Assembly instructions
CNC portal milling machine kit
Alu-Line

SOROTEC GmbH
Withig 12
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MPF.ALxxxx.01.B.BL

Version 2.2.1

	Machine parameters ALU LINE					
	Mechanical properties					
TYPE:	ALU 0605	ALU 0607	ALU 0610	ALU 1105	ALU 1107	ALU 1110
Travels mm:	X: 650 | Y: 550 Z: 220	X: 650 | Y: 750 Z: 220	X: 650 | Y: 1050 Z: 220	X: 1150 | Y: 550 Z: 220	X: 1150 | Y: 750 Z: 220	X: 1150 | Y: 1050 Z: 220
Clamping surface mm:	X: 1000 | Y: 550	X: 1000 | Y: 750	X: 1000 | Y: 1050	X: 1500 | Y: 550	X: 1500 | Y: 750	X: 1500 | Y: 1050
Installation dimensions:	L: 1050 | B: 960 H: 1080	L: 1050 | B: 1160 H: 1080	L: 1050 | B: 1560 H: 1080	L: 1550 | B: 960 H: 1080	L: 1550 | B: 1160 H: 1080	L: 1550 | B: 1460 H: 1080
Passage under portal:	Z: 270					
Ball screws:	X: 16 x 10 mm | Y: 16 x 10 mm | Z: 16 x 5 mm | Tolerance class T07					
Repeatability:	approx. +/- 0.02 mm					
Weight w/o accessories:	approx. 95 kg	approx. 105 kg	approx. 120 kg	approx. 120 kg	approx. 130 kg	approx. 140 kg
Linear guides:	Linear guides 20 mm | carriage with medium preload					
Clamping plate:	Optionally available: aluminum T-slot plate, screen printing plate					
	Software parameters					
Steps / revolution:	X: 3200 | Y: 3200 | Z: 3200 *1)					
Steps / mm:	X: 320 | Y: 320 | Z: 640 *1)					
Max. Feed speed Ge-schwindigkeit:	X: 150 mm/s or 9 m/min | Y: 150 mm/s or 9 m/min | Z: 83 mm/s or 5 m/min *2)					
Acceleration mm/s²:	X: 300 | Y: 300 | Z: 200 *2)					
Remarks:	*1) with 3200 micro steps of the power amplifier *2) with 48 V supply voltage and high-quality power amplifiers.					

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	Machine parameters ALU-LINE HEAVY							
	Mechanical characteristics							
TYPE:	ALU 1105 HEAVY	ALU 1107 HEAVY	ALU 1505 HEAVY	ALU 1507 HEAVY	ALU 1510 HEAVY	ALU 2007 HEAVY	ALU 2010 HEAVY	ALU 2013 HEAVY
Travel mm:	X: 1150 | Y: 550 Z: 220	X: 1150 | Y: 750 Z: 220	X: 1550 | Y: 550 Z: 220	X: 1550 | Y: 750 Z: 220	X: 1550 | Y: 1050 Z: 220	X: 2050 | Y: 750 Z: 220	X: 2050 | Y: 1050 Z: 220	X: 2050 | Y: 1350 Z: 220
Clamping surface mm:	X: 1500 | Y: 550	X: 1500 | Y: 750	X: 1850 | Y: 550	X: 1900 | Y: 750	X: 1900 | Y: 1050	X: 2400 | Y: 750	X: 2400 | Y: 1050	X: 2400 | Y: 1350
Installation dimensions mm:	L: 1550 | B: 960 H: 1080	L: 1550 | B: 1160 H: 1080	L: 2000 | B: 960 H: 1080	L: 2000 | B: 1160 H: 1080	L: 2000 | B: 1460 H: 1080	L: 2450 | B: 1160 H: 1080	L: 2450 | B: 1460 H: 1080	L: 2450 | B: 1760 H: 1080
Passage under portal mm:	Z: 270							
Ball screws:	X: 25 x 10 mm | Y: 16 x 10 mm | Z: 16 x 5 mm | tolerance class T07							
Repeatability:	approx. +/- 0.02 mm							
Weight w/o accessories:	approx. 180 kg	approx. 200 kg	approx. 210 kg	approx. 210 kg	approx. 220 kg	approx. 210 kg	approx. 240 kg	approx. 270 kg
Linear guides:	Linear guides 20 mm | Medium preload carriage							
Clamping surface:	Optionally available: aluminum T-slot plate, screen printing plate							
	Software parameters							
Steps / revolution:	X: 3200 | Y: 3200 | Z: 3200 *1)							
Steps / mm:	X: 320 | Y: 320 | Z: 640 *1)							
Max Feed Speed:	X: 150 mm/s or 9 m/min | Y: 150 mm/s or 9 m/min | Z: 83 mm/s or 5 m/min *2)							
Acceleration mm/s²:	X: 300 | Y: 300 | Z: 200 *2)							
Remarks:	*1) with the power stage set to 3200 microsteps. *2) with 48 V supply voltage and high-quality power amplifiers.							

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	Machine parameters ALU-LINE HEAVY GANTRY				
	Mechanical characteristics				
TYPE:	ALU 1105 HEAVY GANTRY	ALU 1107 HEAVY GANTRY	ALU 1507 HEAVY GANTRY	ALU 1510 HEAVY GANTRY	ALU 2010 HEAVY GANTRY
Travel mm:	X: 1150 | Y: 550 Z: 220	X: 1150 | Y: 750 Z: 220	X: 1550 | Y: 750 Z: 220	X: 1550 | Y: 1050 Z: 220	X: 2050 | Y: 1050 Z: 220
Clamping surface mm:	X: 1500 | Y: 550	X: 1500 | Y: 750	X: 1900 | Y: 750	X: 1900 | Y: 1050	X: 2400 | Y: 1050
Installation dimensions mm	L: 1550 | B: 960 H: 1080	L: 1550 | B: 1160 H: 1080	L: 2000 | B: 1160 H: 1080	L: 2000 | B: 1460 H: 1080	L: 2450 | B: 1460 H: 1080
Passage under portal mm:	Z: 270				
Ball screws:	X: 25 x 10 mm | Y: 16 x 10 mm | Z: 16 x 5 mm | tolerance class T07				
Repeatability:	approx. +/- 0.02 mm				
Weight w/o accessories:	approx. 190 kg	approx. 200 kg	approx. 220 kg	approx. 230 kg	approx. 250 kg
Linear guides:	Linear guides 20 mm | Medium preload carriage				
Clamping surface:	Optionally available: aluminum T-slot plate, screen printing plate				
	Software parameters				
Steps / revolution:	X: 3200 | Y: 3200 | Z: 3200 *1)				
Steps / mm:	X: 320 | Y: 320 | Z: 640 *1)				
Max Feed Speed:	X: 150 mm/s or 9 m/min | Y: 150 mm/s or 9 m/min | Z: 83 mm/s or 5 m/min *2)				
Acceleration mm/s²:	X: 300 | Y: 300 | Z: 200 *2)				
Remarks:	*1) with the power stage set to 3200 microsteps. *2) with 48 V supply voltage and high-quality power amplifiers.				

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Introduction

Congratulations on purchasing our kit for a CNC portal milling machine from the Alu-Line. Before assembly, we recommend reading through these instructions completely and then assembling the kit step by step as described.

General information

Please assemble the kit as carefully as possible and exact – the accuracy of the finished machine depends not only on the quality of the delivered components, but also to a large extent of correct assembly and alignment. All components must be checked prior to assembly to ensure they are free of burrs and reworked if necessary.

Optional accessories

The fully assembled machine can be further supplemented and adapted to your requirements with optional accessories. In the Sorotec shop you will find, among other things, milling spindles, base frames, housings, vacuum tables, control electronics, control software and minimum quantity lubrication.

Attention!

Only carry out the work if you are familiar with the necessary actions and suitable tools are available. Sorotec GmbH assumes no liability for damage to property or personal injury occurring during assembly or operation of the CNC portal milling machine!

Notice:

1. These instructions apply to all Alu-Line kits.

2. **When assembling a kit with 2 ball screws on the X-axis, the sections marked with 2S the additional instructions „Assembly 2nd ball screw X-axis“ must be observed.**

3. **For the Alu Line Heavy and the Alu Line Heavy Gantry, it is essential to observe the additional instructions “Heavy”.**

4. All directions (left, right, front, back, up and down) in this manual are based on the view as shown in the figure below.

Fig. 1: From left to right - Alu-Line 1110, 1107 and 0605

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.

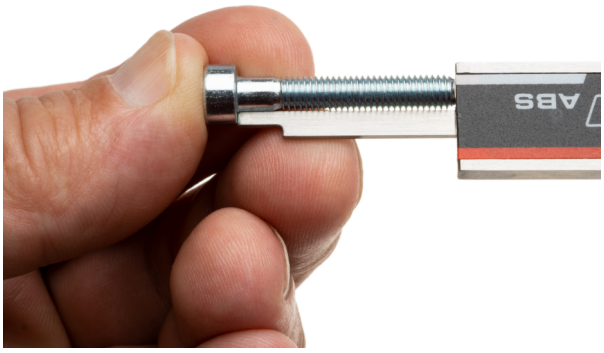
Examples:

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

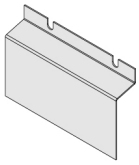
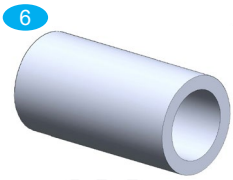
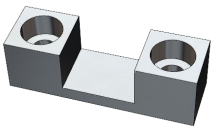
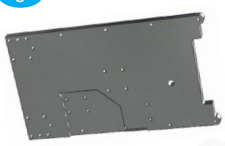
Illustration	Description	Num.
1 	Cover cap 8 120x40 for profile 37 AL.PR.AK.0812040	2
2 	Timing belt cover X single AL.BL.002.01	1
3 	Timing belt cover AL.BL.001.01	1
4 	Abschlussplatte Y Loslager AL.FT.015.01	1
5 	Stop plate Z AL.FT.018.01	1
6 	Spacer sleeve for belt guard Y AL.DH.08.29	2
7 	Stop Z AL.FT.022.01	1
8 	Flange plate X nut AL.FT.019.01	1
9 	Guide plate Y AL.FT.009.01	1

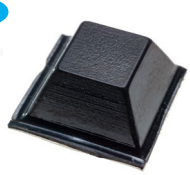
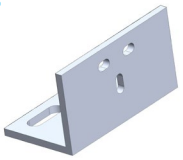
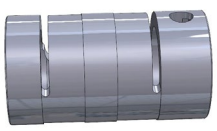
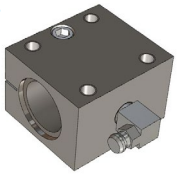
Illustration	Description	Num.
10 	Guide plate Z AL.FT.008.01	1
11 	Device foot (self-adhesive) AL.EZB.0109	8
12 	Fixed bearing retaining clip Y AL.FT.020.01	1
13 	Bracket drag chain X AL.BL.006.01	1
14 	HTD timing belt 89 teeth (X) 177 teeth (Y) 75 teeth (Z) AL.ZAN.HTD3M89.267 (X) AL.ZAN.HTD3M177.531 (Y) AL.ZAN.HTD3M75.225 (Z)	1 1 1
15 	HTD-Zahnriemenrad 36 teeth (X / Y axis) AL.ZAN.HTD3M36.15.08	4
16 	HTD-Zahnriemenrad 24 teeth (Z axis) AL.ZAN.HTD3M24.15	2
17 	Recirculating ball nut 16 x 10 AL.ZAN.KGM1610R.01	2
18 	Recirculating ball nut 16 x 5 AL.ZAN.KGM1605B.01	1

