Assembly instructions
CNC basic module parts set
Hobby-Line 7545

Support for build and operation also in the user forum: **www.hobbyline.info**

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MPF.HL1.7545.B

Version 1.7.1

Attention!

Important information about your parts set

You are about to set up a portal milling machine from a combination of components. After completion of the work described in these instructions, the result is a so-called „**incomplete machine**“ that y*ou may not simply put into operation*. Therefore, please note the following information.

The EC Machinery Directive/EU Machinery Ordinance/9. ProdSV, require functions and measures for a ready-to-operate machine, which must be supplemented and finally checked after the basic machine has been set up before commissioning.

The complete machine consists of three modules: basic machine, housing and electrical personal protection. You can find offers for this in the Sorotec web shop. *If you have any questions about the Machinery Directive, our support will be happy to help you: call us!*

The following list contains the points to consider.

Necessary additions

- Emergency stop (or connection of the emergency stop switch)
- Protective grounding of the machine at the connections provided
- If installed: earthing of the suction / suction-conveying hose cyclone against static discharges
- Protective housing with external emergency stop button
- Operating status display (signal light)
- If not already installed: Workpiece support with suitable clamping devices
- Attachment of all protective and warning notices (pictograms, notices(1))
- Safety accessories (goggles, hearing protection, dust mask)

Final check

During the first start-up, the prescribed functional features must be finally checked. Details can be found in the corresponding descriptions.

The following list contains the items to check.

- All lines are properly attached and cannot get caught in moving parts.
- Where protective earthing is required, this has been carried out properly.
- All protection and warning notices have been attached.
- All protective components (e.g. covers) listed in the instructions are attached.
- The protective functions correspond to the performance of the machine.
- The protective functions work safely and without interference.
- The descriptions required for proper use are readily available on the machine.
- The safety accessories required for machine operation are available.
- Notes on usage restrictions are readily available on the machine.

Buyer‘s consent

The EC Machinery Directive/EU Machinery Ordinance/9. ProdSV stipulates that, depending on the performance/hazard classification of the later, finished machine, the customer must confirm that the measures listed above have been carried out before delivery.
To do this, you filled out the form that you received during the ordering process and sent it back to us.

(1) With the protective housing, the maximum cutter diameter is limited to 8 mm.

Technical specifications

Hobby-Line	4530	6045	7545	10560
Travel	X: 300 mm Y: 450 mm Z: 140 mm	X: 460 mm Y: 600 mm Z: 140 mm	X: 460 mm Y: 750 mm Z: 140 mm	X: 610 mm Y: 1050 mm Z: 140 mm
Clearance under portal	240 mm	240 mm	240 mm	240 mm
Clamping area	X: 355 mm Y: 610 mm	X: 515 mm Y: 760 mm	X: 515 mm Y: 910 mm	X: 665 mm Y: 1210 mm
Outer dimensions	L: 670 mm B: 550 mm H: 650 mm	L: 820 mm B: 680 mm H: 650 mm	L: 970 mm B: 680 mm H: 650 mm	L: 1270 mm B: 860 mm H: 650 mm
Ball screw spindles Tolerance class T07	X: 16 x 10 mm Y: 16 x 10 mm Z: 12 x 4 mm	X: 16 x 10 mm Y: 16 x 10 mm Z: 12 x 4 mm	X: 16 x 10 mm Y: 16 x 10 mm Z: 12 x 4 mm	X: 16 x 10 mm Y: 16 x 10 mm Z: 12 x 4 mm
Weight without accessories	approx. 18 kg	approx. 21 kg	approx. 28 kg	approx. 36 kg

Introduction

Congratulations on the purchase of our kit for a Hobby-Line CNC portal milling machine. We recommend reading through these instructions completely before assembly and then assembling the kit step by step as described.

Required tools

When designing the Hobby Line, care was taken to ensure that no special tools are required for assembly. However, common hand tools such as wrenches, Allen keys, screwdrivers, plastic hammers, etc. should be available. A work surface that is as flat as possible and the size of the base frame is also a prerequisite for a successful construction.

Required accessories

Three stepper or servo motors the size of NEMA 23 for the axis drives. The motors are an integral part of the design and indispensable for the sensible construction of the portal milling machine. If not yet procured, you will find suitable motors in the Sorotec shop:

http://www.sorotec.de/shop/index.php

Optional accessories

The fully assembled machine can be supplemented and adapted to your requirements with optional accessories. In the Sorotec shop you will find:

- Milling spindles
- Electric mounting kit
- Control electronics
- Control software
- T-slot plate
- Vacuum table
- Minimum quantity lubrication
- Vacuum chip disposal
- Enclosure

Attention!

Only carry out the work if you are familiar with the necessary actions and do have suitable tools available.

Sorotec GmbH assumes no responsibility or liability for damage to property or personal injury that occurs during the assembly or operation of the CNC portal milling machine.

General information

Please assemble the kit as carefully and precisely as possible - the accuracy of the finished machine not only depends on the quality of the components supplied, but also to a large extent on the correct assembly and precise alignment. All components must be checked for burrs before assembly and reworked if necessary.

Infosheet Measure Screws

Dimensions

Screw sizes are always given in the form of "diameter x length". In the case of metric screws, the diameter is given by an M. Wood, sheet metal or plastic screws are not specially marked in the dimensioning. The unit of measurement mm is usually not specified.

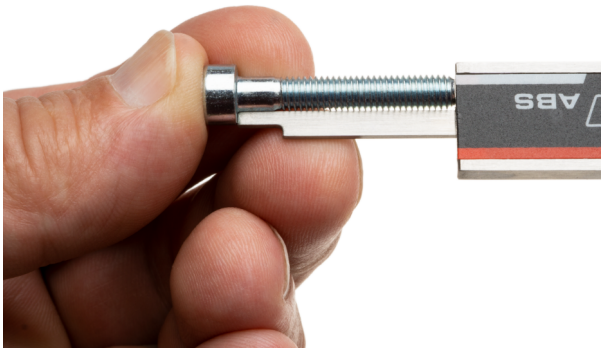
Examples:

M4 x 40 - metric screw with M4 thread and 40 mm length

3 x 25 - wood screw 3 mm in diameter and 25 mm in length

Diameter

Measurements are always made with the vernier caliper and on the outside of the thread. To prevent the cutting edges of the measuring jaws from slipping into the thread grooves, the screw is placed lengthways between the jaws.



Length

Everything that disappears in the material is part of the length of a screw. This means that measurements are taken - ideally with the depth gauge of the caliper - from the underside of the screw head to the end of the screw. Any parts without a thread are also part of the length.

Exception countersunk screw

Because the head of the countersunk screw disappears into the material, the head height here is part of the length. So the length is measured over everything. But really: Only with the countersunk screw!

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Version 1.0 Juli 2020

Scope of delivery

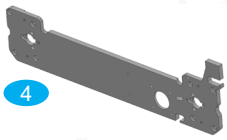
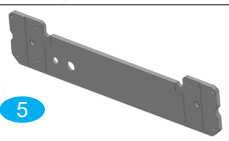
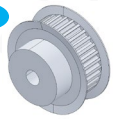
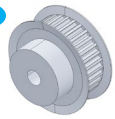
Illustration	Description	Num
1 	ball screw 16 x 10, length 609 mm, with recirculating ball nut ZAN.KGS1610.0609M	1
2 	guide profile Sapa 618 mm HL.FP.0618	1
3 	precision shaft Ø 6h6 617 mm HL1.PW.06.0617	2
4 	face plate fixed bearing side HL1.FT.010	1
5 	face plate loose bearing side HL1.FT.011	1
6 	belt cover HL1.BL.0010	1
7 	toothed belt wheel 3M, 32 teeth, W 9 mm, 6 mm hole HL.ZAN.HTD3M32.09.06	2
8 	toothed belt wheel 3M, 32 teeth, W 9 mm, 6.35 mm hole HL.ZAN.HTD3M32.09.0635	1
9 	timing belt 3M, 1500 mm, 500 teeth, W 9 mm HL.ZAN.HTD3M500.1500	1
10 	rubber sealing profile HL1.HB.E301TPE	1

Illustration	Description	Num
11 	ball screw 16 x 10, length 958 mm, with recirculating ball nut ZAN.KGS1610.0958M	2
12 	guide profile Sapa 918 mm HL.FP.0918	2
13 	precision shaft Ø 6h6 917 mm HL1.PW.06.0917	4
14 	cover profile Sapa 913,5 mm HL.AP.0913.5	2
15 	ball screw 12 x 4, length 220 mm, with recirculating ball nut ZAN.KGS1204.0220M	1
16 	guide profile Sapa 318 mm HL.FP.0318	1
17 	precision shaft Ø 6h6 316 mm HL1.PW.06.0316	2

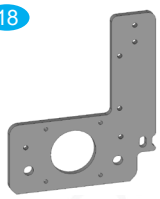
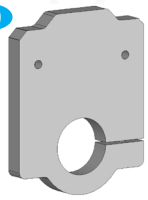
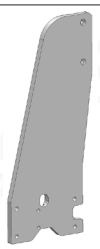
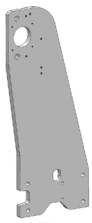
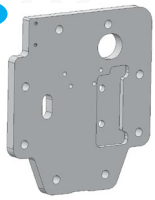
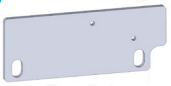
Illustration	Description	Num
18 	motor plate Z HL1.FT.001	1
19 	end plate Z HL1.FT.002	1
20 	right portal plate (loose bearing side) HL1.FT.004	1
21 	left portal plate (driving side) HL1.FT.003	1
22 	sled HL1.FT.005.01	1
23 	nut block table / portal for 16 spindle HL1.FT.009	3
24 	nut block Z axis for 12 spindle HL1.FT.014	1
25 	reference switch bracket X and Y HL1.BL.0005	2
26 	reference switch bracket X HL1.BL.0004	1

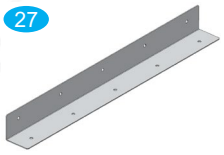
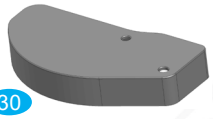
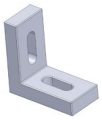
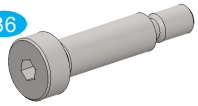
Illustration	Description	Num
27 	drag chain angle for portal HL1.BL.0006	1
28	obsolete	
29	obsolete	
30 	reference switch casing HL1.3D.0001	3
RS 	reference switch EZB.T1	3
31 	drag chain 1 m 18 x 25 mm MZS.1825	3
32 	connector kit for drag chain 18 x 25 mm MZS.A1825	2
33 	mounting bracket for drag chain HL.PR.BW.604020	1
34 	cable tie block 6-20 HL.PR.KB.06.20	6
35 	reference angle Z HL1.BL.0014	1
36 	locating screw DIN 7379, M6 x 25 HL.MED.SMPS12.9V.06.025.08	1
37 	adjusting washer DIN 988 8 x 14 x 0,2 mm MED.SPS.08.14.002	2
38 	miniature flange ball bearing 8 x 22 x 7 mm HL1.MT.0001	2

