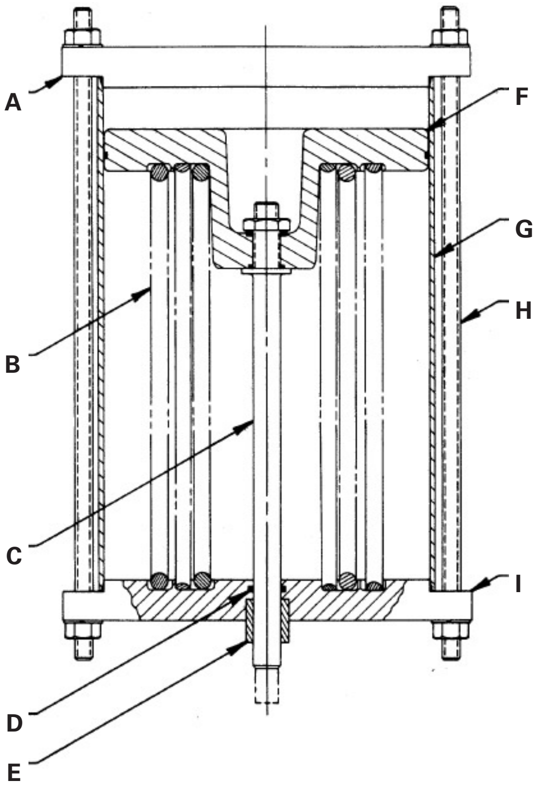
Pneumatic Actuators

CCI Pneumatic Actuators—High performance based on over 30 years' experience



A	Upper Cap
B	Spring(s)
C	Shaft
D	O-Ring
E	Bushing
F	Piston
G	Cylinder
H	Stud
I	Lower Cap

Figure 1: Fail-Open Actuator Assembly

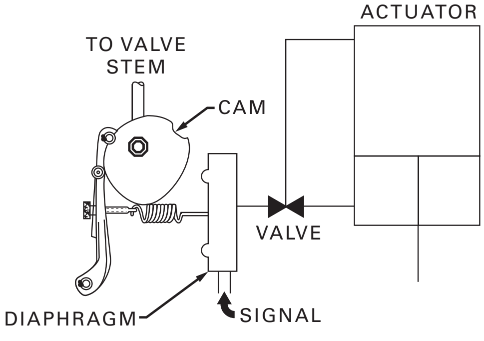


Figure 2: Operational Schematic

As process control requirements become more stringent, buying the proper control valve/actuator system becomes increasingly important. One of the most cost-effective methods of accurately controlling a fluid process is with a CCI DRAG® control valve and a high-performance pneumatic actuator. CCI's pneumatic actuator can be custom-tailored to meet your most demanding control specifications. CCI's control expertise and experience is proven through our application of these high-performance actuators to the most demanding applications the industry has to offer.

The CCI pneumatic actuator is a piston type unit operating from plant air for stiffness and thrust. Thrust capabilities are available up to 40,000 pounds at 100 psig supply. Actuator control is through a variety of positioners that can accommodate virtually any signal range, e.g., 4–20 mA, 3–15 psig (0.2–1.0 kg/cm²), 3–27 psig (0.2–1.8 kg/cm²). CCI pneumatic actuators can easily be split-ranged when valves are installed in parallel for greater rangeability.

The standard fail-open configuration can be seen in Figure 1. Actuators which fail closed or lock in place are also available. A handwheel-operated manual override is available for those valve which may require stroking in a power failure condition. The standard actuator includes an integral bypass valve to equalize cylinder pressures when the override is used. Field experience has shown this configuration to be extremely reliable and trouble-free for years. The standard materials can be seen in Table 1.

CCI actuators come in five sizes in various thrust loads required. The five sizes are 50 in² (322 cm²), 113 in² (729 cm²), 200 in² (1,290 cm²), 313 in² (2,019 cm²) and 400 in² (2,580 cm²).

The actuator size, stroking time, and resolution are determined using a computer program, with input as specified by the customer's needs. Typical actuator sizes for given valve sizes can be seen in Table 2.

Sufficient air supply at the valve is important to ensure proper operation. CCI actuators will operate with supply air pressure up to 150 psig (10 kg/cm²), and as low as 40 psig (3 kg/cm²). Operation outside these limits requires special sizing for unique circumstances. The air line to the valve must be large enough to minimize pressure drops and ensure adequate flow when a high stroking speed is required.

