

Technical Documentation

Linear Tables LT

Order number: 74080480004

Version: V1.04, 08.2006

Berger Lahr GmbH & Co. KG
Breslauer Str. 7
D-77933 Lahr



1. Introduction	4
1.1 Device family	4
1.2 Components	4
1.2.1 Linear table design	4
1.2.2 Motor mounting versions	5
1.3 Directives and standards	5
2. Safety	6
2.1 Qualification of the personnel	6
2.2 Intended use	6
2.3 Safety notes	6
2.3.1 Symbol and notes explanation	7
3. Technical data	8
3.1 General information	8
3.2 Mechanical data	8
3.3 Performance data	8
3.4 Accuracy	8
3.4.1 Positioning accuracy	8
3.4.2 Repeatability	9
3.5 Electrical data	10
3.5.1 Limit switches	10
3.5.2 Motors	12
4. Installation	13
4.1 Ambient conditions	13
4.2 Unloading of the product	13
4.3 Packaging material disposal	13
4.4 Mechanical installation	14
4.4.1 Mounting position of the linear table	14
4.4.2 Quality of the mounting surface	14
4.4.3 Mounting of the linear tables	14
4.4.4 Linear table alignment	15
4.5 Electrical wiring	16
4.5.1 Motor wiring	16
4.5.2 Limit switch wiring	16
5. Commissioning	17
5.1 Preparation	17
5.2 Implementation	17
6. Operation	18
6.1 Basics	18
6.2 Function	18
7. Errors and diagnostics	19
8. Inspection	20
8.1 Inspection after collision	20

8.1.1	Ball screw and ball screw bearings	20
8.1.2	Guides	20
8.1.3	Coupling	20
8.1.4	Timing belt	20
9.	<i>Maintenance</i>	21
9.1	General information	21
9.2	Lubrication	21
9.3	Cleaning	21
9.3.1		21
9.3.2	Cleaning of aluminum parts	22
9.3.3	Cleaning of bellows	22
10.	<i>Service / repair</i>	23
10.1	Exchange of bellows	23
10.2	Limit switch exchange	24
10.3	Motor exchange	25
10.3.1	Straight mounted motor exchange	25
10.3.2	Belt gear motor exchange	26
10.4	Coupling exchange	27
10.5	Timing belt exchange	28
11.	<i>Accessories and spare parts</i>	29
11.1	Accessories	29
11.1.1	Set of rail nuts – galvanized	29
11.1.2	Set of clamping profiles – aluminum anodized	29
11.1.3	Limit switch connectors	30
11.1.4	Limit switch cable with receptacle	30
11.2	Spare parts	31
11.2.1	Exploded view of a linear table LT100	31
11.2.2	Exploded view of a linear table LT150 / 200	32
11.2.3	Exploded view of straight motor mounting	33
11.2.4	Exploded view of motor mounting with belt gear	33
11.2.5	Spare parts list LT100	34
11.2.6	Spare part list LT150	34
11.2.7	Spare part list LT200	34

1. **Introduction**

This document contains important notes on safety, installation and maintenance for Berger Lahr linear tables. Please have this documentation readily available during the entire product service life. In case your manual is lost, you can reorder a new copy from Berger Lahr using the data printed on the type label of your product.

Carefully read these instructions before installation and commissioning of the product. The notes and instructions in this documentation are the basis for safety of personnel, cost efficient operation and a long service life.

The diagrams and drawings are only given as examples. Our products are subject to technical modification and ongoing development. The manufacturer reserves the right to make product modifications without advance notice.

1.1 **Device family**

The Berger Lahr linear table product group consists of the sizes:

LT-100 (Profile width 100mm)

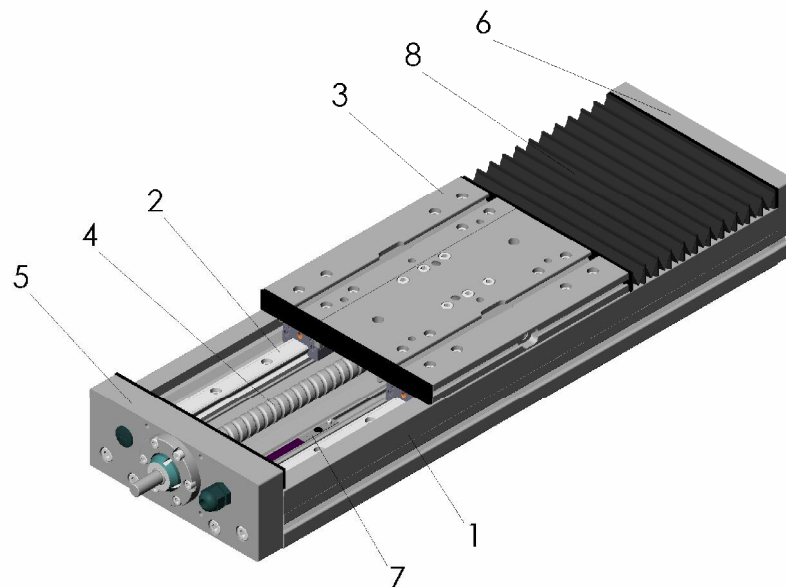
LT-150 (Profile width 150mm)

LT-200 (Profile width 200mm)

The sizes have different outer dimensions, pay loads and maximum strokes.

1.2 **Components**

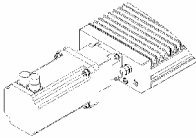
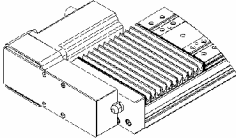
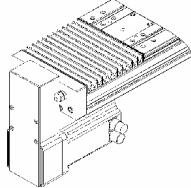
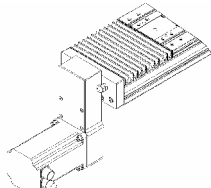
1.2.1 **Linear table design**



1. Base profile
2. Recirculating ball bearing system
3. Carriage
4. Ball screw
5. Front plate with fixed screw bearing
6. End plate with loose screw bearing
7. Inductive limit switch
8. Bellows

1.2.2 Motor mounting versions

The drive can be mounted direct, via a rigid coupling or a zero backlash belt gear.

Straight motor mounting	Belt gear horizontal inside left
	
Belt gear vertical down inside	Belt gear vertical down outside
	

1.3 Directives and standards

Berger Lahr linear tables correspond to EC – machine directives and the harmonized standards:

- EN 292-1:1991: Safety of machinery - Basic concepts, general principles for design – Part1: Basic terminology, methodology
- EN 292-2:1991: Safety of machinery - Basic concepts, general principles for design – Part 2: Technical principles and specifications
- EN 60204-1:1997: Safety of machinery – Electrical equipment of machines – Part 1: General requirements

The manufacturer's declaration of conformity certifies that the device satisfies the requirements of the standards listed above.

2. Safety

2.1 Qualification of the personnel

Qualified personnel are persons who, by technical training, knowledge and experience, are able to assess the work to be done and to recognize and avoid possible dangers. Qualified personnel must be familiar with the current standards, regulations, and accident prevention regulations, which have to be observed when working with linear tables.

According to the EC-machine directives the operator is obliged to instruct the personnel who are responsible for installation, dismantling, commissioning, operation, maintenance and repair.

The operator is obliged to check the entire machine or system after a repair or failure corrective action.

2.2 Intended use

The Berger Lahr linear tables described in this documentation are designed for system application in the industrial automation and are not understood as independently operating devices. Before operation and use of the linear tables, the operator must read all accompanying product documentations, as well as apply all relevant safety standards. Additional safety technology such as safety devices, barriers and emergency-stop systems that are not described in this documentation might be required to safely operate the linear table in a machine or system.

Linear tables are used for example to:

- move high loads
- generate high feed forces
- perform exact movements
- position with high precision

in processes such as: feeding, picking, pressing, tensioning, positioning, moving, etc.

Any use apart from this is not considered as intended use. Berger Lahr is not liable for incurred damages. The respective operator takes the risk.

2.3 Safety notes

Our products are designed and manufactured according to state of the art technology. Unauthorized product modifications are prohibited. We exclude and decline any liability for personal injuries and damage to property, caused by modifications not authorized by the manufacturer in writing.





The operator has to take effective counter measures for DANGERS of our products to persons or property that emerge after installation.

Our instructions and notes must be observed for installation and operation. Furthermore all general safety technology directives do apply, as well as the accident prevention directives and the EC directives.

2.3.1 Symbol and notes explanation

The following special notes can appear anywhere in this documentation or on the product, to

- warn of potential DANGERS
- make aware of important notes

 DANGER	Danger indicates an immediate risky situation that can lead to death or serious personal injury if not observed.
 DANGER	Danger indicates an immediate electrical danger, that can lead to death or serious injury if not observed
 WARNING	Warning indicates a potentially risky situation that can lead to serious personal injury or minor personal injury if not observed.
CAUTION	Caution – used without the safety alarm symbol, indicates a potentially risky situation, that can lead to minor personal injury or damage to the unit or system if not observed.
 NOTE	Note gives important product and product handling information, or informs about additional information in the manual.

