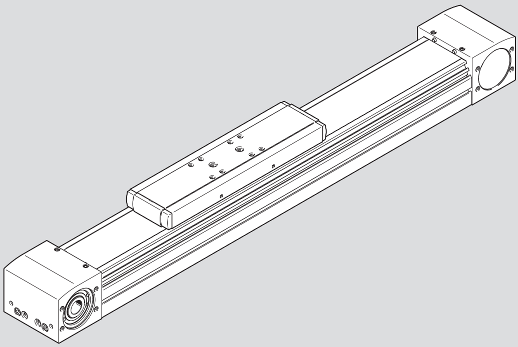
ELGA-TB
Toothed belt axis



Operating instruction

8162887

8162887
2023-05g
[8162889]

Translation of the original instructions

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1 Applicable documents

All available documents for the product → www.festo.com/sp.

2 Safety

2.1 Safety instructions

- Observe the identifications on the product.
- Only use the product if it is in perfect technical condition.
- Before working on the product: Switch off the power supply, ensure that it is off and secure it against being switched on again.
- Store the product in a cool, dry environment protected from UV and corrosion. Keep storage times short.
- Store the product in ambient conditions without oils, greases and grease-dissolving vapours.

2.2 Intended use

The axis positions payloads or moves external guides.
The axis is approved for slide operation.

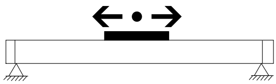

Fig. 1: Slide operation

2.3 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel have knowledge and experience in handling electric drives and axes.

3 Additional information

- Contact the regional Festo contact if you have technical problems → www.festo.com.
- Accessories and spare parts → www.festo.com/catalogue.

4 Product overview

4.1 Product design

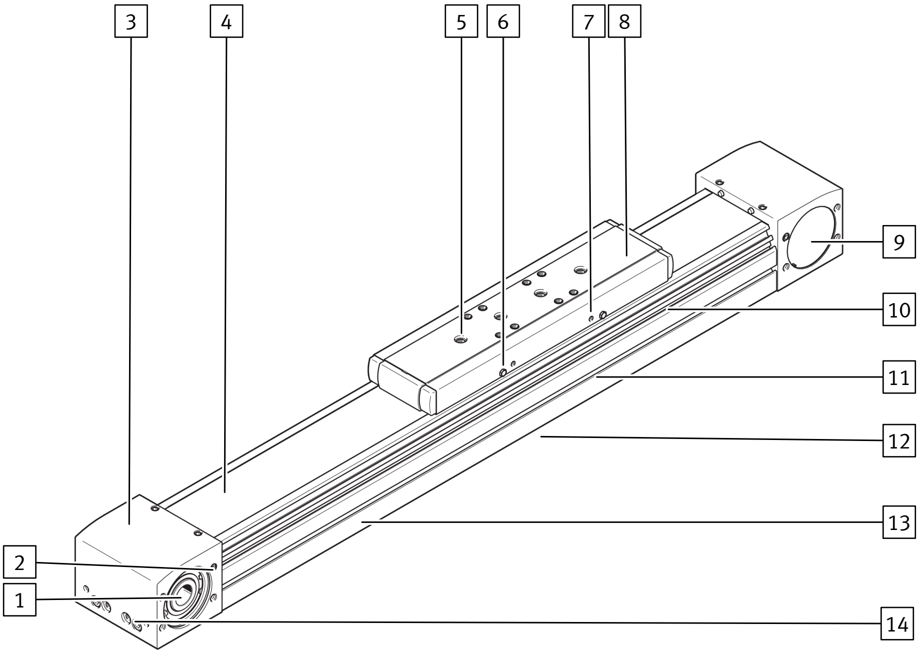

Fig. 2: Product design ELGA-TB (example ELGA-TB-KF)

1	Hollow drive shaft
2	Sealing air connection and threaded hole for motor mounting kit
3	Drive cover
4	Cover strip
5	Threaded hole and centring hole for payload
6	Guide lubrication point
7	Threaded hole for switch lug
8	Slide
9	Shaft cover
10	Slot for sensor
11	Slot for profile mounting, slot nut and sensor bracket
12	Slot for slot nut
13	Profile
14	Threaded hole for foot mounting

4.2 Function

The axis converts the rotary motion of the mounted motor to a linear motion of the slide. The toothed belt drive converts the torque of the motor to a feed force. The linear motion of the slide is precisely guided by the guide. The integrated cover strip prevents abraded particles from access to the immediate vicinity of the drive. Sensors and displacement encoder enable query of end positions, reference position and intermediate position.

5 Transport

⚠ WARNING

Risk of injury due to falling product

If the product is lifted incorrectly, it may fall and cut, crush or separate body parts.

- Lift the product only with suitable load-bearing equipment.

- Store and transport the product in its original packaging. Observe the weight, the dimensions and the ambient conditions.
- Take the centre of gravity of the product into consideration.
- Store and transport the product in a horizontal position.
- Comply with the maximum permitted support clearances when attaching transportation aids ➔ 10.2 Characteristic curves of support distances. Compliance with the support clearances prevents the axis from excessive bending.

6 Assembly

6.1 Safety

⚠ WARNING

Risk of Injury due to Unexpected Movement of Components

For vertical or slanted mounting position: when power is off, moving parts can travel or fall uncontrolled into the lower end position.

- Bring moving parts of the product into a safe end position or secure them against falling.

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Protection of the cover strip

A protective cover is installed on the cover strip to protect it from damage. The protective cover must be removed and disposed of before commissioning. After removing the protective cover, mechanical damage and contamination of the cover strip must be prevented.

6.2 Mounting motor

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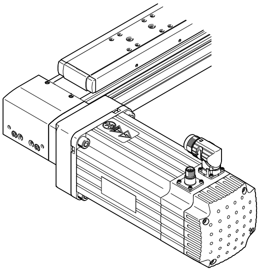
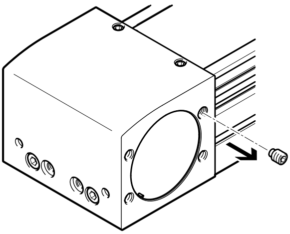
Observe the limit values for forces, torques and speeds if a non-recommended motor and motor mounting kit are used.

