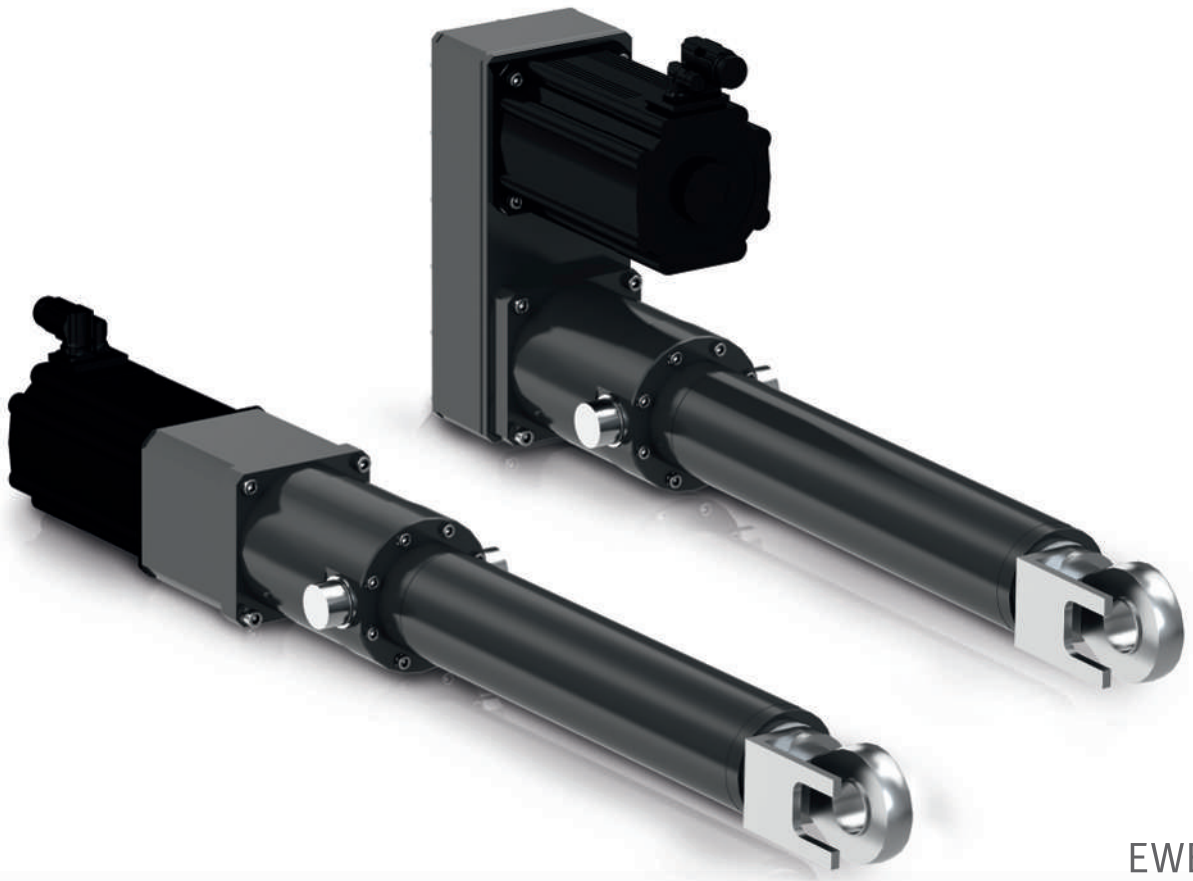


EWELLIX

EWELLIX Linear Actuators

SRSA, SVSA, SLSA

User Manual

We pioneer motion

SCHAEFFLER

Contents

1 About the manual

1.1 Information in this user manual

This manual provides important information on how to work with the device safely and efficiently.

The manual is part of the device, must always be kept in the device's direct proximity and should be available for personnel to read at any time. All personnel working with the device must read and understand this manual before starting any work. Strict compliance with all specified safety notes and instructions is a basic requirement for safety at work.

Moreover, the accident prevention guidelines and general safety regulations applicable at the place of use of the device must also be complied with.

1.2 Symbols

Safety precautions are identified by symbols and signal words as shown. The signal words indicate the severity of the hazard and the chance it could occur. Follow these safety precautions and act cautiously in order to avoid accidents, personal injury and damage to property.

The warning and hazard symbols are defined in accordance with ANSI Z535.6-2011.

1 Warning and hazard symbols

Signs and descriptions	
⚠ DANGER	In case of non-compliance, death or serious injury will occur.
⚠ WARNING	In case of non-compliance, death or serious injury may occur.
⚠ CAUTION	In case of non-compliance, minor or moderate injury may occur.
NOTICE	In case of non-compliance, damage or malfunctions in the product or the adjacent construction may occur.

1.3 Signs

The warning, prohibition, and mandatory signs are defined in accordance with DIN EN ISO 7010 or DIN 4844-2.

2 Warning, prohibition, and mandatory signs

Signs and descriptions	
	General warning
	Electrical voltage warning
	Hot surface warning
	Flammable materials warning
	Observe the manual

Signs and descriptions	
	Wear safety shoes
	Wear eye protection
	General mandatory sign

1.4 Legal notices

The information in this manual reflects the status at the time of publication.

Unauthorized modifications to or improper use of the product are not permitted. Schaeffler accepts no liability in these cases.

1.5 Limitation of liability

All information and notes in this manual were compiled with due consideration given to applicable standards and regulations, the present state of technology and our years of knowledge and experience.

The manufacturer is not liable for any damage resulting from:

- disregarding this manual
- unintended use
- employment of untrained personnel
- unauthorized conversions
- technical changes
- manipulation or removal of the screws on the drive
- use of unapproved spare parts.

Where the device has been customized, the actual product delivered may be different from what is described in this manual. In this case, ask Schaeffler for any additional instructions or safety precautions relevant to these devices.

We reserve the right to make technical modifications to the device to improve usability.

1.6 Availability

A current version of this manual is available at:
https://www.schaeffler.de/std/2223

Ensure that this manual is always complete and legible and is available to all persons engaged in transporting, fitting, dismantling, commissioning, operating, or maintaining the product.

Keep the manual in a safe place for immediate reference.

1.7 Images

The images in this manual may be schematic representations and may differ from the delivered device.

2 General safety regulations

2.1 Intended use

The electromechanical linear actuators are available with planetary roller screws (SRSA), recirculating roller screws for low pitches (SVSA), or high pitches (SLSA).

The electromechanical linear actuators are intended for use only in the following situations:

- axial loads
- applications in industrial environments
- ambient temperature range from 0 °C to +40 °C (+32 °F to +104 °F)
- intermittent operation

The electromechanical linear actuators are designed for use in an industrial environment and are defined as partly completed machinery, meaning that they must be safely integrated into the intended machine.

2.2 Unintended use

The device must not be operated in potentially explosive atmospheres.

Do not use the device to lift people.

2.3 Other applicable documents

This user manual does not replace the user manuals of the supplied components but provides additional instructions for the installation and operation of the electromechanical linear actuator in relation to the overall system.

In addition to this user manual, the following must be observed to ensure safe and proper operation:

- user manual for other components supplied
- regulations applicable at the place of use, depending on the system into which the electromechanical linear actuator is integrated and the environmental conditions present
- regulations of the supervisory authorities (UVV accident prevention regulations)
- recognized technical rules for safe and professional work
- local laws and regulations
- environmental protection regulations
- other applicable regulations

Further information

Further information can be found in the following publication:

HA 1 | EWELLIX High-Performance Actuators | Electromechanical linear actuators, servo lifting columns, servo linear actuators | https://www.schaeffler.de/std/2023

2.4 Qualified personnel

Operator duties:

- Ensure that only qualified and authorized personnel carry out the activities described in these instructions.
- Ensure that personal protective equipment is used.

Qualified personnel meet the following criteria:

- Product knowledge, e.g. by receiving training on how to use the product
- are fully familiar with the contents of this manual and, in particular, with all of the safety instructions
- are familiar with the relevant country-specific regulations

2.5 Hazards

The following hazards can occur when operating the product:

- live parts
- moving parts
- hot surfaces

Failure to observe the instructions and safety measures contained in this manual may result in fatal or serious injury or property damage.

