

## Piezoelectric Micro-Dispensers



Piezo Technology for Medical Engineering and Industry

# Micro Pumps & Valves

## Precision Dosing of Small Volumes



Variety of piezoactuators and lever-amplified systems

### Miniaturized Technology

Displacement pumps are used worldwide in many diverse branches of industry. Increasing miniaturization means the market for their smaller "relatives" is also growing: Micro-dispensers take on distribution and dosing tasks where small volumes in the milliliter or microliter range have to be controlled

### Wide Range of Applications for Promising Technology

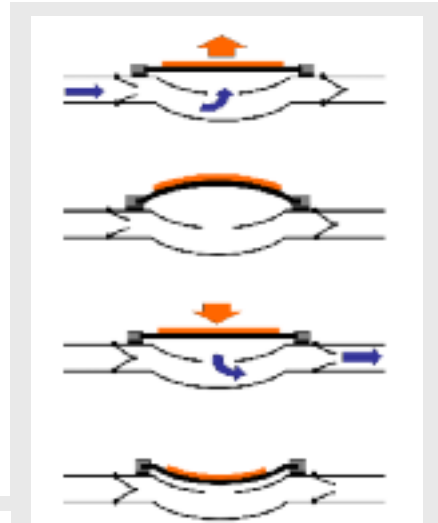
In laboratory and medical engineering, biotechnology or chemical analysis, tiny dispensers accurately dose active substances or medicines. Micropumps take care of the removal of reaction gases in closed processes. Industrial machines benefit from the possibility of using micro-valves to apply lubricants such as oils or grease in a decentralized way at the point where they are required – in an economical, precise and automated way.

### Piezo is the Driving Force

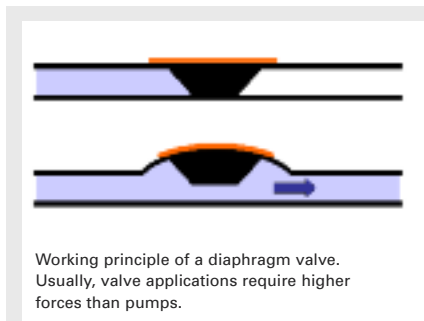
The design is based on the familiar principles of diaphragm pumps and valves and also makes use of the peristaltic principle. The miniaturized drives are based on piezoelectric actuators in various shapes and degrees of integration.

### Adapted for Precision & Force

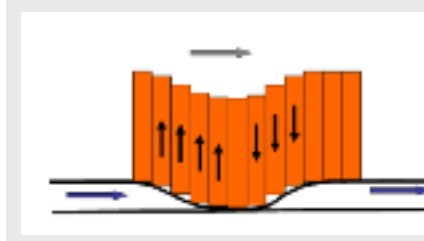
The properties of the pump media – viscosity and drop size, for example – determine the different forces which have to be applied and hence the size of the piezo actuator used. The piezo displacement is a variable parameter which controls the dosing volume. With micropumps, the frequency also determines the flow rate that can be achieved.



Micro-diaphragm pumps operate in a similar way to piston pumps, but the medium to be transported is separated from the drive by a diaphragm. Passive inlet and outlet valves control the pumping direction. Piezo elements in disk form which are mounted directly onto a metal disk make ideal drive systems for micro-diaphragm pumps: This drive solution occupies extremely little space, and the piezo displacement can be very finely adjusted, allowing the pumped volumes to be very precisely defined.

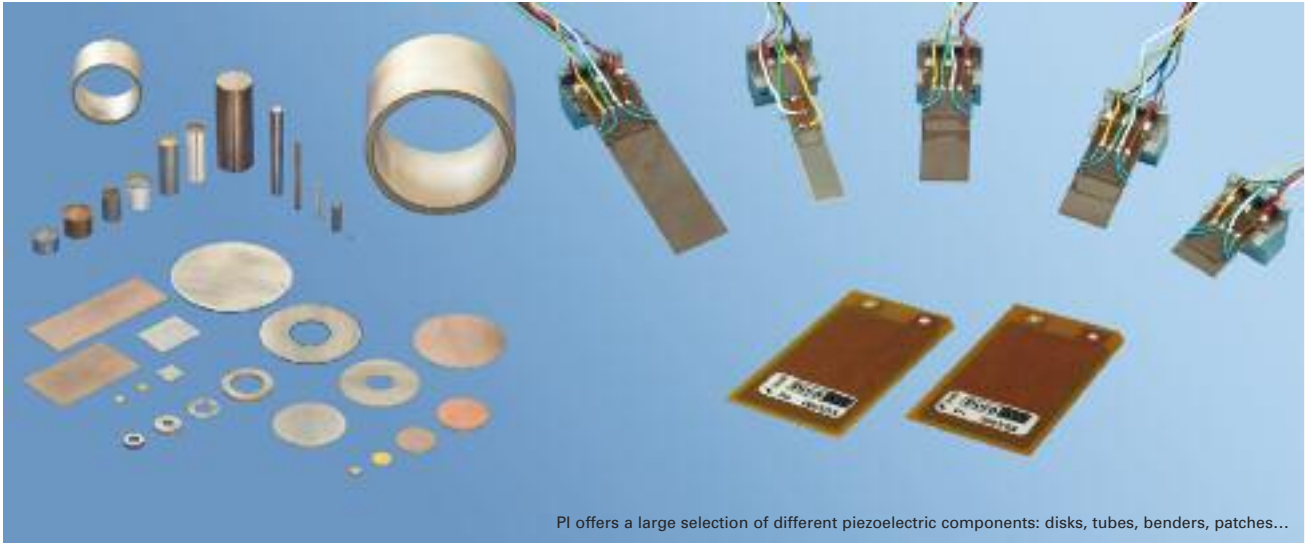


Working principle of a diaphragm valve. Usually, valve applications require higher forces than pumps.



