# Control Valves
# HB-Series

## Watson Mc Daniel HB-Series Control Valves

- 2-Way and 3-Way Valves
- Sizes: 1/2 - 4"
- Threaded (NPT/BSPT) and Flanged (ANSI/DIN)
- Stainless Steel Bodies
- Pneumatically-Actuated and Electrically-Actuated

A **Control Valve** is a device capable of modulating flows at varying degrees between minimal flow and full capacity in response to a signal from an external control device to the valve's actuator. The valve modulates flow through movement of a valve plug in relation to the port(s). The actuator, which can be pneumatically or electrically operated, directs the movement of the stem as dictated by the external control device.

## 2-Way Valves

**2-Way Valve**
(shown with)
**Pneumatic-Actuator**

**2-Way Valve**
(shown with)
**Electric-Actuator**

## 3-Way Valves

**3-Way Valve**
(shown with)
**Pneumatic-Actuator**

**Options & Accessories:**
**Controller, Positioners, I/P Transducers, Air Regulator, Temperature Sensors & Noise Attenuation**

A **Control Valve** is one component of a control loop and relies upon other components for proper function of operation (i.e. controller, sensor, transducer, etc.).

## Control Valves with PNEUMATIC Actuator

**HB-Series 2-Way Valve** shown with Air Filter & Positioner

For **HEATING** applications, a **Normally-Closed/Air-to-Open (ATO)** Valve should be selected. If the Pneumatic Signal to the actuator is interrupted, the valve will automatically fail in the closed position to prevent overheating.

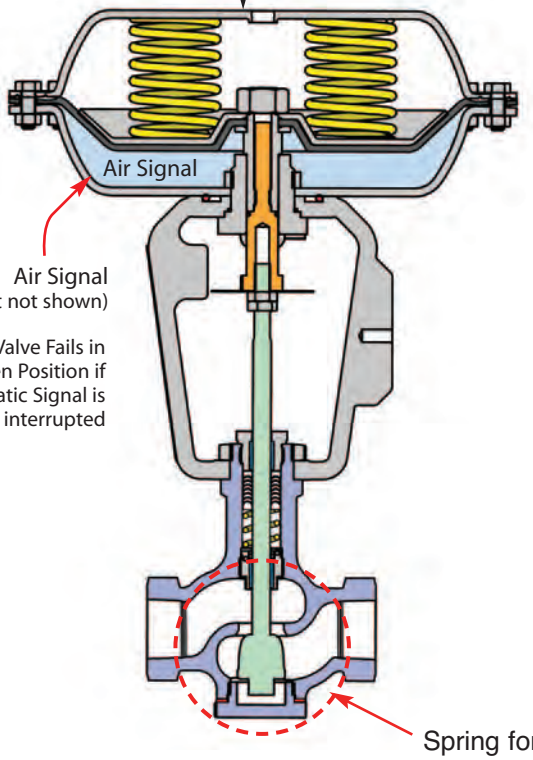
For **COOLING** applications, a **Normally-Open/Air-to-Close (ATC)** Valve should be selected. If the signal to the actuator is interrupted, the valve will automatically fail in the open position to prevent overheating.

The **Max Close-Off Pressure (PSI△P)** of the valve must exceed the inlet pressure to the valve or the valve will not operate. See Max **(PSI△P)** Chart. In applications where the Maximum Close-Off Pressure of the valve is insufficient, a **Valve Positioner** can be utilized to increase the close-off pressure capability of the valve.

