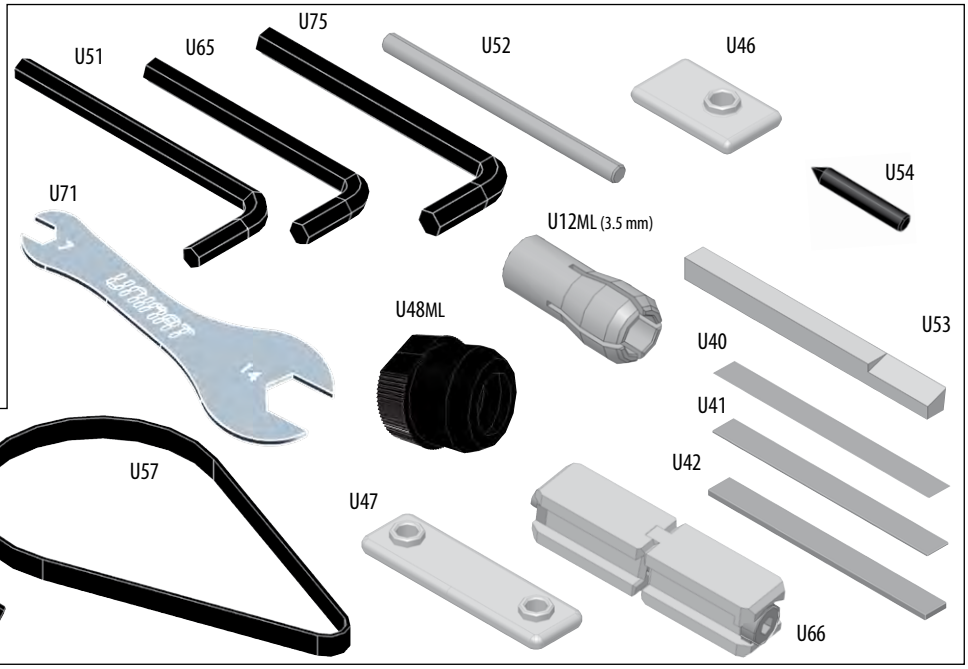
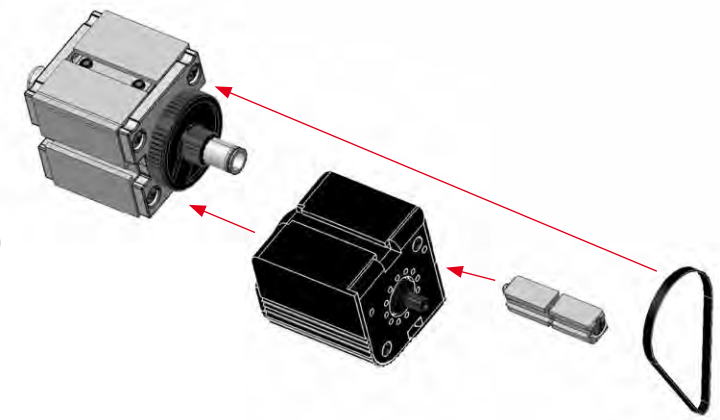


Part list and setup of CNC turning machine 4.3.2

Assembly/General

When setting up the UNIMAT CNC please consider the following

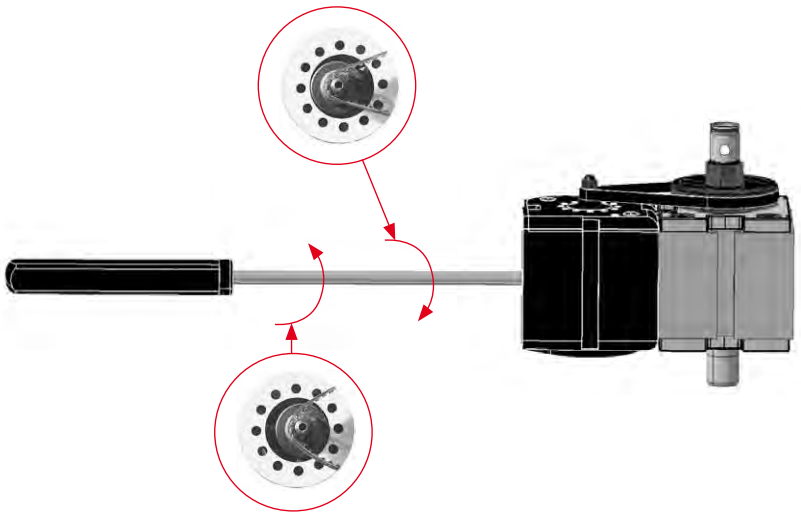
1. A screw connecting two metal parts e.g. machine beds, stabilizing plates etc. can be tightened firmly.
2. If the metal nut clamps two synthetic parts, (e.g. adjust the sledge movement, adjusting motor speed,…) then screw it down very gently.
3. By connecting plastic parts with a metal screw/nut, then screw down very gently e.g. Allen screw into the tailstock housing. The same if the metal screw will be screwed into a plastic part e.g. jig-saw housing.

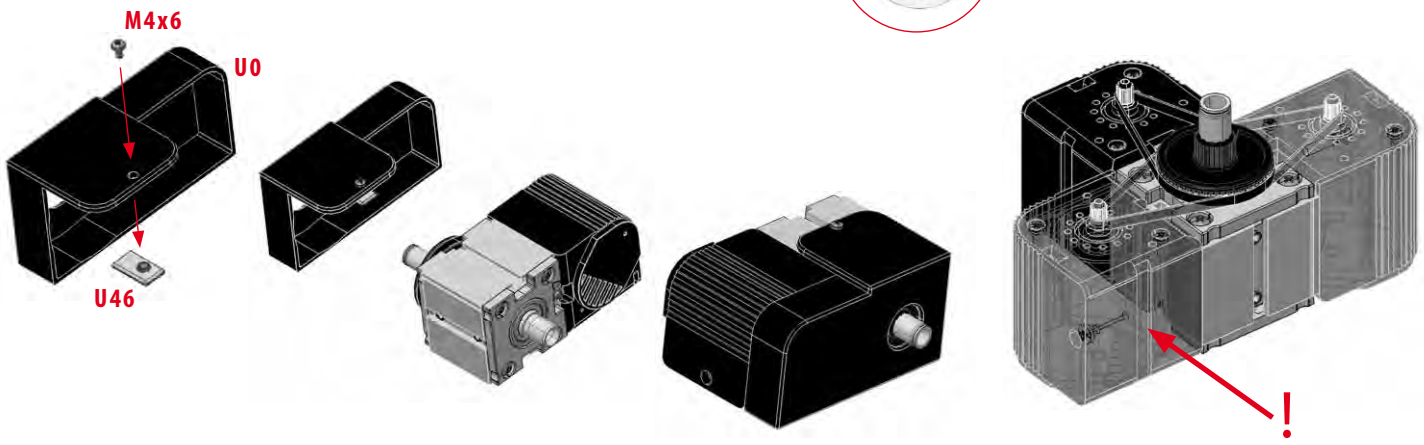


Assembly of the CNC turning machine

MOTOR-HEADSTOCK Unit M1

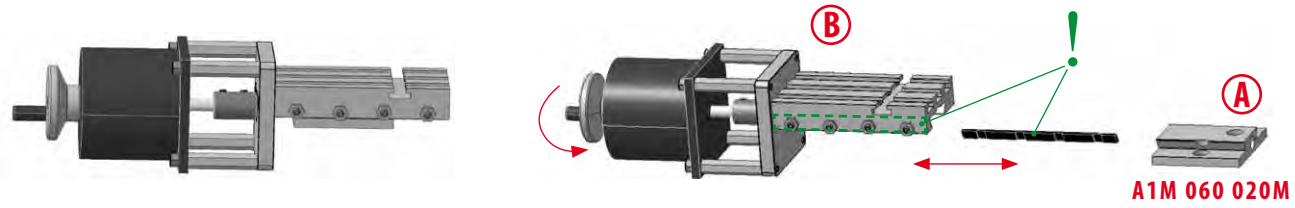
1. Slide connection piece (U66) into the T-slots (groove) between motor (U4ML) and headstock (U2ML).
2. Push headstock (U2ML) across and fix the screw of the connection piece (U66)
3. Adjusting the drive belt (U57): Tighten U57 with screwdriver. Loosen U57, then start motor. Tighten U57 until motor revolutions slightly reduce and the belt U57 is properly tightened.
4. Fixing the drive belt cover (U0). Make sure that the belt will not grind inside the cover. **Note: fix U0 only after Unimat is completely assembled!**



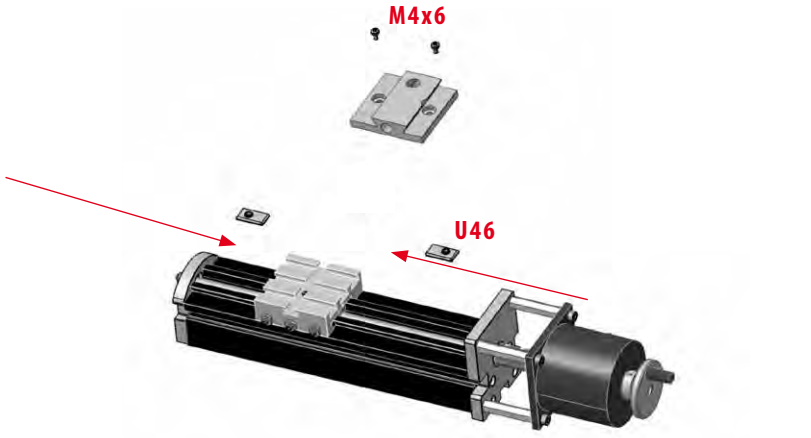


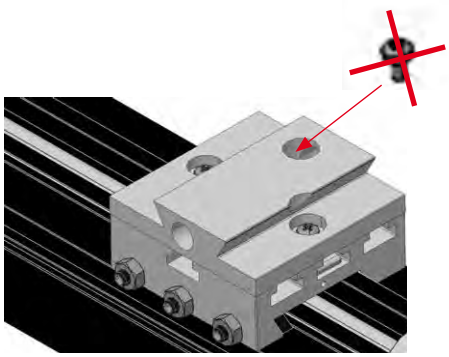
Large slide module M2D

1. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3CNC) by turning the hand wheel until it is released

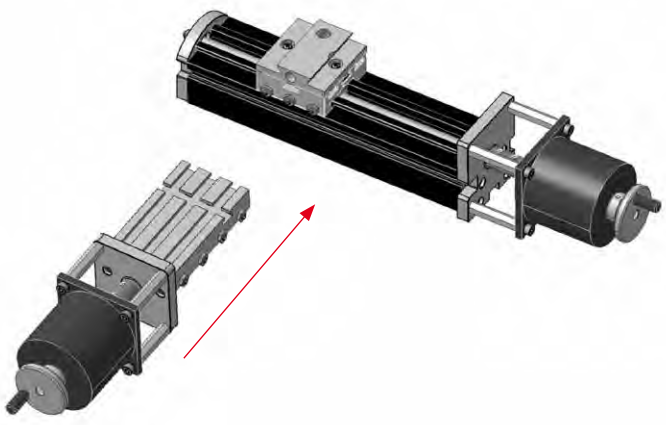


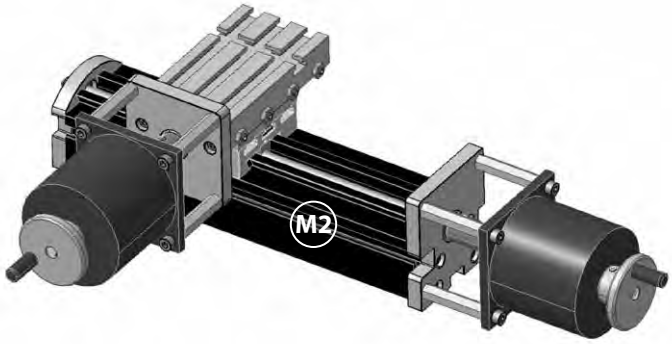
2. Fix the cross-slide guide (A1M 060 020M) to the sattle of the longitudinal slide (U9CNC) with 3 screws (U38) and 3 clamping plates (U46).





3. Slide modul (M2A) assembly: Slide cross-slide body (U3CNC) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.

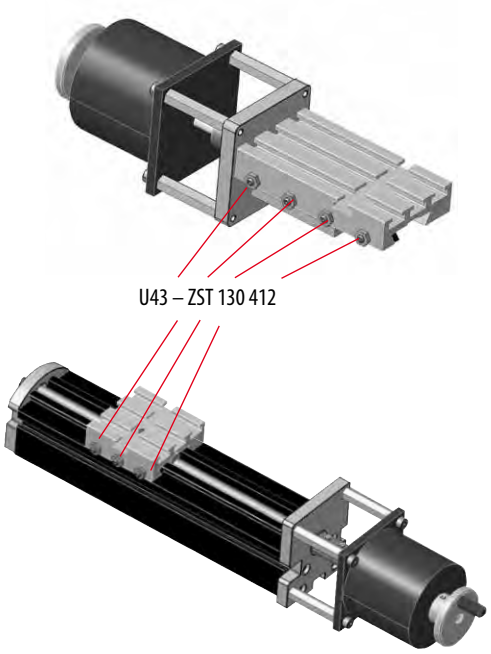




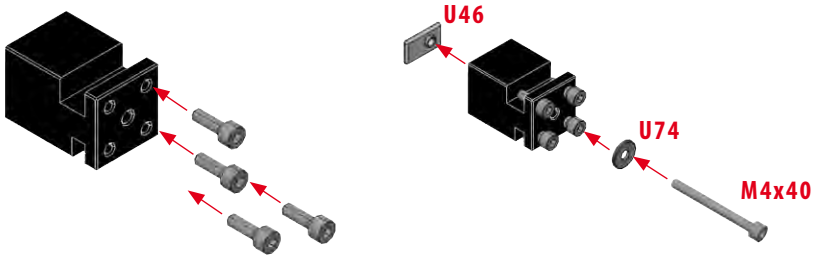
Part list and setup of CNC turning machine 4.3.2

Adjusting the slides:

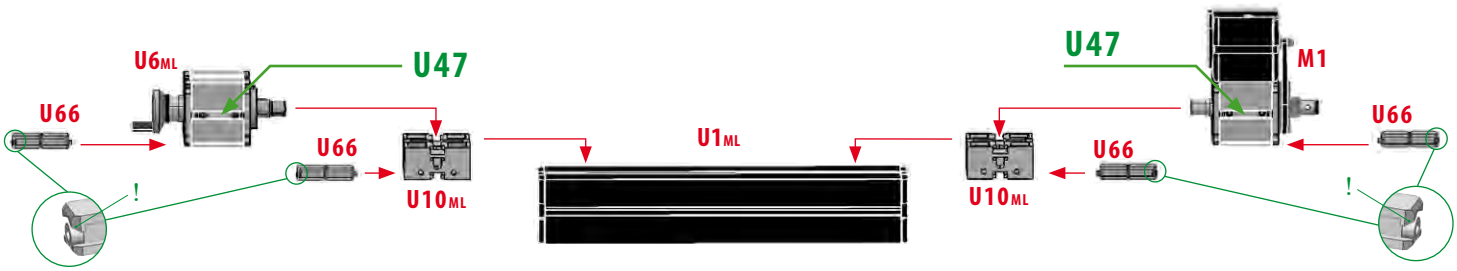
1. Check play: open nut (U43), adjust play with screws M4x12 (ZST 130 412) GIBS: (tapered synthetic adjustment shims) are fitted between the saddle and the profile of the longitudinal slide and the upper and lower part of the cross slide. Correct adjustment of the gibs will ensure smooth and steady operation of the slides. It is adjusted by loosening the nuts and using the screws of the saddle and upper cross-slide part, by pressing the gibs until „play“ is removed. After adjusting, retighten the locking nuts. Milling operations require a tighter adjustment of the gibs than lathe operations.
2. Maintain the slides at regular intervals: clean with a brush and lubricate the gliding surface.



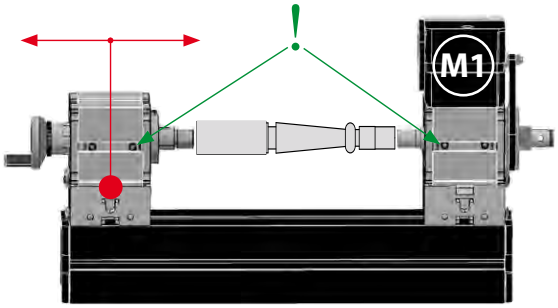
M4: 2 position tool post assembly



Fixing the motor-headstock unit (M1A) and the tailstock (U6ML) to the machine bed by using risers (intermediate piece U10ML)

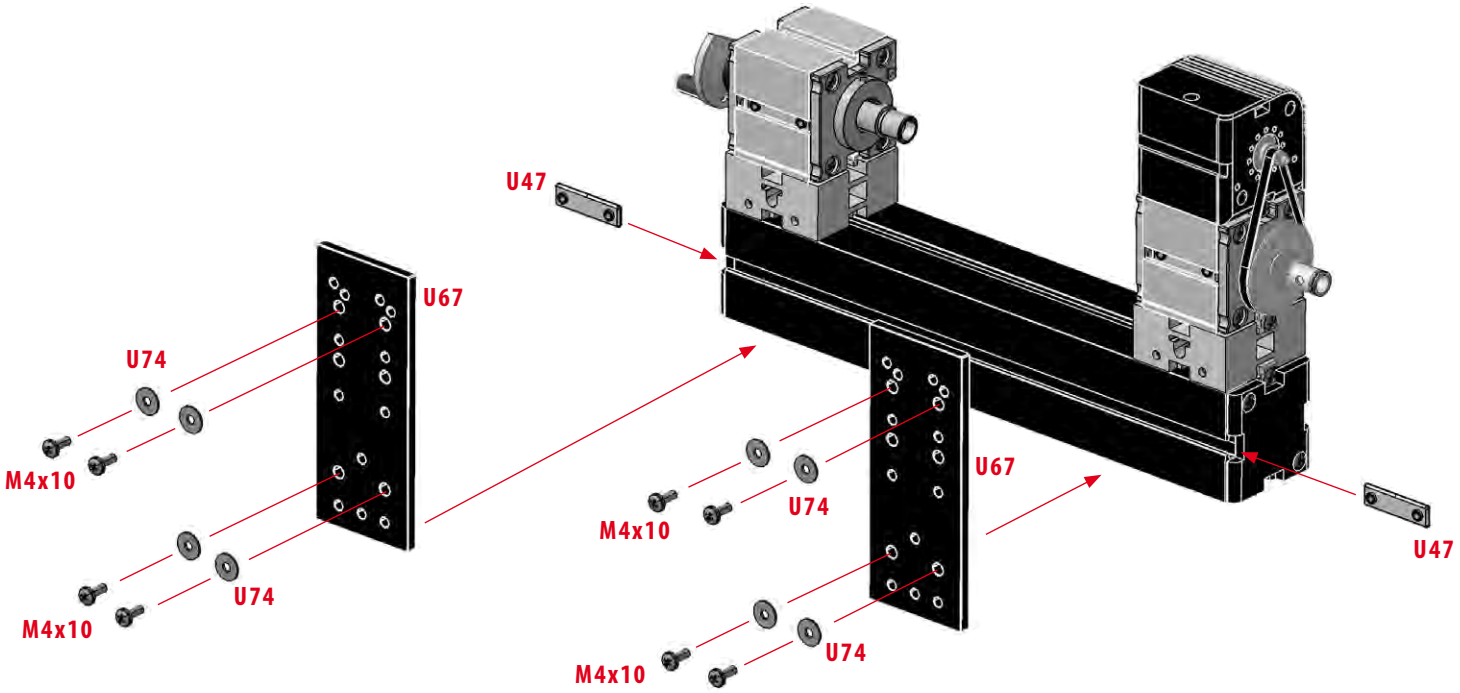


! The clamping plate (U47) with two holes must face the same side (already fixed in U2 and U6ML)

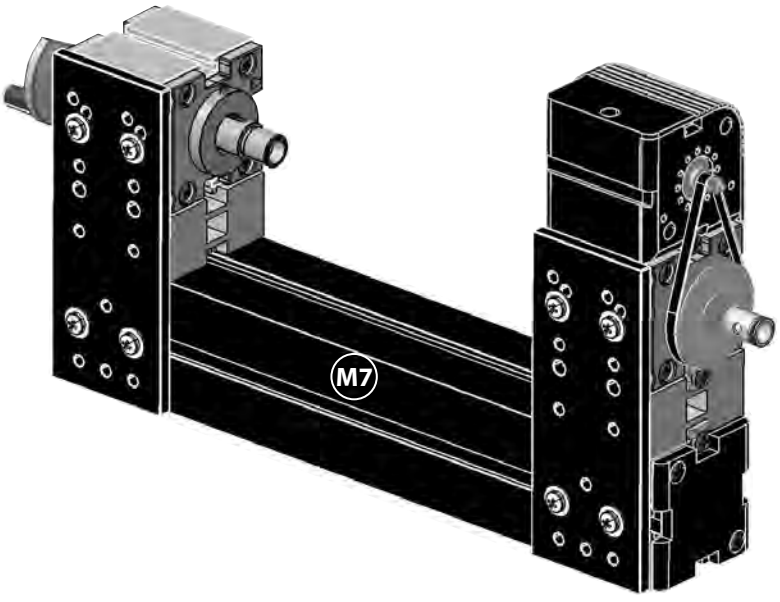


Part list and setup of CNC turning machine

Fix tailstock (U6ML) and motor-headstock unit (M1A) by means of two stabilizing plates (U67). Use screws U31 and plain washer U74. Slide two clamping plates with two holes (U47) into the T-slot of the machine bed (U1ML)



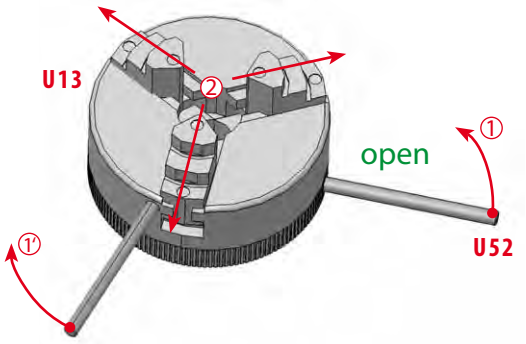
Modul M7A assembled

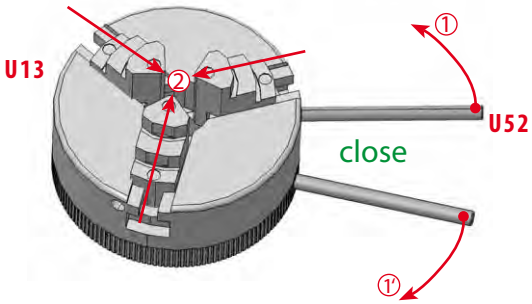


Part list and setup of CNC turning machine

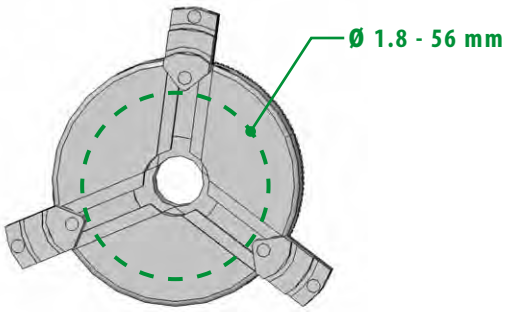
3-jaw chuck (U13): for fixing round, triangular or hexagonal work pieces. The 3-jaw chuck comes with reversal jaws for fixing different sizes of workpieces and can also be used for inside and outside fixation (to clamp or to stretch out)

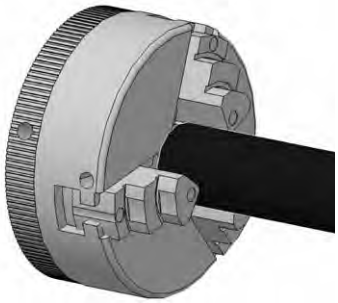
1. Rotating the upper part of the chuck against the lower part makes the jaws open and close. Use 2 rods (U52)

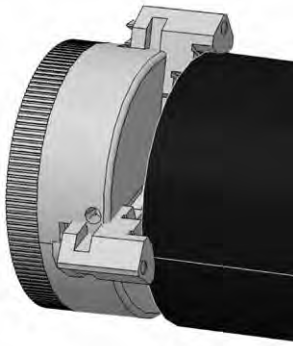




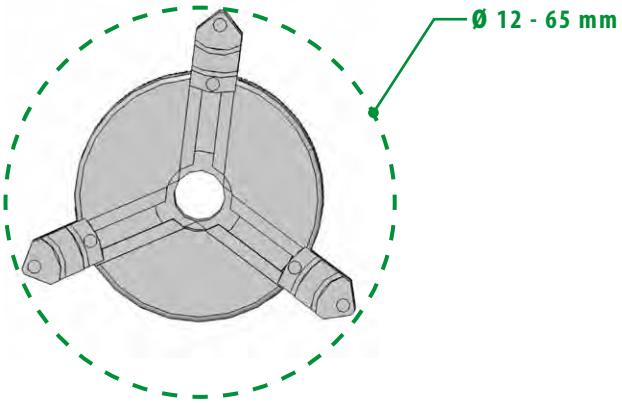
2. For fixing thin work pieces (1.8 to 56mm diameter)



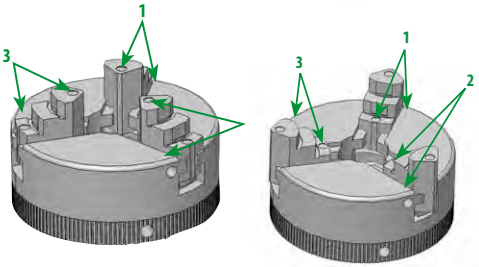




3. For fixing thicker work pieces use reversed jaws 12 to 65 mm



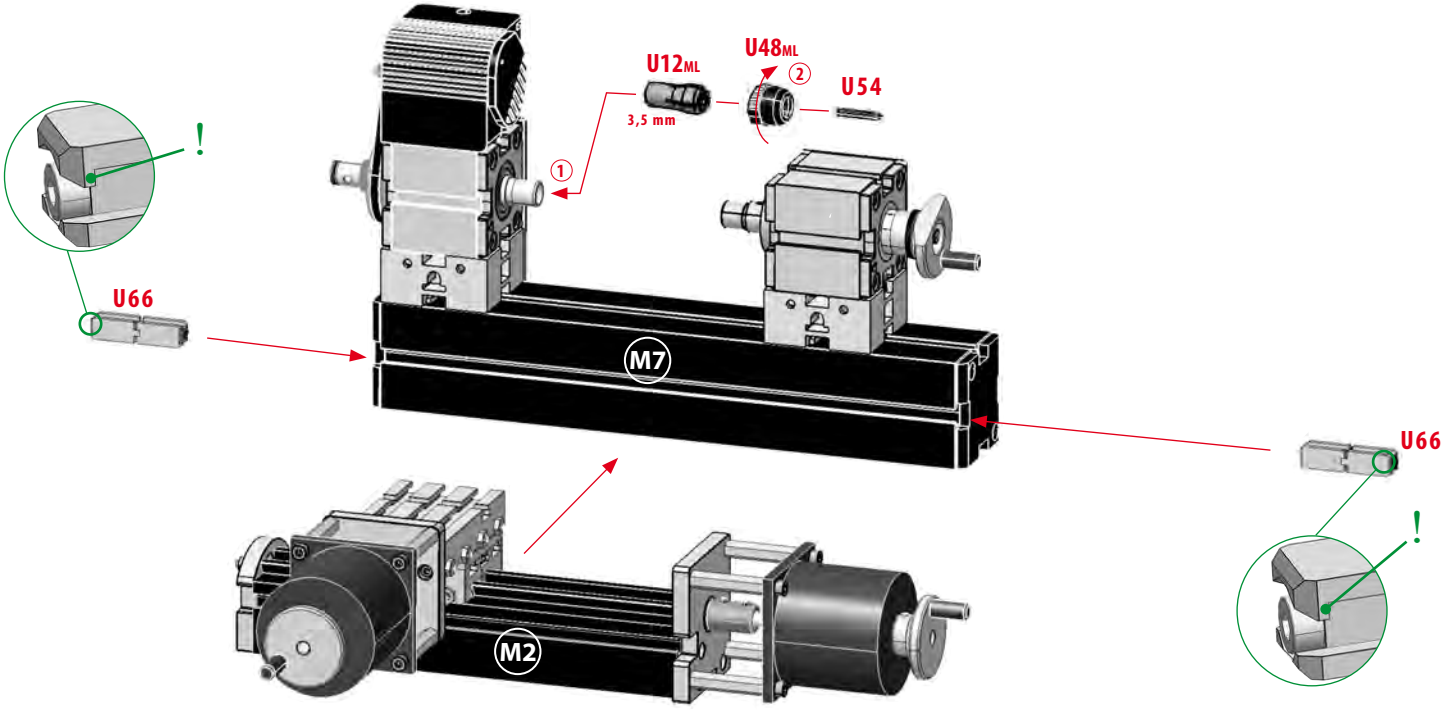
4. Reversing the jaws: turn the chuck until the jaws are released, then reverse them. Each jaw has a number for inside and outside. MIND the position of the numbers



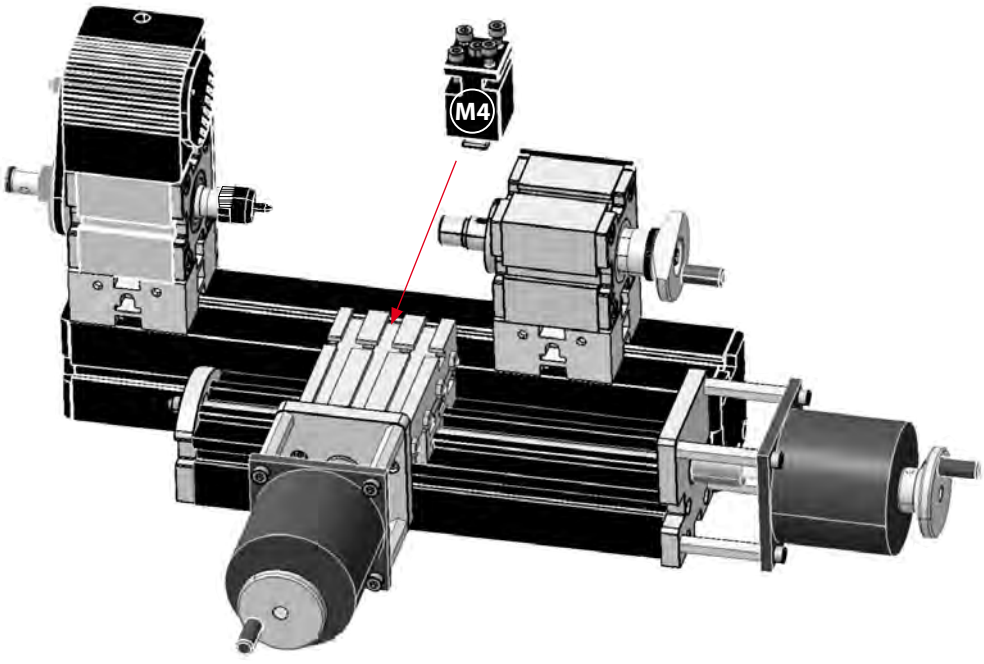
NOTE: if the work piece does not run true (eccentric) loosen the jaws, turn the work piece and clamp again

Assembly of slide module (M2)

1. Insert the 3.5 mm collet (U12ML) into the collet holder (U48ML) and the center punch (U54) into the collet.Finally insert all into the countershaft spindle and tighten the collet holder.Now the cross table element (M2) can be mounted to module M7 using two connection pieces (U66). Note,that the stopper nose of the connection pieces should be on the side of the module M2!



2. Fix 2-position tool post (M4) onto slide module (M2A). Slide T-slot nut (U46) into the T-slot of the cross-slide, then fix screw (U70)

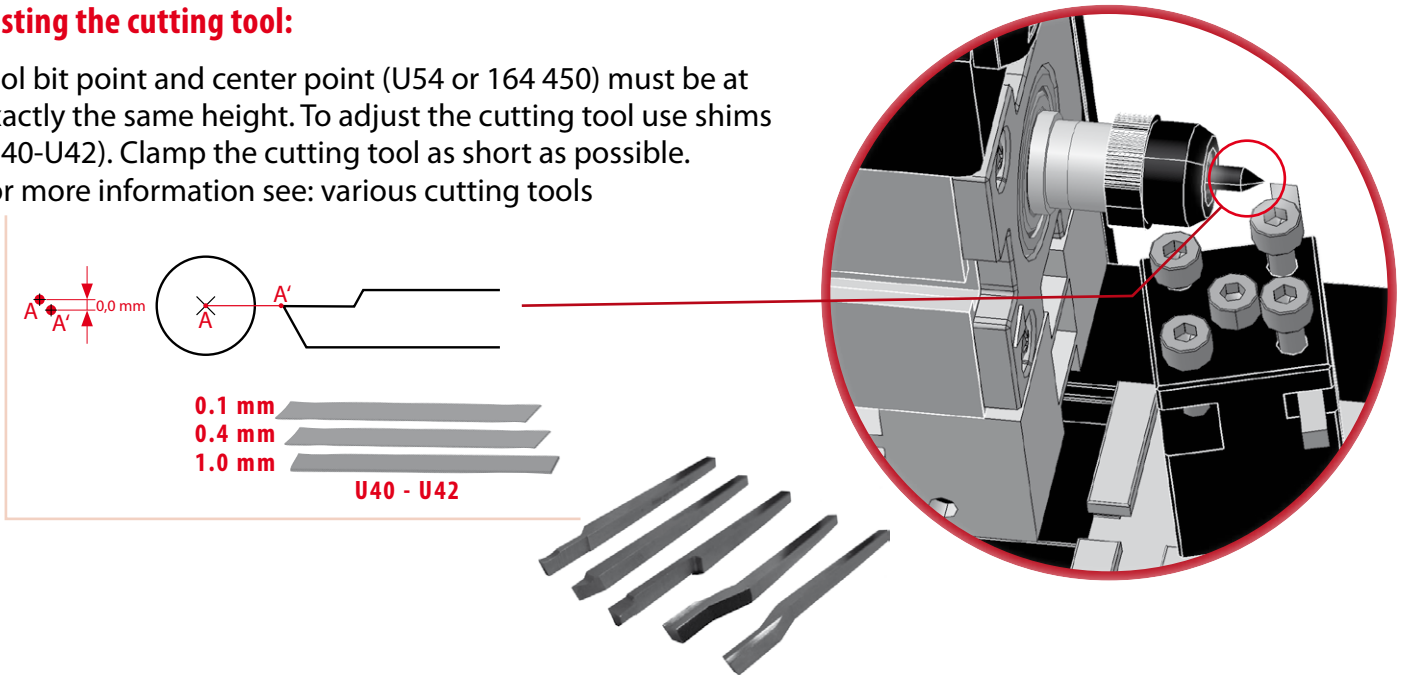


Part list and setup of CNC turning machine 4.3.2

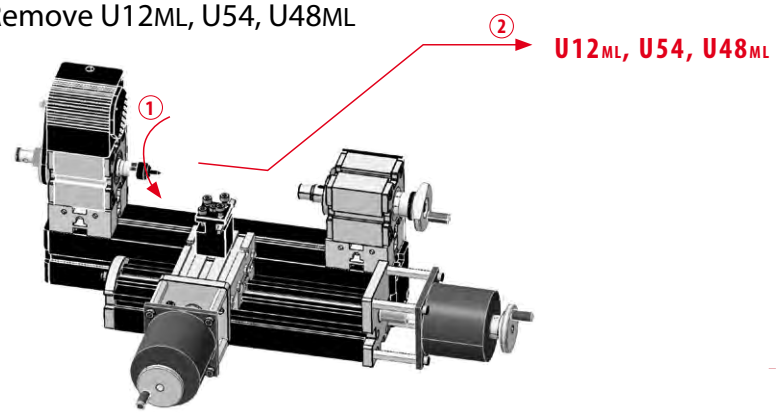
www.youtube.com/thecooltool09

Adjusting the cutting tool:

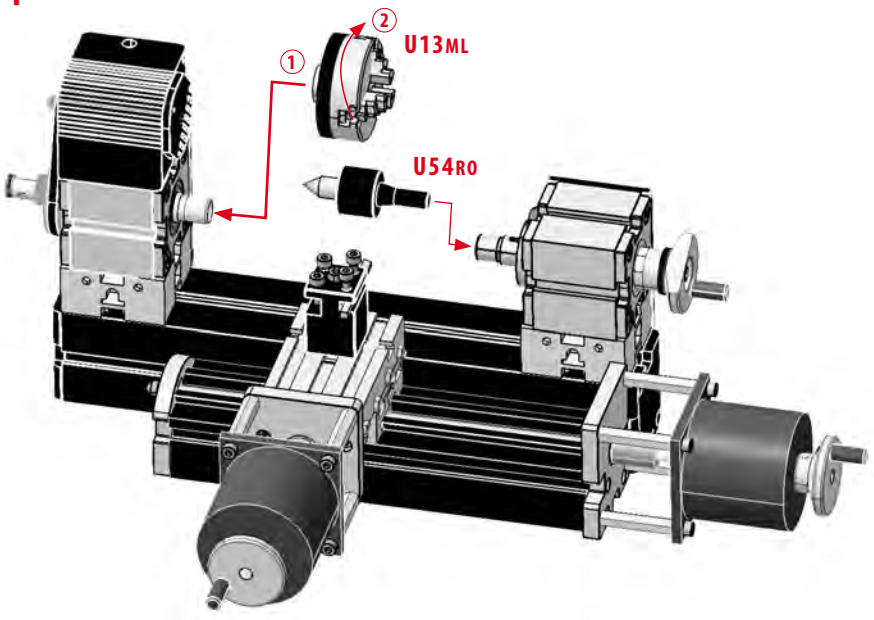
1. Tool bit point and center point (U54 or 164 450) must be at exactly the same height. To adjust the cutting tool use shims (U40-U42). Clamp the cutting tool as short as possible.
   For more information see: various cutting tools



2. Remove U12ML, U54, U48ML



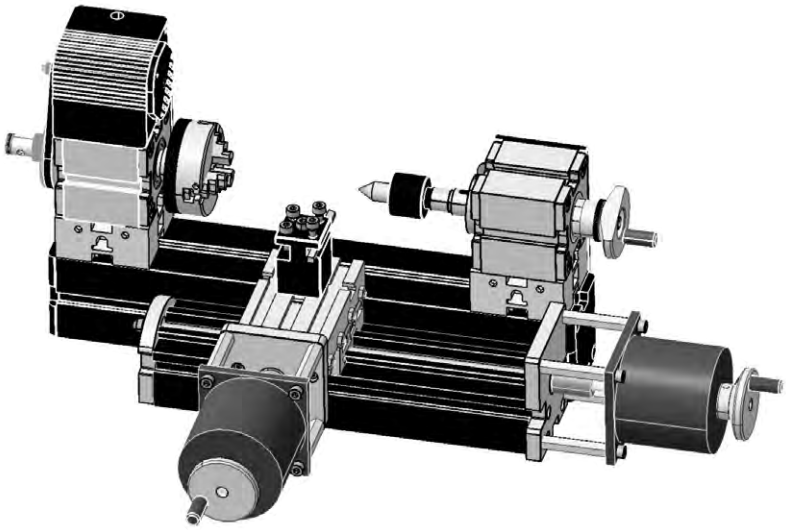
Fix 3 jaw chuck (U13ML) onto headstock and precision live center (U54RO) onto tailstock.

