SVF FLOW CONTROLS
WHITE PAPER

# Selecting Valve Automation Devices for Quarter-Turn Valves in Bio-Pharm Applications

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# Introduction

Every industry has specific requirements for equipment used in the process areas and systems. The requirements may be driven by many potential factors:

- Integration with the process control system
- Area ratings for electrical equipment
- Industry standards
- Environmental considerations, such as corrosion, humidity, temperature
- Access to electrical or compressed air supplies
- The unique processing conditions
- Routine wash downs
- AC or DC voltages, etc.

In addition to the typical considerations in other process industries and applications, the bio-pharm industry always intends to address matters of sterility, aesthetics, and a clean process environment. To achieve this, the process area is routinely subjected to a thorough washdown using caustic media.

## What to Know Up Front

Most types of valves can be fitted with pneumatic or electric actuators to allow the valves to be controlled remotely or by an automation system for flow regulation or on/off service. Actuators can be outfitted with a variety of features, such as open/closed position feedback switches, analog positioners and position feedback outputs, visual position indicators, travel time adjustments, battery backups for power failure response, and more.

The function of the actuator is also important. Engineers must consider the torque required, rated duty cycle, movement rate, inputs and outputs available for control, materials, IP or NEMA rating, and cost. If a problem is encountered that can only be solved by replacing or upgrading the valve or actuator, the replacement may mean much more than the cost of the parts, including labor, down time, lost production, and potential fitment issues after an installation is complete and running. In many cases, replacing a valve can necessitate fully draining a process system if isolation is not possible or practical. For these reasons, proper advance consideration of all factors to correctly select application-specific valve and actuator types is essential.

This article is divided into two major sections:

- Actuator Selection
- Controls Selection

It provides an overview of the pneumatic and electric actuators, controls and feedback devices that are available for integrating automated quarter-turn valves into a control system in the bio-pharm industries.

*It is assumed that the quarter-turn hygienic valve type and materials for a specific application(s) has already been made.*

# 1

# Understanding Valve Actuator Selection

## 1.1 Making the Decision

The decision to automate a valve is usually based on some or all of the following considerations.

- SAFETY
- RELIABLE OPERATION
- CONTROL & PROCESS SYSTEM PERFORMANCE & INTEGRATION
- INACCESSIBLE OR REMOTE VALVE LOCATION
- COST
- EXCESSIVE VALVE TORQUE
- EMERGENCY RESPONSE & WHETHER IT IS FAIL-SAFE

## 1.2 The Distinct Purpose

### 1

#### Move the valve closure member

(disc, ball, or plug) to the desired position. Not only must the actuator provide enough torque or thrust to move the closure member under the most severe conditions, it must also be fitted with the appropriate controls to direct it.

### 2

#### Hold the valve closure member in the desired position.

Particularly in throttling applications where fluids may create a dynamic torque, actuators should have adequate spring or fluid power or mechanical stiffness to overcome this phenomenon.

### 3

#### Seat the valve closure member with sufficient torque to provide the desired shutoff specification.

A butterfly valve for instance is fully seated (closed) when the disc is positioned in a resilient liner (seat). In this rotary position the valve stem torque is at its highest. Actuator sizing for torque-seated butterfly valves may require special accessories particularly on electric actuators to ensure that sufficient torque is sustained in the closed position.

### 4

#### Provide a failure mode in the event of system failure.

This may be fully opened, closed, or as-is depending upon the application. Certain failure mode requirements may eliminate electric actuators yet be ideal for pneumatic or electrohydraulic units.

### 5

#### Provide the required rotational travel (90°, 180°, etc).

Valves requiring more than 90° of rotation include multi-ported valves. A few pneumatic actuator manufacturers offer 180° actuators. For greater than 180°, electric actuators are usually preferred because they are electrically, not mechanically, limited in rotation.

### 6

#### Provide the required operating speed.

All actuators may be regulated in cycle speed depending on the control circuit elements used.

## 1.3 Actuator Speeds

### Pneumatic

Fast cycle speeds (less than one-half the standard actuator cycle time) require careful valve selection. The physical shocks associated with fast cycling can damage the valve parts—especially when combined with high cycle rates. Special preparation of pneumatic actuators—including special solenoids, piping, and quick-exhaust valves—may be required to achieve high cycle speeds.

Pneumatic actuators can be slowed using speed control valves in the air piping. One speed control valve will slow speed in one direction, while two are required to slow speed in both directions. Speed controls do not affect the output torque of pneumatic actuators.