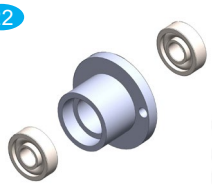
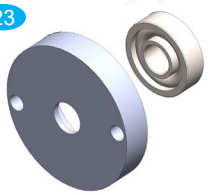
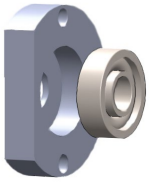
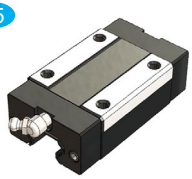
Illustration	Description	Num.
19 	Ball screw 16 x 10 Y axis see page 6 Alu-Line XX05: 837 mm lg. Alu-Line XX07: 1037 mm lg. Alu-Line XX10: 1337 mm lg.	1
20 	Ball screw 16 x 10 X axis see page 6 Alu-Line 06XX: 1015 mm lg. Alu-Line 11XX: 1515 mm lg.	1
21 	Ball screw 16 x 5 Z axis 347 mm lg. AL.ZAN.KGS1605.351	1
22 	Fixed bearing unit (housing + 2 bearings) with through holes AL.ZAN.FL16.01 with fastening threads AL.ZAN.FL16.M5.01	1 2
23 	Floating bearing unit (housing + 1 bearing) AL.ZAN.LL16.01	1
24 	Floating bearing unit with surface (housing + 1 bearing) AL.ZAN.LLB16.01	1
25 	Carriage block type ZFW.NTS.HGH20CA.ZA	11
26 	X-axis linear guide Alu-Line 06XX: 976 mm lg. Alu-Line 11XX: 1476 mm lg. see page 6	2
27 	Z-axis linear guide 486 mm lg. ZFS.HGR20R.01	2

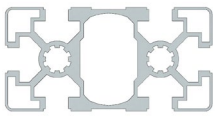
Illustration	Description	Num.
28 	Linear guide Y-axis above Alu-Line XX05: 660 mm lg. Alu-Line XX07: 850 mm lg. Alu-Line XX10: 1150 mm lg. see page 6	1
29 	Linear guide Y-axis below Alu-Line XX05: 793 mm lg. Alu-Line XX07: 993 mm lg. Alu-Line XX10: 1293 mm lg. see page 6	1
30 	Motor plate Y AL.FT.079.01	1
31 	Motor plate Z AL.FT.011.01	1
32 	Plate Z AL.FT.012.01	1
33 	Portal cheek left AL.FT.007.01	1
34 	Portal cheek on the right AL.FT.006.01	1
35 	Profile 10 45 x 90 Alu-Line XX05: 319 mm lg. Alu-Line XX07: 519 mm lg. Alu-Line XX10: 819 mm lg. see page 6	3/5
36 	Profile 10 90 x 90 Alu-Line 06XX: 978 mm lg. Alu-Line 11XX: 1478 mm lg. see page 6	2

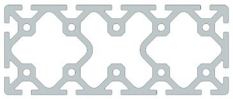
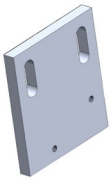
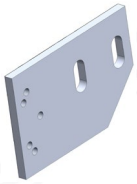
Illustration	Description	Num.
37 	Profile 8 120 x 40 Alu-Line XX05: 589 mm lg. Alu-Line XX07: 789 mm lg. Alu-Line XX10: 1089 mm lg. see page 6	1
38 	Profile 8 200 x 80 Alu-Line XX05: 795 mm lg. Alu-Line XX07: 995 mm lg. Alu-Line XX10: 1295 mm lg. see page 6	1
39 	Reference switch with isolating foil EZB.T1	3
40 	Belt protection Y AL.FT.080.01	1
41 	Switch plate for reference switch Z AL.BL.007.01	1
42 	Switch carrier X AL.FT.027.01	1
43 	Switch carrier Y AL.FT.026.01	1
44 	Drag chain holder X AL.FT.028.01	1
45 	Dirt wiper for rec. ball nut 16 x 10 rec. ball nut 16 x 5 AL.ZAN.SAB16.01	6

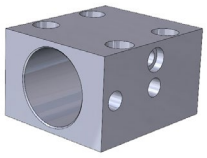
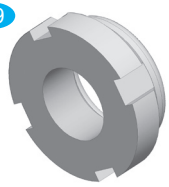
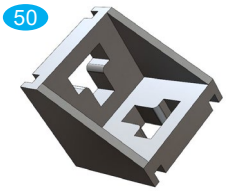
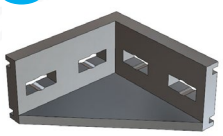
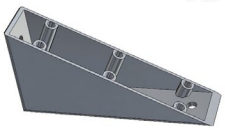
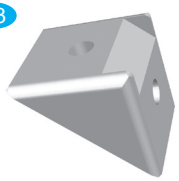
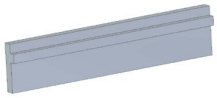
Illustration	Description	Num.
46 	Clamping block for recirculating ball nut AL.ZAN.SBI16.01	2
47 	Front plate drive side see page 6	1
48 	Front plate floating bearing side see page 6	1
49 	Shaft nut M10 x 0,75 AL.ZAN.WM10.075	3
50 	Angle 10 45x45 incl. mounting kit AL.PR.WS.104545	16
51 	Angle 10 45x90 incl. mounting kit AL.PR.WS.104590	5
52 	Angle 8 160x80 including cover cap AL.PR.WS.0816080	6
53 	Angle 8 40x40 AL.PR.WS.084040	4
54 	Z-bracing on the left AL.FT.013.01	1

Illustration	Description	Num.
55 	Z-bracing on the right AL.FT.014.01	1
56 	Groove clip ZB.3D. 0021	1
	Cylinder screw DIN 912 Allen M3x16 A1 M3x20 A2 M4x20 B1 M5x14 C1 M5x16 C2 M5x18 CA (Heavy Gantry only) M5x20 CB M5x30 C4 M5x35 C5 M5x40 C6 M6x14 D1 M6x16 D2 M6x20 D3 M6x25 D4 M8x20 E1 M8x65 E2	
	Hammer nut Nut 8 M5 F Nut 10 M5 G1 Nut 10 M8 G2	
	T-nut without bar M8 H	

Illustration	Description	Num.
	T-head screw slot 10 M8x20 I enclosed with angle 52	
99 	Assembly aid, alignment device AL.FT.031.01	1
	Flat headed screw DIN 7380 Allen M4x6 J1 M6x12 K1 M8x16 L1 M8x20 L3 M8x30 L4 M12x30 M	
	Nut DIN 934 M3 O M4 P M5 Q	
	Flange nut DIN 6923 M8 R enclosed with angle 52	
	Washer DIN 125 3,2 S 4,3 T 5,3 U	
	Straight pin hard Z DIN 6325 5 x 18 mm	

Order numbers of size-dependent parts

		Machine			
	Description	**AL 06XX**	**AL 11XX**	**AL 15XX**	**AL 20XX**
20	Ball screw X (16 x 10)	AL.ZAN.KGS1610.1019	AL.ZAN.KGS1610.1519	AL.ZAN.KGS2520.1920*	AL.ZAN.KGS2520.2420*
26	Linear guide X	AL.ZFS.HGR20R.0976.BL	AL.ZFS.HGR20R.1476.BL	AL.ZFS.HGR20R.1876.BL*	AL.ZFS.HGR20R.2376.BL*
36	Profile 10 90 x 90 (H/HG 90 x 180)	AL.PR.109090S.0978	AL.PR.109090S.1478 AL.PR.1090180S.1478*	AL.PR.1090180S.1878*	AL.PR.1090180S.2378*
		AL XX05	**AL XX07**	**AL XX10**	**AL XX13**
19	Ball screw Y (16 x 10)	AL.ZAN.KGS1610.841	AL.ZAN.KGS1610.1041	AL.ZAN.KGS1610.1341	AL.ZAN.KGS1610.1641*
28	Linear guide Y oben	AL.ZFS.HGR20R.0660.BL	AL.ZFS.HGR20R.0850.BL	AL.ZFS.HGR20R.1150.BL	AL.ZFS.HGR20R.1450.BL*
29	Linear guide Y unten	AL.ZFS.HGR20R.0793.BL	AL.ZFS.HGR20R.0993.BL	AL.ZFS.HGR20R.1293.BL	AL.ZFS.HGR20R.1593.BL*
35	Profile 10 45 x 90	AL.PR.104590L.0319	AL.PR.104590L.0519	AL.PR.104590L.0819	AL.PR.104590L.1119*
37	Profile 8 120 x 40	AL.PR.0812040L3N.0589	AL.PR.0812040L3N.0789	AL.PR.0812040L3N.1089	AL.PR.0812040L3N.1389*
38	Profile 8 200 x 80	AL.PR.0820080S.0795	AL.PR.0820080S.0995	AL.PR.0820080S.1295	AL.PR.0820080S.1595*
47	Faceplate drive side	AL.FT.001.01 AL.FT.046.01*	AL.FT.002.01 AL.FT.118.01*	AL.FT.003.02 AL.FT.105.01*	AL.FT.061.01*
48	faceplate floating bearing side	AL.FT.023.01 AL.FT.047.01*	AL.FT.024.01 AL.FT.043.01*	AL.FT.025.01 AL.FT.032.01*	AL.FT.062.01*

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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* Heavy / Heavy Gantry

Pre-assembly

Tools needed

The following tools and aids must or should be available during assembly:

- Hook wrench KM11 (part of the scope of delivery)
- Assembly aid [1)]
- Common hand tools, such as Allen keys, screwdrivers, plastic hammers, etc.
- As even a work surface as possible in the size of the base frame
- Flat or try square, at least 300 mm long in tolerance class 1 or better
- Dial indicator with stand / holder
- Torque wrench from 6 Nm to at least 25 Nm [2)]
- Flat piece of hard wood as an aid when hammering the sealing plugs flush into the linear guide rails [3)]

Note:

[1)] The assembly aid is part of the scope of delivery. It is only used to align the long lower linear guides 29 on the profiles 38. The assembly aid is placed on the milled stop edges (see page 20).

[2)] To avoid distortion caused by unevenly tightened screws, the use of a torque wrench for load-bearing screws M5 to M8 is recommended. Adhering to the prescribed screw tightening torque also prevents unintentional loosening during later operation of the machine.

3) The sealing lips of the carriages can be damaged by dirt and chips in unsealed holes as well as by plugs that are not flush.

Prepare bracket for surface mounting

When mounting a bracket on a component without fastening grooves, the centering tabs on the bracket must be removed before assembly. This can be done by breaking it off with a screwdriver or hitting it with a hammer. See Fig. 2.

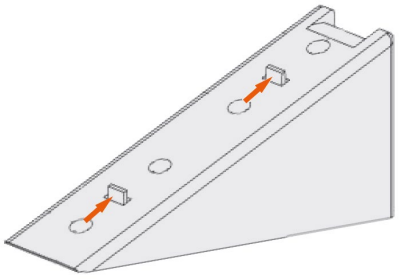

Fig. 2: Centering tabs on the mounting bracket (red arrows)

Roller bearing assembly

In order not to damage the roller bearings during assembly in the floating or fixed bearing units, only the outer bearing rings may be pressed / hit. Use a suitable drive sleeve (tube) and oil the outer bearing ring before assembly. See Fig. 3.

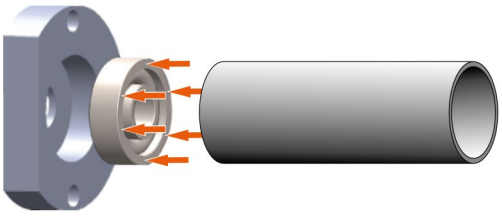

Fig. 3: Bearing assembly with driving sleeve

Ball screws, nuts and bearing units

X and Y axis:

- Pull the circlips (red arrow in Fig. 6) off the assembly sleeve and press a dirt wiper 45 into the recirculating ball nuts 17 of the X and Y axes on both sides.
- Slide the clamping blocks 46 over the recirculating ball nuts 17 in such a way that the locking screws (red ring, Fig. 4) point to the centering points (red arrow) of the recirculating ball nuts.
- Fix the recirculating ball nuts 17 with the locking screws in the clamping blocks.
- X-axis: Screw the clamping block 46 with the recirculating ball nut onto the recirculating ball screw 20 in such a way that the locking screw points to the floating bearing side.
- Y axis: Clamping block 46 with the recirculating ball nut onto the recirculating ball spindle 19 in such a way that the locking screw points to the floating bearing side.
- Press fixed bearing units 22 (X with threads in flange screw connection, Y with through holes) onto the ends of the ball screws 19 and 20 (Y with retaining clip 12) and secure by screwing on the shaft nuts 49.
- To adjust the axial play, tighten the shaft nuts 49 until the ball screws can only be turned with difficulty in the fixed bearing units. Then carefully loosen the shaft nuts slightly (approx. 5°) until the ball screws can be turned easily again.
- Press the floating bearing assembly 23 onto the end of the X ball screw 20.
- Press the flattened bearing assembly 24 onto the end of the Y ball screw 19.