3. Technical data

3.1 General information

Technical specifications are continuously updated and supplemented because of improvement and further development.

For this reason, please consult our product data sheets for technical data. The most current documents are available from your local Berger Lahr sales office or as a download at: <http://www.berger-lahr.com>

3.2 Mechanical data

Please consult the product data sheets (see *Chapter 3.1*) for mechanical data on our linear tables

3.3 Performance data

Please consult the product data sheets (see *Chapter 3.1*) for mechanical data on our linear tables

The external forces and torques listed in the product data sheet are maximum values for each specific part of the load. A maximum value must only be a single load and can't be combined with additional loads. If multiple loads are present at the same time (e.g. M_x and M_y , F_y and M_z) the entire complex load can be approximately estimated with the following formula:

$$\frac{F_y}{F_{y\max.}} + \frac{F_z}{F_{z\max.}} + \frac{M_x}{M_{x\max.}} + \frac{M_y}{M_{y\max.}} + \frac{M_z}{M_{z\max.}} \leq 1$$

Service life

In order to achieve a service life of approximately 10.000 km, we recommend not to exceed 20% of the maximum dynamic forces and torques. Higher loads reduce the service life.

3.4 Accuracy

3.4.1 Positioning accuracy

The positioning accuracy describes the positioning deviation of the linear unit that is allowed for a positioning move to a set position.

The positioning accuracy is influenced by the following factors:

- The mechanics – manufacturing tolerances, ball screw, pitch, ..
- The drive – motor resolution, closed loop circuit, ...
- The motion profile – steep deceleration ramps, high speed,...
- Heat – environmental heat, internal friction heat

3.4.2 Repeatability

The repeatability describes the positioning deviation of the linear unit that is allowed for repeat positioning moves to the same position.

The repeatability is influenced by the following factors:

- Load change
- External temperature changes
- Internal temperature changes, at continuous operation the ball screw heats up through friction and expands
- Change of the motion profile (deceleration ramp, speed, ..)
- Accuracy of the trigger position of the inductive limit switch (signal evaluation)

3.5 Electrical data

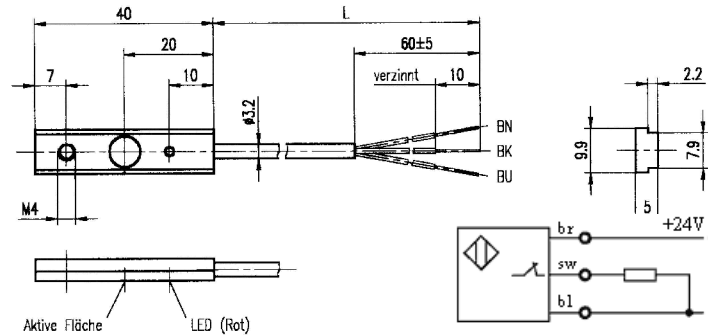
3.5.1 Limit switches



NOTE

Inductive limit switches are available either as normally closed (PNP/NC) or as normally open (PNP/NO) versions.

Inductive proximity switch – PNP/NC – Normally closed short circuit protected



Common Data

Rated operating distance s_r	[mm]	$2.0 \pm 10\%^{1)}$
Assured operating distance s_a	[mm]	$0 \dots 1.6^{1)}$
Hysteresis H	[% v. s_r]	≤ 15
Repeatability R	[% v. s_r]	≤ 5
Ambient temperature range T_a	[°C]	$-25 \dots +95$
Temperature drift	[% v. s_r]	≤ 10
Switching frequency f at U_e	[Hz]	1000
Time delay before availability t_v	[ms]	≤ 10
Operating category		DC 13
Function / operating voltage -indicator		<input type="checkbox"/> <input checked="" type="checkbox"/>

Electrical Data

Rated operational voltage U_e	[V]	24 DC
Supply voltage U_B	[V]	10...30 DC
Ripple	[% of U_e]	≤ 15
Voltage drop U_d at I_e stat./dyn.	[V]	$\leq 3 / -$
Rated insulation voltage U_i	[V]	75 DC
Rated frequency of the supply voltage	[Hz]	DC
Rated operational current I_e	[mA]	150
Lowest supply current I_m	[mA]	-
Short term -peak current I_k T = 20 ms	[A]/[Hz]	- / -
No-load current I_0 at U_e act./not act.	[mA]	$\leq 10 / \leq 3$
Off-state current I_r	[µA]	≤ 10
Protected against all wire interchanges		<input checked="" type="checkbox"/>
Reverse polarity protected		<input checked="" type="checkbox"/>
Rated short circuit current	[A]	100
Output resistance R_a	[kOhm]	33+D
Permissible load capacity	[µF]	≤ 0.5

EMI

ESD/RFI/Burst/IVW	Category	4 / 2 / 4 / 2
Emission		Gr. 1, Cl. B

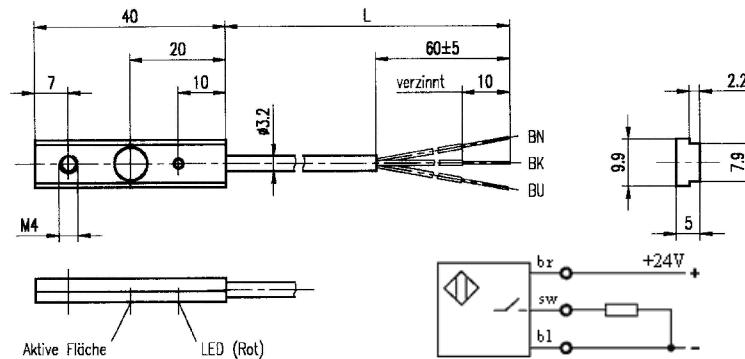
Mechanical Data

Housing material		Al
Mounting torque [Nm]		-
Material of sensing face		POM
Connection type		Cable HK-SO-Li12y11y-HF
Wire amount x wire cross section	[mm²]	3x0.14
Degree of protection		IP 67
Protection class		-
Degree of pollution		3
Weight	[g]	11+36 per meter cCable
Shock		Half sinus. 30 gn, 11 ms
Vibration		55 Hz, 1 mm amplitude, 3 x 30 minutes

Remarks

After overload elimination sensor is again ready to operate.
¹⁾Rated operating distance s_r for aluminum [mm] $0.9 \pm 10\%$
 Assured operating distance s_a for aluminum [mm] $0 \dots 0.7$

Inductive proximity switch – PNP/NO – Normally open short circuit protected



Common Data

Rated operating distance s_r	[mm]	$2.0 \pm 10\%^{1)}$
Assured operating distance s_a	[mm]	$0...1.6^{1)}$
Hysteresis H	[% v. s_r]	≤ 15
Repeatability R	[% v. s_r]	≤ 5
Ambient temperature range T_a	[°C]	$-25...+70$
Temperature drift	[% v. s_r]	≤ 10
Switching frequency f at U_c	[Hz]	1000
Time delay before availability t_v	[ms]	≤ 10
Operating category		DC 13
Function / operating voltage -indicator		<input type="checkbox"/> <input checked="" type="checkbox"/>

Electrical Data

Rated operational voltage U_c	[V]	24 DC
Supply voltage U_B	[V]	10...30 DC
Ripple	[% v. U_c]	≤ 10
Voltage drop U_d at I_c stat./dyn.	[V]	$\leq 3 / -$
Rated insulation voltage U_i	[V]	75 DC
Rated frequency of the supply voltage	[Hz]	DC
Rated operational current I_c	[mA]	150
Lowest supply current I_m	[mA]	-
Short term -peak current I_k T = 20 ms	[A]/[Hz]	- / -
No-load current I_0 at U_c act./not act.	[mA]	$\leq 10 / \leq 3$
Off-state current I_r	[μA]	≤ 10
Protected against all wire interchanges		<input checked="" type="checkbox"/>
Reverse polarity protected		<input checked="" type="checkbox"/>
Rated short circuit current	[A]	100
Output resistance R_a	[kOhm]	33+D
Permissible load capacity		≤ 0.5

EMI

ESD/RFI/Burst/IVW	Category	4 / 2 / 4 / 2
Emission		Gr. 1, Cl. B

Mechanical Data

Housing material		AI
Mounting torque [Nm]		-
Material of sensing face		POM
Connection type		Cable HK-SO-Li12y11y-HF
Wire amount x wire cross section	[mm²]	3x0.14
Degree of protection		IP 67
Protection class		-
Degree of pollution		3
Weight	[g]	11+36 per meter cable
Shock		Half sinus. 30 gn, 11 ms
Vibration		55 Hz, 1 mm amplitude, 3 x 30 minutes
Remarks		AI

After overload elimination sensor is again ready to operate.