Axial kit EAMM-A


Tab. 1: Overview of mounting motors

1. Remove the sealing air plug screw from the threaded hole.



2. Mount the motor and motor mounting kit without tension.

6.3 Mounting axis

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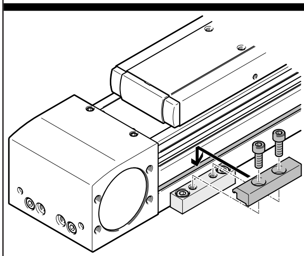
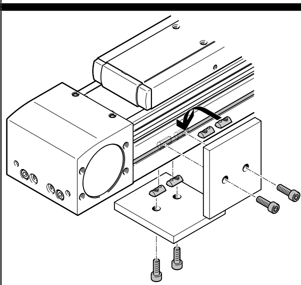
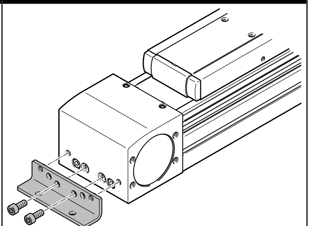
If high parallel torques are applied to the drive system at the same time, this will result in high mechanical loads at the mounting interfaces.

- Use the foot mounting HPE only in combination with the profile mounting MUE or the slot nuts NST.

Profile mounting MUE	**Slot nut NST**	**Foot mounting HPE**
		

Tab. 2: Overview of mounting components

Requirements:
- Adequate clearance for payload to avoid collisions with motor, mounting components and sensor components.
- Sufficient space for maintenance work.
- Flatness of the mounting surface of 0.05% of the stroke length or maximum 0.5 mm over the stroke length of the bearing surface.
- Required support points lie within the specified support clearances ➔ 10.2 Characteristic curves of support distances. Compliance with the support clearances prevents the axis from excessive bending.

1. Place the mounting components on the support points.
2. Tighten the screws. Observe the maximum tightening torque and maximum screw-in depth.

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When used in multi-axis systems: align to the first axis and install without tension.

ELGA-TB-...		-70	-80	-120	-150
Profile mounting MUE					
Thread		Instruction manual ➔ www.festo.com/sp.			
Slot nut NST					
Thread		M5	M5	M6	M6
Max. screw-in depth t_{max}	[mm]	6	6	12	12
Foot mounting HPE					
Thread		M5	M5	M8	M8
Max. tightening torque	[Nm]	5.9	5.9	24	24
Max. screw-in depth t_{max}	[mm]	10	10	16	18

6.4 Mounting payload on the standard slide

⚠ WARNING

Unexpected movement of components.

Injury due to impacts or crushing.

- Before working on the product, switch off the control and secure it to prevent it from being switched back on accidentally.

⚠ WARNING

Risk of Injury due to Unexpected Movement of Components

For vertical or slanted mounting position: when power is off, moving parts can travel or fall uncontrolled into the lower end position.

- Bring moving parts of the product into a safe end position or secure them against falling.

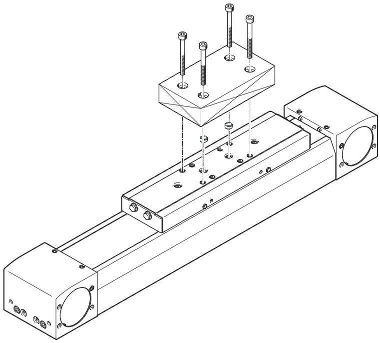

Fig. 3: Mounting payload, example "top mounting"

Requirements:
- Adequate clearance for payload to avoid collisions with motor, mounting components and sensor components.
- Sufficient space for maintenance work.
- A payload mounting surface flatness of 0.01 mm above the slide surface.
- Minimise the guide load. Short lever arms from the guide centre to the force application points and centres of gravity of the payload.

1. Place centring components in the centring holes.
2. Position the payload at the intended location.
3. Tighten the screws. Observe the maximum tightening torque and maximum screw-in depth.

ELGA-TB-...		**-70**		**-80**		**-120**		**-150**	
Direct fastening									
Thread		M5	M6	M5	M6	M5	M6	M6	M8
Max. tightening torque	[Nm]	5.9	9.9	5.9	9.9	5.9	9.9	9.9	24
Max. screw-in depth t_{max}	[mm]	7.5		9	9.7	9.7	12.6	11	10.7
Centring pins	[mm]	∅ 5 H7	–						
Centring sleeve	[mm]	∅ 9 H7							

6.5 Mounting payload on the additional slide

⚠ WARNING

Unexpected movement of components.

Injury due to impacts or crushing.

- Before working on the product, switch off the control and secure it to prevent it from being switched back on accidentally.

⚠ WARNING

Risk of Injury due to Unexpected Movement of Components

For vertical or slanted mounting position: when power is off, moving parts can travel or fall uncontrolled into the lower end position.

- Bring moving parts of the product into a safe end position or secure them against falling.

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- When using an additional external guide, ensure that the axes and guide are precisely parallel and aligned.
- Recommendation: use guide mountings with tolerance compensation.

Tension due to manufacturing tolerances may be encountered with axes with additional slides when mounting an adapter plate supplied by the customer.

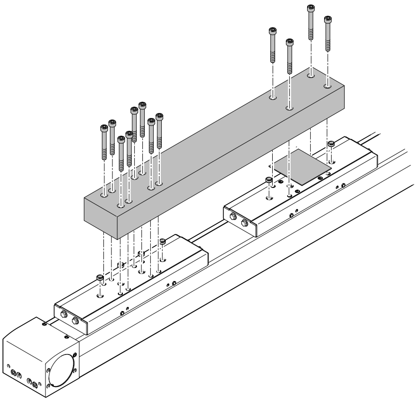


Fig. 4: Mounting payload, example "top mounting"

Requirements:

- A fixed-floating bearing for the carriage connection.
- Use a tolerance compensation in case of height deviation from the standard slide surface.
- Adequate clearance for payload to avoid collisions with motor, mounting components and sensor components.
- Sufficient space for maintenance work.
- A payload mounting surface flatness of 0.01 mm above the slide surfaces.
- Minimise the guide load. Short lever arms from the guide centre to the force application points and centres of gravity of the payload.