2.6 Safety regulations

The following safety regulations must be observed when working with the product. Additional information on hazards and specific behavioral instructions can be found, for example, in the chapters on Assembly, Commissioning, Operation, and Maintenance.

2.6.1 Transport

The product may only be transported under the following conditions:

- Observe the relevant transport regulations.
- Use suitable lifting equipment for transport and assembly.

The weight of the electromechanical linear actuator and motor can be found on the product labels or in the technical documentation provided by the respective manufacturer.

2.6.2 Storage

After a storage period of 3 Jahren, it is recommended to return the electromechanical linear actuator to Schaeffler for maintenance ➤32|9.

2.6.3 Assembly

If the following components are included in the scope of delivery, read the applicable technical documentation of the respective manufacturer for correct assembly:

- motor
- motor cables
- limit switch
- home switch

- brake
- automatic lubrication system
- servoamplifier

If paper or CD-ROM documentation is not provided, download the documentation from the manufacturer's website.

In the event of problems, contact the manufacturer of the components or Schaeffler.

Further information about a component can be found on the type plate or on the packaging.

2.6.4 Commissioning

Only qualified personnel may commission the product.

Observe the safety instructions in this manual and in the technical documentation for the individual components (motor, servoamplifier, etc.).

Before commissioning the product, observe the following documents provided to the customer as part of the contractual documentation:

- technical description
- drawing of the electromechanical linear actuator

The stabilized temperature of the product must not exceed +80 °C (regardless of the surface). Contact Schaeffler for technical support if required.

2.6.5 Maintenance and repairs

Observe the safety instructions in this manual and in the technical documentation for the individual components (motor, servoamplifier, etc.).

Disconnect the power supply to the electromechanical linear actuator before performing maintenance. Ensure that the actuator is not under load or energized before maintenance.

Use suitable safety equipment when maintaining the electromechanical linear actuator.

3 Scope of delivery

The scope of delivery comprises:

- electromechanical linear actuator
- motor power cable
- motor sensor cable
- motion controller
- electronic interface for connection between PC and motion controller
- user manual

3.1 Check for transport damage

1. Check the product immediately upon delivery for any damage during transit.
2. Report any damage during transit promptly as a complaint to the carrier.

3.2 Check for defects

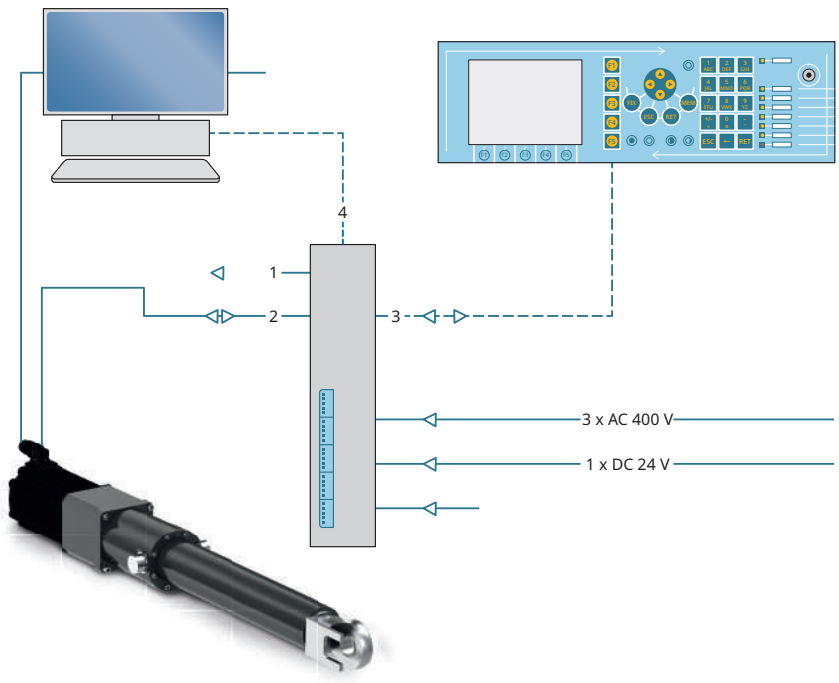
1. Check the product immediately upon delivery for any visible defects.
2. Report any defects promptly to the distributor of the product.
3. Do not put damaged products into operation.

4 Product description

4.1 System components

The electromechanical linear actuator is part of an overall system that is integrated into the surrounding construction as shown in the schematic diagram.

1 Electromechanical linear actuator within the overall system

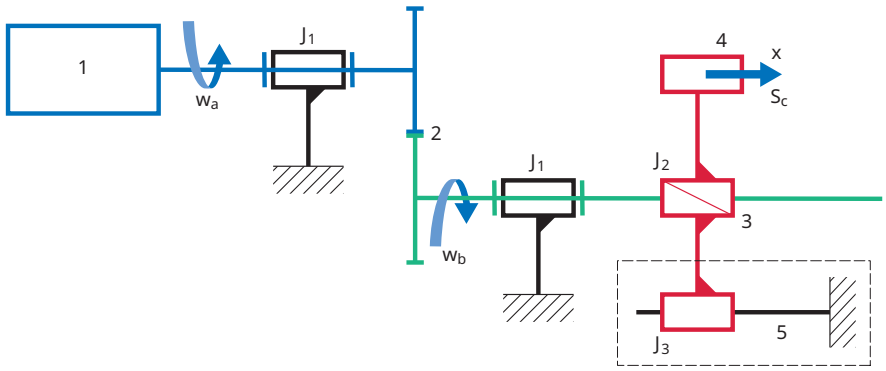


1	Motor power cable	2	Motor sensor cable
3	Communication, if necessary: analog inputs, digital inputs, analog outputs, digital outputs, fieldbus	4	Connection to PC (temporary for setup)
5	Customer's control box	6	Customer's main controller or PLC
7	Sensors (limit switch, home switch)		

4.2 Function principle

The functional principle of the electromechanical linear actuators is described in the following kinematic drawing (created in accordance with standard NF EN ISO 3952-1).

2 Functional principle



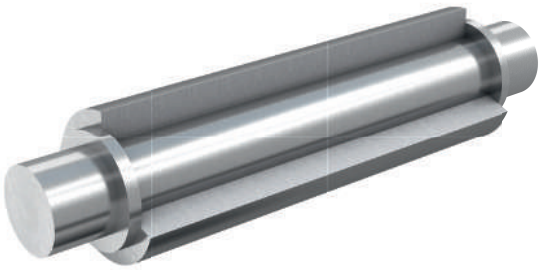
001D07AC

1	Motor rotor	2	Gear system
3	Roller screw or ball screw	4	Push tube of the linear actuator
5	Anti-rotation of the push tube	J_1	Revolute joint
J_2	Screw joint	J_3	Prismatic joint
ω_a	Rotating speed of the motor shaft	ω_b	Rotating speed of the roller screw or the ball screw
S_c	Translation speed of the push tube	x	Movement of the electromechanical linear actuator

The screw drive converts the rotational motion of the screw drive (green) into a translational movement of the nut and the linear actuator push tube (red).

Depending on the design, the anti-rotation of the push tube is either integrated into the linear actuator or located on the customer's machine.