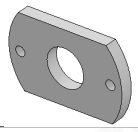
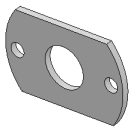
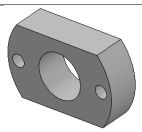
Illustration	Description	Num
39 	fixed bearing retaining plate 4 mm HL1.BL.0009	2
40 	fixed bearing spacer plate 2 mm HL1.BL.0008	2
41 	fixed bearing seat HL1.FT.008	2
42 	fixed bearing spacer sleeve 8 x 12 x 5 mm HL1.DH.001	2
43 	coupling HL1.FL.001	2
44 	min.-ball bearing 688 2RS 8 x 16 x 5 mm HL1.MT.0002	4
45 	min.-ball bearing R4 2RS 6.35 x 15.875 x 4.978 mm HL1.MT.0003	2
46 	sleeve bearing M250 Iglidur HL1.MT.0004	3
DS 	Spacer (3D printed) HL1.MED.DIST.LOLA	1
47 	adjusting washer DIN 988 10 x 16 x 1.2 mm MED.SPS.10.16.012	2
48 	centric roller guide HL.0002	8
49 	eccentric roller guide HL.0003	8

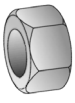
Illustration	Description	Num
50 	castor LFR50/8-6.2RS HL.0005	16
51 	flat nut M8 x 0,75 for exc. roller guide HL.0004 **Fine thread!**	8
52 	adjusting washer DIN 988 8 x 14 x 1 mm 6 MED.SPS.08.14.010	48
53 	table profile 20 x 20 mm Typ B, length 917 mm HL.PR.062020B.0917	2
54 	table profile 20 x 20 mm Typ B, length 482 mm HL.PR.062020B.0482	4
55 	emergency stop 30 mm 1-pole / bore 16 mm ENT.001K	1
59 	washer Ø M8 galvanized, large	
57 	washer Ø M6 galvanized, large	
58 	washer Ø M4 galvanized, large	
	nut DIN 934 59 M4 60 M6	
61 	DIN 985 M6, self-locking nut	
62 	DIN 985 M8 x 1, self-locking nut **Fine thread!**	
63 	DIN 985 M8, self-locking nut	

Illustration	Description	Num
64 	angle 5 20 x 20 mm BL.PR.W.052020	16
65 	set screw DIN 913 M5 x 8	
H1 	hammer nut Nut 6, M4	
H2 	hammer nut Nut 6, M5	
 Z1	cylinder head screw Allen low DIN 7984 M5 x 6	
 Z2	cylinder head screw Allen DIN 912 M4 x 20	
	countersunk screw Allen DIN 7991 S1 M4 x 10 S2 M4 x 16 S3 M5 x 10 S4 M5 x 20	

Illustration	Description	Num
66 	grease nipple M6 45° square ZB.HI.SN007	3
67 	grease nipple M5 45° ZB.HI.SN006	1
68 	rubber foot ZB.PUF001	4
69 	sliding block M6	
	flat headed screw Allen DIN 7380 F1 M3 x 14 F2 M4 x 8 F3 M4 x 10 F4 M4 x 12 F5 M4 x 16 F6 M4 x 25 F7 M4 x 35 F8 M5 x 8 F9 M5 x 14 G1 M5 x 20 G2 M6 x 16 G3 M6 x 20 G4 M6 x 30	
MH 	mounting aid tube Ø i 8 mm HL1.MH.0001	1

Floating bearings are not "loose bearings"

When storing a shaft in a machine, the thermal linear expansion must always be taken into account in the design. In the case of a ball screw made of high-alloy steel, for example, with a length of 0.1 ... 0.2 mm per meter per 10 Kelvin temperature difference, this is quite considerable - the additional tenths have to go somewhere.

If the roller bearings were to be firmly connected at the ends both to the shaft and to the surrounding housing, considerable axial stress would quickly arise as a result of thermal expansion. The bearings would be severely overloaded and would wear out after a short time; Gradually louder, grinding rolling noises are the alarm signal for bearing damage at the end.

Conflicting requirements

For this reason, the fit between the bearing seat on the shaft and the inner ring of the bearing as well as that between the outer ring and the bore in the housing is very tight on the fixed bearing. Great forces may be required for assembly (plastic hammer, if necessary driving sleeve for the inner ring), the use of heat and/or cold to expand or shrink the components can also be helpful. In any case, use oil!

At the floating bearing, a firm clamping should only guarantee the guidance of the shaft radially (so that it does not "slack around"), but it should be movable in the longitudinal direction to allow thermal expansion without the build-up of tension forces. The mobility can take place either between the shaft and the inner ring of the bearing or between the outer ring and the housing seat. The bearing must not jam in one of the seats. However, the seat must not be too loose either: even before any disruptive radial mobility comes into play, one of the rings could begin to "wander" and gradually wear down the seat on the shaft or in the housing.

Fixed bearing (above) and floating bearing in a Sorotec Alu-Line

Compromise: tight but not clamped

In practice, a workable compromise is usually reached by sliding the floating bearing tightly onto the end of the shaft, but without using much force. How large the force may be is at the discretion of the machine builder. The span of justifiable handling ranges from energetic pressing by hand (but without hammer blows) to pushing it onto the “sucking” seat.

Important to know: Standard parts such as bearings also have tolerances. With the problem discussed here, a few thousandths of a millimeter can make a big difference - one bearing is jammed, the next can be easily pushed on. If possible, trying out several bearings can lead to success. Otherwise it has to be reworked. This is also normal and commonplace in mechanical engineering.

Regrind bearing seat

If necessary, use a piece of abrasive fleece to make the loose bearing seat of the ball screw sufficiently free to move. Alternatively, you can also use very fine-grain sandpaper. Make sure you work evenly all around. Try frequently to slide the bearing onto the oiled seat. If the inner ring is tight without binding, the floating bearing is installed correctly.

Attention!
If you have to pull of a bearing that accidentally stuck by gripping the outer ring, it is likely badly damaged and should no longer be used.

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Pre-assembly

Portal plates

For this construction phase you need:		#
1	right portal plate	20
1	left portal plate	21
1	sleeve bearing	46
1	spacer	GS
8	castor	50
4	centric roller guide	48
4	eccentric roller guide	49
8	self-locking nut M8	63
4	flat nut M8 x 0,75 **Fine thread!**	51
24	adjusting washer 8 x 14 x 1 mm	52

- Press the plain bearing 46 together with the spacer ring GS into the bearing hole in the right portal cheek 20 (see Fig. 1a).

Assemble the roller guides of the portal cheeks as shown in pictures 1 and 2. Pay attention to the correct installation position of the guide bolts.

- Install the centric roller guides 48 with the hexagon head on the inside into the lower holes of the portal plates 20 21. Tighten the screw connections well.

- Screw the nut 51 on the roller side flush with the eccentric bolt 49 (do not tighten, Fig. 1c). Assemble the eccentric roller guides with the hexagon socket on the outside in the upper bores of the portal cheeks. Only loosely tighten the nut 63 on the outside by hand - later the guidance of the Y-axis will be adjusted here and the screw tightened.

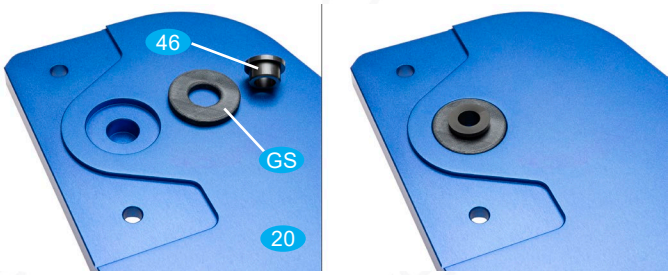

Fig. 1a: Mounting the plain bearing in the right portal cheek

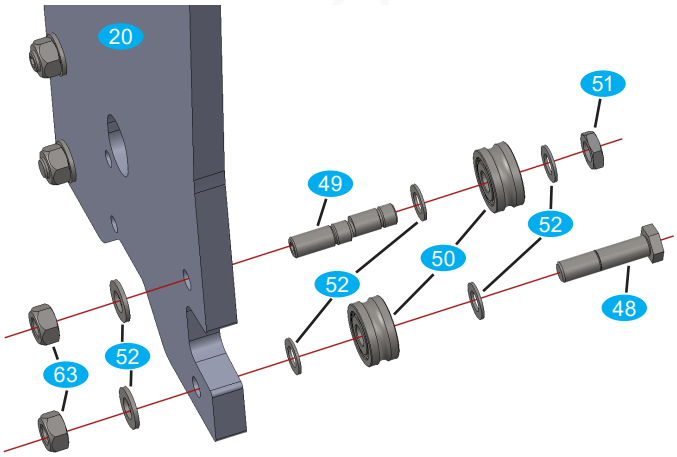

Fig. 1b: Assembly of guide rollers for the portal plate

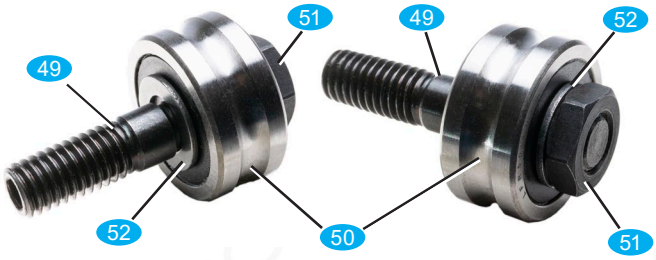

Fig. 1c: Screw on the nut flush with the eccentric bolt

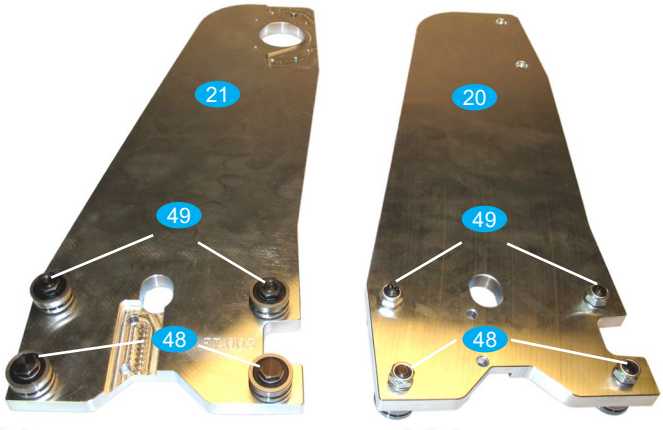

Fig. 2: Mount the hexagon side of the eccentrics towards the outside of the portal cheek.

