**MP149E**

# L-220 Linear Actuator

## User Manual

Version: 1.5.0 Date: 2023-01-16

**This document describes the following high-resolution linear actuators:**

- L-220.10DG
  DC drive with gearhead,
  travel range 13 mm (0.5")
- L-220.10SG
  Stepper motor drive with gearhead,
  travel range 13 mm (0.5")
- L-220.20DG
  DC drive with gearhead,
  travel range 26 mm (1")
- L-220.20SG
  Stepper motor drive with gearhead,
  travel range 26 mm (1")
- L-220.50DG
  DC drive with gearhead,
  travel range 52 mm (2")
- L-220.50SG
  Stepper motor drive with gearhead,
  travel range 52 mm (2")
- L-220.70DG
  DC drive with gearhead,
  travel range 77mm (3")
- L-220.70SG
  Stepper motor drive with gearhead,
  travel range 77mm (3")

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Subject to change without notice. This manual is superseded by any new release. The latest release is available for download from our website.

# Contents

# 1 About this Document

## 1.1 Objective and Target Group of this User Manual

This user manual contains the necessary information on the intended use of the L-220.

Basic knowledge of closed-loop systems, motion control concepts, and applicable safety measures is assumed.

The latest versions of the user manuals are available for download on our website (p. 2).

## 1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

***CAUTION***

**Dangerous situation**

If not avoided, the dangerous situation will result in minor injury.

➢ Actions to take to avoid the risk.

***NOTICE***

**Dangerous situation**

If not avoided, the dangerous situation will result in damage to equipment.

➢ Actions to take to avoid the risk.

***INFORMATION***

Information for easier handling, tricks, tips, etc.

| Symbol/Label | Meaning |
|---|---|
| 1.<br>2. | Action consisting of several steps whose sequential order must be observed |
| ➢ | Action consisting of one or several steps whose sequential order is irrelevant |
| ▪ | Lists |
| p. 5 | Cross-reference to page 5 |

## 1.3 Definition of Terms

| Term | Explanation |
|---|---|
| Load capacity | Maximum load capacity in the vertical direction when the linear actuator is mounted horizontally. The contact point of the load is at the center of the motion platform. |
| Max. push/pull force | Maximum force in the direction of motion. Some stages may have higher forces but with limited lifetimes. In the case of vertical mounting, the specified value (s. 31) for models without a gearhead and brake only applies when the servo mode is on. |
| Rotary encoder | The rotary encoder is a sensor for capturing changes in position. Signals from the sensor are used for axis position feedback. After the controller is switched on, a reference point definition must be performed before absolute target positions can be commanded and reached. |

## 1.4 Further Applicable Documents

The devices and software tools from PI that are mentioned in this documentation are described in separate manuals.

| Product | Document |
|---|---|
| L-220 | MP159EK Short instructions for L-2xx/MA-35/MP-20/MP-15 linear actuators |
| C-863.12 | MS249 User manual |
| C-663.12 | MS241 User manual |
| C-884 | MS243 User manual |
| C-885 | C885T0002 User manual |
| C-663.12C885 | C663T0004 User manual |
| C-863.20C885 | C863T0005 User manual |

# 2 Safety

## 2.1 Intended Use

The L-220 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment which is free of dirt, oil, and lubricants.

In accordance with its design, the L-220 is intended for single-axis positioning, adjusting and shifting of loads at various velocities.

The intended use of the L-220 is only possible when installed and in conjunction with a suitable controller. The controller is not included in the scope of delivery of the L-220.

## 2.2 General Safety Instructions

The L-220 is built according to state-of-the-art technology and recognized safety standards. Improper use of the L-220 may result in personal injury and/or damage to the L-220.

- Only use the L-220 for its intended purpose, and only use it if it is in good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the L-220.

### 2.2.1 Organizational Measures

**User manual**

- Always keep this user manual available when using the L-220.
  The latest versions of the user manuals are available on our website (p. 2) for download.
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- If you give the L-220 to other users, also include this user manual as well as all other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in minor injury and damage to equipment.
- Only install and operate the L-220 after you have read and understood this user manual.

### Personnel qualification

The L-220 may only be installed, started up, operated, maintained, and cleaned by authorized and appropriately qualified personnel.

# 3 Product Description

## 3.1 Model Overview

There are six standard versions of the L-220. All models are high-resolution linear actuators with a limit switch. They differ with respect to:

- Drive type
- Travel range

| Model | Travel range | | | Drive type | | |
|---|---|---|---|---|---|---|
| | 13 mm | 26 mm | 52 mm | 77 mm | DC gear motor | Step gear motor |
| L-220.10DG | + | | | | + | |
| L-220.10SG | + | | | | | + |
| L-220.20DG | | + | | | + | |
| L-220.20SG | | + | | | | + |
| L-220.50DG | | | + | | + | |
| L-220.50SG | | | + | | | + |
| L-220.70DG | | | | + | + | |
| L-220.70SG | | | | + | | + |

