Positioners

Three Valtek® four-way positioners are available to use with the Valtek cylinder actuator: the Beta pneumatic positioner, the Beta IP 2000 electro-pneumatic positioner and the Model 80R pneumatic positioner. All Valtek linear and rotary-action actuators are designed to use these three positioners. Other manufacturers' positioners, such as the Moore 74G, can be mounted on Valtek linear actuators if required.

Valtek positioners are completely field reversible for air-to-open or air-to-close operation. They can be adjusted for split-range operation at the factory or in the field. As a standard, pneumatic positioners use 3-15, 3-9, 9-15, 3-7, 7-11 and 11-15 psi input signals; electro-pneumatic positioners use 4-20, 4-12, 12-20 and 10-50 mA input signals. Other non-standard signals, such as 6-30 psi, are also available.

Beta Positioner

Because of the simple design, lower cost and excellent performance, the Beta is Valtek's standard positioner. It is used on single or double-acting actuators and provides fast, accurate positioning, even in corrosive or high vibration applications. Figure 17-1 is a schematic diagram showing how the Beta positioner operates with either pneumatic or electro-pneumatic modules, although the principles apply to the Model 80R positioner as well.

The Beta positioner is a force-balanced instrument. The schematic shows a Beta pneumatic positioner installed on a double-acting actuator for air-to-open action. Positioning is based on a balance of two forces: one proportional to the instrument signal and the other proportional to the stem position.

