design FAQs

Solenoid Proportional Control Valves

FREQUENTLY ASKED QUESTIONS

Q: What is a solenoid proportional valve?
A: A proportional valve permits operators to vary the output flow rate by changing the electrical current applied to the valve's solenoid. These valves add the accuracy and efficiency of electronic control to a system and are flexible enough to simplify fluid circuitry by replacing multiple valves.

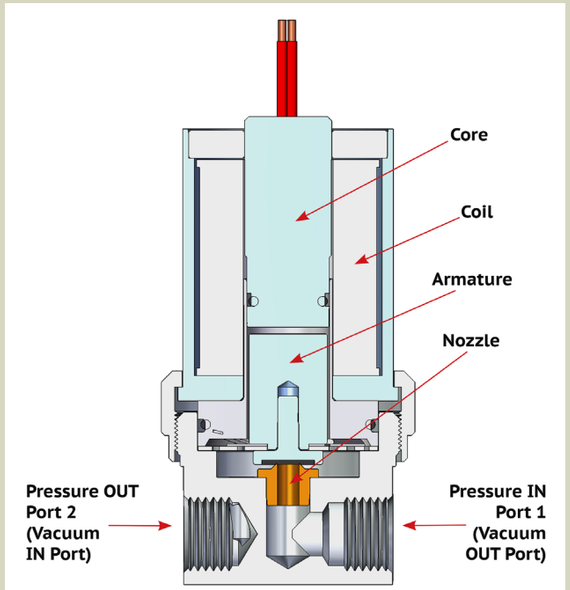
A proportional valve differs from a more traditional solenoid-controlled valve with on-off control. The operation of a proportional valve is more analog, permitting a continuum of flow rates throughout the designed range.

Q: Where are solenoid proportional valves used?
A: Proportional valves can be used wherever variable flow rates are required. They can be prepared to work at fluid pressures from vacuum to 100 psi and the most compact models require 2.5 W or less.

Proportional valves can be found in a variety of manufacturing settings from welding and glue dosing to blow molding and bottle filling. Textile, pharmaceutical, semiconductor, and food processing all use proportional valves. They also make many ventilators, respirators, and other medical devices possible.

Q: How does a proportional valve work?
A: Applying current to a proportional valve moves a solenoid's armature toward its corresponding pole piece core (see illustration). Proportional valves are designed for constant attractive force on the armature over the working stroke. Current may come from a valve driver or power supply.

A spring balances the armature force, keeping the armature from advancing into contact with the pole piece core and creating a multitude of equilibrium positions within the armature's travel. These positions permit proportional fluid flow through the valve. In closed-loop operation, a downstream sensor can provide feedback to a controller. The valve system can also operate on an open-loop basis when less accuracy is required.



In a proportional valve, current applied to the coil attracts an armature toward the core. The degree of travel is proportional to the current, permitting analog flow-rate control.

Q: What is a proportional valve's sensitivity?
A: Traditional on-off valves are usually rated in terms of their response time, but for proportional valves the important measure is sensitivity to changes in current. This is especially of interest at the low flow rates required for precision instruments like mass flow controllers and gas analyzers.

Valve designs with low-friction, low-mass armatures, such as the Humphrey ProControl Series, require less current to lift the armature, permitting instantaneous, controlled valve operation at low lift-off currents for low flow rates.

Some proportional valves can cover their entire range of flow rates in as little as 5 to 8 ms. Fast, precise valve response can help downstream pressure regulation reach a target set point without pressure oscillation.

Q: What is the hysteresis in a proportional valve?
A: A low-friction, low-inertia valve system also exhibits low hysteresis. Hysteresis describes the difference in the relationship between current and flow rate when current is increasing versus when it is decreasing.

A valve design where the solenoid interacts only with the opposing mechanical spring has very little friction and, consequently, little hysteresis. Most miniature proportional valves typically have a 10% hysteresis (full scale).

Q: What flow rates can a proportional valve provide?
A: Flow rates depend on valve design, size, and configuration. Two-way, normally closed proportional valves can provide controlled flow from 0 to up to 300 LPM with a maximum current input of 525 mA under 20v operation. For optimal performance, choose a valve with a flow rate at desired pressure which exceeds your application requirements. This will ensure optimal resolution with the lowest hysteresis and lift-off current.

Also, when the application requires, consider the low end of the flow-rate range and the valve's sensitivity to changes in current during lift off.

Q: How long do proportional valves last?
A: The life of any valve depends on its design and service conditions. Proportional valves with low-mass, low-friction armatures have no contact or stress points, so they exhibit very little wear. Clamping the armature between the valve body and solenoid coil extends life by limiting armature movement in relation to the nozzle.

The low-friction, low-mass ProControl Series from Humphrey, for example, has been tested trouble-free for 100 million cycles.

Q: How will a proportional valve work with my system?
A: Proportional valves are flexible by nature; add a controller and choose the flow rates you need within the valve's range. You may also want to add a metering device for highly accurate closed-loop operation with a controller.

Consider the media the valve will meter. Some proportional valves can be prepared to work with inert gases, possibly eliminating the need for shut-off valves elsewhere in your system. They are pre-set at higher lift-off currents to compress the armature onto the seat.

Although standard proportional valve designs are common, a valve manufacturer like Humphrey can customize aspects of the valve design such as porting and mounting, the position of the pole piece, the nozzle diameter, and the resting armature tension. ■

Sponsored by Humphrey

A D V E R T I S E M E N T

Humphrey®

PROCONTROL™

Proportional Control Valves

NEW PC30

Fast Response PC10

Low Power Consumption PC3

Variable Current = Variable Flow

Low Hysteresis

EXCELLENT CONTROL OF FLOW AND LONG LIFE IN A COMPACT CONSTRUCTION

www.humphrey-products.com • 1-800-477-8707