### Detailed model overview

| Order number | Product name |
|---|---|
| L-220.10DG | High-resolution linear actuator, DC gear motor, 13 mm travel range, 125 N feed force; 3.5 mm/s maximum velocity; ball screw; incremental rotary encoder, 512 counts/rev. resolution, A/B quadrature, RS-422; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 m cable length |
| L-220.10SG | High-resolution linear actuator; 2-phase stepper motor with gearhead; 13 mm travel range; 125 N feed force; 0.8 mm/s maximum velocity; ball screw; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 cable length |
| L-220.20DG | High-resolution linear actuator, DC gear motor, 26 mm travel range, 125 N feed force; 3.5 mm/s maximum velocity; ball screw; incremental rotary encoder, 512 counts/rev. resolution, A/B quadrature, RS-422; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 m cable length |
| L-220.20SG | High-resolution linear actuator; 2-phase stepper motor with gearhead; 26 mm travel range; 125 N feed force; 0.8 mm/s maximum velocity; ball screw; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 cable length |
| L-220.50DG | High-resolution linear actuator, DC gear motor, 52 mm travel range, 125 N feed force; 3.5 mm/s maximum velocity; ball screw; incremental rotary encoder, 512 counts/rev. resolution, A/B quadrature, RS-422; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 m cable length |
| L-220.50SG | High-resolution linear actuator; 2-phase stepper motor with gearhead; 52 mm travel range; 125 N feed force; 0.8 mm/s maximum velocity; ball screw; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 cable length |
| L-220.70DG | High-resolution linear actuator, DC gear motor, 77 mm travel range, 125 N feed force; 3.5 mm/s maximum velocity; ball screw; incremental rotary encoder, 512 counts/rev. resolution, A/B quadrature, RS-422; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 m cable length |
| L-220.70SG | High-resolution linear actuator; 2-phase stepper motor with gearhead; 77 mm travel range; 125 N feed force; 0.8 mm/s maximum velocity; ball screw; limit switch: Hall effect, N/C contact, 5 V, NPN; 0.5 m cable length |

➢ For further technical data, see the specifications (p. 31).

PI also produces custom versions upon request. Custom versions can differ from the described standard products in respect to dimensions, characteristics or other technical data.

➢ If necessary, contact our customer service department directly (p. 29).

## 3.2 Product View

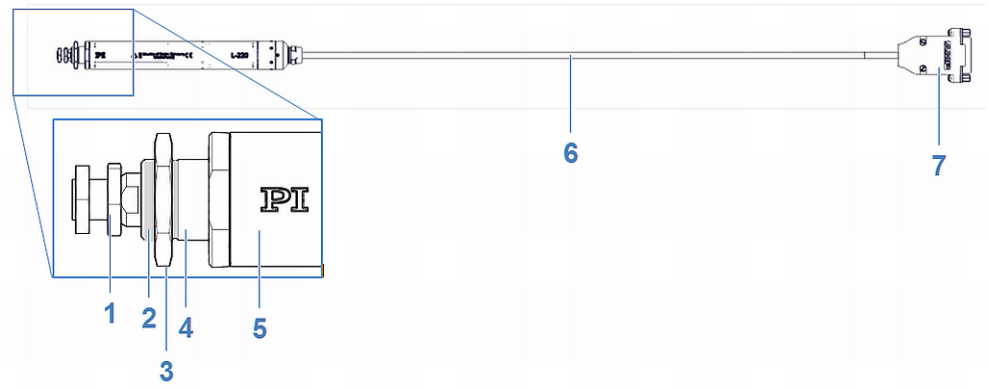



Figure 1: Parts of the L-220 (here with flat tip)

1 Tip, replaceable (here: Flat, mounted on pusher)
2 Thread for clamp connection
3 Mounting nut for clamp connection
4 Smooth cylinder surface, e.g., for mounting in a hole
5 Sleeve
6 Cable
7 Controller connection (HD Sub-D 26, male)

## 3.3 Direction of motion

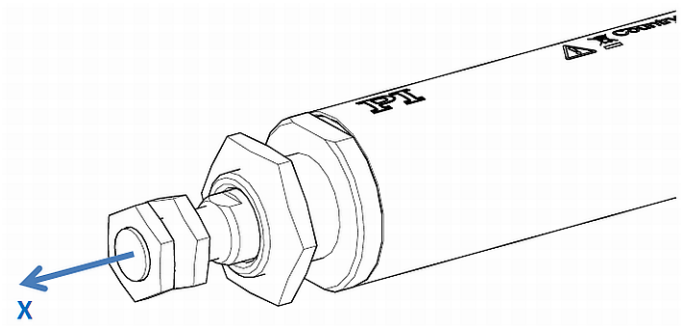



Figure 2: Direction of motion of the pusher (her with flat tip)

X (arrow direction:) Direction of motion on positive command

## 3.4 Product Labeling

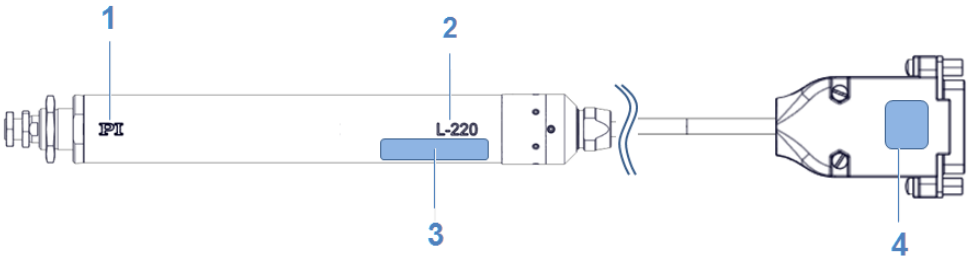



Figure 3: Product labeling

| Position | Labeling | Description |
|---|---|---|
| 1, 3 | PI | Manufacturer's logo |
| 2 | L-220 | Product series |
| 3 | L-220.20SD00 | Product name (example), the characters after the period refer to the model |
| 3 | 415002159 | Serial number (example), individual for each L-220<br>Meaning of the places (counting from left): 1 = internal information, 2 and 3 = year of manufacture, 4 to 9 = consecutive numbers |
| 3 | ⚠ | Warning sign "Observe manual!" |
| 3 | Country of origin: Germany | Country of origin |
| 3 | CE | CE conformity mark |
| 3 | WWW.PI.WS | Manufacturer's address (website) |
| 3 | | Old equipment disposal |
| 4* | | Warning sign "Electrostatic sensitive devices" |