### Electric

Because they are geared motors, the cycle speeds of electric actuators cannot be increased, only slowed. This is easily accomplished with the specification of either special cycle times or with the addition of an electronic speed control card.

Special cycle times are achieved with a different gearing mechanism which also affects output torque. The electronic speed control is infinitely adjustable and can reduce the effective actuator speed up to 20 times without the need for special gearing. Output torque of the actuator is not affected where speed cards are used.

## Pneumatic and Electric Actuators Compared

At times it is necessary for a process engineer to choose between a pneumatically or an electrically actuated valve for a process system. There are advantages to both styles, and it is valuable to have data available to make the best choice.

### Compatibility (Power Source)

First and foremost, in the selection of an actuator type (pneumatic or electric) is to determine the most effective power source for the actuator.

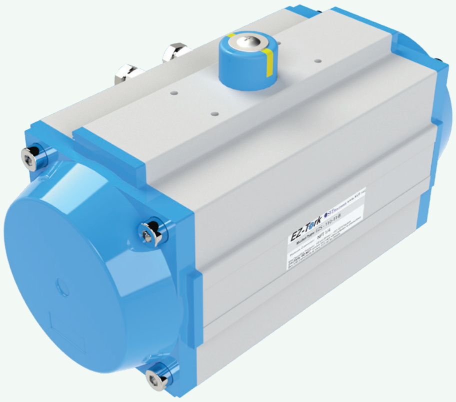
*Points to consider are:*

- Power source availability
- Torque at the valve stem
- Failure mode
- Control accessories
- Speed of operation
- Frequency of operation
- Plant environment
- Size of valve
- System component costs
- System maintenance

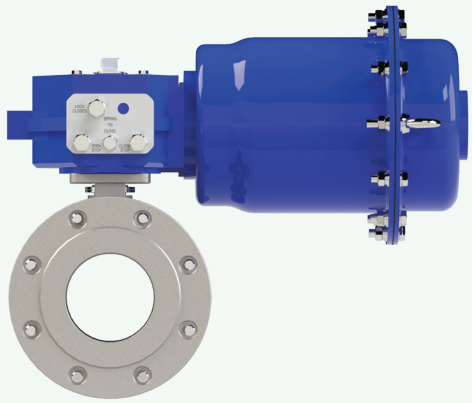
The most practical pneumatic actuators utilize an air pressure supply of 40 to 120 psi (3 to 8 bar). Generally, they are sized for a supply pressure of 60 to 80 psi (4 to 6 bar). Higher air pressure is usually difficult to guarantee (even potentially dangerous) and lower pressures require a very large diameter piston or diaphragm to generate desirable operating torque.

Electric actuators are often used with a 110 VAC power supply but are available with a wide variety of AC and DC motors in single phase and three phase.

# 1.4 Types of Quarter-Turn Pneumatic Actuators



Double Rack & Pinion



Spring & diaphragm

## Temperature range

Both pneumatic and electric actuators may be used in a wide temperature range. The standard temperature range of a pneumatic actuator is from -4 to 174°F (-20 to 80°C) but may be extended to -40 to 250°F (-40 to 121°C) with optional seals, bearings and grease. If control accessories are used (limit switches, solenoid valves etc.) they may not have the same temperature rating as the actuator, and this should be considered in all applications.

In low temperature applications the quality of the supply air in relation to dew point should be considered. Dew point is the temperature at which condensation occurs in air. Condensate may freeze and block air supply lines making the actuator inoperable.

Electric actuators are available in a temperature range of -40 to 150°F (-40 to 65°C). When used outdoors an electric actuator should be sealed from the environment to prevent the introduction of moisture to the internal workings. Condensation may still form inside, if drawn from the power supply conduit, which may have captured rainwater prior to installation. Also, since motors warm the inside of the actuator enclosure when it is operating and cools it when it is not, temperature fluctuations may cause environmental “breathing” and condensation. For this reason, all electric actuators used outdoors should be fitted with a heater.

## Hazardous Areas

It is sometimes difficult to justify the use of electric actuators in a hazardous environment, but if compressed air is not available or if a pneumatic actuator will not provide the operating characteristics required, then an electric actuator with a properly classified enclosure may be used.