3 Revolute joint J_1



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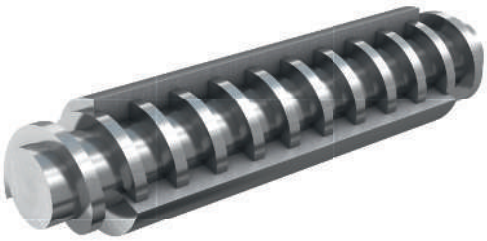
4 Screw joint J_2



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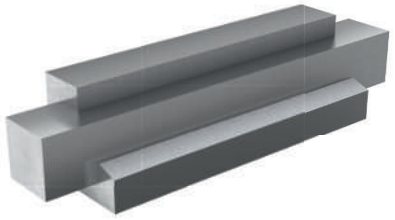
5 Prismatic joint J_3



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The electromechanical linear actuator moves by x mm per motor revolution, where x is defined as follows:

1

$$x = \frac{p_h}{r}$$

The gear ratio r is defined as:

2

$$r = \frac{\omega_a}{\omega_b}$$

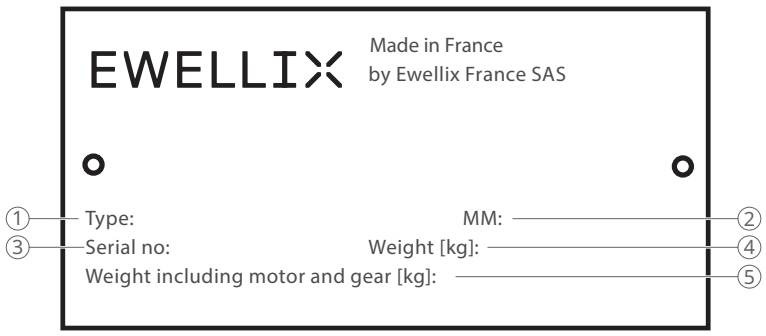
The definition of r may change, depending on the application:

- electromechanical linear actuator with in-line motor without gear:
  $r = 1$
- electromechanical linear actuator with in-line motor and gear:
  $r = r_g$
- electromechanical linear actuator with parallel motor without gear:
  $r = r_b$
- electromechanical linear actuator with parallel motor and gear:
  $r = r_g \cdot r_b$

p_h	mm	Roller screw lead or ball screw lead
r	-	Gear ratio
r_b	-	Belt system ratio
r_g	-	Translation ratio
S_c	mm/s	Translation speed of the push tube
x	mm	Translational movement of the push tube (movement of the linear actuator)
ω_a	rad/s	Rotating speed of the motor shaft
ω_b	rad/s	Rotating speed of the roller screw or the ball screw

4.3 Type plate

6 Product label



1	Designation	2	Month of manufacture (month/year)
3	Serial number	4	Weight
5	Weight, including motor and gear		

5 Transport and storage

Observe the safety regulations for the storage.

Observe the safety regulations for transport.

NOTICE

Damage to the limit switch and home switch

Damage to the limit switch and home switch

- ▸ Always exercise caution when handling the electromechanical linear actuator.

Store the product under the following ambient conditions:

- indoors
- in horizontal position
- in retracted position
- at an ambient temperature of 15 °C to 40 °C
- packed in a plastic film with desiccant (to protect against moisture and condensation).

After a storage period of up to one year and in compliance with the ambient conditions:

- Use the product according to the general recommendations for use.

After a storage period of more than one year and in compliance with the ambient conditions:

- Lubricate the product before commissioning for the first time.

6 Assembly

DANGER

Vertical load drop

Serious or fatal injuries due to crushing

- Never use the brake (motor brake or additional brake) to hold a vertical load when a person is under the load.
- Always lock and move the vertical load using other means.
- Stop the vertical load in the safe lower position.

DANGER

Unintentional startup of the linear actuator

Serious or fatal injuries due to crushing

- Before starting any work on the actuator, disconnect the motor, brake, and fan (if present) from the power supply.
- Secure against unintentional restart by means of locking or labeling.

DANGER

Live components

Risk of fatal electric shock

- First, switch off the power supply to the servoamplifier and then disconnect the motor plug.
- Disconnect the signal plug and then disconnect the power plug.
- Do not touch any plug pins.

WARNING

High surface temperature of the electromechanical linear actuator

Risk of burns or fire

- Allow the electromechanical linear actuator to cool down before performing any work.

NOTICE

Dynamic actuation of the brake

Premature wear and malfunction of the electromechanical linear actuator.

- Never apply the brake dynamically.

6.1 Installing the electromechanical linear actuator

NOTICE

Poor alignment of parts

Reduced service life of the linear actuator and property damage

- Check that all parts to which the linear actuator is attached are correctly aligned over the entire stroke.
- Check that the linear actuator can move freely and that there are no obstacles over the entire stroke length.
- Do not allow radial loads or bending moments to act on the push tube of the linear actuator.
- Avoid impacts on the push tube. Do not hit it with a hammer.
- Do not modify any parts of the linear actuator.
- Do not attach any parts to the linear actuator.

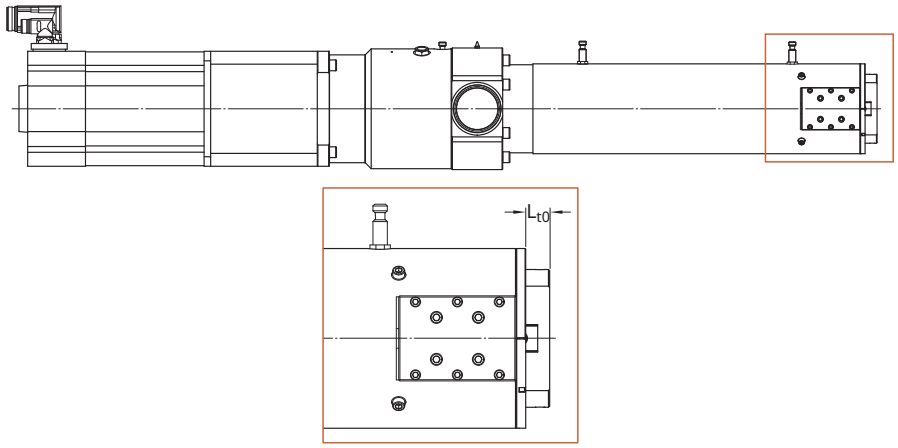
Visual position of the electromechanical linear actuator – definition of L_{t0} and L_t

During mechanical installation or operation of the electromechanical linear actuator, it may be necessary to know the position of the linear actuator relative to the zero position specified in the drawing.

To do this, the length of the push tube L_{t0}, which is visible when the linear actuator is in the zero position shown in the drawing, must be known.

Below are some example drawings that illustrate the definition of L_{t0}.

7 Example 1: Definition of L_t and L_{t0}



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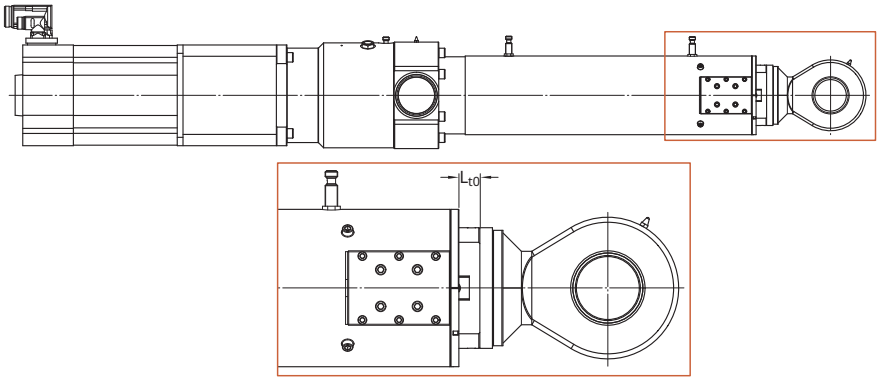
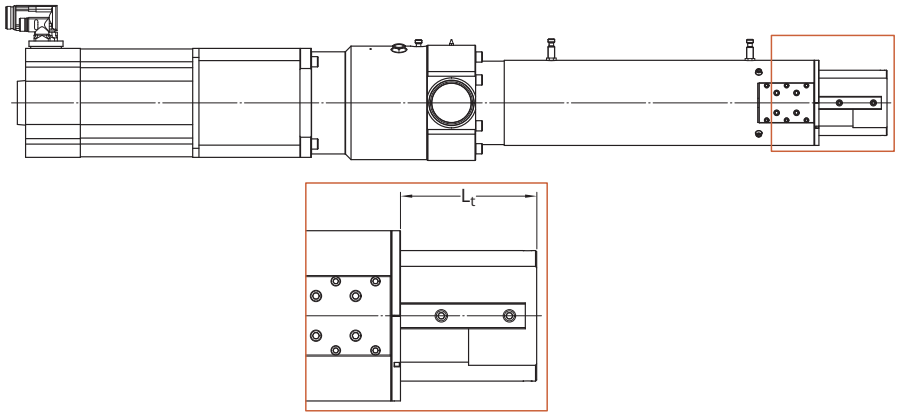
8 Example 2: Definition of L_t and L_{t0}



001D078C

L_t must then be measured: the equivalent dimension of L_{t0} when the linear actuator is in any position.