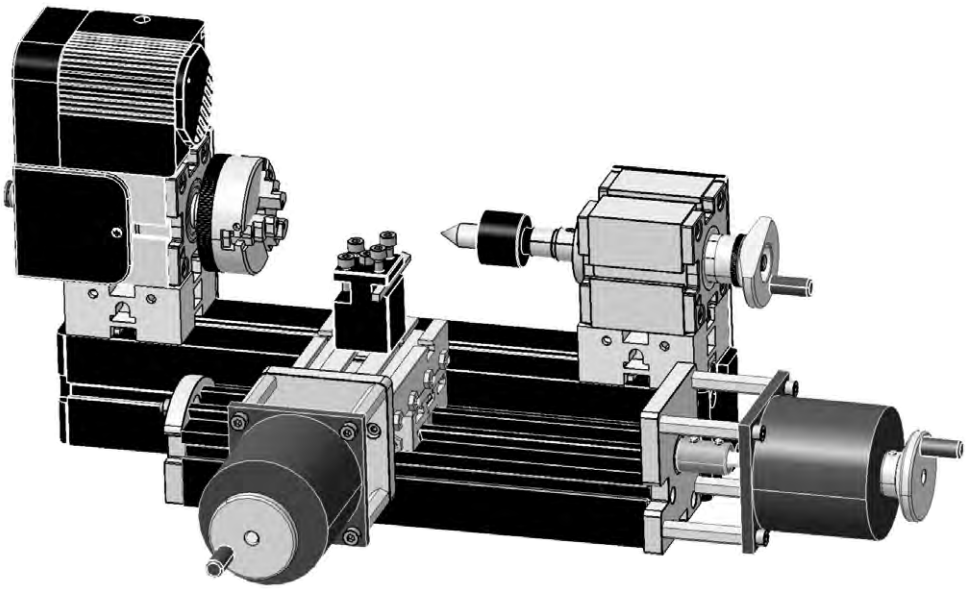


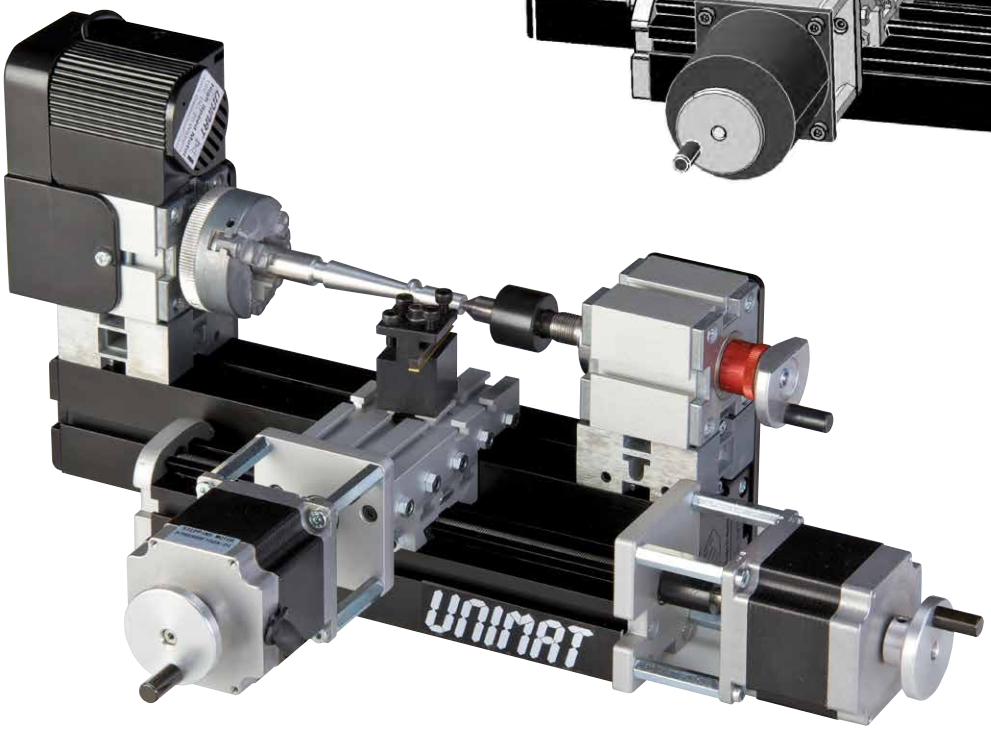
Part list and setup of CNC turning machine

Fix the drive belt cover (U0)

Take a look at "MOTOR-HEADSTOCK Unit M1"



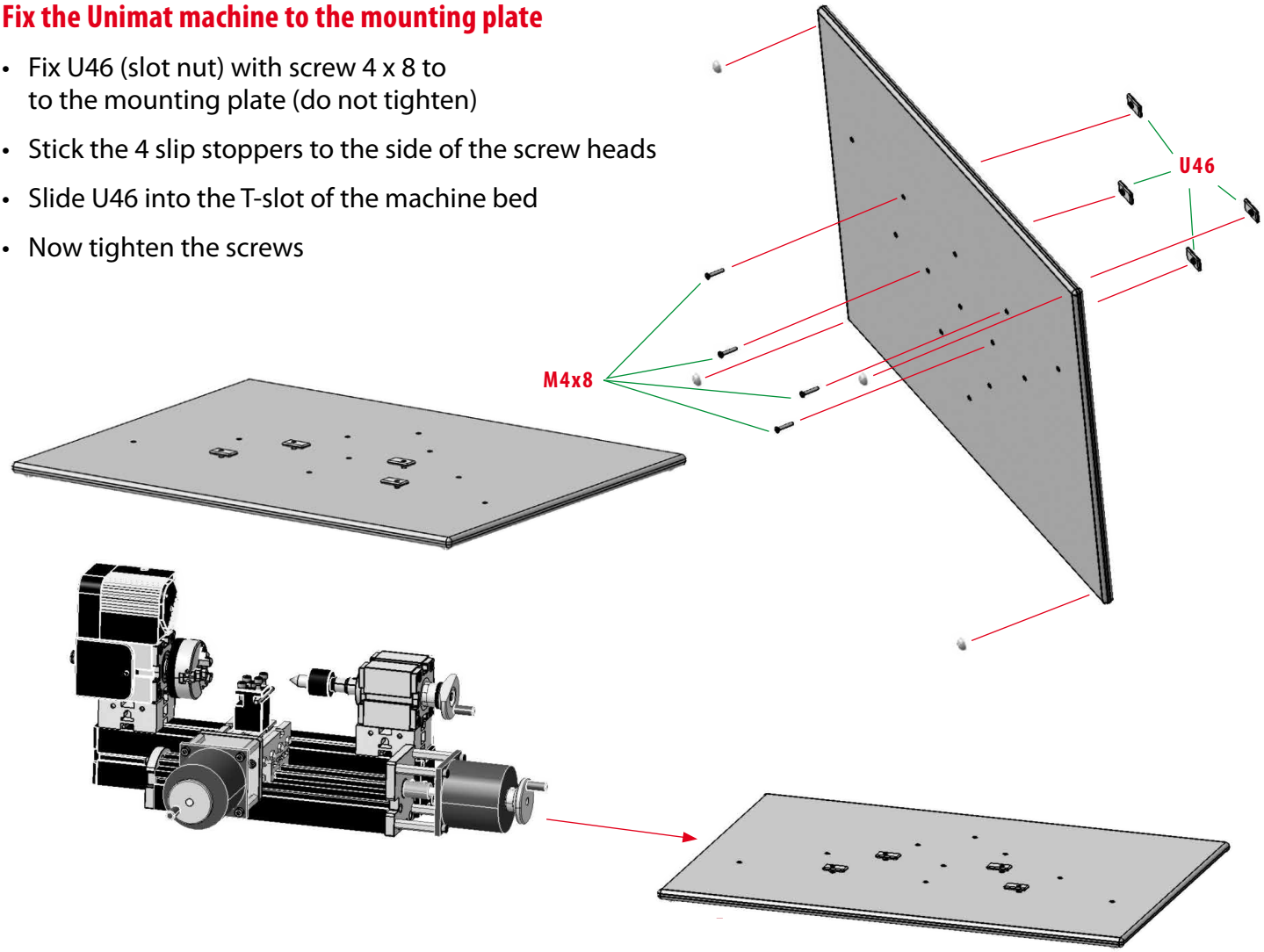


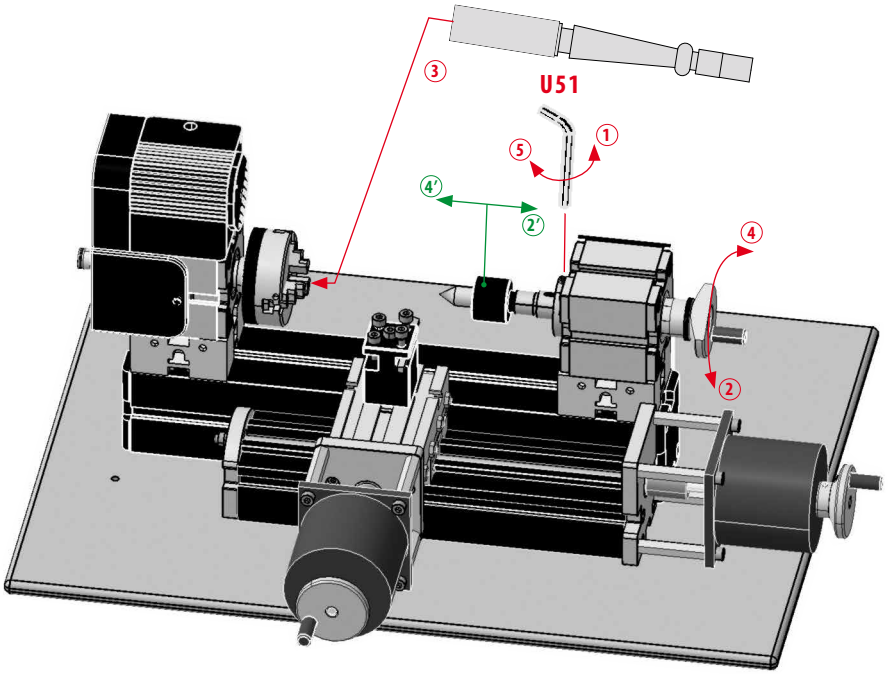


Part list and setup of CNC turning machine

Fix the Unimat machine to the mounting plate

- Fix U46 (slot nut) with screw 4 x 8 to to the mounting plate (do not tighten)
- Stick the 4 slip stoppers to the side of the screw heads
- Slide U46 into the T-slot of the machine bed
- Now tighten the screws

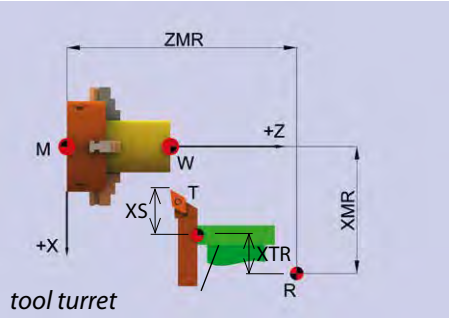




General methods for the CNC Lathe examples

Work piece zero point:

Concerning turning parts, it is common to lay the zero point in the x-coordinate on the rotating axis of the work piece (main spindle). The advantage is that there is no deviation on the final product caused by diameter variations on the raw material. This creates the following problem though: It is impossible for the turning tool tip to reach the lathe center, when a work piece is already mounted. One possible solution is to change the position on the x-axis to an approachable position with a reference switch.



tool turret

Most of the reference switches are to be found at the most distant point on the x-axis of the rotational axis. As the exact distance between the switch position and axis of rotation (XMR) is known, the reference point can be derived. For the workpiece zero point, the following additional distances must be known:

Work tool point to the tool carrier reference point (XS), and the tool carrier reference point to the reference switch (XTR).

For the Unimat CNC Lathes, there are two procedures to solve the problem stated above.

A) Set the zero point of the X-axis before the work piece is mounted.

B) Determine the exact diameter of the raw material, touch the tool with the work piece, and store the determined actual position of the x-axis under „touch".

A) Setting the X-axis zero point without a clamped work piece

1) Start axis and choose lathe (i.e. Uni-Dreh)

2) Mount the tailstock on the machine bed (if not yet). See Ch. 4.3.2. steps 6-9.

3) Make sure that the connecting element (U66) and the screws (U31) of the mounting plate (U67) are tightened. Only then the tailstock is correctly aligned!

4) Insert the live center into the pinole, making sure that it does not tilt and fall out. This could happen without pressure. For this reason, you can set the zero point on the X-axis also with the center (U54) fixed with the 3.5 mm collet on the pinole.

5) Move the point of the turning tool to the point of the live center. Adjusting the cutting tool.

Re-examine the height of the cutting tool. After setting it to the correct height, move the cutting point exactly on the axis of rotation (Cutting tool tip is aligned now with the tip of the center, both seen from above and from the front).

Note: When setting the zero point, turn off the controller box and move the slide by turning the hand wheels. This is more efficient than if the slides were positioned above the software. Finally turn on the controller again to prevent the motors from changing the position of the slide unintentionally.

6) If it has been moved manually (via handwheels), turn off the „Emergency“ button (Press F1) and click „Machine on“ (Press F2).

7) To activate the X-axis (1 - page CNC-28), press the „Homing“ icon. Now the X-reference point is set (in the following examples, this point will be referred to as the work piece zero point). Referenced axes are marked in the preview window with a symbol (2 - page CNC-28).

8) Attention: From now on, the X-axis can only be moved via the software. Through a manual movement of the slide (means of handwheels), the reference point will be lost.

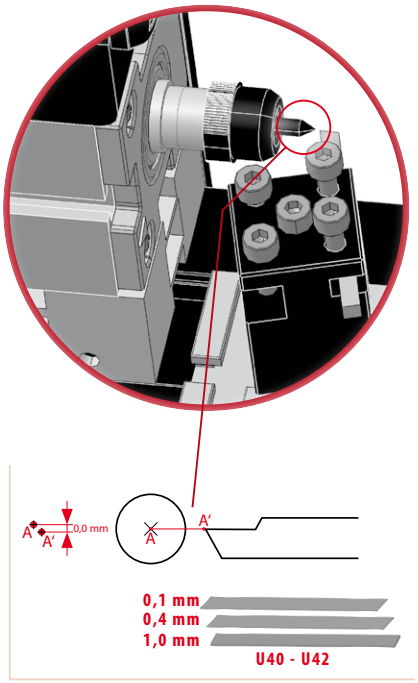
9) Bring the tool to a position where it will not be an obstacle when clamping the work piece.

10) Clamp the work piece (raw material).

11) Move the point of the tool to the zero point on the Z-axis. The zero point is in this case on the very right of the work piece (tailstock side).

12) Mark the Z-axis and click “homing “ icon. Now, the zero point of the Z-axis is set.

13) The processing (G-code) can now begin. Attention! Turn on motor (U4)!



B) Setting the X-axis zero point with a clamped work piece

1) Start axis and choose lathe (i.e. Uni-Dreh).

2) Clamp work piece (raw material).

3) At the point at which the tool is tangent to the work piece, measure the exact diameter.

4) At this point drive up the tool to the workpiece. The workpiece must rotate. Turn on motor (U4).

Note: Turn off the controller to move the slides manually (via hand-wheels). By touching the workpiece, it can also be rotated by hand. Turn the controller on again when finished.

5) Slowly bring the cutting point closer to the work piece. Stop when any light scratches form on the material. The scratching can usually be heard, aswell.

6) If slides have been moved manually turn the „emergency“ off (Press F1) and activate „Machine On“ (Press F2).

7) To activate the X-axis, click the „Homing“ icon.

8) To activate the Z-axis click the „Homing“ icon. Attention: this is NOT the final zero point for the Z-axis. However all axes of the machine must be referenced to select „Touch“ . The actual Z-axis zero point will be set later on.

9) Click „Touch“. A window will open. Make sure that „Coordinate system“ and „P1 G54“ are activated. Type in the distance to the rotation axis in the searchbar (Diameter/Radius, depending on how it was programmed). Accept the value by clicking „OK.“

10) Attention: From now on, the X-axis can only be moved via the software. Through a manual movement of the slide (means of hand-wheels), the reference point will be lost.

11) Move the point of the tool to the zero point on the Z-axis. The zero point is in this case on the very right of the work piece (tailstock side).

12) Mark the Z-axis and click the „homing“ icon. Now, the zero point of the Z-axis is set.

13) The processing (G-code) can now begin. Attention! Turn on motor (U4)!

Project for 2 axis Unimat CNC

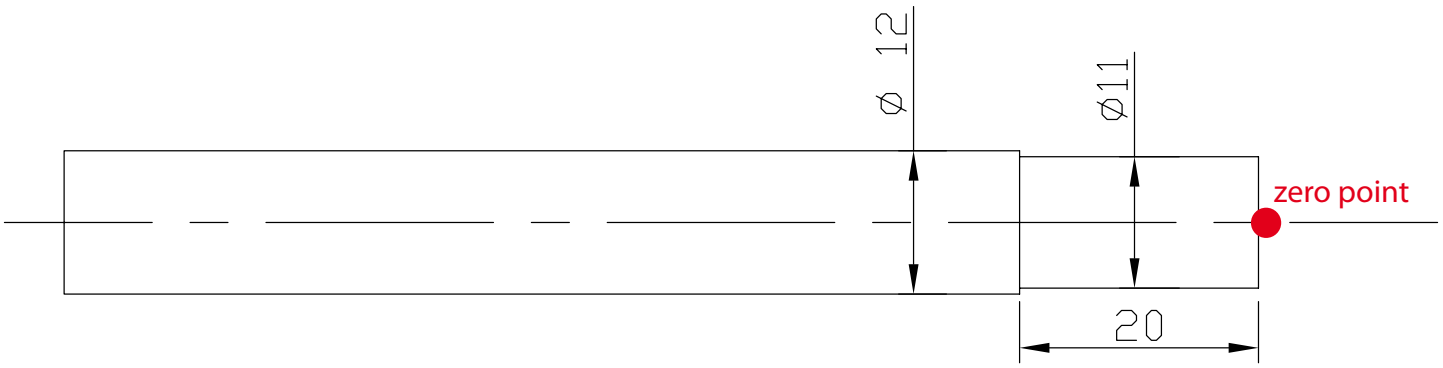
Uni-Dreh

Includes

1) Raw material: Aluminium rod

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)



Project

Turning piece 1

(Aluminium 12 mm Ø, 100 mm long, zero-point: right edge of workpiece on rotation axis)

Tool: Outside turning tool right (162 231 E); max. forward feed rate: 80 mm/min max. feed: 0.2 mm

Approach:

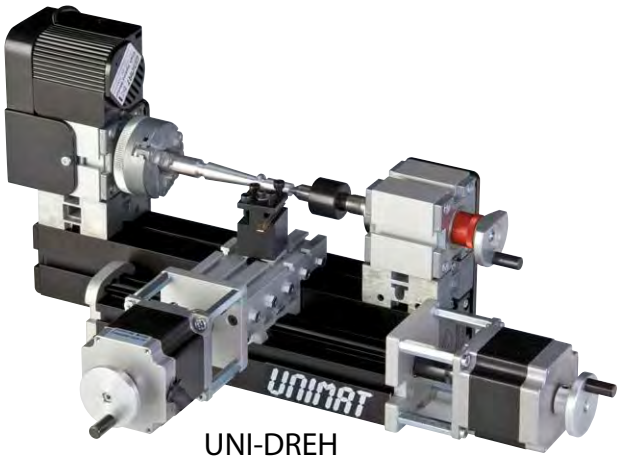
Option 1:

g21
g7 (activate diameter mode)
g0 x20
g0 z1
g0 x11.8
g1 z-20 f50
g0 z1
g0 x11.6
g1 z-20
g0 z1
g0 x11.4
g1 z-20
g0 z1
g0 x11.2
g1 z-20
g0 z1
g0 x11
g1 z-20
g0 x11.4
g0 x20 z1
m02

Option 2:

(radius referred)

g21
g0 x10
g0 z1
g0 x5.9
g1 z-20 f50
g0 z1
g0 x5.8
g1 z-20
g0 z1
g0 x5.7
g1 z-20
g0 z1
g0 x5.6
g1 z-20
g0 z1
g0 x5.5
g1 z-20
g1x5.7
g0 x10 z1
m02



UNI-DREH

Project for 2 axis Unimat CNC

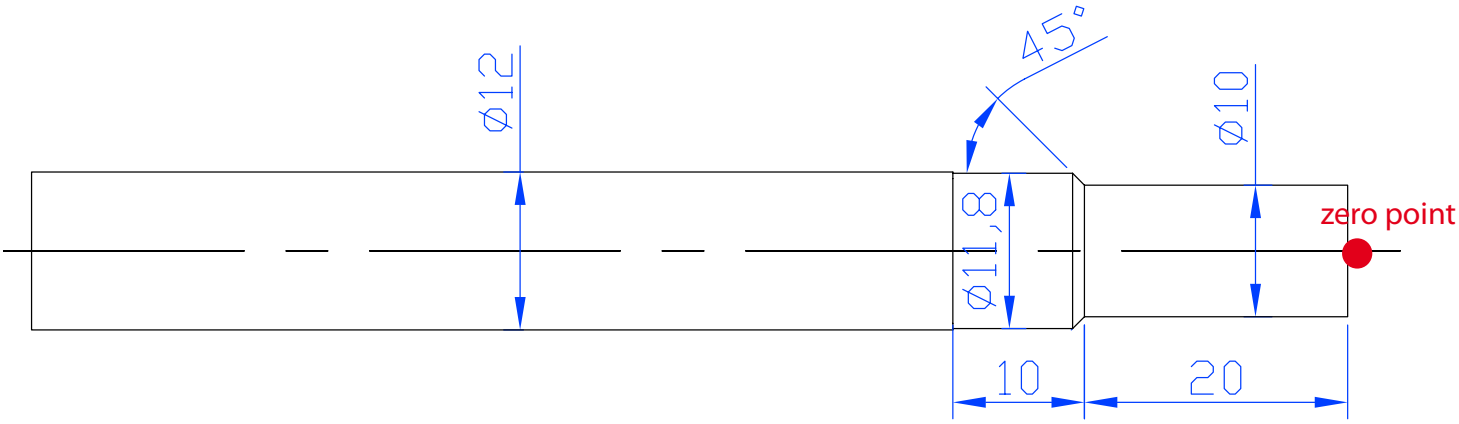
Uni-Dreh

Includes

1) Raw material: Aluminium rod

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)

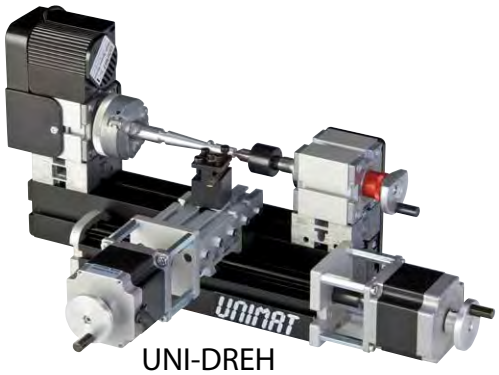


Project

Turning piece 2

(Aluminium 12 mm Ø, 100 mm long, zero-point: right edge of workpiece on rotation axis)

Tool: Outside turning tool right (162 231 E); max. forward feed rate: 80 mm/min max. feed: 0.2 mm



UNI-DREH

Approach:

Option 1:

g21
g7 (activate diameter mode)
g0 x20
g0 z1
g0 x11.8
g1 z-20 f50
g1 x12 z-21
g0 z1
g0 x11.6
g1 z-20
g1 x12 z-21
g0 z1
g0 x11.4
g1 z-20
g1 x12 z-21
g0 z1
g0 x11.2
g1 z-20
g1 x12 z-21
G0 z1
g0 x11
g1 z-20
g1 x12 z-21
g0 z1
g0 x10.8
g1 z-20
g1 x12 z-21
g0 z1
g0 x10.6
g1 z-20
g1 x12 z-21
g0 z1
g0 x10.4
g1 z-20
g1 x12 z-21
g0 z1
g0 x10.2
g1 z-20
g1 x12 z-21
g0 z1
g0 x10
g1 z-20
g1 x12 z-21
g0 z-18
g0 x11.8
g1 z-30
g0 x12
g0 x20 z2
m02

Option 2:

(radius referred)

g21
g0 x10
g0 z1
g0 x5.9
g1 z-20 f50
g1 x6 z-21
g0 z1
g0 x5.8
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.7
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.6
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.5
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.4
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.3
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.2
g1 z-20
g1 x6 z-21
g0 z1
g0 x5.1
g1 z-20
g1 x6 z-21
g0 z1
g0 x5
g1 z-20
g1 x6 z-21
g0 z-18
g0 x5.9
g1 z-30
g0 x6
g0 x10 z2
m02

Project for 3 axis Unimat CNC

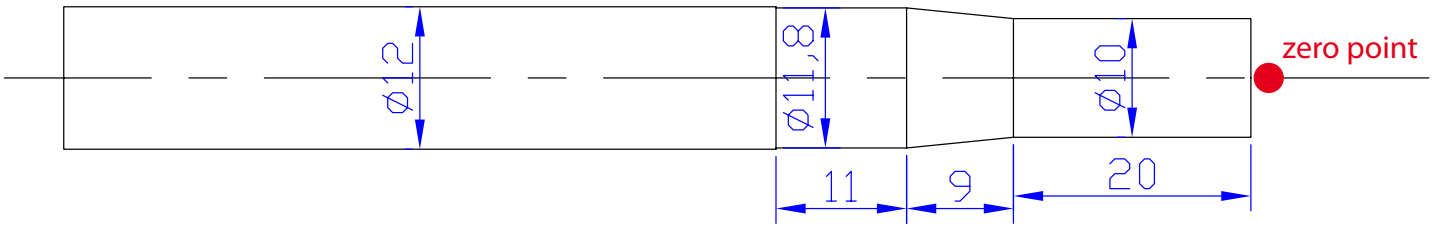
Uni-Dreh

Includes

1) Raw material: Aluminium rod

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)

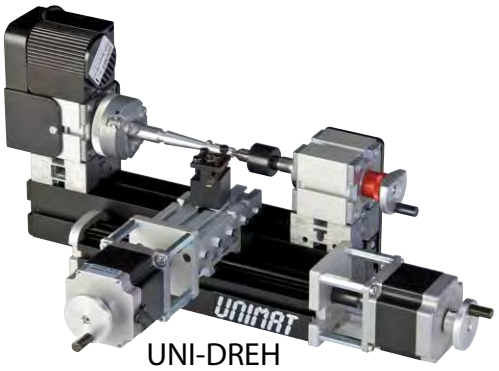


Project

Turning piece 3

(Aluminium 12 mm Ø, 100 mm long, zero-point: right edge of workpiece on rotation axis)

Tool: Outside turning tool right (162 231 E); max. forward feed rate: 80 mm/min max. feed: 0.2 mm



UNI-DREH

Approach:

Option 1:

g21
g7 (activate diameter mode)
g0 x30
g0 z1
g0 x11.8
g1 z-20 f25
g1 x12 z-30
g0 z1
g0 x11.6
g1 z-20
g1 x12 z-30
g0 z1
g0 x11.4
g1 z-20
g1 x12 z-30
g0 z1
g0 x11.2
g1 z-20
g1 x12 z-30
g0 z1
g0 x11
g1 z-20
g1 x12 z-30
g0 z1
g0 x10.8
g1 z-20
g1 x12 z-30
g0 z1
g0 x10.6
g1 z-20
g1 x12 z-30
g0 z1
g0 x10.4
g1 z-20
g1 x12 z-30
g0 z1
g0 x10.2
g1 z-20
g1 x12 z-30
g0 z1
g0 x10
g1 z-20
g1 x12 z-30
g0 z-29
g0 x11.8
g1 z-40
g0 x30
g0 z1
m02

Option 2:

(radius referred)

g21
g0 x15
g0 z1
g0 x5.9
g1 z-20 f25
g1 x6 z-30
g0 z1
g0 x5.8
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.7
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.6
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.5
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.4
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.3
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.2
g1 z-20
g1 x6 z-30
g0 z1
g0 x5.1
g1 z-20
g1 x6 z-30
g0 z1
g0 x5
g1 z-20
g1 x6 z-30
g0 z-29
g0 x5.9
g1 z-40
g1 x6.5
g0 x15
g0 z1
m02

Project for 3 axis Unimat CNC

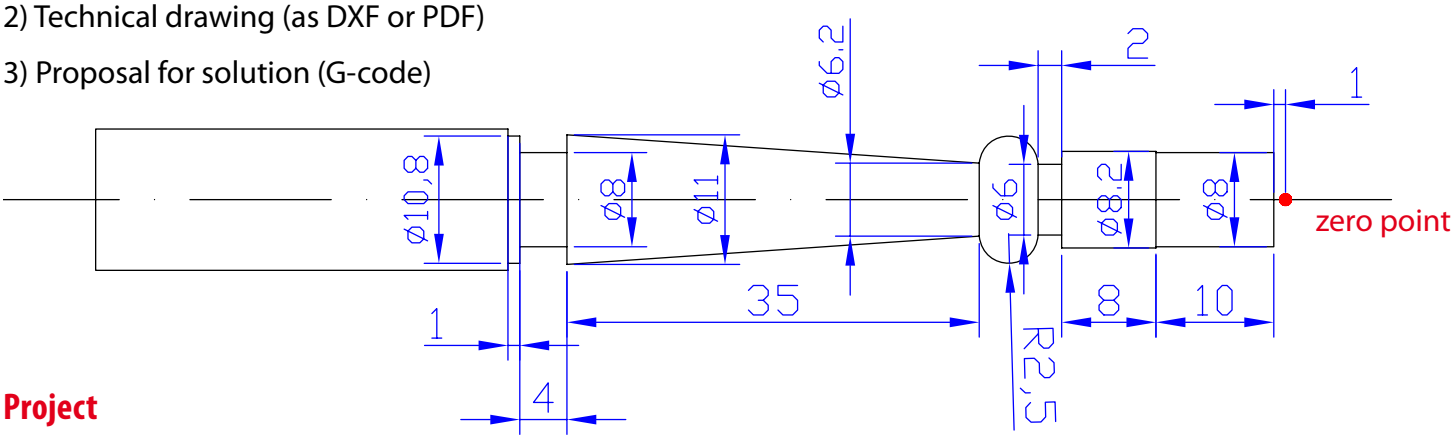
Uni-Dreh

Includes

1) Raw material: Aluminium rod

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)



Project

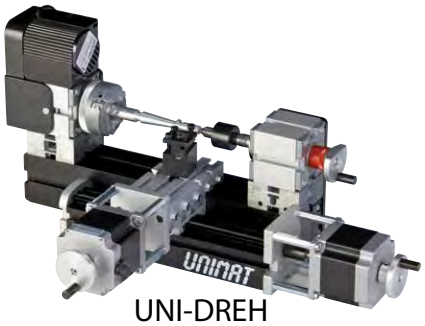
Turning piece 4

(Aluminium Ø 12 mm, 100 mm long, zero-point: 1 mm offset - right edge of workpiece on rotation axis)

Tool: Outside turning tool (162 231 B); max. forward feed rate: 50 mm/min max. feed: 0.2 mm

Approach:

Here you find the programming referred to diameter variant, as this the standard for CNC turning.



