

Original Assembly and Maintenance Instructions

Linear Unit

HSB-beta[®]

Type

Beta 60-ZSE

Beta 80-ZSE

Beta 110-ZSE

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About these instructions

Scope

These instructions apply to the following linear unit with toothed belt drive:

- Beta 60-ZSE
- Beta 80-ZSE
- Beta 110-ZSE

The drawings show the type Beta 80-ZSE and are intended to be examples for all other types where details may appear different.

1 Safety

These installation and maintenance instructions are part of the unit and must be kept readily available at all times for reference. The instructions must be passed on together with the unit to any third party.

It is important that you contact the manufacturer should there be any part of these Operating Instructions that you do not clearly understand.

1.1 Symbols used

In these Operating Instructions, the following warning symbols and other symbols are used:

DANGER



Indicates immediate danger. Failure to comply with this instruction risks death or serious injury.

WARNING




Indicates a danger carrying a medium to high risk. Failure to comply with this instruction may result in death or serious injury.

CAUTION



Indicates a danger carrying low risk. Failure to comply with this instruction may result in minor or moderate injury or material damage.

 **Note**
Indicates tips for the operation and optimum use of the unit.

1.2 Intended use

The mechanical linear drive is designed for installation in machinery and is solely intended for manipulating, positioning, transporting, palletising, loading, unloading, clamping, synchronising, tensioning, testing, measuring, handling and pressing of component parts or tools.

Please take note of the principal fields of application of the linear unit (see Section 4 and Section 3).

In order to guarantee compliance with the law concerning the electromagnetic compatibility of devices (EMC directive), the mechanical linear drive may be used for industrial applications only.

Utilisation of the product for any other purpose would constitute inappropriate use. The manufacturer accepts no liability for any damage resulting from such use. The risk is borne solely by the user.

1.3 General safety

Date of commissioning The linear unit may only be operated when the machine or installation into which it has been installed is found to comply with the following directives, laws, regulations and standards:

- the relevant accident prevention regulations,
- the generally recognised safety guidelines,
- EU directives,
- standards regarding the electromagnetic compatibility of units,
- other applicable standards,
- country-specific regulations.

Safe operation For safe operation, please take into account the following documentation:

- these Operating Instructions for the linear unit, in particular the technical data
- the Operating Instructions for the entire installation

1.4 Use in clean rooms (ISO 14644)

The linear units are not suitable for use in clean rooms and can also not be upgraded for this area.

1.5 Use in potentially explosive areas



The linear units are not suitable for use in potentially explosive areas and can also not be upgraded correspondingly.

1.6 Technical condition of the linear unit

State-of-the-art The unit is state-of-the-art and complies with the applicable regulations. The unit complies with the following EU machinery directive, harmonised standards, European standards and relevant national standards:

- EC Machinery Directive 2006/42/EC
- DIN EN ISO 12 100:2011-03 Safety of Machinery, General Design Guidelines, Risk Assessment and Reduction
- DIN EN ISO 13850:2008-09: Safety of Machinery, Emergency

Equipment

- DIN EN 60 204-1:2006: Electrical equipment of machines
- 2004/108/EC: EMC Directive
- German Electromagnetic Compatibility Act (EMVG): Law on the electromagnetic compatibility of equipment from 26/02/2008 (BGBl I/Federal Law Gazette p. 220)

1.7 Changes to the linear unit

Rebuilding and modifying

There are to be no changes, either structural or safety-related, carried out on the linear unit without the prior written agreement of HSB. We accept no liability for any unauthorised changes carried out on the unit.

The operator may only carry out the maintenance and repair work specified in these Operating Instructions. Any further work involving the replacement of wearing or substitute parts may only be carried out following consultation with our service technicians and by the service technicians themselves or by HSB.

Never remove or decommission any safety or protection devices.

Follow the assembly instructions supplied by the manufacturer when using special attachment parts!

1.8 Requirements for personnel

The linear unit is manufactured using state-of-the-art technology and in compliance with the recognised safety standards. However, there are still risks associated with its use. Therefore, only qualified and trained personnel are permitted to assemble and operate the unit.

Any person involved in the assembly, operation, maintenance, repair or disassembly of a linear unit must have read and understood these instructions, in particular the first section entitled "Safety".

Any work involving live parts may only be carried out by trained electricians. This work involves, for example:

- installation of safety limit switches,
- attachment of a drive,
- checking the drive rotation direction.

1.9 Responsibilities of the operator

Instruction of personnel

In accordance with the EU directive 89/655/EEC Art. 6(1) and 7 on the safe use of work equipment, as well as the EU basic directive 89/391/EEC Art. 1(1) and Art. 6(1), the operator is obliged to provide any person involved in the installation, operation, maintenance, repair

or disassembly of a linear unit with instruction and, in particular, safety-related instruction.

We recommend that the operator acknowledges in writing that the employees have received the appropriate instruction.

Checking the unit

The operator is obliged, in accordance with the EU directive 89/655/EEC Art. 4a on the safe use of work equipment, to check the machine before commissioning, after repair work is carried out and after any malfunction occurs.

Preservation of labels

The operator must ensure that any lettering, information signs or labels are fully legible (in particular the serial number) and always observed. Any damaged or illegible information signs and labels must be replaced.