Sled

For this construction phase you need:		#
1	sled	22
8	castor	50
4	centric roller guide	48
4	eccentric roller guide	49
8	self-locking nut M8	63
4	flat nut M8 x 0,75 **Fine thread!**	51
24	adjusting washer 8 x 14 x 1 mm	52

Assemble the roller guides of the carriage as shown in pictures 3 to 6. Pay attention again to the correct installation position of the guide bolts.

- Install centric roller guides 48 in holes X1 and X2 of the sled 22. Tighten the screw connection well.
- Install eccentric roller guides 49 in the holes X3 and X4 of the sled. Only pull the screw connections loosely by hand.
- Now proceed accordingly for the rollers on the opposite side: centric roller guides in holes Z1 and Z2, eccentrics in holes Z3 and Z4.

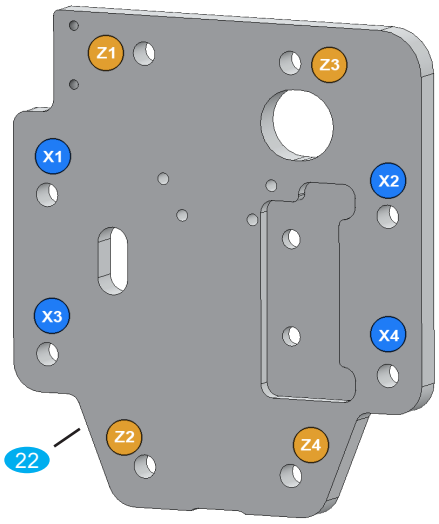

Fig. 3: The holes for the guides in the X and Z direction

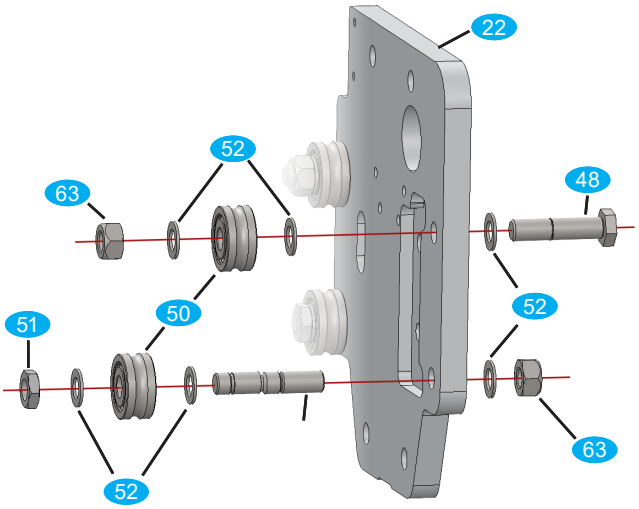

Fig. 4: Assembly of castors on the X axis

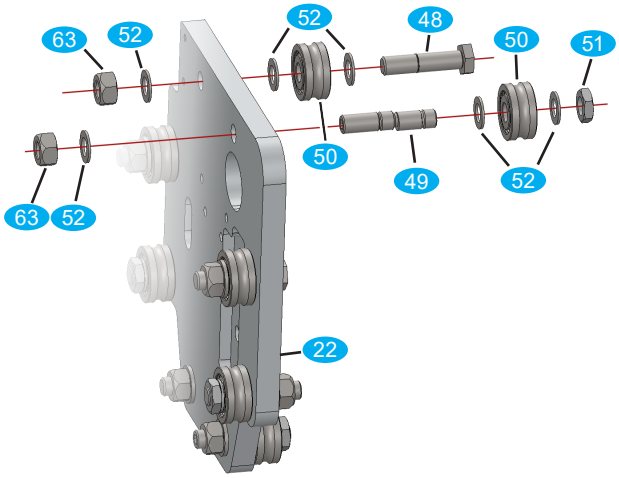

Fig. 5: Assembly of castors Y-axis

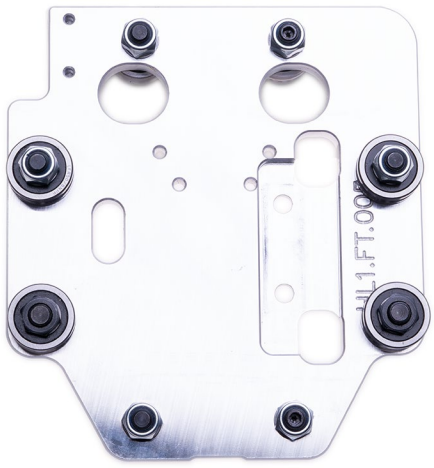

Fig. 6: Fully assembled X and Z castor guide

Sides of the table

For this construction phase you need:		#
2	guide profile 918 mm	12
4	precision shaft 917 mm	13
2	table profile 917 mm	53
12	cylinder head screw M4 x 20	Z2
12	hammer nut M4	H1
	sealing profile	10

Prepare the table sides:

- Load the cross holes of the table profiles 53 with cylinder screws Z2 and screw on one hammer nut H1 a turn or two.
- Place the table profiles 12 with the hammer nuts in the upper side groove of the guide profiles (see figure 7). Align to center: Protrusion must be avoided!
- Press the table profile downwards and tighten the screw connection.

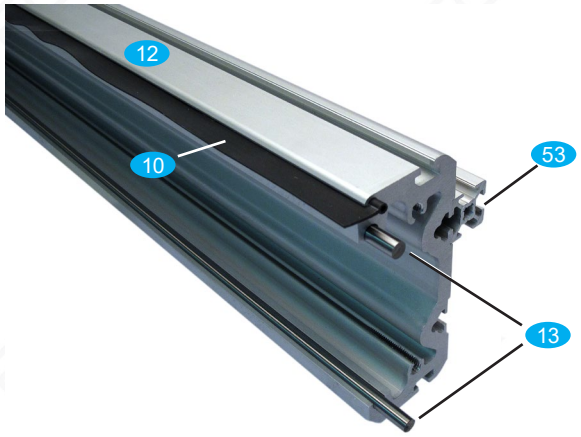

Fig. 7: Lateral guide profile with attachments

- Guide the sealing profile 10 into the designated groove of the guide profile (see picture 7) and cut it flush with scissors.
- Push the precision shafts 13, on which the castors will run later, into the corresponding channels of the guide profiles. Temporarily secure the shafts with a little tape to prevent them from slipping out.

Spindles

Y-axis

For this construction phase you need:		#
2	ball screw 16 x 10 mm, L 958 mm	11
2	fixed bearing retaining plate 4 mm	39
2	fixed bearing spacer plate 2 mm	40
2	fixed bearing seat	41
2	fixed bearing spacer sleeve	42
4	ball bearing 8 x 16 x 5 mm	44
2	adjusting washer 10 x 16 x 1,2 mm	47
2	self-locking nut M8 x 1, **Fine thread!**	62
2	grease nipple M6 45°	66
2	nut block	23
8	flat headed screw M5 x 20	G1
1	mounting aid	MH
4	flat headed screw M6 x 16	G2
	pre-assembled portal plates	

Attention!

Never turn the spindle nut from a ball screw! The spindle nut cannot be reassembled with common tools. A ball screw without a spindle nut has been destroyed and must be replaced with a new part.

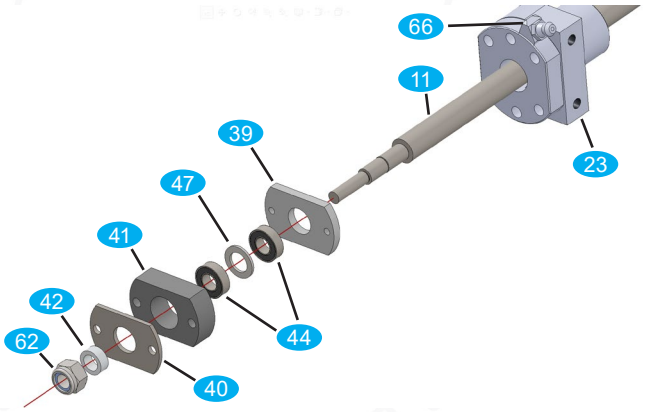

Fig. 8: Mounting the fixed bearings on the Y spindles

Prepare the Y axis spindles:

- First, screw a grease nipple 66 onto each spindle nut. Pay attention to the note aside!
- Lubricate the spindle nuts with a grease gun and remove excess grease with a rag.
- Mount the nut blocks 23 on the spindle nuts with four flat headed screws G1 each (Fig. 9).
- **Carefully** clamp the spindle between two wooden blocks or plastic jaws in a vice.
- Now assemble the parts of the fixed bearings in the order shown in Figure 8. Use the assembly aid MH and a plastic hammer to push the ball bearings 44 onto the fit of the spindle. Attention: Only press the ball bearing onto the inner ring!
- To adjust the axial play, tighten the shaft nut 62 until the fixed bearing unit can only be turned around the ball screw with difficulty. Then carefully loosen the shaft nut a little (approx. 5°) until the ball screw can easily be turned again.
- Finally, screw the spindles with flat headed screws G2 to the nut blocks with the portal plates. Do not tighten the screws.

Note:
The threads of grease nipples tear off easily. Turn the nipples back a full turn now and then when screwing them in.

The grease nipples that come with the spindles are obsolete. Use the grease nipples 66 from the screw set.

The installation position of the grease nipples - pointing through the hole above or through the cutout of the portal cheek below - is determined during assembly. It depends on the version of the spindle nut and can vary (Figs. 10 to 12)

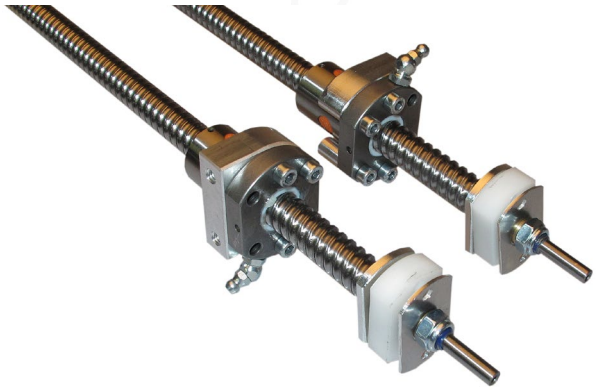

Fig. 9: Grease nipples and nut blocks on the Y spindles.