Air consumption (in SCFM) can be estimated by calculating the swept volume:

V_s = Swept volume = Area (in²) × Stroke (in)
and dividing by the stroking time t (in seconds):
$Q_1(\text{CFM}) = 60V_s/1728\ t$
To convert to SCFM
$Q_2(\text{SCFM}) = Q_1 P_s/14.7$
where: P_s = Supply Pressure (in psia)

Air lines must be sized for no more than 5 psig pressure drop at the actuator inlet, at the flow rate calculated above.

Description of Operation (Figure 2)

As the control signal (electrical or pneumatic) varies, the air pressure on one side of the positioner diaphragm changes. This moves the diaphragm, and with it the spool in the positioner valve moves. This valve supplies air to one side of the piston and vents the other side, which moves the stem in the desired direction. As the stem moves, it rotates a cam (through a linkage) which applies tension to the diaphragm, until a force balance is restored to the diaphragm and it returns to its neutral position, which closes the positioner valve and stem movement stops. The positioner is not affected by

Table 1: Material

Part	Material
End Caps	Aluminum
Spring	Steel
Shaft	SS
O-Ring	Buna-N*
Yoke	Steel
Cylinder	Amalgon* (filament wound reinforced epoxy)
Tubing	SS
Fittings	SS
Bolting	Plated Steel

Table 2: Typical Valve Stroke

Valve Size		Typical DRAG® Valve Stroke
< 4″	50 in^2	3½″
4″ – 8″	113 in^2	6″ > 8″
8″ – 12″	200 in^2	10″ > 12″
12″ – 20″	313 in^2	14″ > 20″
> 20″	400 in^2	> 20″

Table 3: Typical Valve Stroke

	Low Temp. –20 to 450°F (–29 to 232°C)	High Temp. 450 to 1050°F (232 to 566°C)
Dead Band	1%	2%
Hysteresis	1%	2%
Resolution	1%	2%
Linearity	3%	3%

supply air pressure fluctuations, as long as the supply remains above 60 psig (4 kg/cm^2). The positioner's outputs may signal boosters if faster stroking speed is required. Since the positioner is a closed loop device, it is highly accurate and resistant to changes in forces on the stem, due to changes in the process. This results in excellent fluid control under severe conditions of high flow rates and high pressure drops.

Actuator Performance

Presented here as examples are some data from standard models, and some from ultra-high performance actuators for specially demanding applications. Please note that these values are typical of installed use and are not the laboratory figures.

Static Performance

The static performance criteria relate valve position to the input signal, and are influenced by friction and valve hydraulic loads.

Dead band is the measure of the smallest change in control signal required to achieve any stem movement. It is sometimes referred to as sensitivity.

Resolution is the smallest change in stem position possible, in response to a change in control signal equal to dead band.

Hysteresis is the difference in stem position for the same control signal when approached from upscale and downscale.

Linearity is a measure of the deviation from an ideal straight line along the position versus signal graph.

The values in Table 3 are typical in service for DRAG® valves:

CCI is fully equipped to conduct actuator performance testing, both static and dynamic per ISA S26. Source inspection is also available.

Dynamic Response

Dynamic response parameters measure the valve's position as a function of time when the signal is changing. Common parameters for dynamic response are over or undershoot, or time to stabilize in response to a step input, and frequency response at –3dB for sine wave testing. Specifying these parameters is not cost effective unless the dynamic response of the valve is crucial to the rest of the system.

At CCI, if dynamic response requirements are present, a control schematic is designed so as to ensure compliance. Computer simulation of pneumatic actuator response to step and sine wave signals enables our project engineer to meet your control element needs. Because of the custom nature of these schematics no data will be presented here, but your CCI representative can consult the factory about your requirement.

Stroking Speeds

Typical stroking speeds for DRAG® valves vary from .25 in/sec. to 2 in/sec., with speeds up to 6 in/sec. in modulating mode and 12 in/sec. in on-off operation. These specifications translate into stroke times from less than one second to more than 30 seconds. Our computer simulation allows us to select a control circuit to meet the needs of your application.

Fail Modes

Fail modes available include fail-open, fail-closed, and fail in place, with solenoid trip modes including open and closed, plus special circuits for other requirements including redundancy and multiple fail modes.