Attention!

The assembly of the ball nuts on the ball screws must be done very carefully and in a clean environment!

The assembly sleeves of the recirculating ball nuts may only when turning onto the ball screws be removed! See Isel instructions in the appendix.

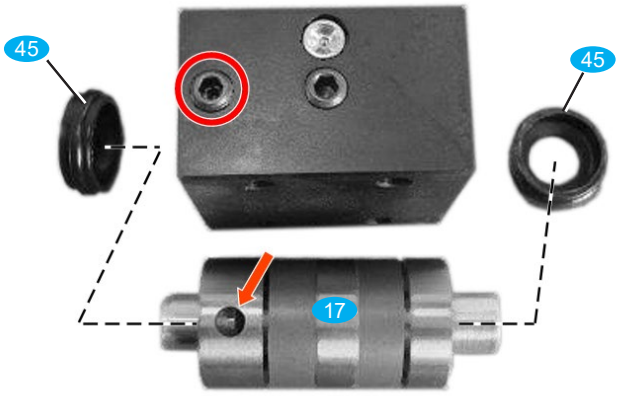

Fig. 4: Press dirt wiper into recirculating ball nut

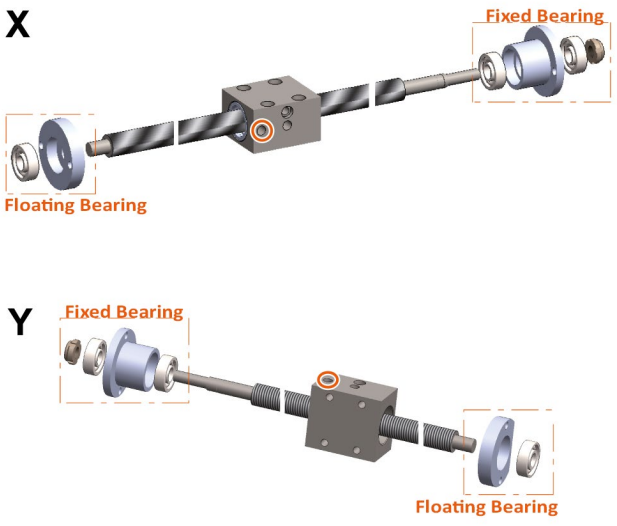

Fig 5: Mounting the X and Y spindle bearings. Use the fixed bearing housing Y with through holes in the flange and with the retaining clip 12.

Z-Axis:

- Pull the circlips (red arrow in Fig. 6) off the assembly sleeve and press a dirt wiper 45 into the recirculating ball nut 18 of the Z-axis on both sides.
- Screw the recirculating ball nut 18 Screw the recirculating ball nut 21 in such a way that the lubricating nipple points to the fixed bearing side of the recirculating ball screw (see figure 6).
- Press the fixed bearing unit 22 (with fastening threads) onto the end of the ball screw 21 and secure it by screwing on the shaft nut 49.
- To adjust the axial play, tighten the shaft nut 49 until the ball screw can only be turned with difficulty in the fixed bearing unit. Then carefully loosen the shaft nut slightly (approx. 5°) until the ball screw can be turned easily again.

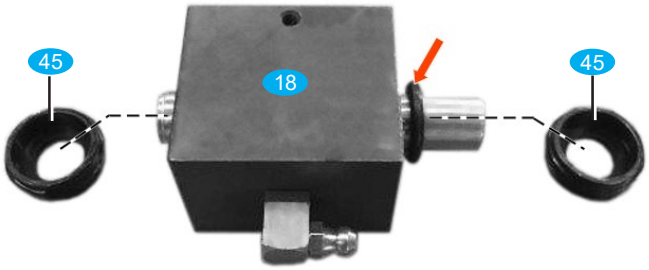

Fig. 6: Replace circlips with wipers

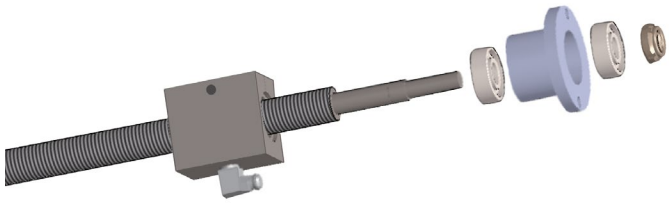

Fig. 7: Bearing assembly Z-axis. Use bearing housing with fastening threads.

Assembly

X-Axis / Base frame

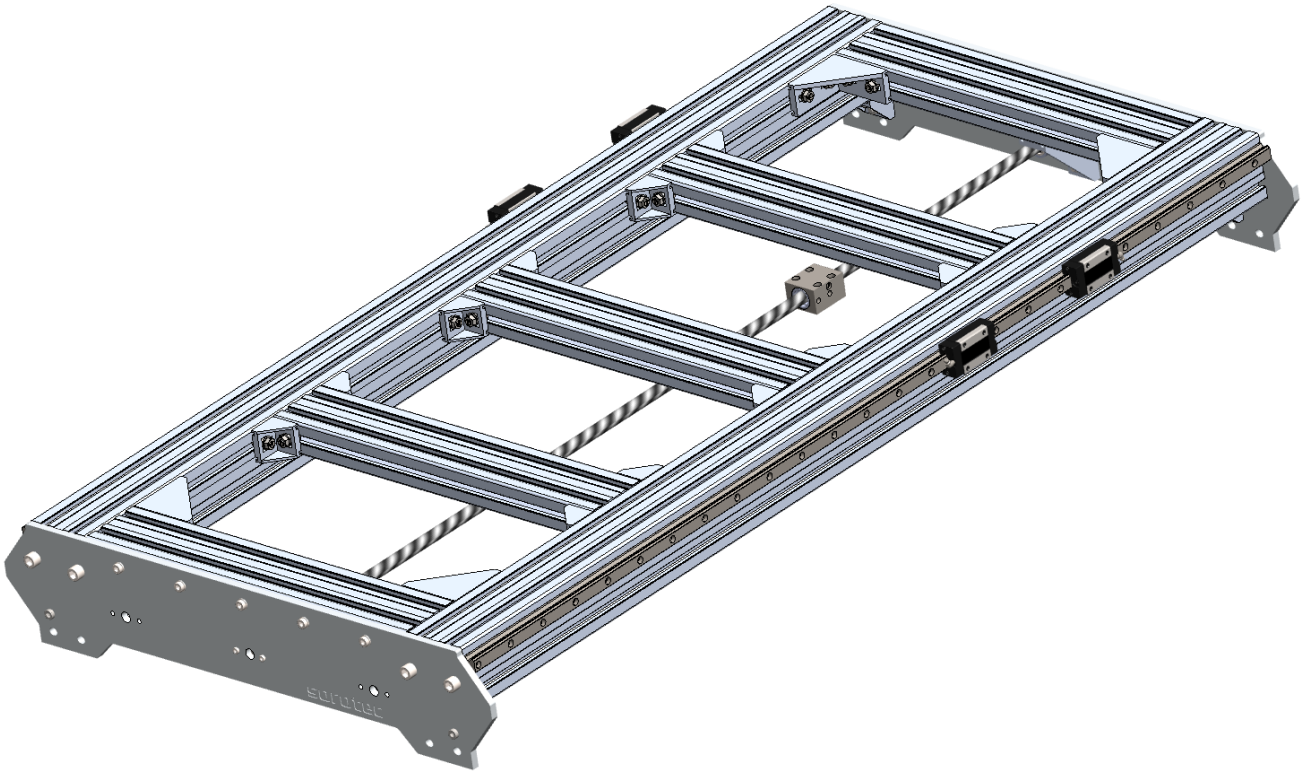

Fig. 8: Completed base frame

- Screw the linear guide 26 to the aluminum profile 36 with cylinder screws M5x20 CB (Heavy Gantry: M5x18 CA) and hammer nuts G1; the edge of the linear guide must lie against the milled stop edge of the aluminum profile (marked with a red arrow in Fig. 9) along its entire length.

- Tighten the screws evenly, starting in the middle and working outwards. Tightening torque: 6 Nm

- Repeat the work steps with the second aluminum profile or second linear guide.

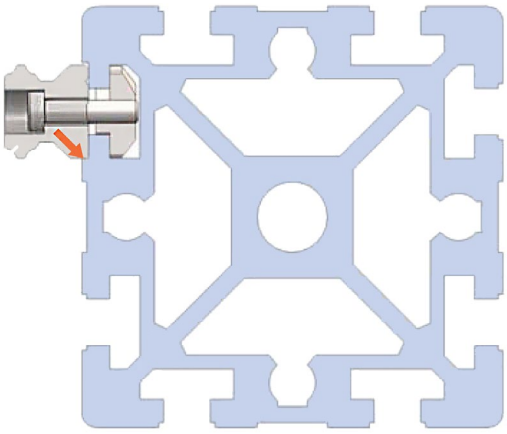

Fig. 9: Installation of linear guide on stop edge

Note:
The following illustrations show the Alu-Line 1107 kit. The assembly of the other kits is analogous.

The rest of the assembly of the base frame is carried out lying on its back, as shown in the adjacent figure.

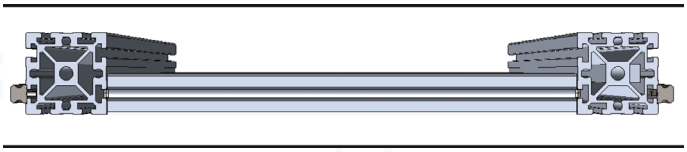

Fig. 10: Lay the base frame on its back

The base frame must be mounted in such a way that there is an air gap of around 0.5 mm between the front sides of the aluminum profiles 35 and the long aluminum profile 36 to align the base frame. On the opposite side, the front sides of the aluminum profiles 35 must be in contact with the long aluminum profile 36. **The parallelism of the base frame does not have to be taken into account in this work step. The base frame is to be fitted with as little tension as possible.**

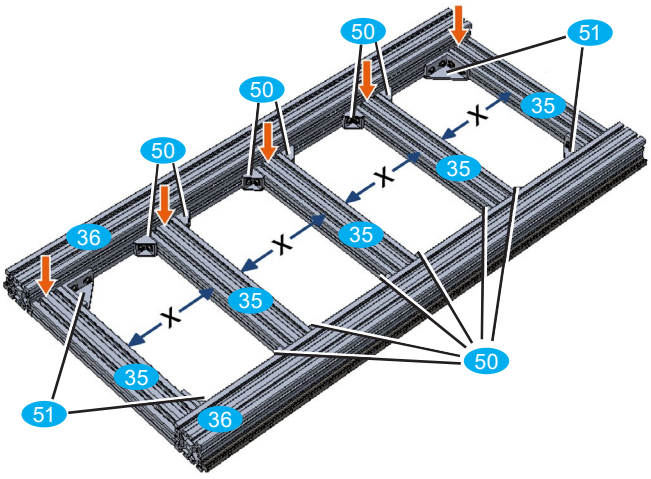

Fig. 11: Leave air gaps for alignment (red arrows)

- Lay out the aluminum profiles 35/36 as shown in Figure 11 on a level work surface and screw them together loosely with angle brackets 50/51, hammer screws I and flange nuts R.
- Move the inner aluminum profiles 35 so that fields (x) of the same length are created.
- Starting from an outside corner, tighten the screws one after the other. Always check the squareness of the base frame and correct if necessary. Tightening torque: 25 Nm
- Equip the front plate drive side 47 with flat-head screws M8x20 L3 and loosely screw on the hammer nuts G2 on the inside.
- Position the front plate on the drive side, threading the hammer nuts into the T-slot of the aluminum profile. To turn the T-nuts 90° in the T-slot, tighten the screws slightly.
- Screw the face plate on the drive side to the aluminum profiles using flat-head screws M12x30 M; Slightly counter-tighten the screws.
- Screw the face plate on the drive side to the profiles with one bracket 51 and two brackets 50; Use M8x20 hammer head screws I, M8x30 pan head screws L4 and M8 flange nuts R, lightly tighten the screws.