## NEMA guidelines

The National Electrical Manufacturers Association (NEMA) has set up guidelines for the construction and installation of electric actuators (and other electrical devices) for use in hazardous areas. The NEMA VII guideline reads:

> VII Hazardous Location Class I (Explosive Gas or Vapor) Meets application requirements of National Electrical Code; conforms with specifications of Underwriters' Laboratories, Inc., used for atmosphere containing gasoline, hexane, naphtha, benzene, butane, propane, acetone, benzol, lacquer-solvent vapors, and natural gas.
>
> Almost all electric actuator manufacturers have an option for a version of their standard product line that conforms with NEMA VII. Another source for hazardous area guidance is available from ATEX.
>
> On the other hand, pneumatic actuators are inherently "explosion-proof". When electric controls are used with pneumatic actuators in hazardous areas, they are generally more cost effective than electric actuators. Solenoid- operated pilot valves (which are electrical devices) may be mounted and powered in a non-hazardous area and piped to the actuator. Limit switches -for position indication- may be housed in a NEMA VII enclosure. The inherent safety of pneumatic actuators in hazardous areas makes them a practical choice in these applications.

## Spring Return

Another safety accessory widely specified in the process industries on valve actuators is the spring-return (fail-safe) option. Upon power or signal failure a spring-return actuator drives the valve to a pre-determined safe position. This is a practical and inexpensive option with pneumatic actuators and is an important reason for the wide use of pneumatic actuators throughout the industry.

Electric actuators are available with a spring return option or a battery backup system to provide predictable "failure" positioning.

## Performance characteristics

Before specifying a pneumatic or electric actuator for valve automation it is important to consider a few of the key performance characteristics of each.

## Duty cycle

Pneumatic actuators have a 100 percent duty cycle. In fact, the harder they work, the better they work. Electric actuators are most commonly available with 25 percent duty cycle motors. This means that to prevent overheating in high cycle applications the motor must rest frequently. Because most on-off automated valves remain idle 95 percent of the time duty cycle is not usually an issue. With optional motors and/or capacitors an electric actuator may be upgraded to 100 percent duty cycle.

## Stalling

Pneumatic actuators may be stalled indefinitely without overheating.

Electric actuators should not be stalled. Stalling an electric actuator draws excessive current, which generates heat in the motor and can cause damage. Torque switches or heat and current sensors are often installed in electric actuators to protect the motor.

## Speed control

The ability to control the speed of a pneumatic actuator is an important advantage of the design. The simplest way to control the speed is to fit the actuator with a variable orifice (needle valve) at the exhaust port of the air pilot. Since electric actuators are geared motors it is impossible to make them cycle faster unless a gearing change is made. For slower operation a pulsing circuit may be added as an option.

## Modulating control

In modulating service an electric actuator interfaces well with existing electronic control systems and eliminates the need for electro-pneumatic controls. A pneumatic or electro-pneumatic positioner is used with pneumatic actuators to provide a means of controlling the valve position.

## Torque-to-weight ratio

Electric actuators have a high torque-to-weight ratio above 4,000 lbf.in. (450 Nm). Pneumatic actuators have an excellent torque-to-weight ratio below 4,000 lbf.in. In bio-pharm systems where tubing is typically used in the piping design, being aware of product weights is helpful.

## Summary of pneumatic and electric actuators

This table of characteristics summarizes the comparison of pneumatic and electric actuators.

| | PNEUMATIC | ELECTRIC |
|---|---|---|
| HAZARDOUS AREAS/NEMA | Inherently explosion-proof, spark-proof | Available with NEMA VII enclosure for hazardous damage |
| SPRING RETURN | Spring-Return (fail-safe) option is practical and economical | Available in Spring-Return or Battery Backup configurations |
| DUTY CYCLE | **100%** duty cycle | **25%** standard duty cycle. May be upgraded. |
| STALLING | May be stalled indefinitely | Should not be stalled |
| SPEED CONTROL | Simple, accurate, and inexpensive speed control | A pulsing circuit may be added to slow the operating speed |
| TORQUE - to - WEIGHT RATIO | Averages **123:1** at 1500 lbf • in (170 N • m) | Averages **44:1** at 1500 lbf • in (170 N • m) |

## 1.5 Addressing Corrosive Environments

For applications in corrosive environments pneumatic and electric actuators are available with some or all of these solutions. Basic actuator coatings are typically hard anodized aluminum but can also be produced with coatings such as polyurethane or epoxy. They are also available in non-metallic or stainless steel.