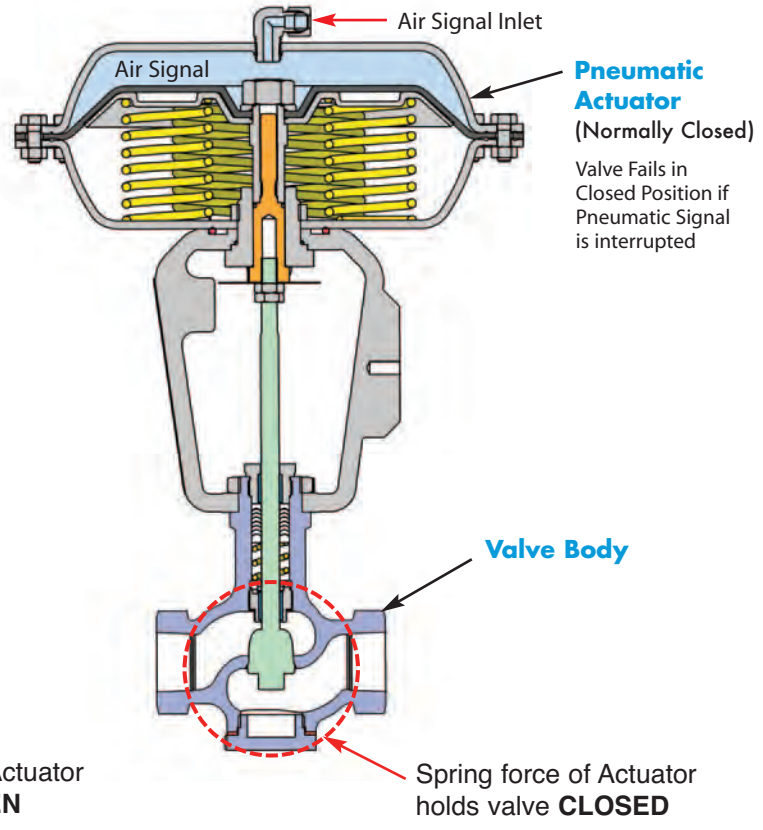
Selecting the correct size valves requires using the capacity charts or specialized sizing software which can me made availabe by the factory. Proper sizing of the control valve is an important aspect of the selection process. Be careful to not oversize the valve. See Engineering Section for more detailed information on valve selection.



**Pneumatic Actuator**
**Air-to-Close**
(Normally Open)




**Pneumatic Actuator**
**Air-to-Open**
(Normally Closed)



## Control Valves with ELECTRIC Actuators

The **HB Series** Stainless Steel 2-Way Control Valve with **Electric Actuator** is a robust, user-friendly alternative to the Pneumatically-Actuated unit. It is ideal for installations where an instrument air source is not available. Electric Actuators utilize either **Super Capacitors** or **Springs** to fail-safe in the event of power loss or signal failure.

### E-Series

On the **E-Series Electric Acutator** there is a choice between using **Super Capacitors (EC Model)** or **Spring Return (ES Model)** as the power source to return the valve to an open or closed position in the event of signal or power failure.

When ultra-fast response times are required, the **EC Actuator** with its ability to fully-cycle the valve in as little as 6 seconds, should be selected.

### SK-Series

The **SK Actuator** is for general purpose use and is only available with fail-closed spring return. These actuators may require 30 seconds to fully stroke the valve. **2-Way Valves with SK Actuators fail-closed in the event of power failure.**



### E-Series Electric Actuator

**2-Way Valve**
with
**Fast-Acting EC Actuator**
uses Capacitors as power source for Fail-Safe Mode


**2-Way Valve**
with
**ES Actuator**
uses Springs as power source for Fail-Safe Mode

### SK-Series Electric Actuator

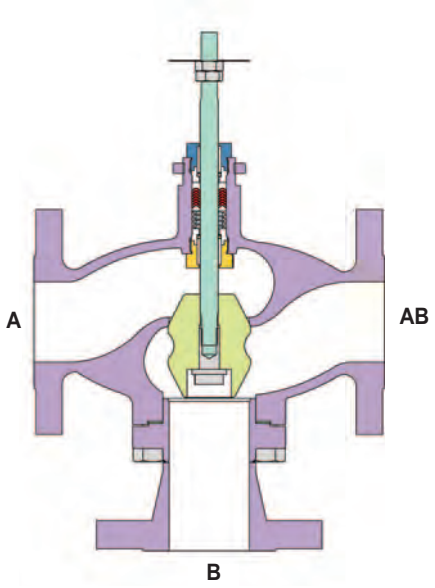
**2-Way Valve**
with
**SK Actuator**
Economical Model uses Springs as power source to Fail in the Closed position

## 3-Way Valves
### with PNEUMATIC or ELECTRIC Actuators

A 3-Way Control Valve is used for either **Mixing** or **Diverting.** In a **Mixing** application, two separate liquid streams are mixed together in a desired proportion.

In a **Diverting** application, a single incoming stream is split into two separate streams. A typical example of this is a Bypass application. In order to produce a consistent flow for stable operation, the pressure drop across both flow paths (from inlet to outlet) must be nearly equal.

