PI Ceramic

PT120-PT140 Piezoceramic Tubes

>> Click http://www.pi.ws/fwd/Piezo-Actuator for the Latest Specs on these Products

Selection of PT piezoceramic tubes.

- **Standard & Custom Sizes**
- **For OEM Applications**
- **XYZ- Positioning**
- **Sub-Nanometer Resolution**

PT series piezoceramic tubes are used in a wide range of applications from microdispensing to scanning microscopy. These monolithic components contract laterally (radially) and longitudinally when a voltage is applied between their inner and outer electrodes. Multi-electrode tubes are available to provide XYZ motion for use in manipulation and scanning microscopy applications (PI also provides ultra-high linearity closed-loop scanning stages for SPM and nanomanipulation).

Precision and Flexibility: PI Ceramic's Strength

PT piezo tubes are manufactured to the tightest tolerances. We can provide tubes with diameters as small as 0.8 mm and tolerances as tight as 0.025 mm.

All manufacturing processes at PI Ceramic are set-up for maximum flexibility. Should our standard actuators not fit your application, let us provide you with a custom design. Our engineers will work with you to find the optimum solution for your application, at a very attractive price, even for small quantities. Some of our custom capabilities are listed below:

- Custom Materials
- Custom Voltage Ranges
- Custom Geometries
- Custom Displacement
- Extra-Tight Tolerances
- Applied Sensors
- Special High / Low Temperature Versions
- Ultra-High Vacuum Versions

Short Leadtime for Standard & Custom Designs

Because all piezoelectric materials used in PT tube actuators are manufactured at PI Ceramic, leadtimes are short and quality is outstanding. All standard and custom actuators are delivered with performance test sheets.

Amplifiers, Drivers & Controllers

PI offers a wide range of control electronics for piezo actuators (see page 28 and www.pi.ws) from low power drivers to multi-channel, closed-loop, digital controllers.

Application Examples

- Micropositioning
- Scanning Microscopy (STM, AFM, etc.)
- Fiber Stretching / Modulation of Optical Path Length
- Micro Pumps / Ink-Jet Printing
- Micromanipulators
- Ultrasonic and Sonar Applications

Technical Data / Ordering Numbers

Ordering Number	Dimensions L x OD x ID**	Max. Operating Voltage [V]	Electrical Capacitance [nF ±20%]	Axial Contraction µm @ max. V	Radial Contraction µm @ max. V	XY Deflection [µm]
PT120.00	20 x 2.2 x 1.0	500	3	4		n/a
PT130.00	30 x 3.2 x 2.2	500	10	8	0.5	n/a
PT130.90	30 x 3.2 x 2.2	500	12	8	0.6	n/a
PT130.94*	30 x 3.2 x 2.2	±200	4 x 2.4	8	0.6	±6
PT130.10	30 x 6.35 x 5.35	500	18	6	1.0	n/a
PT130.14*	30 x 6.35 x 5.35	±200	4 x 3.8	6	1.0	±8
PT130.20	30 x 10.0 x 9.0	500	36	8	4	n/a
PT130.24*	30 x 10.0 x 9.0	±200	4 x 8.5	8	4	±14
PT130.30	30 x 10.0 x 8.0	1000	18	8	3	n/a
PT130.40	30 x 20.0 x 18.0	1000	35	8	5	n/a
PT140.70	40 x 40.0 x 38.0	1000	70	15	10	n/a

All models available with 40 mm length.

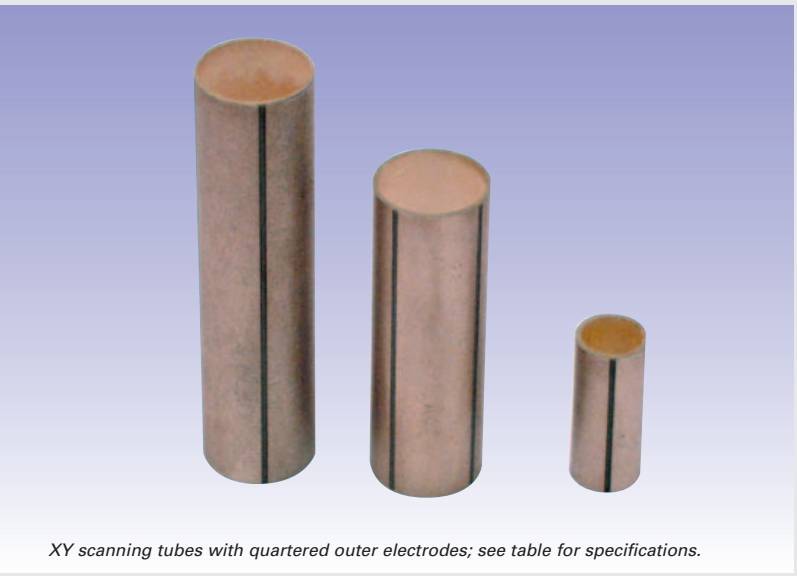
** Quartered electrodes for XY deflection*