UNI-DREH

g21
g7
g0 x16 z0
g0 x11.8
g1 z-65 f50
g1 x11.8 f5
g1 z0 f50
g0 x11.4
g1 z-65
g1 x11.2 f5
g1 z0 f50
g0 x11
g1 z-65
g1 x10.8 f5
g1 z0 f50
g0 x10.6
g1 z-20
g0 x11.6
g0 z-25
g0 x11
g1 x10.6 f10
g1 x11 z-60 f50
g1 x10.6 f5
g1 z-64 f50
g1 x10.2 f5
g1 z-60 f50
g0 x11
g1 x10.2 z-25 f25
g0 x11.6
g1 z-20 f50

g0 x10.8
g1 x10.4 f5
g1 z0 f50
g0 x10.2
g1 z-20
g0 x11
g0 z-25
g0 x10.6
g1 x10.2 f5
g1 x11 z-60 f50
g0 x10.6
g1 x10.2 f5
g1 z-64 f50
g1 x10 f5
g1 z-60 f50
g0 x11
g1 x10 z-25 f25
g0 x11.6
g0 z-20
g0 x10.2
g1 x10 f5
g1 z0 f50
g0 x9.8
g1 z-20
g0 x11.6
g0 z-25
g0 x10.2
g1 x9.8 f5
g1 x11 z-60 f50
g1 x9.8 f5

g1 z-64 f50
g1 x9.6 f5
g1 z-60 f50
g0 x11
g1 x8.6 z-25 f25
g0 x11.6
g0 z-20
g0 x10
g1 x9.6 f5
g1 z0 f50
g0 x8.4
g1 z-20
g0 x11.6
g0 z-25
g0 x9.8
g1 x9.4 f5
g1 x11 z-60 f50
g1 x9.4 f5
g1 z-64 f50
g1 x9.2 f5
g1 z-60 f50
g0 x11
g1 x9.2 z-25 f25
g0 x11.6
g0 z-20
g0 x9.6
g1 x9.2 f5
g1 z0 f50
g0 x9
g1 z-20 f50

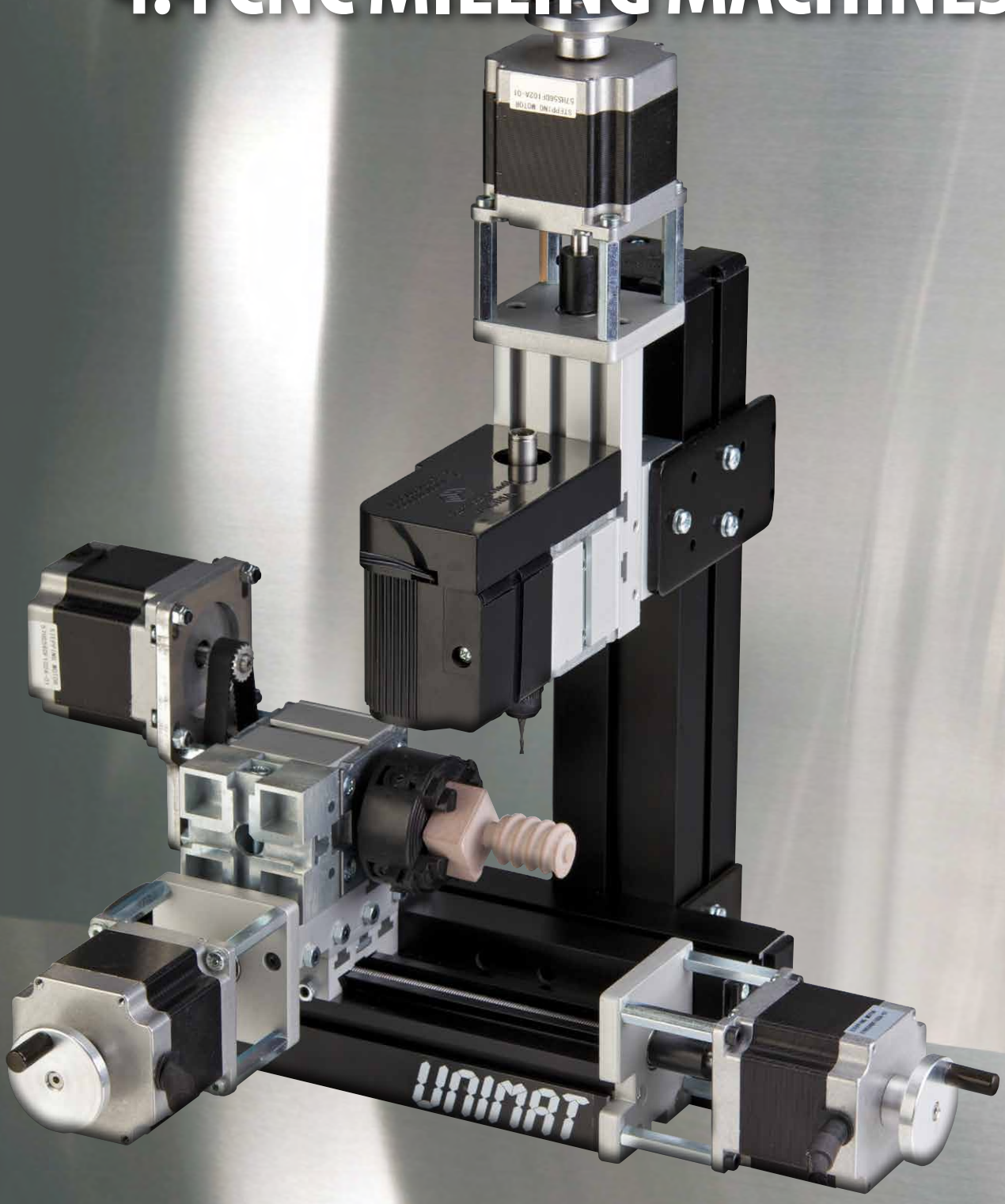
g0 x11
g0 z-25
g0 x9.6
g1 x9 f5
g1 x11 z-60 f50
g0 x9.6
g1 x9 f5
g1 z-64 f50
g1 x8.8 f5
g1 z-60 f50
g0 x11
g1 x8.8 z-25 f25
g0 x11.6
g0 z-20
g0 x9.4
g1 x8.8 f5
g1 z0 f50
g0 x8.6
g1 z-20
g0 x11.6
g0 z-25
g0 x9
g1 x8.6 f5
g1 x11 z-60 f50
g1 x8.6 f5
g1 z-64 f50
g1 x8.4 f5
g1 z-60 f50
g0 x11
g1 x8.4 z-25 f25

g0 x11.6
g0 z-20
g0 x9
g1 x8.4 f5
g1 z0 f50
g0 x8.2
g1 z-20
g0 x11.6
g0 z-25
g0 x8.6
g1 x8.2 f5
g1 x11 z-60 f50
g1 x8.2 f5
g1 z-64 f50
g0 x11.8
g0 z0
g0 x8
g1 z-20 f50
g0 x11.6
g0 z-25
g0 x8.2
g1 x8 f5
g1 x11 z-60 f50
g1 x8 f5
g1 z-64 f50
g0 x11
g0 z-60
g1 x7.8 z-25 f25
g0 x11.6
g0 z-20

g0 x8.2
g1 x7.8 f5
g1 z-18 f50
g0 x9
g1z-10 f50
g1 x7.8 f5
g1 z0 f50
g0 x7.4
g1 z-10 f50
g0 x9
g1 z-18 f50
g0 x8.2
g1 x7.4 f5
g1 z-20 f50
g0 x11.6
g0 z-25
g0 x8.2
g1 x7.4 f5
g1 x11 z-60 f50
g1 x7 z-25 f25
g0 x11.6
g0 z-20
g1 x7 f5
g1 z-18 f50
g1 x6.6 f5
g1 z-20 f50
g0 x11.6
g0 z-25
g1 x6.6 f5
g1 x11 z-60 f50

g1 x6.2 z-25 f25
g0 x11.6
g0 z-20
g1 x6.2 f5
g1 z-18 f50
g1 x6 f5
g1 z-20 f50
g0 x10
g18
g3 x10 r2.5 z-25 f2.5
g1 x9 f5
g2 x9 r2.5 z-20 f2.5
g1 x8 f5
g3 x8 r2.5 z-25 f2.5
g1 x7 f5
g2 x7 r2.5 z-20 f2.5
g1 x6 f5
g3 x6 r2.5 z-25 f2.5
G1 x11 z-60 f50
g0 x12
g0 z0
m02

4.4 CNC MILLING MACHINES



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General Information on CNC Milling

A milling machine is a machine tool used for the shaping of metal and other solid materials. Its basic form consists of a cutter, that rotates in the spindle axis and a table, which the work piece is fixed on. The cutter and work piece move relative to each other, generating a toolpath along which material is removed. The movement is controlled by slides in the different axis (normally X, Y, Z).

Possible categories of Milling machines:

a) Construction and Structure: Knee type milling machines, Plano-milling machines, Special milling machines

b) Milling spindles incorporated: Horizontal milling machines, Vertical milling machines

c) Control type: Mechanical (manual), numerical

Historische Fräsmaschine

The first NC-milling machine was found in 1952. With 3 axes and electron tubes (developed at M.I.T.) it was operated through punched tape. In 1972, the first controls with a built in computer system (CNC) was created (see Chap. 3.2.1).

Some examples (without classification)

Knee type milling machines:

The key feature in this machine is that its table (Work piece) is very adjustable. The machines are rather compact and are aimed at smaller work pieces. Reasons for this include: Bigger projects on the machines augment tilt forces, due to lack of space (Inaccuracy, higher wear), and it is much easier to move the machine itself when working on a large piece, so this type is incongruous (moving a large project on a small machine could cause inaccuracy, higher wear, higher energy consumption, etc.). Typical designs are the Vertical and Horizontal milling machines.

Bed-mill machines:

Here, the machine table lies flat on the (machine) bed, preventing any possibilities of tilting. Mobile machine stands can be mounted along the machine bed as well, which hold the milling spindles. The great advantage is that even big and bulky pieces can be worked with precision on this. In some cases though, it is possible that the machine table moves into one of the axes. The movements of the different axes are distributed to the table, stands and milling unit.

Konsolfräsmaschine

Special milling machines:

These machines derived from the Knee type and Bed-mill machines. To name a few: Portal milling machines, Copy milling machine, Table milling machine, Stationary upper milling machine, Machining centers.

General Information on CNC Milling

We will focus on the portal milling machine which derived from the Bed-mill machine. It has two stands connected by a crossrail carriage (this leads to a sturdy machine) on which the motor spindle with the tool is mounted on. This structure allows for a unique portable technique. The tool can be moved along this crossbeam and also lead the movements in the Z axis. On rare occasions, the machine table is moved in the Z axis (elevated/sunk). The work piece is installed on a clamping table/field and on steadfast stands while the clamping table moves under it. This eases milling on larger materials.

In addition to the milling head located at the crossrail carriage, more can be found along the sides, allowing machining of a work piece from the sides as well.

There are many ways to move the portal parallel so that the stands can move simultaneously:

- The two stands can be placed over a synchronous belt drive or a spindle. The disadvantage of this is that a servomotor must move the entire portal. This could reduce the machine's workspace.
- Gantry Drive: Here the two stands of a portal milling machine move simultaneously driven by a servomotor. The angle-synchronous of the servomotor allows them to function like a drive and makes the portal's mechanical connection superfluous. This design is particularly ideal for long and/or flat materials, considering only the head of the work piece is being moved rather than the piece itself. In CNC-milling centers modified Gantry increased– methods of building with swing – and rotating tool tables are used. At the same time, a relatively large workspace is available for the small machine measurements.

Portal milling machines are often used because of their large work spaces with easy constructions of aluminium profiles and/or rod guidances in the fields of design, prototype, and hobby. This way, soft flat materials (aluminum plates, plastic plates, composite materials, etc.) can be machined or engraved.

The major disadvantage of the portal milling machine though, is that the width and height can not be adjusted according to the material.

General Information on CNC Milling

The basic composition of the most universally favored CNC milling machine is the Knee type milling machine. On this equipment, the work piece travels on the X and Y axes and the tool on the Z axis.

Increasingly CNC machining centers with 5-axis controls are being utilized. They are equipped with three linear axes (X, Y and Z) and two rotating axes (A, B, and/or C).

The rotary turns are executed by the work pieces. The complete machine table is swivel-type. The second rotating axis is placed over the turning table, which is mounted on the machine table (or the turning table is used as the machine table).

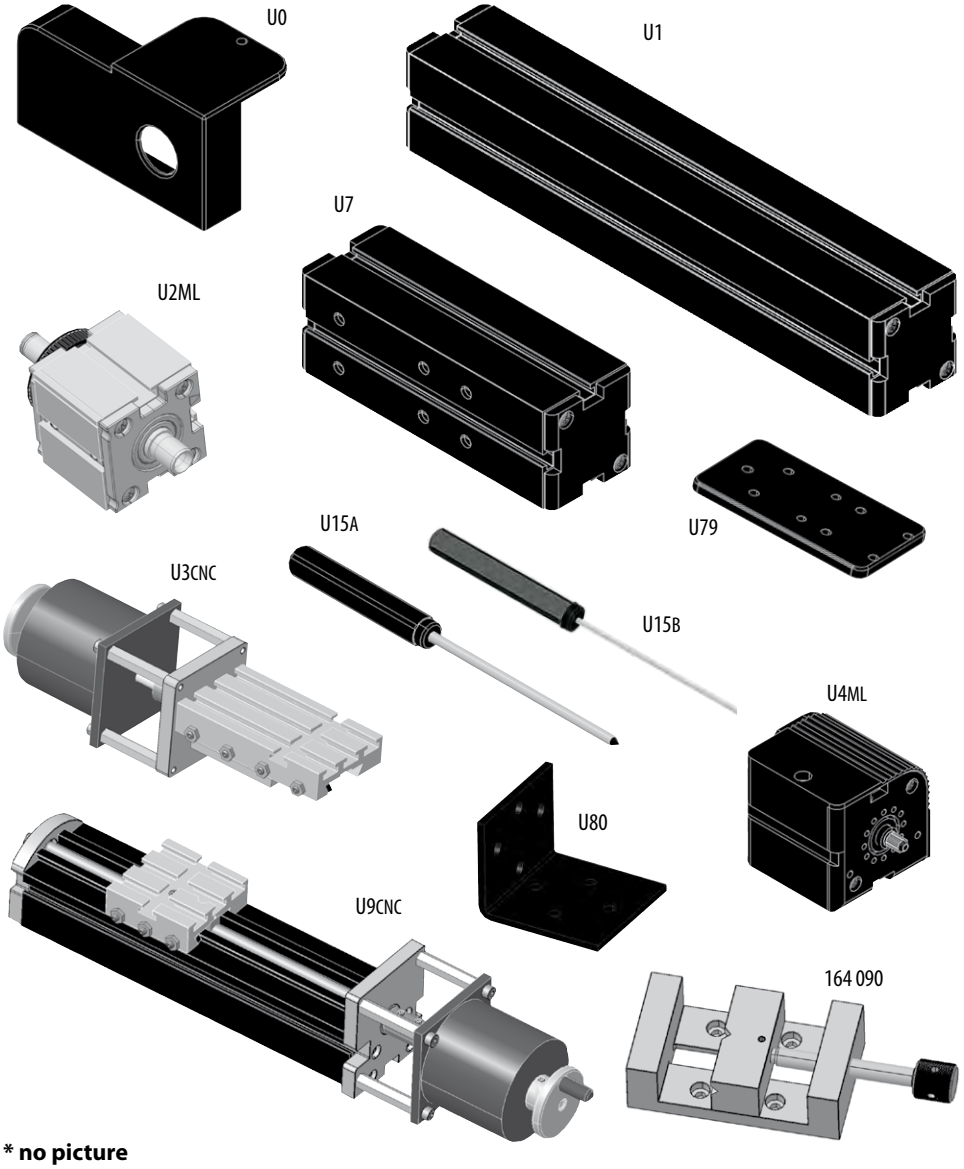
It is possible that the rotation is carried out by the tool. However it is also conceivable that it is both the tool and the work piece combined. These solutions are often more than five axes ahead but can be seen in welding robots, for instance.

Knee type and Plano-milling machines can serve as a basis for these 5 axes milling machines, although it often concerns special portal milling machines.

Part list and setup of 3 axes CNC horizontal mill

www.youtube.com/thecooltool09

U0	1	Drivebeltcover	A1A 000 010
U1	1	Machine bed, long	A1A 020 000 SW
U2ML	1	Countershaft	A1M 035 000
U3CNC	2	Cross slide CNC	164 060 CNC
U4ML	1	Motor	162 420 MH S
U7	1	Machine bed, short	A1A 010 00 SW
U9CNC	1	Longitudinal slide CNC	164 480 CNC
U12ML	1	Collet 1/8"	164 460 1/8"
U15A	1	Screw driver #2	ZWZ 980 010
U15B	1	Screw driver allen key	ZWZ 980 075
U31	4	Screw M4x10	ZSR M40 410
U37	12	Screw M4x8	ZSR M40 408
U38	7	Screw M4x6	ZSR M40 406
U46	13	Slot nut	A1A 060 040
U47	6	Clamping plate	A1A 010 020
U48ML	1	Collet holder	A1A 000 072
U49	4	Clamping jaw	A1A 000 090
U49ML	2	Clamping jaw ML	A1Z 490 000
U51	1	Allen key 2mm	ZWZ 110 200
U52	1	Rod	ZST 110 345
U56CNC	1	Milling head 1.6 mm	F2470 1.60
U57	1	Drive belt (87)	ZRM 730 087
U65	1	Allen key 2,5mm	ZWZ 110 250
U66	4	Connection piece	A1A 000 ZIN SK
U69	4	Screw M4x12	ZSR M40 412
U71	1	7/14 mm straddle wrench	ZWZ 400 700
U74	12	Plain washer	ZSB 250 430
U79	1	Stabilizing plates small	A1Z 470 000
U80	2	Stabilizing angle	A1Z 480 000
	1	Wood mounting plate *	164 400
	4	Rubber buffer *	
	1	Unimat power supply *	161 312
optional			
	1	Steel vise	164 090



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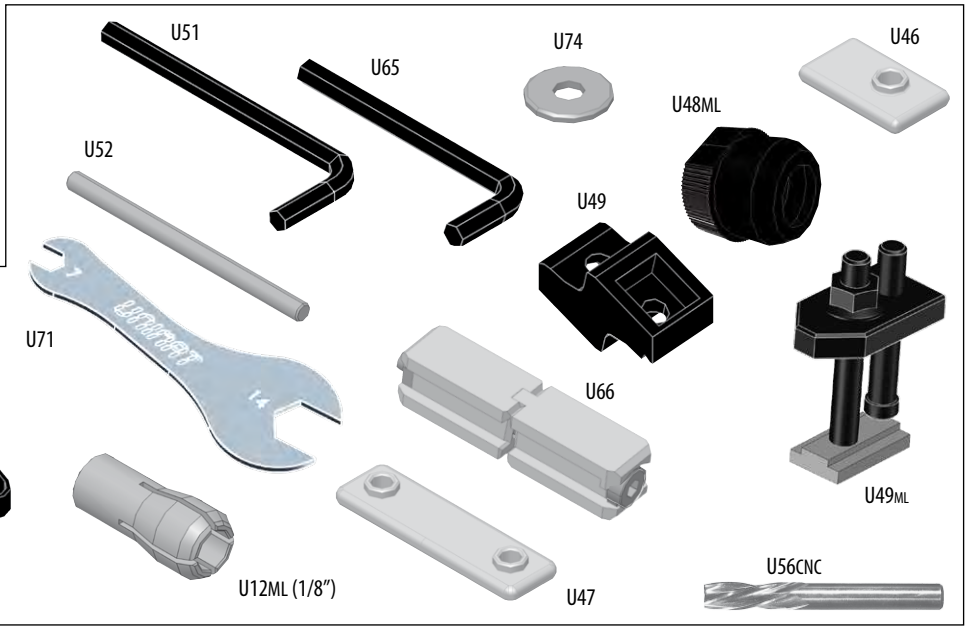
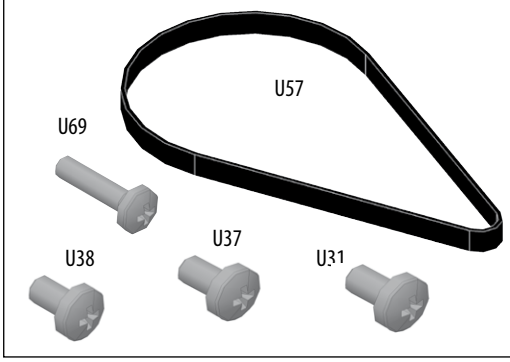




Part list and setup of 3 axes CNC horizontal mill 4.4.2

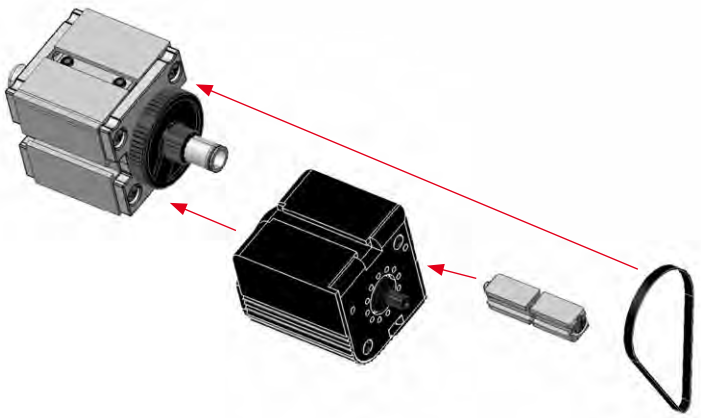
Assembly/General

When setting up the UNIMAT CNC please consider the following

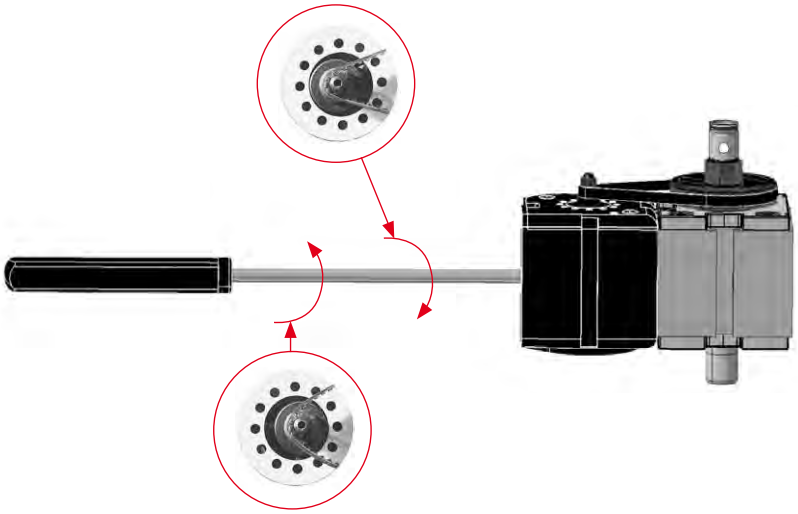
1. A screw connecting two metal parts e.g. machine beds, stabilizing plates etc. can be tightened firmly.
2. If the metal nut clamps two synthetic parts, (e.g. adjust the sledge movement, adjusting motor speed,…) then screw it down very gently.
3. By connecting plastic parts with a metal screw/nut, then screw down very gently e.g. Allen screw into the tailstock housing. The same if the metal screw will be screwed into a plastic part e.g. jig-saw housing.

Assembly of the CNC Horizontal milling machine

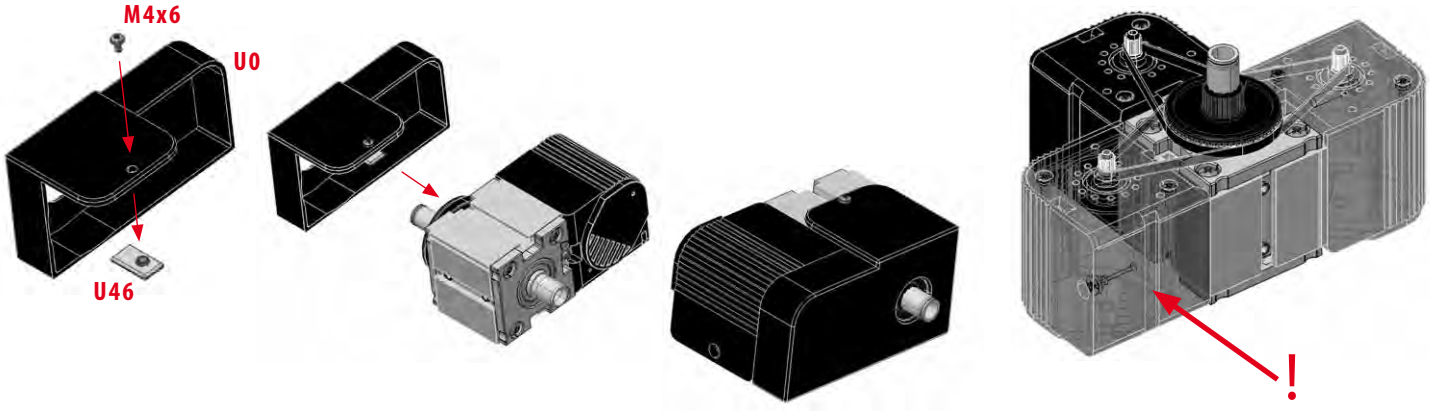
MOTOR-HEADSTOCK Unit M1



1. Slide connection piece (U66) into the T-slots (groove) between motor (U4ML) and headstock (U2ML).
2. Push headstock (U2ML) across and fix the screw of the connection piece (U66)
3. Adjusting the drive belt (U57):
   Tighten U57 with screwdriver. Loosen U57, then start motor. Tighten U57 until motor revolutions slightly reduce and the belt U57 is properly tightened.

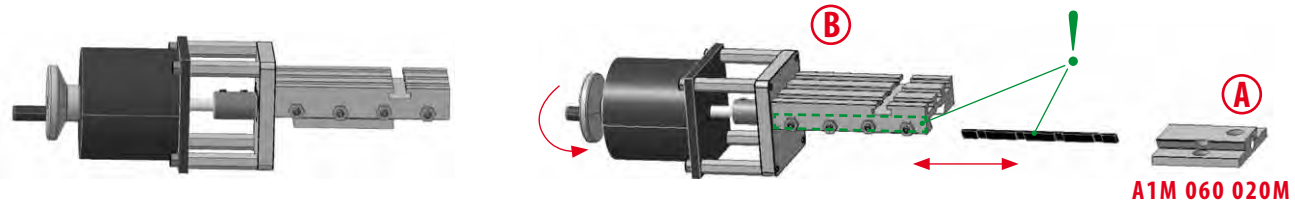


4. Fixing the drive belt cover (U0). Make sure that the belt will not grind inside the cover. **Note: fix U0 only after Unimat is completely assembled!**

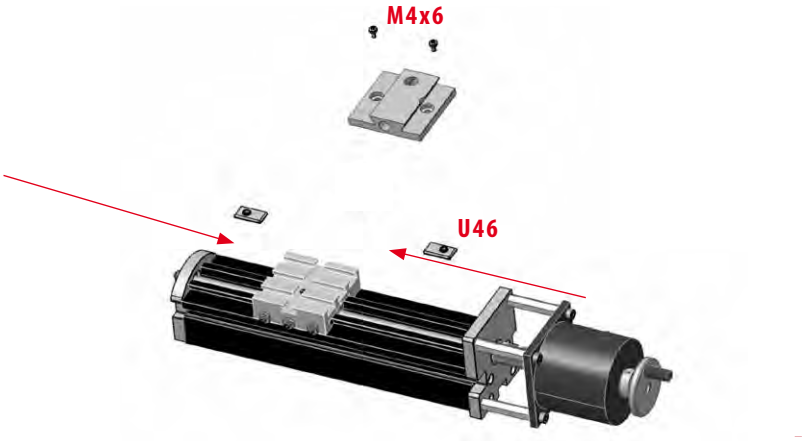


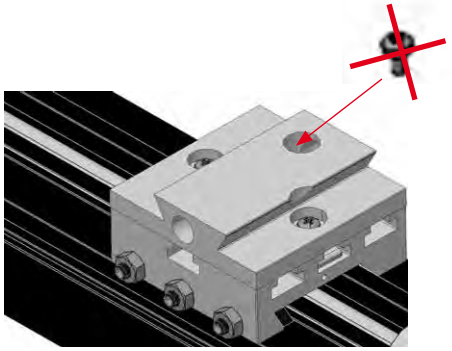
Large slide module M2D

4. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3CNC) by turning the hand wheel until it is released

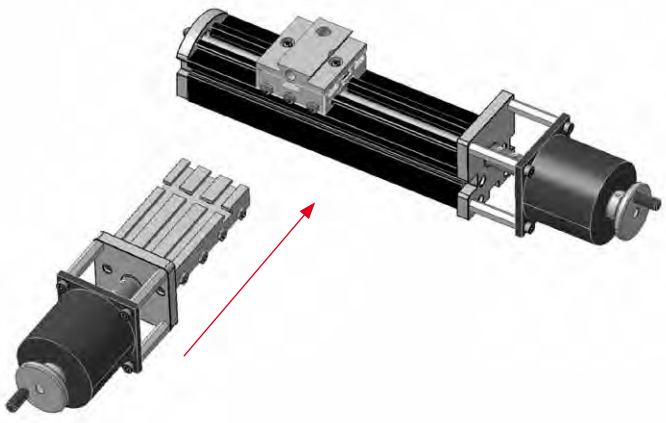


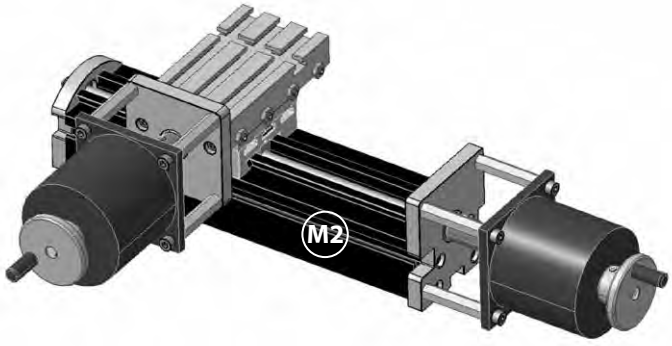
2. Fix the cross-slide guide (A1M 060 020M) to the sattle of the longitudinal slide (U9CNC) with 3 screws (U38) and 3 clamping plates (U46).





3. Slide modul (M2A) assembly: Slide cross-slide body (U3CNC) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.

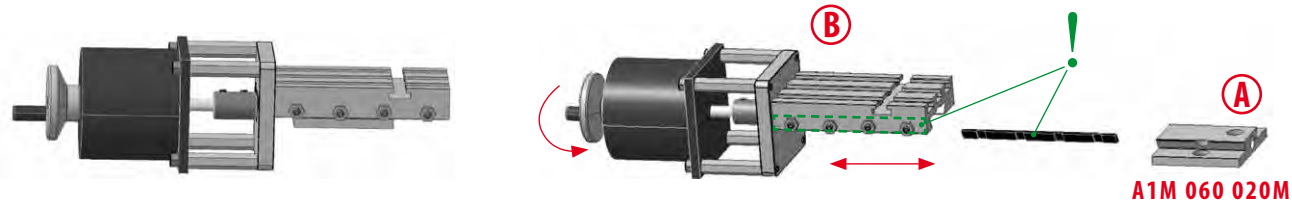




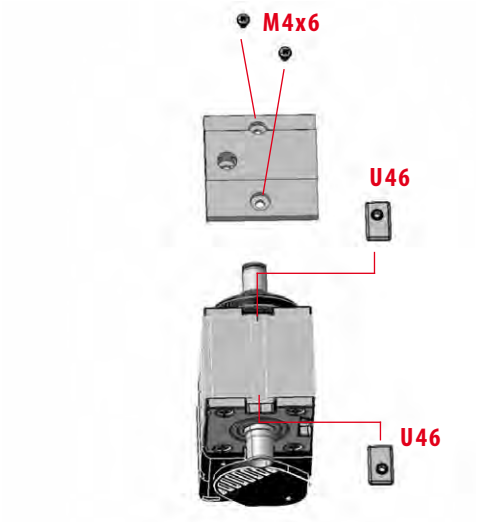
Part list and setup of 3 axes CNC horizontal mill 4.4.2

Small slide module M2B

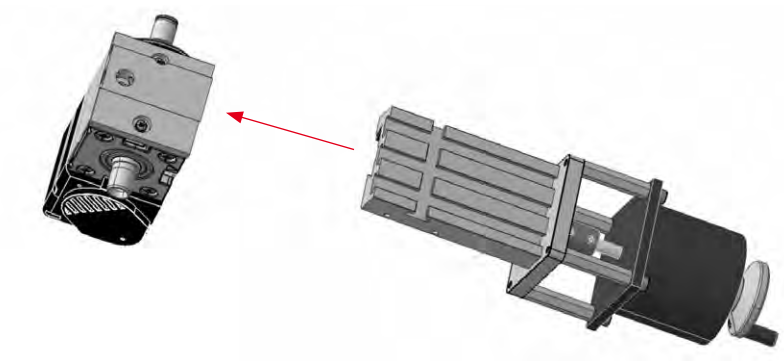
1. M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3 CNC) by turning the hand wheel until it is released.



2. Fix the cross-slide guide (A1M 060 020M) to the headstock (U2ML) with 2 screws (U38) and 2 T-slot nut (U46).



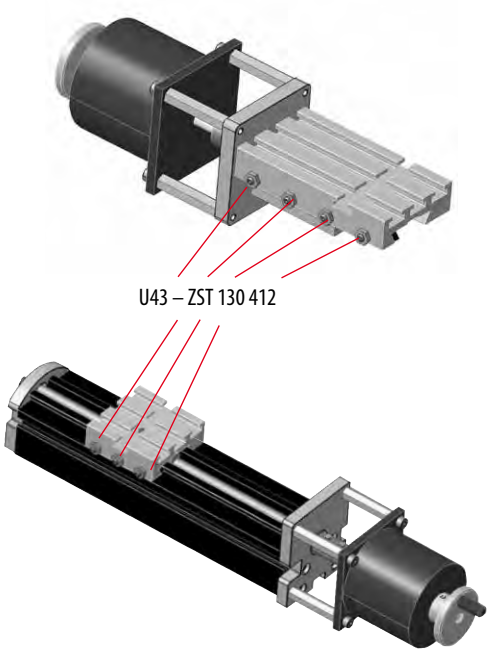
3. Slide cross-slide body (U3ML) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.



Part list and setup of 3 axes CNC horizontal mill 4.4.2

Adjusting the slides:

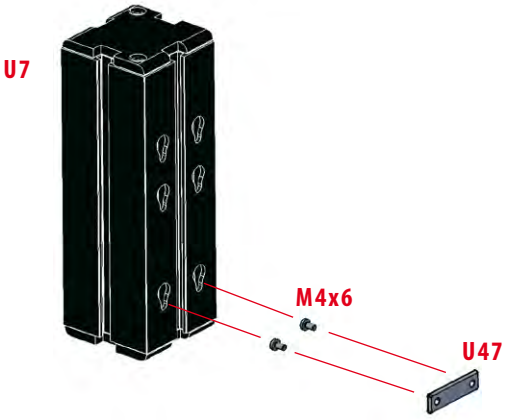
1. Check play: open nut (U43), adjust play with screws M4x12 (ZST 130 412) GIBS: (tapered synthetic adjustment shims) are fitted between the saddle and the profile of the longitudinal slide and the upper and lower part of the cross slide. Correct adjustment of the gibs will ensure smooth and steady operation of the slides. It is adjusted by loosening the nuts and using the screws of the saddle and upper cross-slide part, by pressing the gibs until „play“ is removed. After adjusting, retighten the locking nuts. Milling operations require a tighter adjustment of the gibs than lathe operations.



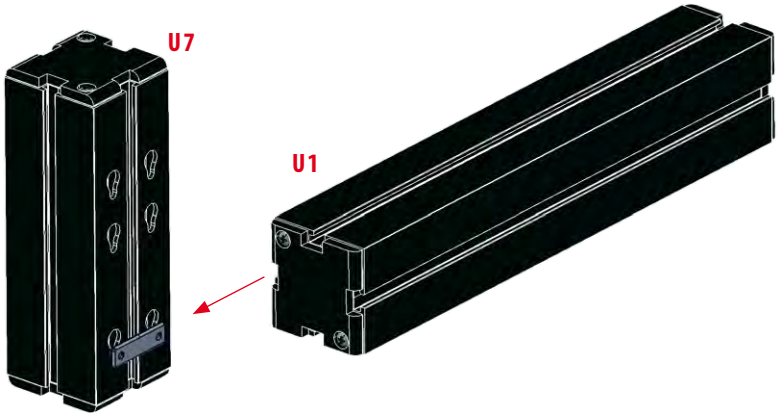
2. Maintain the slides at regular intervals: clean with a brush and lubricate the gliding surface.

Horizontal machine bed combination (M3B)

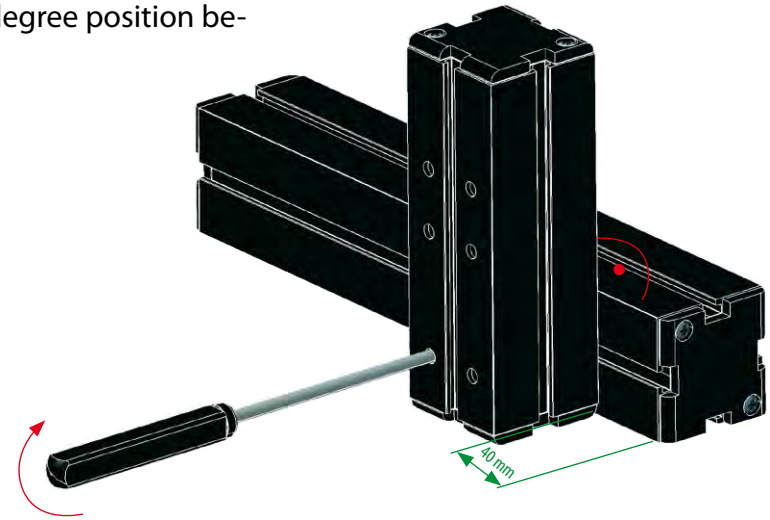
1. Fix the clamping plate (U47) by means of screws (U38) into the small machine bed (U7) NOTE: do not tighten the screws.