¹⁾Rated operating distance s_r for aluminum [mm] $0.9 \pm 10\%$, Assured operating distance s_a for aluminum [mm] $0...0.7$

3.5.2 Motors

CAUTION

Please note, when selecting the motors, that the maximum permissible drive torque of the ball screw (dependent of the pitch) is not exceeded.
The ball screw could be damaged or destroyed.

For each linear table type, there is a variety of Berger Lahr motors available for mounting.

Overview

Type	Stepping motor	Max. motor torque	Servo motor	Max. motor torque
LT-100			SER 366	2,2 Nm
	VRDM 368 LWC	1,5 Nm	SER 368	3,0 Nm
LT-150	VRDM 397 LWC	2,0 Nm	SER 397	4,0 Nm
	VRDM 3910 LWC	4,0 Nm	SER 3910	8,0 Nm
	VRDM 3913 LWC	6,0 Nm	SER 3913	11,5 Nm
LT-200	VRDM 3910 LWC	4,0 Nm	SER 3910	8,0 Nm
	VRDM 3913 LWC	6,0 Nm	SER 3913	11,5 Nm
	VRDM 31117 LWC	12,0 Nm	SER 3916	14,5 Nm
	VRDM 31122 LWC	16,5 Nm	SER 31112	18,0 Nm

For additional motor data please consult the corresponding Berger Lahr data sheets for stepping motors and servo motors.

Please also note the supplementary data sheets:

- Safety notes on motors
- Notes on motor mounting and encoder connection

The current documents can be obtained from your local Berger Lahr sales office or as a download via: <http://www.berger-lahr.com>

Mounting of third party motors

For the majority of motors, mounting adaptors for straight mounting or with a belt gear are available from Berger Lahr. For this please contact your local Berger Lahr sales office.



NOTE

You find notes on mounting your motor at *Chapter 10.3.1* Motor change for straight mounting and *Chapter 10.3.2* Motor change for belt gear

4. Installation

4.1 Ambient conditions

The products were designed for operation under *normal* ambient conditions.

Ambient temperature: - 10°C+ 40°C

Humidity: ≤75% relative humidity annual average / 95% relative humidity on 30 days no condensation.

Storage and transport temperature: - 25 + 70°C




Vacuum: not intended (special limit switches required!)

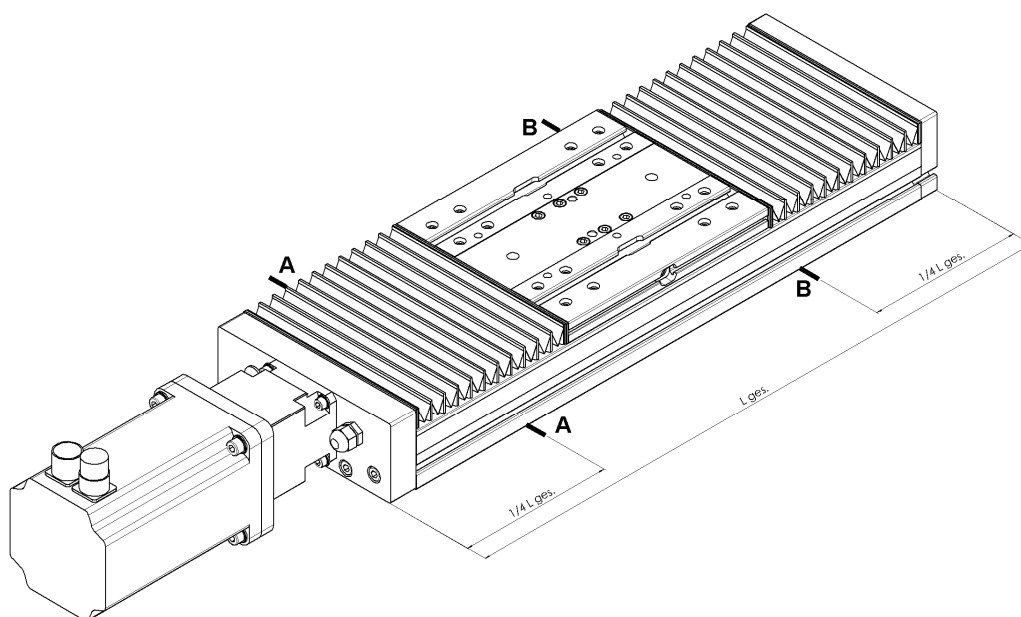
4.2 Unloading of the product

Linear tables are precision products and must be handled with care for this reason. Shocks and impacts to the carriage can destroy the ball screw guides, noise development and / or inaccuracies in the guides can be the consequence. Shocks and impacts to the ball screw cause eccentricity deviation.

We recommend that you bring the linear table in its packaging as close a possible to the installation location and to unpack it there.

After the packaging material is removed, the linear tables may only be lifted up in the designated area A and B (see graphic). The distance from the end plate and front plate is each approximately $\frac{1}{4}$ of the total length of the linear table. The contact areas must be corrected to achieve a balanced load when lifting the linear tables. This is especially true for linear tables with mounted motors.

 DANGER	Do not step under suspended/hanging loads.
 WARNING	Secure the linear table against sliding and tilting while lifting or during transport
 NOTE	Defects caused by handling errors are excluded from any warranty claims.



4.3 Packaging material disposal

Dispose the packaging material according to your local legal rules.

4.4 Mechanical installation

4.4.1 Mounting position of the linear table

Berger Lahr linear tables can be mounted in each position (horizontal, vertical, tilted,...).

In case that the linear table is **not mounted horizontally**, the load is not only carried by the guiding system but also by the ball screw. The ball screw is guided in a pre-tensioned fixed bearing at the motor side and in a loose bearing on the opposite side. This means, that the linear table must be mounted with the **motor facing up**, to stress the ball screw with tensional load only and not with buckling load!

4.4.2 Quality of the mounting surface

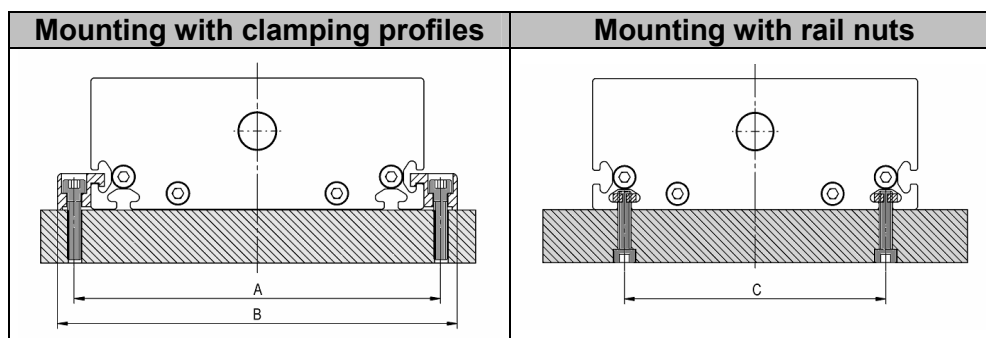
The run off tolerance of the linear tables depends of the quality of the mounting surface, which must be **clean** manufactured and **even**.

The listed linear table - run off tolerance can only be reached if the evenness of the mounting surface varies a maximum of 0,02mm / 300 mm




Further information can be found in our product data sheets (see *Chapter 3.1*)

4.4.3 Mounting of the linear tables

The base of the linear tables consists of an extruded aluminum-precision profile. T-slots are located on three sides of the profile. The T-slots offer ideal mounting and integration possibilities. The linear tables can either be mounted from above with clamping profiles on the sides - or from below with rail nuts.



Drilled hole distance

	LT100	LT150	LT200
A  mm	114	170	220
B  mm	128	190	240
C  mm	66	110	160

Number of mounting elements per side for normal requirements

	LT100	LT150	LT200
Clamping profiles	3 per 500mm	4 per 1000mm	4 per 1000mm
Rail nuts	6 per 500mm	8 per 1000mm	8 per 1000mm

For higher loads or run off tolerance requirements, the distance between the clamping profiles or the rail nuts must be shorter.



NOTE

A selection of matching rail nuts and clamping profiles are available as accessories (see *Chapter 11.1 Accessories*)

4.4.4 Linear table alignment

Depending on the requirements, the side run off tolerance of the linear tables can be aligned. For this, first only slightly tighten the mounting screws of the linear table clamping profile or rail nuts. Deviations over the entire stroke length are measured with a dial gauge by moving the carriage parallel to the reference surface. By individually tightening the mounting screws, the deviations can be corrected and consequently the linear table can be aligned.

4.5 Electrical wiring

4.5.1 Motor wiring

If you received your linear table complete with a Berger Lahr motor, please wire the motor according to the enclosed data sheet.

Please also note the supplementary data sheets:

- Safety notes on motors
- Notes on motor mounting and encoder connection

The current documents are available from your local Berger Lahr sales office or as a download at:

<http://www.berger-lahr.com>



NOTE

Matching motor cables and encoder cables in a variety of lengths are available as accessories. More information is available in the catalog "Accessories for Twin Line"

4.5.2 Limit switch wiring

The cable ends of the mounted inductive limit switches are routed to the outside through a strain relief at the front plate. The limit switches either have a plug M8 x 1 or an open cable end. The contacts of the plugs are clamped and can simply be disconnected without special tools.