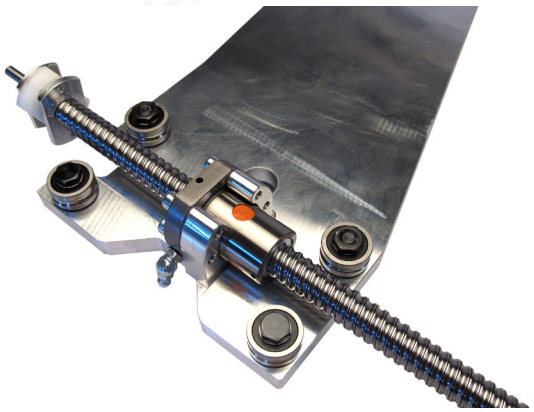

Fig. 10: Right portal cheek with mounted spindle.

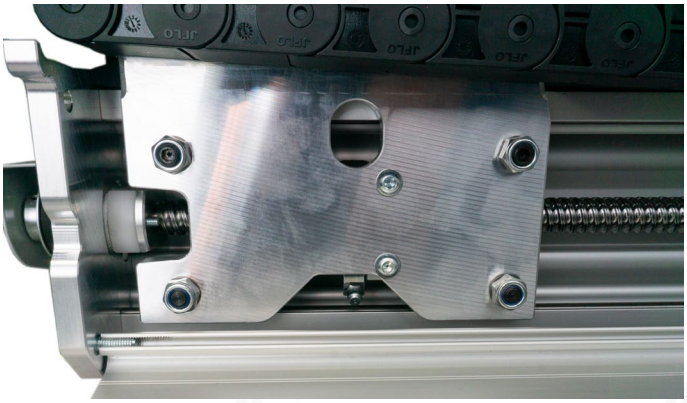

Fig. 11: Left portal cheek with nipple below.

Fig. 12: Right portal cheek with nipple through hole.

X-axis

For this construction phase you need:		#
1	ball screw 16 x 10 mm, L 609 mm	1
1	grease nipple M6 90°	66
1	nut block	23
4	flat headed screw M5 x 20	G1
2	flat headed screw M6 x 16	G2
	pre-assembled sled	

Prepare the X axis spindle:

- Screw the grease nipple 66 onto the spindle nut.
- Lubricate the spindle nuts with a grease gun and remove excess grease with a rag.
- Mount the nut block with the flat headed screws G1.
- Finally screw the spindle to the nut block in the milled pocket of the slide using flat-head screws G2. Do not tighten the screws.

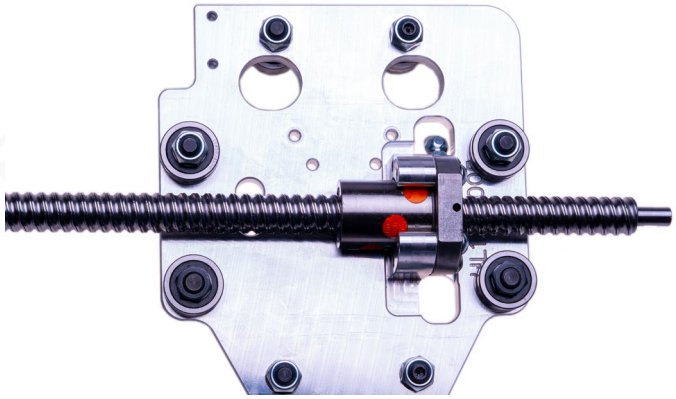

Fig. 13: Sled with the X-spindle installed

Z-axis

For this construction phase you need:		#
1	ball screw 12 x 4 mm, L 220 mm	15
1	grease nipple M5 45°	67
1	nut block	24
6	flat headed screw M4 x 16	F5
	pre-assembled sled with X-axis	

Prepare the Y axis spindle:

- Screw the grease nipple 67 onto the spindle nut.
- Lubricate the spindle nuts with a grease gun and remove excess grease with a rag.
- Mount the nut block with four flat headed screws F5 (lower bores unpopulated).
- Finally screw the spindle with flat-head screws F5 on the nut block on the slide, as shown in Fig. 14. Tighten the screws.

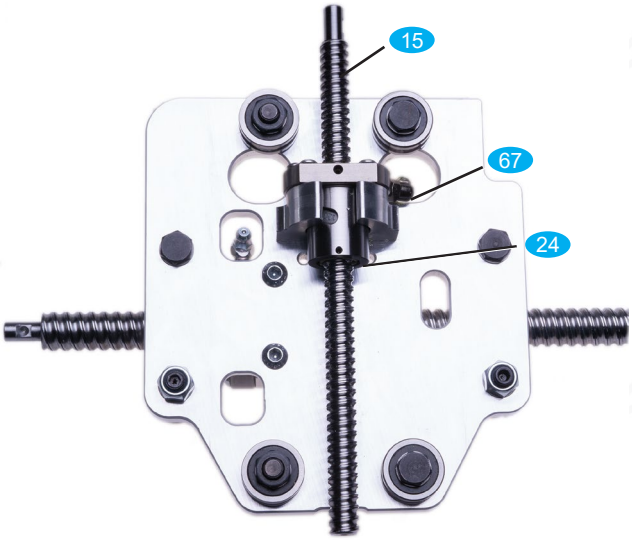

Fig. 14: Sled with the Z-spindle installed

Final assembly

Table

For this construction phase you need:		#
1	face plate fixed bearing side	4
1	face plate loose bearing side	5
2	sleeve bearing	46
8	flat headed screw M6 x 20	G3
4	flat headed screw M4 x 25	F6
4	rubber foot	68
4	washer Ø M6	57
4	nut M6	60
4	sliding block M6	69
	pre-assembled table sides	
	pre-assembled portal plates	

Assemble the table as follows:

- Press the two sleeve bearings 46 into the face plate 5.
- Use the flat-head screws G3 to screw the two pre-assembled table sides to the face plate 5, as shown in Fig. 15. Do not tighten the screws.
- Complete the rubber feet 68 with an M6 nut 60, a washer 57 and a sliding block 69. Insert the feet with the sliding block into the lower longitudinal groove of the side profiles and screw the feet tight as shown in Fig. 16.

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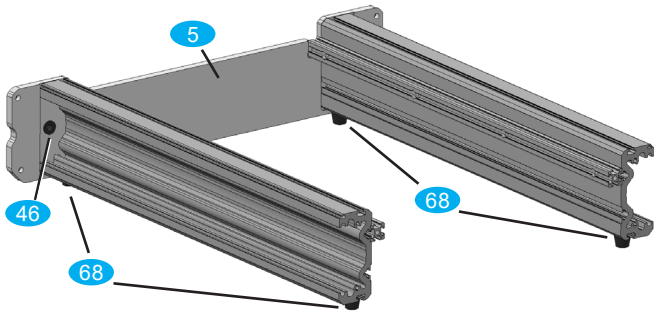

Fig. 15: Basic table structure

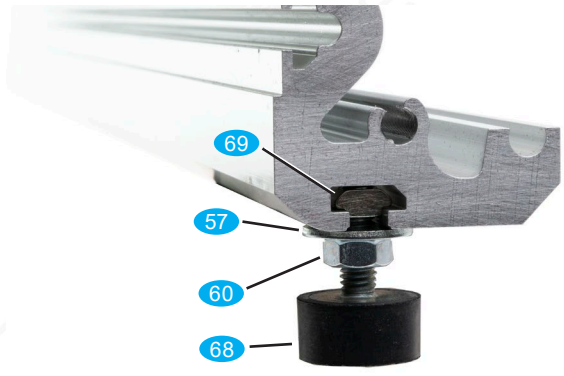

Fig. 16: Installation of rubber foot

- Remove the adhesive tape with which you secured the guide rails (precision shafts 13) in the table sides against slipping out.
- Trace the right portal plate into the guide on the right side of the table, as shown in Fig. 17. To do this, loosen the screw connections of the eccentrics if necessary and turn them with an Allen key until the rollers run tension-free on the rails.
- Insert the front end of the spindle into the sleeve bearing pressed into the face plate.
- Proceed in the same way with the left portal plate.

Note:
The exact setting of the roller guide will be done later.

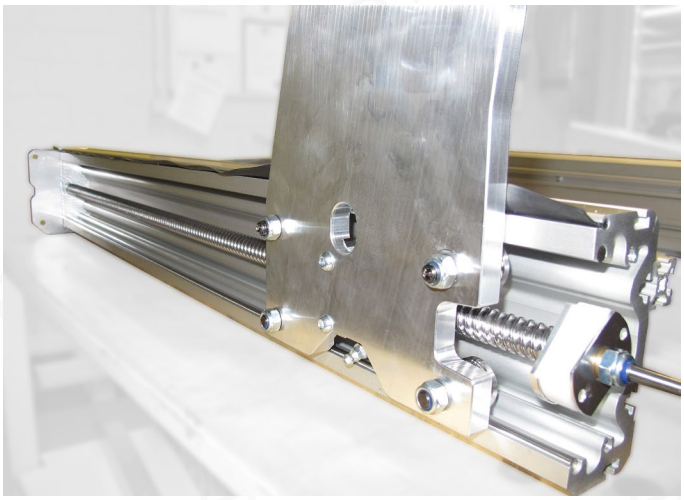

Fig.17: Installation of the right portal cheek

Fixed bearing side

- Use flat-head screws G3 to mount the rear end face plate 4 on the table sides. Do not tighten the screws.
- Use flat-head F6 screws to screw the fixed bearings of the Y-spindles to the rear face plate. Do not tighten the screws.

