How It Works

Actuators

Every valve requires a means of operation via cycling or actuation. Cameron offers a variety of options for operation, including handwheels, levers, gears, and actuators. Actuators are a means by which a valve can be automated so that no human interaction with the valve package is necessary to cycle the valve. Actuators can be remotely operated and can act as shutdown mechanisms in an emergency situation, situation that would be dangerous for human intervention.

At a basic level, an actuator is a control mechanism that is operated by an energy source. This energy — hydraulic pressure, pneumatic pressure, or electric current — moves the internal mechanical parts of the actuator. Actuators can be designed to fail-open (in the case of actuator failure, the valve will stay open) or fail-close (in the case of actuator failure, the valve will stay closed). They also are distinguished by whether they are for quarter-turn (e.g., ball valves, plug valves) or linear (e.g., gate valves) valve operation.

Types

- **Double-acting actuators** have air or liquid supplied to both sides of the piston with one side at higher pressure, which achieves the movement required to actuate the valve. This configuration uses pneumatic or hydraulic pressure of the air or liquid energy to open and close the valve.

- **Spring-return actuators** have air or liquid supplied to only one side of the piston, and the energy to move the mechanisms comes from a spring on the opposite side. This configuration uses pneumatic or hydraulic pressure of the air or liquid to open or close the valve, and the spring acts to affect the opposite motion.

- **Pneumatic actuators** utilize compressed air to generate the operating energy. These actuators are quick to respond but are not ideal for environments under high pressures because gas is compressible. Pneumatic actuators are available in spring-return and double-acting designs.
  - **Piston-style pneumatic actuators** generate linear force by the air acting on the piston. The conversion of this linear force to torque (for use in rotary valves) is achieved by specific actuator designs.

- **Scotch-yoke actuators** include a piston, connecting shaft, yoke, and rotary pin. The yoke is offset 45° from the axis of the piston at the two ends of travel and at 90° to the piston shaft when in the midtravel position. The canted scotch-yoke design is ideal for offset butterfly valve actuation.

- **Rack-and-pinion actuators** output a 180° turn, unlike traditional actuators, which produce a 90° turn of the pinion. This style of actuator is particularly suitable for actuating plug valves.

- **Diaphragm-style actuators** include a rubber diaphragm and stem in a circular steel housing. This style of actuator is ideal for valves requiring shorter travel, such as diaphragm valves and globe valves.

- **Hydraulic actuators** use liquid as a means to apply pressure to the actuator’s mechanical components. They generally can exert a large amount of force because liquid is not compressible but are generally limited in acceleration and speed. Hydraulic actuators are available in spring-return and double-acting designs.
  - **Piston-style hydraulic actuators**, available in scotch-yoke and rack-and-pinion designs, function the same as pneumatic piston-style actuators but utilize liquid instead of gas to generate the operating energy.

- **Direct-gas actuators** utilize a high-pressure natural gas or nitrogen supply to achieve on-off control of a valve in any natural gas transmission application. Direct-gas actuators are available only in double-acting configurations.
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- **Gas-over-oil actuators** use high-pressure gas supplied from the pipeline suspended above a hydraulic fluid to move the mechanics of the actuator. Gas-over-oil actuators are available only in double-acting configurations.

- **Electric actuators** use an electric source, such as a battery, to power the actuator. They usually include intricate electrical circuitry. Because of their use of electricity as a power source, they may not be ideal for remote installations.

**Applications**
The Industrial Revolution brought about the use of water to hydraulically actuate valves, and by the 1920s, pneumatic actuation was in use. With the invention of more advanced process plants with higher pressure requirements, more sophisticated electric designs and innovations in gas-over-oil actuation developed. Around the 1950s, high-pressure gas actuators were created to meet the high pressure demands of the pipeline industry as well as electro-hydraulic actuators for critical fail-safe applications.

Actuators are ideally suited for installations in which human interaction is either not possible or is dangerous, such as where space or installation location inhibits access to the valve operator.

Compact actuators are used on FPSOs or other locations where space and weight are critical. These actuators are designed to provide the powerful torque and thrust output of their larger counterparts but with a reduced installation footprint.

Subsea actuators are designed to withstand the low temperatures, extremely high pressures, and remote accessibility of underwater installations. Only specific actuators are used in subsea applications because the gas in a pneumatic actuator, for example, would compress under the high pressures, rendering the valve package inoperable. Integrated interface panels allow the subsea actuator to be operated by an ROV and easily added to a subsea tree. Our line of LEDEEN* actuators includes a shallow-water series (for installations to 500 ft [152 m]) and a deepwater series (for installations deeper than 500 ft [152 m]).

Direct-gas and gas-over-oil configurations are commonly used in pipeline applications and are ideally suited for sweet natural gas lines, wherein the actuators use the gas in the line. Direct-gas actuators are known to have very smooth operation and, because of their inherent design characteristics, are less likely to leak hydraulic fluid to the environment. Direct-gas actuators also require less cleaning and routine maintenance than gas-over-oil actuators. In both configurations, a biodegradable hydraulic fluid is used in offshore applications for safer operation.