The plug pin out is marked according to the limit switch cable conductors (brown/black/blue). The free cable length at the plug exit is 200mm. At the open cable end, the free cable length is independent of the stroke, but at least 3000mm or 8000mm. The limit switches are coded as follows at the cable end:

- Negative limit switch (motor side): -
- Positive limit switch: +
- Reference switch: Ref



Wiring diagram PNP/NC (normally closed)	Wiring diagram PNP/NO (normally open)
br = brown sw = black bl = blue	br = brown sw = black bl = blue




NOTE

Extension cables with receptacle are available in a variety of lengths as accessories. (see Chapter 11.1 Accessories)

5. Commissioning

5.1 Preparation

 DANGER	Commissioning of the linear tables is only allowed after safety check was performed.
---	--

Check the following list items before the initial commissioning:

- Are all mechanical parts securely mounted?
- Are electrical connections correctly wired?
- Is the system in its home position?
- Do the limit switches function properly?
- Rotation of the motor (→ movement direction of the carriage)
- Are all objects removed from the working area of the linear table?
- Is a collision of the carriage with external objects impossible?
- Are all present persons on the outside of the DANGER zone?
- Is additional safety equipment (Emergency stop, guarding,) active and functional?

5.2 Implementation


Please note that the maximum torque of servo motors is significantly higher than the nominal torque. The maximum torque of the motors must not exceed the permissible torque of the linear table. If necessary the maximum torque must be limited.

Set the speed low for the first movements. Because of the high feed forces that the linear table generates in combination with the servo motor, it is likely that the ball screw is damaged at a collision.

Run the entire motion profile multiple times with low speed to guarantee a safe operation.

6. Operation

6.1 Basics

 NOTE	For a safe and reliable continuous operation it is mandatory to keep the projected technical parameters and to follow the maintenance intervals.
---	--

Berger Lahr linear tables are designed for continuous operation applications. The service life must be calculated individually based on the application. Before operating the linear table, please check again if the actual occurring loads match the required and projected data. Contact your local Berger Lahr sales person if the load (forces, acceleration, speed, feed force, ..) was increased, so that the application can be checked again.

6.2 Function

Berger Lahr linear tables are made of high-strength aluminum precision profile. High forces and torques are possible by selection and placement of the ball screw guides. The movement of the carriage is transmitted via a ball screw. This allows for precise and stiff movements and to achieve high feed forces with high positioning accuracy and repeatability.

The ball screw is not self-locking. For safety technology reasons an additional brake is required for self-locking functionality.

The ball screw pitch has effects on:

- The torque → high pitch – high torque
- The speed → high pitch – higher speed
- The pitch → high pitch – higher inaccuracy
- The self-locking → high pitch – less self-locking

The linear tables are manufactured customized for stroke.

The stroke is the distance that the carriage moves between the trigger points of the negative and positive limit switches. Beyond that, there is a safety distance – S, that is available to compress the bellows.

The safety distances vary depending on the stroke and total length of the linear table:

LT-100: 7 - 10 mm
LT-150: 12 - 15 mm
LT-200: 17 - 20 mm

7. Errors and diagnostics

Occurred fault / error	Possible cause	Rectification
The carriage moves past the limit switch	Limit switch is defective Controller fault	Exchange limit switch - <i>Chapter 10.2</i> Eliminate fault
Motor load increases; controller shuts down due to overload.	Guide or/and ball screw jammed, or tight due to lack of lubrication.	Berger Lahr service is required
Noise and vibrations while operating the linear table at high speeds.	Ball screw speed too high Lack of lubrication (if noise develops) Ball screw eccentric deviation error due to shock or impact.	Reduce speed. Reapply lubricant - <i>Chapter 9.2</i> Ball screw must be exchanged. Berger Lahr service is required
Run out errors and noise of the guides.	Lack of lubrication Shock or impact to the carriage. Guides damaged	Reapply lubricant - <i>Chapter 9.2</i> Guides must be exchanged. Berger Lahr service is required
Carriage has play and positioning is inaccurate.	Backlash in ball screw or in the guides - after a crash - due to lack of lubrication	Berger Lahr service is required

8. Inspection



DANGER

The power to all electrical device components must be disconnected before the beginning of inspection work.

8.1 Inspection after collision

Strong shocks or impacts as a result of a carriage collision - or hard placement or acceleration of objects on the carriage can damage or destroy components of the linear table.

Therefore check the drive train and the guide system after a *Crash* for possible damage.

8.1.1 Ball screw and ball screw bearings

- Check the ball screw by placing a dial gauge at the carriage and then move the carriage manually.
Axial play means ball screw damage.
- Visually inspect the ball screw for damage. Please note the instructions under *Chapter 10.1* Exchange of bellows.
- Check the linear table at commissioning for unusual noises, vibrations and vertical run-out, as well as heat development.



NOTE

Immediately contact your local Berger Lahr sales office when damages of the ball screw and its bearings are detected.

8.1.2 Guides

- Visually inspect the linear tables guides for damage. Please note the instructions under *Chapter 10.1* Exchange of bellows.
- Check the run off tolerance of the linear tables by using a dial gauge and moving the carriage in relation to the reference surface.
- Check the linear table at commissioning for unusual noises and heat development.



NOTE

Immediately contact your local Berger Lahr sales office when damages of the guiding system are detected.

8.1.3 Coupling

- Visually inspect the coupling for damage, e.g. break. Follow the instructions under *Chapter 10.4* Exchange of coupling.

The coupling must be replaced if damaged or broken.


8.1.4 Timing belt

- Visually inspect the timing belt for defects such as tooth deformation and side wear caused by friction. For this remove the housing of the timing belt gear. Follow the instructions under *Chapter 10.5* Timing belt exchange.

The timing belt must be replaced if damaged.

9. Maintenance

9.1 General information

 DANGER	The power to all electrical device components must be disconnected before the beginning of maintenance work.
---	--

In general Berger Lahr linear tables require low maintenance. Because of their enclosed design, they are resistant to penetrating dirt and foreign objects. The used guides and drive elements are sealed and protected by bellows from the outside environment.

9.2 Lubrication

Lubricant is continuously consumed during operating of the linear tables. Periodical lubrication intervals are prerequisite for reliable operation. Insufficient lubrication - or a wrong lubricant increase the wear and tear and reduce the service life. The following factors influence the lubrication intervals:

- Extreme operating temperatures
- High ball screw speeds
- High loads
- High vibration stress
- Permanent small strokes


Berger Lahr Linear tables are equipped with a central lubrication unit, designed for a grease type lubricant, initially applied by the manufacturer. A central lubrication point is located at both ends of the carriage. Both, the ball screw and the guide system can be lubricated at one grease nipple location, depending on the accessibility. Under normal operating conditions and every 400 operating hours the table should be lubricated with 2 – 3 stokes from a common grease gun (grease nipple size DIN3405 – D6). We recommend Klüberplex BEM 34-132 as a lubricant. When using other lubricants we recommend the following minimum requirements according to DIN:

Lubricant	DIN-Type	DIN-Number	Remark
Grease	KP HC 2N-30	51502 / 51825	Calcium soap grease

9.3 Cleaning

The external parts are manufactured out of high-strength aluminum alloys that are anodized to protect the surface. The guide and drive elements are sealed from the outside through bellows in the best possible way.

To facilitate continuous functionality and reliability of operation, the linear table and its parts should be inspected periodically and cleaned if necessary.

 NOTE	<ul style="list-style-type: none">- Do not use compressed for cleaning- Vacuum coarse debris and dirt particles from the surface- Treat the surface only with a damp, soft and lint free cleaning cloth.
---	---

9.3.1

9.3.2 Cleaning of aluminum parts

The anodized surface is limited resistant against alkaline detergents. Please use exclusively neutral detergents for cleaning.

9.3.3 Cleaning of bellows

The bellows are non-sealing covers over the mechanics of the linear tables. They consist of polyester fabric coated with polyurethane on both sides and are resistant to humidity, emulsion, oil, mechanical wears as well as limited to chemicals. Excessive pollution can impair the bellows in their functionality or damage them.



- Remove large particles and dirt regularly from the surface of the bellows.
- Check the bellows regularly from damages.
- Assure before and while in operation, that the bellows can be compressed unhindered.