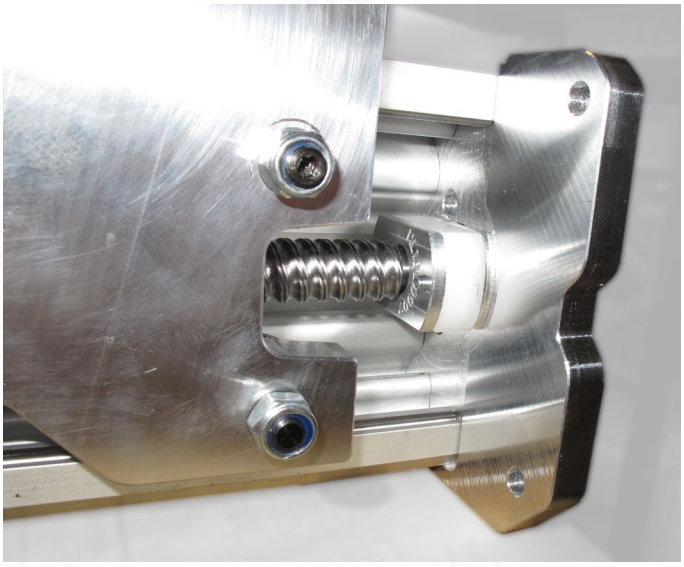

Figure 18: Bolted fixed bearing of the right Y-spindle

Portal

For this construction phase you need:		#
1	guide profile 618 mm	2
2	precision shaft 617 mm	3
4	flat headed screw M6 x 20	G3
	pre-assembled table sled	

Assemble the portal as follows:

- The Z spindle can be rotated out of the spindle nut by its own weight. Secure the spindle against unintentional unscrewing before installation.
- Push the precision shafts 3 into the corresponding channels of the guide profile 2 as shown in Fig. 7 (the sealing profile also shown there is omitted on the portal).
- Trace the sled into the guide profile. To do this, loosen the screw connections of the eccentrics again if necessary and turn them with an Allen key until the rollers run tension-free on the rails.

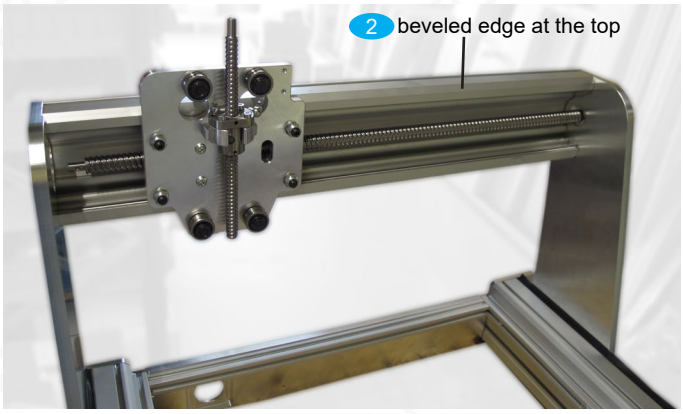

Fig. 19: Portal group consisting of guide profile and sled with roller guidance and spindles for X and Z

Note:
When installed, the beveled edge of the guide profile points upwards (see Figure 17).

- Use flat-head screws G3 to assemble the construction consisting of the guide profile and sled between the portal plates, as shown in Fig. 19. Insert the right end of the X spindle into the sleeve bearing. Do not tighten the screws.

Axis drive X

For this construction phase you need:		#
1	coupling	43
1	ball bearing	45
	obsolete	28
1	Stepper or servo motor NEMA 23	

Assemble the drive for the X axis as follows:

- Push the ball bearing 45 onto the motor axle as far as it will go.

Note:
To push the bearing 45 onto the motor axis, you can use the coupling 43 and a plastic hammer as an assembly aid.

- Push the coupling with the stepped side first onto the motor axle as far as it will go and tighten the threaded pin.

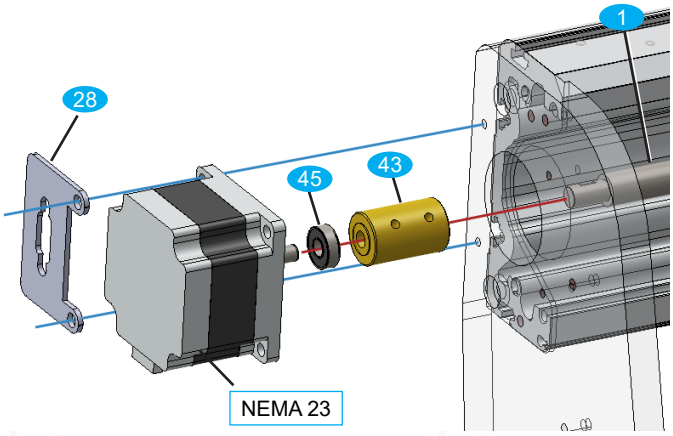

Fig. 20: Assembly of the drive for the X axis

- Attach the motor with the cable connection pointing to the rear. Bolt down the motor using flat-head screws F3. The bracket 28 shown in the picture is obsolete.
- For the time being, do not tighten the setscrew on the spindle side of the clutch.

Tightening the basic screw connection and adjusting the castors

Your portal milling machine has now been set up so far that all screw connections can be tightened and the castors on the X and Y axes can be adjusted. To do this, proceed as follows:

X-axis

- Push the sled all the way to the left by hand (motor side of the spindle).

Note:
If the sled is very difficult or impossible to move, check whether two or more of the motor cables are short-circuited. In this case, the motor can also act as a strong brake without external wiring.

- Push the guide profile forwards and downwards while tightening the connecting screws on the portal plates.
- Loosen the nuts of the eccentric roller guides.
- Now set the guide rollers one after the other. To do this, turn the eccentric with an Allen key until the roller lies against the rail. Continue to turn the eccentric until you can feel a clear resistance - but never more than 5 degrees after the roller is in contact.
- Tighten the nut of the set roller guide and repeat the setting for the second roller.
- ighten the coupling set screw onto the flat of the spindle end.
- Tighten the screw connection between the sled and the nut block of the X axis.

Y-axis

- Push the portal all the way back by hand (fixed bearing side of the Y-spindles).
- Press the sides of the table inwards and downwards while tightening the connecting screws on the face plates.
- Set the roller guides of the portal plates as described for the rollers on the X axis.
- Tighten the screws of the fixed bearings on the rear face plate.
- Tighten the screw connections between the portal plates and the nut blocks of the Y spindles.

Fig. 21: Adjusting the guide rollers

Check the X and Z axes for axial play:

- Loosen the threaded pin on the motor side on the coupling.
- From the rear of the motor, press the motor axis firmly towards the spindle.
- Press the coupling firmly against the bearing.
- Tighten the threaded pin again.

Axis drive Y

For this construction phase you need:		#
2	toothed belt wheel 6 mm hole	7
1	toothed belt wheel 6.35 mm hole	8
1	timing belt	9
1	locating screw M6 x 25	36
2	adjusting washer 8 x 14 x 0,2 mm	37
2	flange ball bearing	38
2	washer M8	56
1	washer M6	57
1	self-locking nut M6	61
4	flat headed screw M4 x 10	F3
	obsolete	29
1	Stepper or servo motor NEMA 23	

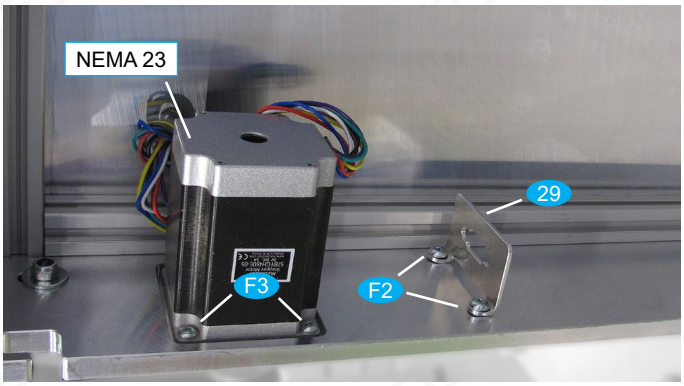

Fig. 22: Y motor and holding plate for plug connection

Assemble the drive for the Y axis as follows:

- Use flat-head screws F3 to bolt the motor into the hole provided in the rear end plate. See Fig. 22.

  The bracket 29 shown in the picture is obsolete.

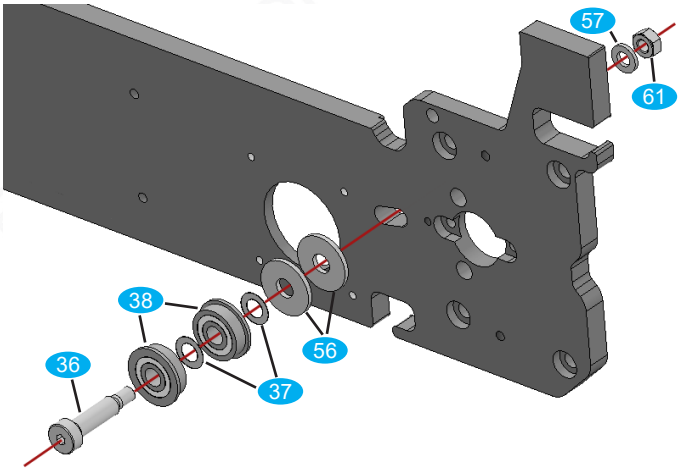

Fig. 23: Mounting the tension pulley (surrounding components are not shown for clarity)

- Assemble the tension pulley as shown in Fig. 23. Do not tighten the screw connection yet.
- Place the toothed belt wheels 7 with the clamping side facing outwards on the Y spindles and tighten the clamping screws.
- Place the toothed belt wheel 8 on the motor shaft with the clamping side facing inwards and tighten the clamping.
- Put on the timing belt 9 as shown in Fig. 24.
- Tighten the timing belt with the tension pulley and tighten the screw connection of the pulley.

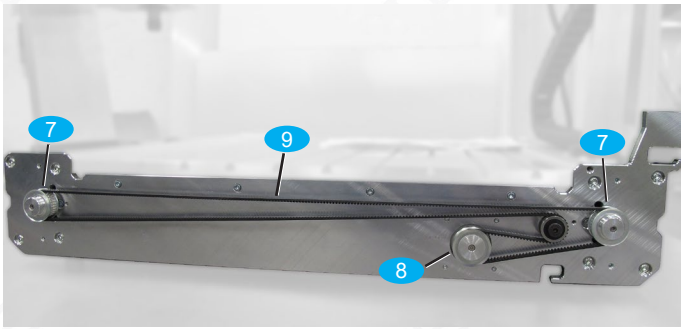

Fig. 24: Structure of the timing belt drive

Note:
The belt tension is set correctly if:

- *on the one hand there is no sag visible and*
- *on the other hand the free rotation is not hindered.*

Guidance Z-axis

For this construction phase you need:		#
1	guide profile 318 mm	16
2	precision shaft 316	17
1	motor plate Z	18
1	end plate Z	19
2	flat headed screw M6 x 20	G3
2	flat headed screw M6 x 30	G4

Assemble the Z-guidance as follows:

- Use flat-head screws G4 to mount the end plate 19 on the guide profile 16. Tighten the screws.
- Push the precision shafts 17 into the corresponding channels of the guide profile.
- Trace the guide profile into the Z-roller guidance from below.

