Valve Actuator for HVAC

PRODUCT INFORMATION

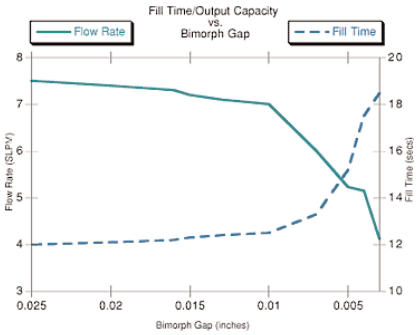
Today's state-of-the-art pneumatic and hydraulic valves are sophisticated systems, each one different than the next. But at the heart of every valve is one common element: an actuator – the device that controls the flow of air or fluid through an orifice. Traditional valve actuators have been solenoids, but size, reliability and power consumption pressures have pushed the limits of these devices.

Midé's solution to these limitations is the QuickPack® piezoelectric bimorph actuator. Compared to solenoids, QuickPack piezo bimorphs are lower profile, more reliable, consume significantly less power, and have the potential for faster response time. Shown in Figures A and B is a high-volume, commercial piezo valve actuator, developed for Siemens Building Technology pneumatic Heating Ventilation and Air-Conditioning (HVAC) building control system.

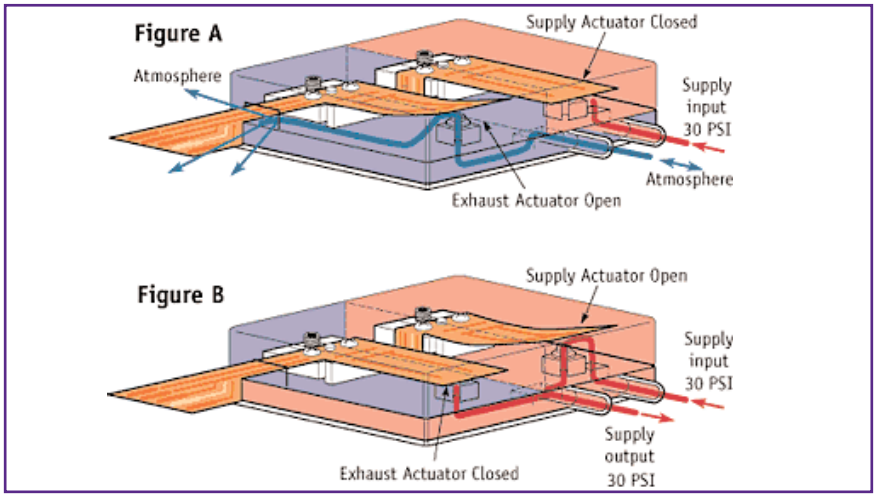
OVERVIEW

Piezo bimorph actuators bend up and down with applied voltage. One piezo layer of the actuator is driven with a positive voltage (with the "poling" direction), causing it to contract along the linear axis, while the other piezo layer is driven with a negative voltage (against the poling direction), causing it to extend along the linear axis. This extension and contraction work together to cause the device to bend in one direction. As the polarity of the voltage is reversed, the device bends in the other direction. The speed of the bending motion is simply a function of applied voltage profile and device construction. Typical piezo bimorphs can operate statically or up to several hundred cycles per second, and custom designs can operate much faster.

The Midé QuickPack bimorph actuator, designed for Siemens' Analog Output Pressure (AOP) valve, controls a pneumatic pressure output proportional to a voltage input. With a constant air pressure input, the dual actuators control air flow through supply and exhaust nozzles balancing pressure in an enclosed control volume and providing the correct output pressure. A cover plate isolates the two bimorphs into two chambers. When the supply actuator seals the control volume, the exhaust actuator vents and the output is at atmospheric pressure - Figure A. When the supply actuator is open and the exhaust actuator is sealed, the valve provides pressure to the output.



The control volume has a pressure sensor which provides feedback for a control loop to regulate the pressure proportional to the input signal. The graph above plots flow rate and fill time vs. bimorph gap for this application. Note that as the input voltage increases and the bimorph gap approaches zero (and hence seals the valve orifice, which has a nozzle diameter of 0.040 inches), the flow rate decreases while the fill time increases.



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Company Background

Midé, active primarily in the aerospace, automotive and manufacturing industries, is known for its ability to conceptualize, design and deliver high performance systems that are tailored to the user's specific application. System components, whether custom designed or sourced from suppliers, are integrated through Midé's extensive suite of expertise in the fields of electronics, actuation, sensing, control, system design & integration.

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The Siemens valve bimorph achieves moderate levels of force and displacement (45.8 grams and 0.0112 inches, respectively, with 0-160V input). By changing key design constraints like piezo length, width and thickness, and by selecting the appropriate material type, Midé was able to customize the bimorph design to best meet Siemens' performance targets.

Compared to Solenoids

Piezoelectric bimorph actuators offer several key benefits over traditional solenoid actuators used in valves, as shown below:

Compared to RAW Piezo Bimorphs

Siemens chose Midé's QuickPack device to solve expensive manufacturing and support problems experienced with raw piezo materials, as shown below right.

With the unique construction of the QuickPack piezo bimorph actuator, Midé has solved the problems associated with raw piezo bimorphs. Key to Midé's innovative design are the protective polyimide skin, pre-attached electrical leads, and guaranteed performance specifications.

Benefits of the QuickPack actuator include:

1. No wires to solder
2. No solder joints to break
3. protection against breakage during assembly
4. resistance to microcracks during operation
5. protection against moisture and the environment

These features have allowed Siemens to reduce manufacturing costs and dramatically improve field reliability, providing a superior, cost-effective, and reliable product to their customers.

	PIEZO BIMORPH ADVANTAGES OVER SOLENOIDS
POWER CONSUMPTION AC OPERATION	**100 TIMES LESS POWER.** Piezo bimorphs consume just 100's of milliwatts of power (100-200V at 1mA); while solenoids consume 10's-100's of watts (10-100V at 1-10A). **NO DUTY CYCLE LIMITATIONS.** Solenoids are often limited to <25%.
POWER CONSUMPTION	**PRACTICALLY ZERO POWER CONSUMPTION.** Depending on the application, piezo bimorphs consume 100-200V at less than 0.01mA. Solenoid power consumption ranges from less than 1 watt to 100's of watts of power, with typical consumption in the 10's to 100's watt range.
DC OPERATION	**NO OVERHEATING.** For "on times" greater than 5-10 seconds (for large force and/or displacement), solenoids risk overheating, but piezo bimorphs do not exhibit this problem.
RESPONSE TIME	**1 MS RESPONSE TIME.** Unlike piezo bimorphs, solenoids rarely operate under 5 ms.
SIZE	**10 TIMES THINNER.** Piezo bimorphs can be less than 0.025 inches thick compared to solenoids, which are typically greater than 0.250 inches in diameter.
RELIABILITY	**NO MOVING PARTS TO WEAR AND BREAK**