**3-Way Valves are ONLY used for liquid applications.**




| | |
|---|---|
| Mixing: | Ports "A" and "B" are Inlets<br>Port "AB" is Outlet |
| Diverting: | Port "AB" is Inlet<br>Ports "A" and "B" are Outlets |



**3-Way Valve**
*Shown with*
**Pneumatic Actuator**


**3-Way Valve**
*Shown with*
**Electric Actuator**

## 2-Way Valves with PNEUMATIC ACTUATORS

Pages 320-323

The **HB Series** Stainless Steel 2-Way Control Valves are made to withstand the rigorous nature of **steam and water service** and are compatible with most other fluids as well. The standard configuration has an equal percentage flow characteristic with metal-to-metal seating, spring-loaded Teflon V-ring stem packing.

The Pneumatic Actuator is controlled by a 3-15 PSIG standard instrument air signal that will modulate the position of the valve. The Actuator can be specified to operate the valve for either **Air-To-Open (Normally Closed)**, typical for **HEATING** applications) or **Air-To-Close (Normally Open)**, typical for **COOLING** applications). Fail-safe Mode can also be re-configured in the field if needed.

**2-Way** Valves with **Pneumatic** Actuator
1/2" - 4" • Threaded & Flanged

## 3-Way Valves with PNEUMATIC ACTUATORS

Pages 324-327

The **HB Series** Stainless Steel 3-Way Control Valves are used for **mixing** two liquid streams, or for **diverting** the flow of a single liquid stream into two streams (bypass).

The disc type design is constructed of Stainless Steel for extended service life.

Teflon seat rings are available for increased shut-off tightness or for water or glycol type service, up to a maximum of 450°F.

**3-Way** Valves with **Pneumatic** Actuator
1/2" - 4" • Threaded & Flanged

## Valve Positioner – Pneumatic or Electro-Pneumatic

Pages 328-331

**Valve positioners** improve control accuracy and increase maximum close-off pressure capability of the valve. The Positioner is mounted to the valve's yoke assembly and linked to the valve stem. It receives a transduced air signal or direct electrical signal from the electronic controller and compares the control signal to the actual position of the valve plug. The Positioner then sends a corrected air signal to the valve's actuator, thereby positioning the valve plug for optimum flow modulation. Available options include **Intrinsically Safe, Explosion-Proof** and **Digital** designs.

## 2 & 3-Way Valves with ELECTRIC ACTUATORS

Pages 332-337

The **HB Series** Stainless Steel 2 & 3-Way Control Valves with **Electric Actuators** are robust, user-friendly alternative to the Pneumatically-Actuated unit. Ideal for installations where an instrument air source is not available. The **E-Series Actuators** utilize either **Capacitors** or **Springs** in order to fully-open or fully-close the valve in the event of signal or power failure. The **SK-Series Actuator** uses springs to Fail in the Closed position in the event of power failure.



## E-Series Electric Actuators for 2 & 3-Way Valves

### Why use E-Series Actuators?

When Ultra-fast response times are needed, the **EC Model** with **Super Capacitors** should be selected. Unit cycles from Open-to-Close in approximately 6 seconds.

When medium response times are adequate, the **ES Model** with **Spring Return Actuators** is a more economical choice.

### 2-Way Valves

Super Capacitor
Fast-Acting
Actuator
**EC**

Spring Return
**ES**

### 3-Way Valves

Super Capacitor
Fast-Acting
Actuator
**EC**

Spring Return
**ES**

## SK-Series Electric Actuators for 2 & 3-Way Valves

The **SK Series Electric Actuators** are an economical choice for **Heating, Boiler Feed Water**, as well as **On/Off HVAC Steam Control** where extremely fast response times are not required.

These Electric Actuators utilize **Spring Return** to retract the stem which allows 2-Way valves to fail fully-closed or 3-Way valves to fail with the “A” Port fully-closed (refer to diagram) in the event of power loss or signal failure.

### 2-Way Valves

### 3-Way Valves

Spring Return
**SK**

## TR890 Series Electronic PID Controllers

Pages 344-349

The TR890 Series Electronic PID Controller is the user-interface which allows adjustment of the set point and controls the electrical signals received from the sensor and outputted to the I/P Transducer or directly to an Electro-Pneumatic Valve Positioner or Electric Actuator. The TR893 is the most common controller model due to its larger, more user-friendly size.

The NANOADAC Series is a PID Controller with added features such as data recording and Modbus Communications (BACnet is optional).