2 Warranty

The warranty conditions are specified in the sales documents (delivery and payment conditions). The warranty claim expires if:

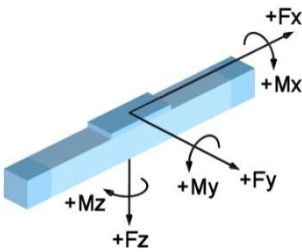
- the unit has not been used in accordance with its intended use,
- these Operating Instructions have not been adhered to,
- the unit has been modified without prior authorisation from the manufacturer,
- screws sealed using locking paint have been opened.

The manufacturer is liable only if genuine substitute parts have been used during any maintenance or repair work carried out on the unit.

3 Technical data – standard design

Technical data – linear unit Type Beta with toothed belt drive	Unit sizes		
	Beta 60	Beta 80	Beta 110
	ZSE	ZSE	ZSE
Drive element	Toothed belt		
Stroke per revolution [mm]	160	220	300
Max. speed [m/s]	5.00	5.00	5.00
Max. acceleration [m/s ²]	30	40	60
Idle torque [Nm]	1.00	1.40	3.35
Maximum stroke (standard) [mm]	7670	7600	7520
Repeat accuracy [mm]	±0.08	±0.08	±0.08
Operating temperature [°C] (continuous operation)	0...80	0...80	0...80
Geometrical moment of inertia I _y [mm ⁴]	400283	1326597	4974348
Geometrical moment of inertia I _z [mm ⁴]	521983	1693634	5898662
Length of carriage [mm]	180	210	320
Weight (without stroke) [kg]	3.10	6.35	15.75
Weight (per 100 mm stroke) [kg]	0.53	0.89	1.56
Weight of carriage [kg]	0.7	1.36	2.57
Max. noise emission [dB A] ¹⁾	80	80	80

¹⁾ The value changes when assembled with other parts of the installation



Forces and moments for Beta linear unit with toothed belt drive

Type designation	Dynamic forces [Nm]				Dynamic moments [Nm]			
	F _x	F _y	F _z	-F _z	M _x	M _y	M _z	M _{idle}
Beta 60-ZSE	750	400	1150	640	40	130	80	1.00
Beta 80-ZSE	1100	640	2400	1600	80	200	200	1.40
Beta 110-ZSE	3600	2400	6400	3200	320	640	480	3.35

M_{idle} = idle torque ±30 %
The specified forces and moments are the respective maximum values for the single load. The individual values must be reduced for a mixed load or the occurrence of several moments or forces at the same time. If in doubt, please contact Technical Support.

Dynamic load ratings of Beta linear unit rail guides

Unit size	Size	No. of rails	No. of carriages	Load rating per carriage C _{dyn} [N] THK / Rex*	Pretension F _v [N] THK / Rex*	M _t [Nm] THK / Rex*	Guiding distance in direction x (lx1) [mm]
Beta 60-ZSE	15	1	2	11271 / 9860	564 / 620	60 / 74	106
Beta 80-ZSE	20	1	2	17700 / 23400	885 / 1500	210 / 240	131
Beta 110-ZSE	25	1	2	25160 / 28600	1258 / 1820	340 / 320	203

Values in () refer to the long carriage in each case.
The values for the load rating and the pretension refer to the standard linear guide system
 * Rex = Rexroth

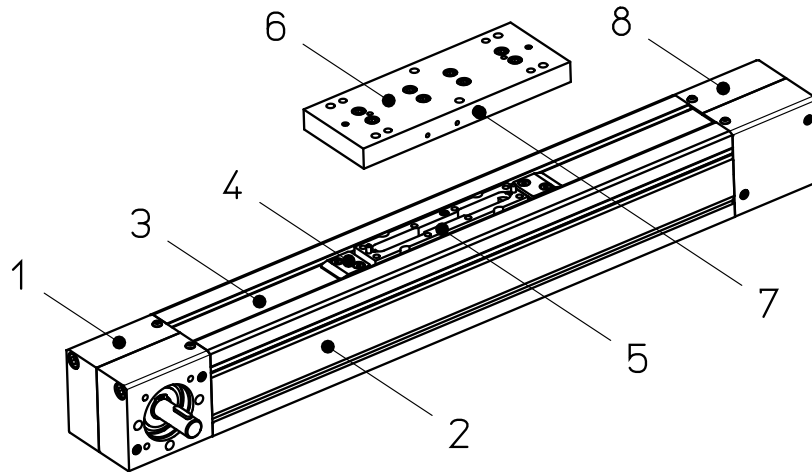
Tightening torques [Nm] for fastening screws						
Fastening screws	M4	M5	M6	M8	M10	The values given are standard values. The values must be correspondingly adapted for shorter screw-in depths.
DIN912/ISO4762-8.8	2.7	5.4	9.0	22.0	43.0	
DIN912/ISO4762-10.9	3.0	5.7	9.0	22.0	43.0	
DIN912/ISO4762-12.9	3.0	5.7	9.0	22.0	43.0	

Tightening torques [Nm] for coupling with clamping hub					
Size	14	19	24	28	38
Coupling diameter [mm]	30	40	55	65	80
Screw size	M3	M6	M6	M8	M8
Tightening torque [Nm]	1.34	10.50	10.50	25.00	25.00

Tightening torques [Nm] for coupling with clamping ring					
Size	14	19	24	28	38
Coupling diameter [mm]	30	40	55	65	80
Screw size	M3	M4	M5	M5	M6
Tightening torque [Nm]	1.34	2.90	6.00	6.00	10.00

4 Product description

Linear unit with toothed belt drive



Legend	1	Bearing housing A	5	Attachment
	2	Basic profile	6	Bearing housing A
	3	Toothed belt	7	Carriage plate
	4	Toothed belt holder	8	

Figure 1: Sub-assemblies of the Beta linear units with toothed belt drive

A mechanical linear drive converts rotation into linear motion and thus facilitates fast, safe and accurate movement of loads from one position to another. It consists of a basic aluminium profile, a moveable carriage which is supported by a guide element (linear guide system) and a drive element (toothed belt drive).

