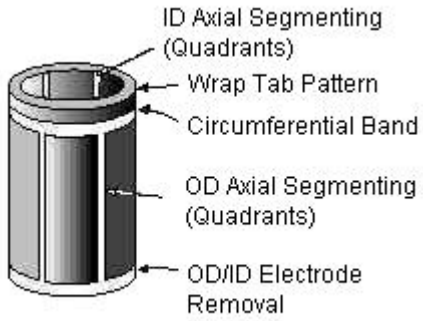
Piezo Ceramic Tubes

Boston Piezo-Optics manufactures piezoceramic tubes from select, void free, high quality, homogeneous PZT billet material. Our exclusive machining process insures meeting and exceeding the most stringent mechanical and acoustic specifications.

Boston Piezo-Optics offers a full line of electroless process coatings. Thin film electroless nickel, copper and gold add durability, solderability, low mass and excellent conductivity. Copper electrodes have the added benefit of being a non-magnetic thin-film surface.

Custom Electrode Options

◇ Single or double wrap tab pattern
◇ OD and ID circumferential bands
◇ Axial segmenting of OD and ID (Angular spacing and width of segments can be specified)
◇ Custom electrode removal on OD and ID
◇ Leadwire attachment
◇ Electrode removal of OD and ID at tube ends



The field of fiber-optics research has benefited from the uniform radial expansion of the tube OD, to stretch optical fibers for enhanced signal tuning. Tube sizes can be custom fabricated to maximize radial expansion for this fiber optic application.

Piezoceramic tubes are recommended for applications where acoustic directivity, simplicity, or size constraints are the primary design concerns. Boston Piezo-Optics manufactures high precision tube crystals from lead zirconate titanate compositions.

Tube applications range from the latest scientific developments of Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM) to medical diagnostics and therapeutics. Other applications include micro positioners and vibration detection, ultrasonic pumps and liquid atomizers, phonograph pickups and hydrophones. Tubes are routinely supplied as transverse rings or longitudinal or radial mode hollow cylinders.

Boston Piezo-Optics's Sonic Mill capabilities are unmatched for the fabrication of piezoceramic tubes. Sonic Milling is much gentler to the walls of the tube which minimizes surface imperfections that could eventually result in cracks or breakage. Sonic milling is ideal for the fabrication of tubes with thinner walls as well as for the fabrication of very small tubes for medical applications. Piezoceramic tubes can be manufactured to internal diameters of less than 1.0 mm and as large as 20 mm using our Sonic mill equipment and expertise.

Electrode choices are electroless nickel, copper and gold. Various electrode patterns are available depending on tube size and application.

General Specifications *(this table is intended only as a general guide)*

Material	Mode of Vibration	Diameter (typical)	Wall Thickness	Length	Electrodes
Lead Zirconate Titanate: PZT-4 PZT-5A* PZT-5H*	Compressional Shear	0.060" 0.100" 0.125" 0.250" 0.375"	0.010" 0.012" 0.015" 0.020" 0.030"	0.125" to 3.000"	Electroless nickel, copper or gold on ID, Electroless nickel, copper or gold, or vacuum deposited chrome/gold or chrome/silver on the OD

PZT-8					

*High Density versions of these materials are available also.

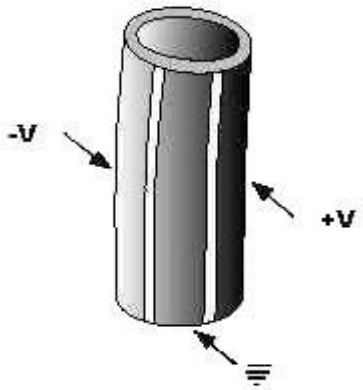
Need to know how much displacement can be achieved by your tube configuration? Try our Static Displacement Calculator to see the theoretical motion, or use the fomulas below:

Scan Range when driving single quadrants:

$$\frac{\sqrt{2}d_{31} V L^2}{\pi D h}$$

V - Drive Voltage
D = Outside Diameter
h = Wall Thickness

Segmented Tube



Scan Range is doubled when equal and opposite drive is applied to two opposing quadrants

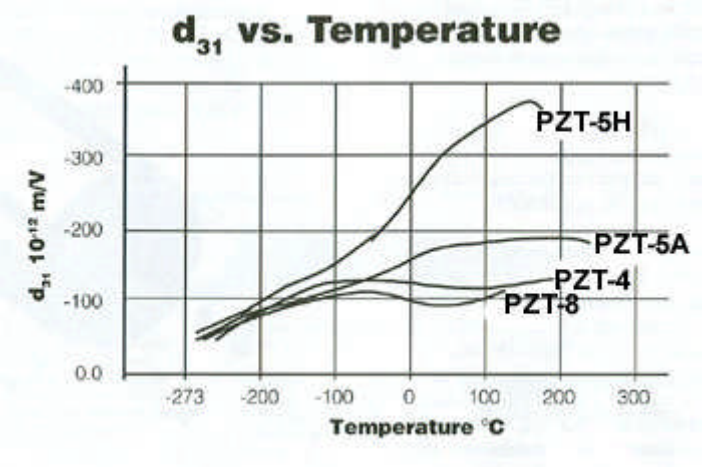
Static Displacement

Length (L)

$$\Delta L = \frac{2d_{31} V L}{(OD - ID)}$$

Radial (r)

$$\Delta r = d_{33} V$$



Questions? *Contact us to discuss your particular application.*

Suggested Reading

1. "Introduction to Scanning Tunneling Microscopy" - C. Julian Chen, Oxford University Press, 1993.

2. Applied Physics Letters, Jan. 6, 1992, pp. 132-134. "Electromechanical Deflections of Piezoelectric Tubes with Quartered Electrodes" - C. Julian Chen

3. Review of Scientific Instruments, Aug. 1986, pp. 1688-1689. "Single-Tube Three Dimensional Scanner for Scanning Tunneling Microscopy" - G. Binning and D.P.E. Smith