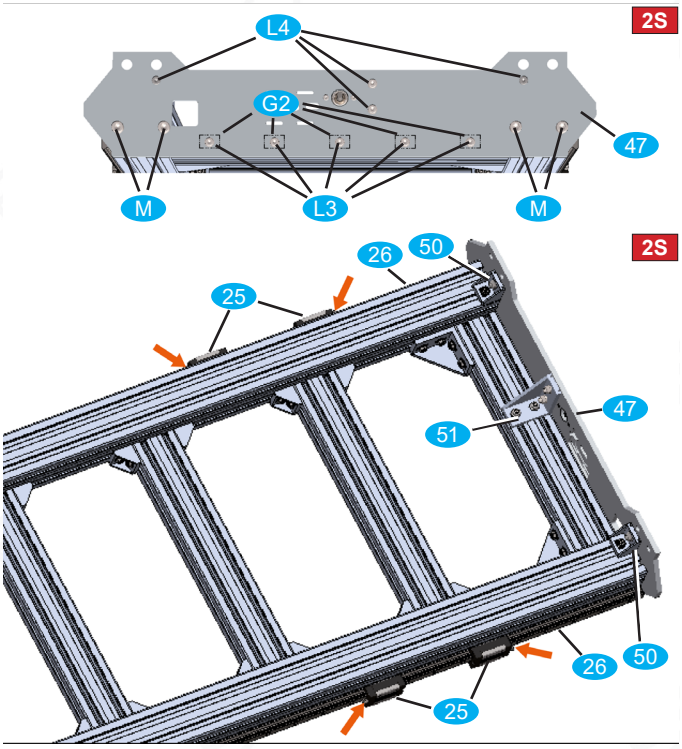

Fig. 12: Assembly of the front plate on the drive side

- Tighten all fastening screws (L3/L4/M) of the front plate drive side and the brackets 50/51.

- Slide two carriages 25 onto the linear guides 26 on both sides; the following should be noted:

  - Ground, blank surfaces on the long sides of the carriage point downwards to the work surface.

  - Lubricating nipples on the carriages point outwards and towards the work surface (red arrows in Fig. 12). If necessary, turn the lubricating nipples or screw them to the opposite end.

- Screw the fixed bearing unit 22 of the pre-assembled ball screw 20 to the face plate on the drive side using cylinder screws M5x30 C4 and washers U; slightly counter-tighten the screws.

- Equip the front plate floating bearing side 48 with M8x20 screws L3 and loosely screw on the hammer nuts G2 on the inside.

- Position the front plate on the floating bearing side, threading the hammer nuts into the T-slot of the aluminum profile. To turn the T-nuts 90° in the groove, tighten the screws slightly.

- Screw the floating bearing unit 23 to the face plate with cylinder screws M5x30 C4 and washers U; slightly counter-tighten the screws.

- Screw the floating bearing side end plate to the aluminum profiles with flat-head screws M12x30 M; Slightly counter-tighten the screws.

- Screw the end plate on the floating bearing side to the profiles with two angle brackets 50, slot 10 M8x20 T-head screws I, M8x30 flat-head screws L4 and M8 flange nuts R; Slightly counter-tighten the screws.

- Tighten all fastening screws (L3/ L4 / M) of the floating bearing side front plate, and the brackets. This does not apply to the fastening screws L4.

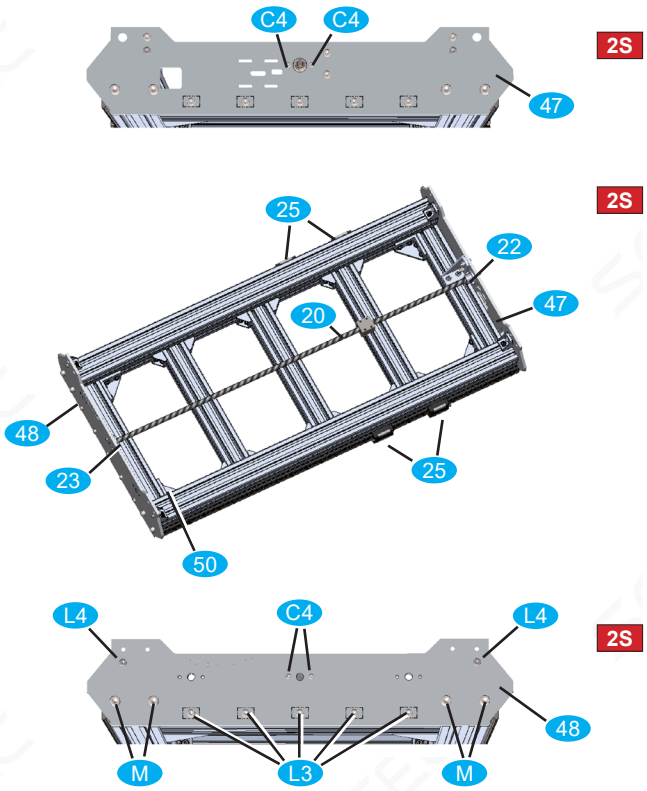

Fig. 13: Installation of the X spindle

Note:
The fastening screws of the bearing units are tightened after alignment.

When installing the reference switch, observe the additional installation instructions „Electrical installation kit“ if necessary.

- Equip the switch carrier X 42 with cylinder screws M5x16 C2 and loosely screw on two T-nuts slot 10 M5 G1 on the inside.
- Place the switch carrier X on the fixed bearing side of the base frame as shown in Fig. 14, threading the hammer nuts into the T-slot of the aluminum profile.
- Tighten the screws C2 while turning the hammer nut by 90° in the T-slot.
- Lay the enclosed foil between the reference switch 39 and the switch carrier X. Screw on the reference switch as shown in Fig. 14 using Cylinder screws M3x16 A1 and washers 3.2 S.

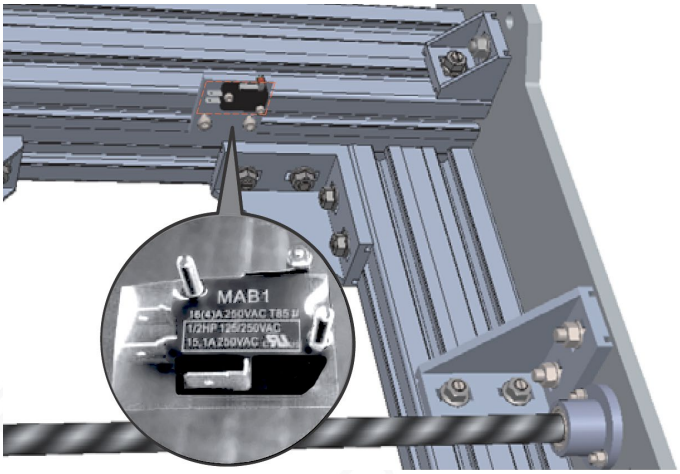

Fig. 14: Location and assembly of the X reference switch

Y-Axis / Portal

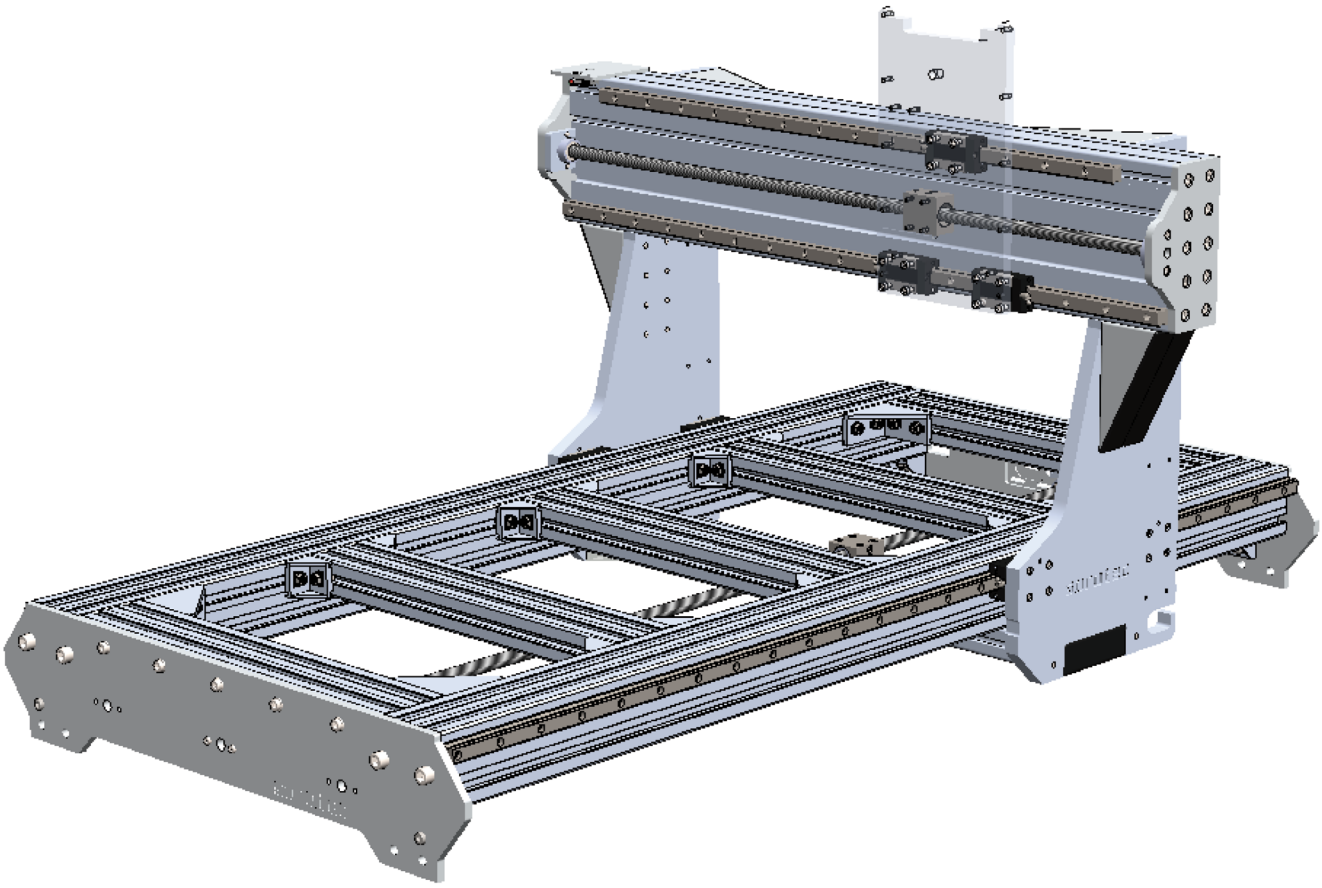

Fig. 15: The finished portal

Note:
For reasons of clarity, the front cylindrical pin and carriage are not shown in the magnified view.