Depending on the design, the carriage can absorb forces and moments in all directions and is non-positively connected to the guide and drive element via the attachment.

The basic profile is self-supporting up to a certain length and fitted with slots to keep it in place.

Optionally, the linear unit can be fitted with accessories such as inductive or mechanical limit switches and other built-on parts (see Section 6.3).

The operating area can be flexibly arranged. Several linear units of types Alpha, Beta or Delta can be configured to cover a large area (2 axes) or a spatial arrangement (3 axes).

A plate can be used to connect driven linear units to non-driven linear units of the same type, for example in order to be able to take on large loads.

5 Transport and storage

The mechanical linear drive is a precision instrument. Any heavy impact to this instrument may damage the mechanics and impair its functionality.

CAUTION



Risk of damage by heavy impact or bending!

Only transport an assembled linear unit using transport locks.

In order to avoid any damage to the linear unit when storing or transporting it, the following measures must be taken in order to protect it from jolting or slipping:

- Transport the unit in a sufficiently large container
- Use cushioned packaging

The weight values for the units are listed in Section 3.

The units must be protected against:

- dirt,
- corrosion,
- water
- and an aggressive atmosphere.

6 Assembly and alignment

The linear unit can be mounted as follows:

- With mounting brackets
- With screws in the sliding blocks
- With screws in the factory-fitted threaded rails

☛ Mount the linear unit only on a flat surface. Standard parallelism <math>< 0.2 \text{ mm}/1000 \text{ mm}</math>.

☛ Mounting the linear unit using the threaded rails is recommended for the following situations:
 for highly dynamic applications
 where the linear unit is attached at only 2 fixing points

6.1 Assembling the linear unit with mounting brackets

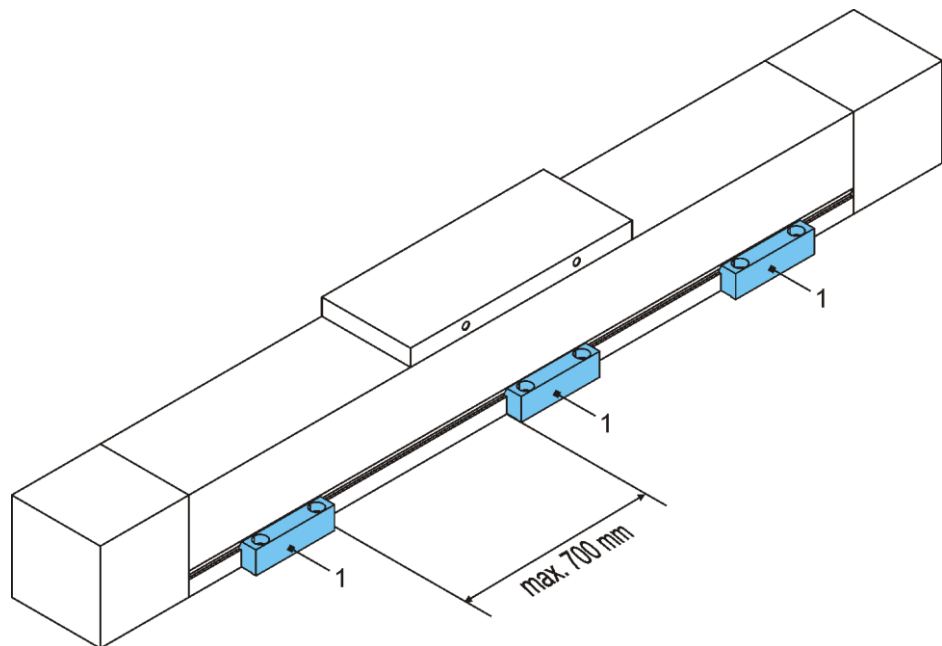


Figure 2: Mounting brackets (1)

☛ The recommended maximum distance between the mounting brackets is 700 mm.

Proceed as follows

1. Loosely fit the mounting brackets (1) into position (Figure 2).
2. Align the linear unit axially.
3. Screw the mounting brackets (1) into place (for tightening torques refer to Section 3).

6.2 Screwing linear unit into place from underneath

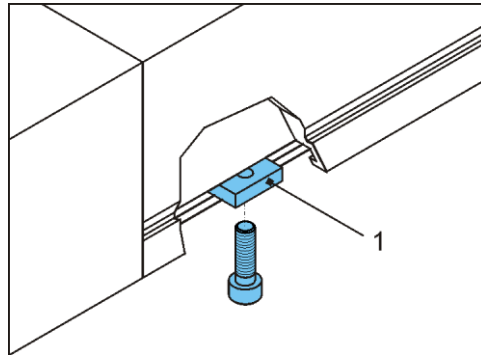


Figure 3: Sliding blocks (1) in the slot on the underside of the basic profile

Secure the linear unit using fastening screws from below using the sliding blocks or the threaded rails in the basic aluminium profile (Figure 3).