## 1.6 Actuator Sizing

The most important step in developing an automated valve specification is to determine a sizing criterion. If a valve is to operate in a process handling clean liquids at moderate pressures and temperatures, the manufacturer's published operating torque is usually adequate for actuator sizing. Under certain conditions, however, the torque required to operate a valve may increase. In this case a sizing safety factor may need to be applied based on the following guidelines:

| MEDIA & SERVICE FACTORS | | | |
|---|---|---|---|
| MEDIA | Multiplier | SERVICE | Multiplier |
| Clean, particle free, non lubricating (water, alcohol, etc) | 1 | Simple On & Off Operations | 1 |
| Clean, particle free, lubricating (oils, hydraulic fluid, etc) | 0.8 | Manual Throttling Service | 1.25 |
| Slurries or heavily corroded and contaminated systems | 2 | Positioner Control | 1.5 |
| Gas or saturated steam, clean and wet | 1 | Once per day operations (on/off) | 1.2 |
| Gas or superheated steam, clean and dry | 1.3 | Once every two days or a "Plant Critical" operation (on/off) | 1.5 |
| Gas dirty unfiltered (natural gas, chlorine) | 1.5 | Once per month or less frequently (on/off) | 2 |
| Liquid, black liquor, lime slurry | 1.8 | Applications below -20˚F | 1.25 |
| Liquid, viscous, molasses | 1.3 | | |

**NOTE: Consult the valve manufacturer for Specific Safety Factors recommendations**

## 1.7 Control and Connect

Once an actuator type has been chosen the next step is to determine the type of control and feedback that is required for the process control system.

*See Section #2 "Selecting Automation Accessories for Valves".*

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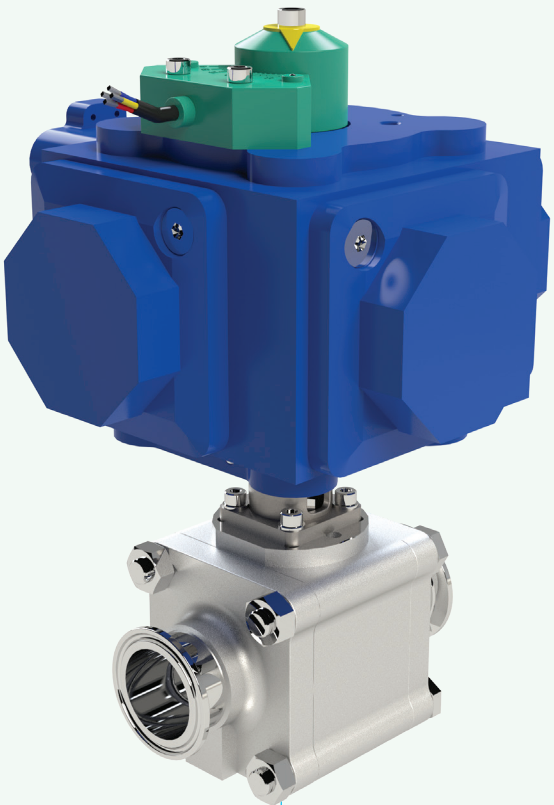
# Selecting Automation Accessories for Valves

# Today's process controls range from complete computer systems to the staff-monitored electromechanical type



(push buttons, heavy-duty relays, etc). In the process area, there may also be pressure switches temperature controllers, or other process-monitoring devices that must tie into the control valve and therefore the actuator.

It is not uncommon, in bio-pharm systems, to locate some control accessories - such as pilot valves for actuators - in a local cabinet from where air pressure is run to the actuators. This helps reduce the number of components in the process area that may create opportunities for contamination. It is also a way to reduce the presence of maintenance personnel on the process floor.

The pneumatic actuator is the workhorse for the automation of quarter-turn valves. When selecting a pneumatic rotary actuator for valve control in process applications, it is important that it be compatible with other components of the control system (power medium, control signals, etc), the environment (corrosion, temperature), the system (speed, cycle frequency, fail mode), and, of course, the valve.

To work well with an existing control network, the pneumatic actuator must be available with a few basic control accessories.

**Solenoid Valve** — *As a pilot device, available in various voltages and construction for the area classification*

**Limit Switches** — *For indicating valve position, sequence cycling, alarms, etc*

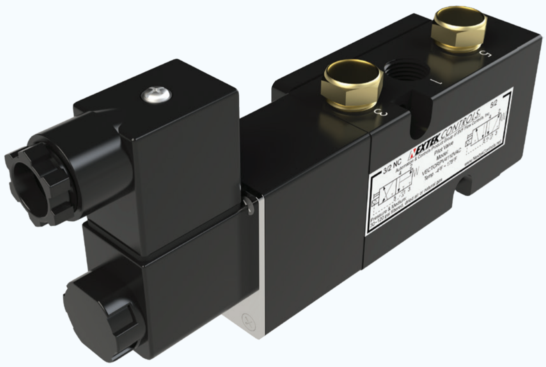
**Positioners** — *To throttle the valve in response to a varying control signal*

For environmental compatibility, the actuator should be available with corrosion-resistant (anodized, stainless-steel) trim, various coatings (polyurethane, epoxy, etc.), and weatherproof, hazardous-area, or intrinsically safe control accessories.

