Handling of Piezo Actuators

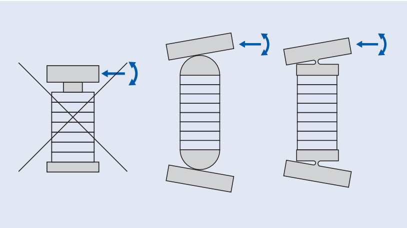

Fig. 52: Avoiding lateral forces and torques

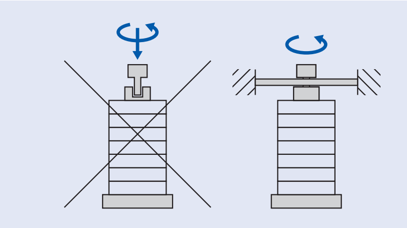

Fig. 53: Prevention of torques

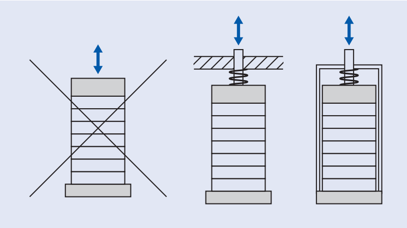

Fig. 54: Avoiding tensile stresses by means of a mechanical preload

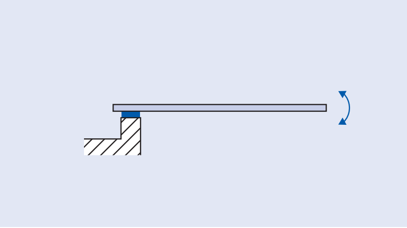

Fig. 55: Mounting of a one-sidedly clamped bending actuator by gluing

Piezo actuators are subject to high mechanical and electrical loads. Moreover, the brittle ceramic or crystalline materials require careful handling.

- Avoid mechanical shocks to the actuator, which can occur if you drop the actuator, for example.
- Do not use metal tools during installation.
- Avoid scratching the ceramic or polymer coating and the end surfaces during installation and use.
- Prevent the ceramic or polymer insulation from coming into contact with conductive liquids (such as sweat) or metal dust.
- If the actuator is operated in a vacuum: Observe the information on the permissible piezo voltages for specific pressure ranges (p. 150).
- If the actuator could come into contact with insulating liquids such as silicone or hydraulic oils: Contact info@piceramic.com.
- If the actuator has accidently become dirty, carefully clean the actuator with isopropanol or ethanol. Next, completely dry it in a drying cabinet. Never use acetone for cleaning. When cleaning in an ultrasonic bath, reduce the energy input to the necessary minimum.
- Recommendation: Wear gloves and protective glasses during installation and start-up.

DuraAct patch actuators and encapsulated PICMA® piezo actuators have a particularly robust construction. They are partially exempt from this general handling information.

Mechanical Installation (fig. 52, 53, 54)

- Avoid torques and lateral forces when mounting and operating the actuator by using suitable structures or guides.
- When the actuator is operated dynamically: Install the actuator so that the center of mass of the moving system coincides with the actuator axis, and use a guiding for very large masses.
- Establish contact over as large an area as possible on the end surfaces of a stack actuator.
- Select opposing surfaces with an evenness of only a few micrometers.

Gluing

- If the mounting surface is not even, use epoxy resin glue for gluing the actuators. Cold-hardening, two-component adhesives are well suited for reducing thermo-mechanical stresses.
- Maintain the operating temperature range specified for the actuator during hardening and observe the temperature expansion coefficients of the involved materials.

Uneven mounting surfaces are found, for example, with PICMA® Bender and PICMA® Chip actuators, since these surfaces are not ground after sintering (fig. 55).

Applying a Preload (fig. 54)

- Create the preload either externally in the mechanical structure or internally in a case.
- Apply the preload near the axis within the core cross-section of the actuator.
- If the actuator is dynamically operated and the preload is created with a spring: Use a spring whose total stiffness is approximately one order of magnitude less than that of the actuator.