All standard PT Tubes are made of PIC151 PZT material (see page 40).

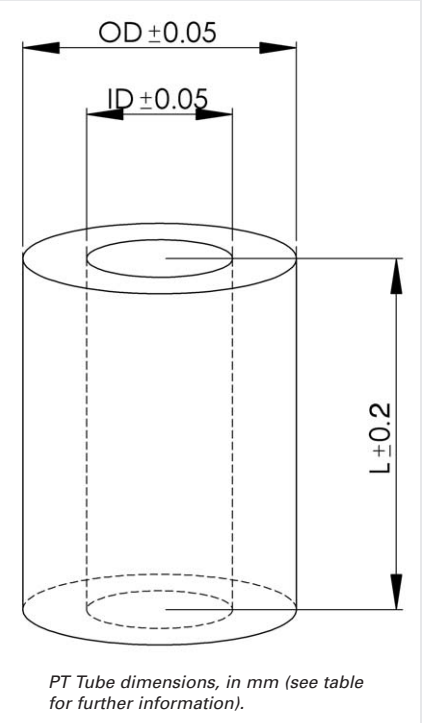
*** OD, ID ±0.05 mm all models except PT120 / PT 130.00 (±0.1 mm)*

Other specifications on request.

Specifications subject to change without notice.



XY scanning tubes with quartered outer electrodes; see table for specifications.



PT Tube dimensions, in mm (see table for further information).

Design

Dimensions: max. L: 50 mm
max. OD: 80 mm
min. wall thickness: 0.30 mm

Electrodes: fired silver-plated inside and outside as standard thin film electrodes (e.g. copper-nickel or gold) as outer electrodes

Options: single or double wrapped, circumferential bands axial segmenting (quartered outer electrodes)

Polarization: inner electrode, positive potential

Useful Equations

Axial contraction and radial displacement of piezo tube actuators can be estimated by the following equations:

(Equation 1)

$$\Delta L \approx d_{31} \cdot L \cdot \frac{U}{d}$$

where:

d_{31} = *strain coefficient (displacement normal to polarization direction) [m/V]*

L = *length of the PZT ceramic tube [m]*

U = *operating voltage [V]*

d = *wall thickness [m]*

(Equation 2)

$$\Delta d \approx d_{33} \cdot U$$

where:

Δd = *change in wall thickness [m]*

d_{33} = *strain coefficient (field and displacement in polarization direction) [m/V]*

U = *operating voltage [V]*

The radial contraction is the superposition of the increase in wall thickness and the tangential contraction; it can be estimated by the following equation:

$$\frac{\Delta r}{r} \approx d_{31} \frac{U}{d}$$

where:

r = *tube radius*

d_{31} = *strain coefficient (displacement normal to polarization direction) [m/V]*

U = *operating voltage [V]*

d = *wall thickness [m]*

The quartered electrodes option makes XY scanning possible — employing the superposition of the axial and radial contraction, similar to bending devices. These scanner tubes, which flex in X and Y, are widely used in scanning-probe microscopes. The scan range of these components is defined by:

(Equation 3)

$$\Delta x \approx \frac{2\sqrt{2} \cdot d_{31} \cdot L^2 \cdot U}{\pi \cdot ID \cdot d}$$

where:

Δx = *scan range in X and Y (for symmetrical electrodes) [m]*

d_{31} = *strain coefficient (displacement normal to polarization direction) [m/V]*

U = *symmetric operating voltage [V]*

L = *length [m]*

ID = *inner diameter [m]*

d = *wall thickness [m]*

Tube actuators are not designed to withstand large forces (see PICA-Tube actuators), but their high resonant frequencies make them especially suitable for dynamic operation.
PT Tubes are also used as transducers in ultrasonic and sonar applications.