* also on the opposite side of the connector

## 3.5 Scope of Delivery

| Order number | Component |
|---|---|
| L-220 | Linear actuator according to order (p. 5), with flat tip and spherical tip (**not** mounted on delivery) |
| MP159EK | Short instructions for L-2xx/MA-35/MP-20/MP-15 linear actuators |
| K3110154 | UNC bolt for adaptation to a connector of an extension cable (2 units) |

## 3.6 Suitable Controllers

The L-220 must be connected to a suitable controller. The following controllers from PI are suitable for the operation of the L-220:

| Mechanics | Controller | PC interface | Multiple controllers on the same PC |
|---|---|---|---|
| L-220.x0DG | C-863 | USB, RS-232, daisy chain network | Yes, same interface |
| | C-884 | USB, RS-232, TCP/IP | Yes |
| L-220.x0SG | C-663.12 | USB, RS-232, daisy chain network | Yes, same interface |

The required PC software is included in the scope of delivery of the controllers from PI. The operating parameters must be adjusted depending on the version of the L-220 used.

## 3.7 Technical Features

### 3.7.1 Rotary Encoder

The models with DC motors are equipped with a rotary encoder. A rotary encoder, also called an incremental or incremental rotary encoder, is implemented at a rotating point in the drivetrain, e.g., the motor shaft. To determine the relative position, the controller counts the encoder signals, the so-called impulses.

### 3.7.2 Limit Switches

The L-220 is equipped with noncontact, Hall-effect limit switches.

Each limit switch sends its signal to the controller on a dedicated line. The controller then stops the motion. If the controller does not stop the motion in time, the linear actuator runs into the hard stop.

See "Limit Switch Specifications" for more information (p. 34).

### 3.7.3 Reference Point Switch

The L-220 is equipped with one direction-sensing reference point switch that is located at about the midpoint of the travel range. This sensor transmits a TTL signal that indicates whether the linear actuator is on the positive or negative side of the reference point switch.

See the controller user manual and/or associated software manuals for the commands that make use of the reference point signal.

For more information, see "Reference Point Switch Specifications" (p. 34).

# 4 Unpacking

1. Unpack the L-220 with care.
2. Compare the contents with the items listed in the contract and the packing list.
3. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

# 5 Installation

## 5.1 General Notes on Installation

**NOTICE**

**Cable break!**

A cable break leads to failure of the linear actuator.

➢ Install the linear actuator so that the cable is not bent too strongly or crushed.

**NOTICE**

**Increased friction!**

Lateral forces that act on the pusher of the linear actuator increase the friction of the internal drive components. Increased friction impairs the motion of the pusher and increases wear on the drive components.

➢ Avoid lateral forces on the tip and on the pusher of the L-220.

**NOTICE**

**Heating up of the L-220 during operation!**

The heat produced during operation of the L-220 can affect your application.

➢ Install the L-220 so that the application is not impaired by the dissipated heat.

***INFORMATION***

Models with DC gear motors are equipped with integrated signal drivers for cable lengths ≤10m between the linear actuator and the motor controller

## 5.2 Providing a Suitable Mechanical Mounting and Installation Environment

A suitable mechanical mounting and installation environment are necessary for the proper use of the actuator.

- Make sure that the following conditions have been met:
  - Material and statics of the mounting are designed so that the static and dynamic forces that occur can be safely and continuously managed.
  - The dimensions of the mounting are adapted to the dimensions of the actuator (see above figures and dimensions (p. 35)).
  - The intended motions of the pusher and the load must not be inhibited by the dimensions of the installation environment.
- Take into account the following specifications as well when planning the application and installing the actuator:
  - Dimensions of the tip selected (see Dimensions (p. 35))
  - Travel range: (see data table (p. 31))
  - Space requirements for a kink-free and proper guiding of the connecting cable and additional motor cables
  - Length of the connection cable and the motor cable
- If the limit switches of the actuator cannot be reached with the planned minimum and maximum displacements: Make sure that the actuator and the load **only move within the planned range**. Suitable measures:
  - Corresponding programming of the controller
  - Emergency off switch
  - Automatic shutdown systems
- Avoid or label danger areas that result from the installation of the actuator and from use, in accordance with the legal regulations (e.g. risk of crushing in the case of heavy moving loads, fast actuator motions and/or high drive torques).

The complete dimensions of the actuator and relevant individual parts can be found in the figures in the section Dimensions (p. 35).

## 5.3 Installing the Linear Actuator in a Mechanical Mounting

**NOTICE**

**Incorrect tightening torque of the mounting nut!**

The motion of the pusher can be hindered by a mounting nut that has been tightened too strongly. This reduces the positioning accuracy.

➢ Tighten the mounting nut to a maximum torque 10 Nm.

**INFORMATION**

To achieve an optimum repeatability, the mounting shaft must not have any backlash.

During mounting, make sure that there is a faultless connection between the actuator and the mechanical mounting.

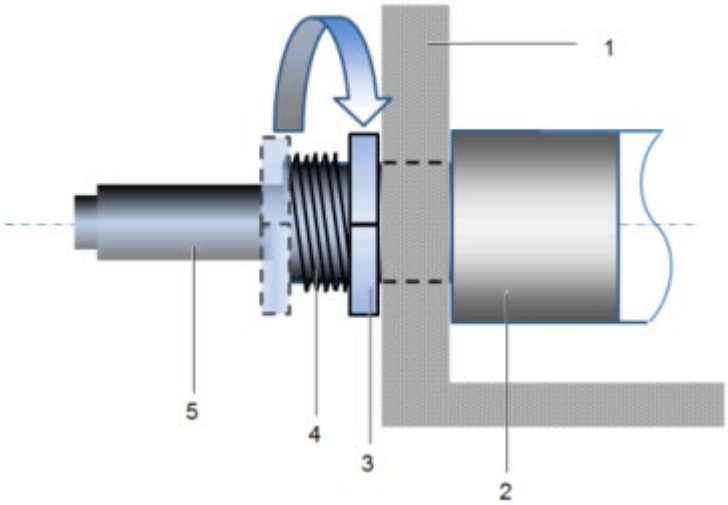



Figure 4: Clamp connection (schematic)

1 Mechanical mounting
2 Sleeve
3 Mounting nut
4 Mounting shaft with thread
5 Pusher

We recommend installing the actuator in the mechanical mounting with a clamp connection. The following instructions refer to this case.