# Pilot Valve

A pilot valve for a pneumatic actuator is a control device that receives a manual or power signal and then directs air pressure to the air inlet ports of the actuator to drive it to the desired position. The most common type of pilot device is the solenoid-operated valve. As an electric device, it readily interfaces with widely used control systems and may also be supplied with low-wattage coils for compatibility with computer control signals.

*Pilot valves for pneumatic actuators are categorized by the number of port openings or ways air may flow through them.*



For instance, a three-port (three-way) valve has a pressure port, output port, and exhaust port. The three-way valve is a logical choice for spring-return pneumatic actuators because only one air chamber is alternately pressurized or exhausted in normal operation.

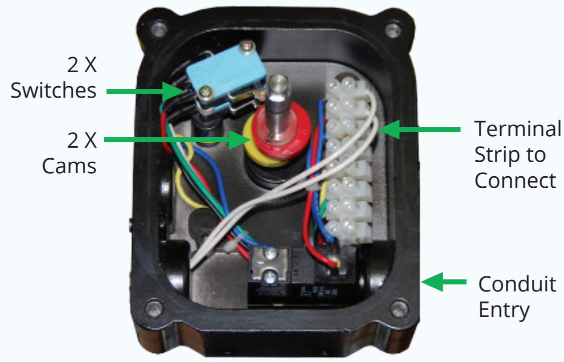
A four-way valve has a pressure port, two output ports, and an exhaust function. The two output ports will pressurize one or the other chambers of a double-acting cylinder and so it is used with these types of pneumatic actuators.

# Limit Switches

For a pneumatic actuator, the term limit switch may be a misnomer. The term more properly applies to electric rotary actuators that are fitted with limit switches to interrupt the power to the motor when the actuator has reached its desired limit of rotation. As a functional term, "position-indicating switch" (or Feedback Switch) is more properly applied to limit switches when they are used with pneumatic actuators.

Indeed, a switch fitted to a pneumatic actuator does not limit its travel but instead indicates (through switches) when the actuator has reached, or has not reached, a specified point of rotation.

*Also referred to as a switch box, the position-indicating switch box encloses the switch elements, cams, and terminal strip and has a rotating input shaft that is fitted to the auxiliary shaft of the actuator to pick up rotary motion.*




The switch housing is composed of an input shaft that externally couples to the actuator's auxiliary drive shaft and is fitted internally with adjustable cams, snap-acting switches that are mounted to align with the cams and a terminal strip for incoming wiring. As the actuator cycles, the input shaft of the switch box rotates, and the cams actuate the switches. When the switches are used to indicate the limits of the cycle, the cams are adjusted to operate the switch when the desired position is reached.

Position-indicating switches are used for a variety of applications: light indication (powering indicator lamps on a control panel), system sequence cycling, alarms, electrical interlocking, etc. Some switch enclosures may be fitted with other devices, such as a potentiometer or position transmitter for continuous feedback of the valve's position.

When the switches are connected to signal lights, they should be arranged so that both lights are on in mid-travel, with one or the other being extinguished at the ends of travel. This helps the operator avoid being misled by a burned-out lamp.

Switch boxes for pneumatic actuators are often specified by the type and quantity of switches required. Examples of the types of switches available are mechanical (snap acting) and proximity.

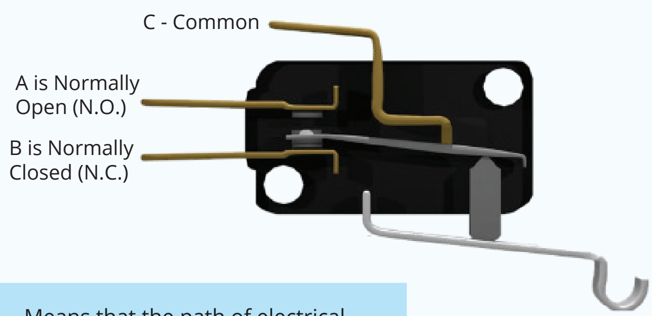
## Mechanical Switches

These switches are also called “Snap Acting” switches as there is a distinct sound (snap) as the contacts shift within the switch.

Mechanical switches are usually expressed in terms of the number of poles and throws they contain. A pole is a component of the switch that is moved by the switch action to make or break electric contact. The possible electric connections that can be made by a given pole are called throws.