Proceed as follows

1. Align the linear unit.
2. Align the sliding blocks (1) / threaded rails.
3. Screw the linear unit into place
(for tightening torques refer to Section 3).

6.3 Setting the maximum stroke

DANGER



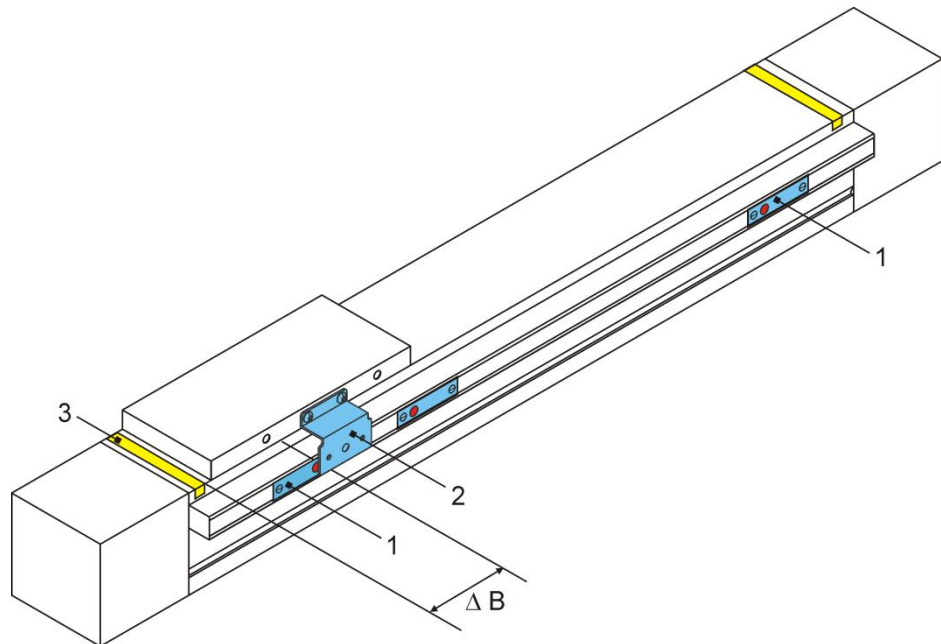
Risk of serious injury from overturning transport devices. Should the carriage come to a stop beyond the safety area, the transport device mounted on this may break off or overturn. The linear unit can be damaged beyond repair. Please take note of the specified safety area when setting up the unit and set the limit switches correspondingly. Electric switches may only be connected by a qualified electrician.

☛ Allow for a sufficient braking distance to ensure that there is enough time to slow down the carriage in the case of an emergency stop.

6.3.1 Adjusting the position of the inductive limit switches

The duty of the inductive limit switches is to shut down the electric drive before the mechanical limit of travel is reached.

The necessary braking distance (ΔB) depends on the speed and deceleration. This braking distance must be less than the distance between the trip point of the limit switch and the actual mechanical limit of travel.



Legend	1	Inductive limit switches
	2	Trip cam
	3	Band marking the safety area

Figure 4: Inductive limit switches

CAUTION



The limit switches must trip so that the carriage comes to a stop immediately short of the safety area. At delivery, the safety area is marked with a band (3).

Proceed as follows

1. Switch on the power supply for the limit switches.
2. Loosen the fastening screws for the limit switch.
3. Move the carriage up to the braking position.
4. Move the limit switch (NC) far enough under the switching cam for it to trip and the LED on the sensor to go out.
5. Move the carriage away.
6. Tighten the limit switch fastening screws.
7. Check the correct position of the limit switch: Move the carriage along by hand and check the switch tripping point.
8. Fit the limit switch bar cover.

6.3.2 Adjusting the position of the mechanical limit switches

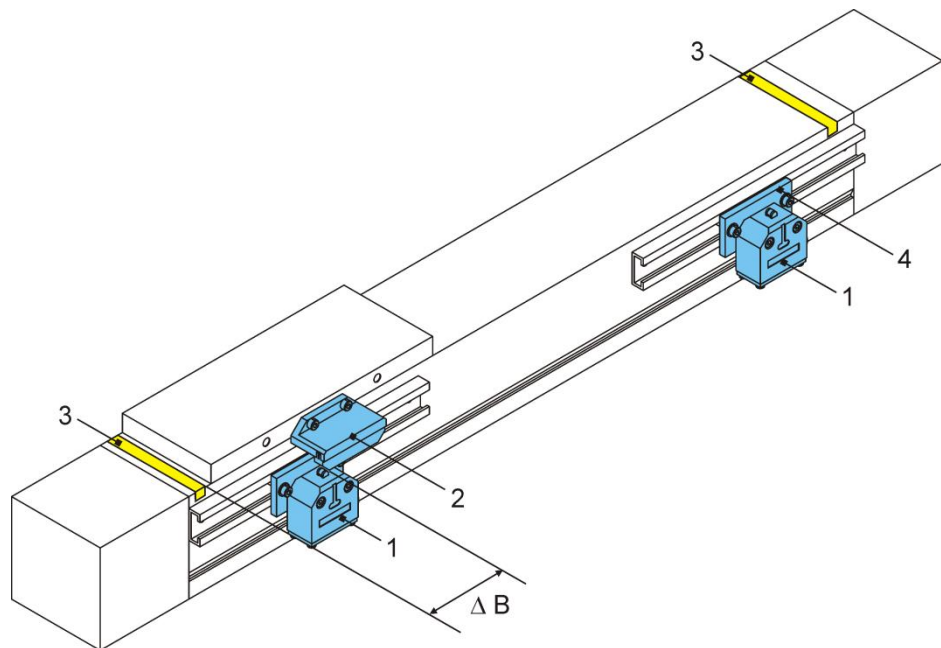
Mechanical safety limit switches (NC) must be used if there is a risk that persons may be endangered unless the electric drive shuts down immediately.