### Requirements

- ✓ You have read and understood the general notes on installation (p. 13).
- ✓ You have provided your application with a suitable mounting for the mounting shaft of the actuator.
- ✓ The tip is **not** mounted on the actuator.

### Tools and accessories

- Open-end wrench AF 17

### Installing the actuator

1. Loosen the mounting nut on the mounting shaft of the actuator.
2. Position the actuator in the mounting of your application.
3. If necessary, put a suitable flat washer or a suitable spring washer on the mounting shaft.
4. Manually screw the mounting nut into the thread of the mounting shaft with a few rotations.
5. To clamp the actuator in the mounting, tighten the mounting nut using the open-end wrench until you feel a resistance. The torque may **not** exceed 10 Nm!
6. Check that the actuator is affixed firmly in the mounting.

## 5.4 Mounting a Tip

***NOTICE***

**Damage of the mechanics from torques at the tip**

➢ Avoid generation of torques when mounting or changing the tip.

***INFORMATION***

The supplied tips make it possible to realize different mechanical connections to a load:

- A flat tip allows a wide-area connection to a load.
- A spherical tip allows a punctiform connection to a load.

To achieve optimum repeatability:

➢ Use a tip.

Make sure that the selected tip is completely screwed in and does not have any backlash.

The tip is used to establish contact with the load. On delivery, the tip is **not** preassembled.

The scope of delivery includes a tip with flat and hemispherical contact surfaces. An M6 inner thread is provided for mounting the tip in the pusher.

### Requirements

- ✓ You have read and understood the general notes on installation (p. 13).
- ✓ The pusher has been moved out so that you can easily reach the tip.
  In the delivery state, the pusher is moved out.

### Tools and accessories

- Supplied tip
- Optional:
  - Open-end wrench AF 7
  - Open-end wrench AF 8

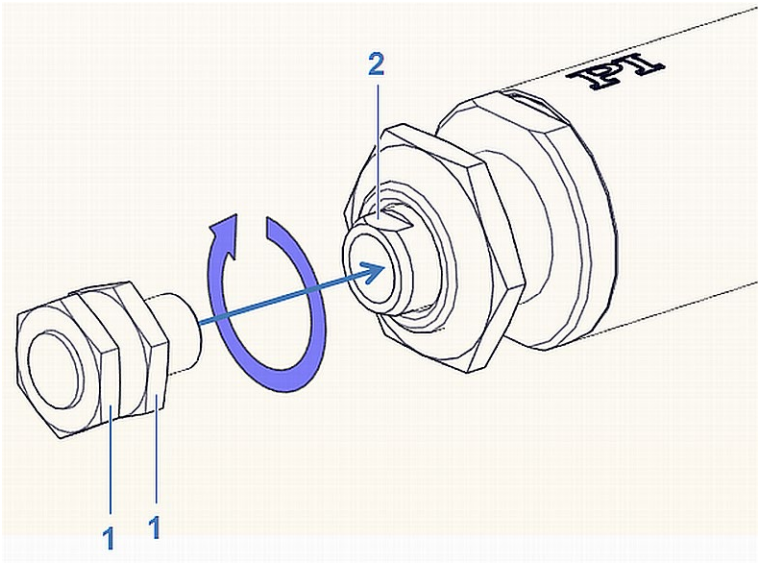



Figure 5: Mounting the tip, schematic

1 Wrench flat of the tip
2 Wrench flat of the linear actuator

### Mounting a tip

1. Screw the selected tip by hand into the inner thread of the pusher (see figure above).
2. If necessary: Tighten the tip further with a tightening torque of max. 2 Nm:
   a) Position an AF 7 open-end wrench on the wrench flat of the linear actuator.
   a) Position an AF 8 open-end wrench on the wrench flats of the tip.
   b) Screw the tip further into the pusher with the AF 8 open-end wrench.
3. Make sure that the tip is affixed firmly.

## 5.5 Changing the Tip

**NOTICE**

**Damage of the mechanics from torques at the tip**

➢ Avoid generation of torques when mounting or changing the tip.

### Requirements

✓ You have read and understood the general notes on installation (p. 13).

✓ You have made the L-220 accessible for changing the tip.

✓ The pusher has been moved out so that you can easily reach the tip.
In the delivery state, the pusher is moved out.

### Tools and accessories

- Supplied tip
- Open-end wrench AF 7
- Open-end wrench AF 8

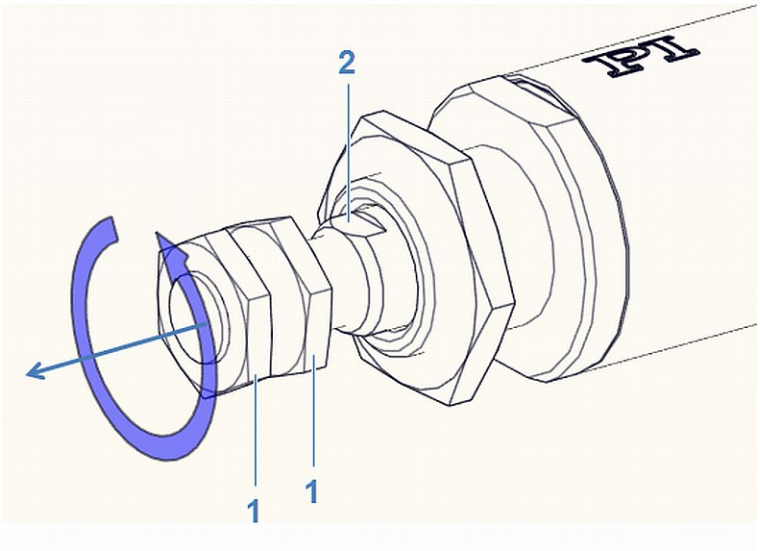



Figure 6: Removing the tip

1 Wrench flat of the tip
2 Wrench flat of the linear actuator

### Removing and changing the tip

1. Position an AF 7 open-end wrench on the wrench flat of the linear actuator.
2. Position an AF 8 open-end wrench on the wrench flats of the tightened tip.