2. Slide the T-slot of the long machine bed (U1) over the clamping plate (U47).

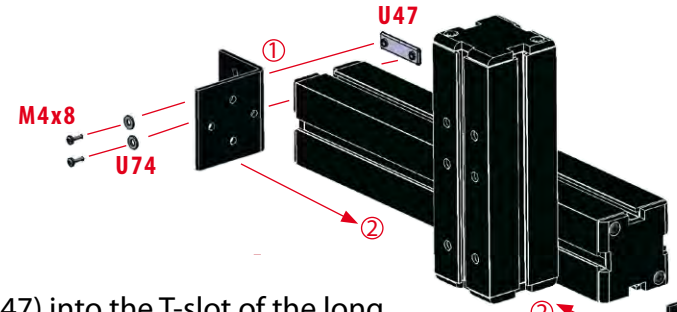


3. Tighten the screws properly and measure a 90 degree position between the two machine beds.

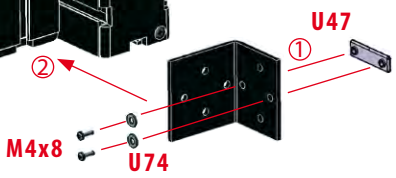


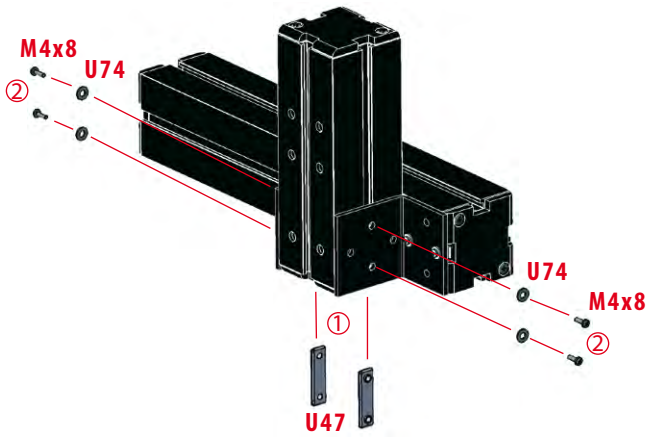
4. Right angle reinforcement by means of stabilizing angle

4.1. Connect stabilizing angle (U80) with clamping plate (U47), screw M4x8 (U37) and washer (U74). NOTE: do not tighten the screws. Slide the clamping plate (u47) with stabilizing angle (U80) into the T-slot of the small machine bed (U7ML) until the angle is fixed to the long machine bed (U1ML).



4.2. Slide the second clamping plate (U47) into the T-slot of the long machine bed (U1ML) and fix it with the screws M4x8 (U37) through the stabilizing angle (U80). Now tighten all screws properly.

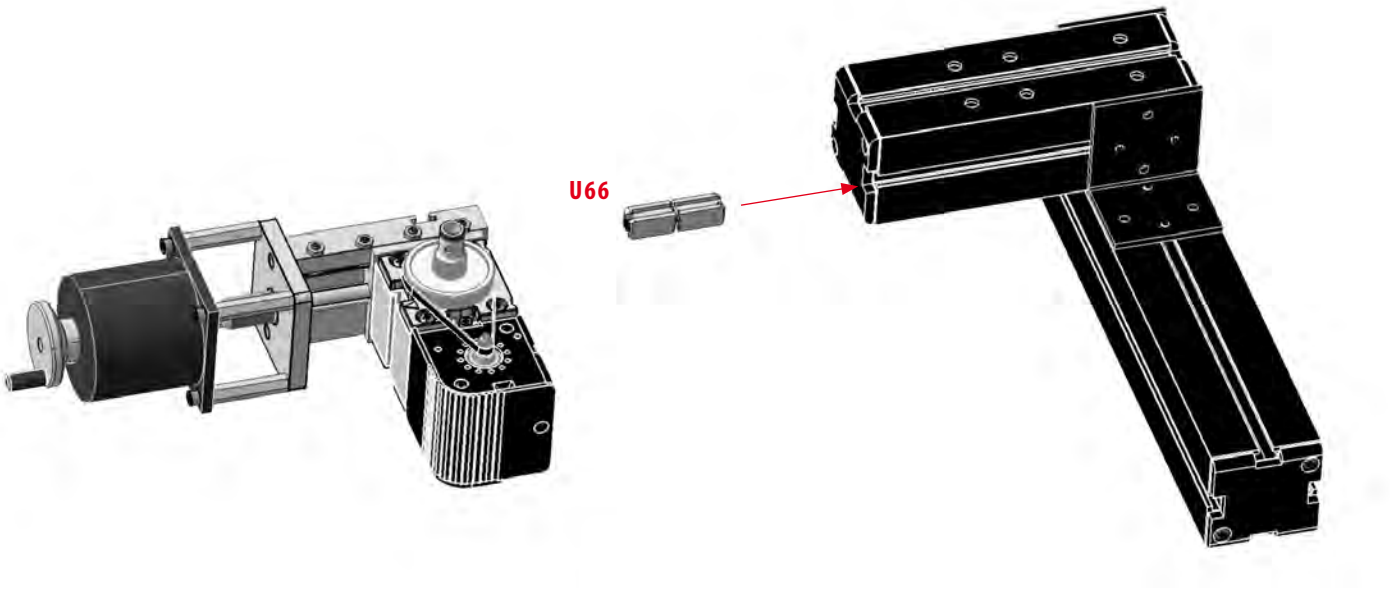




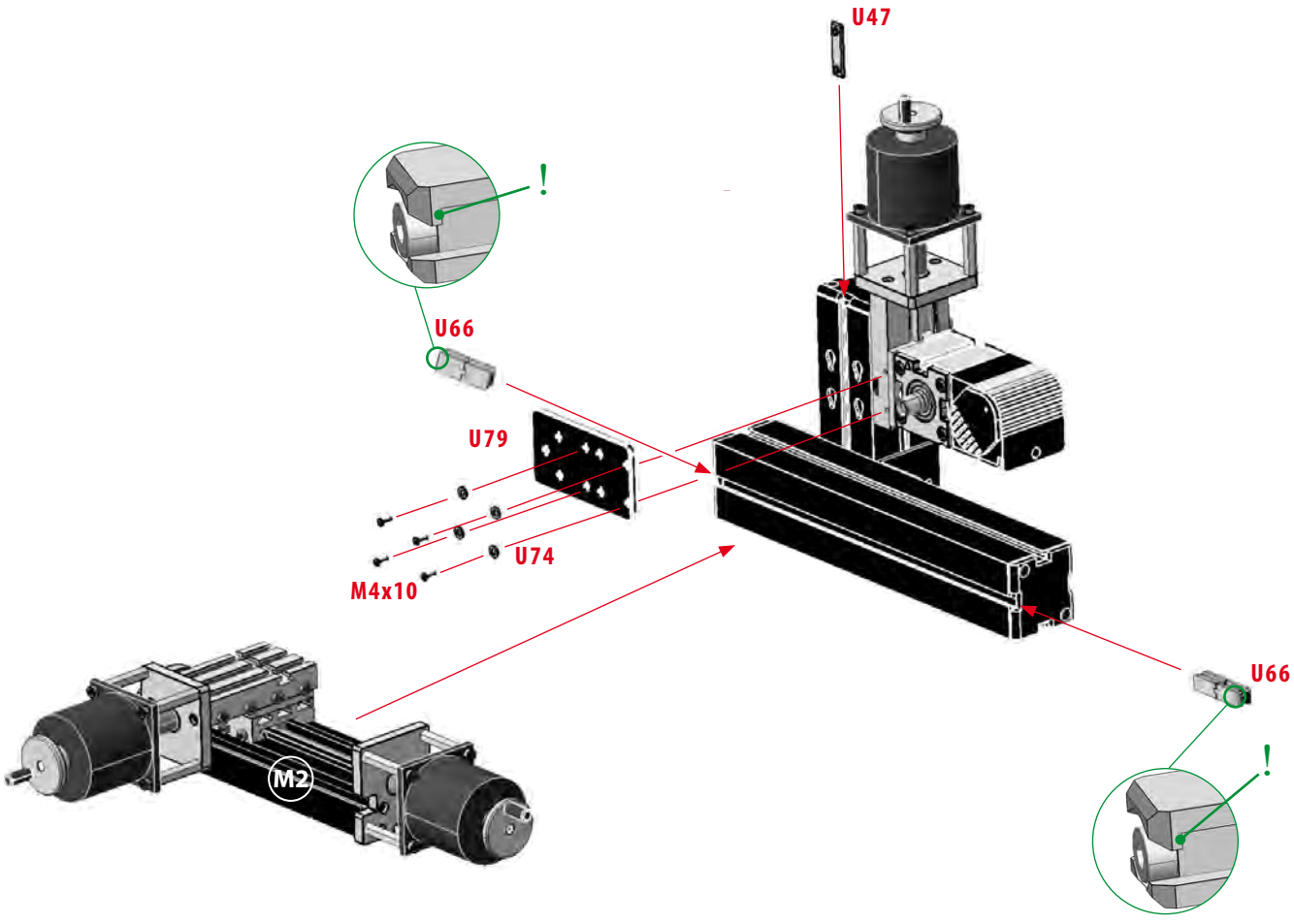
Part list and setup of 3 axes CNC horizontal mill 4.4.2

www.youtube.com/thecooltool09

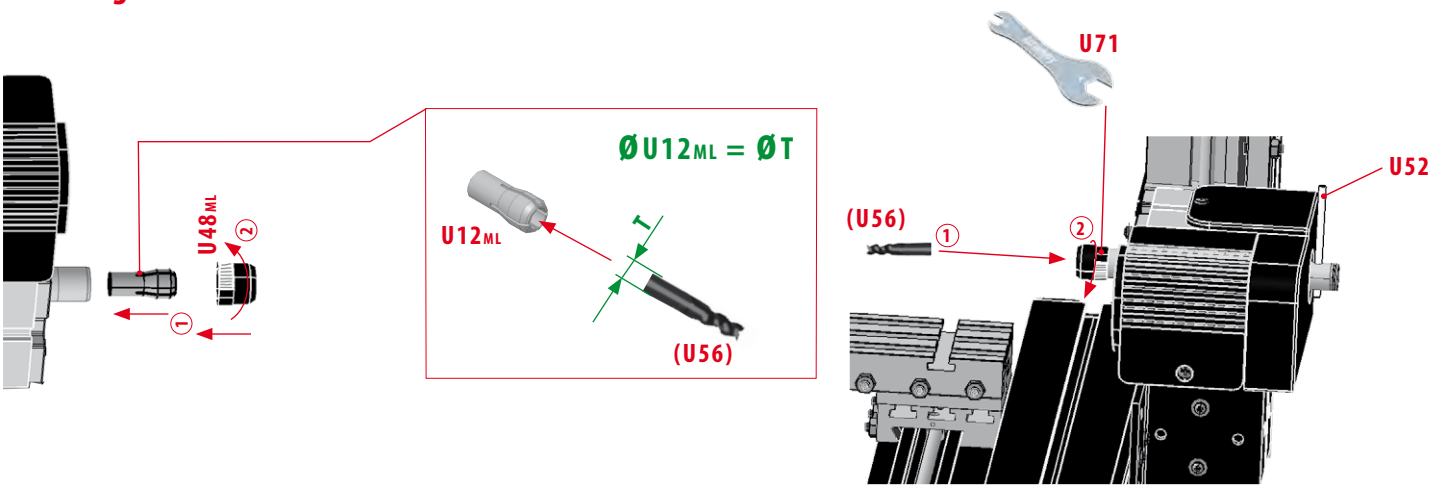
Mounting of small slide module



Mounting of big slide module M2

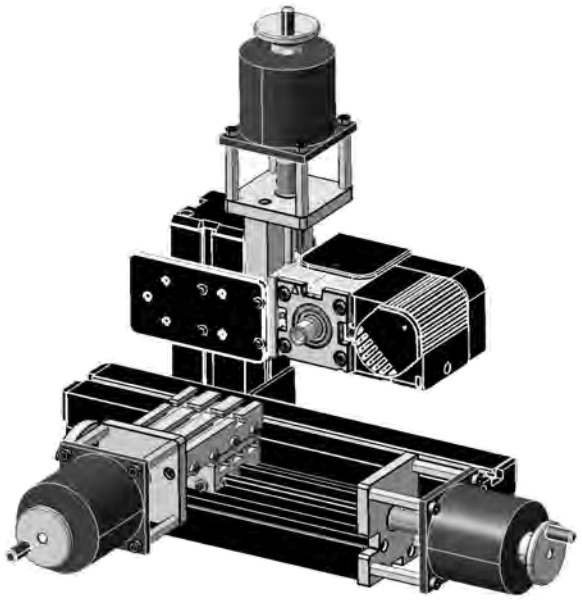


Mounting of the tool

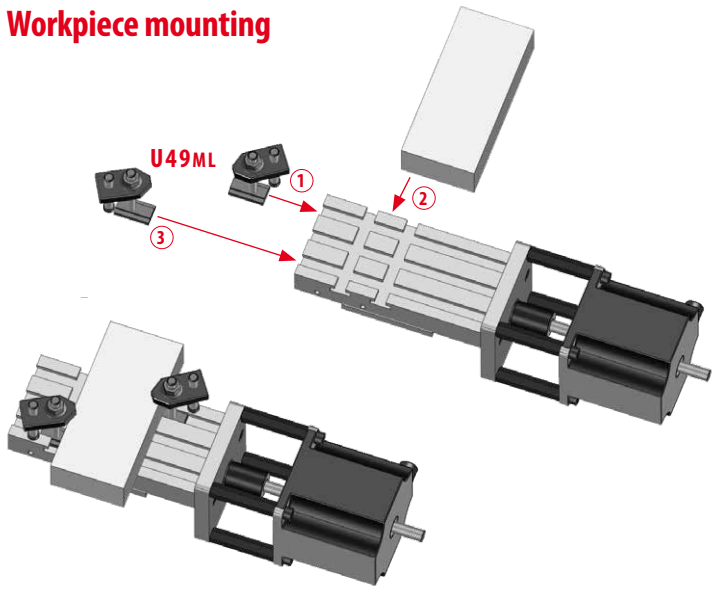


Mounting of drive belt cover (U0)

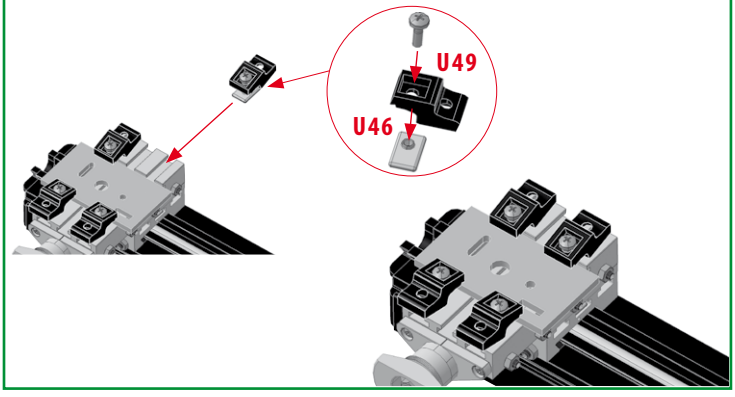
Fix the drive belt cover (U0). Take a look at "MOTOR-HEADSTOCK Unit M1" (page CNC_2-26)



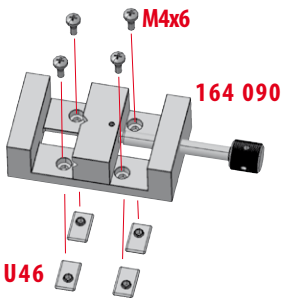
Workpiece mounting

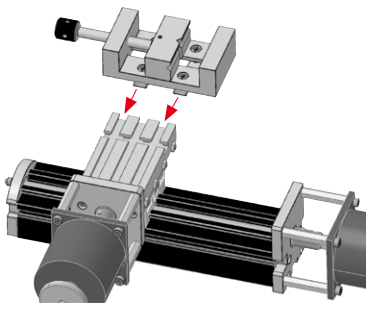


Same like the manual machines!



Assembly of optional milling vice (164 090)

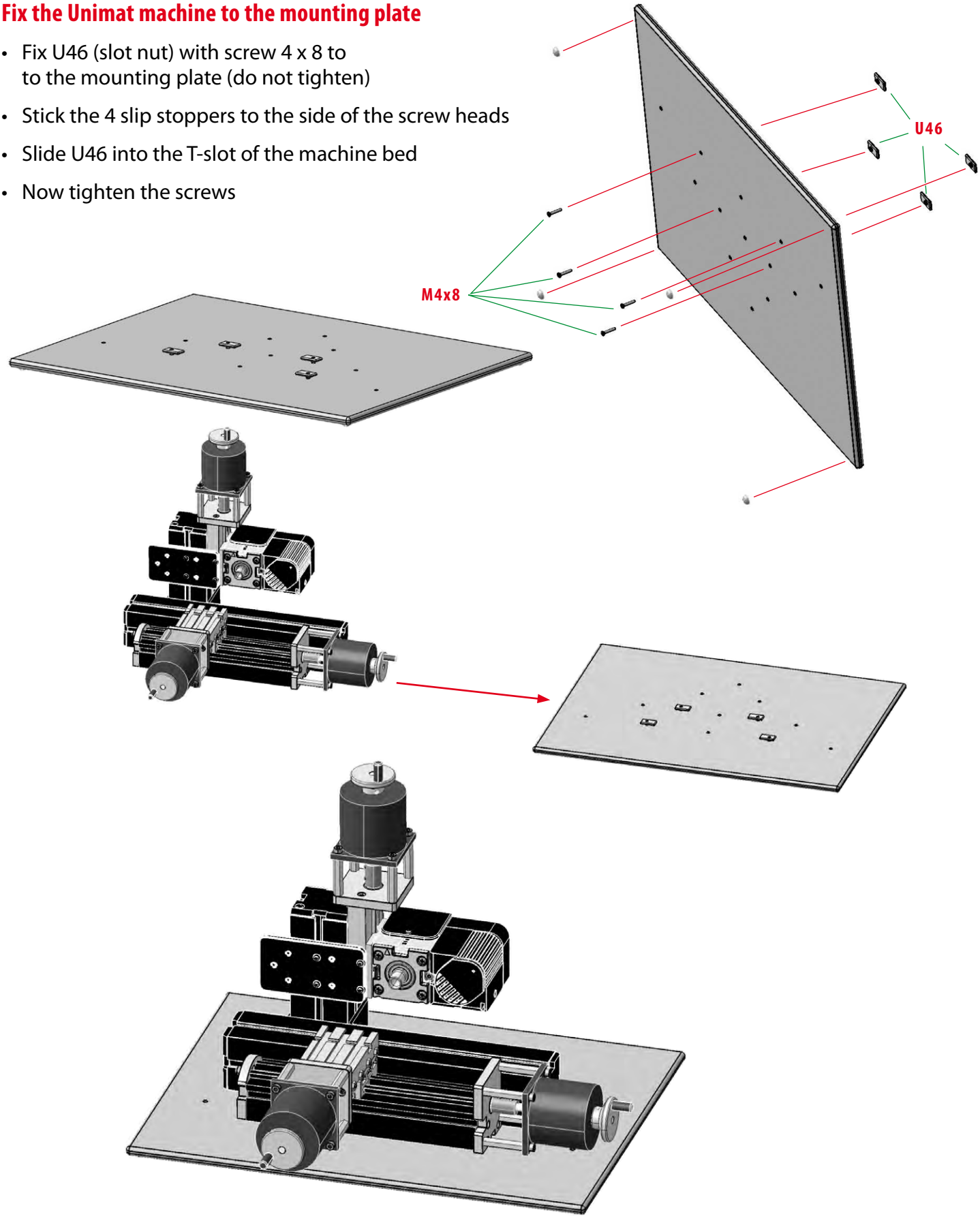




Part list and setup of 3 axes CNC horizontal mill

Fix the Unimat machine to the mounting plate

- Fix U46 (slot nut) with screw 4 x 8 to to the mounting plate (do not tighten)
- Stick the 4 slip stoppers to the side of the screw heads
- Slide U46 into the T-slot of the machine bed
- Now tighten the screws



Project for 3 axis horizontal Unimat CNC

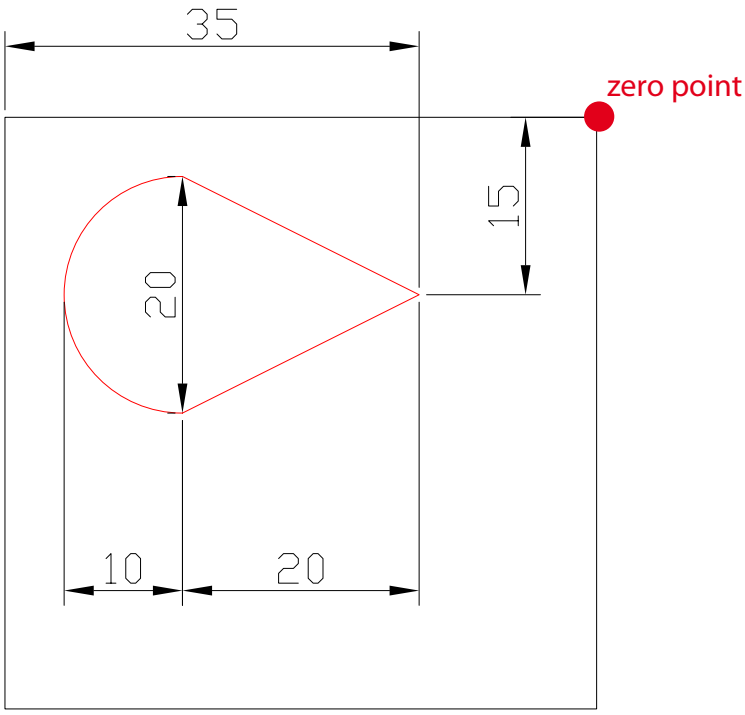
Uni-Fraes-H3

Includes

1) Raw material: Corian

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-Code)



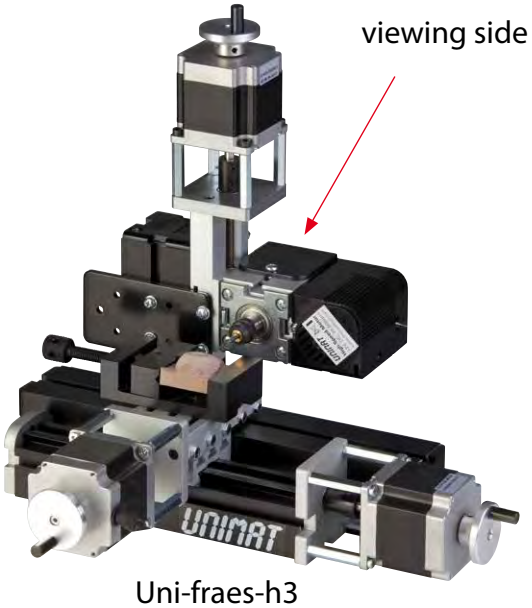
Project

Engraving with Unimat horizontal milling machine

(raw material: Corian 50x50 mm, zero point right upper corner, material surface)

Engraving depth: 1 mm

Tool: 1.6 mm bit, max. forward feed rate: 200 mm/min
max. feed: 1.0 mm



Uni-fraes-h3

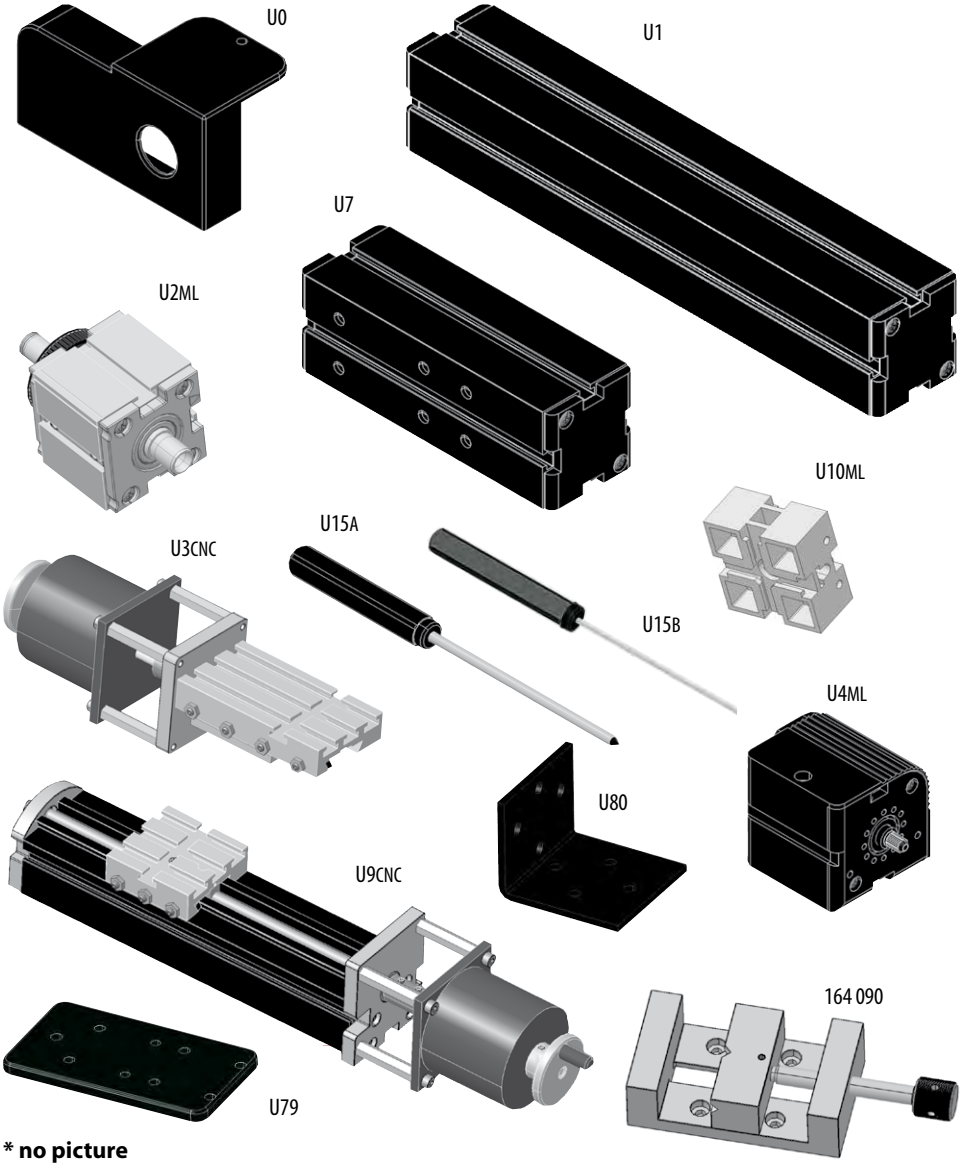
Approach:

g21
g0 z2
g0 x0 y0
g0 x-15 y-15
g0 z0.5
g1 z1 f50
g1 x-35 y-5 f180
g13 x-35 y-25 i0 j-10
g1 x-15 y-15
g0 z5
g0 x0 y0
m02

Part list and setup of 3 axes CNC vertical mill

www.youtube.com/thecooltool09

U0	1	Drivebeltcover	A1A 000 010
U1	1	machine bed, long	A1A 020 000 SW
U2ML	1	Countershaft	A1M 035 000
U3CNC	2	Cross slide CNC	164 060 CNC
U4ML	1	Motor	162 420 MH S
U7	1	Machine bed, short	A1A 010 00 SW
U9CNC	1	Longitudinal slide CNC	164 480 CNC
U10ML	1	Intermediate piece	A1M 000 100
U12ML	1	Collet 1/8“	164 460 1/8“
U15A	1	Screw driver #2	ZWZ 980 010
U15B	1	Screw driver allen key	ZWZ 980 075
U31	8	Screw M4x10	ZSR M40 410
U37	12	Screw M4x8	ZSR M40 408
U38	7	Screw M4x6	ZSR M40 406
U46	13	Slot nut	A1A 060 040
U47	7	Clamping plate	A1A 010 020
U48ML	1	Collet holder	A1A 000 072
U49	4	Clamping jaw	A1A 000 090
U49ML	2	Clamping jaw ML	A1Z 490 000
U50	1	Screw M4x70	ZSR M40 470
U51	1	Allen key 2mm	ZWZ 110 200
U52	1	Rod	ZST 110 345
U56CNC	1	Milling head 1.6 mm	F2470 1.60
U57	1	Drive belt (87)	ZRM 730 087
U65	1	Allen key 2,5mm	ZWZ 110 250
U66	5	Connection piece	A1A 000 ZIN SK
U69	4	Screw M4x12	ZSR M40 412
U71	1	7/14 mm straddle wrench	ZWZ 400 700
U74	18	Plain washer	ZSB 250 430
U79	3	Stabilizing plate small	A1Z 470 000
U80	2	Stabilizing angle	A1Z 480 000
	1	Locking nut M4	ZMU 340 120
	1	Wood mounting plate *	164 400
	4	Rubber buffer *	
	1	Unimat power supply *	161 312
optional			
	1	Steel vise	164 090



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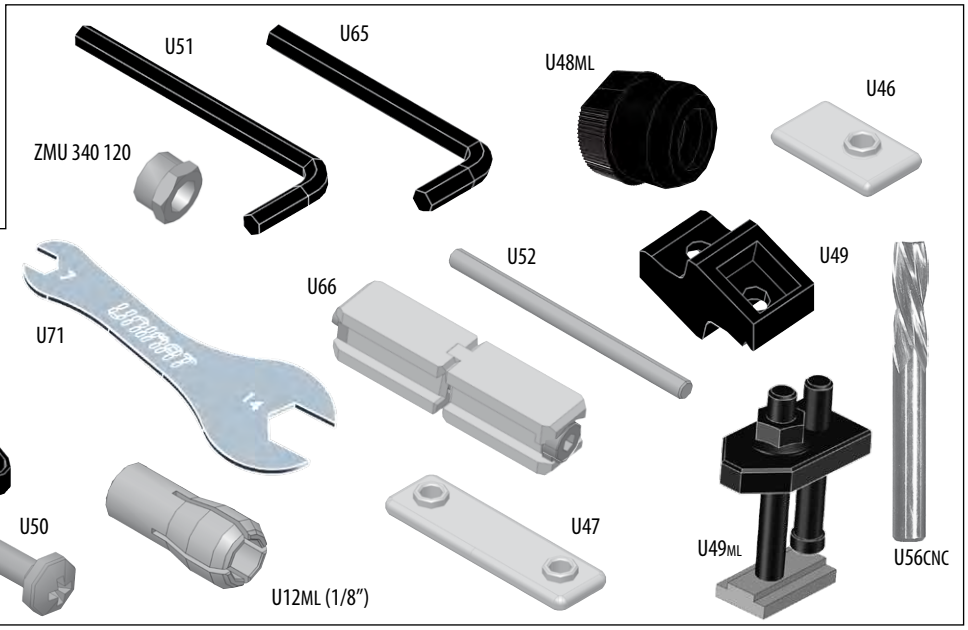


Part list and setup of 3 axes CNC vertical mill 4.4.4

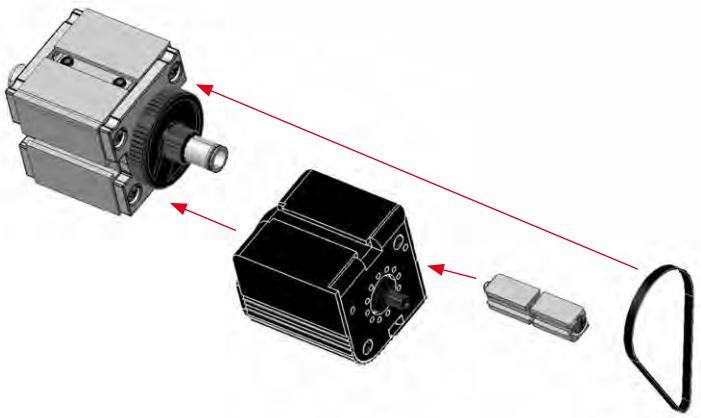
Assembly/General

When setting up the UNIMAT CNC please consider the following

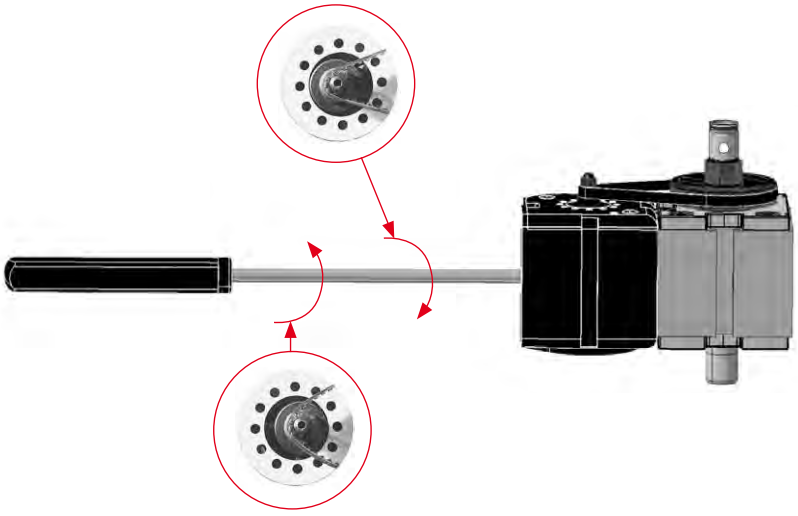
1. A screw connecting two metal parts e.g. machine beds, stabilizing plates etc. can be tightened firmly.
2. If the metal nut clamps two synthetic parts, (e.g. adjust the sledge movement, adjusting motor speed,…) then screw it down very gently.
3. By connecting plastic parts with a metal screw/nut, then screw down very gently e.g. Allen screw into the tailstock housing. The same if the metal screw will be screwed into a plastic part e.g. jig-saw housing.

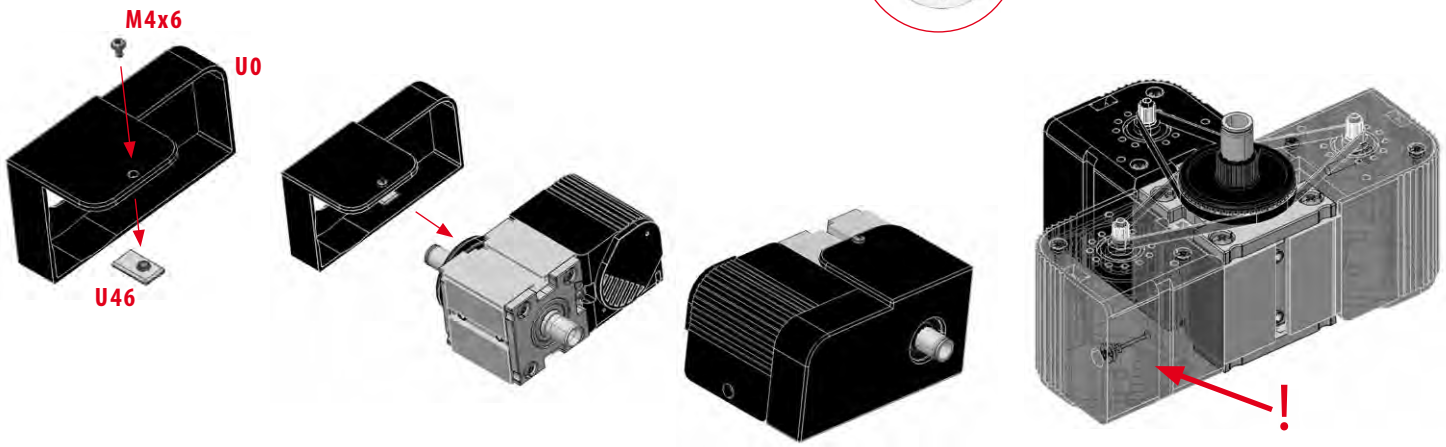
Assembly of the CNC Vertical milling machine

MOTOR-HEADSTOCK Unit M1



1. Slide connection piece (U66) into the T-slots (groove) between motor (U4ML) and headstock (U2ML).
2. Push headstock (U2ML) across and fix the screw of the connection piece (U66)
3. Adjusting the drive belt (U57): Tighten U57 with screwdriver. Loosen U57, then start motor. Tighten U57 until motor revolutions slightly reduce and the belt U57 is properly tightened.
4. Fixing the drive belt cover (U0). Make sure that the belt will not grind inside the cover. Note: fix U0 first when Unimat is completely assembled! **Note: fix U0 only after Unimat is completely assembled!**

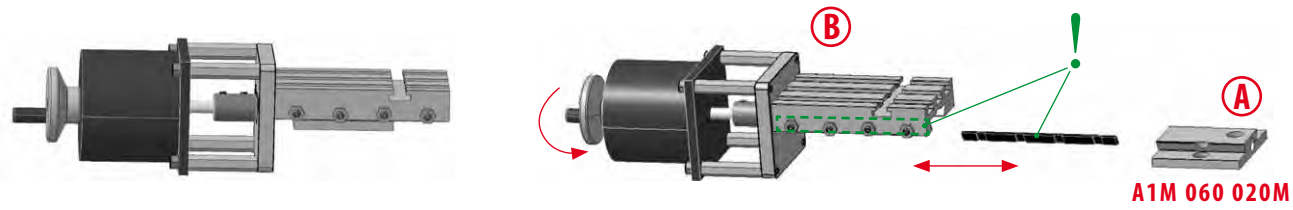




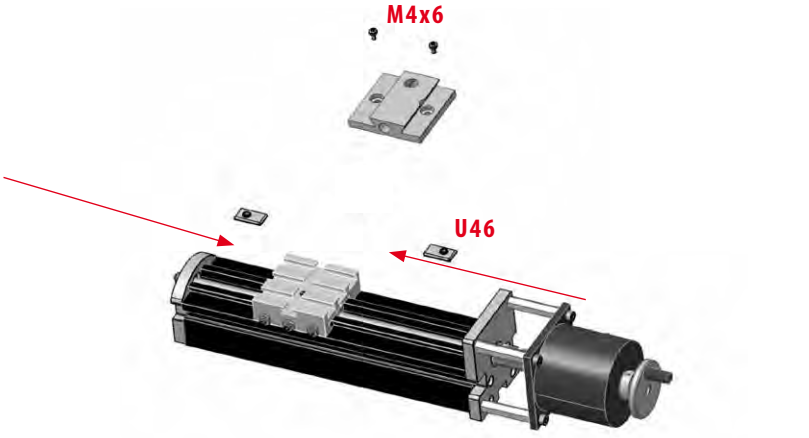
Part list and setup of 3 axes CNC vertical mill

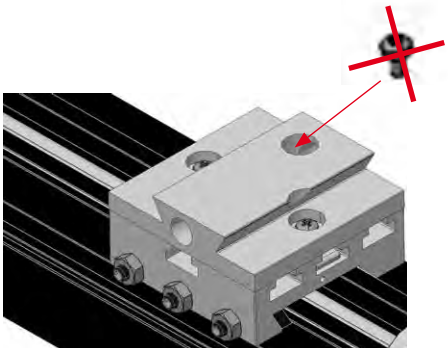
Large slide module M2D

1. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3CNC) by turning the hand wheel until it is released

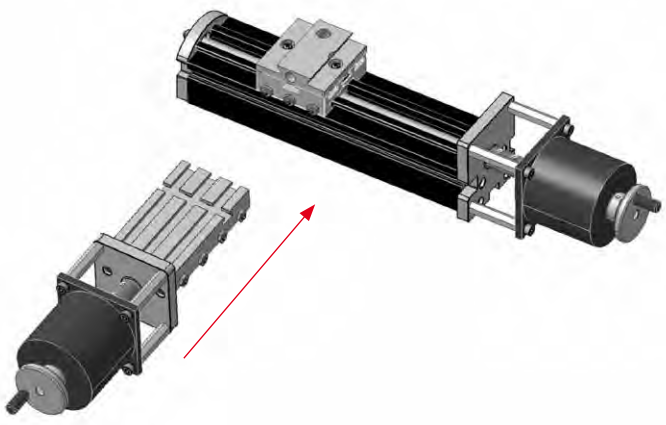


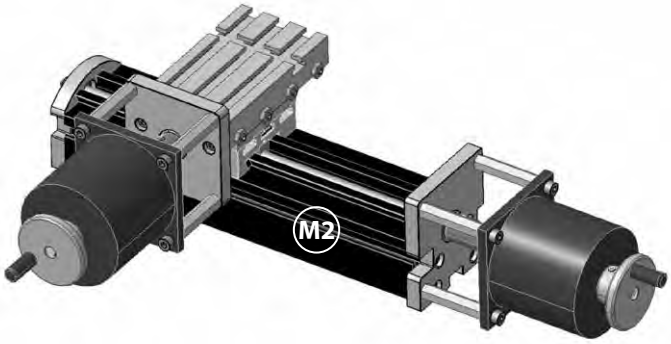
2. Fix the cross-slide guide (A1M 060 020M) to the sattle of the longitudinal slide (U9CNC) with 3 screws (U38) and 3 clamping plates (U46).