The drive may be started up only once all limit switches are correctly adjusted and are connected!

Mechanical safety limit switches may be combined with inductive limit switches.

External dampers must be fitted as protection against mechanical damage.

The necessary braking distance (ΔB) depends on the speed and deceleration. This braking distance must be less than the distance between the trip point of the limit switch and the actual mechanical limit of travel (Figure 5).



Legend	1	Mechanical limit switches
	2	Trip cam
	3	Band marking the safety area
	4	Retaining plate
	B	Braking distance

Figure 5: Mechanical limit switches

CAUTION



The limit switches must trip so that the carriage comes to a stop immediately short of the safety area. At delivery, the safety area is marked with a band (3).

Proceed as follows

1. Switch on the power supply for the limit switches.
2. Loosen the clamping screw for the retaining plate (Figure 5).
3. Move the carriage up to the safety area.
4. Push the limit switch along until it trips.
5. Tighten the clamping screw on the retaining plate.
6. Check the correct position of the limit switch: Move the carriage along by hand and check the switch tripping point.
If this leaves insufficient braking distance, repeat the adjustment process.

6.4 Installing the drive

Make sure that the direction of rotation of the external drive corresponds to the direction of rotation of the spindle or the toothed belt, so that the limit switches operate correctly.

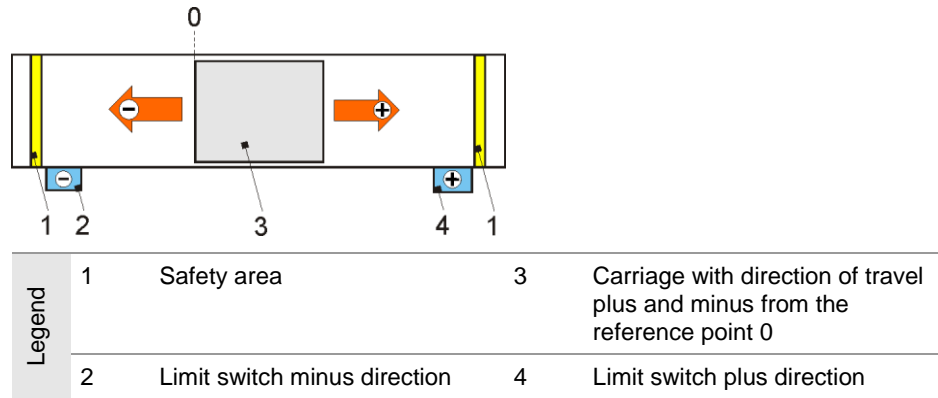


Figure 6: Example of direction of travel and limit switch circuits

6.4.1 Installing the motor

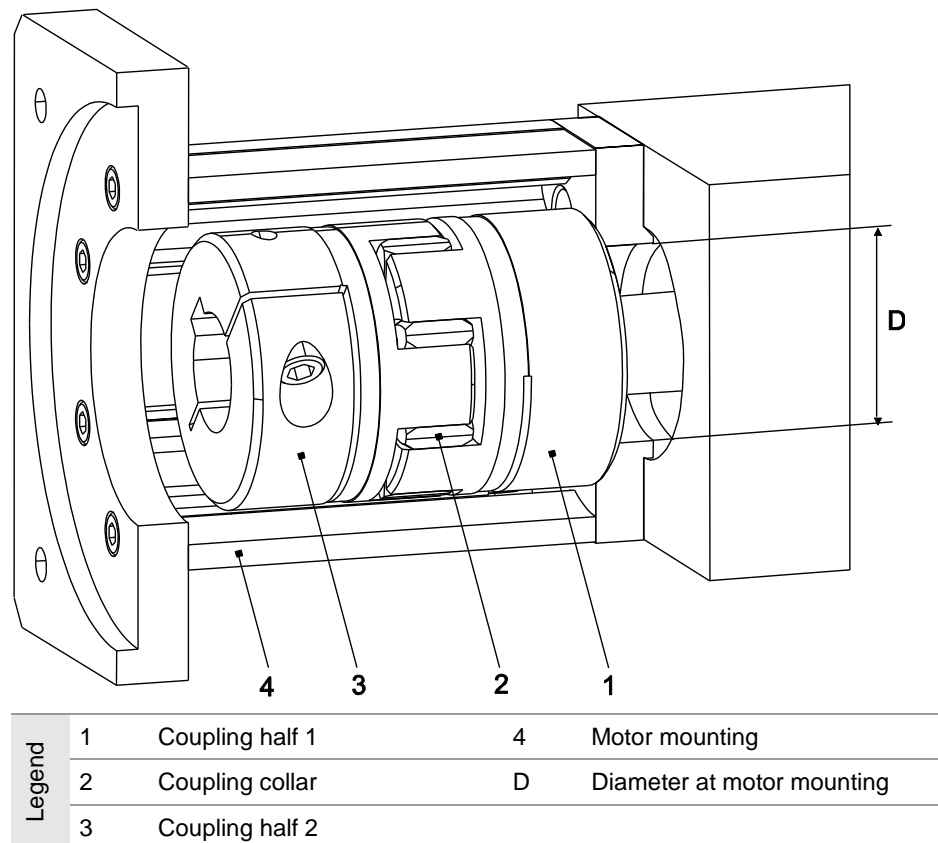


Figure 7 Motor mounting with motor coupling at drive journal

Proceed as follows

1. Place the motor and the coupling elements in the mounting position alongside the linear unit.
2. Check the direction of rotation of the motor. It must correspond to the safety limit switches (Figure 6). Change the direction of rotation of the motor if required.
3. If the coupling diameter is smaller than the D measurement at the motor mounting (4), first mount the coupling half 1 (1) (bore flush with the drive shaft) and then the motor mounting (4) (Figure 7).