1. Place centring components in the centring holes.
2. Mount the adapter plate on the standard slide.
3. Place the tolerance compensation elements on the additional slide.
4. Align and mount the adapter plate on the additional slide.

5. Tighten the screws. Observe the maximum tightening torque and maximum screw-in depth.

ELGA-TB-KF-...-Z...		-70		-80		-120		-150	
Direct fastening									
Thread		M5	M6	M5	M6	M5	M6	M6	M8
Max. tightening torque	[Nm]	5.9	9.9	5.9	9.9	5.9	9.9	9.9	24
Max. screw-in depth t_{max}	[mm]	7.5		9	9.7	9.7	12.6	11	10.7
Centring pins	[mm]	∅ 5 H7	–						
Centring sleeve	[mm]	∅ 9 H7							

6. Check the running behaviour of the slides.

6.6 Mounting sensor

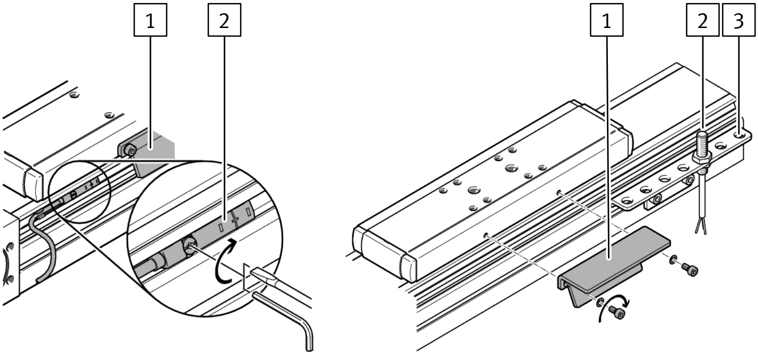


Fig. 5: Mounting switch lug, sensor and sensor bracket

1 Switch lug	3 Sensor bracket
2 Sensor	

Requirements:

- Protect the sensor from external magnetic or ferritic influences with min. 10 mm distance from slot nuts.
- Use a hardware limit switch with N/C contact function to guarantee protection in the event of a sensor failure.
- Use an inductive sensor.
- The measuring system is mounted.
- Mounting is only possible on the side without measuring system for axes with measuring system ELGA-...-M1/-M2.
- Query the switching lug only with inductive sensor. Not with ELGA-TB-...-F1.

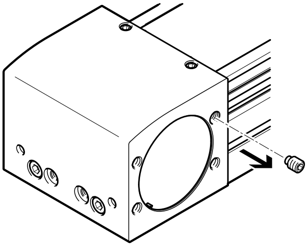
1. Mount the switch lug.
2. If necessary, mount the sensor bracket.
3. Mount the sensor.
4. If necessary, mount the cable with clips.
5. If necessary, mount the slot cover.

6.7 Connecting sealing air

The use of sealing air at approx. ± 0.02 MPa (± 0.2 bar, ± 2.9 psi) reduces or prevents the following forms of contamination:

- The application of negative pressure minimises the release of abraded particles into the environment.
- The application of overpressure reduces the penetration of dirt into the drive train.

1. Remove the sealing air plug screw from the threaded hole.



2. Mount the fitting and connect the hose.

7 Commissioning

WARNING

Risk of injury due to unexpected movement of components.

- Protect the positioning range from unwanted intervention.
- Keep foreign objects out of the positioning range.
- Perform commissioning with low dynamic response.

NOTICE

Elasticity of the toothed belt

The elasticity of the toothed belt generates an additional spring effect at high acceleration and deceleration, which can lead to an inadmissible nominal/actual deviation when the slide is moved or when the end position is reached.

- Consider the setpoint deviation determined during the test run during parameterisation of position setpoint values.

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Block-shaped acceleration profiles without jerk limitation can have the following effects:

- High mechanical loads on the lead screw due to high force peaks.
- Overshooting effects during positioning.
- Rise of the entire system.

Recommendation: reduce high force peaks in the acceleration and deceleration phases by using the jerk limitation.

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Identical axes can generate different running noises depending on the parameterisation, mode of operation, type of mounting, installation environment and components.

Requirements:

- The motor encoder is referenced to the reference mark by a homing run.
- The motor encoder has the absolute reference to the reference mark.
- The direction of movement of the slide is determined by the direction of rotation of the motor.
- The mounting of the drive system has been checked.

- The protective cover of the cover strip is removed.
- The installation on the motor has been checked.
- There are no foreign objects in the movement space of the drive system.
- Maximum permissible feed force and drive torque as a function of acceleration, deceleration, e.g. with stop function or quick stop, speed, moving mass and mounting position, are not exceeded.
- Axis is not mechanically overloaded and dynamic setpoint deviation is not exceeded as a result of force peaks, torque peaks or overshoot effects, e.g. overrunning the end position.
  Overloads and overruns as a result of jerk limitation must be restricted by reduced acceleration and deceleration setpoints or optimised controller settings.
- The software end positions are not within the effective range of the mechanical stops.
- No homing or test run to mechanical end stops.

1. Start check run.
2. Select permissible reference points "against reference switch" for the homing.
3. Start the homing run with reduced speed setpoints, acceleration setpoints and deceleration setpoints.
4. Start the test run with reduced speed setpoints, acceleration setpoints and deceleration setpoints.
5. Check that the slide completes the entire travel cycle within the specified time.
   ↳ The slide stops its travel when it reaches a limit switch and the drive system is ready for operation.

8 Maintenance

8.1 Safety

⚠ WARNING

Unexpected movement of components.

Injury due to impacts or crushing.

- Before working on the product, switch off the control and secure it to prevent it from being switched back on accidentally.