3. Screw the tip out of pusher with the AF 8 open-end wrench.
4. Mounting the selected tip (p. 16).

# 6 Start-Up

## 6.1 General Notes on Start-Up

***CAUTION***

**Unintentional motion of the linear actuator while connecting it to the controller!**

- ➢ Do not place any objects in areas where they can be caught by moving parts.
- ➢ Keep your fingers at a safe distance from the motion range of the linear actuator.

***NOTICE***

**Damage if a wrong motor controller is connected!**

Connecting a linear actuator to an unsuitable controller can cause damage to the linear actuator or controller.

- ➢ Connect a linear actuator with DC motor to a DC motor controller only.
- ➢ Connect a linear actuator with stepper motor to a stepper motor controller only.

***NOTICE***

**Damage due to the pusher crashing into the hard stop!**

When the limit switches are deactivated, the motion of the pusher is aborted by the hard stop and the L-220 can be damaged.

- ➢ Do **not** deactivate the limit switches in the software.
- ➢ Test limit switch operation at low velocities only.

***NOTICE***

**Damage or considerable wear due to high accelerations!**

High accelerations can cause damage to or considerable wear on the mechanical system.

- ➢ Stop the motion immediately if a controller malfunction occurs.
- ➢ Ensure that the end of the travel range is approached at low velocity.
- ➢ Set the control signal so that the moving part does not stop abruptly or try to continue motion at the end of the travel range.
- ➢ Determine the maximum velocity for your application.

**INFORMATION**

The maximum velocity for a linear actuator with a stepper motor should be determined in the application. If the commanded velocity is too high, the stepper motor might stop without the controller detecting this state.

**INFORMATION**

For models with DC motors:

Improper setting of the servo-control parameters can impair the performance of the L-220. This can have the following consequences:

- Oscillation
- Imprecise approach of the position
- Settling time is too long

➢ If the performance of the L-220 is not satisfactory, check the settings for the servo-control parameters of your controller.

**INFORMATION**

Moving the pusher outwards corresponds to the positive direction of motion.

## 6.2 Starting up the Linear Actuator

**NOTICE**

**Damage if an incorrect controller or motor cable is connected!**

Connecting a stage to an unsuitable controller or using an unsuitable motor cable can cause damage to the stage or controller.

➢ Only connect a stage to a suitable controller.

➢ To connect the stage to the controller, only use a motor cable that is suitable for the controller.

**Requirements**

✓ You have read and understood the general notes on installation (p. 13).

✓ You have installed the controller.

✓ You have read and understood the user manual of the controller.

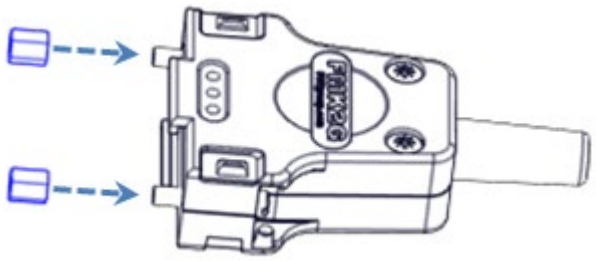
✓ The controller is switched off.

### Tools and accessories

- Cable from the scope of delivery of the stage (p. 8)
- Suitable tools for tightening the screws to the connections

### Connecting the L-220 to a controller

1. Remove the ESD protection from the motor connection of the L-220.
2. Connect the L-220, cable, and controller with each other as shown in the corresponding connection diagram (see above).
   For connecting an extension cable, it might be required to affix the provided UNC bolts to the corresponding connector; using a hex key AF 5mm or a compliant tool (see schematic illustration below). Note that the tightening torque must **not** exceed **2.5 Nm**.



3. Use the integrated screws to secure the connections against accidental disconnection.

## 6.2.1 L-220 Entries in the Positioner Database of PI

For PI controllers, you can select the connected linear actuator from a positioner database in the corresponding PC software. The appropriate operating parameters are thus loaded to the controller. You can find a detailed description in the user manual for the controller or in the manual for the PC software used.

# 7 Maintenance

**NOTICE**

**Damage due to improper maintenance!**

The L-220 can become misaligned as a result of improper maintenance.

- Do not loosen any sealed screws.

## 7.1 Performing a Maintenance Run

Depending on the operating conditions and the period of use of the L-220, the following maintenance measures are required:

### Maintenance run

The maintenance run serves to distribute the existing lubricant.

- After 500 operating hours or at least after 1 year, perform a maintenance run over the entire travel range, in order for the lubricant present to be equally distributed.
- If you operate your stage continuously over only a short travel range (<20%of the entire travel range), perform a run across the entire travel range approximately every 2000 motion cycles.

### Lubrication

Under laboratory conditions, the stage needs extra lubrication in exceptional cases only. For continuous industrial use, the lubrication intervals must be defined individually.

- If you have any questions, contact our customer service department (p. 29).

## 7.2 Cleaning the L-220

### Requirements

- ✓ You have disconnected the linear actuator from the controller.

### Cleaning the linear actuator

- If necessary, clean the surfaces of the linear actuator with a cloth that is dampened with a mild cleanser or disinfectant.

