We move your ideas
For more than 40 years we have been developing and producing Piezoceramics and other Piezo products in high volumes for a wide range of applications. Our experience and ability to produce high volumes of bending actuators and systems with Piezoceramics, mechanics and electronics, allow us to offer products of the highest quality combined with competitive prices. Our products are customized and well known for their long lifetime and reliability. We have produced and sold more than 100 million products worldwide.

We are the leading manufacturer of Piezo bending actuators for different applications in a variety of markets.

WWW.PIEZOPRODUCTS.COM
In 1880 Jacques and Pierre Curie discovered that when deformed under mechanical stress, quartz crystals became electrically charged – positively and negatively – on prism-shaped surfaces. They called this reaction the piezoelectric effect. Above a certain temperature (called the Curie temperature) these kinds of materials possess a cubic elementary cell with a centre of symmetry. The main areas of the positive and negative charges are found in the centre of the elementary cell of the crystal. The materials are paraelectric. There is no detectable piezoelectric effect.

Below the Curie temperature, the materials show a spontaneous polarisation. This spontaneous polarisation is caused by the displacement of ions of the elementary cell, resulting in the loss of the centre of symmetry. The main areas of the positive and negative charges are no longer to be found in the centre of the elementary cell of the crystal. The elementary cell possesses an electric dipole. The piezoelectric properties of the ceramics, important for applications, are only produced by this polarisation process. In this case, the ceramics are exposed to a very strong electric field.

**THE PIEZO-EFFECT**

**MOVES YOUR IDEAS**

deformed under mechanical stress, quartz crystals become electrically charged

the same materials undergo dimensional change under the influence of an electric field
### PIEZOELECTRIC PRODUCTS
FOR ACTUATOR AND SENSOR APPLICATIONS

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<th>BENDING ELEMENTS</th>
<th>MODULES AND DEVICES</th>
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<td>Single and multilayer ceramics, such as:</td>
<td>Single layer and multilayer bending actuators for:</td>
<td>Textile machine modules for:</td>
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<td>- Braille equipment</td>
<td>- Jacquard machines</td>
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<td>- Plates</td>
<td>- Textile machines</td>
<td>- Raschel machines</td>
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<td>- Specially shaped parts</td>
<td>- Hard disk drives</td>
<td>- Circular knitting machines</td>
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<td>- Piezoelectric generators</td>
<td>- Household appliances</td>
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<td>- Medical Devices</td>
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<td></td>
<td>Ultrasonic transformers for:</td>
<td>Piezoelectric generators for:</td>
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<td>- Flow measuring</td>
<td>- Energy harvesting applications</td>
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<tr>
<td></td>
<td></td>
<td>- Non-battery operated radio switches</td>
</tr>
</tbody>
</table>

Piezo ceramics in different shapes
BENDING ACTUATORS

customized bending actuators for different applications

MODULES AND DEVICES

all from one source: customized modules and devices with Piezo ceramics as the core technology plus mechanics and electronics

atomizing system for medical devices

atomizing system, e.g. for cooling counters

module for single needle selection in warp knitting machines

module for single needle selection in circular knitting machines

LIQUIFOG® atomizing system, e.g. for cooling counters
The contraction of the ceramic when the operating voltage is applied results in deflection and force on the tip of the bending actuator. Or, if a force is applied to the tip, this generates an electrical charge.

**WORKING PRINCIPLE**

**PIEZO BENDING ACTUATOR**

When two piezoelectric ceramic plates are bonded together with a supporting material and counter-actuated, this results in pronounced deformation of the composite similar to the case of a bimetal. Its design enables deflections of several millimetres and forces up to several Newton and a short cycle time of a few milliseconds can be achieved. Therefore, the Piezo bending actuator can be employed as a high performance and fast-reacting control element. Due to the high speed of deflection, productivity is higher compared to the use of electromagnets. As a result of its compact design, the Piezo bending actuator takes up significantly less space. Piezo ceramic benders can also be used as sensors. Bending generates a charge/voltage on both ceramic layers. Parallel connecting both ceramics layers will add their charge. Thus they are suitable for measuring big and small movements/vibrations/accelerations and energy harvesting. Our Piezo benders usually have a working life of more than a billion cycles.