There are four configurations of electric limit switches: single-pole-single-throw; single-pole-double-throw; double-pole-single-throw; and double-pole-double-throw.

| SPDT Switch *(Single Pole Double Throw)* | |
|---|---|
| Normally* **OPEN** | Means that the path of electrical flow (circuit) between the ‘**C**’ contact and ‘**A**’ is “open” when the switch is at rest. |
| Normally* **OPEN** | Means that the path of electrical flow (circuit) between the ‘**C**’ contact and ‘**B**’ is “made” when the switch is at rest. |



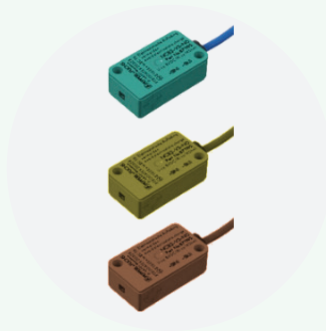

**Normally* - there is no contact by the cam, or at rest.*

## Proximity Switches

These switches/sensors operate when a metallic or magnetic object is brought into proximity with the switch sensing area. These switches are inherently protected against dust and moisture and some require a power circuit. Two types of proximity switches are the proximity sensor and reed switch.

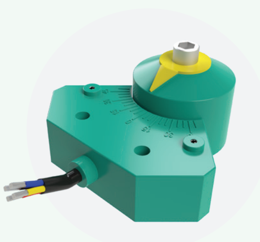
## Inductive Sensors

Inductive sensors are switches that operate when a metallic object is brought into proximity with the sensing face. Most inductive sensors comply with several NEMA ratings. The sensors are protected against dust, moisture, and oil. Internal solid-state circuitry prevents shock and vibration from affecting sensor operation. They require power to operate as the sensing area is a field of electro-magnetism.



## Reed Switches

Another low-current proximity switch (250 to 500 mA) is the reed switch. Action is initiated when a ***magnet*** is placed in the proximity of the sensing area. ***Reed switches do not require a power supply***.

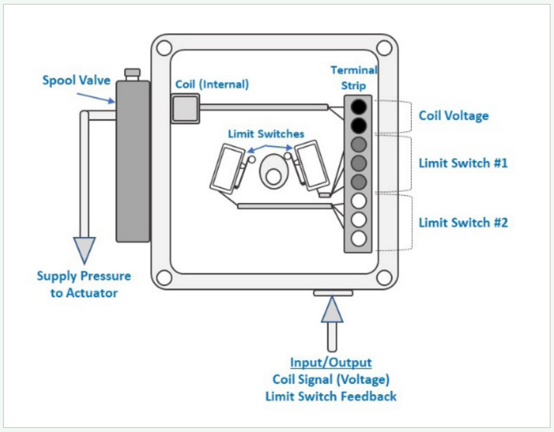



### *Major advantages of reed switches:*

- **Fully hermetically sealed metal contact.**
- **Reed switches can operate in moist and dust ambient conditions**
- **Temperature variation from -60°C to +155°C. (-76°F to 311°F)**
- **Zero power to operate**

*A common practice, when switches are required on a valve actuator, is to specify a low profile, hermetically sealed device that is produced from a non-metallic housing to resist washdown and corrosion.*

# A Fully Integrated Solution




Because it is common that both a feedback limit switch and a pilot valve are part of a typical automated valve package, there are fully integrated devices that incorporate both of these elements into one enclosure. A good example is the ***Nexus-LP*** from ***SVF Flow Controls***.

*At least one advantage of this product is that the field wiring connects through a single conduit entry tying both the pilot valve power wiring and the feedback terminals of the limit switches.*

# Other methods of position indication

If continuous monitoring of an actuator's position is required, as in modulating or "jogging" applications, a switch box may be fitted with a potentiometer. As the shaft of the switch box rotates, it likewise rotates the input shaft of the potentiometer. The continuously decreasing or increasing resistive signal may then be converted into a valve position at the control panel. When the actuator is located far from the control system, the result may be an unreliable resistive signal due to the inherent resistance of the long wire. In this case a resistance-to-current transducer circuit may be preferred. The circuit board is usually installed in the switch box with the potentiometer and provides a 4-to-20 mA signal to continuously indicate valve position. See "Transducers" below.