If the coupling diameter is larger than the D measurement at the motor mounting (4), first mount the motor mounting (4) and then the coupling half 1 (1) (bore flush with the drive shaft). Tighten the coupling clamping screw using the mounting bore on the motor mounting (4).

4. If necessary, push the coupling collar (2) onto the coupling.
5. Fix the coupling half 2 (3) to the motor journal.
6. Attach the motor to the motor mounting.

7 Commissioning

WARNING



Risk of injury or damage to other installation parts as a result of quick linear motion of the transport device due to load thrown out.

Only authorised personnel are permitted to commission the linear unit.

DANGER



Risk of crushing due to incorrect direction of movement of the transport device.

Should the direction of rotation of the drive (motor or gearbox) and the carriage drive (spindle or toothed belt) not correspond, the mounted transport device may travel in the wrong direction. Around all rotating parts, e.g. GX shaft and around the toothed belt (when used without cover band), there is a risk of being pulled in, and of clothing or body parts being caught up and trapped. There is also a risk of crushing around the moving carriage. These hazards can be countered by installing effective safety mechanisms that comply with the current standards and are state-of-the-art. These are not supplied with the linear unit and must be installed by the manufacturer of the overall installation.

Use of the deflection belt drive without the protective hood supplied is not permitted.

Only qualified electricians are permitted to carry out any work on the electrical installation or check the direction of rotation.

Checking the unit before commissioning

Before commissioning, the following must be checked:

- whether the holding devices used are consistent with the mass and acceleration information provided by the manufacturer,
- whether the machine or installation in which the linear unit is installed corresponds to the provisions set out by the machinery directive, the harmonised standards, the European standards or the national standards,
- whether the linear unit is correctly mounted,
- whether the inductive and/or mechanical limit switches are correctly connected and functioning properly,
- whether the direction of rotation of the motor shaft and, if applicable, the intermediary gearbox corresponds to the direction of rotation of the spindle or the toothed belt.

If there are faults detected during this inspection, commissioning is not permitted.

Test run

In order to avoid any accidents or collisions, the linear unit must be moved along the stroke several times at a rate slow enough that it can be stopped in time in case of an emergency.

The installation can be started up after it has been ensured that there is no risk of a collision when exceeding the maximum stroke.

8 Operation

WARNING



The drive motor can heat up considerably during operation. In this case, refer to the operating instructions supplied for the drive motor.

In addition, hazards can occur due to noise, tilting and falling, failure to observe ergonomic principles, and the surroundings in which the unit is used.

Various combinations of hazards are also possible.

These items should be analysed by the manufacturer or operator of the overall installation in a separate risk assessment.

CAUTION



Risk of damage due to harmful environmental influences!

The linear unit may only be operated under ambient conditions which are permitted by the manufacturer.

Ambient conditions

The linear unit may be operated only within the permitted temperature range of 0-80 °C.

Operating in damp, abrasive conditions may result in foreign objects entering the linear unit. In order to prevent this, the operator must take the necessary measures to avoid the ingress of foreign objects, e.g. folding plates, wash plates, sealing air.

Required inspection

The linear unit must be occasionally checked during operation to see that it is functioning correctly.

The personnel responsible must check the linear unit and the machinery for any visible signs of damage or defects at least once during each shift.

Should there be any changes observed which may compromise safety, it must be switched off immediately.

Emergency stop

The maximum permissible load values are also not allowed to be exceeded in an emergency stop situation.

9 Decommissioning

WARNING



Risk of injury or damage to other installation parts due to falling installation parts.

Only authorised personnel are permitted to disassemble the linear unit.

1. Disconnect the machine/installation from the mains supply.
2. Disassemble the drive from the linear unit.
3. Unscrew the linear unit from the machine/installation.

10 Maintenance

DANGER



Around all rotating parts, e.g. GX shaft and around the toothed belt (when used without cover band), there is a risk of being pulled in, and of clothing or body parts being caught up and trapped. There is also a risk of crushing around the moving carriage.

For this reason, lubrication of the linear unit may be carried out only while it is moving slowly (max. 0.025 m/s), and for any cleaning work the linear unit drive must be shut down and secured against being restarted.

- All ball bearings fitted are sealed and maintenance-free.
- Remove excessive dust and dirt from the cover band and other parts of the linear unit regularly.
- The toothed belt is maintenance-free. Replace the toothed belt should there be any breakage or stretching beyond the elastic area.