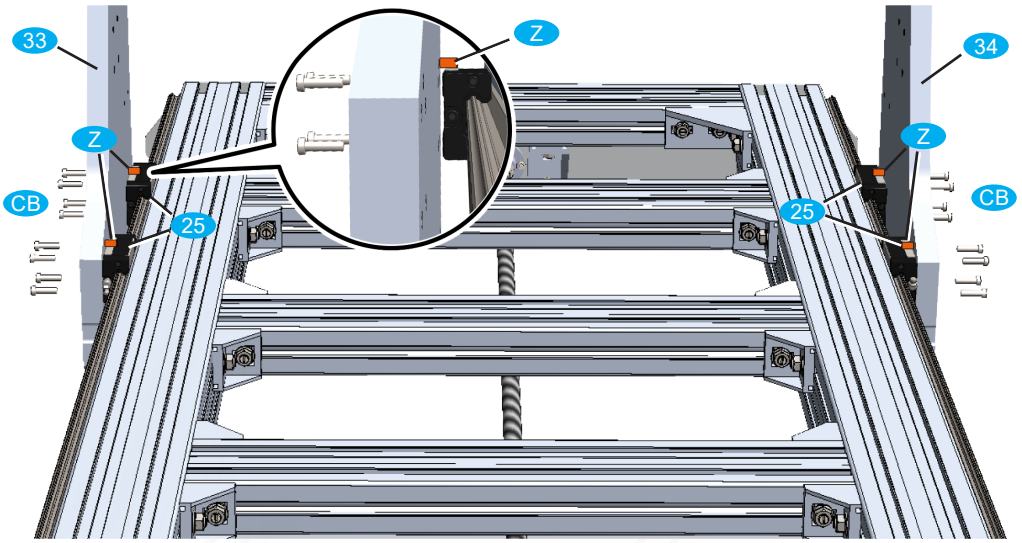

Fig. 16: Assembly of the portal cheeks

- Drive the cylindrical pins Z into the portal cheeks 33/34 until they protrude about 3 ... 4 mm on the outside.
- Place the portal cheeks 33/34 with the cylinder pins on the carriages and screw tight with cylinder screws M5x20 CB. Tightening torque: 6 Nm

- Align the upper linear guide 28 on the aluminum profile 38 in the middle and mount it with cylinder screws M5x20 CB and slot 8 M5 F hammer nuts; Slightly counter-tighten the screws.
- Place the assembly aid 99 on the milled stop edge (red arrow in Fig. 17) of the aluminum profile 38.
- Place the lower linear guide 29 on the aluminum profile 38 with the edge of the linear guide against the assembly aid and fasten with cylinder screws M5x20 CB and slot 8 M5 hammer nuts F.
- Slightly counter-tighten the screws to turn the hammer nuts 90° in the T-slot.
- Press the lower linear guide against the assembly aid and tighten the screws in the area of the assembly aid. Tightening torque: 6 Nm
- Gradually move the assembly aid over the entire length of the linear guide; press against the linear guide and tighten the screws in the area of the assembly aid.

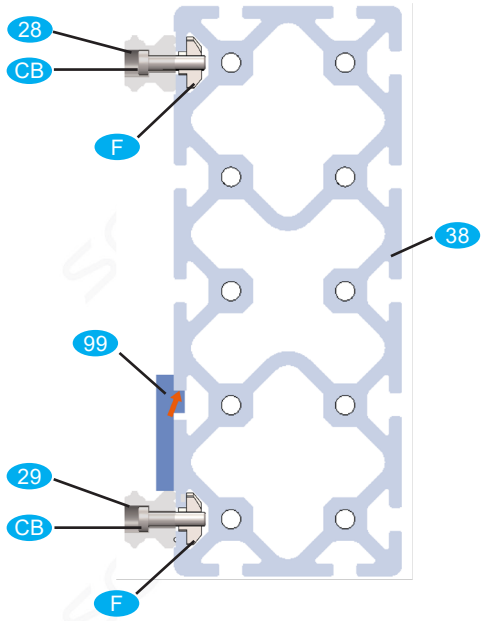

Fig. 17: Assembly of the guide rails

Note:
The screws CB of the upper linear guide 28 are tightened during alignment.

- Lay down the aluminum profile 38 with the lower linear guide 29 at the top as shown in Fig. 18.
- Pre-assemble the bracket 52 with flat-head screws M8x16 L1 and slot nuts H on the aluminum profile; Slightly counter-tighten the screws so that the brackets can just about be moved on the aluminum profile.

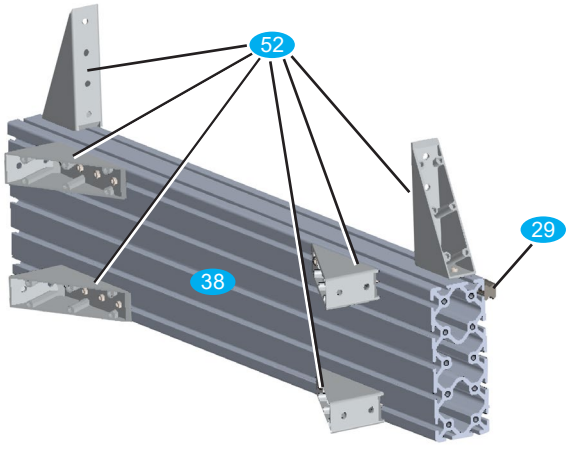

Fig.18: Pre-assembly of the connecting bracket

- Place the aluminum profile 38 with the mounted brackets 52 on the portal cheeks 33 /34 and align in the middle.
- Push the bracket against the portal cheeks and screw in place with L1 flat-head screws.
- Tighten the connecting screws of the brackets and the aluminum profile.
- Screw two brackets 53 to the aluminum profile 37 on both sides with M8x16 L1 flat-head screws and sliding blocks H; Only tighten the screws so that the angles can still just be moved.
- Insert the aluminum profile with brackets into the recesses of the portal cheeks 33/34 and screw on with M8x16 L1 flat-head screws.
- Tighten angle / aluminum profile screw connections.
- Snap the groove clip into place at the height of the reference switch X on the top side of the beam profile.
- Slide four sliding blocks H into the upper T-slots of the aluminum profile.

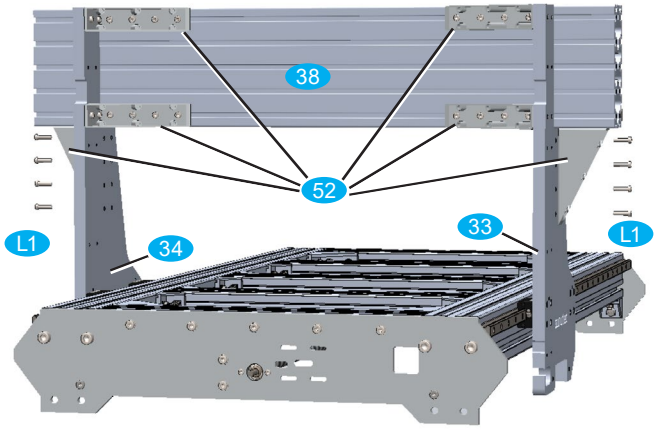

Fig. 19: Assembly of the portal

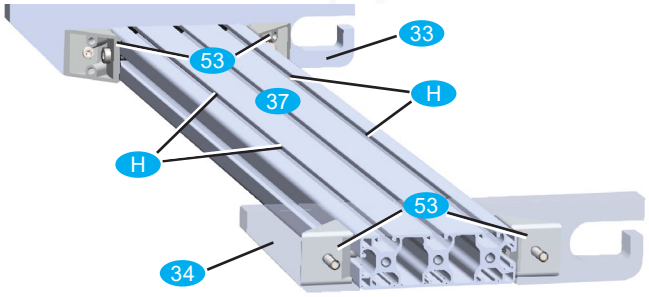

Fig. 20: Installation of the beam profile

Fig. 21: The slot clip activates the reference switch X

On the side of the base frame on which an air gap remained, as described on page 11, some screw connections are loosened to adjust the X-axis so that the width of the base frame can be adjusted (red double arrows in Fig. 22).

- Slightly loosen the screw connections (16x) marked with red arrows in Figure 22.
- Move the portal several times from one end of the base frame to the other end and gradually tighten the loosened screws again.
- Check whether the portal can be moved easily over the entire travel path over the base frame after tightening all screws.

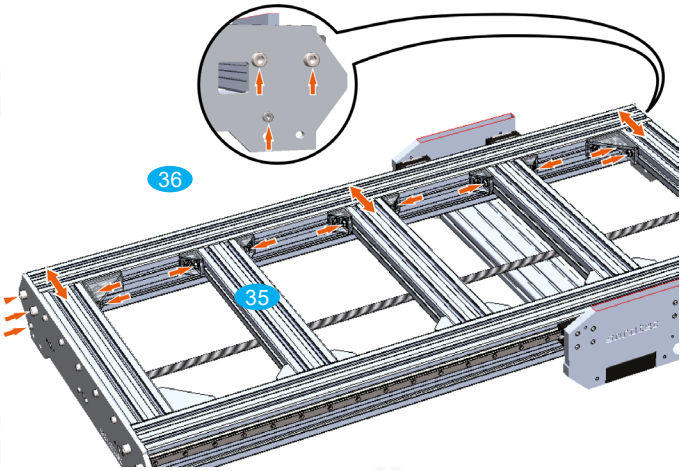

Fig. 22: Adjustment of the base frame

- Screw the X-nut flange plate 8 to the aluminum profile 37 using flat-head screws M8x16 L1 and the sliding blocks H already inserted; Only tighten the screws so far that the flange plate X-nut can still be moved.

- Move the portal until the recirculating ball nut clamping block 46 is over the X nut flange plate 8.

- Screw clamping block 46 to flange plate X nut 8. Use the cylinder screws M5x30 C4 (tightening torque: 2 Nm) and the cylinder screws M5x40 C6 with hammer nuts slot 8 M5 F (tightening torque: 6 Nm).

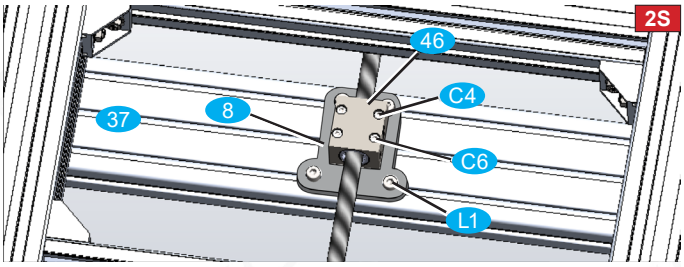

Fig. 23: Connection of X-spindle nut and portal beam

- Move the portal as far as possible towards the face plate on the drive side 47 by turning the ball screw 20 (red arrow in Fig. 24).

- Tighten the fastening screws of the flange plate X nut 8 / aluminum profile 37 festziehen (see above).

- Tighten the fastening screws C4 on the fixed bearing unit. Tightening torque: 6 Nm

- Move the portal by turning the ball screw 20 as far as possible towards the end plate on the floating bearing side 48 (Fig. 25).

- Tighten the fixing screws C4 for the floating bearing unit. Tightening torque: 6 Nm.

- Drive the cylinder pins Z into the guide plate Y 9 from the rear until they protrude by approx. 3 ... 4 mm at the front.

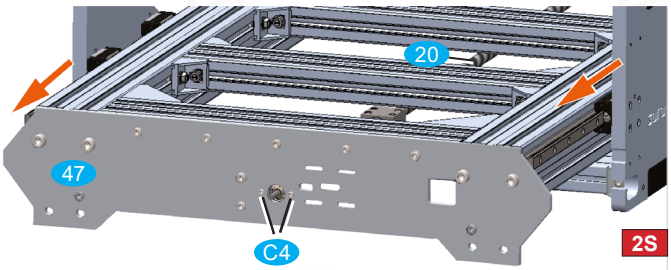

Fig. 24: Adjustment of the X-spindle (1)

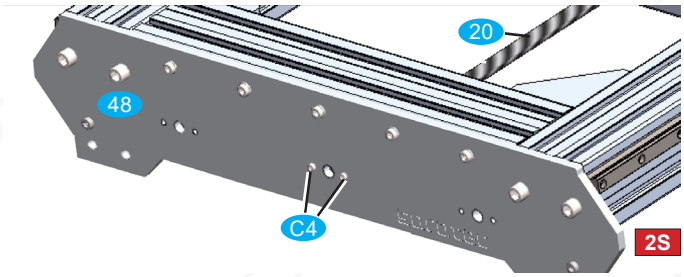

Fig. 25: Adjustment of the X-spindle (2)

Note:
The clamping block 46 must be aligned in such a way that the lubricating nipple points upwards as shown in Fig. 26/27. The floating bearing must point to the right side of the machine as shown.

- Place the clamping block 46 with the recirculating ball nut on the stop edges on the back of the guide plate Y (red arrows in Figure 26) and screw with cylinder screws M5x35 C5. Tightening torque: 6 Nm.