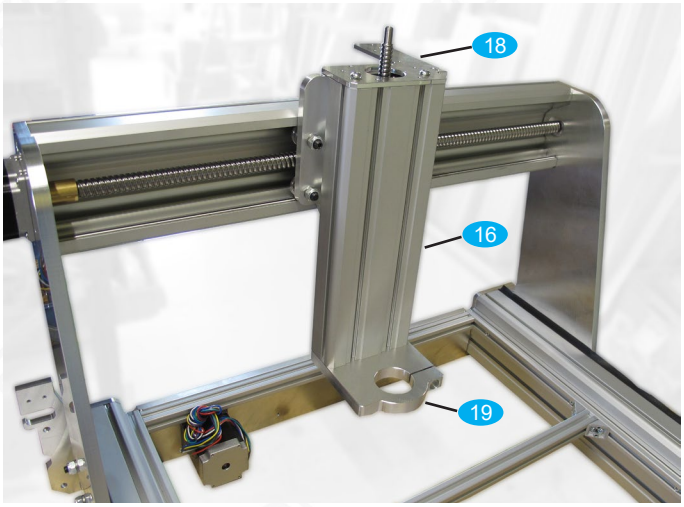

Fig. 25: The parts of the Z-axis guide

- Mount the motor plate 18 on the guide profile with flat-head screws G3. Do not tighten the screws. Fig. 36 on page 21 alternatively shows the installation of the plate in the reverse position in order to achieve a space-saving course of the drag chain connected here.

Axis drive Z

For this construction phase you need:		#
1	coupling	43
1	ball bearing	45
4	flat headed screw M4 x 10	F3
	obsolete	29
1	Stepper or servo motor NEMA 23	

Assemble the drive for the Z axis as follows:

- Push the ball bearing 45 onto the motor axle as far as it will go.

Note:
To push the bearing 45 onto the motor axis, you can use the coupling 43 and a plastic hammer as an assembly aid.

- Slide the coupling with the flat side first onto the spindle and screw the grub screw firmly onto the flat end of the spindle.

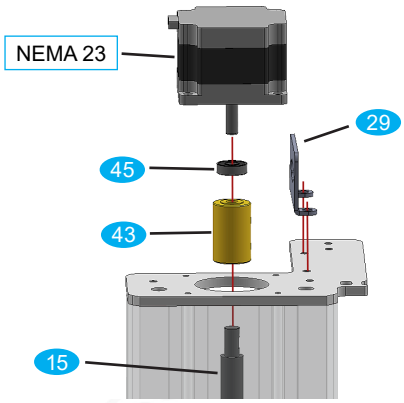

Fig. 26: Assembly of the drive for the Z axis

- Attach the motor with the cable connection pointing to the right. Screw the motor with flat head screws F3. Tighten the second set screw of the coupling.
- Set the rollers of the Z guide as described on page 17 for the X axis.
- Tighten the screw connections on the motor plate.
- The bracket 29 shown in the picture is obsolete.

Rail Locking

For this construction phase you need:		#
8	set screw	65

The precision shafts that serve as rails for the roller guides must be secured against slipping. To do this, screw the set screws 65 into the corresponding holes:

- left and right in the rear face plate
- in the left portal plate (engine side)
- in the motor plate of the Z guide

Note:
Tighten the grub screws carefully hand-tight! Excessive preload on the rails leads to crackling noises when moving the axes.

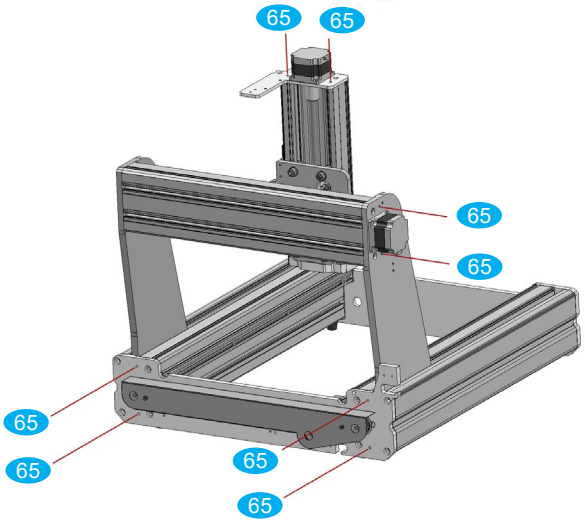

Fig. 27: Threaded holes for the rail lock

Side covers

For this construction phase you need:		#
2	cover profile	14
1	sealing profile	10
8	flat headed screw M6 x 20	G3

Assemble the side covers as follows:

- Guide the sealing profile 10 into the designated groove of the cover profile and cut it flush with a sharp knife.
- Mount the cover profiles with flat headed screws G3. The cover profiles are deliberately one millimeter shorter than the table profiles for better mobility. Do not overtighten the screws to avoid bending the face plates.

Fig. 28: For maintenance of the spindles, the side covers can be easily opened after removing the upper screws.

Attachment parts

Emergency switch

For this construction phase you need:		#
1	Emergency switch 30 mm	55

- Mount the emergency stop switch in the hole provided in the front face plate, as shown in Fig. 29.

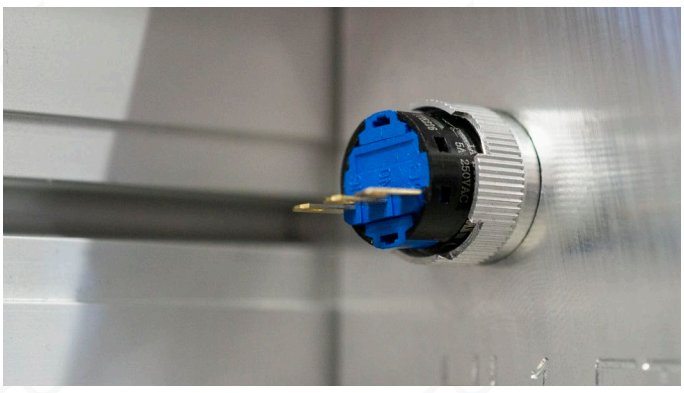

Fig. 29: Emergency stop switch, view from behind

Reference switches

For this construction phase you need:		#
3	reference switch casing	30
3	reference switches	RS
2	bracket X / Y	25
1	bracket Z	26
1	reference angle Z	35
2	flat headed screw M4 x 8	F2
6	flat headed screw M3 x 14	F1
6	flat headed screw M5 x 8	F8
6	hammer nut M5	H2

The reference switches RS, the housings 30 and the holding plates 25 / 26 together form a unit.

- Mount the housing 30, switch RS and holding plates 25 / 26 with flat-head screws F1.
- Mount the reference switches with flat head screws F8 and hammer nuts H2 at the end positions of the axes, as shown in Figs. 30 to 34.

  Position the retaining plates of the X and Y switches flush with the outer edge of the machine, the plate of the Z switch 90 mm below the upper edge of the motor plate.
- The reference angle 35 is used to trigger the reference switch on the Z axis. Mount the bracket to the sled using flat-head screws F2 as shown in Fig. 33.