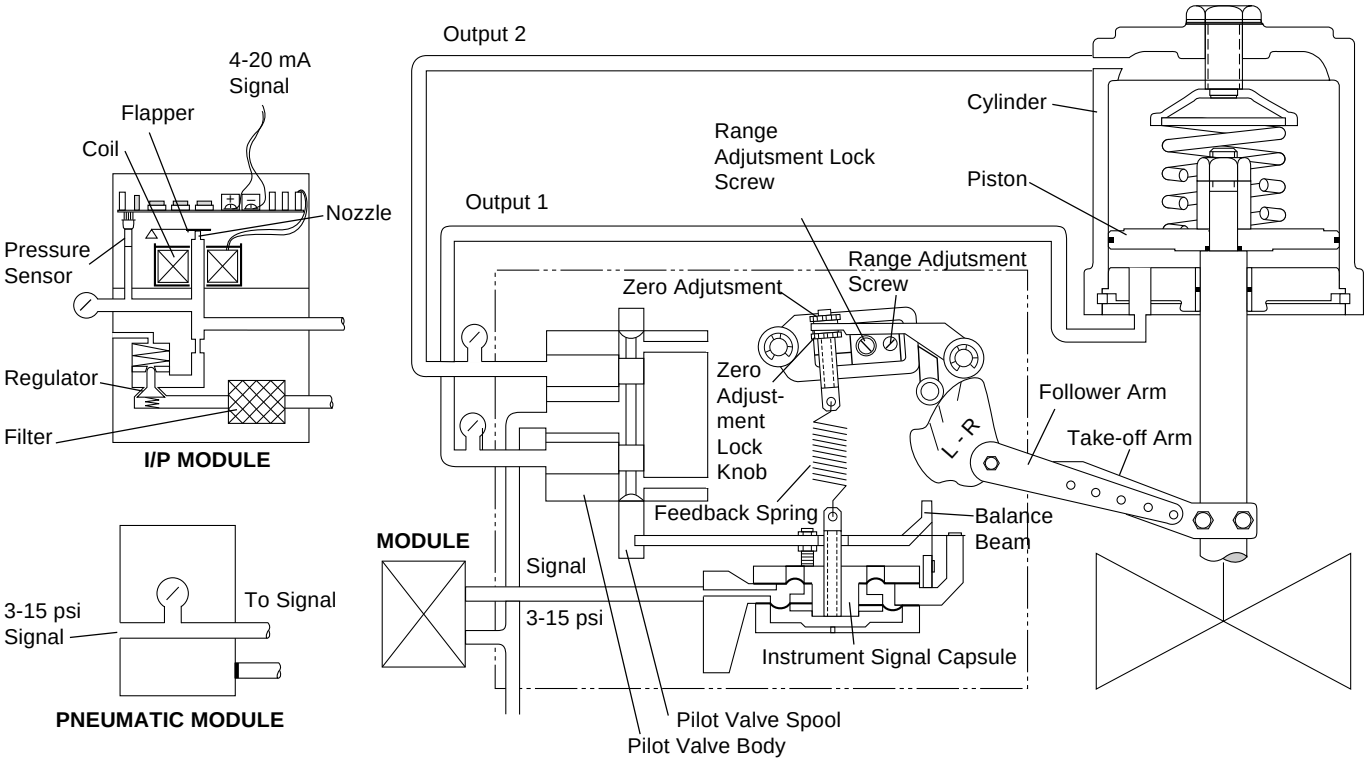

Figure 17-1: Beta Positioner Operation

As an IP positioner, a 4-20 milliamp (standard) control signal is sent to the positioner where the IP module converts it to a 3-15 psi air pressure signal. As a pneumatic positioner, a 3-15 psi (standard) pressure is used directly by the positioner.

The pressure signal acts upon the diaphragms in the instrument signal capsule creating a downward force. The motion of the actuator stem is transmitted to the top end of the feedback spring through the follower arm and cams. As a result, tension in the feedback spring will vary as the stem position changes.

When these opposing forces balance exactly, the system will be in equilibrium and the stem will be in the position called for by the instrument signal. If these opposing forces are not in balance, the balance beam will move up (or down) and, by means of the spool valve, will change the output pressures and flow rate. This will cause the piston to move until the tension on the feedback spring opposes exactly the instrument signal pressure.

The detailed sequence of positioner operations are as follows: An increase in the instrument signal forces the instrument signal capsule and balance beam downward. This motion of the balance beam also pulls the pilot valve spool downward from its equilibrium position. This opens the pilot valve ports, supplying air to port 1 and exhausting air from port 2. This causes the actuator piston to move upward.

This upward motion of the piston is transmitted back to the positioner through the feedback linkage and cam resulting in the spring being stretched proportionally to the valve position. The piston continues to stroke upward until the force in the feedback spring increases sufficiently to counter the force generated by the instrument signal capsule. At this point, the balance beam and spool begin to return to their equilibrium position. As the valve spool ports start to close, the air flow rate to the actuator is decreased.

After the piston has reached the required position, the feedback spring tension force will equal the force generated in the instrument signal capsule. The balance beam and instrument signal capsule will remain in their equilibrium positions with no air flowing to the actuator until a change in the instrument signal is made.

A decrease in the instrument signal reverses the described actions causing a proportional downward movement of the actuator piston and stem.

TABLE 17-I:
Typical Actuator Stroking Speeds

Actuator Size	Time (Seconds) For Maximum Stroke*		Stroke (in.)
	1/4" Tubing	3/8" Tubing	
25	1.2	1.0	1.5
50	3.5	3.1	3
100	9.6	8.6	4
200	20.8	18.4	4
300	31.3	27.7	4

Actuation pressure: 60 psi

* Stroking time only (does not include time from receipt of signal to beginning of stem motion). Increased speeds are available with booster valves.

Beta IP 2000 Electro-pneumatic Positioner

The IP 2000 module receives a 30-150 psi air supply pressure from the Beta positioner and converts it to a 3-15 psi output signal. This signal is proportional to a 4-20 mA input signal or a 10-50 mA input signal depending on the model used.

The supply pressure from the Beta Positioner is filtered as it passes through a field-replaceable, coalescing filter element in the module. Next it passes through an internal pressure regulator that regulates it to approximately 22 psi. The air then goes through an orifice that restricts the flow and air consumption.

The air is further controlled to 3-15 psi using a stiff spring-suspended flapper that is attracted by an electromagnet to a nozzle. A temperature compensated piezoresistive pressure sensor mounted on the control circuit board senses the I/P output pressure. The pressure sensor and circuitry create a feedback loop, which determines how much current to send to the electromagnet for a desired pressure output. The electromagnet in the feedback loop varies the nozzle-flapper spacing, which regulates the I/P output pressure to 3-15 psi proportional to the 4-20 (or 10-50 mA) input signal.

Model 80R Pneumatic Positioner

The Model 80R pneumatic positioner is used when high frequency response is required by the user.

Specifications and Performance

Tables 17-II and 17-III present the specifications and performance data for all three Valtek positioners. Table 17-I shows typical stroking speeds with Valtek positioners and actuators. If faster stroking speeds are required, boosters can be incorporated (see section 19, "Accessories").