8.2 Checking toothed belt wear

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The toothed belt is tensioned for its entire service life.
The toothed belt must not be retensioned.

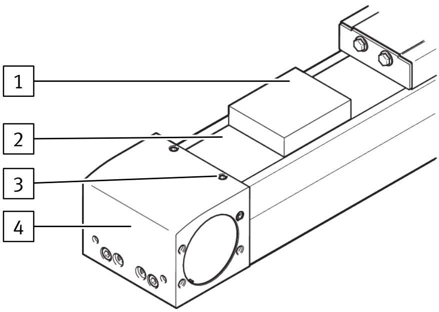
1. ELGA-TB:
   - Initial check: after 5000 km.
   - Periodic check: every 1000 km.

   ELGA-TB-...-F1:
   - Initial check: after 1000 km.
   - Periodic check: every 500 km.
2. If the toothed belt shows visible wear, send the axis to Festo or contact Festo Service.

8.3 Retensioning cover strip

1. Check the cover strip for wave formation every 2000 km.
2. Retension the cover strip as follows if waves are detected.
3. Replace the belt reversals and the cover strip if retension is no longer possible.

Retensioning cover strip on both sides for the standard reversal ELGA-...



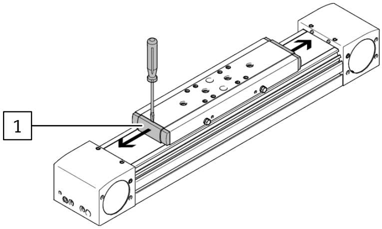
1	Clamping element
2	Cover strip
3	Screw
4	End cap

Fig. 6: Retensioning cover strip

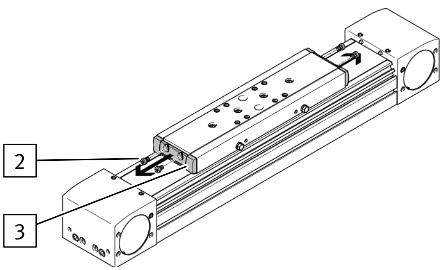
1. Unscrew the screws [3].
2. Push the cover strip [2] into the cover [4].
3. Tighten the cover strip with a clamping element [1].
4. Tighten the screws to 2 Nm.

Retensioning cover strip for magnetic reversal ELGA-...-P11

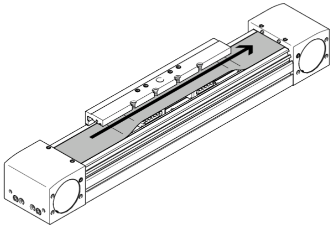
1. Lever the clips [1] off both sides of the covers with a screwdriver.



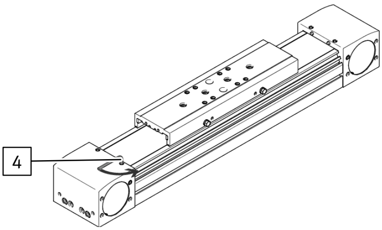
2. Remove the screws [2] on both sides of the covers [3].
   Remove the covers from both sides of the slide.



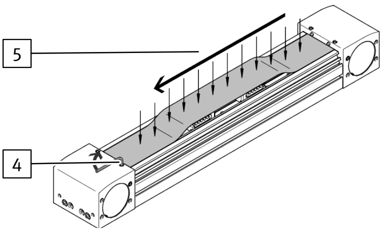
3. Check the cover strip for wave formation.
   – If the cover strip contacts the slide or if there is wave formation, retension the cover strip ➔ Step 4.
   – Install the removed slide components without contact with cover strip and slide ➔ Step 7.



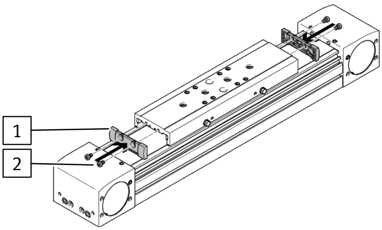
4. Unscrew clamping screws 4 on one side.



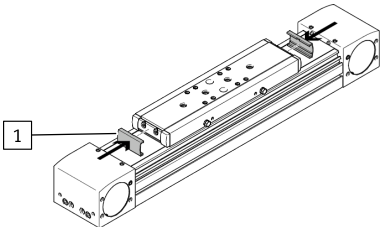
5. Slowly press the cover strip flat onto the guide surfaces in the direction of the loosened clamping screws 5.
   Tighten the clamping screws 4 to 2 Nm while maintaining the tension of the cover strip.



6. Place the covers 3 on the slide on both sides. The cover strip must not contact the cover.
   Tighten the screws 2 to 1.2 Nm for sizes 70 and 80 and to 2 Nm for sizes 120 and 150.



7. Place the clips [1] on the covers on both sides and press until they click into place.



8.4 Cleaning axis

Clean the product with a clean, soft cloth and non-abrasive cleaning agents.

8.5 Lubricating axis

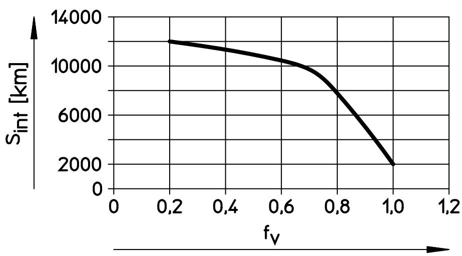
Relubrication of the plain-bearing guide is not required.
Requirements:
Recirculating ball bearing guide ELGA-TB-KF

- The pressure grease gun LUB-1, 647958 is available.
- For ELGA-TB-KF: the roller-bearing grease LUB-KC1, 684474 is available.
- For ELCC-TB-KF-F1: Elkalub VP 874 roller-bearing grease supplied by Chemie-Technik, Vöhringen, is available.
- The lubrication adapter LUB-1-TR-I, 647959 or LUB-1-TR-L, 647960 is available.