Table 4: Standard Actuators

Typical Stroke	0-6	8-12	14-18	20-24
50 in^2 (322 cm^2)	Yes	-	-	-
113 in^2 (729 cm^2)	Yes	Yes	-	-
200 in^2 (1290 cm^2)	-	Yes	Yes	-
313 in^2 (2019 cm^2)	-	-	Yes	Yes
400 in^2 (2580 cm^2)	-	-	Yes	Yes

All sizes available as fail-open, fail-closed or fail in place.

As an example of CCI's capabilities in pneumatic actuator performance, the following data are from a high performance actuator supplied to an electric power utility for 500°F (260°C) steam turbine bypass service:

Actuator:
113 in^2 (729 cm^2)
Fail Closed
Manual Override Option
12-inch (30.5 cm) Stroke
Redundant Solenoid Trip Mode

Stroke Speed:
2 seconds—open
2 seconds—closed

Dead Band:
1.5%

45%-55% Step:
< 1% Overshoot
< 5 seconds to position

Sine Wave Response:
–3dB at 3Hz with no resonance to 2 Hz

This specification was met on 24 valves supplied.

Factory Adjusted

Every actuator built at CCI is fully factory adjusted and inspected before shipment. Positioner travel and gain adjustments are made, as are pressure settings and volume booster and limit switch settings (if the actuator is so equipped). In addition to any customer performance requirements, every actuator is put through our series of operability tests, including stroking speed and fail mode tests. Our commitment to quality ensures a highly reliable product.

Other Actuators

Virtually any type of actuator may be used on a DRAG® valve. Electromechanical actuators are used for modulating duty, where stroking speed may be low and high stiffness is required, or in locations where only electrical power is available. Hydraulic actuators, either self-contained (electric or air pump with each unit) or externally-powered, may also be used for certain applications. Advantages may include dynamic response, static performance and excellent thrust.

The Bottom Line:

BETTER CONTROL INCREASES EFFICIENCY.

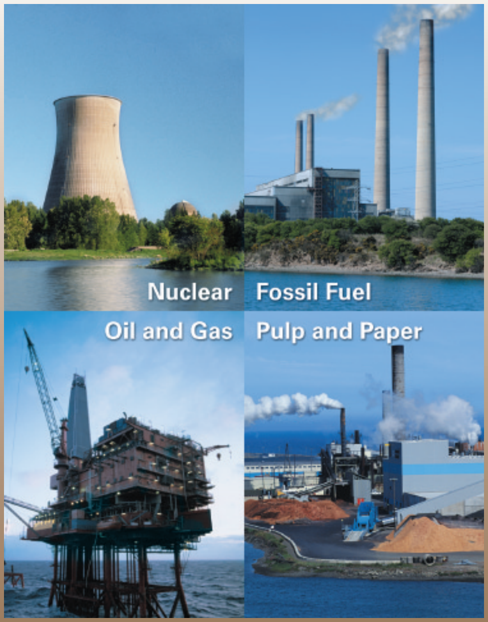
The best way to get better process control is by specifying a CCI DRAG® valve with a high performance pneumatic actuator. With high reliability and excellent control, your process will perform most efficiently. Over 30 years of building control valves for demanding service enables us to custom design an integrated control system optimized for your application.

CCI World Headquarters— California
Telephone: (949) 858-1877
Fax: (949) 858-1878
22591 Avenida Empresa
Rancho Santa Margarita, California 92688 USA

CCI Korea
Telephone: 82 31 985 9430
Fax: 82 31 985 0552/3
26-17, Pungmu-Dong
Kimpo City
Kyunggi-Do 415-070
South Korea

CCI Switzerland
formerly Sulzer Thermtec
Telephone: 41 52 262 11 66
Fax: 41 52 262 01 65
Hegifeldstrasse 10, P.O. Box 65
CH-8404 Winterthur
Switzerland

CCI Japan
Telephone: 81 726 41 7197
Fax: 81 726 41 7198
194-2, Shukunosho
Ibaraki-City
Osaka 567-0051
Japan



We Solve Control Valve Problems

DRAG CONTROL VALVES

SULZER Valves

info@ccivalve.com
www.ccivalve.com

211 ■ 08/00 2.5M