TABLE 17-II: Valtek Positioners Performance Data

Positioner Performance

The following data is based on tests of the Beta pneumatic, Beta IP 2000, 80R positioners mounted on a double-acting cylinder actuator having a piston area of 25 square-inches. Air-to-open, Fail-closed configuration. Characteristics may vary for larger actuators. **Supply Press:** 60 psi; **Cylinder Balance Press:** 45 psi; **Valve Stroke:** 1.5 -inches; **Instrument Pressure Range:** Pneumatic 3-15 psi, Electro-pneumatic 4-20 mA

Specification	Beta Pneumatic	Beta IP 2000 Electro-pneumatic	Model 80R Pneumatic
Linearity - Independent	±1.0% F.S.	±1.0% F.S.	±1.5% F.S.
Hysteresis - Maximum position error for the same value of input when approached from opposite directions.	0.5% F.S.	0.5% F.S.	0.25% F.S.
Repeatability - Maximum variation in position for the same value of input when approached from same direction.	0.2% F.S.	0.2% F.S.	0.2% F.S.
Response Level - Maximum change in input required to cause a change in valve stem position in one direction.	0.2% F.S.	0.2% F.S.	less than 0.1%F.S.
Dead Band - Maximum change in input required to cause a reversal in valve stem movement.	0.3% F.S.	0.3% F.S.	less than 0.1% F.S.
Resolution - Smallest possible change in valve stem position.	0.1% F.S.	0.1% F.S.	less than 0.1%F.S.
Steady State Air Consumption	0.25 SCFM @60 psi	0.31 SCFM @60 psi	0.26 SCFM @60 psi
Supply Pressure Effect - Position change for 10 psi supply pressure change.	0.05% F.S.	0.06% F.S.	0.05% F.S.
"Open-loop" Gain - Ratio of output pressure unbalance to instrument pressure change with locked stem @60 psi.	300:1	400:1 psi/mA	High: 550:1 Low: 300:1
Maximum Flow Capacity	11 SCFM @60 psi	11 SCFM @60 psi	12.4 SCFM @60 psi
Frequency Response - -6dB frequency Phase angle at -6dB *(with sinusoidal input ±5% F.S. centered about 50% F.S.)*	0.8 Hz -71°	0.8 Hz -71°	2.3 Hz -96°**
Stroking Speed - Closed to open - Open to closed -	2.3 in./sec. 1.3 in./sec.	2.3 in./sec. 1.3 in./sec.	2.2 in./sec. 1.7 in./sec.

* Selectable by changing gain spring

** High gain

Table 17-III: Valtek Positioners Specifications

Specification	Beta Pneumatic	Beta IP 2000	80R Pneumatic
Input signal Range	3-15 or 6-30 with 2, 3 and 4-way split range	4-20 and 10-50 mA with 2, 3 and 4-way split range	3-15 or 6-30 with 2 or 3-way split range available
Supply pressure	30 psi to 150 psi	30 psi to 150 psi	30 psi to 150 psi
Ambient Temperature Limits	Std: -20° F to 180° F; Ext: -50° F to 250° F	Std: -20°F to 180° F; Ext: -40°F to 180° F	Std: -40° F to 140° F Ext: -20° F to 180° F
Connections	Supply, instrument and output: 1/4" NPT; Gauges: 1/8" NPT	Air supply and output: 1/4" NPT; Gauges: 1/8" NPT; Electrical: 1/2" NPT conduit w/screw terminals inside	Supply, instrument and output: 1/4" NPT Gauges: 1/8" NPT
Gauges: Signal: *(dual scale)* Output:	0-30 psi, 0-2 kg/cm^2 0-160 psi, 0-10 kg/cm^2	0-30 psi, 0-2 kg/cm^2 0-160 psi, 0-10 kg/cm^2	0-30 psi, 0-2 kg/cm^2 0-160 psi, 0-10 kg/cm^2
Standard Materials	Stainless steel, anodized aluminum, nickel-plated steel, epoxy powder-painted steel and Buna-N	Stainless steel, anodized aluminum, nickel-plated steel, epoxy powder-painted steel and Buna-N	Anodized aluminum, stainless steel, nickel-plated brass, Buna-N and epoxy powder-painted steel
Loop Load	———	5.3 volts + 5 ohms (Equivalent to 270 ohms at 20 mA)	———
Hazardous Location Approvals (FM approved) (CSA pending)	———	Intrinsically safe: Class I, Division 1, Groups A,B,C,D; Class II, Groups E,F,G Explosion-proof: Class I, Division 1, Groups B,C,D; Class II, Groups E,F,G Non-incendive Class I, Division 2, Groups A,B,C, D,F,G	———
Enclosure	———	Nema 4x	———
Net weight	3 lbs.	5.5 lbs.	3 lbs.