10.1 Lubrication

Influencing factors

The following influencing factors are important for an accurate regulation of lubrication intervals:

- Load
- Speed
- Motion sequence
- Operating temperature
- Degree of contamination

Short lubrication intervals

Short lubrication intervals are required for:

- operation under the influence of dust and dampness
- heavy load
- high speed (up to V_{max})
- short strokes

Initial lubrication

☛ After commissioning, carry out the initial lubrication. The basic lubrication has already been carried out by the manufacturer.

Refer to the lubrication directives on the following pages.

Lubrication points for standard linear units

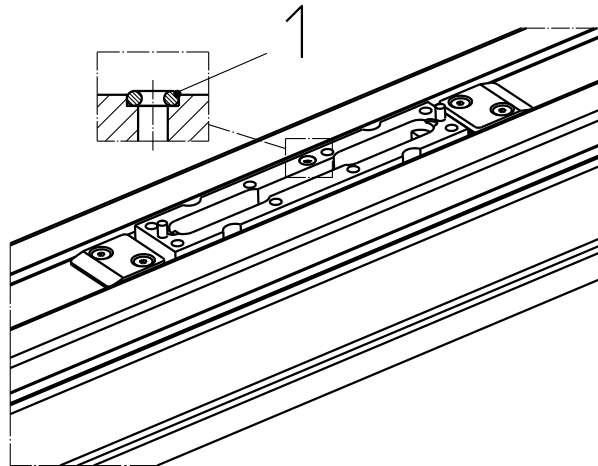


Fig. 8: Lubricating hole on the carriage

In order to relubricate the linear guide system, there is a lubricating hole on the carriage which must be supplied with grease using the part built onto the carriage. For this purpose, there is a recess in the lubricating hole in which an appropriate O-ring (1) is inserted as a seal.

Lubrication points for linear units with optional carriage plate

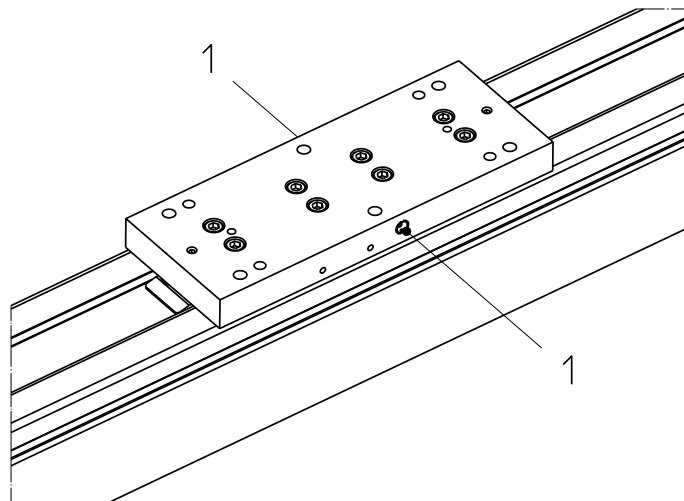


Fig. 9: Lubrication point (1) on the carriage on both sides

The linear guide system can be relubricated at one of the two lubrication points (1).

Lubrication method

Lubrication should take place as far as possible while in motion so that the grease is distributed and no pressure builds up.

Lubrication plan for lubrication point F (for rail guide)

Guide carriage size	Lubrication interval	Amount of grease [cm ³] per guiding carriage	Type of grease
15 with ball chain	approx. 5,000 km*	approx. 0.4	Grease in accordance with DIN 51825-KPE1R-20, e.g. Klüberplex BE 31-102 ☛ If a different type of grease is used, please comply with the instructions provided by the lubricant manufacturer! ☛ Grease with a solid lubricant percentage (e.g. graphite, MoS ₂) must not be used!
20 with ball chain		approx. 0.6	
25 with ball chain		approx. 1.2	
15 without ball chain	approx. 2,000 km*	approx. 0.8	
20 without ball chain		approx. 1.4	
25 without ball chain		approx. 2.8	

* Or at least twice a year. The lubrication interval depends on the ambient conditions and the load. Relubrication "in motion"!

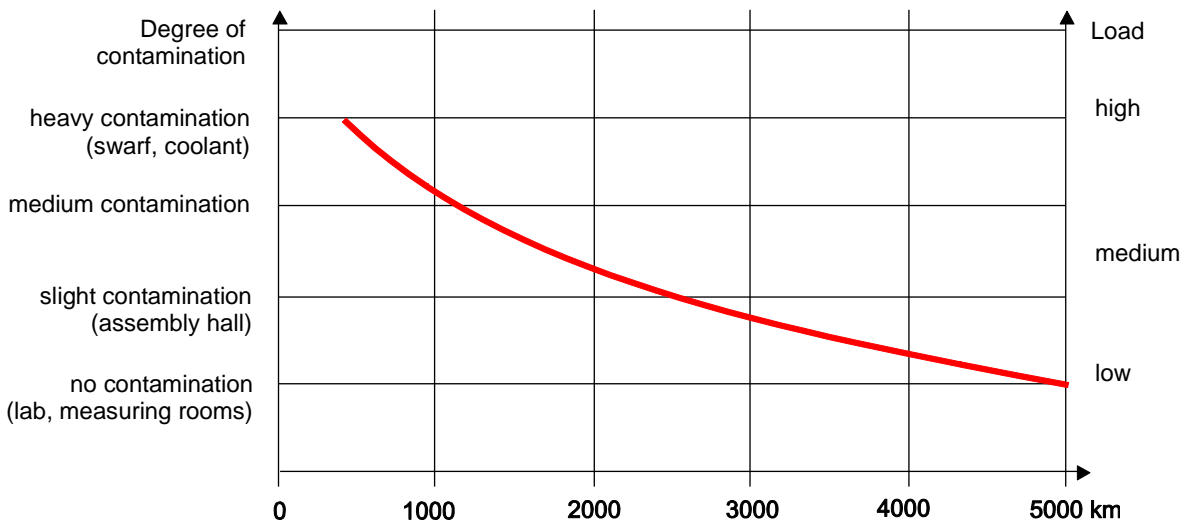


Figure 9: Relubrication intervals for the linear guide system with ball chain

10.2 Replacing the toothed belt

☛ For optimum function during operation, it must be ensured during installation that no foreign bodies enter the basic profile or other parts of the linear unit.