**PIEZO BENDING SENSOR**

The contraction of the ceramic when the operating voltage is applied results in deflection and force on the tip of the bending actuator. Or, if a force is applied to the tip, this generates an electrical charge.
### Overview Bending Actuators

A small selection of our actuators and their typical characteristic values.

<table>
<thead>
<tr>
<th>Type</th>
<th>Material</th>
<th>Total length [mm]</th>
<th>Free length [mm]</th>
<th>Width [mm]</th>
<th>Thickness [mm]</th>
<th>Total displacement [mm]</th>
<th>Blocking force on each side $F_b$ [mN]</th>
<th>Capacity per ceramic side $C$ [nF]</th>
<th>Operating voltage $U_{\text{max}}$ [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>M1100</td>
<td>49.95</td>
<td>38.0</td>
<td>7.2</td>
<td>0.80</td>
<td>2</td>
<td>450</td>
<td>45</td>
<td>230</td>
</tr>
<tr>
<td>Type 2</td>
<td>M1100</td>
<td>49.0</td>
<td>38.0</td>
<td>2.1</td>
<td>0.90</td>
<td>2</td>
<td>150</td>
<td>14</td>
<td>230</td>
</tr>
<tr>
<td>Type 3</td>
<td>M1876</td>
<td>47.4</td>
<td>38.0</td>
<td>1.9</td>
<td>0.80</td>
<td>2.2</td>
<td>180</td>
<td>18</td>
<td>230</td>
</tr>
<tr>
<td>Type 4</td>
<td>M1100</td>
<td>47.4</td>
<td>38.0</td>
<td>1.5</td>
<td>0.80</td>
<td>1.8</td>
<td>100</td>
<td>10</td>
<td>230</td>
</tr>
<tr>
<td>Type 5</td>
<td>M1876</td>
<td>47.0</td>
<td>38.0</td>
<td>5.9</td>
<td>0.80</td>
<td>2.8</td>
<td>500</td>
<td>60</td>
<td>230</td>
</tr>
<tr>
<td>Type 6</td>
<td>M1100</td>
<td>36.0</td>
<td>30.0</td>
<td>2.1</td>
<td>0.67</td>
<td>1.4</td>
<td>150</td>
<td>11</td>
<td>230</td>
</tr>
<tr>
<td>Type 7</td>
<td>M1876</td>
<td>32.5</td>
<td>27.5</td>
<td>1.9</td>
<td>0.70</td>
<td>2</td>
<td>450</td>
<td>10</td>
<td>230</td>
</tr>
<tr>
<td>Type 8</td>
<td>M1334</td>
<td>25.0</td>
<td>18.0</td>
<td>7.2</td>
<td>0.48</td>
<td>0.10</td>
<td>150</td>
<td>40</td>
<td>230</td>
</tr>
<tr>
<td>Type 9</td>
<td>M1100</td>
<td>12.5</td>
<td>9.5</td>
<td>1.9</td>
<td>0.80</td>
<td>0.05</td>
<td>180</td>
<td>16/21</td>
<td>230/130</td>
</tr>
<tr>
<td>Type 10</td>
<td>M1334</td>
<td>9.0</td>
<td>6.5</td>
<td>1.0</td>
<td>0.50</td>
<td>0.07</td>
<td>2100</td>
<td>1.9/2.3</td>
<td>230/130</td>
</tr>
</tbody>
</table>

1) cf. Specification sheet piezoelectric Ceramics
2) Unlimited displacement and blocking force will be determined at $U_{\text{max}}$ at the specified free length and at 23°C ambient temperature
3) The deflected bending actuator will be pressed back to zero position to determine $F_b$.
4) Capacity is measured at 1V/1kHz and 23°C ambient temperature.
5) Recommended operating voltage is 0.8 x $U_{\text{max}}$
6) With a ceramic length of 10.5 mm and 12.5 mm
7) With a ceramic length of 7.7 mm and 9 mm

All values are approximate and no guarantee of specific technical properties. Changes in the course of technical progress are possible without notice.
Performance features of three different kinds of Piezo actuators: Comparison of values of force and deflection of stacks, actuators with path transformations and bending actuators.