# 8 Troubleshooting

| Problem | Possible causes | Solution |
|---|---|---|
| Reduced positioning accuracy | Mounting nut is fastened too tight | ➢ Tighten the mounting nut to a maximum torque 10 Nm. |
| Functional impairment after system modification | ▪ Motor controller has been replaced<br>▪ L-220 was replaced by another model. | Motor controller from PI:<br>➢ Load the parameters from the stage database that correspond to the combination of motor controller and L-220 model.<br>Motor controller from a third-party supplier:<br>➢ Check the operating parameters. |
| The mechanics do not move. | Cable not connected correctly or defective | ➢ Check the connecting cable. |
| | Lateral forces are affecting the pusher | Lateral forces increase the friction on the internal drive components.<br>➢ Avoid lateral forces on the tip and on the pusher of the L-220. |
| The mechanics do not move, but generate operating noise. | Values for the velocity, acceleration and/or load are too high | ➢ Reduce the velocity.<br>➢ Reduce the acceleration.<br>➢ Reduce the load on the mechanical system. |
| The mechanical system did not stop in time and ran into the limit stop | ▪ Velocity is too high (see chapter Limit Switches p. 9)<br>▪ Limit switch is defective<br>▪ Motor controller ignores the limit switch signal | 1. Stop the motor.<br>2. Command the mechanical system away from the hard stop.<br>3. Check the settings of the motor controller for the limit switch processing. |
| For L-220.x0SD models: Actual position deviates from the displayed position. | The motor is overloaded by an external load torque or the mass to be driven in the case of strong acceleration or deceleration. | The motor skips steps. The information on the current position is lost without the controller detecting the state.<br>➢ Determine the maximum velocity for a stage with a stepper motor in the application.<br>➢ Start a new reference move. |

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 29).

# 9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (mailto:info@pi.de).

- If you have questions concerning your system, have the following information ready:
  - Product and serial numbers of all products in the system
  - Firmware version of the controller (if present)
  - Version of the driver or the software (if present)
  - Operating system on the PC (if present)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The latest versions of the user manuals are available on our website for download.

# 10 Technical Data

## 10.1 Specifications

Subject to change. You can find the latest product specifications on the product web page at www.pi.ws.

### 10.1.1 Data Table

| Motion | L-220.x0DG | L-220.x0SG | Unit | Tolerance |
|---|---|---|---|---|
| Active axes | X | X | | |
| Travel range in X | L-220.10DG: 13<br>L-220.20DG: 26<br>L-220.50DG: 52<br>L-220.70DG: 77 | L-220.10SG: 13<br>L-220.20SG: 26<br>L-220.50SG: 52<br>L-220.70SG: 77 | mm | |
| Maximum velocity in X, unloaded | 3.5 | 0.8 | mm/s | Typ. |

| Positioning | L-220.x0DG | L-220.x0SG | Unit | Tolerance |
|---|---|---|---|---|
| Unidirectional repeatability in X | 0.5 | 0.5 | µm | Typ. |
| Bidirectional repeatability in X | ±1 | ±1 | µm | Typ. |
| Minimum incremental motion in X | 0.1 | 0.1 | µm | Typ. |
| Reference switch | Hall effect, N/C contact, 5 V, NPN | Hall effect, N/C contact, 5 V, NPN | | |
| Limit switches | Hall effect, N/C contact, 5 V, NPN | Hall effect, N/C contact, 5 V, NPN | | |
| Motor encoder | Incremental rotary encoder | – | | |
| Resolution, motor encoder | 512 | – | Cts./rev. | |
| Motor encoder: Sensor signal | A/B quadrature, RS-422 | – | | |

| Drive Properties | L-220.x0DG | L-220.x0SG | Unit | Tolerance |
|---|---|---|---|---|
| Drive type | DC gear motor | 2-phase stepper motor with gearhead | | |
| Maximum power consumption | 4 | – | W | |
| Motor resolution | – | 24 | Full steps/ rev. | |
| Nominal voltage | 12 | 3,5 | V | |
| Nominal current, RMS | 0.28 | 0.25 | A | Typ. |
| Peak current, RMS | 0.56 | – | A | Typ. |
| Drive force in negative direction of motion in X | 125 | 125 | N | Typ. |
| Drive force in positive direction of motion in X | 125 | 125 | N | Typ. |
| Torque constant | 0.0115 | – | N·m/A | Typ. |
| Resistance phase-phase | 19.8 | 12.5 | Ω | Typ. |
| Inductance phase-phase | 0.42 | 6.3 | mH | |
| Back EMF, phase-phase, rotational | 1.21 | 11 | V/kRPM | Max. |
| Number of pole pairs | 1 | – | | |

| Mechanical Properties | L-220.x0DG | L-220.x0SG | Unit | Tolerance |
|---|---|---|---|---|
| Drive screw type | Ball screw | Ball screw | | |
| Drive screw pitch | 1 | 1 | mm | |
| Gear ratio i | 12493 : 567 | 387283 : 5103 | | |
| Holding force in X, passive | – | 125 | N | Typ. |
| Moved mass in X, unloaded | L-220.10DG: 20<br>L-220.20DG: 20<br>L-220.50DG: 25<br>L-220.70DG: 30 | L-220.10SG: 20<br>L-220.20SG: 20<br>L-220.50SG: 25<br>L-220.70SG: 30 | g | |
| Permissible push force in Y | 1 | 1 | N | Max. |
| Overall mass | L-220.10DG: 210<br>L-220.20DG: 230<br>L-220.50DG: 260<br>L-220.70DG: 290 | L-220.10SG: 230<br>L-220.20SG: 250<br>L-220.50SG: 280<br>L-220.70SG: 320 | g | |
| Material | Stainless steel, bronze | Stainless steel, bronze | | |

| Miscellaneous | L-220.x0DG | L-220.x0SG | Unit | Tolerance |
|---|---|---|---|---|
| Connector | HD-D-Sub 26-pin (m) | HD-D-Sub 26-pin (m) | | |
| Recommended controllers/drivers | C-863<br>C-885 with C-863.20C885<br>C-884<br>ACS modular controller | C-663.12<br>C-885 with C-663.12C885<br>ACS modular controller | | |
| Cable length | 0.5 | 0.5 | m | |
| Operating temperature range | 5 to 40 | 5 to 40 | °C | |