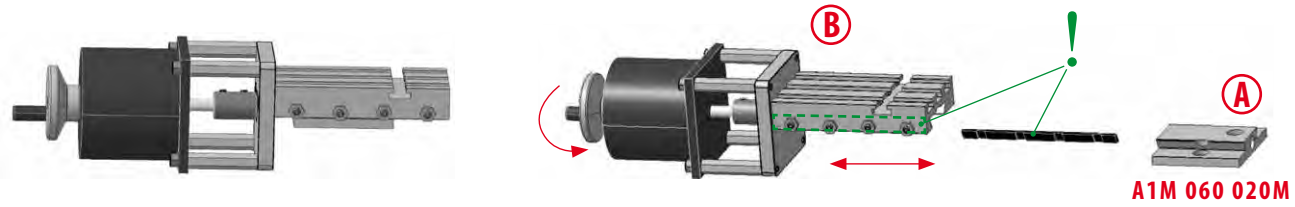
3. Slide modul (M2A) assembly: Slide cross-slide body (U3CNC) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.



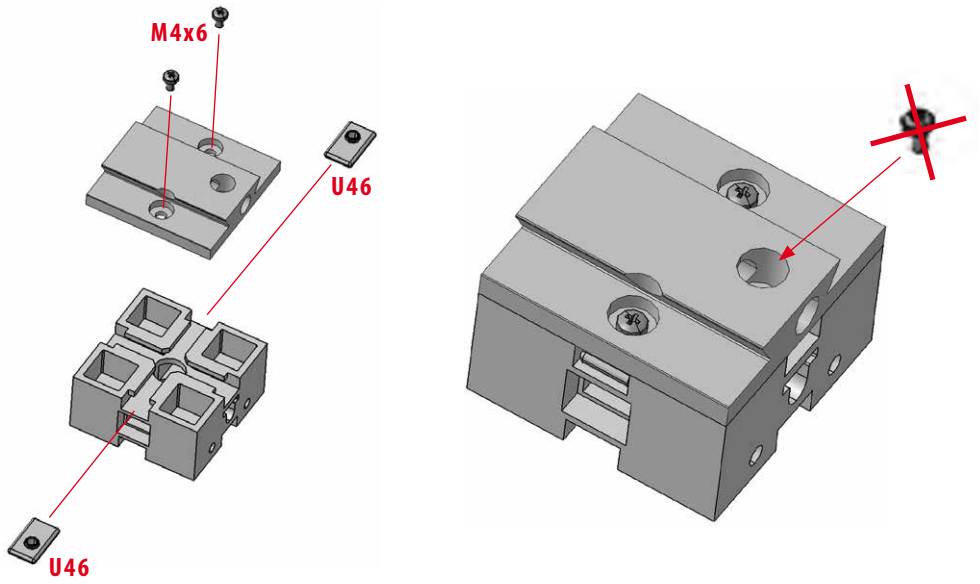


Small slide module M2C

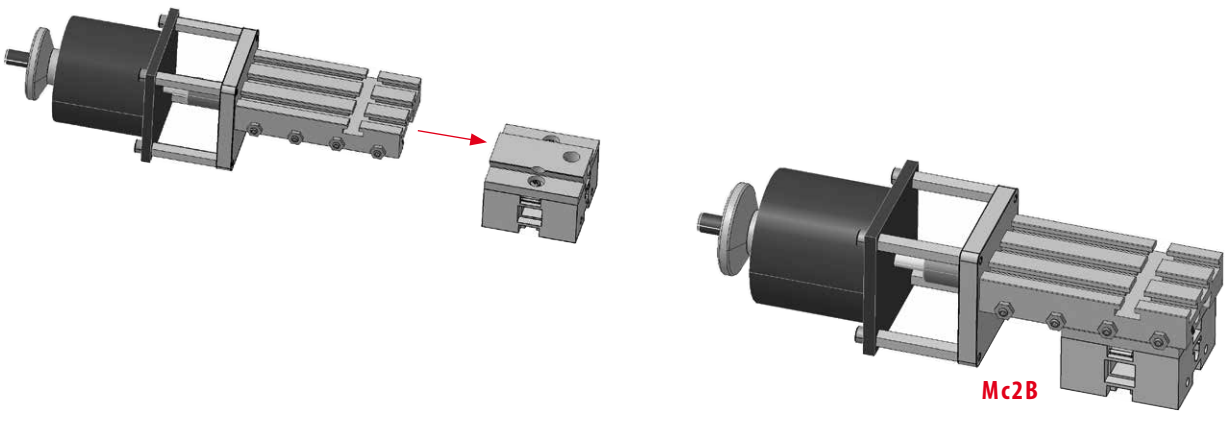
1. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3 CNC) by turning the hand wheel until it is released.



2. Fix the cross-slide guide (A1M 060 020M) to the intermediate piece (U10ML) with 3 screws (U38) and 3 T-slot nut (U46).

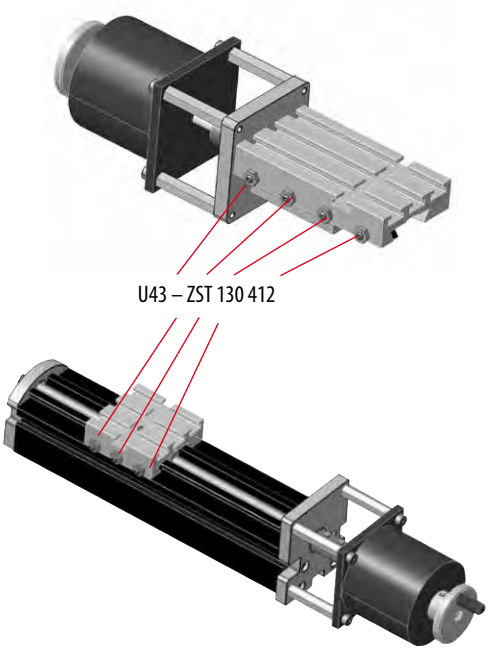


3. Slide cross-slide body (U3ML) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.



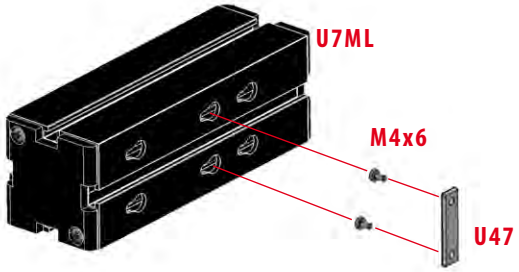
Adjusting the slides:

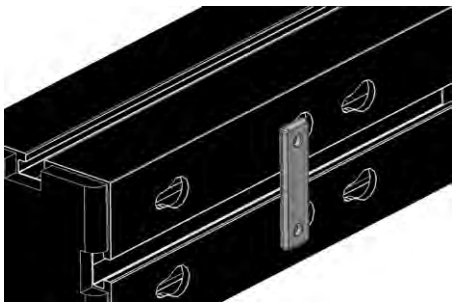
1. Check play: open nut (U43), adjust play with screws M4x12 (ZST 130 412) GIBS: (tapered synthetic adjustment shims) are fitted between the saddle and the profile of the longitudinal slide and the upper and lower part of the cross slide. Correct adjustment of the gibs will ensure smooth and steady operation of the slides. It is adjusted by loosening the nuts and using the screws of the saddle and upper cross-slide part, by pressing the gibs until „play“ is removed. After adjusting, retighten the locking nuts. Milling operations require a tighter adjustment of the gibs than lathe operations.
2. Maintain the slides at regular intervals: clean with a brush and lubricate the gliding surface.



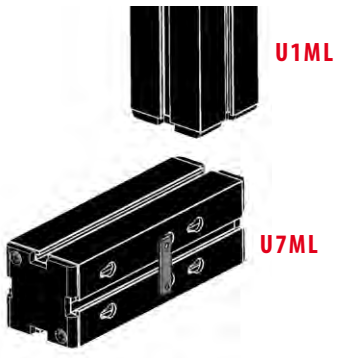
Vertical machine bed combination (M3B)

1. Fix the clamping plate (U47) by means of screws (U38) into the small machine bed (U7) NOTE: do not tighten the screws.

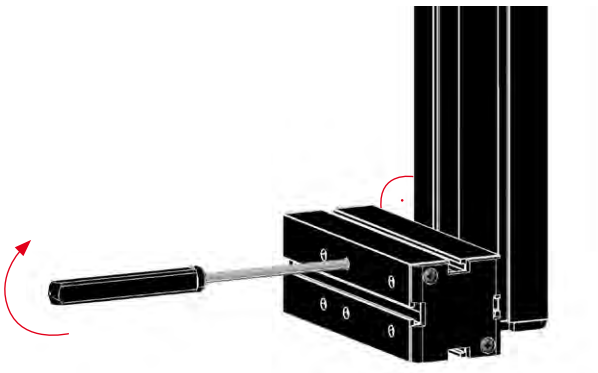




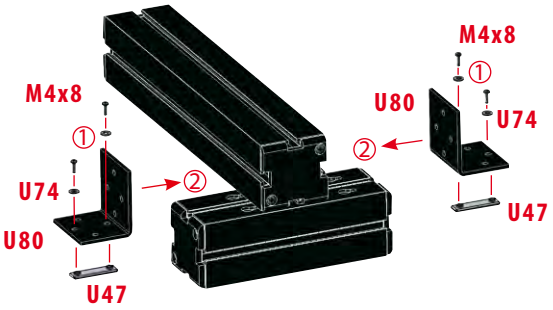
2. Slide the T-slot of the long machine bed (U1) over the clamping plate (U47).

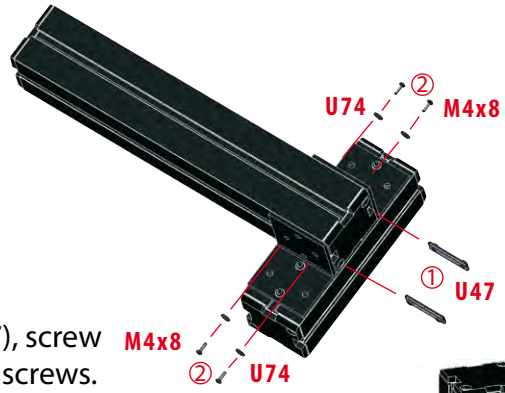


3. Tighten the screws properly and measure a 90 degree position between the two machine beds.



4. Right angle reinforcement by means of stabilizing angle



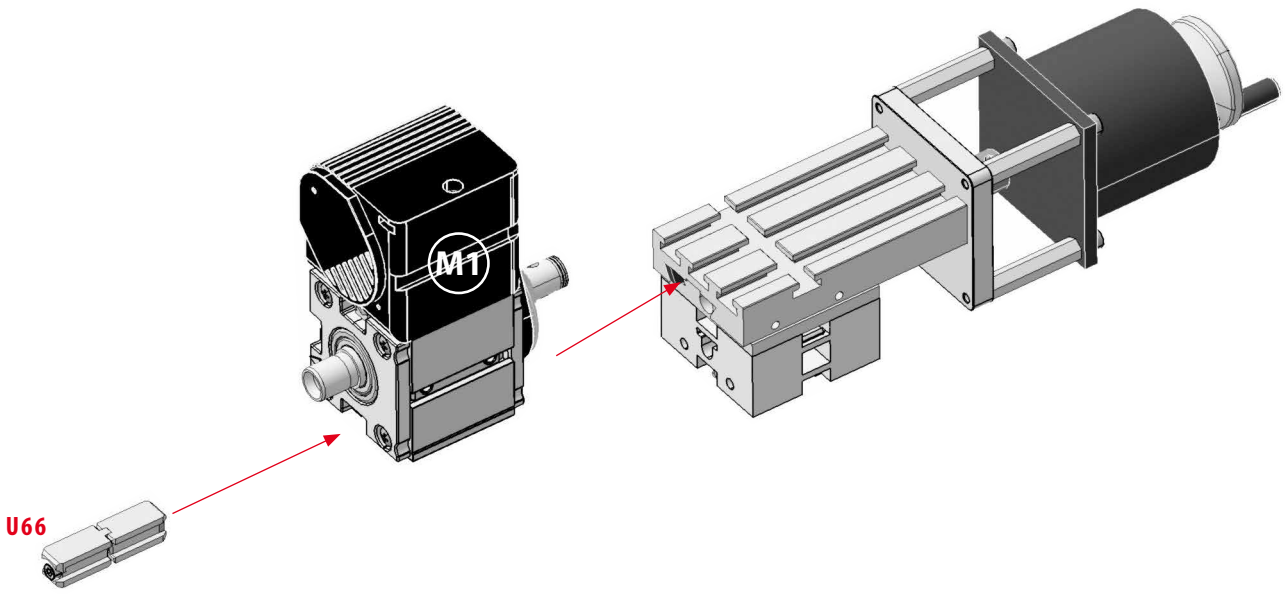


4.1. Connect stabilizing angle (U80) with clamping plate (U47), screw M4x8 (U37) and washer (U74). NOTE: do not tighten the screws. Slide the clamping plate (u47) with stabilizing angle (U80) into the T-slot of the small machine bed (U7ML) until the angle is fixed to the long machine bed (U1ML).

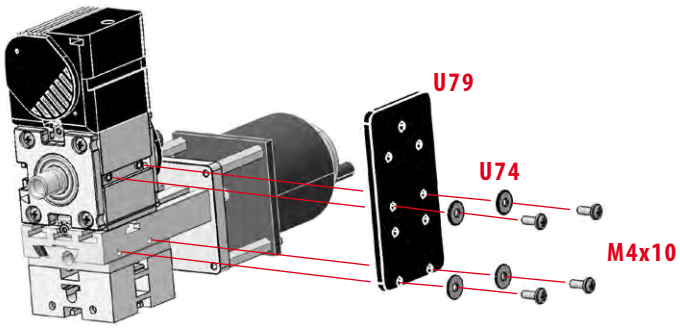
4.2. Slide the second clamping plate (U47) into the T-slot of the long machine bed (U1ML) and fix it with the screws M4x8 (U37) through the stabilizing angle (U80). Now tighten all screws properly.

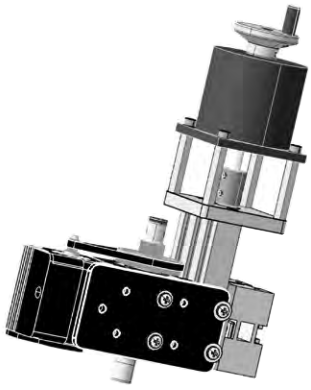
Z-axis motor-headstock unit (Mc4):

1. Fix cross-slide module with intermediate piece (for Z-axis) M2B to motor-headstock unit (U66) with connection piece (U66).



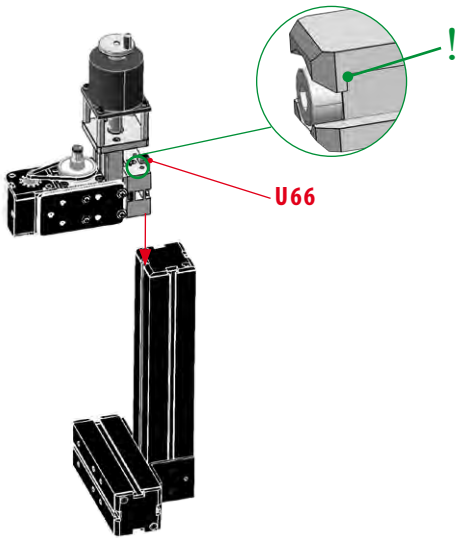
2. Fix motor-headstock unit (M1A) by means of stabilizing plate (U79). Use screws U31 and plain washer U74.



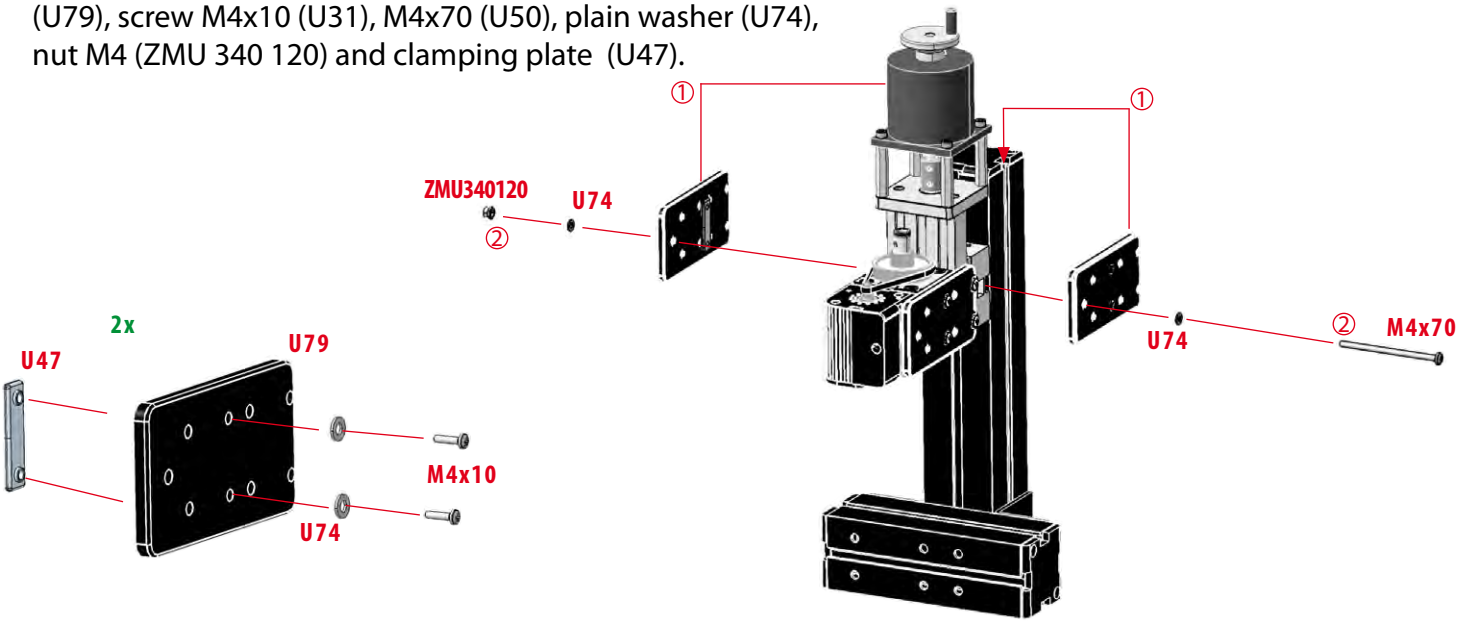


Fix the Z-axis motor-headstock unit (Mc4) on the vertical machine bed combination.

1. Slide the connection piece (U66) into the T-slot of the intermediate piece (U10ML). Then slide it into the T-slot of the long machine bed (U1ML). Find the right position (depending of the work piece size). Now tighten the screws properly.



2. Fix the z-axis motor headstock unit by means of stabilizing plate (U79), screw M4x10 (U31), M4x70 (U50), plain washer (U74), nut M4 (ZMU 340 120) and clamping plate (U47).

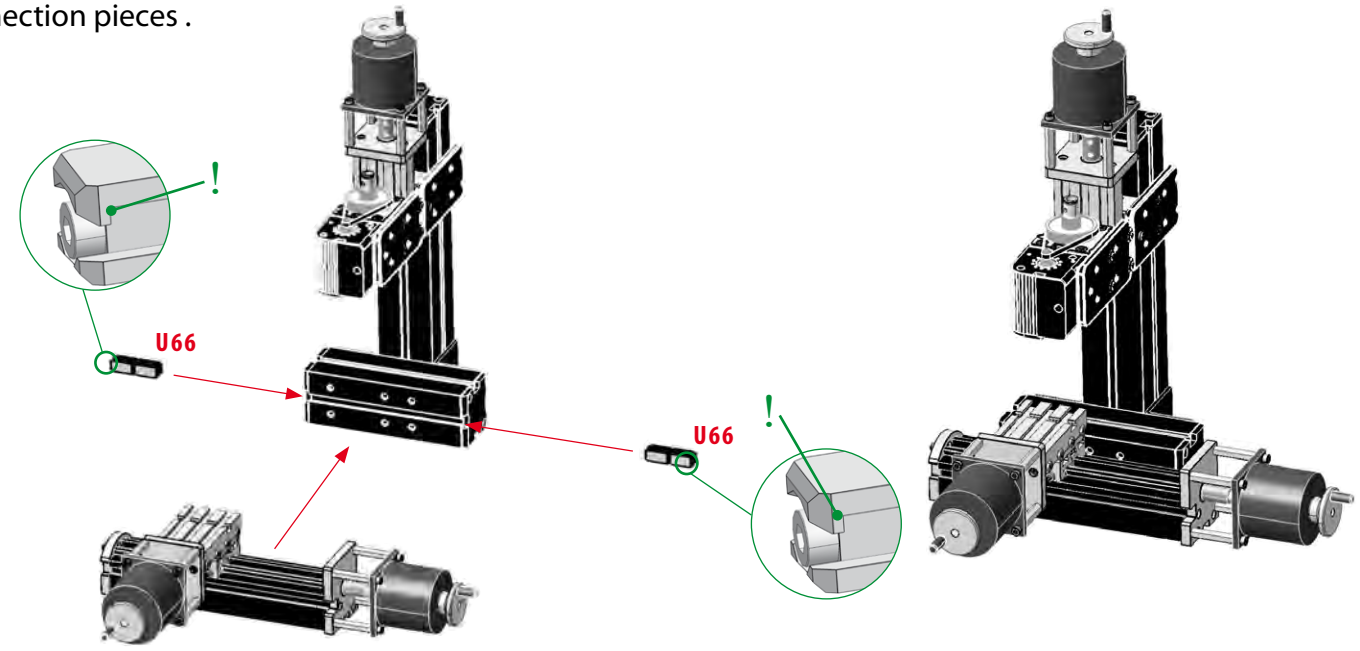


Part list and setup of 3 axes CNC vertical mill 4.4.4

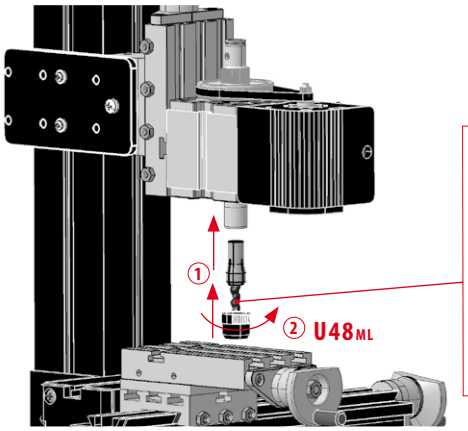
www.youtube.com/thecooltool09

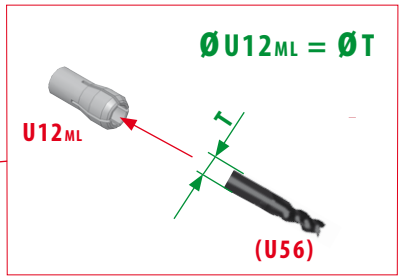
Mounting of big slide module M2D.

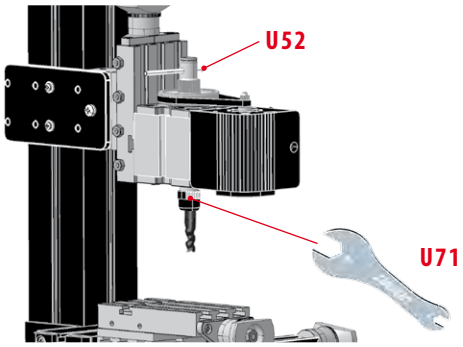
1. Fix big slide module (M2D) to the short machine bed (U7ML) by using connection pieces .



Mounting of the tool

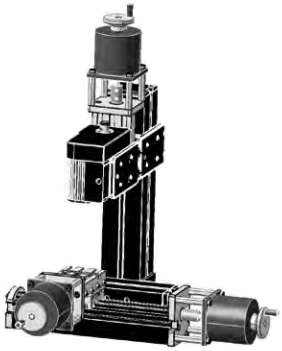




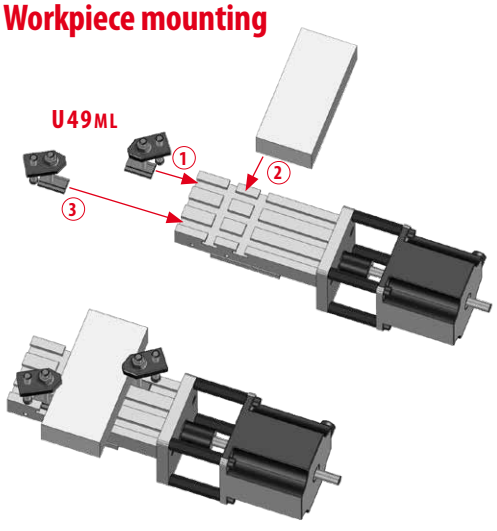


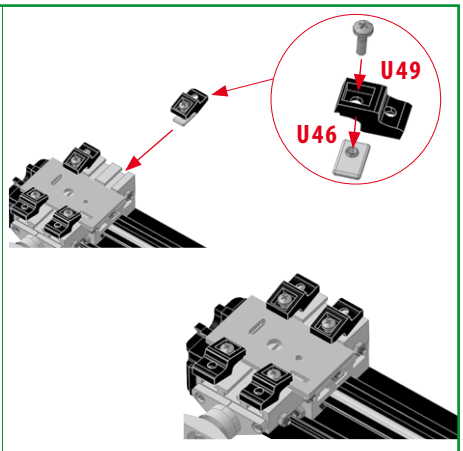
Mounting of drive belt cover (U0)

Fix the drive belt cover (U0). Take a look at "MOTORHEADSTOCK Unit M1")



Workpiece mounting



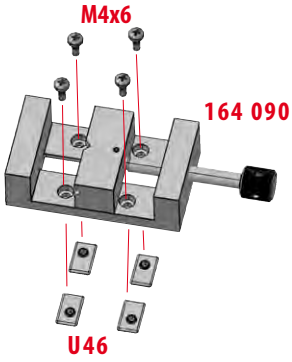


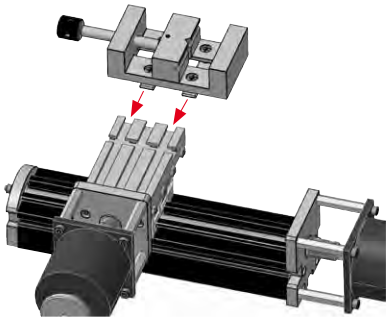
Same like the manual machines!

Part list and setup of 3 axes CNC vertical mill

www.youtube.com/thecooltool09

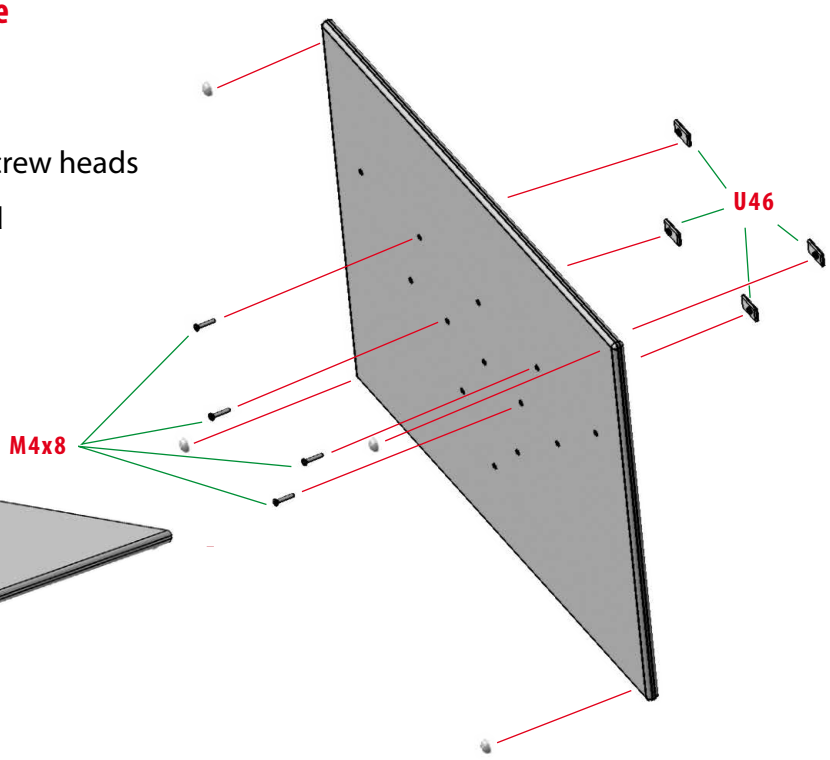
Assembly of the optional milling vice (164 090)

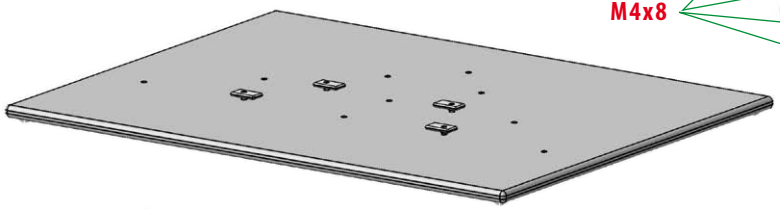


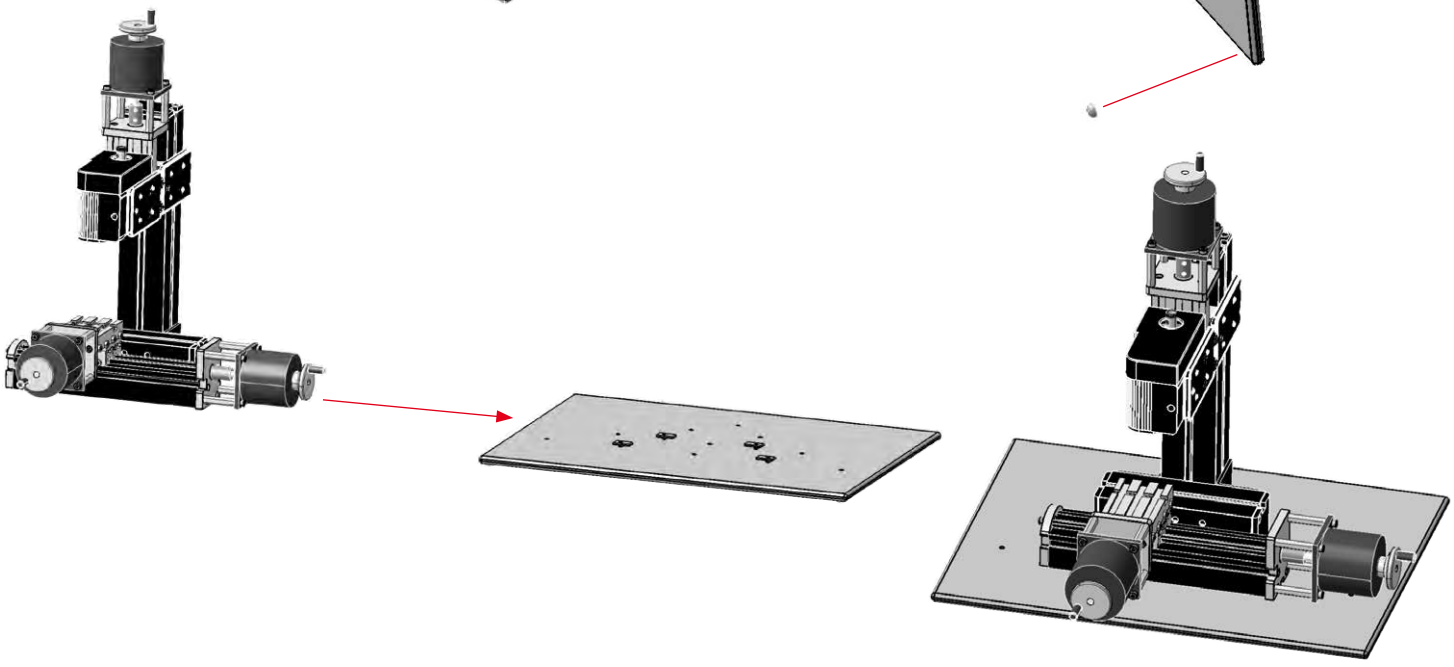


Fix the Unimat machine to the mounting plate

- Fix U46 (slot nut) with screw 4 x 8 to to the mounting plate (do not tighten)
- Stick the 4 slip stoppers to the side of the screw heads
- Slide U46 into the T-slot of the machine bed
- Now tighten the screws







Project for 3 axis Unimat CNC

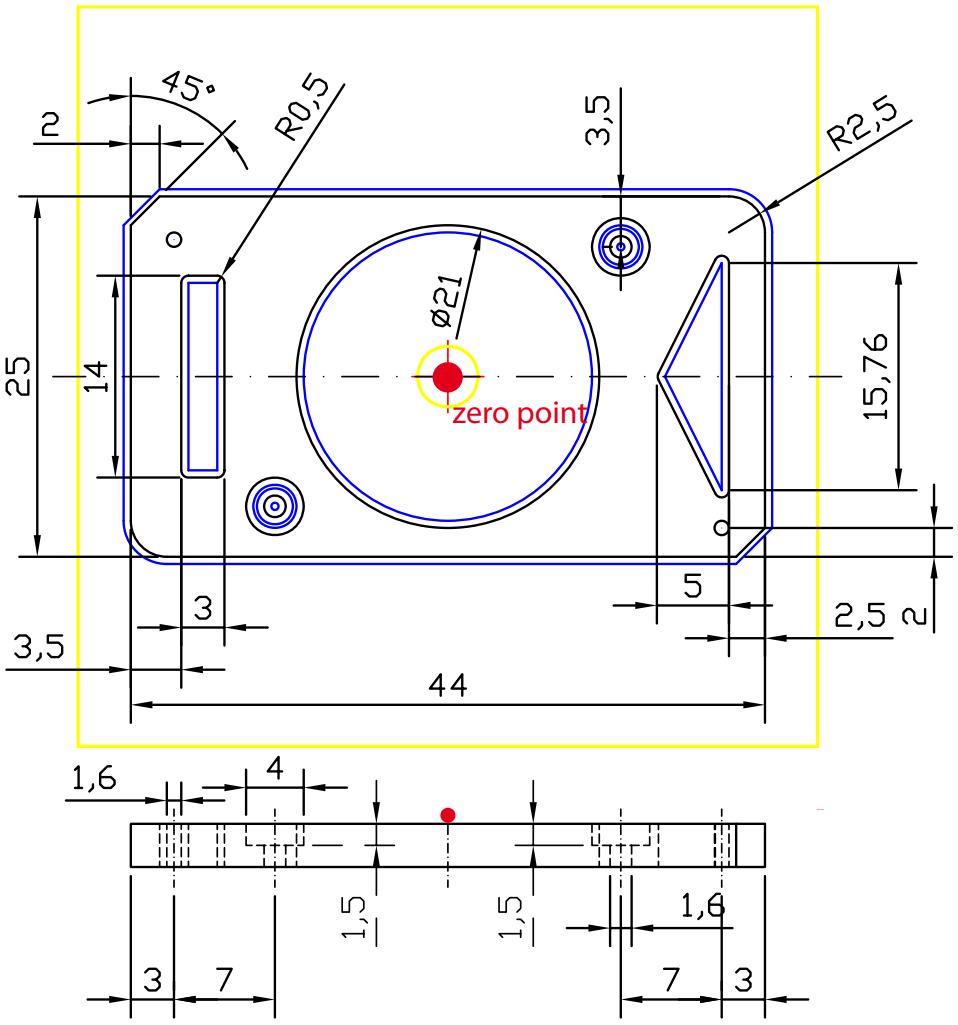
Uni-Fraes-V3

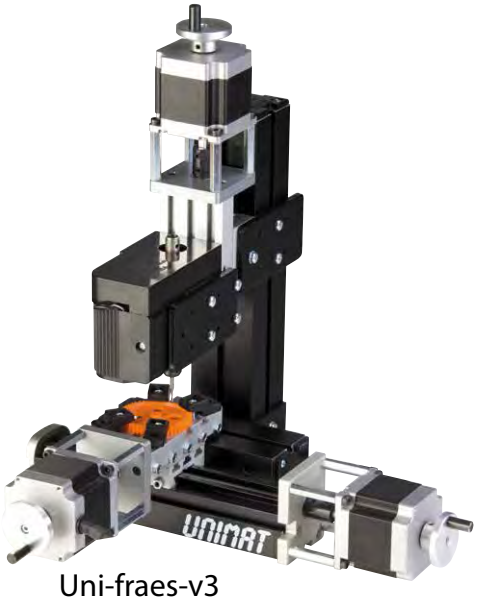
Includes

1) Raw material: Acrylic

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)





Uni-fraes-v3

Yellow: raw material

Black: work piece

Blue: tool path

Project

Contour milling with pockets 1

Acrylic plate 50x50x3 mm, fixation center hole, the zero point is at the center of the fixation hole and on the material surface. Mount the work piece in the middle of the y axis travel. Place an even and thin plate of wood or plastic in between the workpiece and the slide to protect the slide from being scratched or damaged.