**BENEFITS OF PIEZOCERAMIC BENDING ACTUATORS**

- The bending actuator produces no heat → **NO COOLING** is required
- Lower energy consumption compared to the solenoid → **REDUCED OPERATING COSTS**
- Rapid positioning speed → significantly **INCREASED PRODUCTIVITY**
- Higher reliability → **REDUCED DOWNTIME**
- Compact construction of the bending actuators → significantly **LESS SPACE**
- Silent operation → **MOST CONVENIENT AND COMFORTABLE** workplace
FOR TEXTILE MACHINES

PIEZOCERAMIC BENDING ACTUATORS AND SYSTEMS
WITH ELECTRONICS AND MECHANICS

- module for single needle selection in warp knitting machines
- module for single needle selection in circular knitting machines
- circular knitting machine

DIFFERENT APPLICATIONS

PIEZOCERAMIC BENDING ACTUATORS
AND ATOMIZERS

- Braille keyboard
- humidifier “Liquifog” for cooling counters
- battery free radio switch

Piezo inhaler
IN A PERFECT COMBINATION
PIEZOELECTRIC CERAMICS AND ELECTRONICS

FROM PIEZOELECTRIC CERAMIC ELEMENTS TO PIEZOELECTRIC MODULES

Johnson Matthey Piezo Products is well known for its competence in development and production in all areas of electrical engineering, electronics and mechanics. This enables us to find Piezo solutions for all types of industry. We are able to correctly match ceramic and electronic parts together and to supply them as a module according to individual customer requirements. We can supply a complete system for control, actuator and sensor modules.

PIEZOELECTRIC CERAMICS COVER A WIDE RANGE OF APPLICATIONS

The two key features used are deflection and a controlling force which are applied variably in different actuator systems. We are specialized in piezoelectric modules. A complete Piezo system – for example, a control module for textile machines – consists of the “Piezoelectric ceramic bending actuator” component, mechanical parts and driving electronics. We can add a control computer to the system as an option. We work closely with our customers to achieve the best possible solution for their requirements.
TYPICAL PIEZO APPLICATIONS
WE MOVE YOUR IDEAS

Textile Machine Industry
As a control element in the manufacture of patterned fabrics for curtain and lace.

Braille Instruments
Piezoelectric bending actuators control the pins in Braille keyboards. This enables the blind and the partially sighted to "read" the contents of a line.

Industrial Automation
Pneumatic valves such as for electro-pneumatic position regulators for opening and closing pipelines.

Automobiles
Piezo ceramic products have been used in the automotive industry in different fields of application for many years. Our Piezo elements were first used in cars 25 years ago. We continue to work with innovations and pioneering process technologies to create new applications.

Airplanes
Our Piezo products are distinguished by their high reliability, and are present even in aircrafts, where the demands on the materials used are very high.

Medical Applications
Our Piezoelectric bending actuators and atomizers are perfectly suitable to work precisely and reliably in medical devices and in aerosol therapy. There is a wide range of medical applications where Piezoceramic systems offer the right solutions.
HIGHEST QUALITY
MODULES AND DEVICES

Piezo systems developed and produced at one site
- HIGHEST QUALITY
All from one source – Piezoceramics, electronics and mechanics
- ONE PARTNER
Fast handling and easy maintenance
- HIGHEST PRODUCTIVITY
Special coating
- LONGER LIFETIME
Customized solutions
- OPTIMIZED FOR YOUR APPLICATION

WWW.PIEZOPRODUCTS.COM

SUMMARY
JOHNSON MATTHEY PIEZO PRODUCTS

More than 40 years of experience in Piezo technology
Main products are bending elements, atomizers, modules and devices
Customized products available for actuator and sensor applications as well as for energy harvesting
Market leader for bending actuators
Over 100 million Piezo products produced
Long term partnerships from the initial idea through to series production