### 10.1.2 Maximum Ratings

L-220 stages are designed for the following operating data:

| Device | Maximum operating voltage | Operating frequency | Maximum power consumption |
|---|---|---|---|
| L-220.0DG | 12 V | - | 4 W |
| L-220.0SG | 48 V | - | - |

### 10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the L-220:

| | |
|---|---|
| Area of application | For indoor use only |
| Maximum altitude | 2000 m |
| Relative humidity | Max. 80 % for temperatures up to 31 °C<br>Linearly decreasing to 50 % at 40 °C |
| Storage temperature | -25 °C to 85 °C |
| Transport temperature | -25 °C to 85 °C |
| Supply fluctuations | Max. ±10 % of the nominal voltage |
| Degree of pollution | 2 |
| Degree of protection according to IEC 60529 | IP040 |

### 10.1.4 Limit Switch Specifications

| | |
|---|---|
| Type | Magnetic (Hall effect) sensor |
| Supply voltage | +5 V / ground |
| Signal output | Open collector (wiring 5 V to 24 V / max. 50 mA) |
| Signal logic | The signal level changes when passing the limit switch. The signal logic is active high. That means:<br>▪ Proper operation of the motor: Collector switches through.<br>▪ Limit switch reached: Collector blocks |

### 10.1.5 Reference Switch Specifications

| | |
|---|---|
| Type | Magnetic (Hall effect) sensor |
| Supply voltage | +5 V / GND |
| Signal output | Open collector (wiring 5 V to 24 V / max. 50 mA) |
| Signal logic | Blocking or switching through of the collector after passing the reference switch, depending on the direction. |

## 10.2 Dimensions

### 10.2.1 L-220

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

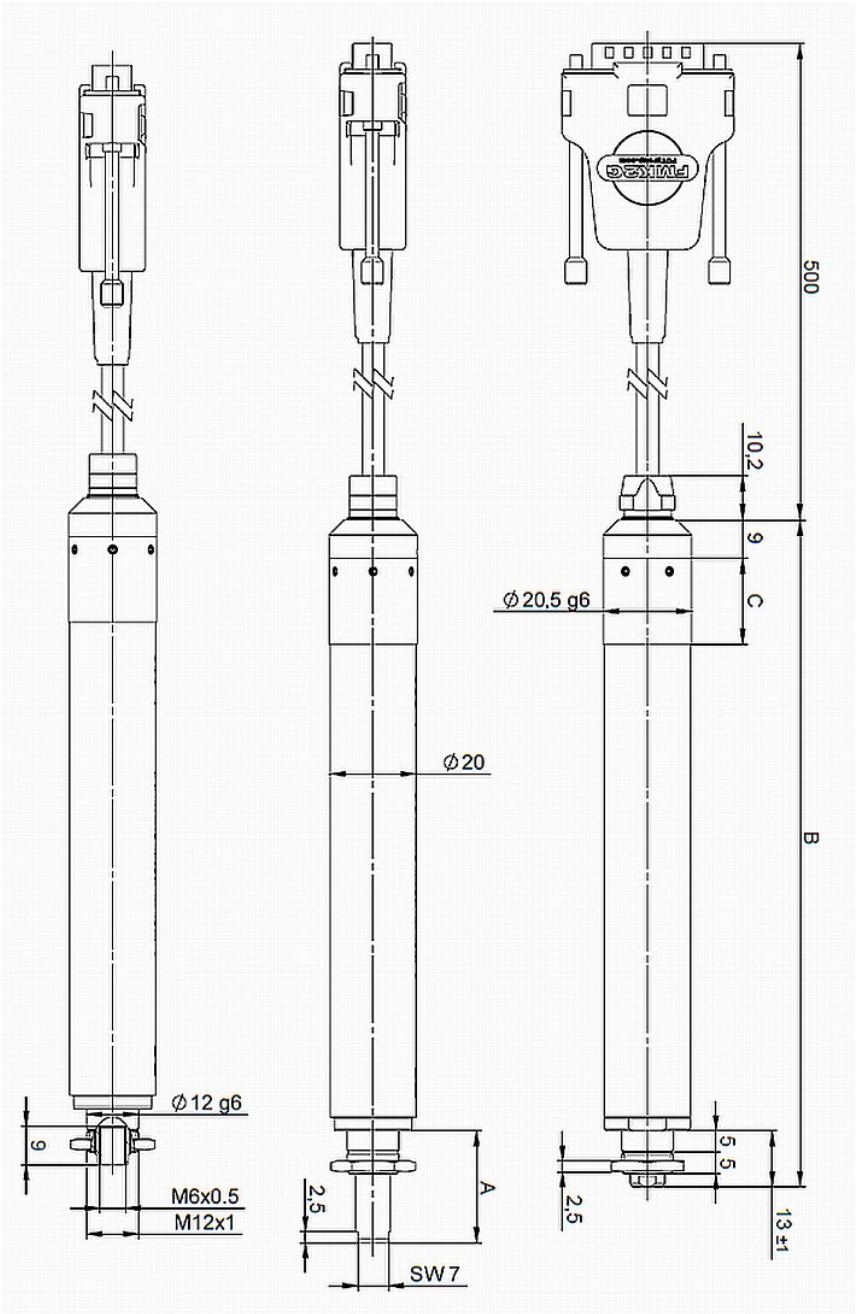



Figure 7: Dimensions of the L-220

| | Travel range | A | B | C |
|---|---|---|---|---|
| L-220.10SG | 13 | 26 | 148.3 | 13 |
| L-220.10DG | 13 | 26 | 155.2 | 19.9 |
| L-220.20SG | 26 | 39 | 161.5 | 13 |
| L-220.20DG | 26 | 39 | 168.4 | 19.9 |
| L-220.50SG | 52 | 65 | 186.6 | 13 |
| L-220.50DG | 52 | 65 | 193.5 | 19.9 |
| L-220.70SG | 77 | 90 | 211.6 | 13 |
| L-220.70DG | 77 | 90 | 218.5 | 19.9 |