# Electrical Enclosures

Switch boxes designed for use in explosive environments (hazardous areas) must be able to withstand an internal explosion without igniting the explosive mixture surrounding the switch enclosure. The enclosure is thus designed to withstand the maximum expected internal explosion pressure without damage or excessive distortion and to provide venting for the pressure through channels of such dimensions that gases will be cooled below the ignition temperature before reaching the surrounding atmosphere. Thus, the design of a hazardous area switch enclosure involves careful consideration of housing thickness, cover fit, and tolerances.

Many switch enclosures incorporate multiple construction standards that are listed by the National Electrical Manufacturers Association (NEMA IV, VII, IX, etc.) to satisfy a wide range of applications. Hazardous area device selection and area definitions are also covered by ATEX.

# Selecting Controls for Modulating Valve Applications

## Pneumatic Positioners

When a valve is used for modulating/throttling rather than simple on-off service, it may be considered a rotary control valve. A control valve is a process control element that varies the flow of fluid as required by a process in response to a system control signal. To provide fast, sensitive, and accurate positioning in response to a control signal, an actuator must be fitted with a pneumatic positioner. A pneumatic positioner is basically a relay that senses and compares an instrument signal and the valve stem position. Because it is usually mounted to the top of a rotary actuator it senses valve position through the actuator shaft.

Most basic positioners have linear characterization. This means that the input signal to output rotation is directly proportional, which enables the process engineer to select a valve that will provide system characteristics. Standard ball valves, for example, provide equal percentage flow like many other quarter-turn valves do.

**TERMS ASSOCIATED WITH POSITIONERS**

**Direct Acting**
Increasing input signal opens the valve (increases flow).

**Reverse Acting**
Increasing input signal closes the valve (decreases flow).

**Resolution**
The smallest possible change in valve position.

**Deadband**
The maximum range through which the input signal can be varied without initiating change in valve position.

**Hysteresis**
The maximum difference in valve position for a given input signal during a full range traverse in each direction.

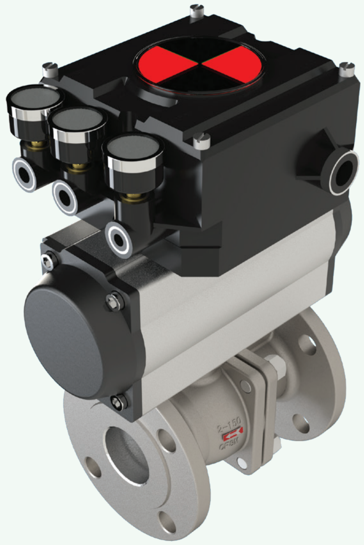
# Transducers

A transducer is a device that converts one signal type to another. In the case of control instrumentation, a current-to-pneumatic transducer accepts an analog milliamp control signal from a field instrument and converts it to a proportional pneumatic signal for the positioner. The most common conversions used with control valves are for systems being controlled and monitored with electronic instrumentation but with pneumatically actuated control valves. The use of a transducer is the most practical method for interfacing the two types of equipment. As an electromechanical device, a transducer must be carefully selected for environmental compatibility, hazardous areas, sensitivity, vibrations, etc.

One drawback of transducers is that it is sometimes difficult to locate them near the positioner, which may then require long runs of wire or pneumatic tubing. To satisfy this, some manufacturers have integrated the transducer into the positioner. These hybrids are known as electro-pneumatic positioners.

# Standard instrument signals

Instrument signals are used to interface between various elements in the control process. Information may be transmitted from a sensor to a controller, or a controller to an actuator, etc. Standard instrument signals allow a wide variety of products made by different manufacturers to work together. Common standard instrument signal ranges are shown below.



The high end of a standard instrument signal range is usually 5 times the value of the low end. For instance, 20mA is 5 × 4 mA, 15 psi is 5 × 3 psi, etc. The low end usually does not have a value of zero. This provides a positive method of determining the difference between a device that is indicating the low end of a range and a device that is not functioning. This is known as live zero.

The main exceptions to these conventions are resistance-type inputs which usually have a low end of zero and various values of high ends.

Split ranges are usually fractions of standard instrument signals. For example, 3 to 15 psi is often split into 3 to 9 psi and 9 to 15 psi, each of which is half of the standard range. Split ranging is a process by which the input signal range [3 to 15 psi (0.2 to 1 bar)] is used to pilot two control valves. In practice, the first control valve cycles through its full stroke in the range 3 to 9 psi (0.2 to 0.6 bar), and the second valve strokes through the 9 to 15 psi (0.6 to 1 bar) range.

In pneumatic devices, pressure [psi (bar)] is the usual variable for instrument signals. In electric devices, the variable may be current (mA), DC voltage (VDC), or resistance [ohms (O)]. The following table gives instrument signal ranges for pneumatic and electric devices.