Tool: 1.6 mm end mill, max. forward feed rate: 100 mm/min max. feed: 1.5 mm

Approach:

g21
g0 z10
g0 x-19 y10.5 (left up hole)
g0 z1
g1 z-1 f50
g0 z1
g0 z-1
g1 z-2 f50
g0 z1
g0 z-2
g1 z-3.6 f40
g0 z10
g0 x-17.7 y6.2 (left box)
g0 z1
g1 z-1.2 f50
g1 y-6.2 f100
g1 x-16.3
g1 y6.2
g1 x-17.7
g1 z-2.4 f50
g1 y-6.2 f100
g1 x-16.3
g1 y6.2
g1 x-17.7
g1 z-3.6 f50
g1 y-6.2 f100
g1 x-16.3
g1 y6.2
g1 x-17.7
g0 z10
g0 x-12 y-9 (left down pocket)
g0 z1
g1 z-1.5 f50
g1 x-10.8 f80
g2 x-10.8 y-9 i-1.2 j0
g1 x-11.25
g2 x-11.25 y-9 i-0.75 j0
g1 x-12 y-9
g1 z-2.5 f50 (left down hole at the pocket)
g0 z2
g0 z-2
g1 z-3.6 f50
g0 z10
g0 x19 y-10.5 (rigth down hole)
g0 z1
g1 z-1 f50
g0 z1
g0 z-1
g1 z-2 f50
g0 z1
g0 z-2
g1 z-3.6 f40
g0 z10
g0 x15.3 y0 (left triangle)
g0 z1
g1 z-1.2 f50
g1 x18.7 y-7.08 f100
g1 y7.08
g1 x15.3 y0
g1 z-2.4 f50
g1 x18.7 y-7.08 f100
g1 y7.08
g1 x15.3 y0
g1 z-3.6 f50
g1 x18.7 y-7.08 f100
g1 y7.08
g1 x15.3 y0
g0 z10
g0 x12 y9 (right up pocket)
g0 z1
g1 z-1.5 f50
g1 x13.2 f80
g2 x13.2 y9 i-1.2 j0
g1 x12.85
g2 x12.85 y9 i-0.75 j0
g1 x12 y9
g1 z-2.5 f50 (right up hole at the pocket)
g0 z2
g0 z-2
g1 z-3.6 f50
g0 z10
g0 x19.5 y13.3 (outside contour)
g0 z1
g1 z-1.2 f50
g1 x-20.33 f100
g1 x-22.8 y10.83
g1 y-10
g3 x-19.5 y-13.3 r3.3
g1 x20.33
g1 x22.8 y-10.83
g1 y10
g3 x19.5 y13.3 r3.3
g1 z-2.4 f50
g1 x-20.33 f100
g1 x-22.8 y10.83
g1 y-10
g3 x-19.5 y-13.3 r3.3
g1 x20.33
g1 x22.8 y-10.83
g1 y10
g3 x19.5 y13.3 r3.3
g1 z-3.6 f50
g1 x-20.33 f100
g1 x-22.8 y10.83
g1 y-10
g3 x-19.5 y-13.3 r3.3
g1 x20.33
g1 x22.8 y-10.83
g1 y10
g3 x19.5 y13.3 r3.3
g0 z10
g0 x9.7 y0 (inside contour)
g0 z1
g1 z-1.2 f50
g2 x9.7 y0 i-9.7 j0 f100
g1 z-2.4 f50
g3 x9.7 y0 i-9.7 j0 f100
g1 z-3.6 f50
g2 x9.7 y0 i-9.7 j0 f10
m02

Project for 3 axis Unimat CNC

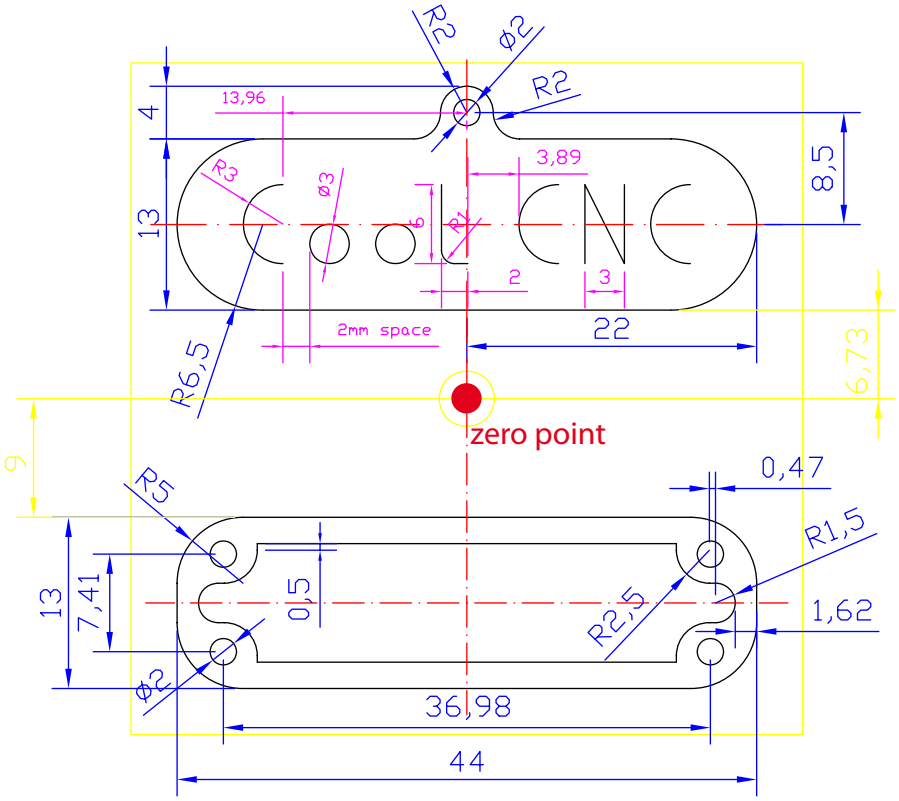
Uni-Fraes-V3

Includes

1) Raw material: Acrylic

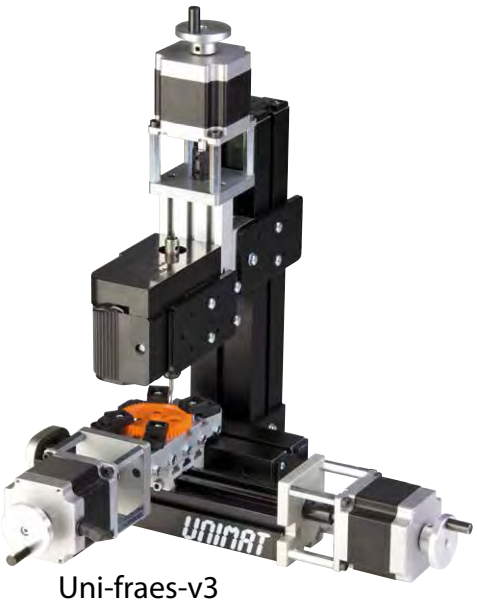
2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)



Yellow: raw material

Black: work piece



Uni-fraes-v3

Project

Contour milling with Cutter Compensation and Incremental Positioning Mode

Acrylic plate 50x50x3 mm, fixation center hole, the zero point is at the center of the fixation hole and on the material surface. Mount the work piece in the middle of the y axis travel. Place an even and thin plate of wood or plastic in between the workpiece and the slide to protect the slide from being scratched or damaged.

Tool: **maximal 1.0 mm** end mill, max. forward feed rate: 100 mm/min max. feed: 1.2 mm

For this sample you have to setup your tool database . We use a 1 mm tool (no. 45).

You will get the same result if you use a 0.8 mm end mill (only the „engraving“ is finer). For this you have to define the 0.8 mm tool in your database, which is no.40 (t40). Use a “Feed Override” of 70 %.

Tool database:

Tool	*POC*	*Z*	*DIAM*	*COMMENT*
1	*1*	*0.511*	*0.125*	*1/8 end mill*
2	*2*	*0.1*	*0.0625*	*1/16 end mill*
3	*3*	*1.273*	*0.201*	*#7 tap drill*
30	*30*	*4*	*0.5*	*end mill 0.5 mm*
35	*35*	*5*	*0.6*	*end mill 0.6 mm*
40	*40*	*6*	*0.8*	*end mill 0.8 mm*
45	*45*	*8*	*1.0*	*end mill 1.0 mm*
50	*50*	*9*	*1.2*	*end mill 1.2 mm*
55	*55*	*10*	*1.6*	*end mill 1.6 mm*
60	*60*	*10*	*2.0*	*end mill 2.0 mm*
65	*65*	*10*	*3.0*	*end mill 3.0 mm*

Approach:

g21
g0 z30
g0 x0 y0
m06 t45
(start with the Cool-CNC part)
g0 y21.73 z2
m03
(assembly hole)
g42 (cutter compensation right)
g0 y22.73
g0 z0.3
g1 z-1.2 f30
g2 x0 y20.73 i0 j-1 f100
g2 x0 y22.73 i0 j1
g1 z-2.2 f30
g2 x0 y20.73 i0 j-1 f100
g2 x0 y22.73 i0 j1
g1 z-3.6 f30
g2 x0 y20.73 i0 j-1 f100
g2 x0 y22.73 i0 j1
g0 z2
g40 (cancel cutter compensation)
(script)
g0 x-13.96 y16.23
g0 z0.5
g1 z-1.2 f30
g91 (set incremental positioning mode)
g3 x0 y-6 i0 j-3 f80
g1 z-1.2 f30
g2 x0 y6 i0 j3 f80
g1 z-1.2 f30
g3 x0 y-6 i0 j-3 f80
g0 z5.6
g0 x2 y1.5
g0 z-1.7
g1 z-1.5 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0
g1 z-1.2 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0
g1 z-1.2 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0
g0 z5.6
g0 x5
g0 z-1.7
g1 z-1.5 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0
g1 z-1.2 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0

g1 z-1.2 f30
g2 x3 y0 i1.5 j0 f80
g2 x-3 y0 i-1.5 j0
g0 z5.6
g0 x5 y4.5
g0 z-1.7
g1 z-1.5
g1 y-5 f80
g3 x1 y-1 r1
g1 x1
g1 z-1.2 f30
g1 x-1 f80
g2 x-1 y1 r1
g1 y5
g1 z-1.2 f30
g1 y-5 f80
g3 x1 y-1 r1
g1 x1
g0 z5.6
g0 x6.89 y6
g0 z-1.7
g1 z-1.5 f30
g3 x0 y-6 i0 j-3 f80
g1 z-1.2 f30
g2 x0 y6 i0 j3 f80
g1 z-1.2 f30
g3 x0 y-6 i0 j-3 f80
g0 z5.6
g0 x2
g0 z-1.7
g1 z-1.5 f30
g1 y6 f80
g1 x3 y-6
g1 y6
g1 z-1.2 f30
g1 y-6 f80
g1 x-3 y6
g1 y-6
g1 z-1.2 f30
g1 y6
g1 x3 y-6
g1 y6
g0 z5.6
g0 x5
g0 z-1.7
g1 z-1.5 f30
g3 x0 y-6 i0 j-3 f80
g1 z-1.2 f30
g2 x0 y6 i0 j3 f80
g1 z-1.2 f30
g3 x0 y-6 i0 j-3 f80
g90 (set absolute positioning mode)
g0 z2
(cut out)
g0 x24 y11.23
g42 (cutter compensation right)

g0 x22 y13.25
g0 z0.3
g91 (set incremental positioning mode)
g1 z-1.5 f30
g3 x-6.5 y6.5 i-6.5 j0 f80
g1 x-11.5
g2 x-2 y2 i0 j2
g3 x-2 y2 i-2 j0
g3 x-2 y-2 i0 j-2
g2 x-2 y-2 i-2 j0
g1 x-11.5
g3 x-6.5 y-6.5 i0 j-6.5
g3 x6.5 y-6.5 i6.5 j0
g1 x31
g3 x6.5 y6.5 i0 j6.5
g1 z-1.2 f30
g3 x-6.5 y6.5 r6.5 f80
g1 x-11.5
g2 x-2 y2 r2
g3 x-2 y2 r2
g3 x-2 y-2 r2
g2 x-2 y-2 r2
g1 x-11.5
g3 x-6.5 y-6.5 r6.5
g3 x6.5 y-6.5 r6.5
g1 x31
g3 x6.5 y6.5 r6.5
g1 z-1.2 f30
g3 x-6.5 y6.5 i-6.5 j0 f80
g1 x-11.5
g2 x-2 y2 i0 j2
g3 x-2 y2 i-2 j0
g3 x-2 y-2 i0 j-2
g2 x-2 y-2 i-2 j0
g1 x-11.5
g3 x-6.5 y-6.5 i0 j-6.5
g3 x6.5 y-6.5 i6.5 j0
g1 x31
g3 x6.5 y6.5 i0 j6.5
g90 (absolute positioning mode)
g0 z10
g40 (cancel cutter compensation)
(seal model)
g0 x-18.49 y-11.445
(holes)
g41 (cutter compensation left)
g91 (set incremental positioning mode)
g0 x-1 z-9.7
g1 z-1.5 f30
g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g1 z-1.2 f30

g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g1 z-1.2 f30
g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g0 z5.6
g40 (cancel cutter compensation)
g0 x1 y-7.41
g42 (cutter compensation right)
g0 x-1 z-1.7
g1 z-1.5 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g1 z-1.2 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g1 z-1.2 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g0 z5.6
g40 (cancel cutter compensation)
g0 x37.98
g41 (cutter compensation left)
g91 (set incremental positioning mode)
g0 x-1 z-1.7
g1 z-1.5 f30
g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g1 z-1.2 f30
g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g1 z-1.2 f30
g3 x2 y0 i1 j0 f80
g3 x-2 y0 i-1 j0
g0 z5.6
g40 (cancel cutter compensation)
g0 x1 y7.41
g42 (cutter compensation right)
g0 x-1 z-1.7
g1 z-1.5 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g1 z-1.2 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g1 z-1.2 f30
g2 x2 y0 i1 j0 f80
g2 x-2 y0 i-1 j0
g0 z5.6
g40 (cancel cutter compensation)

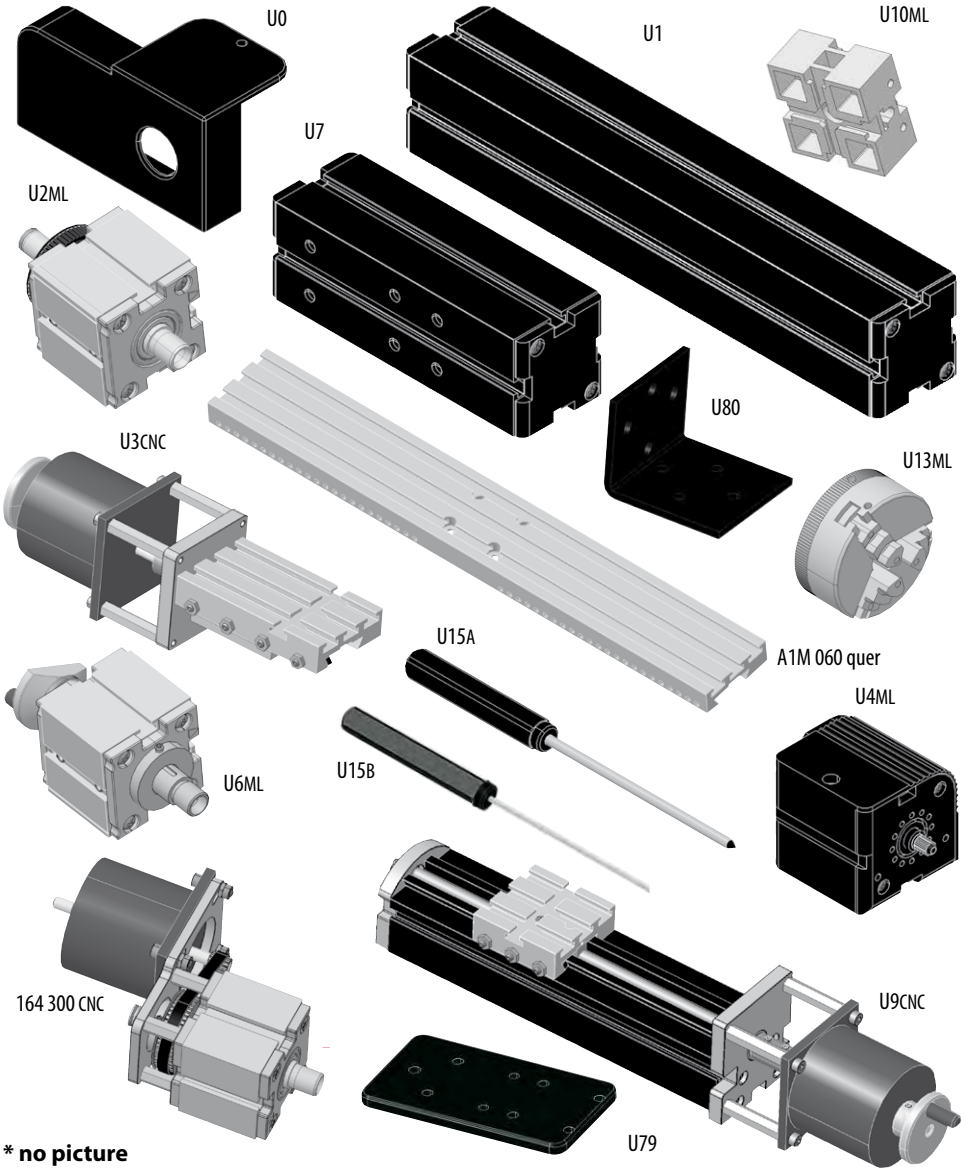
g90 (absolute positioning mode)
(inside countour)
g0 x18.49 y-15.5
g41 (cutter compensation left)
g0 x20.38 z0.3
g1 z-1.2 f30
g91 (set incremental positioning mode)
g3 x-1.5 y1.5 r1.5 f80
g1 x-0.47
g2 x-2.5 y2.5 r2.5
g1 y0.5
g1 x-32
g1 y-0.5
g2 x-2.5 y-2.5 r2.5
g1 x-0.47
g3 x-1.5 y-1.5 r1.5
g3 x1.5 y-1.5 r1.5
g1 x0.47
g2 x2.5 y-2.5 r2.5
g1 y-0.5
g1 x32
g1 y0.5
g2 x2.5 y2.5 r2.5
g1 x0.47
g3 x1.5 y1.5 r1.5
g1 z-1.2 f30
g3 x-1.5 y1.5 r1.5 f80
g1 x-0.47
g2 x-2.5 y2.5 r2.5
g1 y0.5
g1 x-32
g1 y-0.5
g2 x-2.5 y-2.5 r2.5
g1 x-0.47
g3 x-1.5 y-1.5 r1.5
g3 x1.5 y-1.5 r1.5
g1 x0.47
g2 x2.5 y-2.5 r2.5
g1 y-0.5
g1 x32
g1 y0.5
g2 x2.5 y2.5 r2.5
g1 x0.47
g3 x1.5 y1.5 r1.5
g1 z-1.2 f30
g3 x-1.5 y1.5 r1.5 f80
g1 x-0.47
g2 x-2.5 y2.5 r2.5
g1 y0.5
g1 x-32
g1 y-0.5
g2 x-2.5 y-2.5 r2.5
g1 x-0.47
g3 x-1.5 y-1.5 r1.5

g3 x1.5 y-1.5 r1.5
g1 x0.47
g2 x2.5 y-2.5 r2.5
g1 y-0.5
g1 x32
g1 y0.5
g2 x2.5 y2.5 r2.5
g1 x0.47
g3 x1.5 y1.5 r1.5
g0 z5.6
g40 (cancel cutter compensation)
g90 (absolute positioning mode)
(outside contour)
g0 x24 y-17.5
g42 (cutter compensation right)
g0 x22 y-15.5 z0.3
g1 z-1.2 f30
g91
g1 y1.5 f80
g3 x-5 y5 r5
g1 x-34
g3 x-5 y-5 r5
g1 y-3
g3 x5 y-5 r5
g1 x34
g3 x5 y5 r5
g1 y1.5
g1 z-1.2 f30
g1 y1.5 f80
g3 x-5 y5 r5
g1 x-34
g3 x-5 y-5 r5
g1 y-3
g3 x5 y-5 r5
g1 x34
g3 x5 y5 r5
g1 y1.5
g1 z-1.2 f30
g1 y1.5 f80
g3 x-5 y5 r5
g1 x-34
g3 x-5 y-5 r5
g1 y-3
g3 x5 y-5 r5
g1 x34
g3 x5 y5 r5
g1 y1.5
g0 z26
g40
g90
m05
g0 x-50 y25
m02

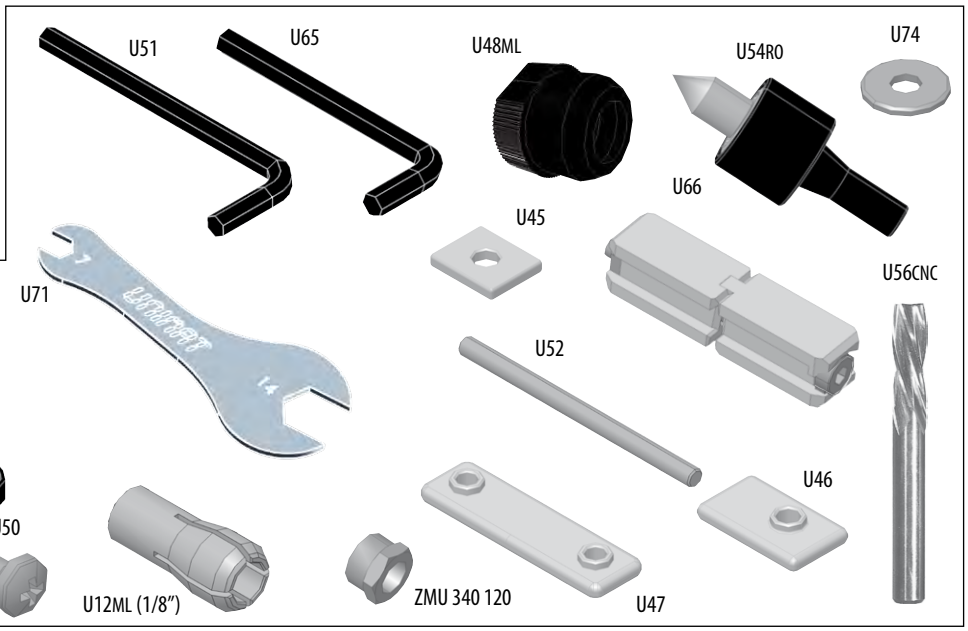
Part list and setup of 4 axes CNC vertical mill

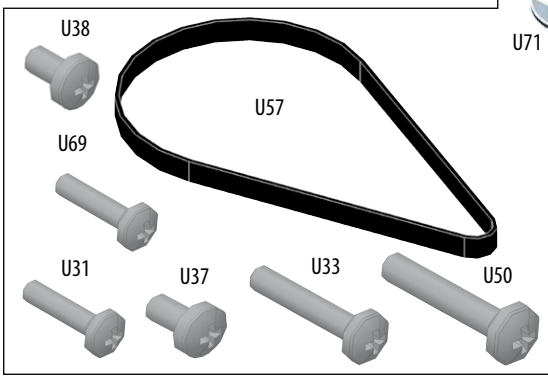
www.youtube.com/thecooltool09

U0	1	Drivebeltcover	A1A 000 010
U1	1	Machine bed, long	A1A 020 000 SW
U2ML	1	Countershaft	A1M 035 000
U3CNC	2	Cross slide CNC	164 060 CNC
U4ML	1	Motor	162 420 MH S
U6ML	1	Tailstock	164 040
U7	1	Machine bed, short	A1A 010 00 SW
U9CNC	1	Longitudinal slide CNC	164 480 CNC
U10ML	3	Intermediate piece	A1M 000 100
U12ML	1	Collet 1/8“	164 460 1/8“
U13ML	1	3 or 4 jaw chuck	164 430 / 162 050
U15A	1	Screw driver #2	ZWZ 980 010
U15B	1	Screw driver allen key	ZWZ 980 075
U31	16	Screw M4x10	ZSR M40 410
U33	1	Screw M4x50	ZSR M40 450
U37	12	Screw M4x8	ZSR M40 408
U38	7	Screw M4x6	ZSR M40 406
U45	1	Intermediate plate	A1A 000 160
U46	10	Slot nut	A1A 060 040
U47	9	Clammping plate	A1A 010 020
U48ML	1	Collet holder	A1A 000 072
U50	1	Screw M4x70	ZSR M40 470
U51	1	Allen key 2mm	ZWZ 110 200
U52	2	Rod	ZST 110 345
U54Ro	1	Live center	164 450
U56CNC	1	Milling head 1.6 mm	F2470 1.60
U57	1	Drive belt (87)	ZRM 730 087
U65	1	Allen key 2,5mm	ZWZ 110 250
U66	9	Connection piece	A1A 000 ZIN
U69	4	Screw M4x12	ZSR M40 412
U71	1	7/14 mm straddle wrench	ZWZ 400 700
U74	26	Plain washer	ZSB 250 430
U79	5	Stabilizing plate small	A1Z 470 000
U80	2	Stabilizing angle	A1Z 480 000
	1	Rotary table CNC	164 300 CNC
	1	Locking nut M4	ZMU 340 120
	1	Cross plate - cross slide	A1M 060 quer
	1	Wood mounting plate *	A1M 060 quer
	4	Rubber buffer *	
	1	Unimat power supply *	161 312



* no picture





Part list and setup of 4 axes CNC vertical mill 4.4.6

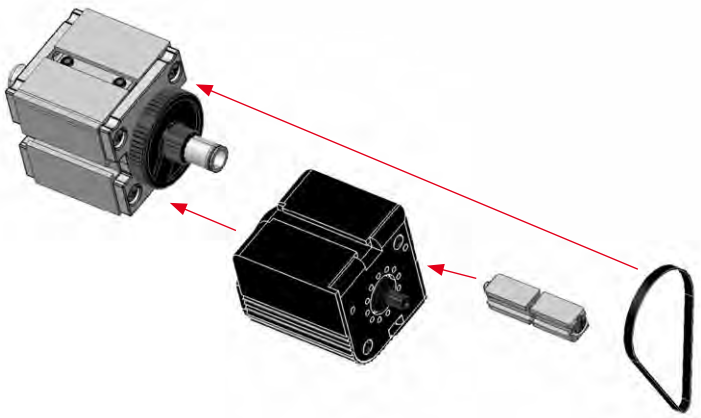
Assembly/General

When setting up the UNIMAT CNC please consider the following

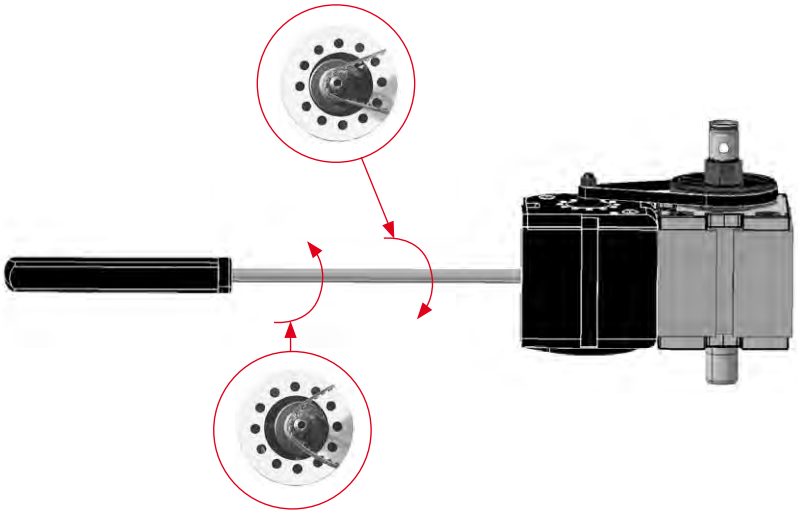
1. A screw connecting two metal parts e.g. machine beds, stabilizing plates etc. can be tightened firmly.
2. If the metal nut clamps two synthetic parts, (e.g. adjust the sledge movement, adjusting motor speed,…) then screw it down very gently.
3. By connecting plastic parts with a metal screw/nut, then screw down very gently e.g. Allen screw into the tailstock housing. The same if the metal screw will be screwed into a plastic part e.g. jig-saw housing.

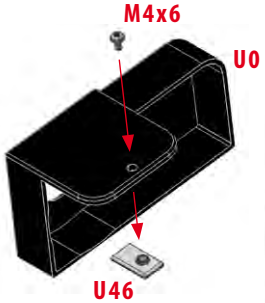
Assembly of the CNC 4 axes milling machine

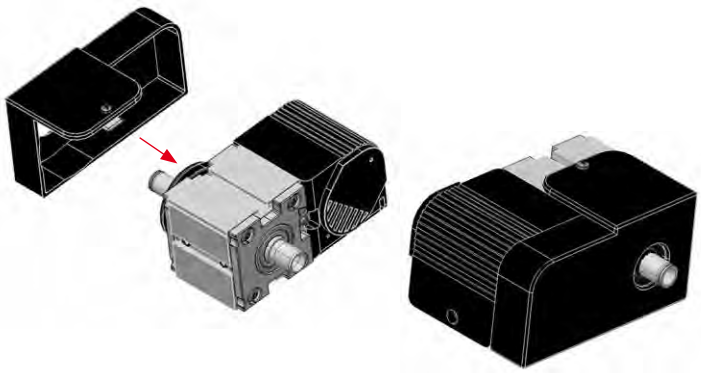
MOTOR-HEADSTOCK Unit M1

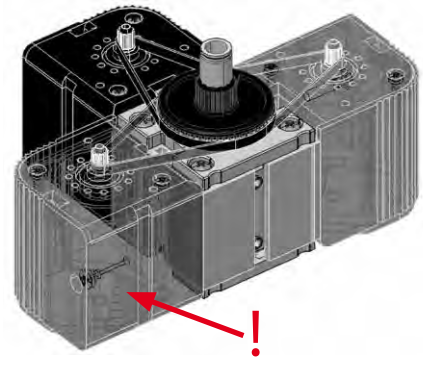


1. Slide connection piece (U66) into the T-slots (groove) between motor (U4ML) and headstock (U2ML).
2. Push headstock (U2ML) across and fix the screw of the connection piece (U66)
3. Adjusting the drive belt (U57): Tighten U57 with screwdriver. Loosen U57, then start motor. Tighten U57 until motor revolutions slightly reduce and the belt U57 is properly tightened.
4. Fixing the drive belt cover (U0). Make sure that the belt will not grind inside the cover. Note: fix U0 first when Unimat is completely assembled! **Note: fix U0 only after Unimat is completely assembled!**



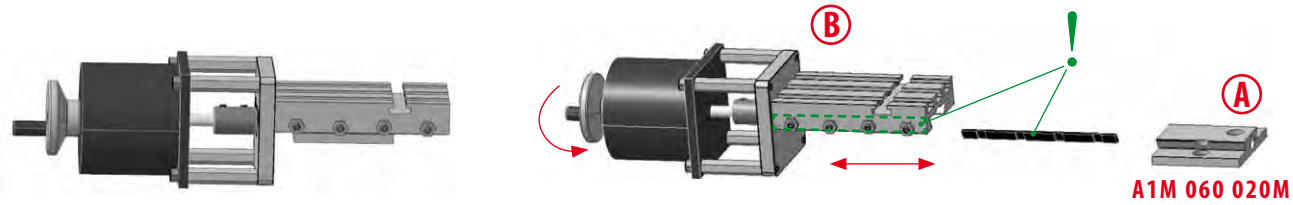




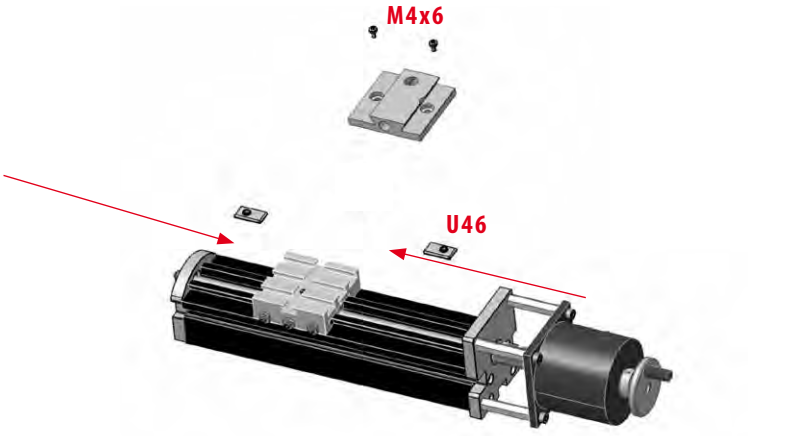


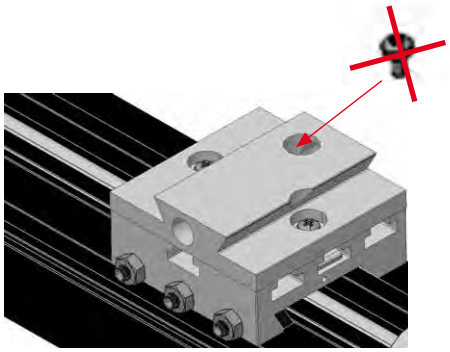
Large slide module M2D

1. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3CNC) by turning the hand wheel until it is released

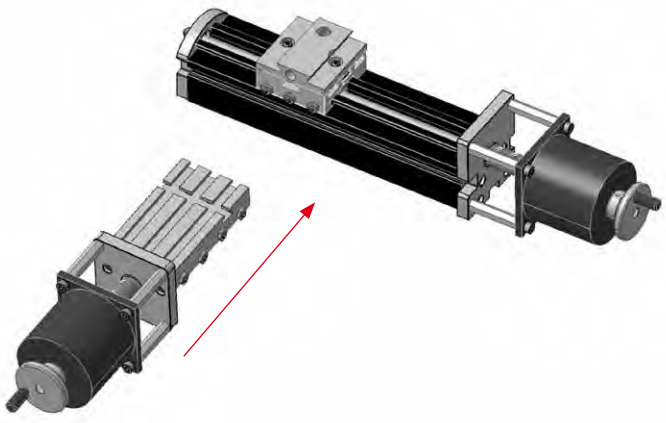


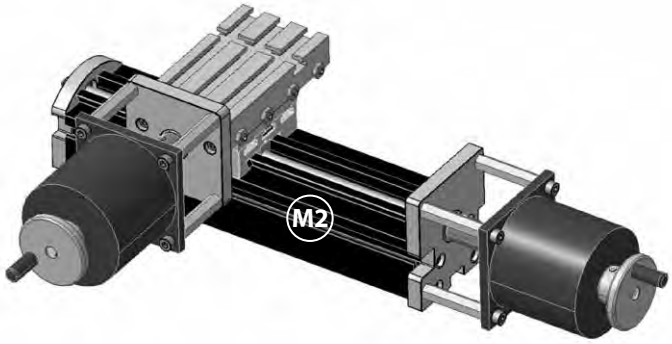
2. Fix the cross-slide guide (A1M 060 020M) to the sattle of the longitudinal slide (U9CNC) with 3 screws (U38) and 3 clamping plates (U46).