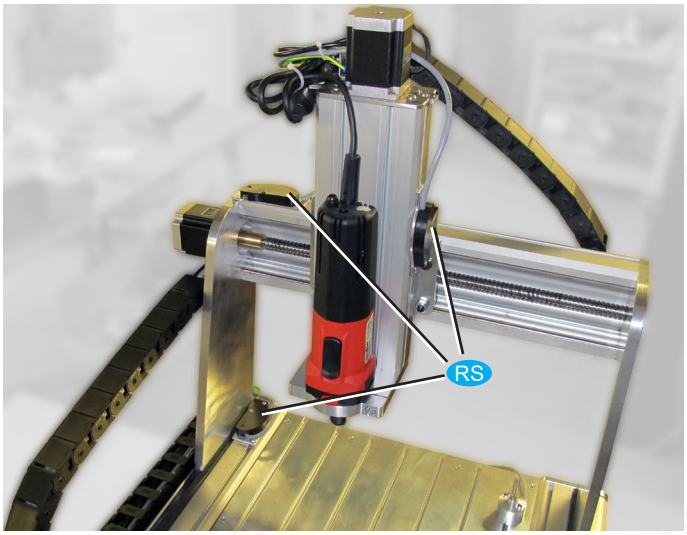

Fig. 30 Position of the reference switches on the machine

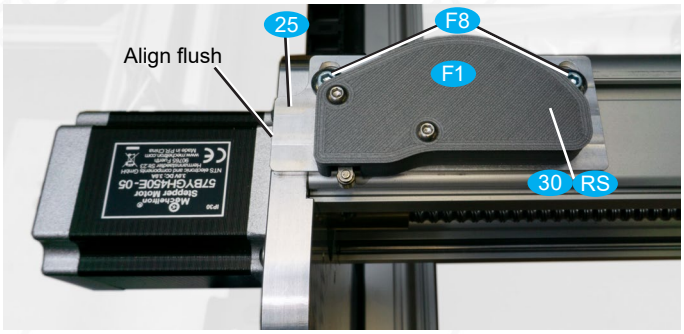

Fig. 31: Reference switch X axis

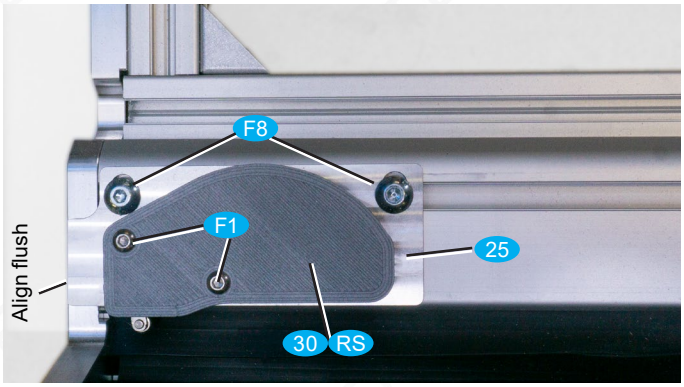

Fig. 32: Reference switch Y axis

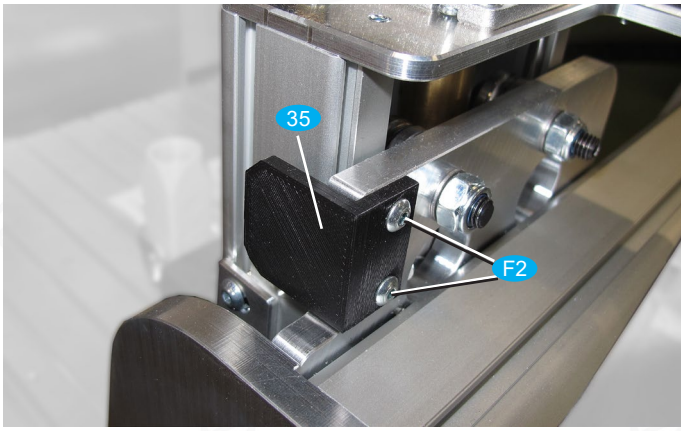

Fig. 33: Reference angle Z axis

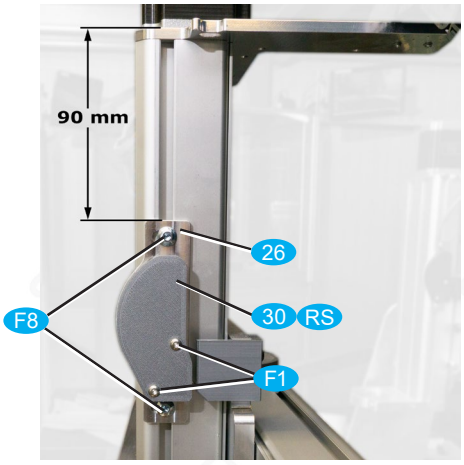

Fig. 34: Reference switch Z axis

Drag chains

For this construction phase you need:		#
1	drag chain angle	27
2	drag chain	31
2	connector kit for drag chain	32
1	mounting bracket for drag chain	33
5	flat headed screw M4 x 8	F2
5	hammer nut M4	H1
2	flat headed screw M5 x 14	F9
5	countersunk screw M4 x 10	S1
2	countersunk screw M4 x 16	S2
3	washer M4	58
3	nut M4	59
6	cable tie block	34
6	countersunk screw M5 x 10	S3
6	hammer nut M5	H2

Proceed as follows to assemble:

- Attach the drag chain angle 27 to the back of the guide profile 12 using flat-head screws F2 and hammer nuts H1, as shown in Figs. 35 and 36.
- Fasten the connection kit 32 to the motor plate 18 using countersunk screws S1. Adjust the length of the X drag chain 31 by removing or adding links.
- Hang the X drag chain in the connection kit and fasten the free end to the drag chain bracket with countersunk screws S1, washers 58, nuts 59 and the second part of the connection kit, as shown in Fig. 35.
- Mount the mounting bracket 33 with flat-head screws F9 on the right portal plate, as shown in Fig. 36.
- Screw the second connection kit 32 to the mounting bracket with two countersunk screws S2, washers 58 und nuts 59 and adjust the length of the Y drag chain 31.

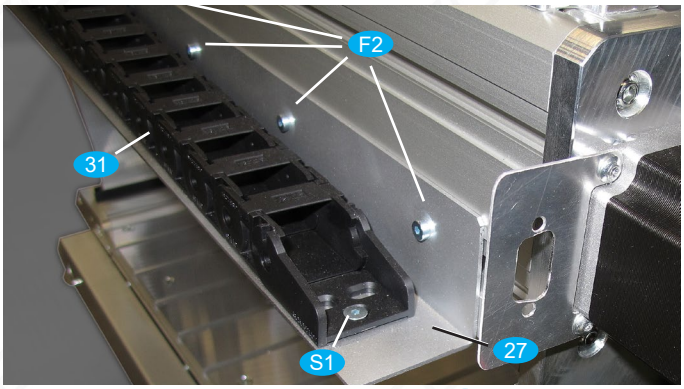

Fig. 35: Mounting the drag chain angle 27 on the back of the guide profile for the X axis

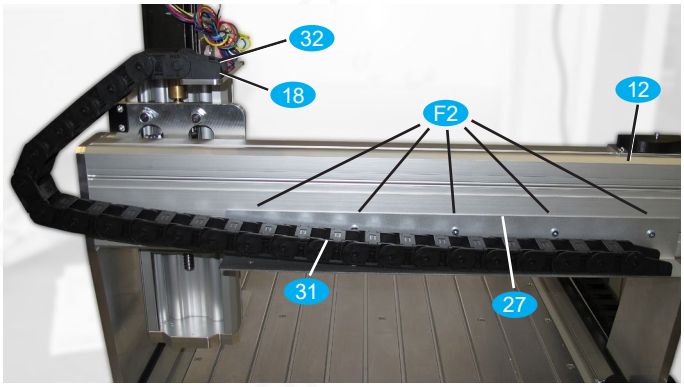

Fig. 36: Assembly of the drag chain for the X axis. Deviating from the standard construction, the motor plate 18 with the drag chain support is installed on the inside to save width.

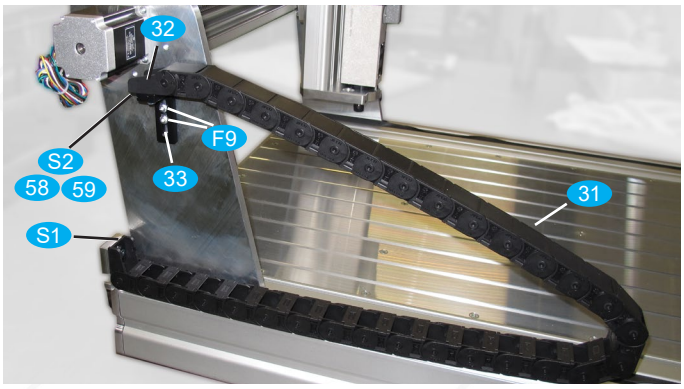

Fig. 37: Assembly of the drag chain for the Y axis

- Hang the Y-drag chain in the connection kit and fasten the free end to the rear face plate using the connection kit and countersunk screws S1, as shown in Fig. 37.

The cable tie blocks 34 can be fixed in the profile grooves with countersunk screws S3 and hammer nuts H2 and serve as variable fastening points for the cabling.

Table bracing

For this construction phase you need:		#
5	table profile 482 mm	54
16	angle	64
8	flat headed screw M4 x 12	F4
32	cylinder head screw M5 x 6	Z1
8	hammer nut M4	H1
32	hammer nut M5	H2

Note:
The following instructions describe the regular procedure. When installing a groove or screen printing plate with hammer nuts, it can be easier to retrofit the middle struts from below.

Assemble the table bracing as follows:

- Screw a table profile 54 mit with flat head screws F4 and hammer nuts H1 from the inside to the front and rear face plate, as shown in Fig. 39.
- Screw the middle table profiles at an even distance with angles 64, cylinder head screws Z1 and hammer nuts H2.

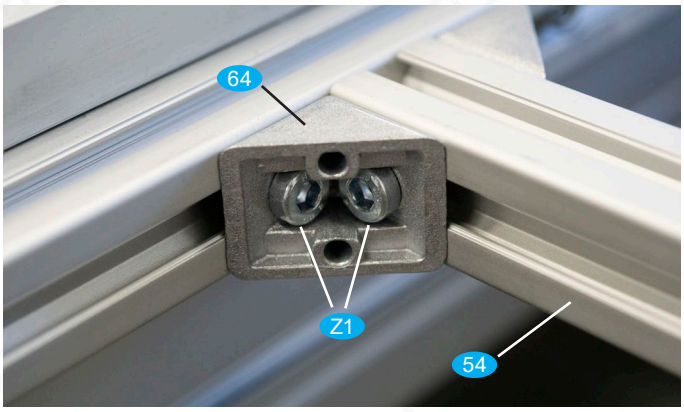

Fig. 38: Corner connection with angle

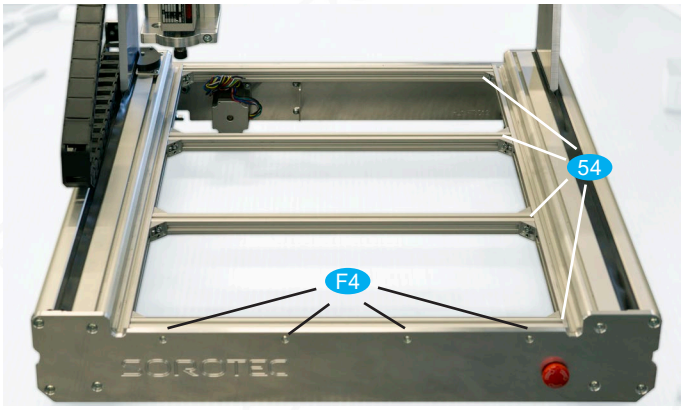

Fig. 39: The finished base for the table top. The number of screws in the face plate depends on the width of the machine.

Belt cover

For this construction phase you need:		#
1	belt cover	6
2	flat headed screw M4 x 35	F7

- Mount the belt cover 6 with flat head screws F7.

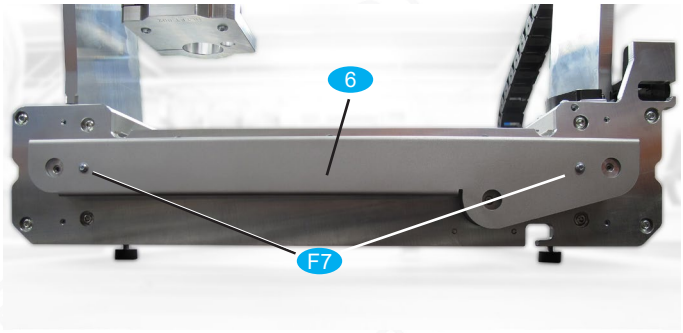

Fig. 40: Fully assembled toothed belt cover

Workpiece support

For this construction phase you need:		#
20	Countersunk screw M5 x 20	S4
20	Hammer nut M5	H2

Note:
Fastening is done in the same way for each type of workpiece support.

- Equip the mounting holes of the workpiece support with countersunk screws S4.
- On the underside of the pad, thread the T-nuts H2 onto the bolts one turn at a time (Fig. 41).

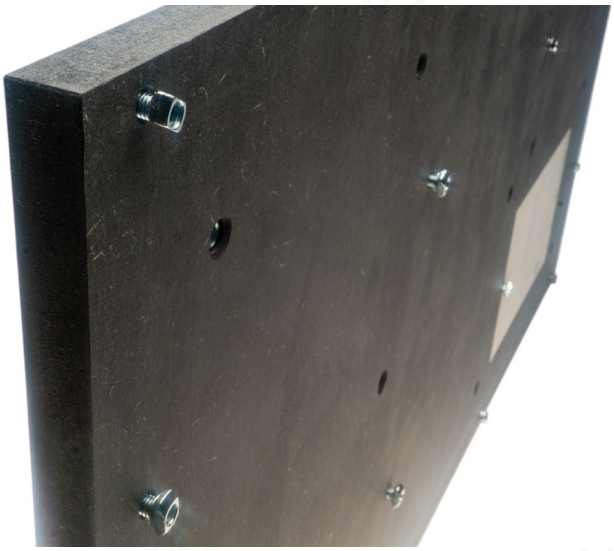

Fig. 41: Underside of an MDF workpiece support with cap nuts turned on

- Align the T-Nuts lengthwise to the profiles they will sink into in the next step.
- Place the workpiece support on the table profiles. Align hammer nuts that do not dip into the grooves of the table profiles by lifting the plate and carefully turning the respective countersunk screw. Repeat aligning the nuts all around until the panel drops into place.
- Tighten the countersunk screws.