9 Example 3: Definition of L_t and L_{t0}



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The position relative to the zero position specified in the drawing then corresponds to $L_t - L_{t0}$.

6.2 Assembling the motor

Information on the assembly can be found in the manufacturer's technical documentation. The manufacturer's name and the designation of the motor are indicated on the type plate.

6.3 Connecting the motor cable

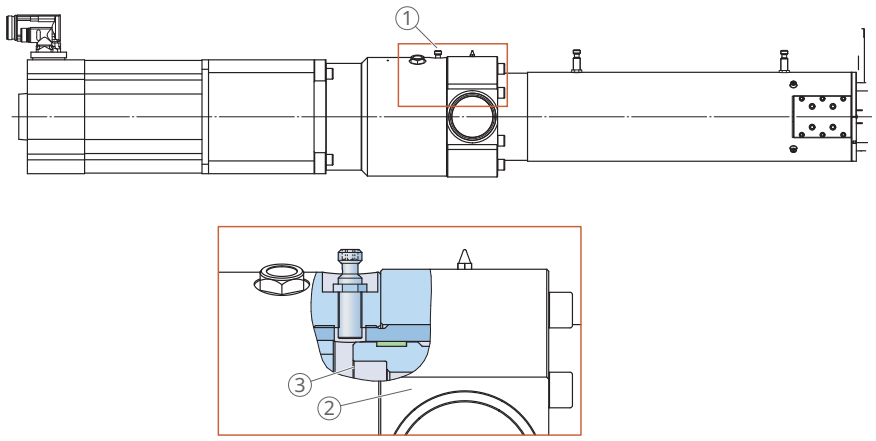
If motor cables are included in the scope of delivery, you will find connection information, a technical description or a wiring diagram in the technical documentation of the motor or servoamplifier. The cable designation can be found on the cable itself or on the packaging.

6.4 Connecting the limit switch

For information on the digital input used to connect the limit switch, refer to the technical documentation of the servoamplifier.

Installing the limit switch for the "retracted position"

10 Installing the limit switch for the retracted position



1	Limit switch for the retracted position	2	Threaded nut (rear)
3	Detection surface		

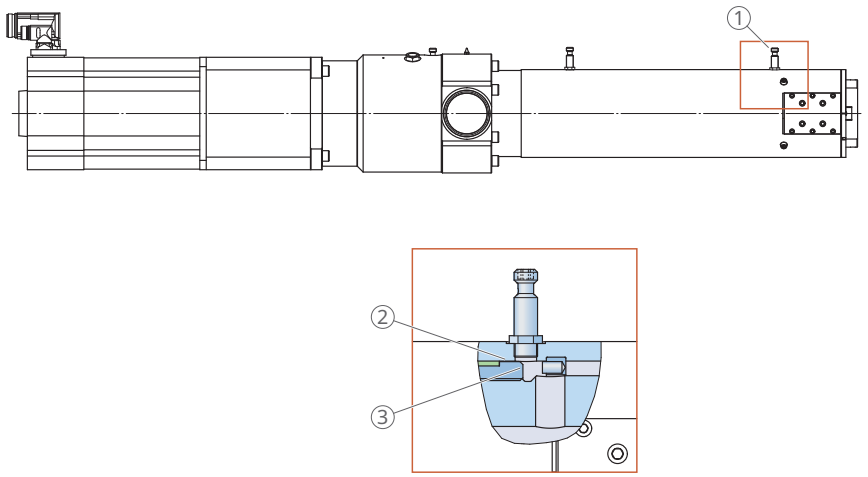
This surface is detected by the limit switch. In this view and in this position, L_t corresponds to the value L_{t0}.

1. Move the linear actuator so that $L_t = L_{t0}$ (±0.5 mm) ➤16|6.1.
2. Carefully screw the limit switch into the designated threaded hole by hand until it touches the roller nut.
3. Loosen the limit switch slightly to create a gap between the limit switch and the roller nut.
4. Stop loosening the limit switch as soon as detection by the limit switch ceases.
5. Secure the limit switch in this position by tightening the lock nut (tightening torque: 7 Nm).

6. Check whether the limit switch detects the roller nut in this position.
7. Move the linear actuator so that $L_t = L_t + 3$ mm (±0.5 mm).
8. Check that the limit switch no longer detects in this position.

Installing the limit switch for the “extended position”

11 Installing the limit switch for the extended position



1	Limit switch for the extended position	2	Roller nut (rear)
3	Detection surface		

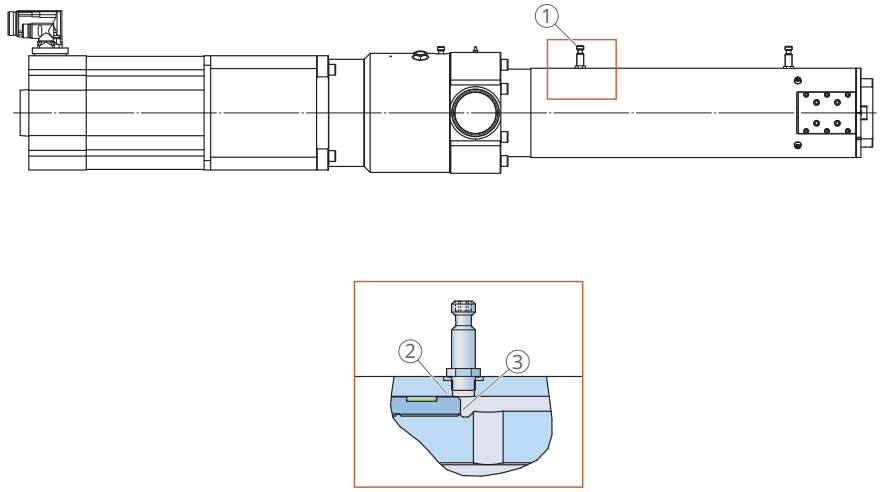
This surface is detected by the limit switch. In this view and in this position, L_t corresponds to the value L_{t0} + stroke.

1. Move the linear actuator so that $L_t = L_{t0}$ and stroke (±0.5 mm) ➤16|6.1.
2. Carefully screw the limit switch into the designated threaded hole by hand until it touches the roller nut.
3. Loosen the limit switch slightly to create a gap between the limit switch and the roller nut.
4. Stop loosening the limit switch as soon as detection by the limit switch ceases.
5. Secure the limit switch in this position by tightening the lock nut (tightening torque: 7 Nm).
6. Check whether the limit switch detects the roller nut in this position.
7. Move the linear actuator so that $L_t = L_t + 3$ mm (±0.5 mm).
8. Check that the limit switch no longer detects in this position.

6.5 Connecting and assembling the home switch

For information on the digital input used to connecting the home switch, refer to the technical documentation of the servoamplifier.

12 Installing the home switch



1	Home switch	2	Roller nut (front)
3	Detection surface		

This surface is detected by the home switch. In this view and in this position, L_t corresponds to the value L_{t0} and the stroke specified for the home switch in the linear actuator drawing.

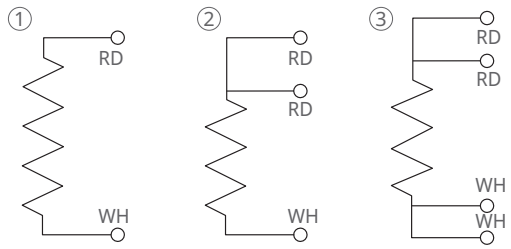
1. Move the linear actuator so that $L_t = L_{t0}$ and the stroke specified in the drawing for the home switch (±0.5 mm), ➤16|6.1.
2. Carefully screw the limit switch into the designated threaded hole by hand until it touches the roller nut.
3. Loosen the limit switch slightly to create a gap between the limit switch and the roller nut.
4. Stop loosening the limit switch as soon as detection by the limit switch ceases.
5. Secure the limit switch in this position by tightening the lock nut (tightening torque: 7 Nm).
6. Check whether the limit switch detects the roller nut in this position.
7. Move the linear actuator so that $L_t = L_t + 3$ mm (±0.5 mm).
8. Check that the home switch no longer detects in this position.
9. Move the linear actuator so that $L_t = L_{t0}$ and the stroke specified in the drawing for the home switch –3 mm (±0.5 mm).
10. Check that the limit switch no longer detects in this position.