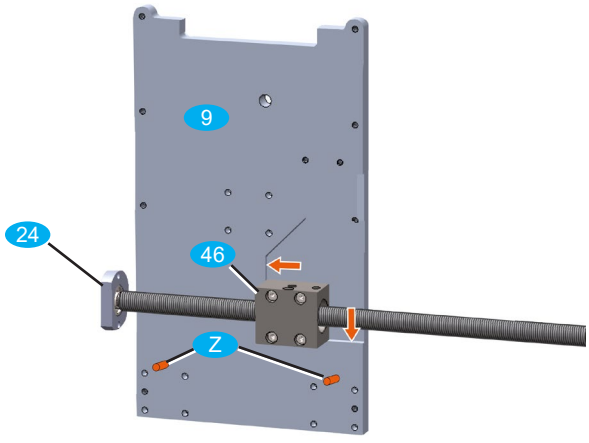

Fig. 26: Pre-assembly of guide plate Y and Y spindle

- Slide one carriage 25 onto the upper linear guide 28 and two carriages onto the lower linear guide 29; the following should be noted:

  - Ground, blank surfaces on the long sides of the carriage point upwards

  - Grease nipples on the carriages point outwards and upwards; to do this, turn the grease nipple if necessary or screw it to the opposite end

- Place the guide plate Y 9 with the cylindrical pins Z on the lower carriage (clamping block 46 at the back).

- Screw the guide plate Y to the lower carriage using cheese head screws M5x16 C2. Tightening torque: 6 Nm

- Screw guide plate Y to the upper carriage; Slightly counter-tighten the screws.

- Slide the guide plate Y back and forth several times as far as possible to the left and right on the linear guides; while doing so, gradually tighten the fastening screws of the upper carriage. Tightening torque: 6 Nm

- Slide the guide plate Y back and forth several times as far as possible to the left and right on the linear guides; while doing so, gradually tighten the fastening screws of the upper linear guide. Tightening torque: 6 Nm

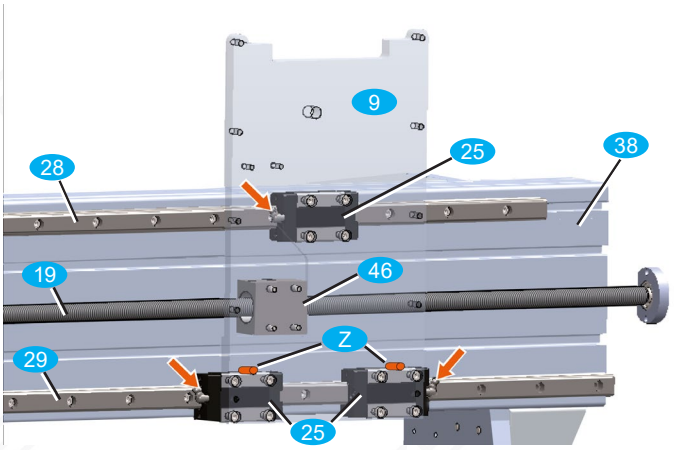

Fig. 27: Attachment of the Y guide plate and Y spindle

- Screw end plate Y loose bearing 4 to the aluminum profile 38 with cylinder screws M8x20 E1. Tightening torque: 25 Nm.

- Mount floating bearing unit 24 on end plate Y floating bearing 4 with cylinder screws M5x20 CB; slightly counter-tighten the screws.

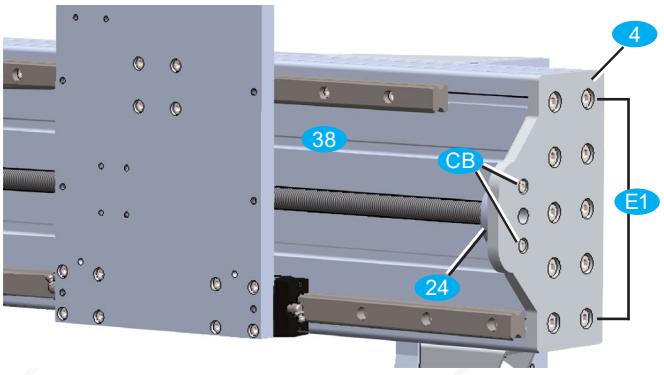

Fig. 28: Portal end plate on the right

- Screw the motor plate 30 to the aluminum profile 38 using cylinder screws M8x20 E1. Tightening torque: 25 Nm.

- Push the fixed bearing retaining clip Y 12 over the fixed bearing unit 22 and fasten it with cylinder screws M5x16 C2 on the motor plate Y 30; Slightly counter-tighten the screws.

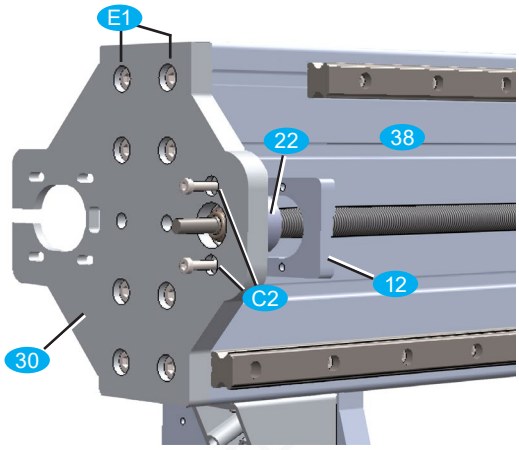

Fig. 29: Portal end plate on the left

- Move the guide plate Y 9 by turning the ball screw 19 as far as possible towards the end plate Y 4 on the floating bearing side.

- Tighten the fixing screws C4 for the floating bearing unit. Tightening torque: 6 Nm

- Move the guide plate Y 9 as far as possible towards the motor plate Y 30 by turning the ball screw 19.

- Tighten the fixing screws C4 of the fixed bearing unit. Tightening torque: 6 Nm

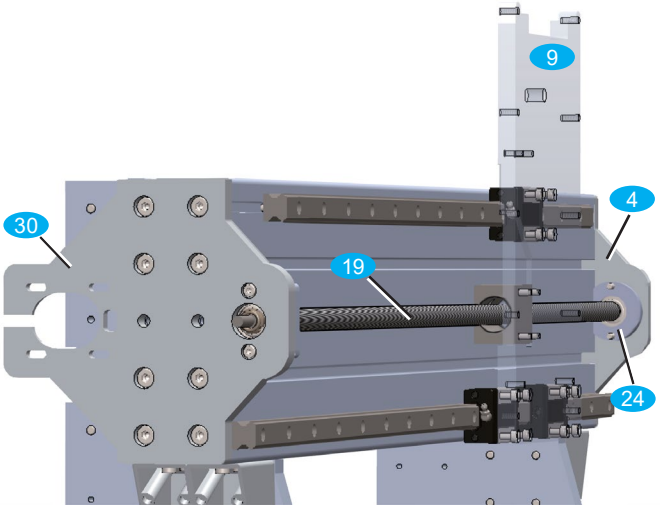

Fig. 30: Adjustment of the Y spindle

- Shorten two of the cylinder head screws M5x14 C1 supplied by about 3 mm for the screw connection of the switch carrier Y 43.

- Equip the switch carrier Y with shortened screws and loosely screw on two slot 8 M5 F hammer nuts on the inside.

- Position switch carrier Y on the fixed bearing side as shown in Figure 31, threading hammer nuts into the T-slot of the aluminum profile.

- Tighten the screws, turning the hammer nuts by 90° in the T-slot.

- Place the insulation foil between the reference switch F and switch carrier Y and screw on the reference switch as shown with cylinder screws M3x20 A2, washers S and nuts M3 O.

Note:
When installing the reference switch, observe the additional installation instructions „Electrical installation kit“ if necessary.

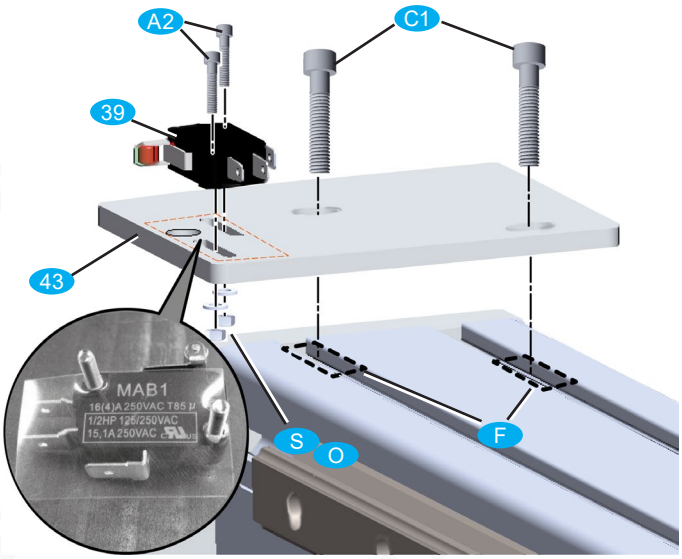

Fig. 31: Reference switch Y. Screws C1 shortened by 3 mm.

- Degrease the surfaces to be glued and stick one device foot 11 each to the fixed bearing retaining clip Y 12 and the guide plate Y 9.

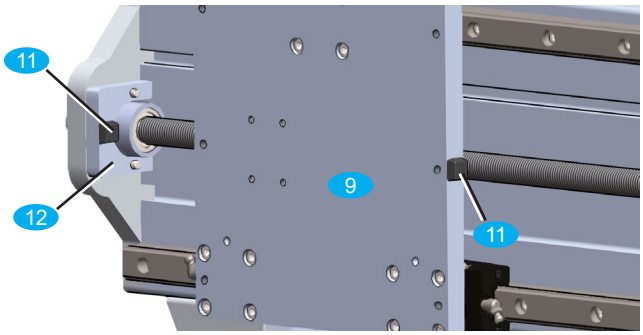

Fig. 32: Self-adhesive device feet as stop buffers

- Degrease the adhesive surfaces and stick four device feet 11 to the portal cheeks 33/34.

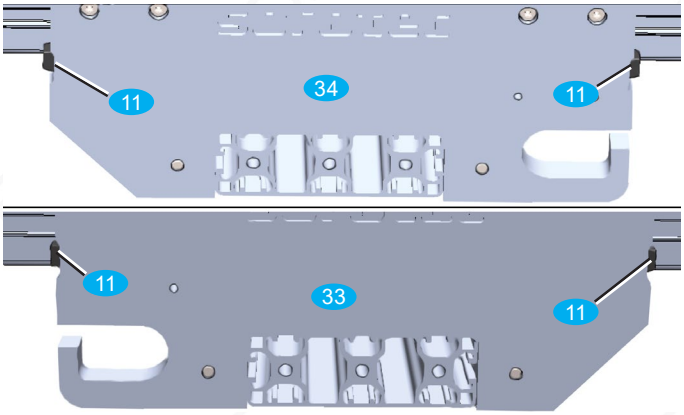

Fig. 33: Stop buffers on portal cheeks

- Attach cover caps 1 (2x) on both sides.
- Attach cover caps 52 (6x) on both sides.