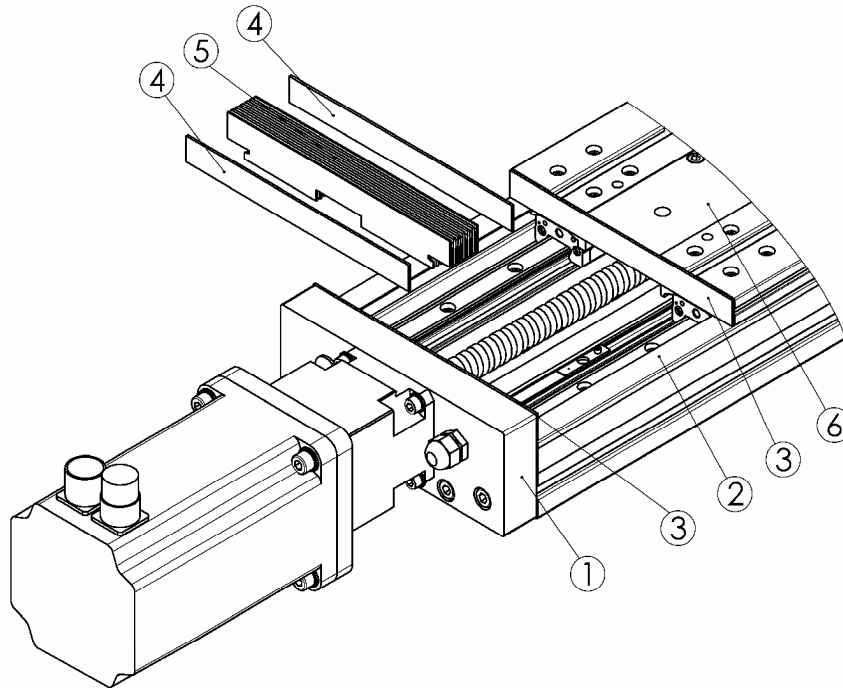
NOTE

The bellows are only limited resistant against alkaline detergents. We recommend to use exclusively neutral detergents for cleaning. Damaged bellows must be replaced immediately.

10. Service / repair

 DANGER	Only authorized professional personnel must conduct the exchange of defective parts.
 DANGER	Power to all electrical components of the device must be safely disconnected before any service work is carried out.

10.1 Exchange of bellows

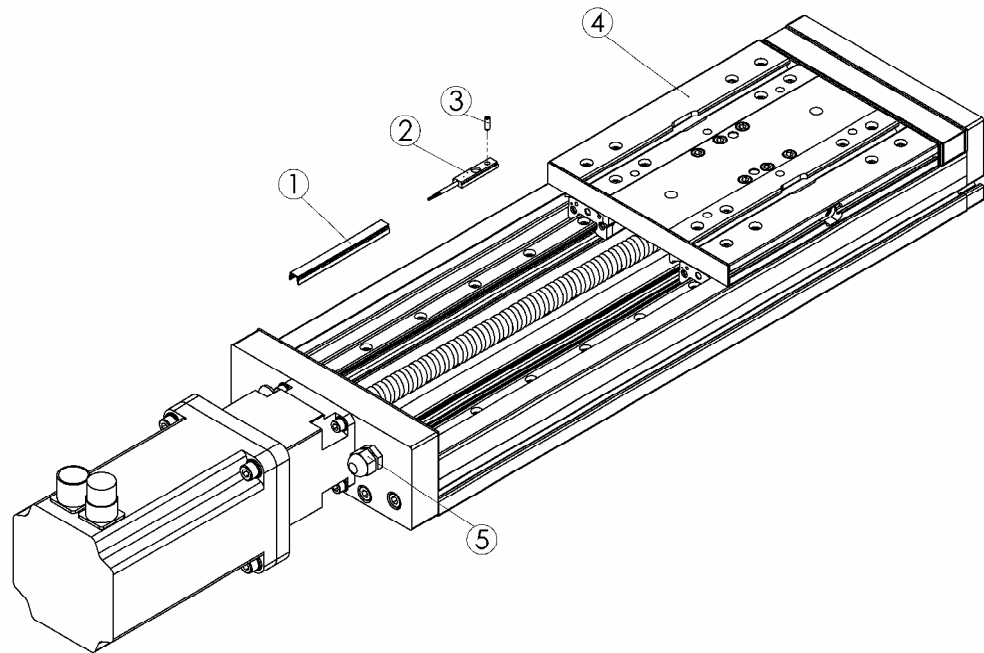


In general the used bellows are maintenance free. However, if an exchange is necessary it must be carried out (order must be kept) as follows:

- Move carriage (6) of the linear table over to the opposite end position.
- Loosen the adhesive tapes (4) of the bellows (5) from the textile-coated tapes (3) of the carriage (6) and the front plate (1).
- Manually compress the bellows (5) to solid length.
- Rotate bellows (5) in the compressed state across the base profile (2) until the guide notches in the support frame of the bellows (5) are bare.
- Remove the bellows (5) from the base profile (2).
- Remove textile-coated tapes (3) from the front plate (1) and the front surface of the carriage (6).
- Clean adhesive surfaces of the front plate (1) and the carriage (6). Adhesive surface must be free of oil.
- Place the new textile-coated tapes (3) according to the previous location on the inside of the front plate (1) and on the front surface of the carriage (6).
- Use bellows (5) of the same count.
- Press adhesive tapes (4) of the bellows (5) on to the textile-coated tapes of the front plate (1) and the carriage (6).
- Check bellows for proper run in the base profile. The bellows must not be moved jerkily.

10.2 Limit switch exchange

The limit switches are mounted protected in the T-slots on the inside of the base profile. The limit switch cables are covered in the groove with a plastic profile. The cable ends exit at the front plate via a strain relief. The switching points of the limit switches are adjusted for that the carriage travel to the end position is $\frac{1}{2}$ stroke from the center of the linear table.



- Move carriage (4) to the opposite end position of the limit switch (2).
- Disconnect electrical connection of the limit switch (2) from the drive control.
- Remove bellows (see *Chapter 10.1 Exchange of bellows*)
- Remove plastic cover (1) of the limit switch cables from the groove.
- Mark position of the limit switch (2) at the base profile.
- Loosen attachment screw (3) of the limit switch (2) and remove completely from the limit switch housing
- Tilt limit switch (2) and swivel out of the base profile groove.
- Loosen strain relief (5) at the front plate.
- Pull limit switch cable out of the strain relief (5).
- Remove limit switch (2).
- Route cable of the new limit switch (2) through the strain relief (5) to the outside.
- Tilt limit switch (2) and insert into the groove of the base profile.
- Mount limit switch (2) in the previously marked position with attachment screw (3).
- Route limit switch cable in the groove to the front plate.
- Pull extra cable through the strain relief (5).
- Tighten strain relief (5).
- Cover limit switch cable in the groove again with the plastic profile (1).
- Mount bellows (see *Chapter 10.1 Exchange of bellows*)
- Reestablish electrical connection of the limit switch (2) to the drive control.
- Check function of the new limit switch.

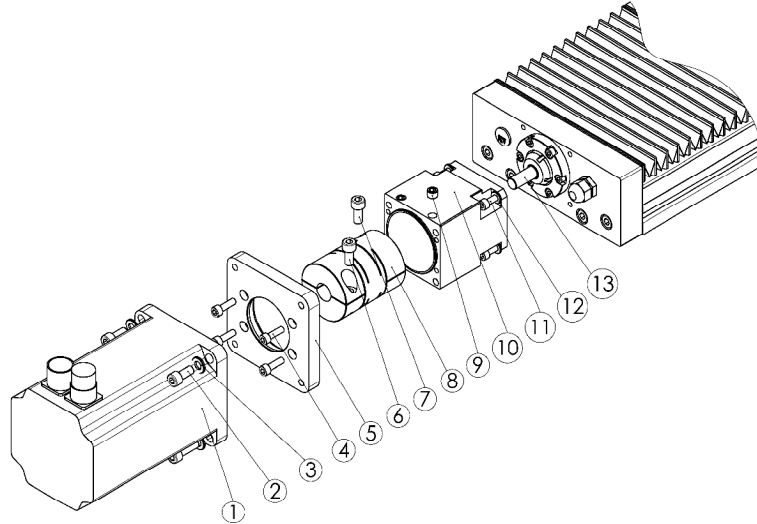
10.3 Motor exchange



DANGER

The ball screw of the linear table is not self-locking. In a vertically mounted system the carriage of the linear table must be secured from falling before repair work is started!