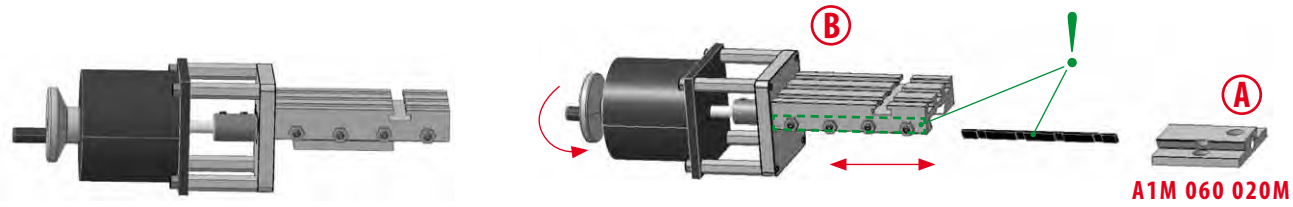
3. Slide modul (M2A) assembly: Slide cross-slide body (U3CNC) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.



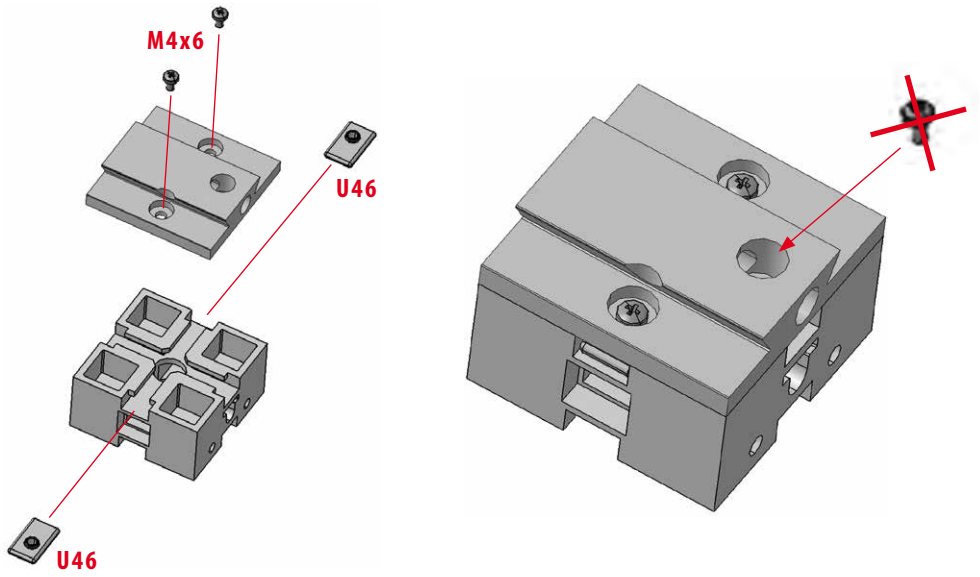


Small slide module M2BC

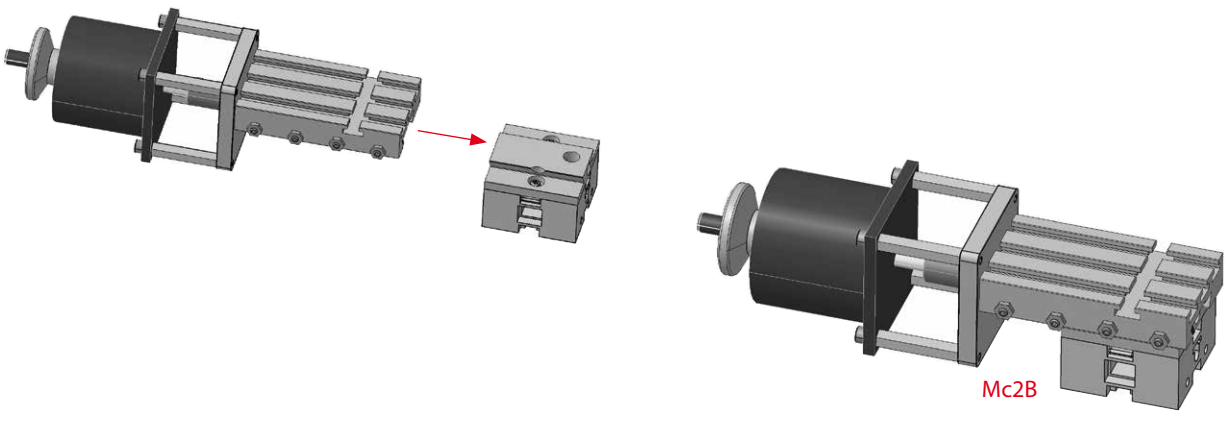
1. Cross-slide module with intermediate piece (for Z-axis) M2B: take off cross-slide guide (A1M 060 020M) from the cross-slide body (U3 ML) by turning the hand wheel until it is released.



2. Fix the cross-slide guide (A1M 060 020M) to the intermediate piece (U10ML) with 3 screws (U38) and 3 T-slot nut (U46).



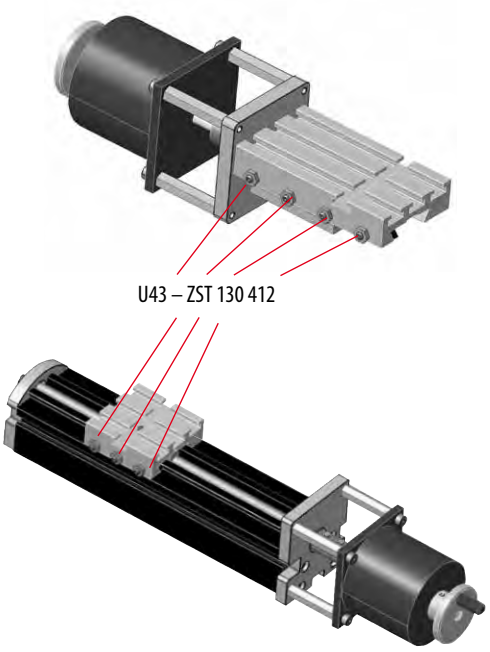
3. Slide cross-slide body (U3ML) over cross-slide guide (A1M 060 020M). Watch the proper position of the gibs between the two parts.



Part list and setup of 4 axes CNC vertical mill 4.4.6

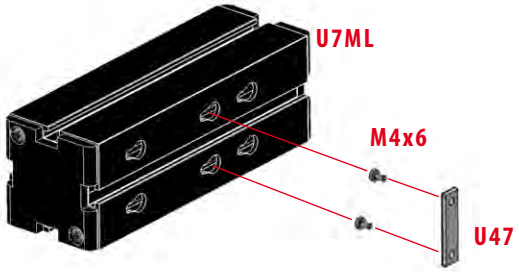
Adjusting the slides:

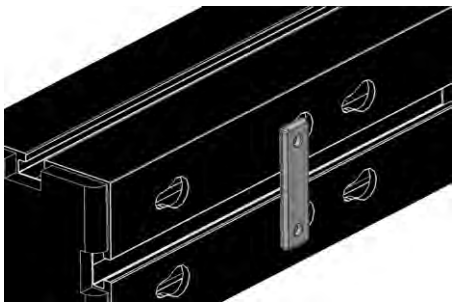
1. Check play: open nut (U43), adjust play with screws M4x12 (ZST 130 412) GIBS: (tapered synthetic adjustment shims) are fitted between the saddle and the profile of the longitudinal slide and the upper and lower part of the cross slide. Correct adjustment of the gibs will ensure smooth and steady operation of the slides. It is adjusted by loosening the nuts and using the screws of the saddle and upper cross-slide part, by pressing the gibs until „play“ is removed. After adjusting, retighten the locking nuts. Milling operations require a tighter adjustment of the gibs than lathe operations.
2. Maintain the slides at regular intervals: clean with a brush and lubricate the gliding surface.



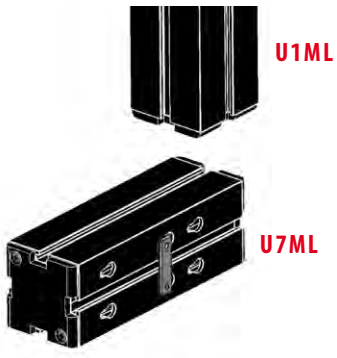
Horizontal machine bed combination (M3B) - Variante 1

1. Fix the clamping plate (U47) by means of screws (U38) into the small machine bed (U7) NOTE: do not tighten the screws.

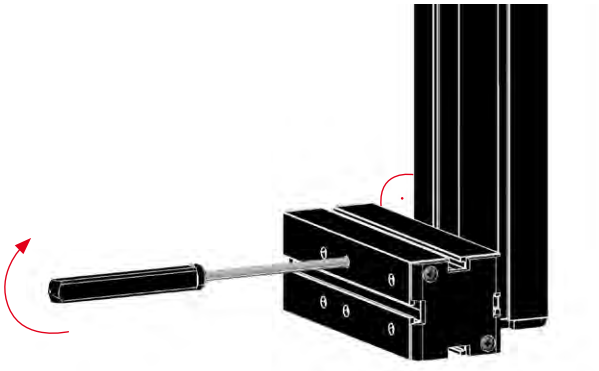




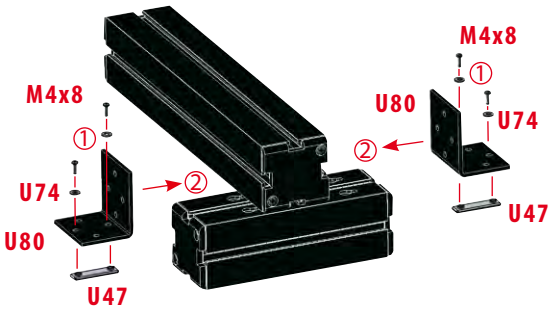
2. Slide the T-slot of the long machine bed (U1) over the clamping plate (U47).

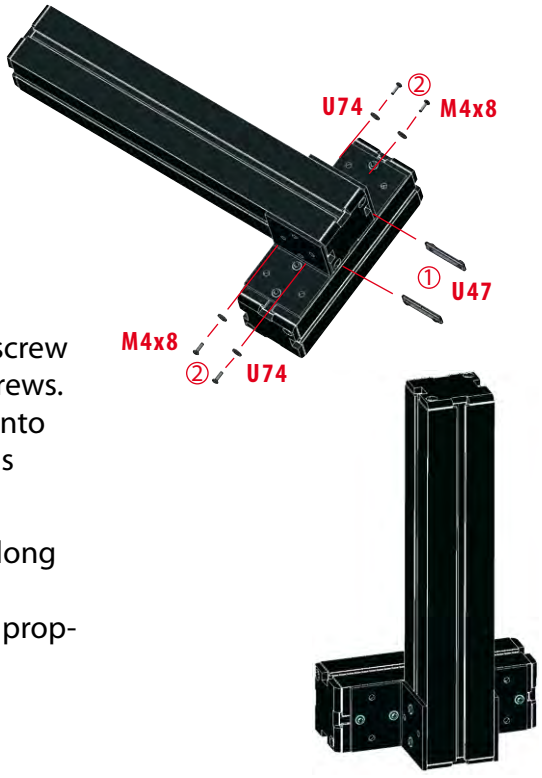


3. Tighten the screws properly and measure a 90 degree position between the two machine beds.



4. Right angle reinforcement by means of stabilizing angle



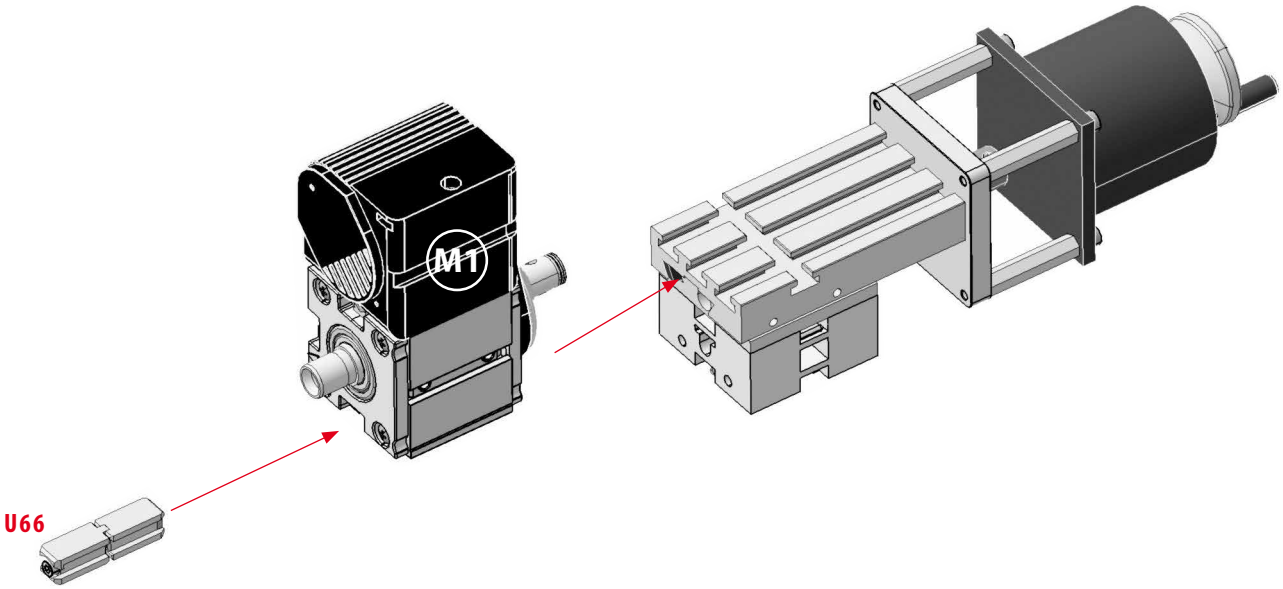


4.1. Connect stabilizing angle (U80) with clamping plate (U47), screw M4x8 (U37) and washer (U74). NOTE: do not tighten the screws. Slide the clamping plate (u47) with stabilizing angle (U80) into the T-slot of the small machine bed (U7ML) until the angle is fixed to the long machine bed (U1ML).

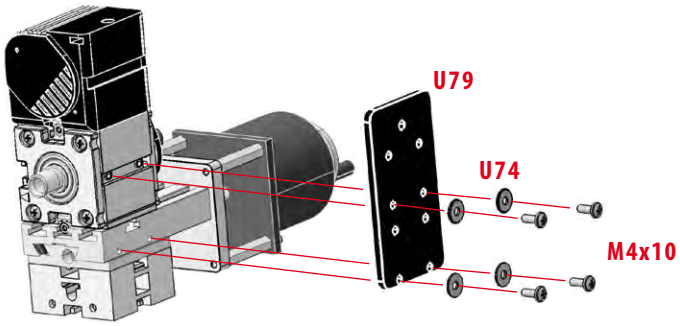
4.2. Slide the second clamping plate (U47) into the T-slot of the long machine bed (U1ML) and fix it with the screws M4x8 (U37) through the stabilizing angle (U80). Now tighten all screws properly.

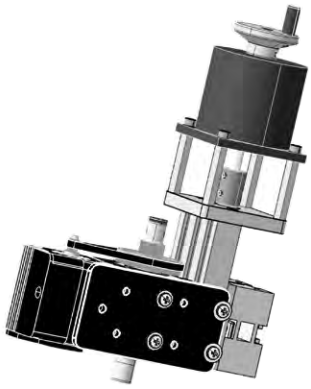
Z-axis motor-headstock unit (Mc4):

1. Fix Cross-slide module with intermediate piece (for Z-axis) M2B to motor-headstock unit (U66) with connection piece (U66).



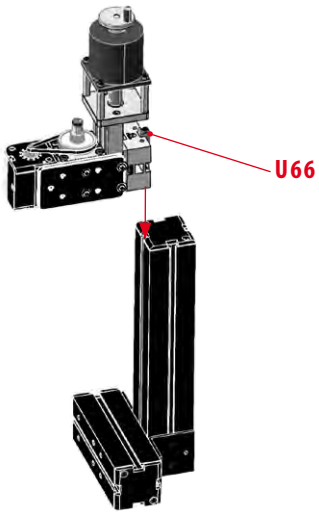
2. Fix motor-headstock unit (M1A) by means of stabilizing plate (U79). Use screws U31 and plain washer U74.



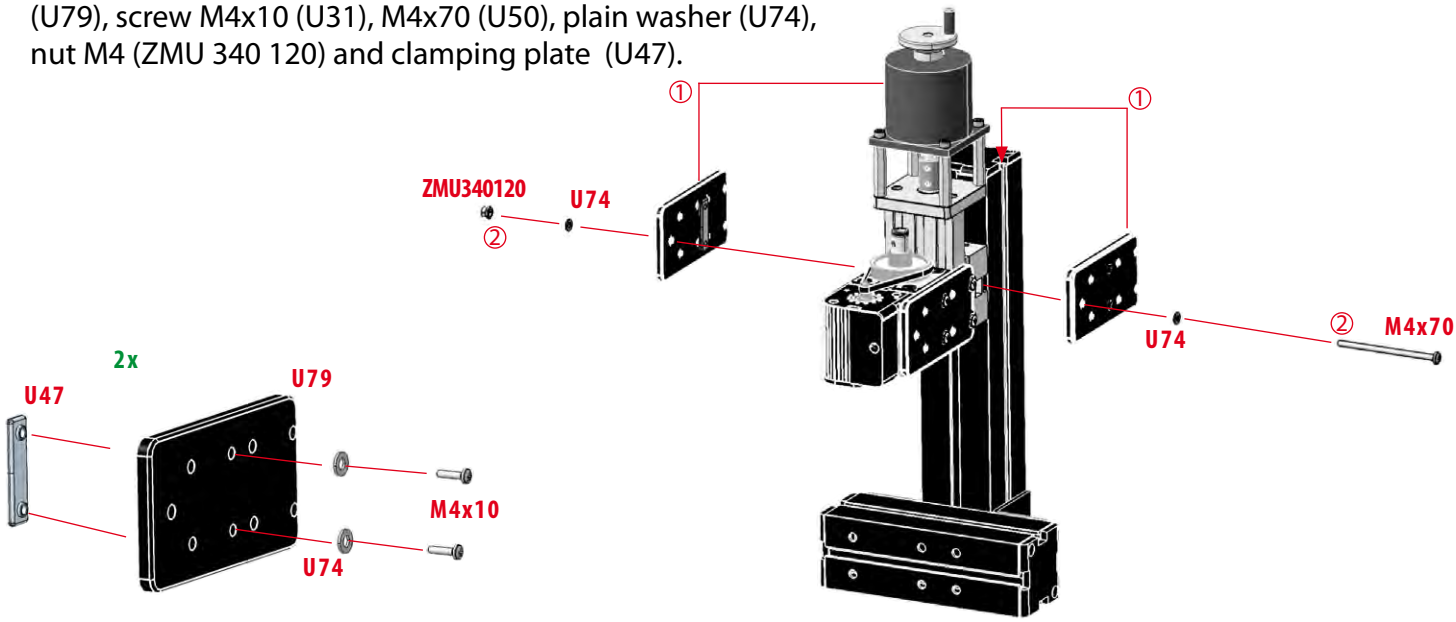


Fix the Z-axis motor-headstock unit (Mc4) on the vertical machine bed combination.

1. Slide the connection piece (U66) into the T-slot of the intermediate piece (U10ML). Then slide it into the T-slot of the long machine bed (U1ML). Find the right position (it depending of the work pice size). Now tighten the screws properly.

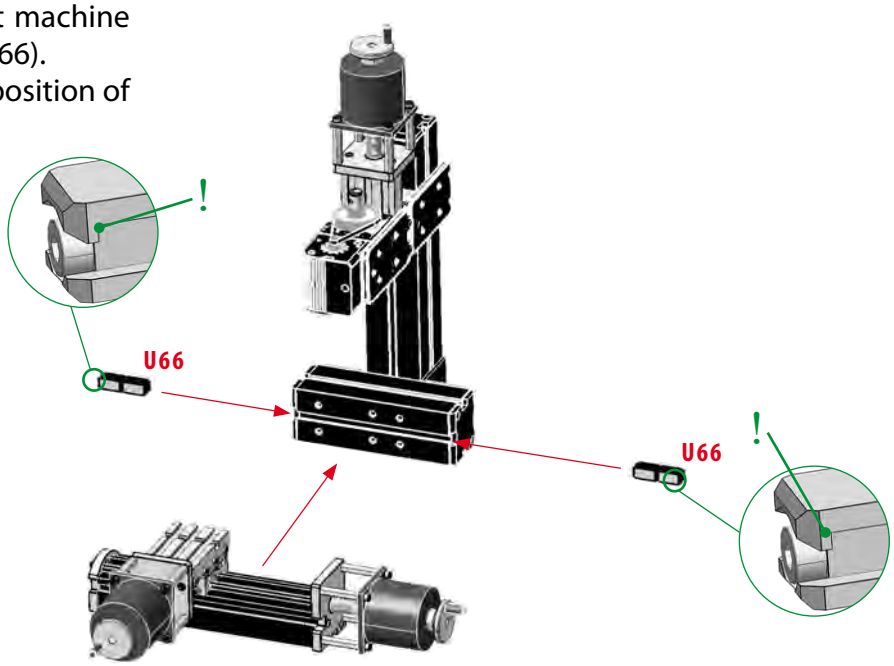


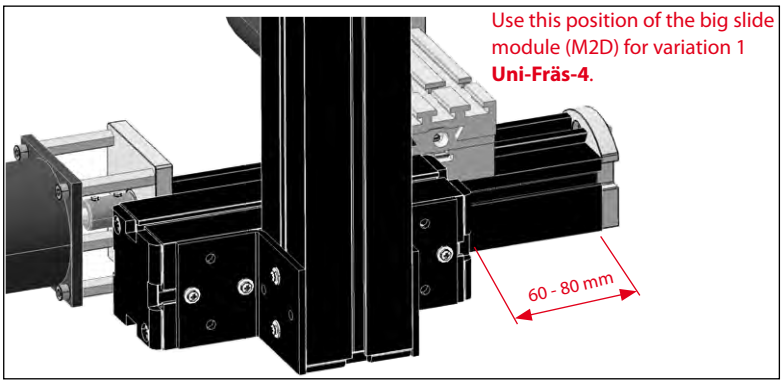
2. Fix the z-axis motor headstock unit by means of stabilizing plate (U79), screw M4x10 (U31), M4x70 (U50), plain washer (U74), nut M4 (ZMU 340 120) and clamping plate (U47).



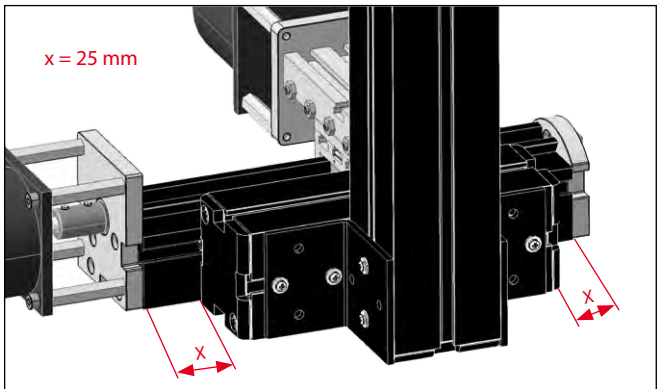
Assembly of big slide module M2D.

Fix the big slide module (M2C) to the short machine bed (U7ML)with two connection pieces (U66). Depending on the machine variation the position of the big slide module is different.

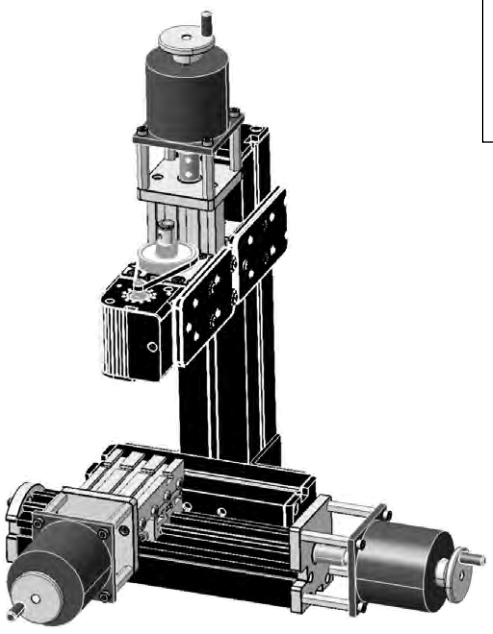




Use this position of the big slide module (M2D) for variation 1 **Uni-Fräs-4**.

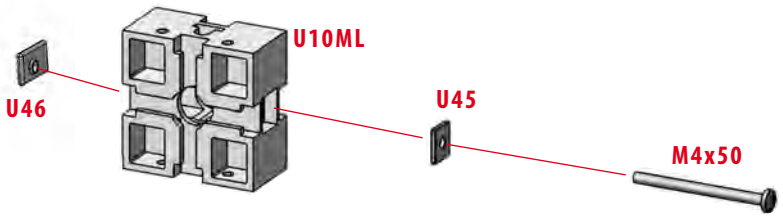


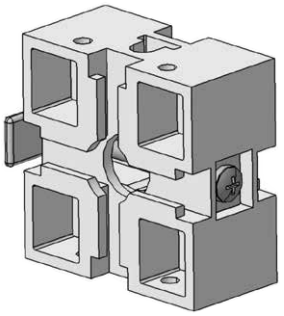
Use this position of the big slide module (M2D) for variation 2.
(with cross plate cross slide - A1M 060 quer) inkl. in **Uni-CNC-Set**.



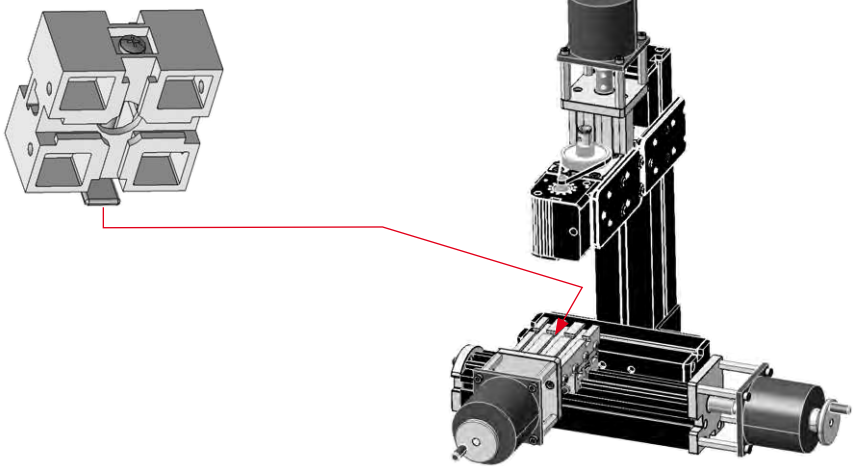
Assembly of CNC rotary table to the big slide modul M2D

1. Fix T-slot nut (U46) by screw M4x50 (U33) and slot nut (U45). Note: do not tighten the screw

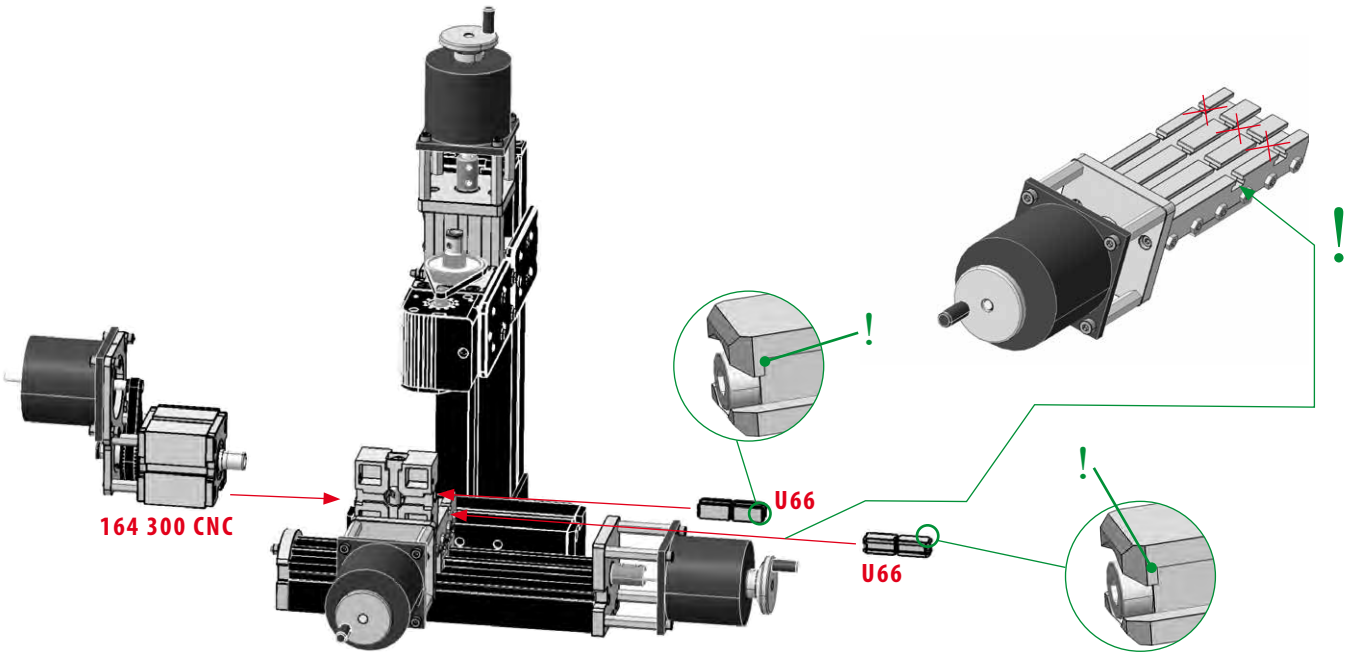




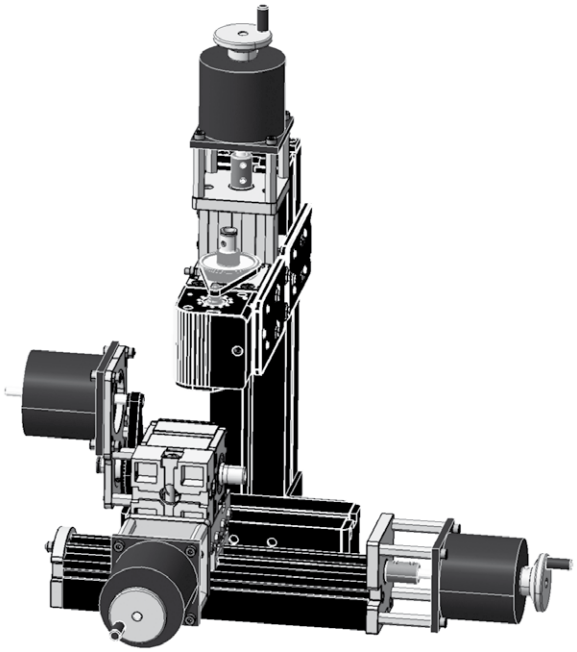
2. Slide the T-slot nut (U46) into the middle T-slot of the cross slide. Note: do not tighten the screw



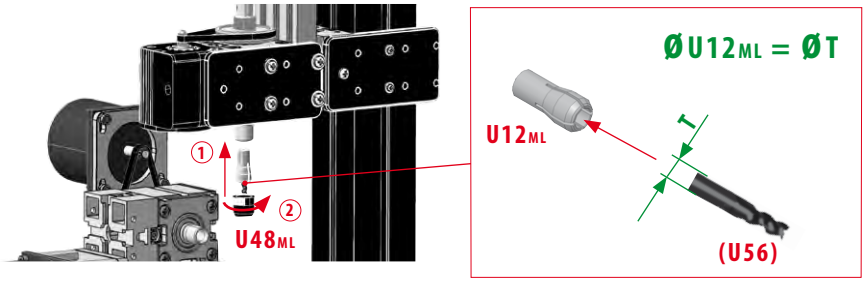
3. Fix the CNC-rotary table (164300CNC) to the cross slide and intermediate piece by using connection piece (U66).

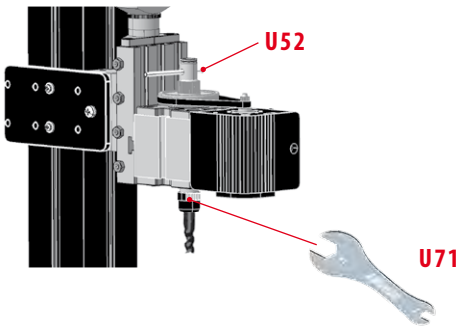


4. Tighten all the screws (connection pieces and M4x50).



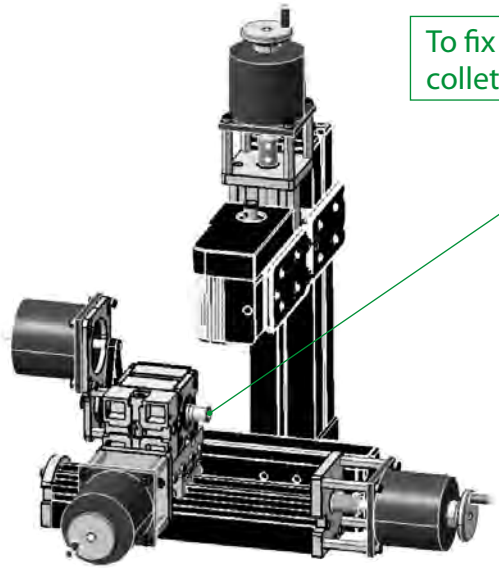
Mounting of the tool



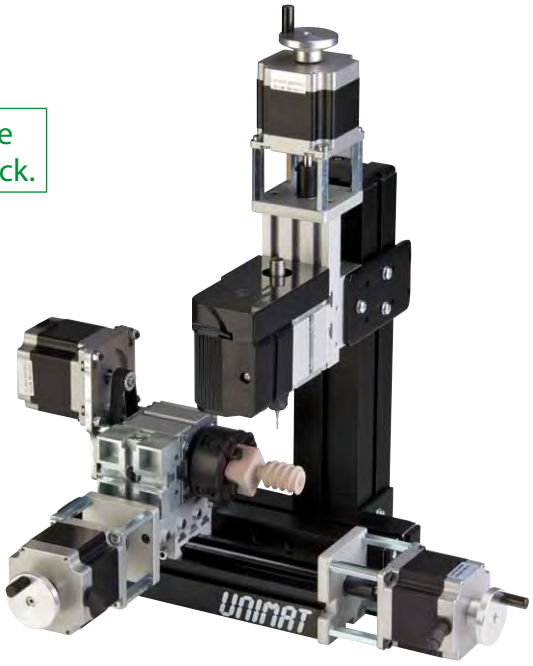


Mounting of drive belt cover (U0)

Fix the drive belt cover (U0). Take a look at "MOTOR-HEADSTOCK Unit M1"



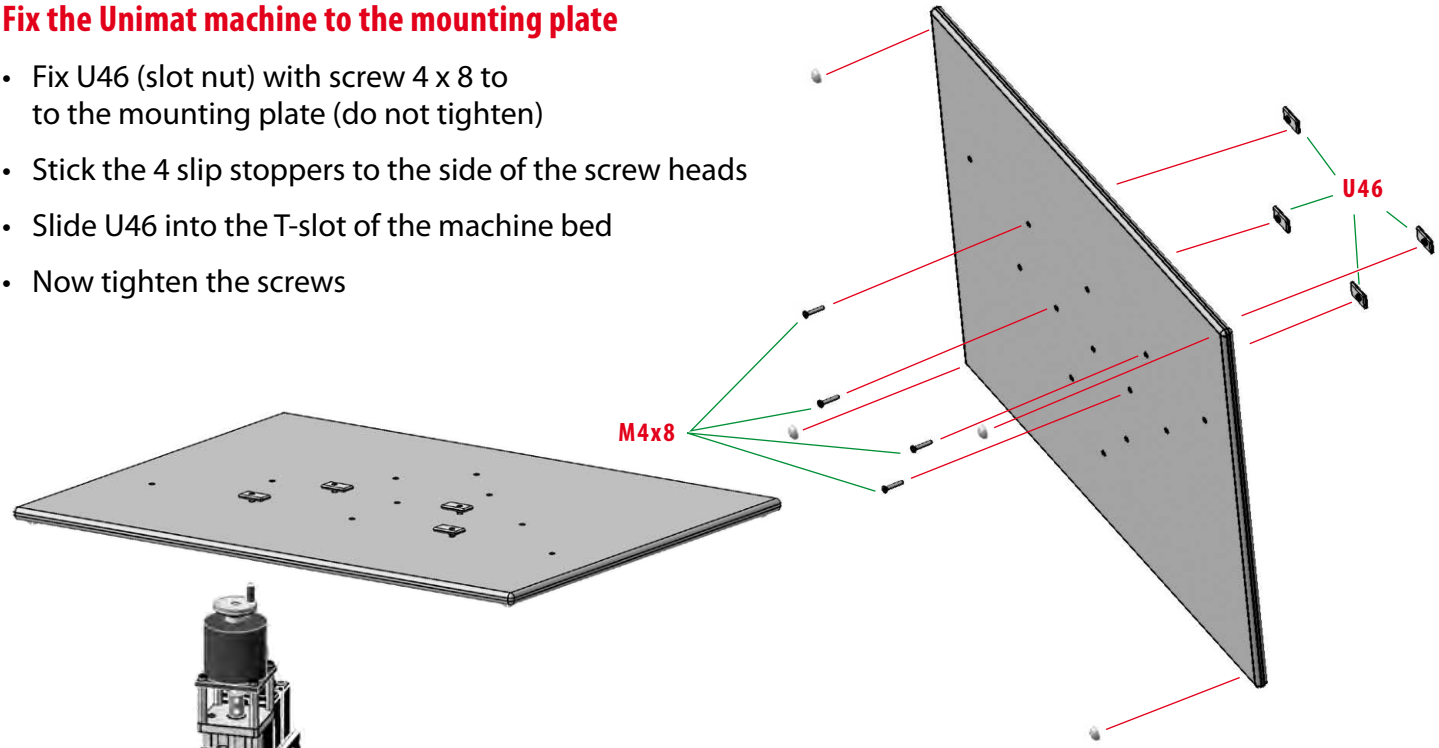
To fix the work piece you can use collets, 4 jaw chuck or 3 jaw chuck.