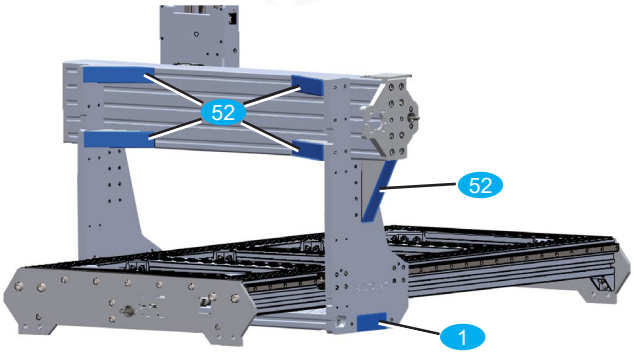

Fig. 34: Positions of the cover caps

Z-Axis / Spindle mount

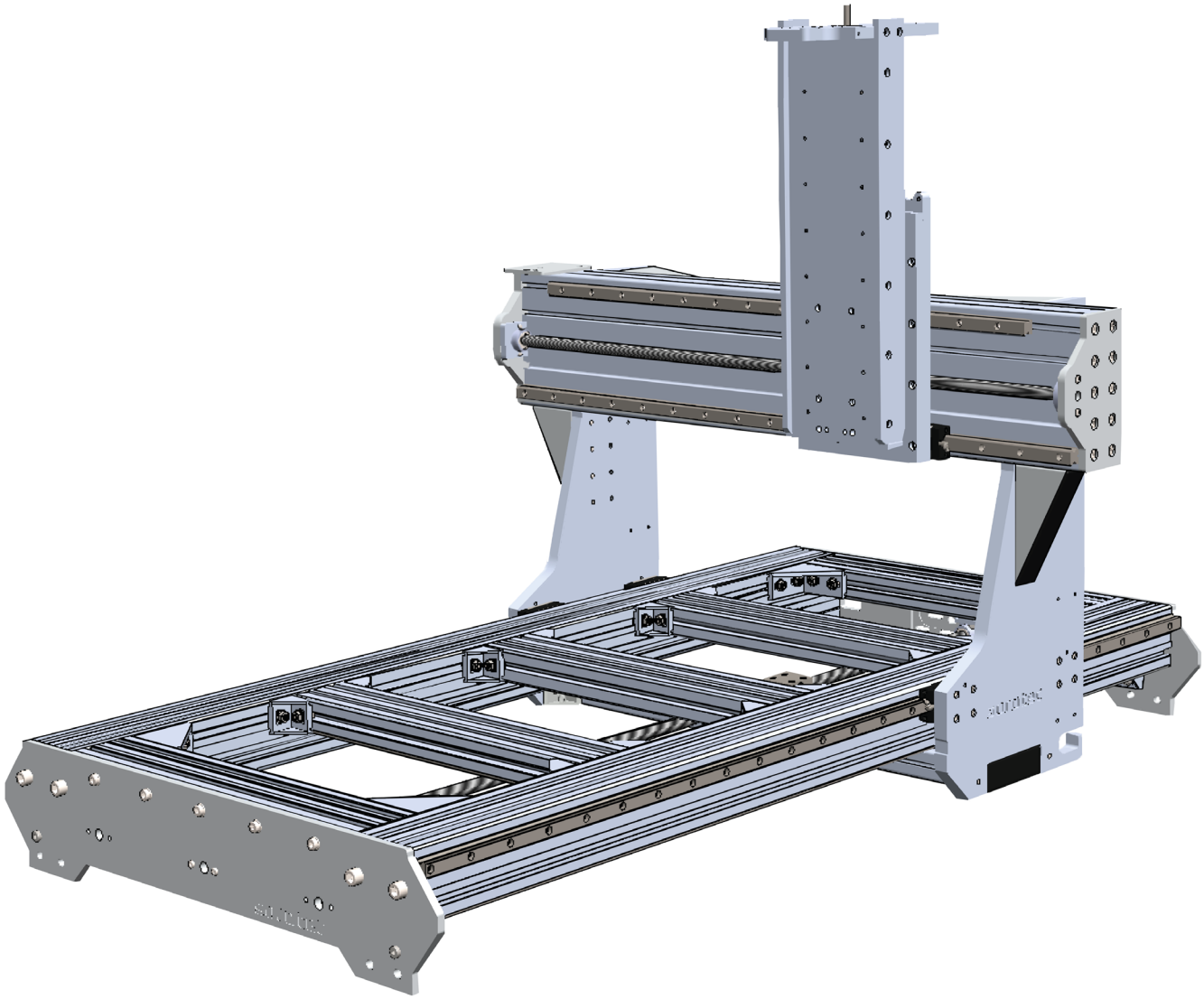

Fig. 35: Mechanically completely constructed Alu-Line

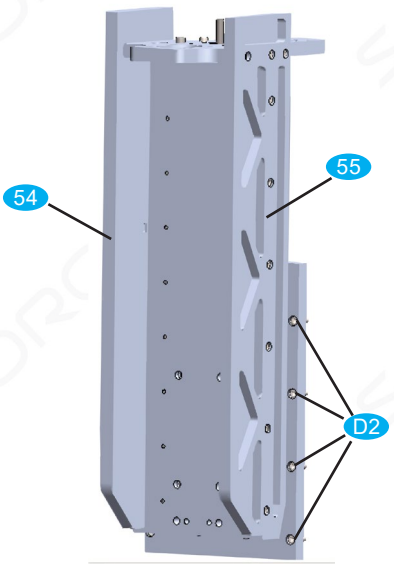

Fig. 36: Z axis assembly

Note:

The Z-axis is build as a single assembly. The complete Z-axis is then screwed to the Y guide plate with the screws D2.

The following illustrations show the assembly with the large Z-braces 54 / 55. The assembly with the standard Z-braces (see figure above) is carried out analogously.

- Knock the cylindrical pins Z into the guide plate Z 10 until they protrude about 3 ... 4 mm from the underside.

- Screw the carriage 25 to the guide plate Z 10 using cylinder screws M5x14 C1; slightly counter-tighten the screws. The following should be noted:

  - Ground, blank surfaces on the long sides of the carriage point to the center or to the ball screw

  - The lubricating nipples on the carriages point towards each other and outwards (red arrows in Fig. 37). If necessary, turn the lubricating nipples or screw them to the opposite end.

- Screw the recirculating ball nut 18 to the guide plate Z 10 using cylinder screws M6x14 D1; slightly counter-tighten the screws.

- Screw the end stop Z 7 to the guide plate Z 10 with cylinder screws M6x20 D3 Tightening torque: 10 Nm.

- Degrease the adhesive surfaces and attach two device feet 11 to the end stops Z 7.

- Screw the switching plate for the reference switch Z 41 to the guide plate Z 10 using flat-head screws M4x6 J1.

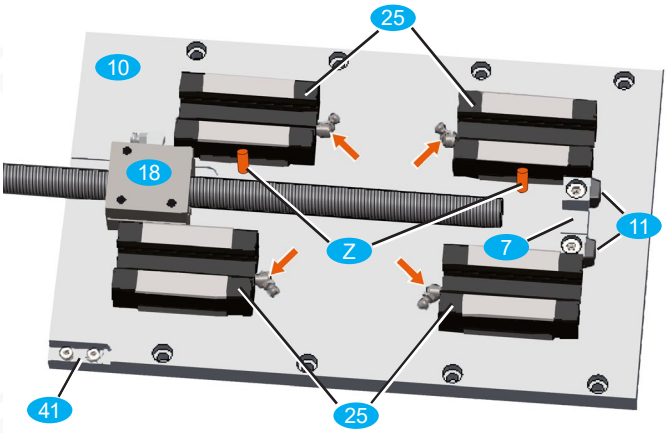

Fig. 37: Z spindle and carriage on guide plate

- Align the left linear guide 27 flush with the lower edge of the Z-axis plate 32 and screw it on with cylinder screws M5x20 CB; the edge (red marking in Figure 38) of the linear guide must lie against the milled stop edge of the Z-axis plate over its entire length. Tightening torque: 6 Nm

- Align the right linear guide 27 flush with the lower edge of the Z-axis plate 32 and screw it on with cylinder screws CB; slightly counter-tighten the screws.

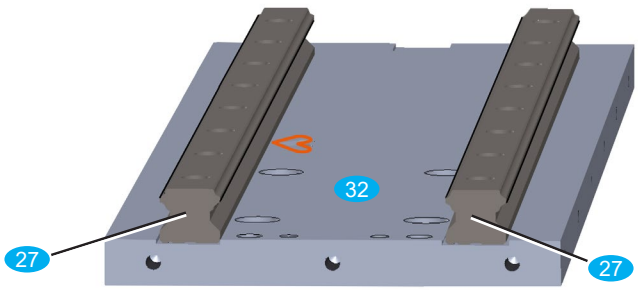

Fig. 38: Z-axis guide rails

Note:
The fastening screws of the right linear guide are tightened during alignment.

- Slide the carriage of the Z guide plate 10 onto the linear guides of the Z axis plate 32.
- Push the guide plate Z to the side (red arrows in Fig. 39) so that the left-hand carriages are in contact with the cylinder pins. Screw the left carriage in this position. Tightening torque: 6 Nm
- Slide guide plate Z back and forth several times over the entire travel on the linear guides; while doing so, gradually tighten the fastening screws of the two right-hand carriages. Tightening torque: 6 Nm
- Slide guide plate Z back and forth several times over the entire travel on the linear guides; gradually tighten the fixing screws of the right linear guide. Tightening torque: 6 Nm

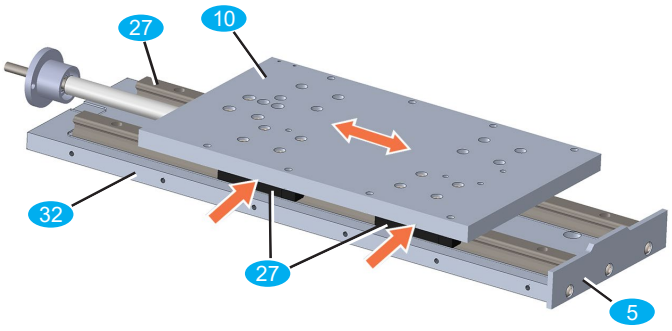

Fig. 39: Adjustment of the Z-axis guide

- Screw the stop plate Z 5 to the Z-axis plate 32 using flat-head screws M6x12 K1.
- Seal the holes in the linear rails with cover caps.
- Screw the motor plate Z 31 to the Z-axis plate 32 with cylinder screws M6x25 D4; slightly counter-tighten the screws.
- Screw the fixed bearing unit 22 to the Z-axis plate 32 with cylinder screws M5x20 CB; slightly counter-tighten the screws.
- Screw the Z reinforcements 54/55 to the Z axis plate with cylinder screws M5x14 C1; Tightening torque: 6 Nm

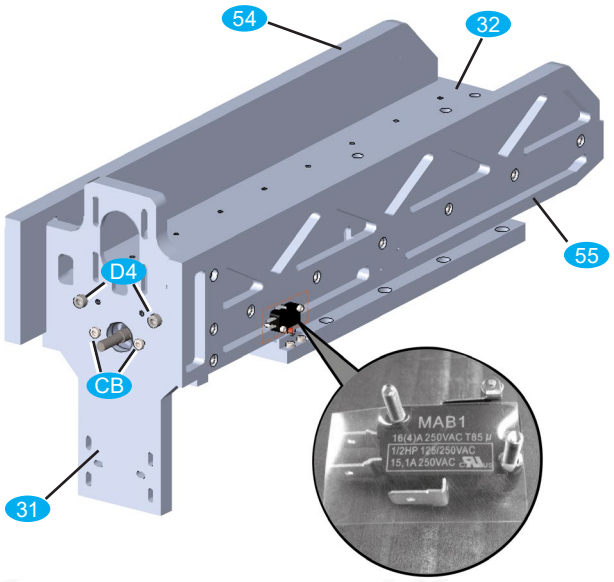

Fig. 40: Completion of the Z-axis

Note:

If one of the Z reinforcements 54/55 cannot be pushed onto the Z axis plate with slight pressure, the corresponding groove of the Z reinforcement must be reworked with a file.

When installing the reference switch, observe the additional installation instructions „Electrical installation kit“ if necessary.

- Tighten the fastening screws motor plate Z 31/ plate Z-axis 32. Tightening torque: 6 Nm
- Move the guide plate Z 10 as far as possible towards the motor plate Z by turning the ball screw.
- Tighten the fixing screws CB of the fixed bearing unit. Tightening torque: 6 Nm
- Place the insulation foil between the reference switch 39 and the Z reinforcement 55 and screw on the reference switch as shown in Fig. 40.
- Screw the complete Z-axis assembly to the Y guide plate with cylinder screws M6x16 D2; slightly counter-tighten the screws.

For alignment, a dial gauge must be attached to the moving part of the Z-axis and a stop bracket must be attached to the base frame. Turning the ball screw of the Z-axis moves it up and down (see figure 41).

- Align the Z-axis on the guide plate Y in such a way that the dial gauge does not deflect when the Z-axis moves up and down. In this position, tighten the fastening screws D2. Tightening torque: 10 Nm.