## 10.2.2 Tips

### Flat tip

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

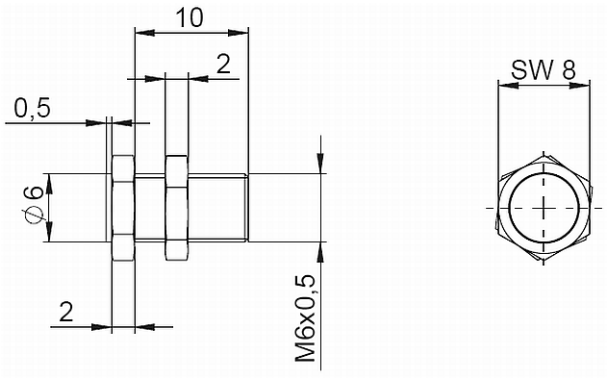



Figure 8: Dimensions of the flat tip

### Round tip

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

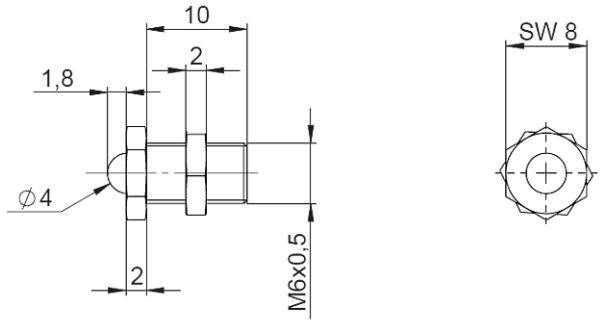



Figure 9: Dimensions of the round tip

## 10.3 Pin Assignment

### 10.3.1 HD D-Sub 26 (m)

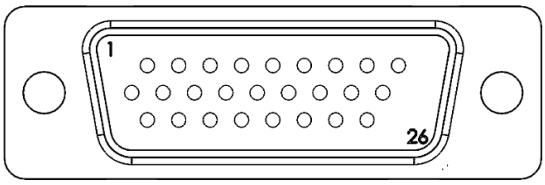



Figure 10: HD D-Sub 26 (m)

**Pin assignment for the L-220.x0SG models**

| Pin | Signal | Direction |
|---|---|---|
| 1 | Motor A+ | Input |
| 2 | Motor A+ | Input |
| 3 | Motor A- | Input |
| 4 | Motor A- | Input |
| 5 | Motor B+ | Input |
| 6 | Motor B+ | Input |
| 7 | Motor B- | Input |
| 8 | Motor B- | Input |
| 9 | - | - |
| 10 | REF | Output |
| 11 | Limit E1 (neg) | Output |
| 12 | Limit E2 (pos) | Output |
| 13 | - | - |
| 14 | - | - |
| 15 | - | - |
| 16 | - | - |
| 17 | ID I/O | Bidirectional |
| 18 | Limit Power (+5 V) | Input |
| 19 | - | - |
| 20 | - | - |
| 21 | - | - |

| Pin | Signal | Direction |
|---|---|---|
| 22 | - | - |
| 23 | - | - |
| 24 | - | - |
| 25 | GND (limit) | GND |
| 26 | - | - |

### Pin assignment for the L-220.x0DG models

| Pin | Signal | Direction |
|---|---|---|
| 1 | Motor + | Input |
| 2 | Motor + | Input |
| 3 | Motor - | Input |
| 4 | Motor - | Input |
| 5 | - | - |
| 6 | - | - |
| 7 | - | - |
| 8 | - | - |
| 9 | - | - |
| 10 | REF | Output |
| 11 | Limit E1 (neg) | Output |
| 12 | Limit E2 (pos) | Output |
| 13 | - | - |
| 14 | - | - |
| 15 | - | - |
| 16 | - | - |
| 17 | ID I/O | Bidirectional |
| 18 | Limit Power (+5 V) | Input |
| 19 | Encoder A+ | Output |
| 20 | Encoder A- | Output |
| 21 | Encoder B+ | Output |
| 22 | Encoder B- | Output |
| 23 | - | - |

| Pin | Signal | Direction |
|---|---|---|
| 24 | - | - |
| 25 | GND (limit, encoder) | GND |
| 26 | Encoder power (+5 V) | Input |

## 10.4 Tightening Torque for Screws, ISO 4762 - A2

The following tightening torques for screws according to ISO4762 (corresponds to DIN 912) - A2 may not be exceeded.

| Value | Maximum tightening torque |
|---|---|
| M3 | 1.5 Nm |
| M4 | 2 Nm |
| M5 | 2.5 Nm |
| M6 | 3 Nm |

# 11 Old Equipment Disposal

Within the EU, electrical and electronic equipment must not be disposed of with the municipal residual waste.

Dispose of your old equipment according to the local regulations or return it free of charge to the following address:

PI miCos GmbH

Freiburger Strasse 30

79427 Eschbach, Germany

# 12 European Declarations of Conformity

For the L-220, declarations of conformity were issued according to the following European statutory requirements:

- EMC Directive
- RoHS Directive

The standards applied for certifying conformity are listed below.

- EMC: EN 61326-1
- Safety: EN 61010-1
- RoHS: EN IEC 63000