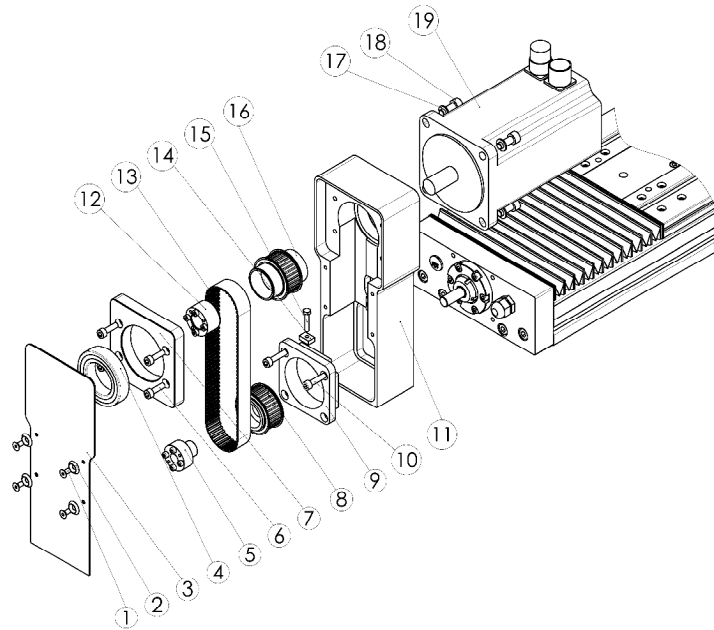
10.3.1 Straight mounted motor exchange



- Remove sealant screw (9) from the housing of the coupling (10).
- Loosen attachment screw (6) of the coupling (8). It might be necessary to rotate the ball screw to line up the attachment screw and the service hole.
- Secure motor (1) from falling and remove mounting screws (2) including the washers (3).
- Carefully pull motor (1) in axial direction out of the coupling (8) and the motor adapter plate (5) without jamming it.
- Clean flange and shaft of the new motor and remove damages.
- Insert new motor (1) back in to the motor adapter plate (5) as well as the hole of the coupling (8). Then mount the motor (1) with the washers (3) and screws (2) to the motor adapter plate (5).
- Tighten attachment screw (6) of the coupling (8). (see table: Torque for couplings)
- Close hole in the housing of the coupling (10) with sealant screw (9).

Torque for couplings

Size	LT100	LT150	LT200
Torque (Nm)	4,3	14,5	35



- Loose and remove screws (1) including the washers (2)
- Remove cover (3) of the timing belt gear.
- Loosen screws (10) of the tension plate (9).
- Relax timing belt (13) by loosening the tensioning screw (15).
- Remove screws (6) of the counter bearing plate (7).
- Press counter bearing plate (6) including counter bearing (4) with 2 screws (6) from the pulley (16).
- Secure motor (19) from falling and remove mounting screws (18) including washers (17).
- Pull motor (19) with attached pulley (16) by tilting it out of the timing belt (13) as well as the belt gear housing (11).
- Measure and note or mark axial mounting position of the pulley (16) in relation to the motor (19) flange.
- Loosen screws of the tensioning element (12) and remove pulley (16) from the motor (19) shaft.
- Clean flange and shaft of the new motor and remove damages.
- Slide pulley (16) with tensioning element (12) on to motor shaft (19) and resume former mounting position.
- Tension screws of the tensioning element (12). (see table: Torques for tensioning elements)
- Insert motor (19) with pulley (16) into belt gear housing (11) and mount timing belt (13) on pulley (16).
- Mount motor (19) with the washers (17) and screws (18) at the belt gear housing (11).
- Slide counter-bearing plate (7) with counter bearing (4) onto pulley (16) and mount with the screws (6) mount.
- To eliminate belt slack, slightly move belt gear in tensioning direction.
- Attach tensioning screw (15) to tension plate (9).
- Tension timing belt (13) by tightening the tensioning screw (15). (for tensioning distance see table timing belt pre tensioning)
- Tighten screws (10) of the tension plate (9).
- Mount cover (3) of the timing belt gears with screws (1) as well as the washers (2).

Torques for tensioning elements

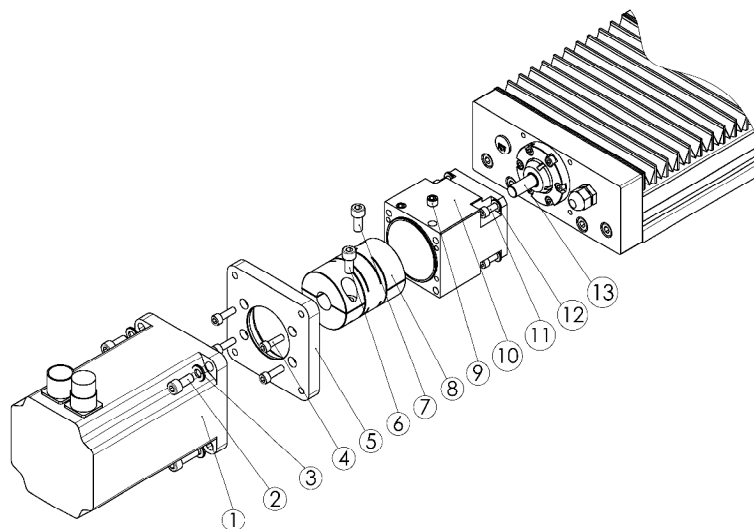
Size	LT100		LT150		LT200		
Shaft diameter	8	9	12	14	12	14	19
Tensioning moments (Nm)	1,2	1,2	1,2	2,1	4,9	4,9	4,9

Timing belt pre tensioning

Normally the timing belt is maintenance free. The timing belts are correctly pre tensioned at the Berger Lahr factory to 30% of the maximum operating force. Only with a special belt tension measuring device the belt tension can be adjusted optimally. Measuring the pre tensioning distance and counting the tensioning screw revolutions can achieve a setting sufficient for practical use

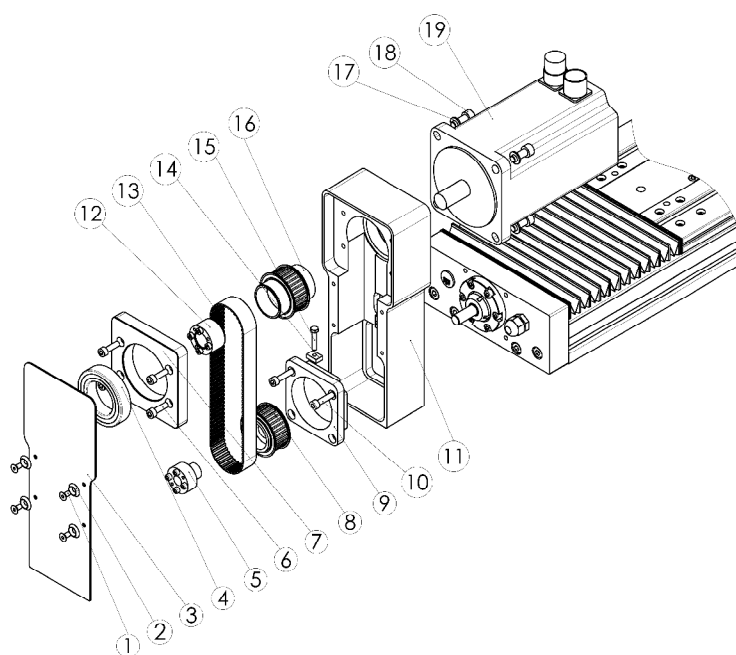
Size	LT100	LT150	LT200
Pre-tensioning force per span (F_y)	60	85	150
Pre-tensioning distance (mm)	0,1	0,1	0,2
Screw revolutions	1/8	1/8	1/4

10.4 Coupling exchange



- Remove motor as described in *Chapter 10.3.1*.
- Remove screws (4) and take off motor adapter plate (5).
- Remove screws (11) including washers (12) and take off housing of the coupling (10).
- Loosen second attachment screw (7) of the coupling (8) and pull coupling off the linear table ball screw stud (13).
- Slide the new, cleaned coupling (8) to the stop of the linear table ball screw stud (13).
- Tighten attachment screw (7) of the coupling (8) again. (see table: Torques for couplings Chapter 10.3.1)
- Place back and mount housing of the coupling (10) with screws (11) and washers (12).
- Align coupling (8) in the housing of the coupling (10) until the attachment screw (6) lines up with the hole in the housing of the coupling (10).
- Place back motor adapter plate (5) on housing of the coupling (10) and mount with screws (4).
- Mount motor back as described in *Chapter 10.3.1*.

10.5 Timing belt exchange



- Remove motor as described in *Chapter 10.3.2*.
- Exchange timing belt (13).
- Mount motor again as described in *Chapter 10.3.2*.

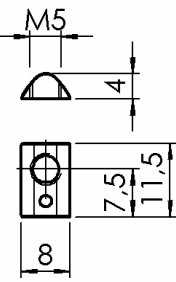
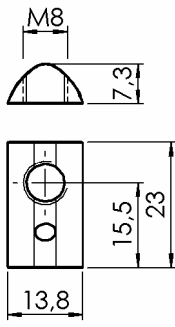
11. Accessories and spare parts

11.1 Accessories

The following accessories are available for all LT device family linear tables.