6.6 Connecting the temperature sensor

If this option is selected, the following information is required for the electrical connection:

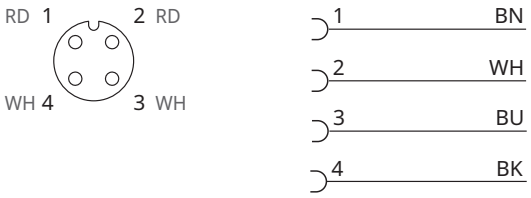
- type of temperature sensor: Pt100
- internal wiring (between plug and temperature sensor): 4 wires
- wiring to external environment: 2, 3, and 4 wires
- connection: M12x1 connector

13 Internal wiring



1	2 wires	2	3 wires
3	4 wires		

14 Connector assignment



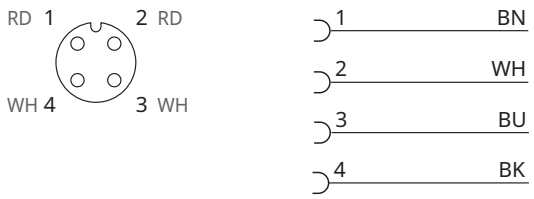
RD	Red	WH	White
BN	Brown	BU	Blue
BK	Black		

6.7 Connecting the sensor cable

If this option is selected, the following information is required for the electrical connection.

- manufacturer: IFM Electronic (or equivalent)
  - PUR cable EVC005, length 5 m
  - PUR cable EVC006, length 10 m
  - PUR cable EVC086, length 15
  - PUR cable EVC087, length 20
  - PUR cable EVC088, length 25
- cable diameter 4.9 mm
- min. bending radius 10 × cable diameter
- connections
  - M12×1 connector
  - non-insulated wires

15 Connecting the sensor cable



RD	Red	WH	White
BN	Brown	BU	Blue
BK	Black		

6.8 Connecting the additional brake mounted on the screw

Information about the brake (designation, type, voltage, current) can be found in the user manual of the selected manufacturer.

6.9 Assembling the automatic lubrication system

If an automatic lubrication system is included in the scope of delivery, refer to the manufacturer's technical documentation for assembly information. The designation of the lubrication system can be found on the type plate or on the lubrication pump.

6.10 Assembling the servoamplifier

If a servoamplifier is included in the scope of delivery, refer to the manufacturer's technical documentation for assembly information. The designation of the servoamplifier can be found on the type plate.

7 Commissioning

DANGER

Live components

Risk of fatal electric shock

- First, switch off the power supply to the servoamplifier and then disconnect the motor plug.
- Disconnect the signal plug and then disconnect the power plug.
- Do not touch any plug pins.

WARNING

High surface temperature of the electromechanical linear actuator

Risk of burns or fire

- Allow the electromechanical linear actuator to cool down before performing any work.

7.1 First commissioning

Prerequisites for commissioning:

- The mechanical and electrical installations were performed correctly.
- The software to define the servoamplifier parameters is installed.
- The hardware connection between the computer and the servoamplifier is installed.

Defining the servoamplifier parameters

1. Switch on the servoamplifier (auxiliary power supply or low-voltage supply only).
2. Start the software for defining the servoamplifier parameters.
3. Check the connection between the computer and the servoamplifier.
4. Define the servoamplifier parameters by selecting or entering the following information:

› motor (if applicable, associated resolver or encoder) and, if applicable, the associated brake

› movement of the linear actuator per motor revolution

› the linear actuator speed defined for the application

› the linear actuator acceleration defined for the application

› the definition of the start control parameters (see instructions for the servoamplifier)

5. Save the changes in permanent memory.

Checking the transfer of the parameters to the permanent memory

1. Switch off the servoamplifier.
2. Switch on the servoamplifier.
3. Check whether the changed parameters have been correctly adopted in the servoamplifier.

Commissioning

1. Switch on the power supply to the servoamplifier.
2. Check the function of the motor brake, for example as follows:

› When motor torque is applied, a braking noise must be audible.

› When motor torque is removed, a braking noise must be audible.

3. Move the linear actuator a short distance (less than the overstroke value specified in the drawing) in the positive direction to see the actual movement direction of the push tube.
   For the definition of the positive direction, see ➤38|11. Observe the instructions for the limit switch. In general, the push tube extends when a positive movement is requested. Otherwise, reverse the direction of rotation of the motor.
4. Slowly and gradually move the linear actuator to the retracted position and check the limit switch in the retracted position.
5. Slowly and gradually move the linear actuator to the extended position and check the limit switch in the extended position.
6. If a limit switch is installed: slowly and gradually move the linear actuator to a position where the status of the limit switch changes and check the function of the limit switch.
7. Create a program to define the zero reference.
8. Check that the program works correctly regardless of the starting position of the linear actuator ➤26|7.3.
9. Measure the two end positions (by pressing the push tube into the extended and retracted positions) within which the linear actuator can move without activating the limit switches. The positions are defined in relation to the zero point defined above.

Step 4: check the position control behavior

1. Allow the linear actuator to move backward and forward slowly over the entire stroke several times.
2. Check the position control behavior while the speed and acceleration of the linear actuator are gradually increased.

Further information on checking the position control behavior. ➤27|7.4.

7.2 General operating recommendations

NOTICE

High loads in the linear actuator and push tube

Property damage to the linear actuator and its external environment

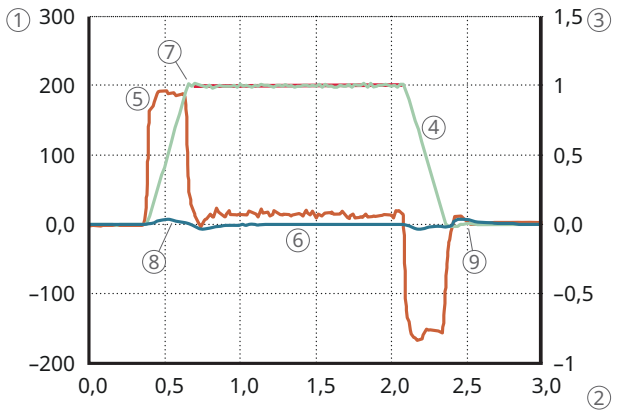
- Do not stop the movement of the linear actuator by sudden mechanical interruption.

The movement of the linear actuator must not be stopped by a sudden mechanical interruption, except when the motor is running at a low speed (value below or equal to a few percent of the maximum speed) and when the force is limited to a low value (by determining a restriction to the motor current). Otherwise, the kinetic energy stored in the internal rotating parts is stopped within a very short time. This can lead to very high loads (within the linear actuator and the push tube of the linear actuator), which may severely damage the linear actuator and the operating environment.

- The linear actuators have 2 internal mechanical stops: one in the retracted position and one in the extended position. These stops should only be used manually at slow speed and under low load. They are not designed to withstand the linear actuator being pushed against them at extreme speed or under extreme load.
- During initial use, it is advisable to increase the cycle rate of the linear actuator slowly without causing overheating. As a rule, the constant temperature of the linear actuator should not exceed +80 °C (regardless of the measurement surface) ➤33|9.1.
- Depending on the cycle rate, duty cycle definition (load, speed, acceleration profiles, or deceleration profiles), and ambient conditions, the linear actuator may heat up to a greater or lesser extent.

