

3.8 Actuators

Pneumatically-operated control valve actuators are the most popular type in use, but electric, hydraulic, and manual actuators are also widely used. The spring-and-diaphragm pneumatic actuator is most commonly specified due to its dependability and simplicity of design. Pneumatically-operated piston actuators provide high stem force output for demanding service conditions. Adaptations of both spring-and-diaphragm and pneumatic piston actuators are available for direct installation on rotary control valves.

3.8.1 Diaphragm Actuators

- Pneumatically-operated diaphragm actuators use air supply from controllers, positioners, or other sources.
- Various styles include: direct-acting, in which the increasing air pressure pushes the diaphragm down and extends the actuator stem (Figure 3.37); reverse-acting, in which the increasing air pressure pushes the diaphragm up and retracts the actuator stem (Figure 3.37); reversible, in which actuators can be assembled for either direct or reverse action (Figure 3.38); direct-acting unit for rotary valves, in which the increasing air pressure pushes down on the diaphragm, which, depending on orientation of the actuator lever on the valve shaft, may either open or close the valve (see Figure 3.39).
- Net output thrust is the difference between diaphragm force and opposing spring force.
- Molded diaphragms provide linear performance and increased travels.
- Output thrust required and supply

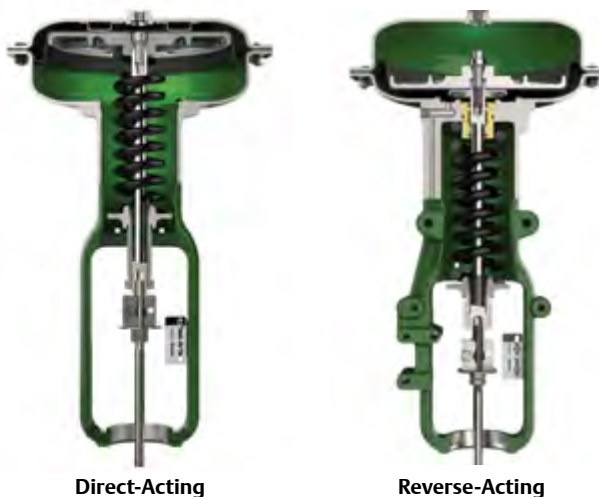


Figure 3.37 Diaphragm Actuators

air pressure available dictate size.

- Diaphragm actuators are simple, dependable, and economical.

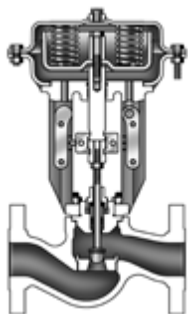


Figure 3.38 Field-Reversible Multi-Spring Actuator



Figure 3.39 Diaphragm Actuator for Rotary Valve

3.8.2 Piston Actuators

- Piston actuators are pneumatically-operated using high-pressure plant air up to 150 psig (10.3 bar), often eliminating the need for a supply pressure regulator.
- Piston actuators furnish maximum thrust output and fast stroking speeds.
- Piston actuators are double-acting to give maximum force in both directions, or spring-return to provide fail-open or fail-closed operation (Figure 3.40).
- Various accessories can be incorporated to position a double-acting piston in the event of supply pressure failure, including pneumatic trip valves and lock-up systems.

- Other versions for service on rotary control valves include a sliding seal in the lower end of the cylinder. This permits the actuator stem to move laterally, as well as up and down without leakage of cylinder pressure. This feature permits direct connection of the actuator stem to the actuator lever mounted on the rotary valve shaft, thus eliminating one joint or source of lost motion.



Figure 3.40 Control Valve with Double-Acting Piston Actuator



Figure 3.41 Control Valve with Scotch-Yoke Piston Actuator

3.8.3 Manual Actuators

- Manual actuators are useful where automatic control is not required, but where ease of operation and good manual control is still necessary (Figures 3.42 and 3.43). They are often used to actuate the bypass valve in a three-valve bypass loop around control valves for manual control of the process during maintenance or shut down of the automatic system.
- Manual actuators are available in various sizes for both globe-style and rotary valves.

- Dial-indicating devices are available for some models to permit accurate repositioning of the valve plug or disk.
- Manual actuators are much less expensive than automatic actuators.



Figure 3.42 Manual Actuator for Sliding-Stem Valves



Figure 3.43 Manual Actuator for Rotary Valves

3.8.4 Rack-and-Pinion Actuators

Rack-and-pinion designs provide a compact and economical solution for rotary valves (Figure 3.44). Because of backlash, they are typically used for on/off applications or where process variability is not a concern.



Figure 3.44 Rack-and-Pinion Actuator

3.8.5 Electric Actuators

Electric actuator designs use an electric motor and some form of gear reduction to move the valve plug (Figures 3.45 and 3.46). While electric actuators have traditionally been limited to on/off operation, some are now capable of continuous control. The use of brushless motors in electric actuators can reduce or eliminate motor burnout associated with turning the motor on and off rapidly. The initial purchase price still tends to remain above that of pneumatic actuation. The primary usage of electric actuation is in areas where instrument air is not readily available or where an insufficient quantity of valves exist to justify the cost of a compressor system. ■



Figure 3.45 Electric Actuator for Sliding-Stem Valve



Figure 3.46 Electric Actuator for Rotary Valve