## I/P Transducer, Air Filter/Regulator & Electronic Temperature Sensors

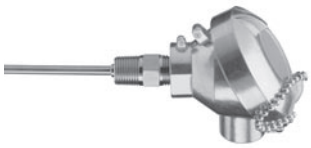
Page 350-352

### TA901 Electro-Pneumatic (I/P) Transducer

The TA901 is an electro-pneumatic transducer that converts an electrical signal (4-20 mA) from the Controller to an air signal (3-15 PSIG) for supply to the control valve Actuator or valve Positioner.

### TA987 Air Filter & Regulator

The TA987 is recommended for filtering and regulating the pressure of plant compressed air, and for delivering clean, dry air at the proper pressure to pneumatic control devices. The filtering element removes particles as small as 5 microns.



### TDD & TMD – 100 Ω & 1000 Ω RTDs
### TJD & TKD – Type J & Type K Thermocouples

Both RTD (Resistance Temperature Device) and Thermocouple sensors are available options. These devices sense the temperature of the fluid or product being heated or cooled and transmit an electrical signal to the PID controller.

## 76 Series Thermowells for RTD & Thermocouple Temperature Sensors

Page 353

Thermowells are used for applications where the process media may be corrosive or contained under pressure – to prevent damage to the sensor and to facilitate removal of the sensor from the process. To prevent leakage of the process fluid, spring-loaded sensors must always be installed in a thermowell.

# 2-Way Valve with Pneumatic Actuator

**for HEATING • COOLING • FLUID TRANSFER • Steam, Air, & Water**

**2-Way • 1/2" – 4"**

Valve Design conforms to ANSI/ASME B 16.34

| | |
|---|---|
| Models | **HB 2-Way Valve with Pneumatic Actuator** |
| Service | Steam, Air, Water |
| Sizes | 1/2" - 4" |
| Connections | NPT, 150# FLG, 300# FLG |
| Body Material | 316 Stainless Steel |
| Plug and Seat Material | Stainless Steel (Std.) |
| PMO Max. Operating Pressure | 720 PSIG @ 100˚F |
| TMO Max. Operating Temperature | 450˚F @ 497 PSIG |
| Min Operating Temperature | -20˚F |
| Max Air Supply Pressure | 50 PSIG |
| Max Ambient Temperature | 280˚F |
| Min Ambient Temperature | -20˚F |

## DESIGN PRESSURE/TEMPERATURE RATING – PMA/TMA

| | | |
|---|---|---|
| NPT | 497 PSIG | @ 450˚F |
| 150# FLG | 182 PSIG | @ 450˚F |
| 300# FLG | 497 PSIG | @ 450˚F |

The HB Series Stainless Steel 2-Way Control Valves are made to withstand the rigorous nature of steam service and are compatible with air, water, and other fluids as well. These stainless steel valves are a cost-effective alternative when compared to valves with bronze, cast iron or cast steel bodies. The standard configuration has an equal percentage flow characteristic with metal-to-metal seating, spring-loaded Teflon V-ring stem packing and Pneumatic Actuator. The Pneumatic Actuator is controlled by a 3-15 PSIG standard instrument air signal that will modulate the position of the valve.

The Actuator can be specified to operate the valve for either **Air-to-Open** (**Normally Closed**, typically for "**HEATING**" applications) **or Air-to-Close (Normally Open**, typically for "**COOLING**" applications), but can also be re-configured in the field if needed.

## TECHNICAL INFORMATION

| | |
|---|---|
| Plug Design | Equal Percentage |
| | Linear |
| | Soft-Seat |
| Leakage Rating | ANSI/FCI-70-2 Class IV, VI |
| Rangeability | 50:1 |
| Travel (1/2" - 2" Body) | 3/4" |
| (2 1/2" - 4" Body) | 1 1/8" |
| Body Design Rating | ASME 150/300 |
| Diaphragm Design | Semi-rolling, Multi-spring |
| Action Options | Fail Open |
| | Fail Closed |
| | Field Reversible |
| Positioner Mounting | IEC 60534-6-1 (NAMUR) |