Example: Low risk of tracking error faults or over speed faults

16 Example 1



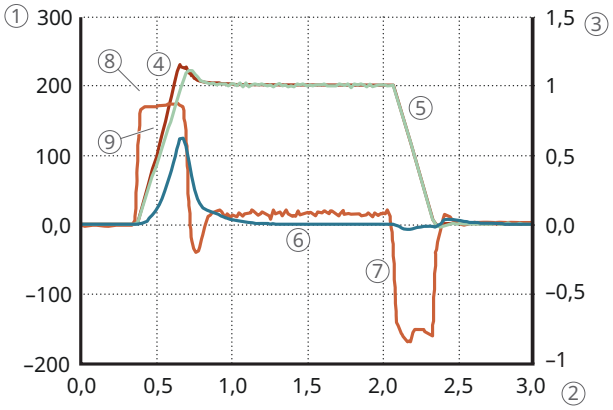
1	Speed in mm/s	2	Time in s
3	Motor current/10 and over speed fault in mm	4	Actual speed [mm/s] [mm/s]
5	Over speed fault [mm] [mm/s]	6	Motor current/10 [A] [mm/s]
7	Actual speed and setpoint speed identical	8	Over speed fault 1
9	Over speed fault 2		

In this example, there is no difference between the speed setpoint and the actual speed. For example, if a threshold that triggers an over speed fault is set at 230 mm/s and this diagram remains consistent over multiple forward and backward movements, the risk of an over speed fault is very low.

The tracking error fault value is low (max. 40 µm). For example, if the level at which a tracking error fault is triggered is set at 0.7 mm and this graph remains consistent after multiple forward and backward movements, the risk of generating a tracking error fault is very low.

Example: High risk of tracking error faults or over speed faults

17 Example 2



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1	Speed [mm/s]	2	Time [s]
3	Motor current/10 and over speed fault [mm]	4	Setpoint speed [mm/s]
5	Actual speed [mm/s] [mm/s]	6	Over speed fault [mm] [mm/s]
7	Motor current/10 [A] [mm/s]	8	Speed overshoot
9	Over speed fault		

In this example, there is a significant difference between the speed setpoint and the actual speed, resulting in a speed overshoot (maximum speed close to 230 mm/s), which is required to reduce the tracking error fault. For example, if the threshold for triggering an over speed fault is set at 230 mm/s, the risk of generating an over speed fault is very high.

The value of the tracking error fault is significant (max. 0.6 mm). If the threshold value for triggering a tracking error fault is set at 0.7 mm, for example, the risk of a tracking error fault occurring is very high.

7.3 Defining the zero reference

The zero reference defined by the search for the home switch is reproducible for a given linear actuator, but not identical between different linear actuators.

NOTICE

Unexpected positions of the linear actuator

Severe damage to the linear actuator

- When replacing the linear actuator, all positions must be redefined based on the zero reference of the new linear actuator.

The zero reference is defined using the home switch depending on the condition. The following options are possible:

- integrated home switch
- home switch attached to the machine driven by the linear actuator

Case 1: integrated home switch

✓ The limit switches in the servoamplifier must be activated to perform a zero point search using the home switch from any starting position of the linear actuator.

✓ The zero point is defined depending on the actual possibilities of the customer application.

✓ The search for the zero point must always begin in a direction in which the push tube moves toward the retracted position. Write the following program as follows:

1. Move the push tube of the linear actuator upward until the push tube reaches the limit switch in the retracted position.
2. Retract the push tube until the home switch detects the roller nut.
3. Start a search for the first zero point of the encoder (or resolver).
4. Define the zero point as soon as the zero point of the encoder (or resolver) has been found.

✓ The search for the zero point must always begin in a direction in which the push tube moves toward the extended position. Write the following program as follows:

5. Move the push tube of the linear actuator upward until the push tube reaches the limit switch in the extended position.
6. Retract the push tube until the home switch detects the roller nut.
7. Start a search for the first zero point of the encoder (or resolver).
8. Define the zero point as soon as the zero point of the encoder (or resolver) has been found.

In general, there is not necessarily a correlation between the zero reference defined by a zero reference search and the zero reference position specified in the drawing. Very often, these two zero references correspond to two different positions.

Case 2: home switch attached to the machine driven by the linear actuator

Depending on the servoamplifier version (see the servoamplifier user manual for information), it may be necessary to ensure that the camshaft length detected by the home switch is greater than the stroke achieved by the linear actuator during one motor revolution. Once this precaution has been taken, the options provided by the servoamplifier for determining the zero reference are sufficient to address any possible issues.

Define a zero point that remains unchanged even when replacing the linear actuator with a new one:

1. Move the linear actuator to a mechanical stop.
2. Define the zero point in relation to the position reached.

7.4 Checking the behavior of the position control system

NOTICE

Tracking error fault or over speed fault

Severe property damage

- Check that the position control system is functioning correctly before commissioning for the first time.

For more information on tracking error faults or over speed faults, refer to the technical documentation of the servoamplifier manufacturer.

Depending on the servoamplifier manufacturer, a tracking error fault or an over speed fault may result in the motor torque being switched off. If this is the case and occurs at the maximum speed of the linear actuator, the linear actuator will continue to move due to the kinetic energy of the rotating inside the linear actuator. As a result, it is very likely that the linear actuator will come to an abrupt stop against its internal mechanical stopper or the mechanical stop of the machine. In both cases, this can lead to severe property damage. To avoid this, it is recommended that you check the position control system behavior.

First, read the technical documentation of the servoamplifier to determine whether a method exists or whether the servoamplifier manufacturer has developed special tools for this test. Otherwise, use the following method, which is a simplified evaluation of the position control system behavior.

Evaluation method

The behavior of the position control system is estimated using measurements that were created with the servoamplifier scope tool while the linear actuator performs forward and backward movements. The scope tool allows the user to track the progression of control variables as a function of time. For example, it is possible to view the variation of speed and motor current as a function of time in a diagram.

To assess the behavior of the position control system, the speed setpoint, actual speed, tracking error fault, and motor current of the linear actuator must be displayed. The corresponding variable names can be found in the technical documentation for the servoamplifier. Based on observations of the shape of the recorded curves, the risk of occurrence of a tracking error fault or over speed fault can be assessed on a scale from zero to very high.

Detailed description of the method:

1. Bring the linear actuator into its final operating condition.

   The linear actuator must be installed in a machine and able to perform the work it is intended for.
2. Reduce the value of the maximum movement speed.
   Take a maximum speed equal to 1/10 of the maximum speed defined for the application.
3. Reduce the acceleration and deceleration values.
   Take a value equal to 1/10 of the acceleration and deceleration values defined for the application.
4. First, initiate a forward movement of the linear actuator and then perform a reverse movement. Create a scope tool recording at the same time.
5. Compare the recorded graph with the following example graphs.
6. Draw a conclusion about the risk level that may lead to a tracking error fault or over speed fault.

If the risk is low:

7. Increase the speed value and the acceleration and deceleration values.
8. Repeat the measurements with the scope tool during forward and backward movement of the linear actuator.
9. Reassess the risk of generating an error.
10. Repeat these steps until the speed, acceleration, and deceleration values defined for the application are reached.

If the risk is high:

11. Reduce the values for the over speed and/or tracking error fault.
    Do not increase the speed value and the acceleration and deceleration values.
12. Identify measures to reduce the risk of a tracking error fault or over speed fault.
    Read the technical documentation for the servoamplifier.

The customer should ensure that the commissioning steps suggested in the described method do not cause any problems.

7.5 Position control system parameters

NOTICE

Position control system too dynamic or too rigid

Noise and shorter product life due to vibrations caused by the position control being too dynamic or too rigid

- Check the position control system parameters.

The parameters of the position control system determine the dynamics and stiffness of the control system, but also its stability.

The parameter-setting software supplied with the servoamplifier, or the information provided in the technical documentation, is used to calculate or evaluate the values of the control parameters for the current control loop, speed control loop and position control loop.

These parameters are usually set so that the linear actuator performs the desired tasks correctly. However, it is the responsibility of the user to ensure that this is actually the case for their application.

For more information, refer to the technical documentation provided by the servoamplifier manufacturer.

8 Troubleshooting

⚠ WARNING

Live components

Risk of injury due to electric shock

- Disconnect the devices from the supply voltage before carrying out any work on the drive or control unit.

Malfunctions are either mechanical or electrical in nature. The cause of a fault (e.g., “The linear actuator does not move”) may be a mechanical problem (e.g., blocked motor brake) or an electrical problem (e.g., no power supply to the servoamplifier). The assignment of the cause is not always clear. In the event of a malfunction, consider all possible causes, both mechanical and electrical, to identify all possible solutions.

