

## **Piezoelectric Valve Key to Extended Battery Life of New Auto-Adjusting Personal Oxygen System**

Long-term oxygen therapy is the only intervention known to increase life expectancy for the over 30 million chronic obstructive pulmonary disease (COPD) sufferers in the United States. Providing individuals with the correct amount of oxygen is critical to preventing blood oxygen levels from dropping below normal and stressing vital organs, limiting ambulation, and ultimately decreasing longevity.

Historically, oxygen conservers, devices that deliver oxygen only when an individual inhales, were designed to deliver a fixed-minute or fixed-pulse dose of oxygen per breath. Since most users are ill, making the manual adjustments required to increase or decrease the oxygen flow of these units can be difficult for them. Additionally, these oxygen conservers do not provide an optimal solution for the individual, since the units do not automatically monitor breathing and adjust oxygen dosage based on the patient's activity level.

Executive Vice President of evoMedical Solutions Rich Kocinski set a goal to design a conserver that could monitor an individual's exertion level, through breathing patterns, and auto-adjust the oxygen supply to meet the individual's needs, which would also make the device more efficient and use less oxygen.

The initial design result was a unit that used a unique microprocessor and pressure transducer to monitor oxygen requirements for every breath. Sophisticated algorithms instructed a multi-solenoid valve mechanism to deliver the oxygen dose required by the user at any activity level. However, because solenoid valves have a high current draw, the unit's rechargeable batteries lasted for only about four days. To eliminate frequent battery replacement or battery chargers, Kocinski sought an option that would provide the advantages of an

electric unit yet eliminate high draw on the batteries. Short battery life was also a sales barrier as distributors did not want to offer the product knowing that patients would balk at battery costs and frequent changes.

When Kocinski learned of Festo's new Piezovalve, which have a low current draw, he investigated further. "When we integrated the Festo Piezovalve into our design, we went from valve current draw of 90 percent of total down to a valve current draw of less than three percent of total," Kocinski explains. "That opened the door to even greater battery life extension if we were able to cut down on the processor, transducer, and instrumentation electrical overhead. The Festo Piezovalve was the game changer we had hope to find, but weren't sure we would."

Kocinski continues, "Rather than invest in low power chips sets, which would have required us to do recoding and change the firmware and hardware design, we did a lot of things to manage power in the circuits. During the design stage, we went from three or four days on a set of standard AA alkaline batteries to 1300 hours, which is approximately a year's worth of usage. In the process we took away the short battery life barrier to sales and revolutionized the industry."

### **Piezo valves in this medical device**

The core of the Festo Piezovalve is a patented carbon/ceramic gap bender that is self compensating for temperature and can control flows up to 20 liters/min. The bender is packaged in a 7mm thick body with integrated header pins for easy PCB integration. The valve has 3 ports and can be used either as a pair of 2/2 valves or a 3 way valve with a closed center port.

Unlike conventional solenoid valves, which require constant power to remain open, piezo valves remain in position after being "charged" in a manner similar to a small capacitor. This gives them the properties of a latching valve, even when used in partially opened proportional applications. In addition, The Festo

Piezovalve requires significantly less energy to open in the first place - about 1 millijoule (mJ), compared to the 5 mJ that a low power 1 watt solenoid requires. This combination of power saving characteristics enables long battery life even when individuals require high oxygen delivery settings.

Electrical design plays a large part in the performance of the Festo Piezovalve. Its proportional characteristic allows the designer to slowly open or close the valve to reduce noise or to soften gas delivery. Its dynamic nature works well in closed loop controls.

SmartDose Mini+, the newly designed oxygen conserver from evo Medical Solutions, is the only unit that adjusts to patient needs, offers the convenience of long battery life, and is available in both liquid oxygen and gaseous oxygen format.

“I’ve been designing medical devices for more than 20 years,” notes Kocinski. “This is the one I’m most proud of — it’s the one that will benefit people the most. After all, it gives the breath of life day after day on two AA batteries.”

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