Roller-bearing guide ELGA-TB-RF

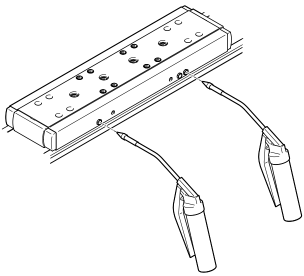
- The oil gun AZTP-SL, 8041022, is available.
- The oil cartridge AZLO-H1-C-10 , 8086576, is available.
- Elkalub VP 916 oil, supplied by Chemie-Technik, Vöhringen, is available.
- The metering needle kit AZTN-DS, 8086577, is available.

1. Calculate the load comparison factor f_v with formula for combined loads ➔ 10.1 Technical data, mechanical.
2. Take the lubrication interval S_{int} as a function of the load comparison factor f_v from the characteristic curve.



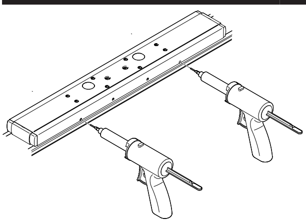
3. Determine the load factors:
   – Dusty and dirty environment.
   – Nominal stroke < 300 mm or > 2000 mm.
   – Ambient temperature > +40 °C.
   – Operating age > 3 years.
   – The travel profile matches triangular operation, e.g. frequent acceleration and braking.
4. If there is a load factor, halve the lubrication interval S_{int}. If there are multiple load factors, reduce the lubrication interval S_{int} to a quarter of the standard interval.
5. If necessary, replace the needle point of the pressure grease gun with the lubrication adapter, axial outlet or radial outlet.
6. Press the pressure grease gun on the lubrication nipple of the recirculating ball bearing guide. Inject the roller bearing grease at the front left and right.

ELGA-TB-KF-...		**-70**	**-80**	**-120**	**-150**
Grease volume per lubricating hole	[g]	0.45	0.8	2	3.4



7. Press the oil gun onto the lubricating hole for the roller bearing guide. Inject the roller bearing grease at the front left and right.

ELGA-TB-RF-...		**-70**	**-80**	**-120**
Grease volume per lubricating hole	[ml]	1	1.5	2.5



8. Move along the complete travel distance during the lubrication process to distribute the grease evenly in the interior.
9. If necessary, grease other components with roller bearing grease, e.g. the guide rail.

9 Fault clearance

⚠ WARNING

Unexpected movement of components.

Injury due to impacts or crushing.

- Before working on the product, switch off the control and secure it to prevent it from being switched back on accidentally.

⚠ WARNING

Risk of injury due to unexpected movement of components.

- Protect the positioning range from unwanted intervention.
- Keep foreign objects out of the positioning range.
- Perform commissioning with low dynamic response.

Malfunction	Cause	Remedy
Loud running noises, vibrations or rough running of the axis.	Coupling distance too short.	– Observe the permissible coupling spacings ➔ Assembly instructions of the motor mounting kit.
	Torsional stresses	– Install axis without tension. Make sure that the contact surface is flat ➔ 6.3 Mounting axis. – Change the arrangement of the payload. – Align axes parallel to each another.
	Current controller settings.	– Optimise controller data, e.g. speed, acceleration, ...
	Resonance oscillation of the axis.	– Change travel speed.
	Wear on bearing or guide.	– Contact local Festo Service. – Replace axis.
	Toothed belt wear.	– Contact local Festo Service. – Replace axis.
	Insufficient lubrication of the guide.	– Lubricate the guide ➔ 8.5 Lubricating axis.

Malfunction	Cause	Remedy
Vibrations on the slide.	Operation at the resonant frequency of the axis.	– Change travel speed. – Change the acceleration. – Increase axis stiffness, e.g. shorter support distances. – Change the payload geometry.
Long oscillations of the profile.	Resonant frequency of profile and payload too low.	– Increase axis stiffness, e.g. shorter support distances. – Change the payload geometry.
Slide does not move.	Coupling slips.	– Check the mounting of the shaft-hub connection ➔ Assembly instructions of the motor mounting kit.
	Loads are too high.	– Reduce forces and torques. Consider dynamics.
	Screws too long for mounting payload.	– Observe the screw-in depth ➔ 6.4 Mounting payload on the standard slide.
	Toothed belt torn.	– Contact local Festo Service. – Replace axis.
Overruns the end position.	Sensor does not switch.	– Check sensor, installation and parameterisation.
Idling torque too high.	Wear in the drivetrain.	– Contact local Festo Service. – Replace axis.
Toothed belt skips.	Toothed belt pretensioning too low.	– Contact local Festo Service. – Replace axis.
	Current controller settings.	– Optimise controller data, e.g. speed, acceleration, ...
	Loads are too high.	– Reduce travel speed.
Wave formation on the cover strip or aluminium abrasion on the axis.	Wear on belt reversals.	– Retension cover strip. – Replace belt reversal and cover strip.
Oil leak between profile housing and cover.	Oil sensor full.	ELGA-TB-RF: – Replace oil sensor. – Contact local Festo Service.

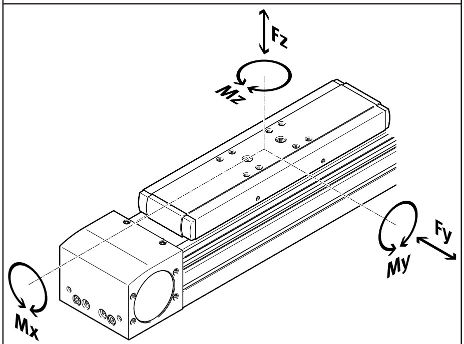
Tab. 3: Fault clearance

10 Technical data

10.1 Technical data, mechanical

ELGA-TB-...			-70	-80	-120	-150
Design		...	Electromechanical axis with toothed belt			
Guide		-G	Plain-bearing guide			–
		-KF	Recirculating ball bearing guide			
		-RF	Roller bearing guide			–
Mounting position		...	Any			
Max. feed force	[N]	-G -RF	350	800	1300	–
		-KF	350	800	1300	2000
		-F1	260	600	1000	–
Max. driving torque	[Nm]	-G -RF	5	15.9	34.1	–
		-KF	5	15.9	34.1	73.9
		-F1	3.7	11.9	26.2	–
Max. idling torque at speed = 0.2 m/s and with cover strip	[Nm]	-G	0.5	1	3	–
		-KF	0.6	1	2.8	4
		-KF-F1	0.8	1.5	4.5	–
		-RF	0.7	1.4	3	–
		-RF-F1	1	1.9	5.7	–
Max. speed	[m/s]	-G	5			–
		-KF	5			
		-RF	10			–
Max. acceleration	[m/s ^{2}]	...	50			
Repetition accuracy	[mm]	...	±0.08			
Feed constant	[mm/rev]	...	90	125	165	232
Ambient temperature	[°C]	...	-10 ... +60			
Degree of protection		–	IP40			
		-P0	IP00			