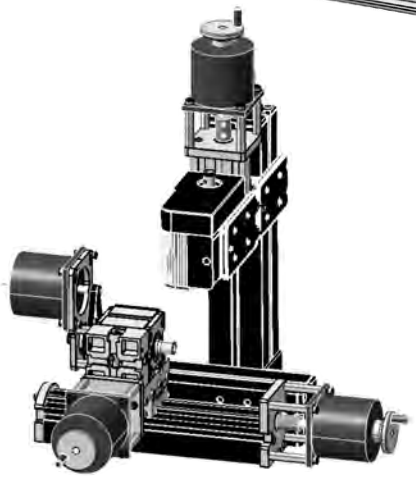


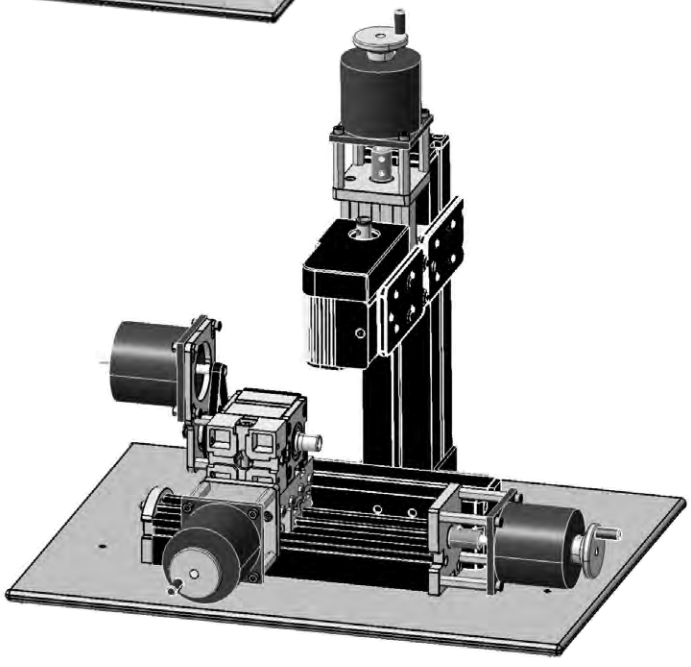
Part list and setup of 4 axes CNC vertical mill

Fix the Unimat machine to the mounting plate

- Fix U46 (slot nut) with screw 4 x 8 to to the mounting plate (do not tighten)
- Stick the 4 slip stoppers to the side of the screw heads
- Slide U46 into the T-slot of the machine bed
- Now tighten the screws

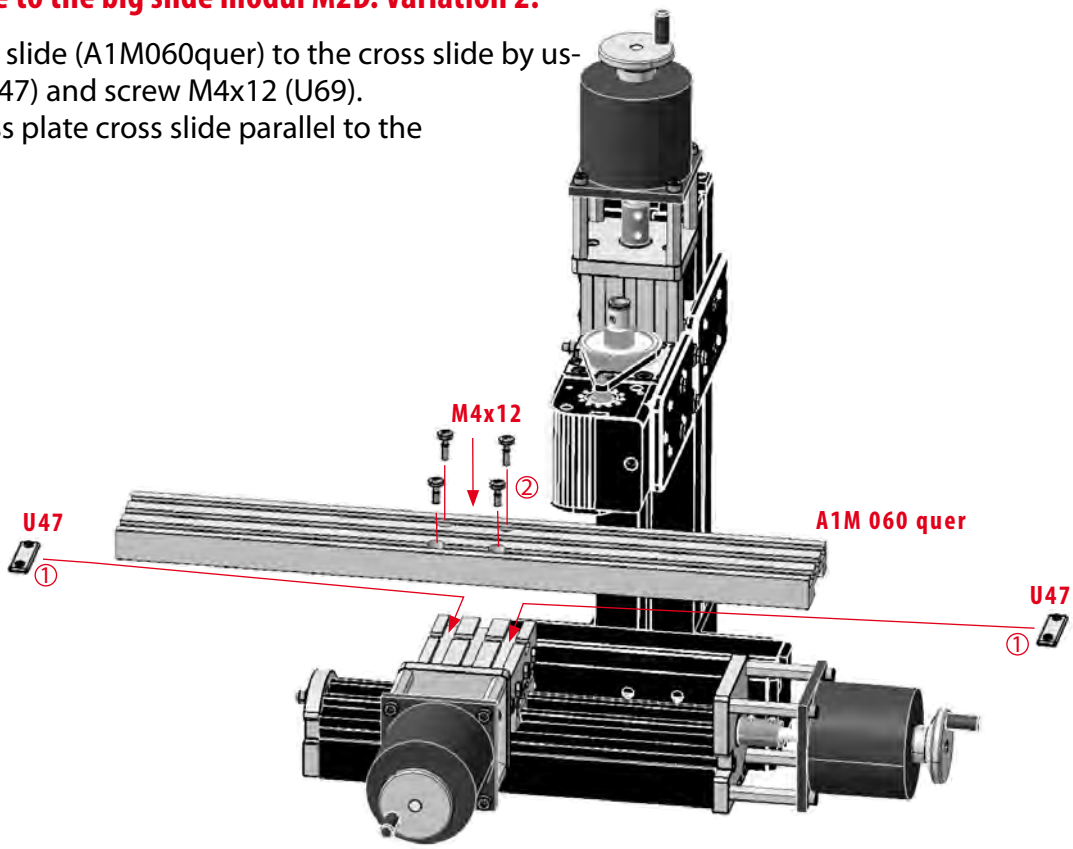




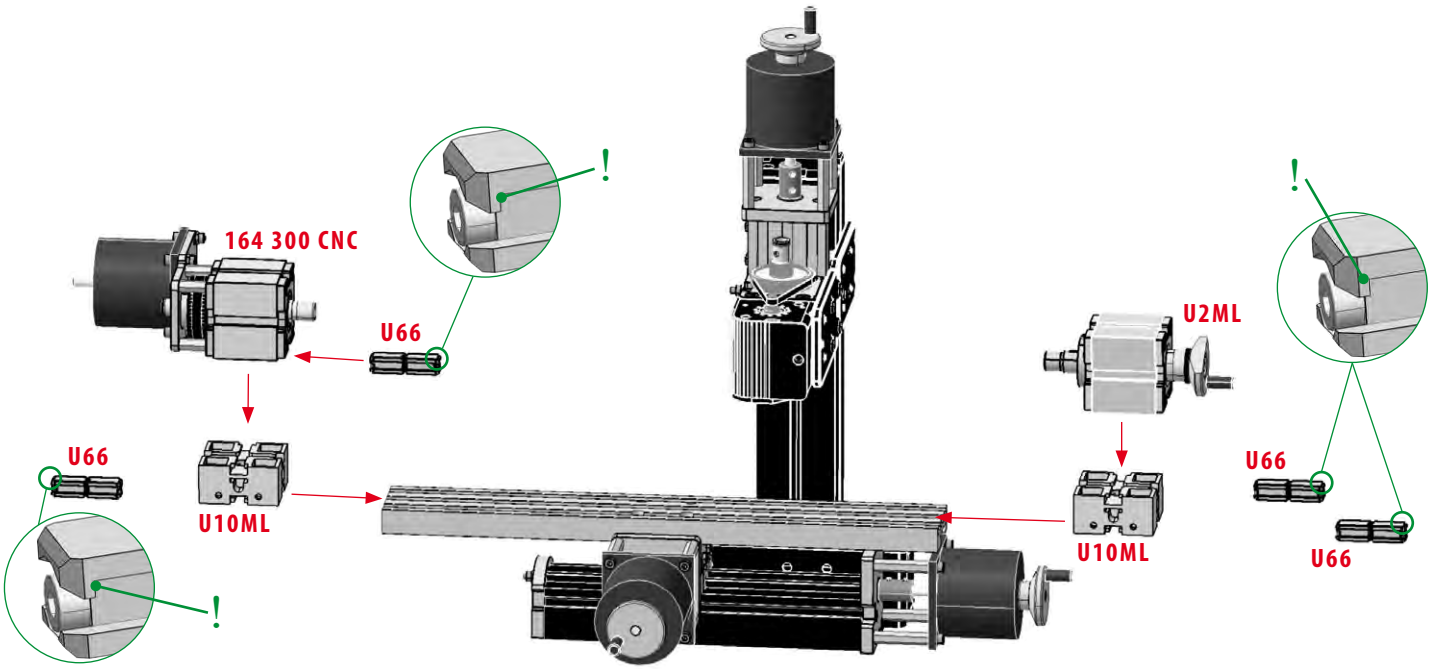


Assembly of CNC rotary table to the big slide modul M2D. Variation 2.

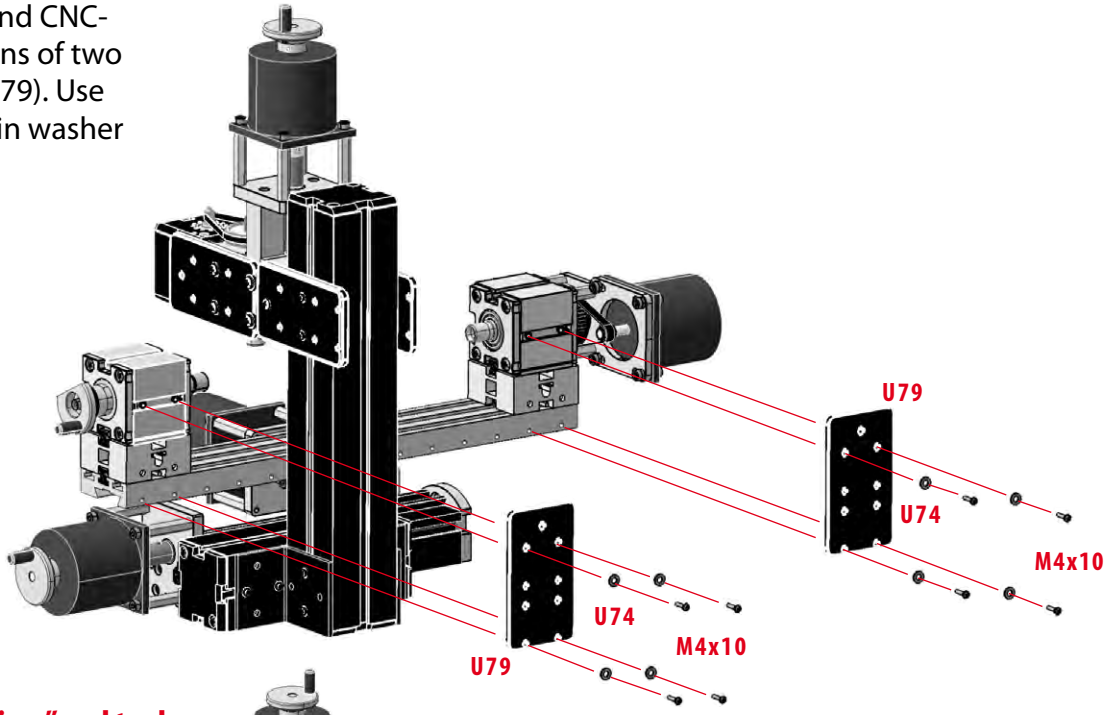
1. Fix the cross plate cross slide (A1M060quer) to the cross slide by using clamping plate (U47) and screw M4x12 (U69).
   Attention: Fix the cross plate cross slide parallel to the longitudinal slide!



2. Fix the CNC-rotary table (164300CNC) and the tailsstock to the cross plate cross slide by using connection pieces (U66). For bigger work piece diameter use also intermediate pieces. The distance between CNC-rotary table and tailstock depends of the work piece length. The middle of the work piece shoot be at the middle of the cross slide.

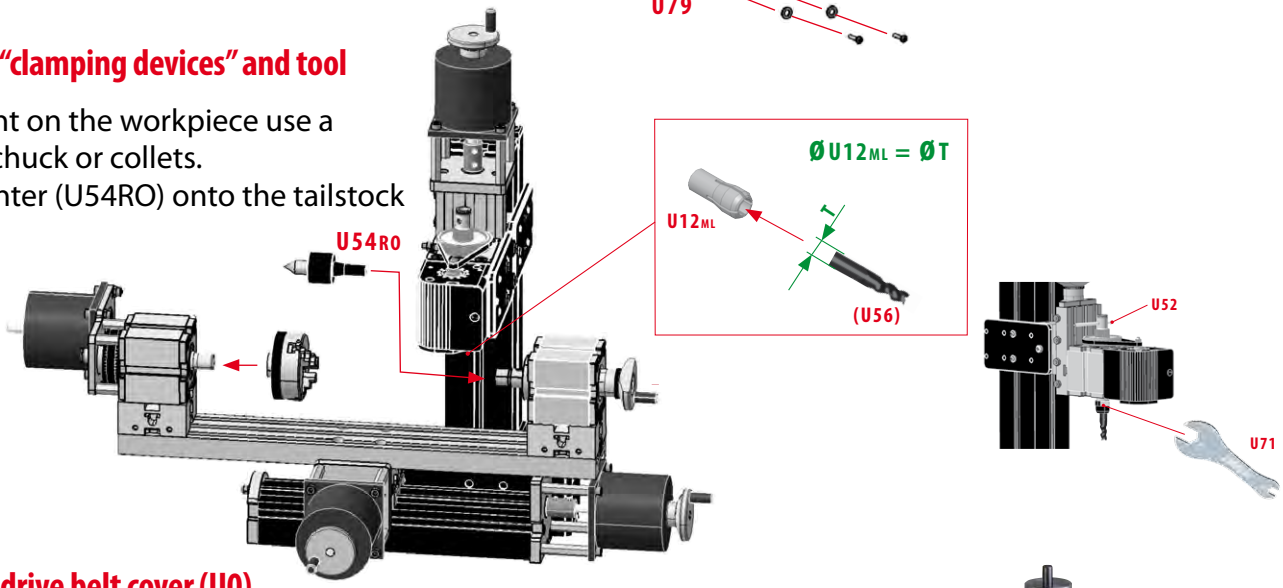


3. Fix tailstock (U6ML) and CNC-rotary table by means of two stabilizing plates (U79). Use screws U31 and plain washer U74.



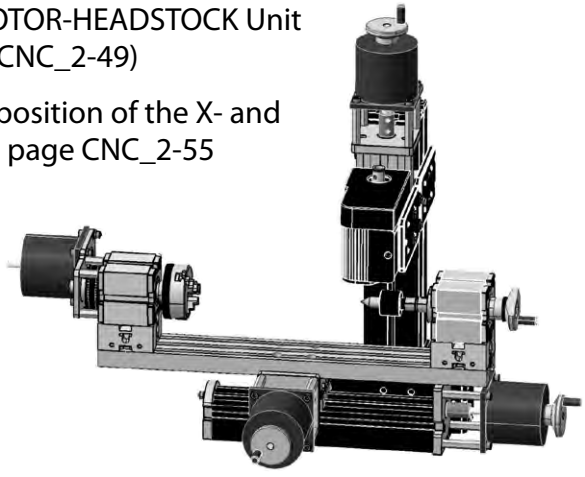
Mounting of "clamping devices" and tool

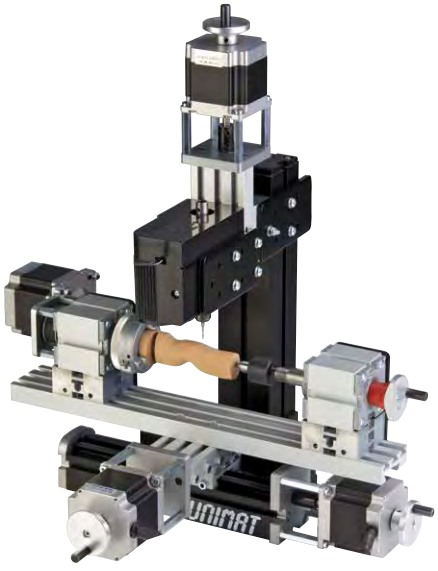
1. Dependent on the workpiece use a 4 - or 3 jaw chuck or collets.
2. Fix the center (U54RO) onto the tailstock



Mounting of drive belt cover (U0)

1. Fix the drive belt cover (U0). Take a look at "MOTOR-HEADSTOCK Unit M1" (page CNC_2-49)
2. Check the position of the X- and Y-slide, see page CNC_2-55





Part list and setup of 4 axes CNC vertical mill

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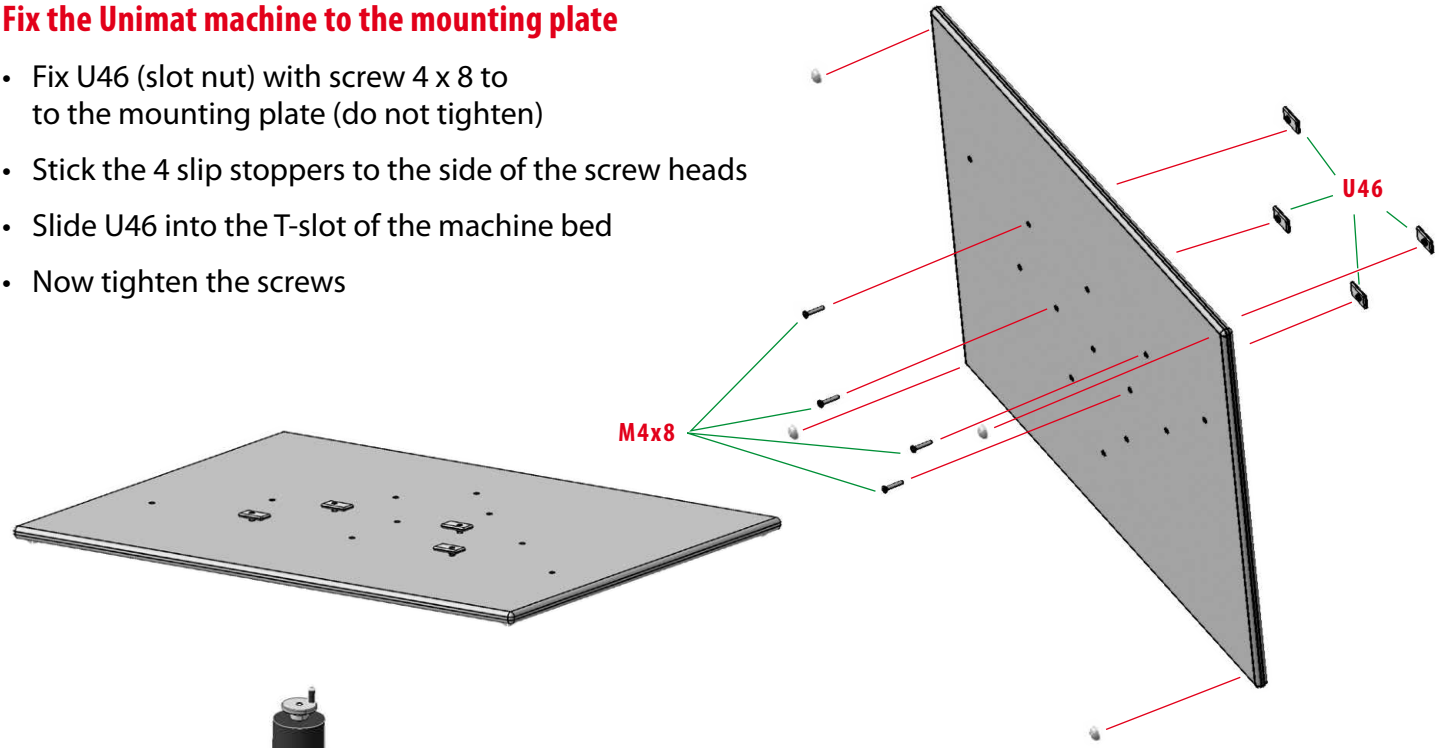
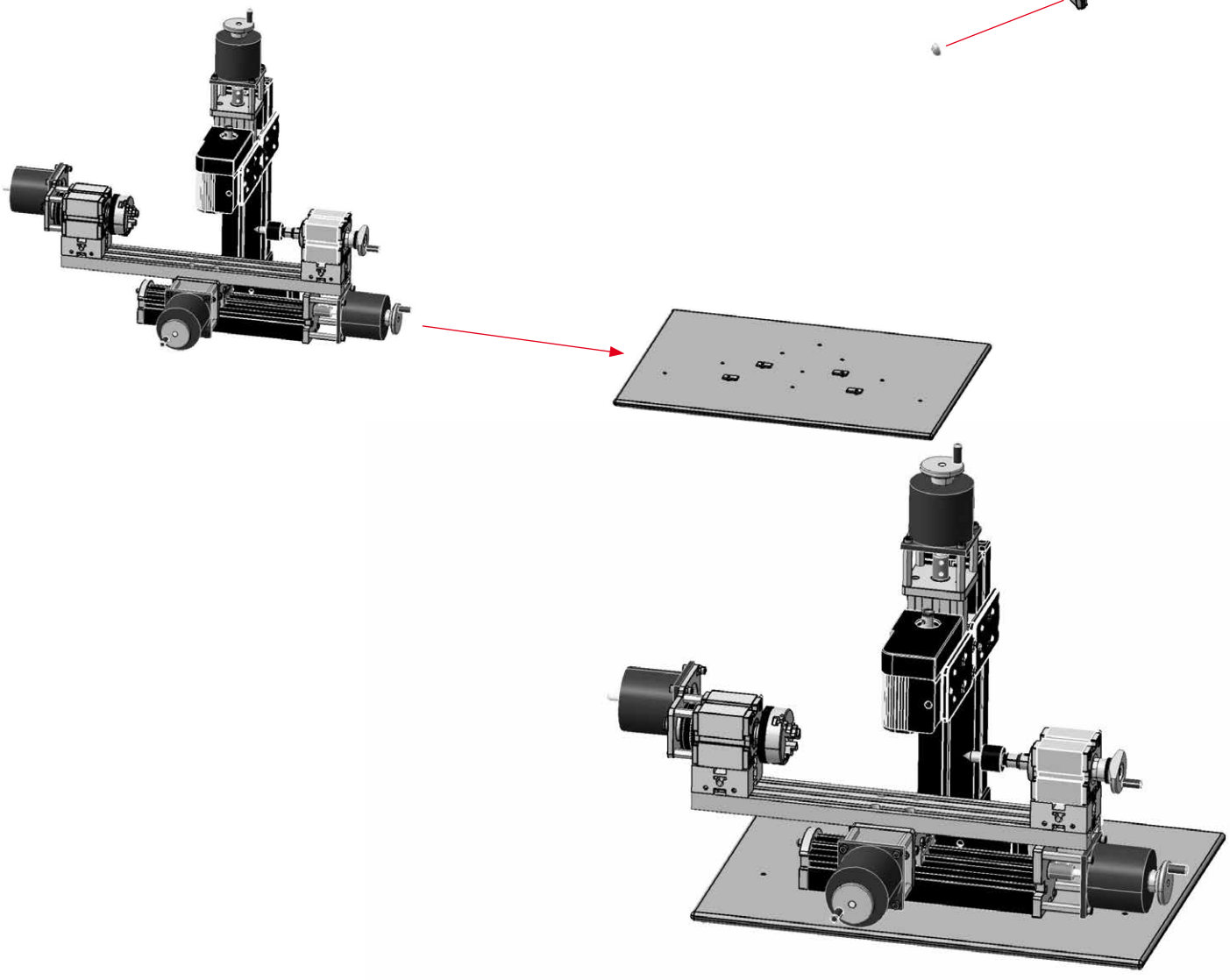
- Stick the 4 slip stoppers to the side of the screw heads
- Slide U46 into the T-slot of the machine bed
- Now tighten the screws





Project for 4 axis Unimat CNC

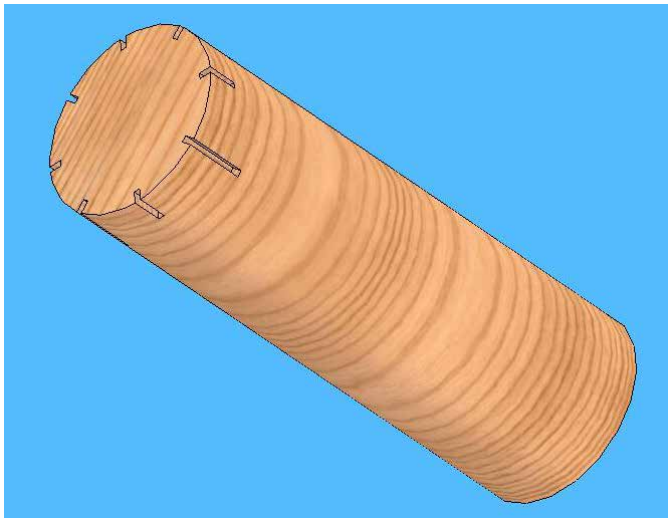
Uni-CNC-Set

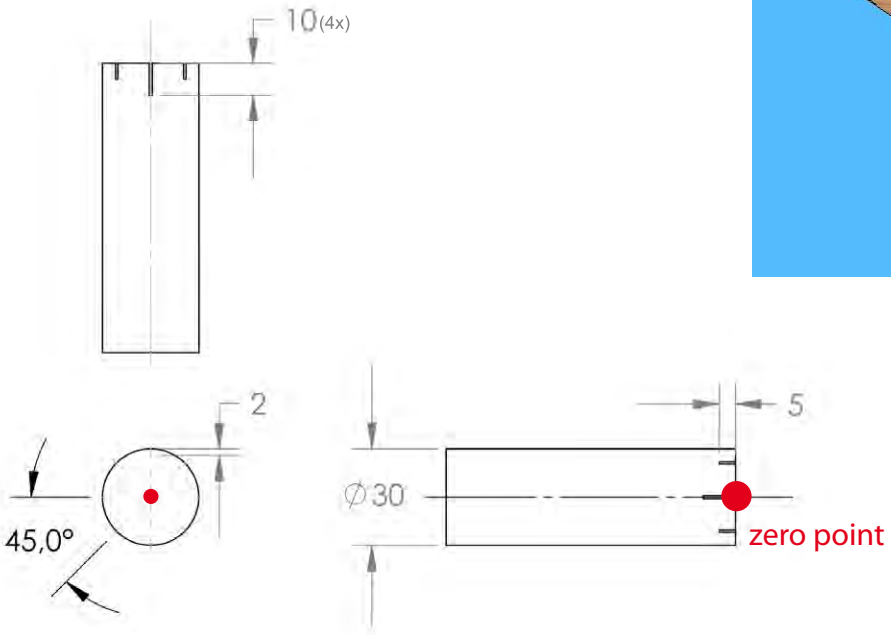
Includes

1) Raw material: beech dowel Ø 30 mm

2) Technical drawing (as DXF or PDF)

3) Proposal for solution (G-code)





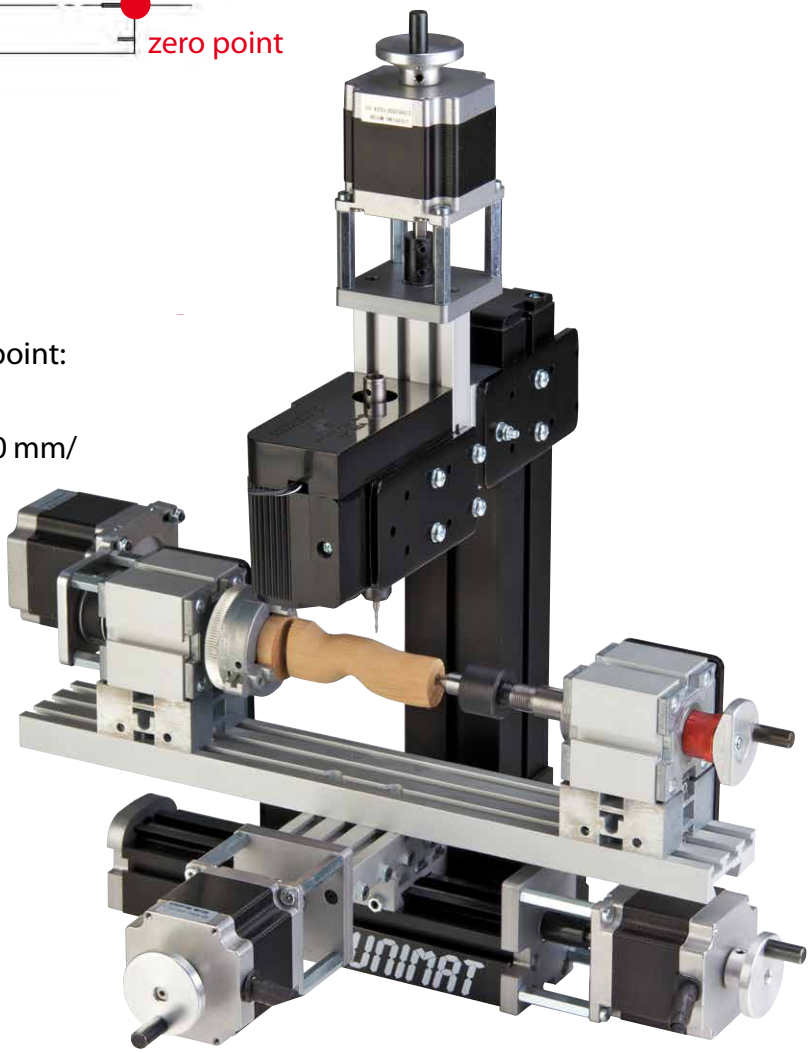
Project

Scale sample

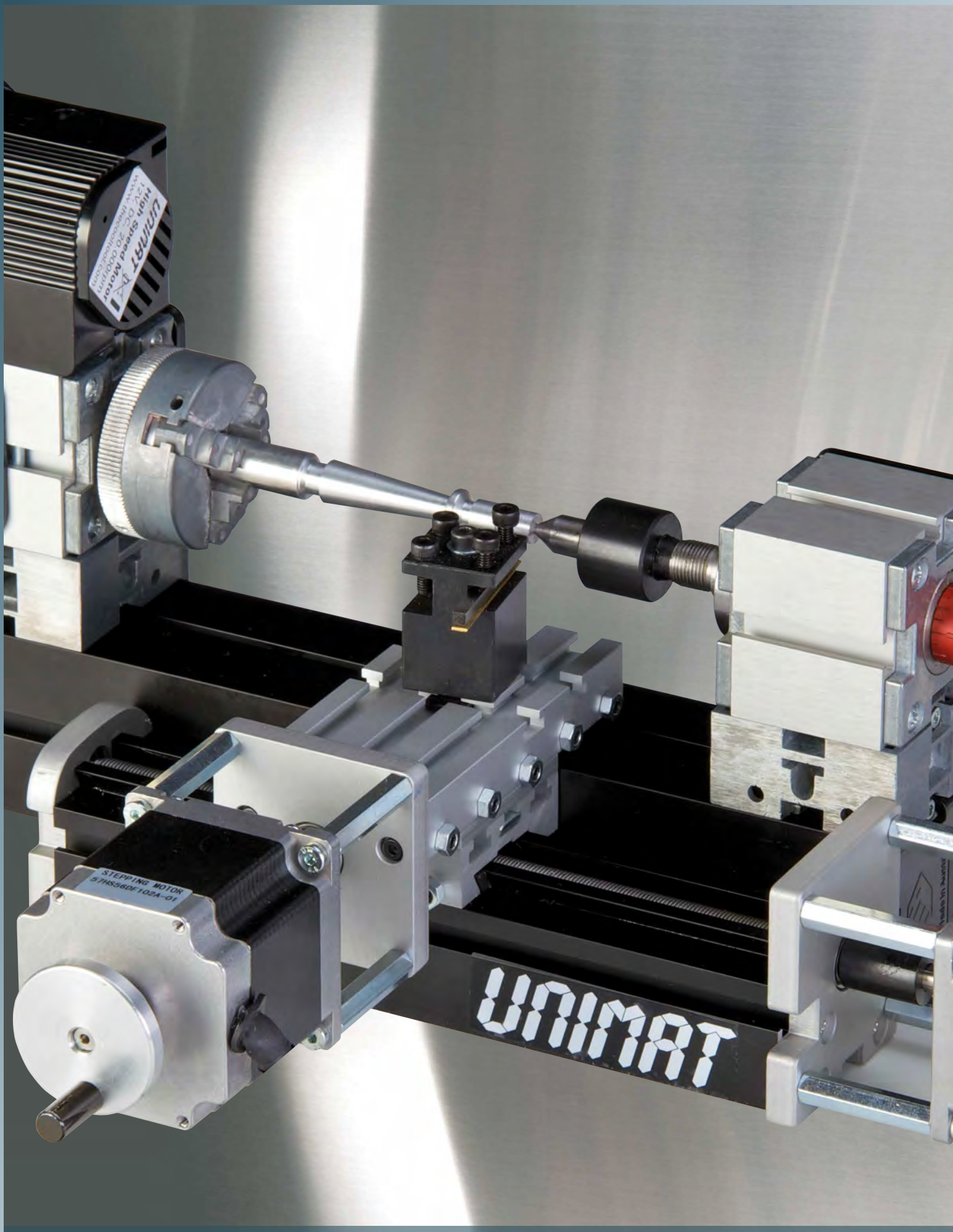
Raw material: beech dowel Ø 30 x 90 mm, zero point: right edge of workpiece on rotation axis

Tool: 1.6 mm end mill, max. forward feed rate: 150 mm/ min max. feed: 2.0 mm

g21
g0 z20
g0 x2 y0 a0
g0 z13
g1 x-10 f70
g0 x2
g0 a45
g1 x-5
g0 x2
g0 a90
g1 x-10
g0 x2
g0 a135
g1 x-5
g0 x2
g0 a180
g1 x-10
g0 x2
g0 a225
g1 x-5
g0 x2
g0 a270
g1 x-10
g0 x2
g0 a315
g1 x-5
g0 x2
g0 a0 z20
m02



Notes



The cool tool est. 1982

Education