The principle of peristaltic pumping makes directional valves obsolete; the pumping direction in this case is specified by the order in which the individual actuator elements are driven.

## Compact – Fast – High-Dynamics Piezoceramic Elements Drive Micropumps



PI offers a large selection of different piezoelectric components: disks, tubes, benders, patches...

### Reliable and Fast

The special properties of the piezo ceramics permit flexible flow rates of a few tenths of a microliter to several hundred milliliters per minute at pumping frequencies up to the kilohertz range accompanied by high dosing accuracy. The switching times of a few microseconds are significantly faster than those of magnetic designs. The piezo drives have the power and stiffness values required to also work against pressures of up to tens of bars and are thus also suitable for use with more viscous media.

Piezo ceramics are fundamentally very simple to use and integrate; their compact size even makes them suitable for integration into so-called labs-on-a-chip.

### Variable Shapes, Different Forces

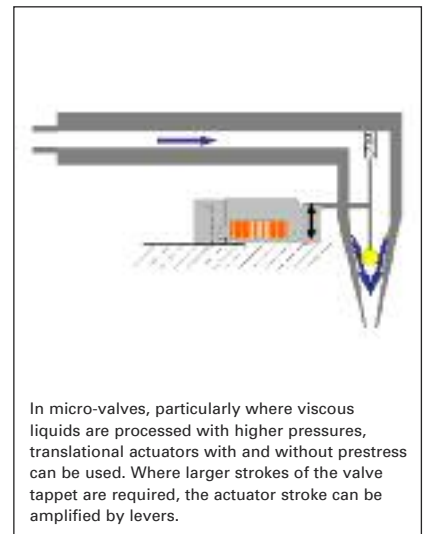
Simple piezo ceramic disks or rings are mounted onto a metal or silicon disk and, as the most compact bender element, thus control the opening or closing of diaphragm pumps or valves.

An alternative is to use piezo bender elements, which PI Ceramic can manufacture in almost all shapes and forms.

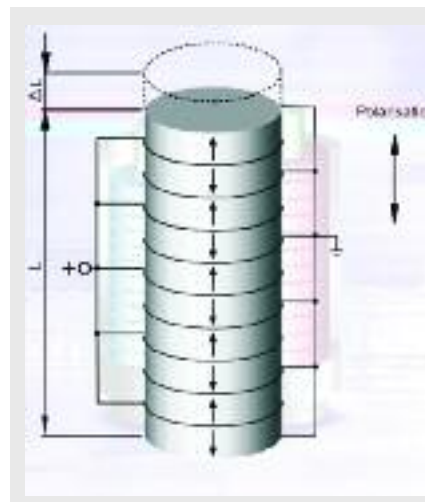
Small piezoelectric tubes have also been used for a long time for the drop-

on-demand method as used in ink-jet-printing, for example. Piezo patches or, for greater forces, piezo stack actuators operate peristaltic pumps.

The corresponding drive electronics are compact and can even be used in portable instruments – for dosing medication, for example.



In micro-valves, particularly where viscous liquids are processed with higher pressures, translational actuators with and without prestress can be used. Where larger strokes of the valve tappet are required, the actuator stroke can be amplified by levers.



### Piezo Actuators: Fast, Reliable and Easy to Integrate

Piezo actuators convert electrical energy directly into mechanical energy and vice versa. Travel ranges of up to one millimeter can typically be achieved with resolutions down to the nanometer range. High dynamics with frequencies of up to several kilohertz are also achievable. The movement is based on crystalline effects and so there are no rotating parts and no friction; piezo actuators are therefore maintenance-free and non-wearing and, because no lubrication is required, they are vacuum compatible. They can move large loads and have a very compact design.

# PI –the Market Leader for Piezo Ceramic Drives

## Competence, Experience, ISO-9001 Quality

PI Head Office in Karlsruhe/Germany



### Competitive Advantage is Down to Exceptional Reliability

Nothing is as certain as the use of tried-and-tested technology. Micro-dosing systems benefit from the use of piezo ceramic drives because they are small, highly dynamic and flexible. Adapted to the application, adjustable dosing rates are reliably achieved with high accuracy – down to the microliter range.

### Secure Your Competitive Edge with the Market Leader

Physik Instrumente was founded in 1969 and specialized in high-precision positioning systems with piezo ceramic drives at a very early stage. Physik Instrumente (PI) is now the market leader for piezo ceramic drive technology, which is used mainly for high-precision positioning tasks such as those found in quality assurance or the semiconductor industry. The latter, in particular, places extremely high demands on reliability: The stoppage of a production unit costs the chip manufacturer hundreds of thousands of dollars and cannot be tolerated.

### Competence in the Piezo Business

In 1992, the subsidiary company PI Ceramic was founded as the development and production facility for piezo drives. PI Ceramic develops and manufactures piezo ceramic materials, which are used in all today's high-tech markets, in industrial automation and semiconductor technology as well as in medical, mechanical and precision engineering, in aviation and aerospace and the auto industry, and the broad field of telecommunications. In addition to the broad spectrum of standard products, a top priority is the fastest possible implementation of custom-engineered solutions.

### Integration Services

PI and PI Ceramic not only manufacture the drives but also integrate them into mechanical motion systems. Moreover, PI also develops the controller and, if applicable, the regulation system to suit the requirements of the complete system.

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