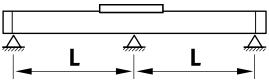
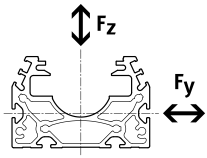
ELGA-TB-...			-70	-80	-120	-150
Max. permissible forces and torques on the slide						
ELGA-TB-G						
Fy	[N]	...	80	200	380	–
Fz	[N]	...	400	800	1600	–
Mx	[Nm]	...	5	10	20	–
My	[Nm]	...	30	60	120	–
Mz	[Nm]	...	10	20	40	–
ELGA-TB-KF, ELGA-TB-KF-...-F1						
Fy	[N]	...	1500	2500	5500	11000
Fz	[N]	...	1850	3050	6890	11000
Mx	[N]	...	16	36	104	167
My	[N]	...	132	228	680	1150
Mz	[N]	...	132	228	680	1150
ELGA-TB-RF, ELGA-TB-RF-...-S						
Fy	[N]	...	500	800	2000	–
Fz	[N]	...	500	800	2000	–
Mx	[Nm]	...	11	30	100	–
My	[Nm]	...	20	90	320	–
Mz	[Nm]	...	20	90	320	–
ELGA-TB-RF-...-L						
Fy	[N]	...	500	800	2000	–
Fz	[N]	...	500	800	2000	–
Mx	[Nm]	...	11	30	100	–
My	[Nm]	...	40	180	640	–
Mz	[Nm]	...	40	180	640	–
ELGA-TB-RF-...-XS						
Fy	[N]	...	–	800	2000	–
Fz	[N]	...	–	800	2000	–
Mx	[Nm]	...	–	30	100	–
My	[Nm]	...	–	40	150	–
Mz	[Nm]	...	–	40	150	–

ELGA-TB-...			-70	-80	-120	-150
ELGA-TB-RF-...-F1, ELGA-TB-RF-...-S-...-F1						
Fy	[N]	...	400	640	1600	–
Fz	[N]	...	400	640	1600	–
Mx	[Nm]	...	8.8	24	80	–
My	[Nm]	...	16	72	256	–
Mz	[Nm]	...	16	72	256	–
ELGA-TB-RF-...-L-...-F1						
Fy	[N]	...	400	640	1600	–
Fz	[N]	...	400	640	1600	–
Mx	[Nm]	...	8.8	24	80	–
My	[Nm]	...	32	144	512	–
Mz	[Nm]	...	32	144	512	–
ELGA-TB-RF-...-XS-...-F1						
Fy	[N]	...	–	640	1600	–
Fz	[N]	...	–	640	1600	–
Mx	[Nm]	...	–	24	80	–
My	[Nm]	...	–	32	130	–
Mz	[Nm]	...	–	32	130	–
Calculating the load comparison factor						
fv			$fv = \frac{\lvert Fy,dyn \rvert}{Fy,max} + \frac{\lvert Fz,dyn \rvert}{Fz,max} + \frac{\lvert Mx,dyn \rvert}{Mx,max} + \frac{\lvert My,dyn \rvert}{My,max} + \frac{\lvert Mz,dyn \rvert}{Mz,max} \leq 1$			
						

Tab. 4: Technical data, mechanical

10.2 Characteristic curves of support distances

The maximum permissible support distance L without profile mounting MUE/central support EAHF as a function of force Fy/Fz with a maximum deflection of 0.5 mm.