Introducing the Load Evenly (fig. 56)

The parallelism tolerances of the mechanical system and the actuator result in an irregular load distribution. Here, compressive stresses may cause tensile stresses in the actuator. Regarding the even application of a load, there are diverse design solutions that differ from each other in axial stiffness, separability of the connection and rotatability in operation, e.g. in the case of lever amplification.

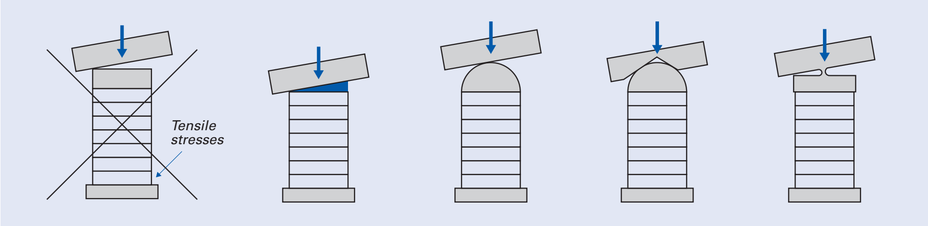

Fig. 56: Avoiding an irregular load application

- Gluing the actuator (cf. gluing section)
- Hardened spherical end piece with point contact to even opposing surface
- Hardened spherical end piece with ring contact to a spherical cap
- Connection via a flexure joint
- If the actuator is coupled in a milling pocket, make sure that there is full-area contact on the end surface of the actuator. For this purpose, select the dimensions of the milling pocket correspondingly or make free cuts in the milling pocket (fig. 57).
- If a point load is applied to the end piece of the actuator: Dimension the end piece so that its thickness corresponds to half the cross-sectional dimension in order to prevent tensile stresses on the actuator (fig. 58).

Electrical Connection (fig. 59)

From an electrical point of view, piezo actuators are capacitors that can store a great amount of energy. Their high internal resistances lead to very slow discharges with time constants in the range of hours. Mechanical or thermal loads electrically charge the actuator.

- Connect the case or the surrounding mechanics to a protective earth conductor in accordance with the standards.
- Electrically insulate the actuator against the peripheral mechanics. At the same time, observe the legal regulations for the respective application.
- Observe the polarity of the actuator for connection.
- Only mount the actuator when it is short-circuited.
- When the actuator is charged: Discharge the actuator in a controlled manner with a 10 kΩ resistance. Avoid directly short-circuiting the terminals of the actuator.
- Do not pull out the connecting cable of the amplifier when voltage is present. The mechanical impulse triggered by this could damage the actuator.

Safe Operation

- Reduce the DC voltage as far as possible during actuator operation (p. 151). You can decrease offset voltages with semi-bipolar operation.
- Always power off the actuator when it is not needed.
- Avoid steep rising edges in the piezo voltage, since they can trigger strong dynamic forces when the actuator does not have a preload. Steep rising edges can occur, for example, when digital wave generators are switched on.

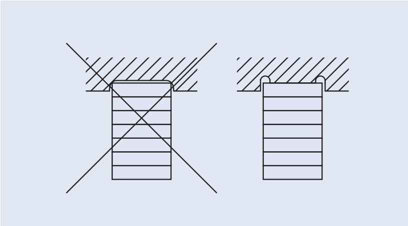

Fig. 57: Full-area contact of the actuator

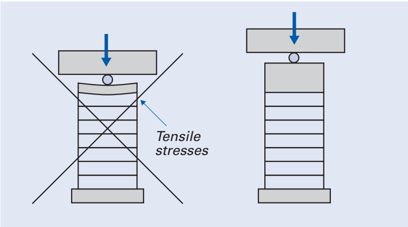

Fig. 58: Proper dimensioning of the end pieces in the case of point contact

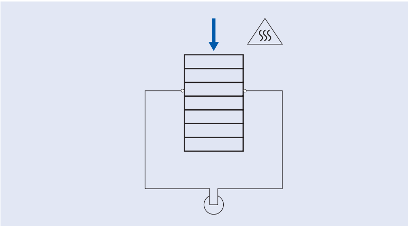

Fig. 59: Mechanical loads electrically charge the actuator. Mounting only when short-circuited