3 Malfunctions during the inspection prior to initial commissioning

Malfunction	Possible cause	Remedy
Linear actuator does not move	Motor connection not correct	▸ Check the motor connection.
	Resolver connection not correct	▸ Check the motor connection.
	No power supply to the motor	▸ Check the voltage, the status of the main switch, and the status of the fuses above the servoamplifier. ▸ Check that the servoamplifier enables linear actuator movement and motor torque.
	Incorrect movement definition	▸ Check that all movement parameters (target position, speed, and acceleration) are correctly defined in the servoamplifier.
	Servoamplifier error	▸ Read the technical documentation for the servoamplifier. Depending on the error number, possible causes are suggested with appropriate solutions. » Depending on the error number, possible causes are suggested with appropriate solutions.
Linear actuator moves and stops immediately with a servoamplifier error	Motor connection not correct	▸ Check the motor connection.
	Resolver connection not correct	▸ Check the motor connection.
	Servoamplifier error	▸ Read the technical documentation for the servoamplifier. » Depending on the error number, possible causes are suggested with appropriate solutions.
Linear actuator moves in the wrong direction	Incorrect motor connection/resolver connection or incorrect servoamplifier parameter	▸ Check the motor connection. ▸ Change the direction of movement in the servoamplifier parameters.
Linear actuator vibrates in the stop position	The parameters for the position control system are not adapted to the application	▸ Optimize the definition of the position control system parameters in relation to the application.

4 Mechanical malfunctions

Malfunction	Possible cause	Remedy
Linear actuator does not move	Motor brake blocked	▸ Check the brake connection and voltage supply.
	System moved by the linear actuator is blocked	▸ Check the mobility of the system moved by the linear actuator.
Linear actuator draws high current and/or produces noise during movement	Motor brake blocked	▸ Check the brake connection and voltage supply.
	System moved by the linear actuator is blocked	▸ Check the mobility of the system moved by the linear actuator.
Linear actuator is too hot	Servoamplifier error	▸ Measure the RMS torque value over a complete cycle (including the pause before the start of a new cycle). Send this information to Schaeffler for analysis.
	Ambient temperature too high	▸ Observe the permissible ambient temperature.

If a fault cannot be resolved using the above measures, contact Schaeffler.

Requesting support

If you are unable to resolve the malfunction, contact Schaeffler. Information on how to contact technical support is available from Schaeffler.

Please have the following information available:

- serial number of the linear actuator (format: ARxxxxx-yyyy. Example: AR33543-0223 corresponds to linear actuator no. 223 with design file no. 33543.)
- type and duration of the malfunction (frequency: continuous, occasional, one-off)
- time of the malfunction and conditions during the malfunction (describe in detail)
- if possible, photos or screenshots of the malfunction

9 Maintenance

Schaeffler offers the following maintenance services for linear actuators.

Linear actuator (without motor)

Maintenance level 1

This service includes the complete disassembly, cleaning, relubrication, and reassembly of the linear actuator. All components undergo a visual inspection. The condition of the roller screw or ball screw is outlined. All of the following components are replaced:

- bearings
- seals
- coupling star
- profile rail guides, if the linear actuator has an anti-rotation
- dampers
- guides
- air filter
- grease fittings
- belt, if the linear actuator has an integrated pulley belt system

Maintenance level 2

This service includes the Level 1 maintenance for the linear actuator and replacement of the rollers of the roller screw.

Maintenance level 3

This service includes the Level 1 maintenance for the linear actuator and complete replacement of the roller screw.

For the motor of the linear actuator (only if originally supplied by Schaeffler)

Maintenance level 1

This service includes the complete disassembly, cleaning and reassembly of the motor. All components undergo a visual inspection. All of the following components are replaced:

- bearings
- seals

For the gearbox of the linear actuator (only if originally supplied by Schaeffler)

Maintenance level 1

This service includes complete disassembly, cleaning and reassembly of the gearbox. All components undergo a visual inspection. All of the following components are replaced:

- bearings
- seals

For each maintenance level, a concept tailored to your needs can be set up in order to minimize the consequences of component unavailability. For further information, contact Schaeffler.

9.1 Lubrication

DANGER

Live components

Risk of fatal electric shock

- First, switch off the power supply to the servoamplifier and then disconnect the motor plug.
- Disconnect the signal plug and then disconnect the power plug.
- Do not touch any plug pins.

WARNING

High surface temperature of the electromechanical linear actuator

Risk of burns or fire

- Allow the electromechanical linear actuator to cool down before performing any work.

NOTICE

Damage to property due to unclean operation

Too much grease generates heat in the actuator

- Do not use grease that is contaminated by other products or particles.
- Avoid injecting air into the lubrication channels.

If an automatic lubrication system is installed, it can be temporarily disconnected so that relubrication can be performed with a manual grease gun.

For highly dynamic applications, regular inspection of the linear actuator's function and its lubrication is recommended.

The recommendations (type, frequency, and grease quantity) for good lubrication conditions over the entire service life of the linear actuators are provided as guidelines:

- If necessary, adapt the grease specification to the specific conditions of the application, depending on ambient temperature, the definition of the linear actuator's duty cycle (speed, acceleration, load, cycle rate), and the way in which the linear actuator dissipates heat.
- Check whether the lubrication recommendations result in good lubrication conditions.

The temperature of the linear actuator can be checked with a temperature sensor. A temperature sensor can be ordered as an option or added at a later date if the linear actuator is returned to Schaeffler. For further information, contact Schaeffler.

Lubricating the roller screw (or ball screw)

5 Lubricating the roller screw (or ball screw)

Type	See user manual (technical data)
Quantity	Until overflowing
Frequency	See user manual (technical data)

1. Position the linear actuator at the lubrication point (see user manual).
2. Inject half of the required amount of grease.
3. Slowly apply 10 double strokes over the entire stroke length to distribute the grease along the screw shaft.
4. Repeat steps 1, 2, and 3.

This is a closed system. Relubrication is most effective when the old grease is removed. The condition of the old grease can be checked and the quantity and period of relubrication can be adjusted to the actual operating conditions (temperature, speed, load, etc.). During relubrication, the old grease enters the free space within the linear actuator. If the entire free space is filled, the linear actuator may overheat.

Please contact Schaeffler for information on available maintenance services for the linear actuator.

Lubricating the linear actuator

The linear actuator is supplied lubricated.

Lubricating the bearings

The bearings are lubricated for life.

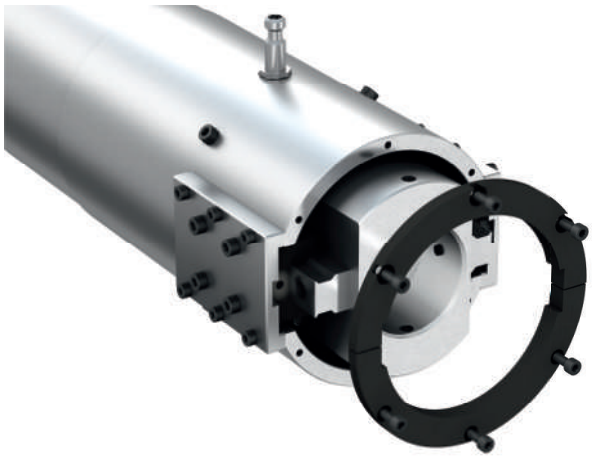
Lubricating the profile rail guides

6 Lubricating the profile rail guides

Type	See user manual (technical data)
Quantity	Until overflowing
Frequency	See user manual (technical data)

1. Position the linear actuator in the middle of its stroke.
2. If necessary, remove the two plastic covers.

18 Plastic cover removal



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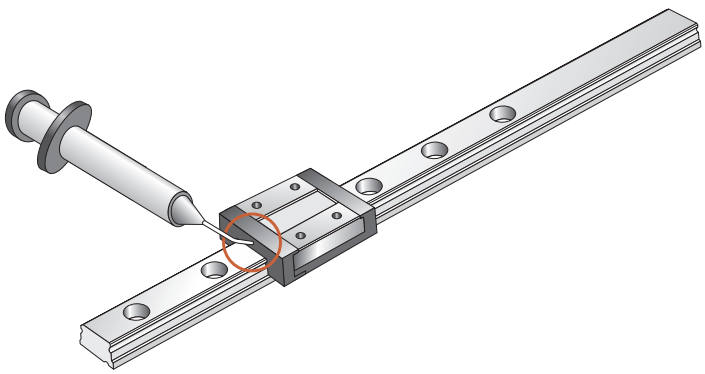
3. Inject grease into the lubrication hole or the grease fitting of each rail.