**Instrument Signal Ranges**

| RANGE TYPE | STANDARD | SPLIT |
|---|---|---|
| Pneumatic Pressure (PSIG) | 3 to 15 | 3 to 9<br>9 to 15 |
| Electric DC Current, mA | 4 to 20 | 4 to 12<br>12 to 20 |
| Voltage VDC | 1 to 5<br>10 to 50 | 1 to 3<br>3 to 5<br>10 to 30<br>30 to 50 |
| Resistance, Ohms | 0-10k<br>0-5k<br>0-135 | |

## Uses of a pneumatic positioner

1 Temperature control

2 Level Control

3 Split ranging

4 Loops with slow response

5 Reverse action relative to actuator

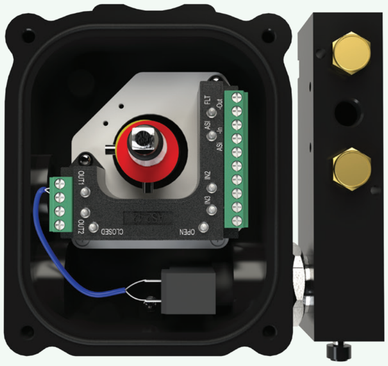
*Split ranging is a process by which the input signal range [3 to 15 psi (0.2 to 1 bar)] is used to pilot two control valves. In practice, the first control valve cycles through its full stroke in the range 3 to 9 psi (0.2 to 0.6 bar), and the second valve strokes through the 9 to 15 psi (0.6 to 1 bar) range.*

Positioners are available in a variety of materials of construction, accessories, characterized cams, position transmitters, and integral transducers.

# About Bus Protocol

*Wiring of automated valves can be done by hard wiring each input and output to the process automation system or by a network or bus system, such as Modbus, PROFIBUS, DeviceNet, or Ethernet. Using networking solutions can be highly advantageous, especially with large numbers of valves and multiple control inputs and outputs per valve.*

## Two-Wire Control (As-I)



An increasingly common technique for controlling and communicating with automated valves in process areas is Two-Wire Control.

Based on various bus protocols (DeviceNet, As-I etc.) there are a variety of systems that cover simple on/off valve control to full system integration, diagnostics and control. The choice becomes a plant/platform-wide decision.

AS-Interface (Actuator Sensor Interface, AS-I) is designed for connecting simple field I/O devices (such as actuators and valve position sensors) in discrete process applications using a single 2-conductor cable. AS-Interface is an 'open' technology supported by a multitude of automation equipment vendors. It is a networking alternative to the hard wiring of field devices, and it can be used as a partner network for higher level fieldbus networks such as Profibus, DeviceNet, Interbus and Industrial Ethernet. It offers a low-cost remote I/O solution.

### Applications

Systems that utilize 8 or more valve actuators can benefit from Bus Technology. Typically these systems have automated valves controlled by a programmable logic controller (PLC).

## AS-Interface vs. Conventional System

AS-Interface is a versatile, low cost alternative to traditional hard wired I/O. It can replace traditional point-to-point wiring with a better, more flexible solution that is easier to install, operate and maintain and easier to re-configure.

### Conventional System

Typical batching valve wiring networks attach each of the inputs and outputs (I/O) to a central location resulting in multiple wire runs for each field device. Large expenditures are needed for cabling conduit, installation and I/O points. Space for I/O racks and cabling must be accommodated in order to attach only a few field devices.

### AS-Interface Network

A simple gateway interfaces the network into the field communication bus. Data and power are transferred over the two-wire network to each of the AS-Interface compatible field devices.

Each valve communication module contains an AS-Interface ASIC and other electronics to gather open or closed position status and power solenoid or other ancillary devices on or off. Other AS-Interface modules are available to gather inputs and switch power outputs.

**FEATURES**

- Ideally suited for on/off batch process valves and other discrete applications
- 62 field devices per network master
- Simple electronics for economical and robust performance
- Transfer medium is unshielded two-wire cable for both data and power supply
- Signal transmission has high tolerance to EMI
- Easy to install providing the greatest cost savings with the least complexity
- Free choice of network topology allows optimized wiring network
- Variety of gateways available to seamlessly tie into high level bus networks

# In Closing

A process control scheme will likely be developed for very specific outputs, rates and materials. It may also need to address pressure and temperature conditions and hazardous area locations. With the many options, classifications and control solutions available today it is always a good idea to work with a highly experienced automation supplier.

# About the Author

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