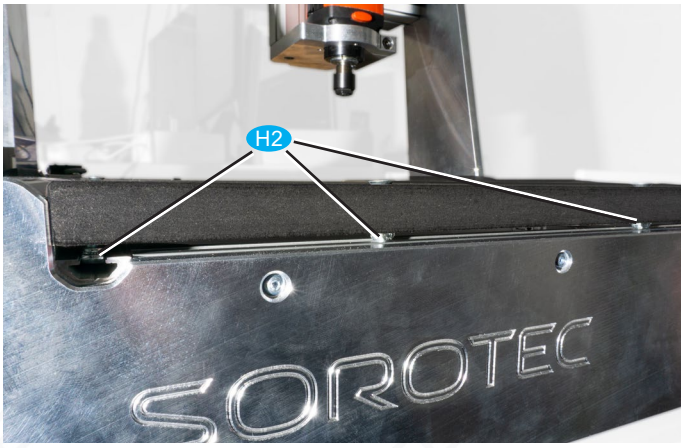

Fig. 42: Hammer nuts not yet properly aligned

Note:
The assembly of the workpiece support requires some patience. It may be easier to attach the top without the middle table profiles and to install them later from below.

Milling spindle

Note:
Only tighten the screw of the collar clamp just enough that you can no longer turn the milling motor. Otherwise the output bearing of the motor could be damaged.

Use liquid screw lock (e.g. Loctite) to prevent the clamp from loosening.

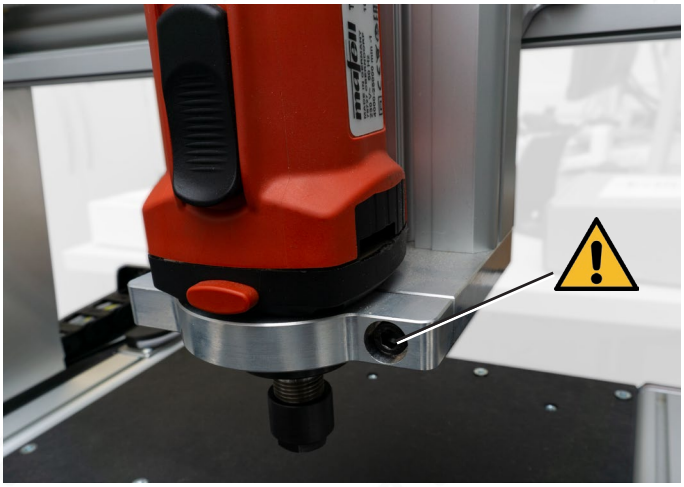

Fig. 43: Carefully tighten the collar clamp

Maintenance

In normal use, the portal milling machine should be lubricated every six months, but at the latest after twelve months. To do this, proceed as follows:

Note:
There is a video instruction about lubrication: https://youtu.be/mlZTcE045v0

All axes

- When removing excess grease, wipe with a cloth over the precision shafts of the roller guide to counteract the formation of flash rust.

X axis

- Remove the Z-axis reference angle 35.
- Remove the end plate 19 of the Z axis with the milling spindle mounted in it.
- Loosen the spindle-side clamping screw in the drive coupling 43 of the Z axis.
- Lift the Z-axis guide profile 16 upwards out of the roller guide.
- Lubricate the spindle nut of the X axis with a grease gun, as shown in Fig. 44.
- Remove excess fat with a rag.
- Assemble the Z-axis parts back into place.

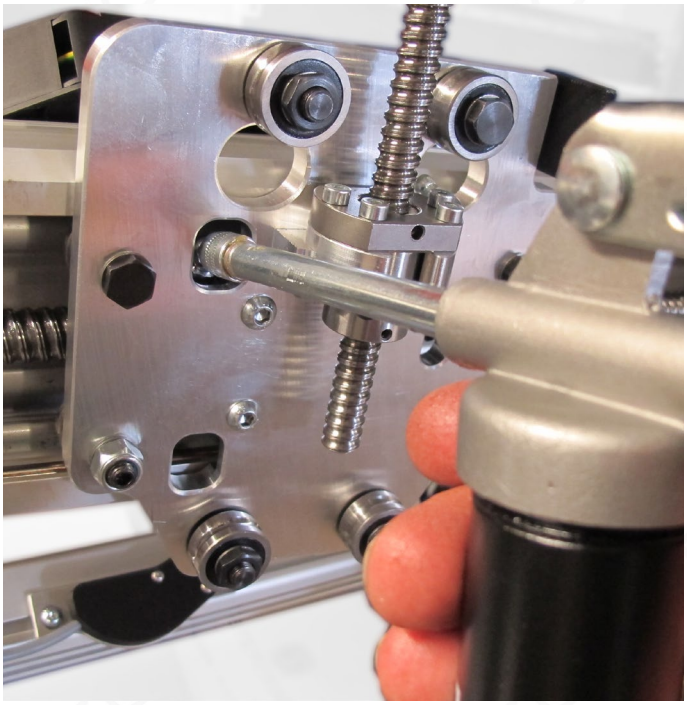

Fig. 44: Lubricating the X axis

Note:
As a grease gun, we recommend the „mini grease gun“ set from the Sorotec online shop (item no. SM.00018).

The machine kit also includes a thinner tube with a slimmer nozzle. These parts fit any standard grease gun.

Common multi-purpose grease is sufficient to lubricate the spindle nuts.

The guide rollers are encapsulated and lubricated for life. Lubrication is neither possible nor necessary.

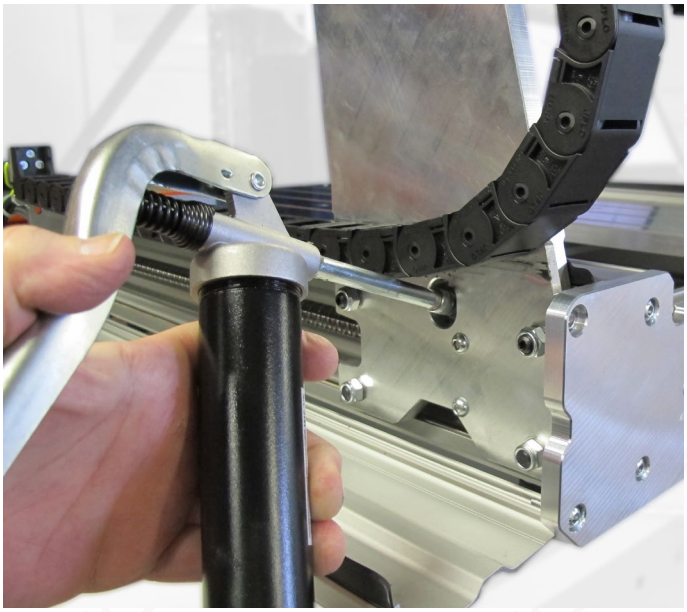

Fig. 45: Lubricating the Y axis - left side.

Y axis

- Remove the top screws of the cover profiles 14 at the front and rear.
- Loosen the lower screws and open the covers.
- Lubricate the Y axis spindle nuts as shown in Figs. 45 and 46. The position of the grease nipples can vary.
- Close and screw on the covers.

Z axis

- Lubricate the Z-axis spindle nut as shown in Fig. 47.

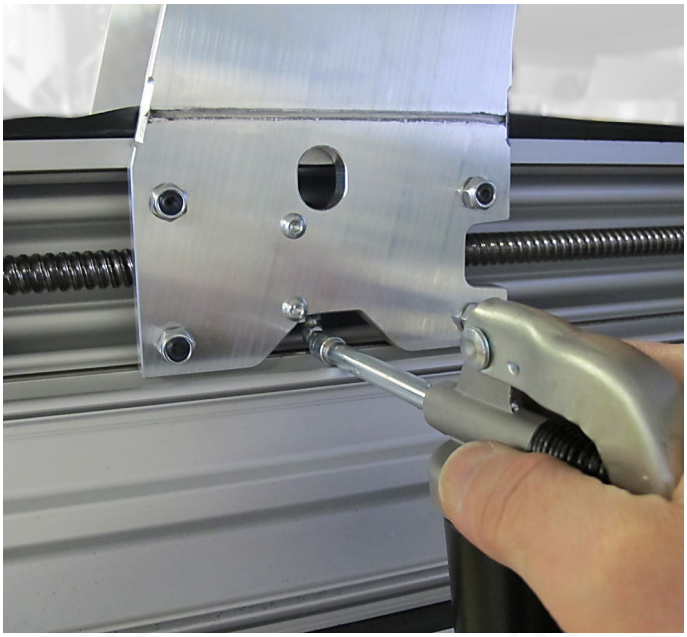

Fig. 46: Lubricating the Y axis - right side.

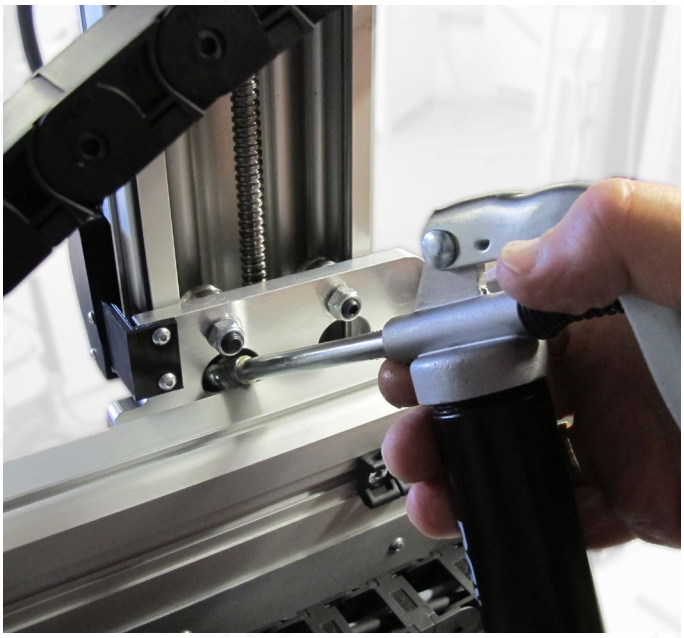

Fig. 47: Lubricating the Z axis