Support distance	Force load
	

Tab. 5: Overview of support distance and force load

ELGA-TB-G-70/80/120

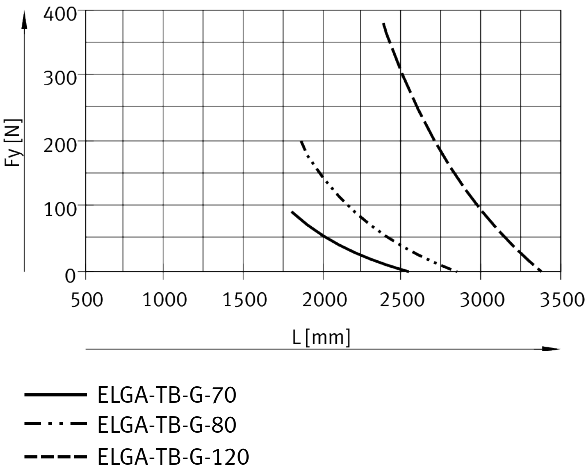


Fig. 7: ELGA-TB-G, support distance L as a function of force Fy

ELGA-TB-G-70/80/120

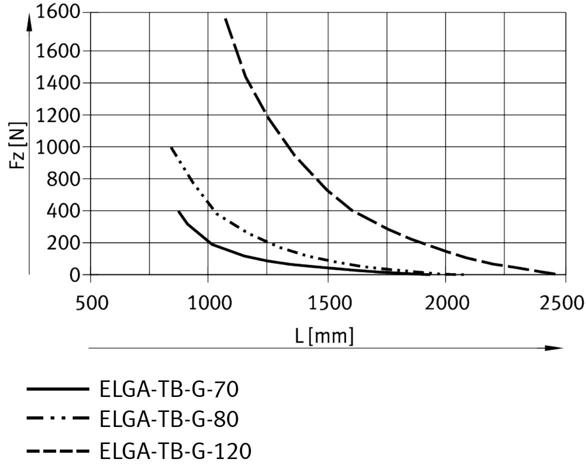


Fig. 8: ELGA-TB-G, support distance L as a function of force Fz

ELGA-TB-KF-70/80/120/150

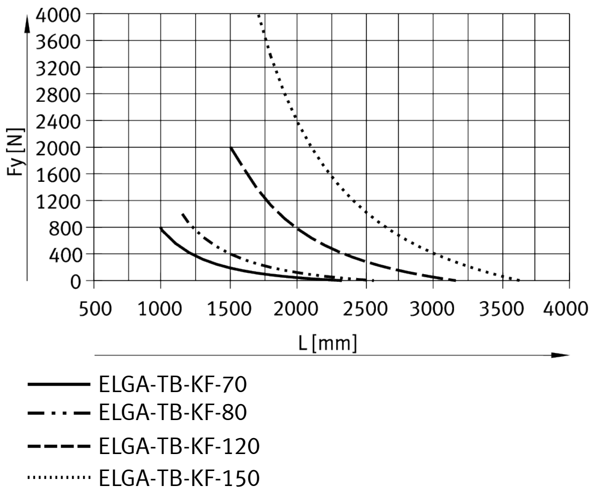


Fig. 9: ELGA-TB-KF, support distance L as a function of force Fy

ELGA-TB-KF-70/80/120/150

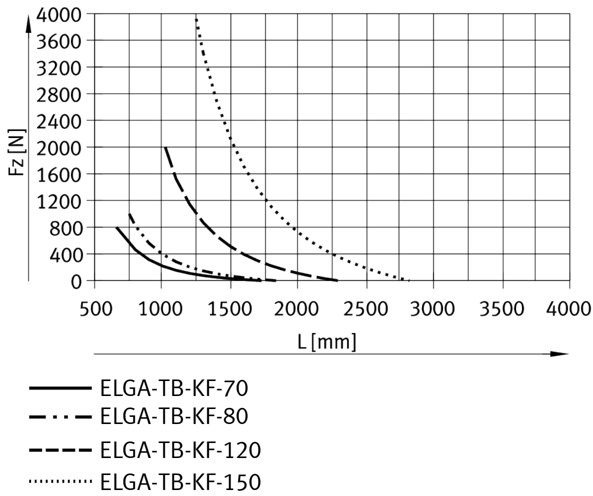


Fig. 10: ELGA-TB-KF, support distance L as a function of force Fz

ELGA-TB-KF-F1

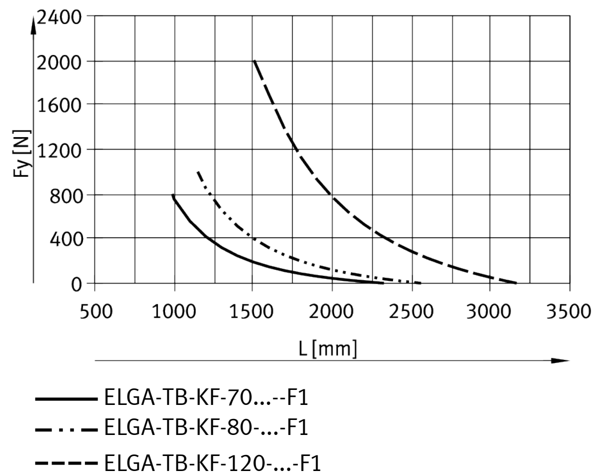


Fig. 11: ELGA-TB-KF-F1, support distance L as a function of force Fy

ELGA-TB-KF-F1

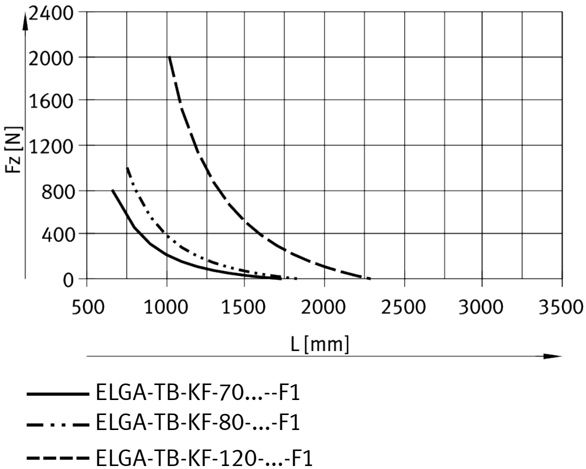


Fig. 12: ELGA-TB-KF-F1, support distance L as a function of force Fz

ELGA-TB-RF-70/80/120

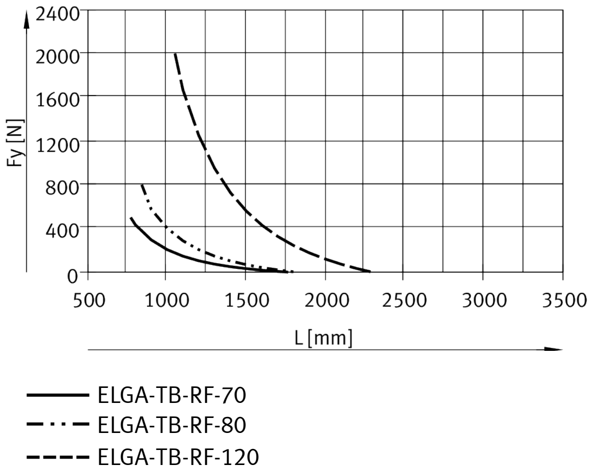