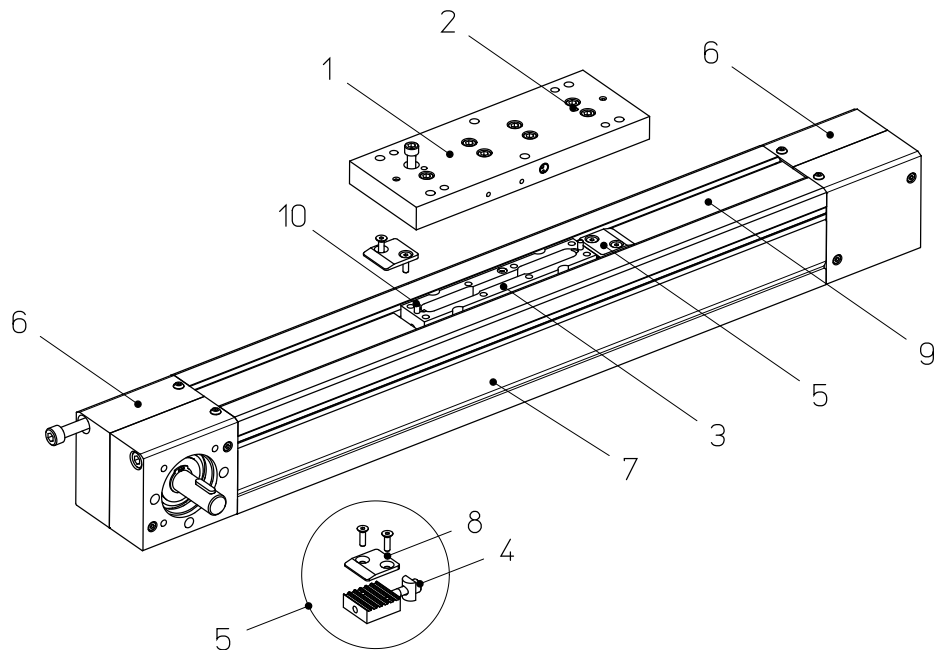
☛ Do not damage the standard parts (screws, etc.) as they will be used again.

CAUTION



Damage due to lack of lubrication!

Do not lose or damage the O-ring between the parts, otherwise the lubrication of the guiding carriage will not be ensured.



Legend	1	Carriage plate	2	Threaded bores for jacking
	3	Attachment	4	Tensioning screws
	5	Toothed belt holder	6	Bearing housing
	7	Basic profile	8	Top part of toothed belt holder
	9	Toothed belt	10	Alignment pins

Figure 10: Replacing the toothed belt

Proceed as follows

1. Remove the drive (motor, gearbox).
2. Move the carriage into the middle of the linear unit.
3. Remove fastening screws from the carriage plate (1). Then press carriage plate off the attachment (3) using jacking screws in the threaded bores provided for this purpose (2).
Attention! O-ring seal must not be lost!
4. Undo the tensioning screws (4) and pull both toothed belt

- holders (5) out of the attachment.
5. Unscrew both bearing housings (6).
 6. Pull both toothed belt holders out of the basic profile (7) in the direction of the bearing housings.
 7. Unscrew the top parts of the toothed belt holders (8).
 8. Pull the faulty toothed belt (9) out of the two bearing housings.
 9. Fasten new toothed belt to the old toothed belt using adhesive tape. (Tooth visible upward.)
 10. Using the old toothed belt, pull the new toothed belt through the basic profile until it protrudes by approximately the same amount at both ends of the basic profile.
 11. Push the ends of the new belt into the bottom of the bearing housings until the ends protrude from the bearing housings at the top.
 12. Fasten the toothed belt holders to the ends of the toothed belt and push into the basic profile to the attachment.
 13. Correctly screw both bearing housings onto the basic profile. The fastening screws must be secured with Loctite 243.
 14. Fasten both toothed belt holders to the attachment using the tensioning screws, but do not tension. The tensioning screws must be secured with Loctite 243.
 15. Place the toothed belt under high tension using tensioning screws.
 16. Set the required tension accurately using a belt tensioning measurement device (see Operating Instructions for the measurement device).
- ☛ Only the required tension which is correctly set will guarantee optimal operation of the unit.
17. The measuring position and the Hz figure applicable for the toothed belt are supplied with the replacement toothed belt. Tension the toothed belt in such a way that the Hz figure given is shown.
 18. Make sure the O-ring seal is positioned correctly in the attachment.
 19. Fit the carriage plate to the two pins on the attachment.
 20. Screw the carriage plate to the attachment underneath. Only use the original screws.
- ☛ If you do not use the original screws, make sure the screws are not too long, otherwise they will sit on the basic profile or the cover band and damage this part.