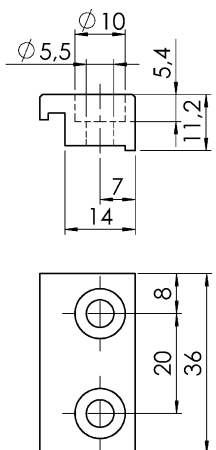
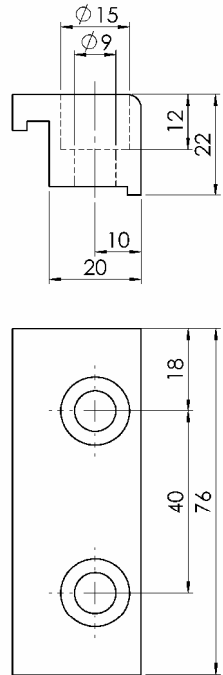
11.1.1 Set of rail nuts – galvanized

A set is comprised of 20 pieces rail nuts

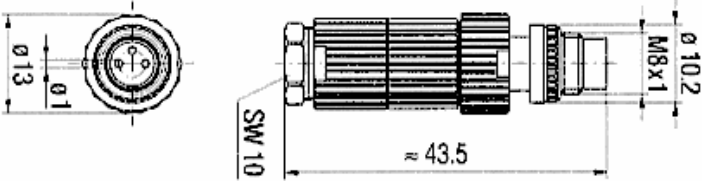
Designation	Designation
Rail nut set St 5-20	Rail nut set St 8-20
	
Order number	Order number
74080490001	74080490002

11.1.2 Set of clamping profiles – aluminum anodized

A set is comprised of 10 clamping profiles

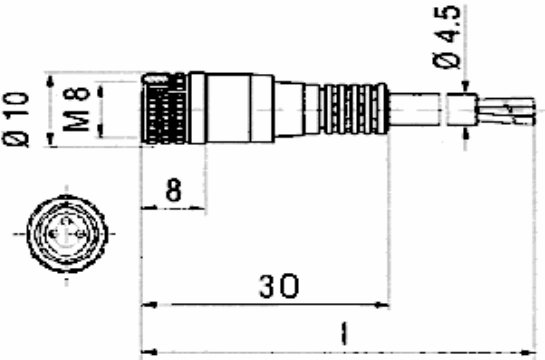
Designation	Designation
Clamping profile set Al 5-10	Clamping profile set Al 8-10
	
Order number	Order number
74080490003	74080490004

11.1.3 Limit switch connectors

Designation	
Limit switch connector - 3 pole	
	
Order number	
74080490005	

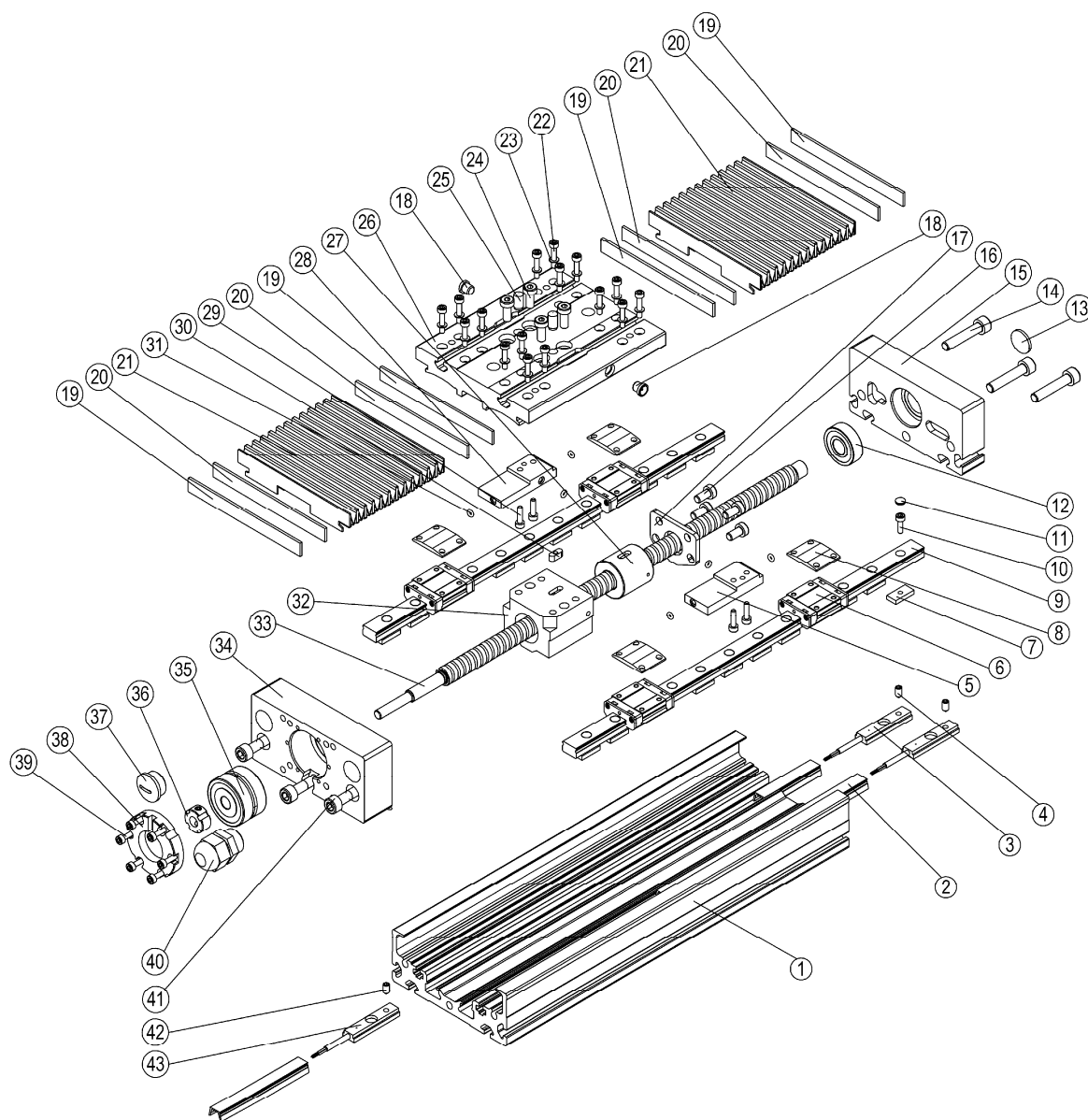
11.1.4 Limit switch cable with receptacle

Limit switch cables are available with 5m and 10m cable length, the opposite cable end is open.

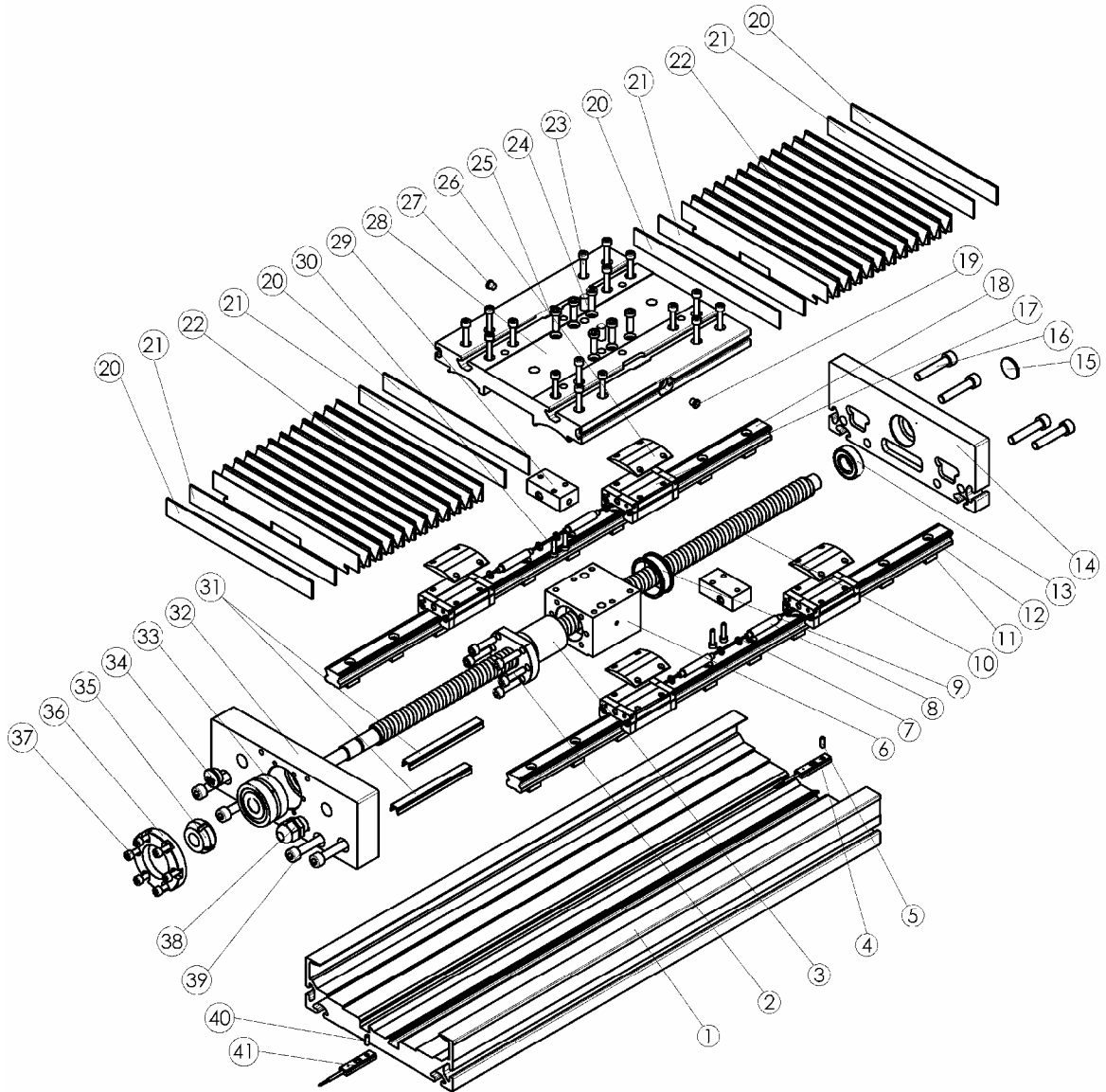
Designation	Designation
Limit switch cable – 3-pole - 5m	Limit switch cable – 3-pole - 10m
	