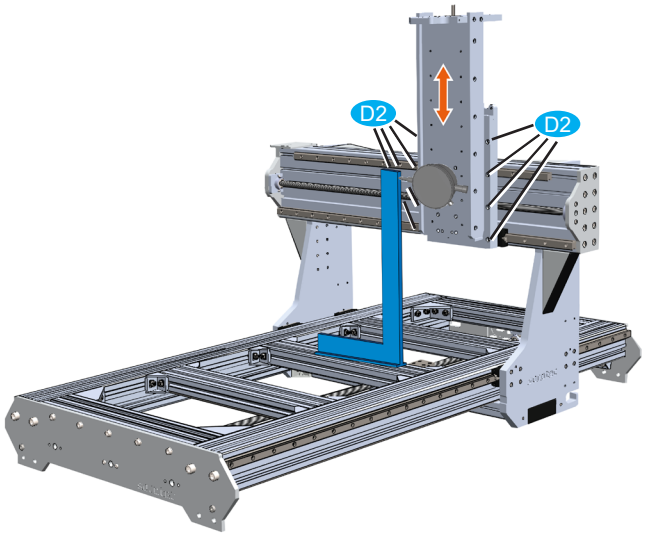

Fig. 41: Aligning the Z axis

Assembling the axis drives

Note:
The stepper motors shown below are not part of the scope of delivery. They are shown to clarify the structure of the axis drives.

X-Axis

- Push the HTD toothed belt wheel 15 as far as possible onto the shoulder of the ball screw 20 and fix it with the locking screw.
- Screw the stepper motor to the front plate 47 on the drive side using cylinder screws B1, nuts M4 P and washers T; slightly counter-tighten the screws.
- Slide the HTD toothed belt wheel 15 onto the output shaft of the stepper motor, align it with the HTD toothed belt wheel on the ball screw and fix it with the locking screw.
- Put on the HTD toothed belt (89 teeth) 14 and tension it by moving the stepper motor; Tighten the stepper motor mounting screws B1.

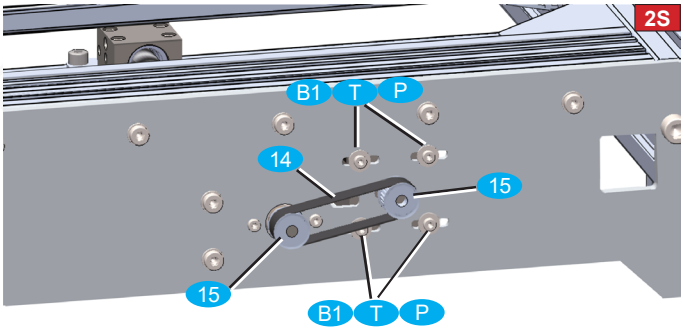

Fig. 42: X-axis drive

- Loosen the screws L3 above the X drive a few turns, slide the X single toothed belt cover 2 under the screw heads and tighten the screws again.

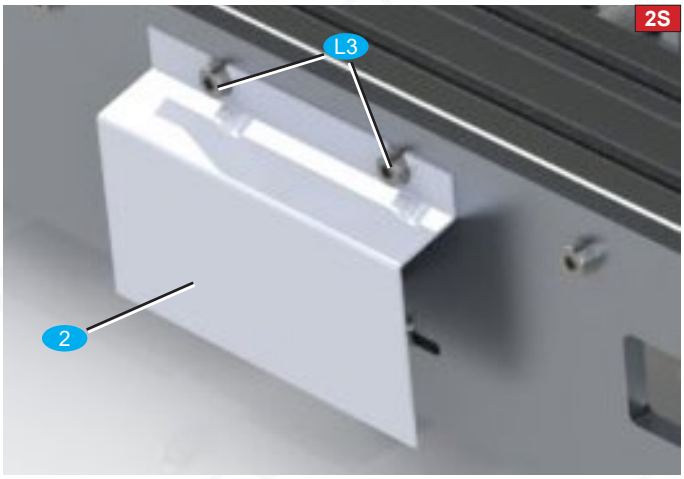

Fig. 43: Cover X drive

Y-Axis

- Push the HTD toothed belt wheel 15 as far as possible onto the shoulder of the ball screw 19 and fix it with the locking screw.
- Screw the stepper motor to the motor plate Y 30 using cylinder screws M4x20 B1, nuts M4 P and washers T; slightly counter-tighten the screws.
- Slide the HTD toothed belt wheel 15 onto the output shaft of the stepper motor, align it with the HTD toothed belt wheel on the ball screw and fix it with the locking screw.
- Put on the HTD toothed belt 14 (130 teeth) and tighten it by moving the stepper motor; Tighten the stepper motor mounting screws B1.

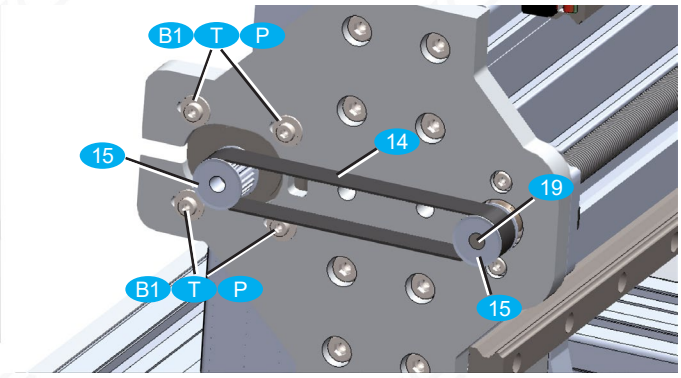

Fig. 44: Y drive

- Insert cylinder screws M8x65 E2 through the holes in the belt guard Y 40, slide spacer sleeves 6 over the screws and screw everything to the machine as shown in Fig. 45.

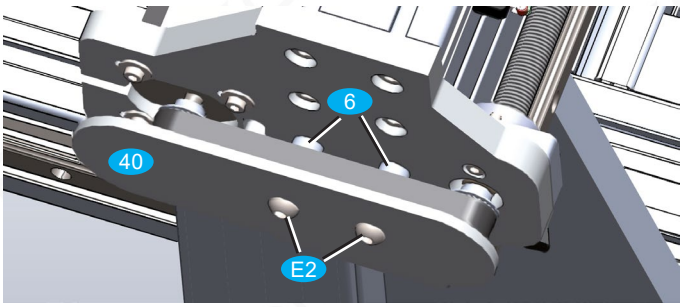

Fig. 45: Mounting the X drive cover

Z Axis

- Push the HTD toothed belt wheel 16 as far as possible onto the shoulder of the ball screw 21 and fix it with the locking screw.
- Screw the stepper motor to the motor plate Z 31 using cylinder screws M4x20 B1, nuts M4 P and washers T; slightly counter-tighten the screws.
- Slide the HTD toothed belt wheel 16 onto the output shaft of the stepper motor, align it with the HTD toothed belt wheel on the ball screw and fix it with the locking screw.
- Put on the HTD toothed belt 14 (75 teeth) and tension it by moving the stepper motor; Tighten the stepper motor mounting screws B1.
- Screw the toothed belt cover Z 3 (not shown) to the Z reinforcements on the left and right using flat-head screws M4x6 J1 (red arrows in Figure 46).

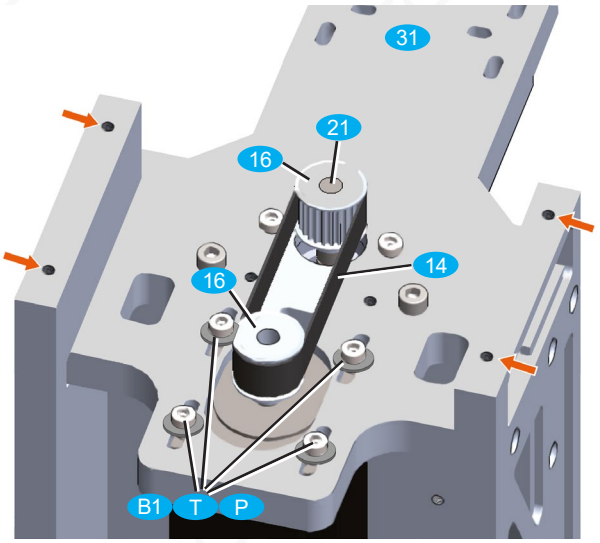

Fig. 46: Z drive

Appendix

Instructions from
ISEL „Assembly and maintenance instructions for ball screw nuts“

Assembly and maintenance instructions
Ball screw nuts

isel® From Components to Systems

Installation
- Adjust the running clearance between nut and spindle with the adjusting screw (Fig. 2). Check the clearance along the whole spindle (the axial backlash is reached before radial clamping).
- The ball screw spindle must be installed free from radial stress: Move the carriage back and forth while tightening the bearings.

Lubrication instructions
Before commissioning , it is imperative that the spindle is lubricated over the entire length of the thread with the help of the nut (Fig. 2).
For lubrication use the customary roller bearing oil and grease (sodium soap grease). However, avoid lubricants s with graphite and MOS additives.
Due to the axial movement between nut and spindle, the lubricant loss is greater than with roller bearings, so that no lifetime lubrication is possible.

- Oil lubrication
Heating is less with oil lubrication than with grease at high spindle speeds (over 500 min-1).
Therefore, the maintenance intervals are shortened. Re-lubricate every 40 to 60 operating hours depending on use conditions.
Item No.: 299 020

- Grease lubrication
Grease lubrication offers the advantages of independent installation position and long lubrication intervals (300 to 700 operating hours) up to a rotational speed of approx. 800 min-1.
Use sodium soap grease if possible and fill about half of the nut volume with grease. (Ex works GP00/000F-20 according to DIN 510502)
Item No.: 299 031

Protective measure
Protect the lubricated ball screw from dust, swarf and moisture, etc. with wipers . Item No.: 213500 0001

Oil viscosity classes according to DIN 51517 T3 CLP ISO-VG for spindle Ø16 mm

Average rotat. speed (min⁻¹)	Recommended ISO viscosity class at 40 °C	Required viscosity at operating temperature approx. 30 °C (cST)
20	ISO VG 460	approx. 875
100	ISO VG 220	approx. 360
500	ISO VG 46	approx. 66
1,000	ISO VG 22	approx. 36
1,500	ISO VG 15	approx. 28

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Assembly and maintenance instructions
Ball screw nuts

isel® From Components to Systems

Ball screw nuts with clamping block or carriage and a spindle of the same pitch compose the ball screw.
The ball screw nut is **delivered** with a mounting sleeve protected from corrosion and ready to assemble.

⚠ The ball screw nuts, spindles and clamping blocks are precision components and should be handled with the utmost cleanliness and care.

Assembly
1. Clean the spindle thoroughly up to the thread root.
2. Remove the retaining ring on the opposite side of the bore (the side of the mounting sleeve that is not stripped off).
3. Push the mounting sleeve over the machined shaft end (apply concentrically to the spindle axis, Fig. 1), so that the bore is on the outside and rotate the ball screw nut carefully and completely on the spindle.
4. You can push wipers as protection in the grooves of the ball screw nut (facing outwards). The notch on the wiper must lie under the bore.

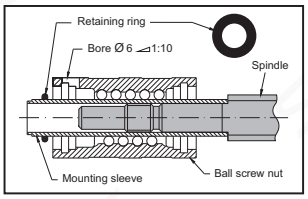

Fig. 1: Ball screw nut with spindle

5. Fix the ball screw nut with the special M8 x 0.75 stud in the clamping block or linear carriage (Fig. 2).

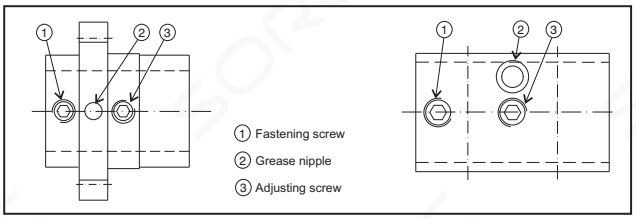

Fig. 2: Two different clamping blocks

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