Fig. 13: ELGA-TB-RF, support distance L as a function of force Fy

ELGA-TB-RF-70/80/120

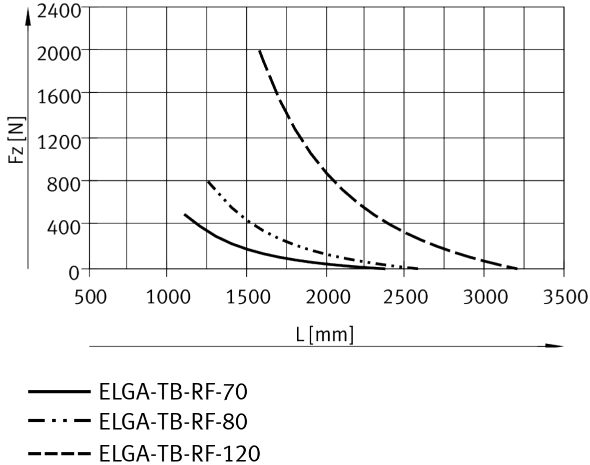


Fig. 14: ELGA-TB-RF, support distance L as a function of force Fz

ELGA-TB-RF-70/80/120-F1

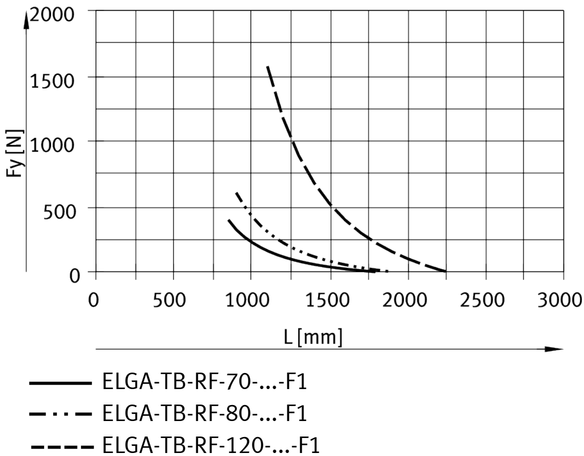


Fig. 15: ELGA-TB-RF-F1, support distance L as a function of force Fy

ELGA-TB-RF-70/80/120-F1

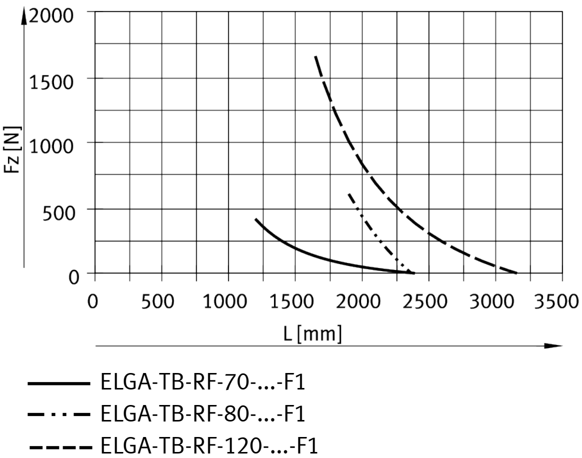


Fig. 16: ELGA-TB-RF-F1, support distance L as a function of force Fz

10.3 Characteristic speed curves

Speed v as a function of rotational speed n.
ELGA-TB-G-...

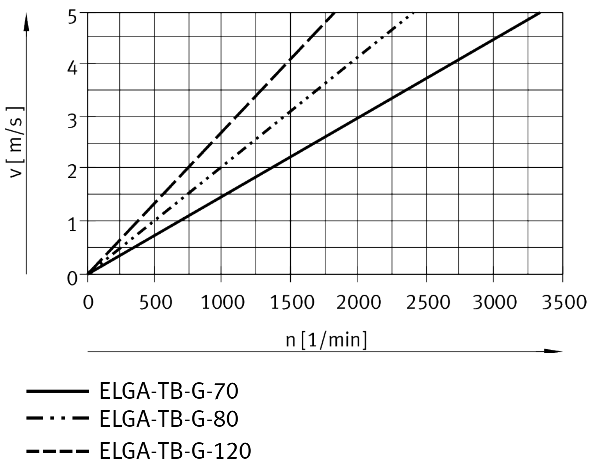


Fig. 17: ELGA-TB-G, speed v as a function of rotation speed n

ELGA-TB-KF-...

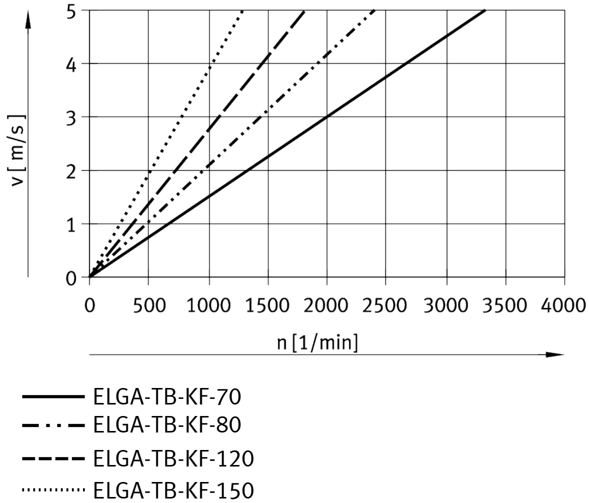


Fig. 18: ELGA-TB-KF, speed v as a function of rotation speed n

ELGA-TB-RF-...

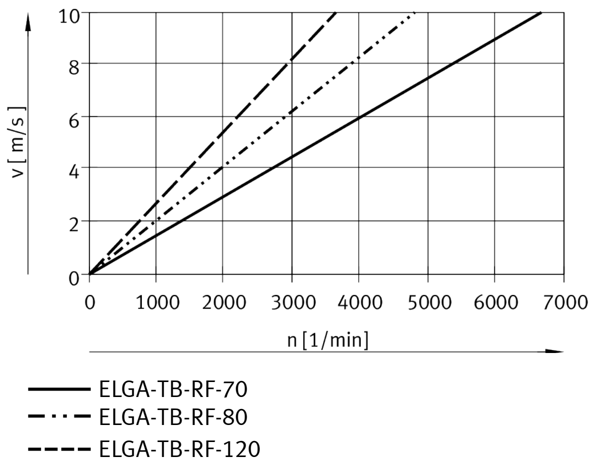


Fig. 19: ELGA-TB-RF, speed v as a function of rotation speed n

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