Proportional valves eliminate design headaches

New design produces consistent flow and gain.

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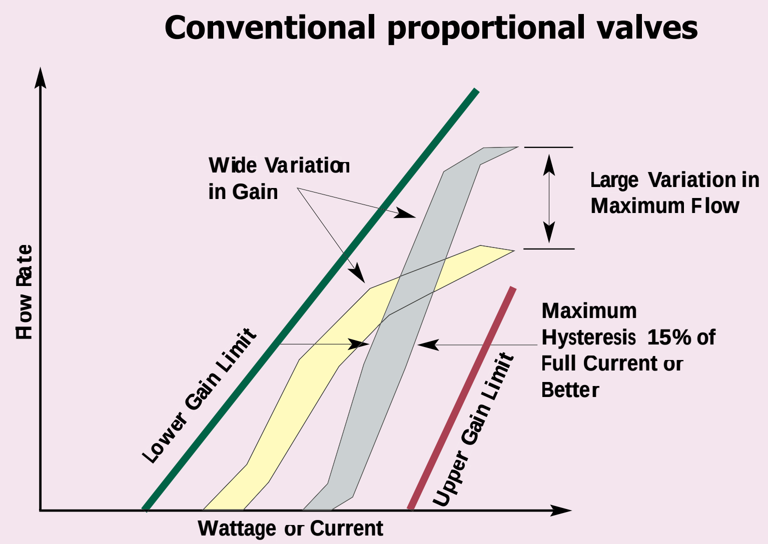
Proportional valves are a great alternative when an application requires more than on-off control, but not the high precision and expense of servo valves. As such, proportional valves are widely used in a multitude of applications, including the control of gas and air flow from medical respirators, dialysis machines, and paint-delivery and semiconductor-manufacturing systems.

The beauty of the valves is the ease with which they can vary the rate of flow, with output proportional to input current. However, most such valves have several major characteristics that can make precise control difficult, including hysteresis and variable maximum flow and gain.

Hysteresis can be as high as 15%, which can wreak havoc in a closed-loop control system. The second problem is maximum flow can vary significantly from one unit to another of the same size and from the same manufacturer. Finally, gain tends to vary from one unit to another with the current generation of valves. Gain for a proportional valve is the rate of flow change in response to a change in valve input current. Variations in gain result in a large performance envelope for a given family of valves. This puts the burden on the OEM to adapt its design to compensate for these variations when performance of the end product is to be identical from one machine to another. Design, installation, and testing can be laborious and expensive when trying to achieve matched performance levels.

Gain varies from valve to valve mainly because of mechanical and geometrical tolerances in normal manufacturing processes. Most manufacturers use a chemically-etched or stamped flat spring to counter-act plunger or armature movement. Electric current in the valve coil creates a magnetic force that pulls the armature. Manufacturers tend to compensate for variations in gain and flow by making the valve's specification window quite large.

The EVP proportional valve has standard and manifold mounting options, a variety of orifice sizes and control voltage ranges, and three different electrical connectors



Performance curves for two conventional proportional valves show wide variations. OEMs are often forced to adjust their designs to compensate for the wide range of possible flows and gains.

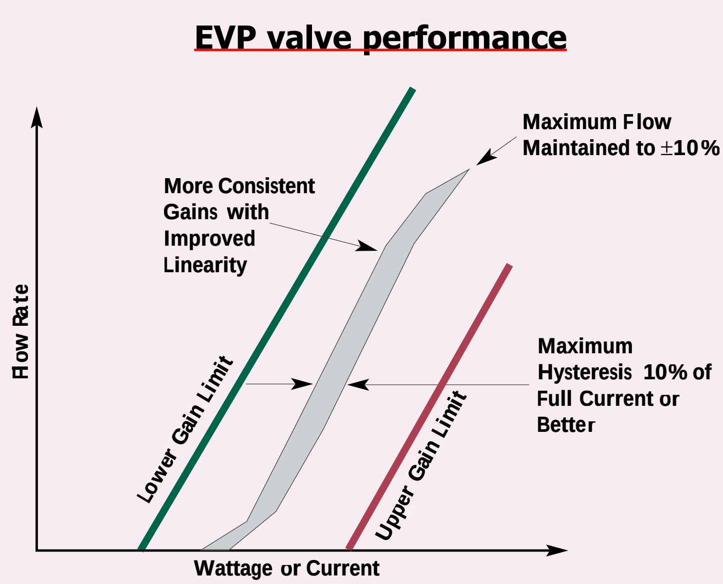
Clippard Instrument Laboratory has developed a new proportional valve, the EVP Series, that significantly reduces the variation in gain. It is based on the reliable and rugged design of the company's EV Series directional valve, which combines a simple design, low-power consumption, fast response, and long life—exceeding a billion cycles in some operations. The armature is the heart of the valve. It resembles a metal spider with flexing legs.

This new spider and included mating surface provide proportional flow characteristics. A key advantage of the new valve is its factory-adjustable core. The core enables the adjustment of the magnetic field to compensate for mechanical tolerance variations which plague other proportional valves.

For example, press fitting the core closer to the armature increases the magnetic field and creates more force or pull on the armature. This design makes it possible to control the magnetic field strength on the armature.

Therefore, even with varying spring rates and mechanical part tolerances, the new design provides a consistent gain relationship between flow rate and electrical current. Consistent valve gains will greatly improve closed-loop systems that need precise control at ramp up and ramp down. More-predictable gain will also improve PID-algorithm control and lessen the chance of instability. In addition, there will be relatively consistent linear gain over the entire flow range. The valve also maintains tighter tolerances on maximum flow, ±10% or better.

The EVP valves can enhance proportional control in analytical machines, mass-flow controllers, and medical applications such as non-invasive blood-pressure monitoring, dialysis, and respirators. The valve is also suited for a host of other control applications, including anesthesia machines, gas chromatograph equipment, paint-delivery systems, mass-flow controllers, and semi-conductor CMP (chemical-mechanical-planarization) operations. Finally, adding a pressure sensor and comparator circuit results in an economical electronic pressure controller.



The EVP proportional valve maintains hysteresis less than 10% of full current over the entire flow range. More-consistent gains and linearity from valve to valve improve the performance of closed-loop control systems.