Order number	Order number
74080490006	74080490007

11.2 Spare parts

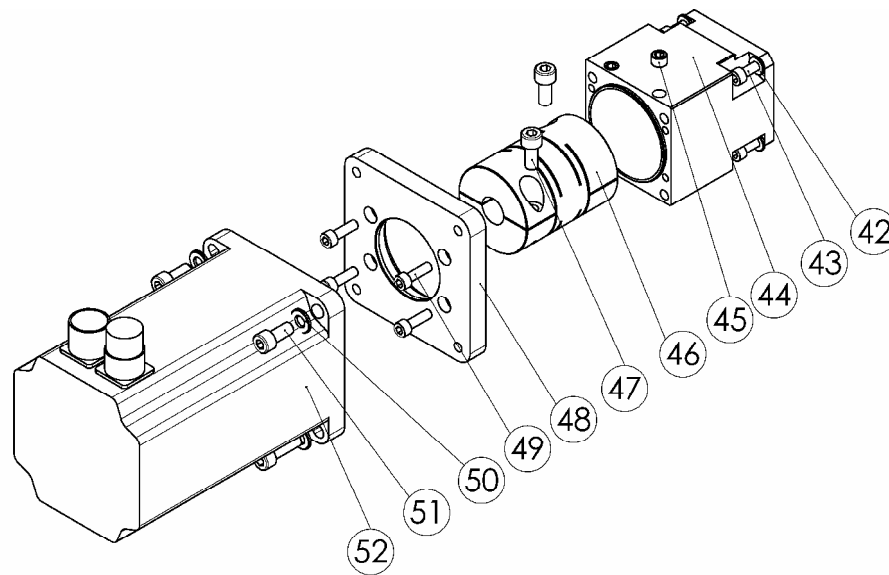
11.2.1 Exploded view of a linear table LT100 with position numbering of all parts



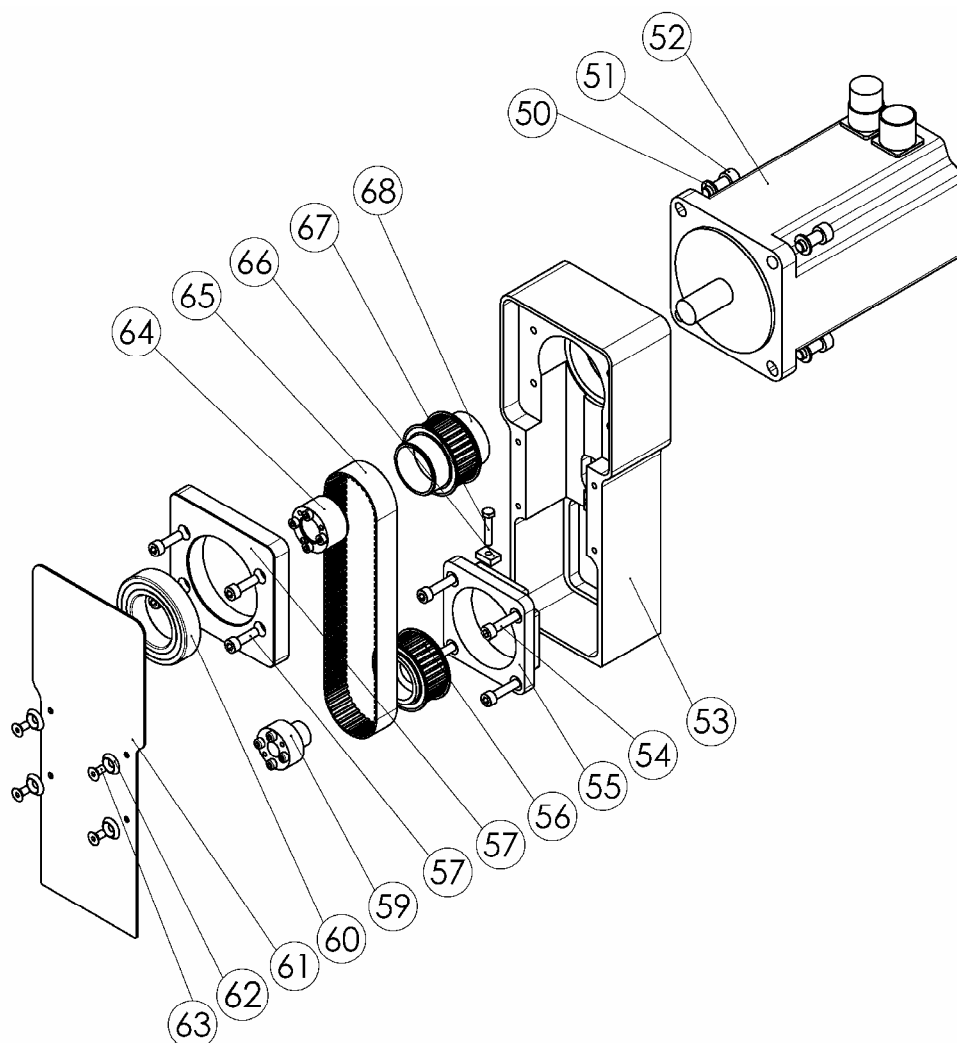
11.2.2 Exploded view of a linear table LT150 / 200 with position numbering of all parts



11.2.3 Exploded view of straight motor mounting with position numbering of all parts



11.2.4 Exploded view of motor mounting with belt gear with position numbering of all parts



11.2.5 Spare parts list LT100

Pos.	Designation	Unit	Order number
	Bellows LT100 set is comprised of :	Amount of bellows / Piece	
21	1 x Bellows LT100		
20	2 x Adhesive tape LT100		
19	2 x Textile coated tape LT100		
42	Limit switch - PNP/NC - 5m Cable	Piece	0000052060001
42	Limit switch - PNP/NC - 10m Cable	Piece	0000052060003
42	Limit switch - PNP/NC - Plug	Piece	0077040004600
3	Limit switch - PNP/NO - 10m Cable	Piece	0000052060057
3	Limit switch - PNP/NO - Plug	Piece	0077040005100
46	Coupling Ø8mm	Piece	0000033550064
46	Coupling Ø9mm	Piece	0000033550065
65	Timing belt	Piece	0000033550049

11.2.6 Spare part list LT150

Pos.	Designation	Unit	Order number
	Bellows LT150 set is comprised of :	Amount of bellows / Piece	
22	1 x Bellows LT150		
21	2 x Adhesive tape LT150		
20	2 x Textile coated tape LT150		
41	Limit switch - PNP/NC - 5m Cable	Piece	0000052060001
41	Limit switch - PNP/NC - 10m Cable	Piece	0000052060003
41	Limit switch - PNP/NC - Plug	Piece	0077040004600
41	Limit switch - PNP/NO - 10m Cable	Piece	0000052060057
41	Limit switch - PNP/NO - Plug	Piece	0077040005100
46	Coupling Ø12mm	Piece	0000033550066
46	Coupling Ø14mm	Piece	0000033550067
65	Timing belt	Piece	0000033550070

11.2.7 Spare part list LT200

Pos.	Designation	Unit	Order number
	Bellows LT200 set is comprised of :	Amount of bellows / Piece	
22	1 x Bellows LT200		
21	2 x Adhesive tape LT200		
20	2 x Textile coated tape LT200		
41	Limit switch - PNP/NC - 5m Cable	Piece	0000052060001
41	Limit switch - PNP/NC - 10m Cable	Piece	0000052060003
41	Limit switch - PNP/NC - Plug	Piece	0077040004600
41	Limit switch - PNP/NO - 10m Cable	Piece	0000052060057
41	Limit switch - PNP/NO - Plug	Piece	0077040005100
46	Coupling Ø19mm	Piece	0000033550068
65	Timing belt	Piece	0000033550071