19 Application of grease to the lubrication hole



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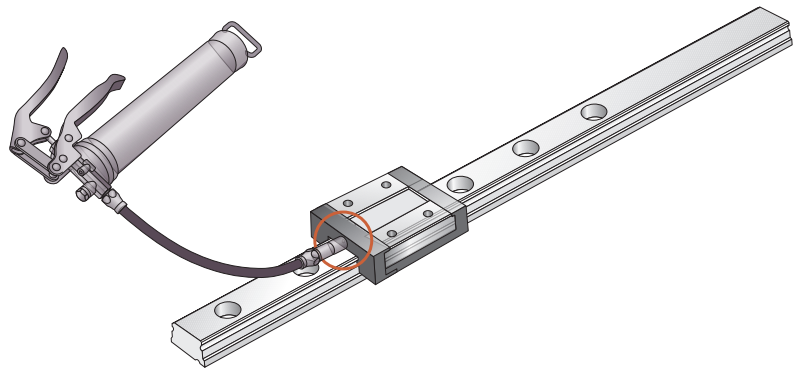
20 Application of grease to the lubrication nipple



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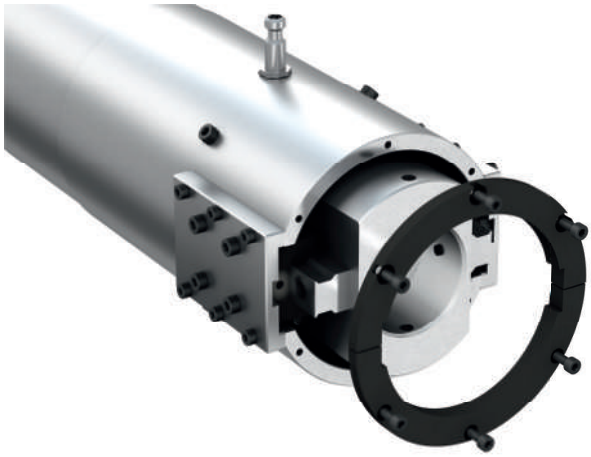
4. Install the plastic covers.
5. Slowly apply 10 double strokes over the entire stroke length to distribute the grease along the guide.

21 Plastic cover removal



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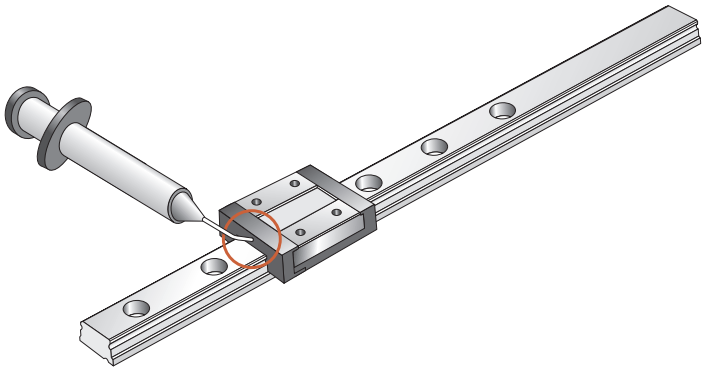
22 Application of grease to the lubrication hole



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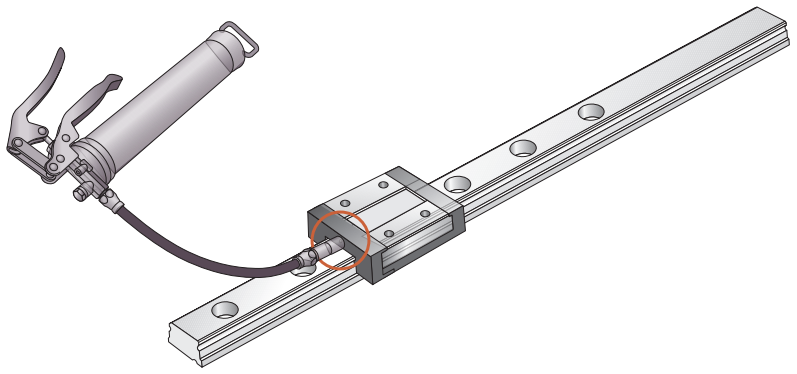
23 Application of grease to the lubrication nipple



Lubricating the plain bearings

7 Lubricating the plain bearings

Type	See user manual (technical data)
Quantity	Until overflowing
Frequency	See user manual (technical data)

Lubricating the gearbox

The gearbox is lubricated for life.

9.2 Performing routine tests

Checking the additional brake

For an additional brake (optional) and in static use, it is recommended to check the air gap annually (and to measure it through a hatch).

8 Checking the additional brake

Correct air gap	See user manual (technical data)
Engagement time	See user manual (technical data)
Disengagement time	See user manual (technical data)

Visual inspection of the belt

If the linear actuator is equipped with a belt (optional) and pulleys, visually inspect the condition of the toothed belts for surface damage.

For further details, please refer to the belt manufacturer's technical documentation.

9 Checking the belt

Manufacturer	See user manual (technical data)
Type	Timing belt
Reference	See user manual (technical data)
Tensile force (new belt)	See user manual (technical data)
Tensile force (used belt)	See user manual (technical data)

10 Disposal

Observe the local regulations for disposal.

As the linear actuator is principally made of steel and stainless steel, some grease or oil may be present inside. When disposed of, the motor and some accessories – such as limit switches and encoders – are treated as electronic scrap.

Dispose of the product according to the different requirements for each material:

- iron
- aluminum
- copper
- plastic
- electronic components
- oil and grease (not mixed with solvents)

11 Technical information

You will find a detailed description of the delivered product in the following two documents (“Approval documentation”):

- technical description
- drawing of the linear actuator

The technical data for some products in this manual are taken from the documentation of the respective manufacturers and are for information purposes only. If the manufacturers of the products change technical data, Schaeffler assumes no responsibility for any resulting issues. Contact the manufacturer of the product before assembly.

For further information on performance, operating limits, and operating environment, please refer to the quotation and other approval documentation. The performance and operating limits of the linear actuator, as well as the operating environment, are described in the technical requirements defining the configuration.

Dimensions and drawing of the linear actuator

Refer to the linear actuator drawing for linear actuator dimensions and the description of the accessories.

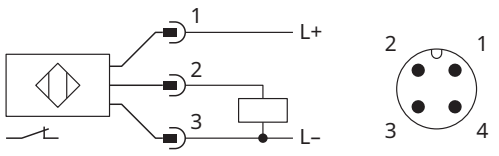
Limit switches

The following information is required for correct connection:

10 Technical information

IFM Electronic (or equivalent)	**IFC207 (or equivalent)**
Sensor type	Inductive
Technology	DC PNP
Output	Normally closed
Power supply voltage	24
Current consumption	<10 mA (with DC 24 V)
Max. current output	100 mA
Connection	M12×1 connector

24 Connection of the limit switch



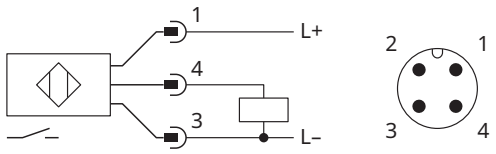
Please refer to the technical documentation of the servoamplifier manufacturer for information on which digital input can be used to connect limit switches.

Home switch

11 Technical data

IFM Electronic (or equivalent)	IFC204 (or equivalent)
Sensor type	Inductive
Technology	DC PNP
Output	Normally open
Power supply voltage	24
Current consumption	<10 mA (at DC 24 V)
Max. current output	100mA
Connection	M12×1 connector

25 Home switch connection



Please refer to the technical documentation of the servoamplifier manufacturer for information on which digital input can be used to connect the home switch.

12 Replacement parts

If you require additional information or replacement parts, please contact Schaeffler.

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