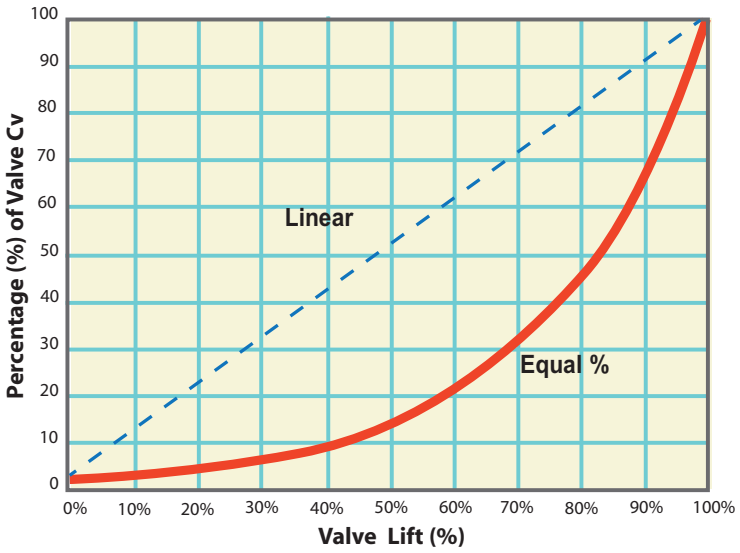
## Description & Operation

A control valve is a device capable of modulating flow at varying degrees between minimal flow and full capacity in response to a signal from an external control device. The valve modulates flow through movement of a valve plug in relation to the port(s) located within the valve body. The valve plug is attached to a valve stem, which, in turn, is connected to the actuator. The actuator, which can be pneumatically or electrically operated, directs the movement of the stem as dictated by the external control device.

## Options & Associated Control Loop Accessories

- Positioner: Pneumatic, Electro-Pneumatic or Explosion-Proof
- PID Electronic Controllers (TR890 Series)
- I/P converters (Model TA901)
- Air Filter Regulators (Air Sets-Model TA987)
- Thermocouples
- RTD's
- Pressure Transmitters

## Flow Characteristic Curve




CONTROL VALVES

# 2-Way Valve with Pneumatic Actuator

2-Way • 1/2" – 4"

I/P = Close-Off Pressures using I/P Transducer Only
w/Pos. = Close-Off Pressures with Positioner

| Size | Connection | Partial Valve Model Code† | | Actuator in² | Max Close-Off Pressure (PSI△P) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Air-to-Open (Fail Close) | | | | | Air-to-Close (Fail Open) | |
| | | | | | Standard Actuator Range (PSIG) | | Optional Actuator Range (PSIG) | | | Standard Actuator Range (PSIG) | |
| | | Full Port | Cv | | 3-15 PSIG Signal 8-15 PSIG Bench | | 3-15 PSIG Signal 5-15 PSIG Bench | 3-21 PSIG Signal 12-21 PSIG Bench | 3-15 PSIG Signal 13-23 PSIG Bench | 3-15 PSIG Signal 3-8 PSIG Bench | |
| | | | | | I/P | w/Pos. | I/P | with Positioner | | I/P | w/Pos. |
| 1/2" | NPT | HB1000F-12N | 5 | 50 | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 3/4" | NPT | HB1000F-13N | 6.5 | | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 1" | NPT | HB1000F-14N | 10 | | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 1 1/2" | NPT | HB1000F-16N | 22 | | 170 | 270 | 75 | 430 | - | 220 | 665 |
| 2" | NPT | HB1000F-17N | 42 | | 85 | 140 | 40 | 225 | - | 115 | 350 |
| 1/2" | 150# FLG | HB1000F-121 | 5 | 50 | 275* | 275* | 145 | 275* | - | 275* | 275* |
| 3/4" | 150# FLG | HB1000F-131 | 6.5 | | 275* | 275* | 145 | 275* | - | 275* | 275* |
| 1" | 150# FLG | HB1000F-141 | 10 | | 275* | 275* | 145 | 275* | - | 275* | 275* |
| 1 1/2" | 150# FLG | HB1000F-161 | 22 | | 170 | 270 | 75 | 275* | - | 220 | 275* |
| 2" | 150# FLG | HB1000F-171 | 42 | | 85 | 120 | 40 | 225 | - | 115 | 275* |
| 2 1/2" | 150# FLG | HB1000F-181 | 70 | | 35 | 60 | 15 | 100 | - | 50 | 160 |
| 2 1/2" | 150# FLG | HB1000F-181 | 70 | 100 | 100 | 160 | - | - | 245 | 140 | 435 |
| 3" | 150# FLG | HB1000F-191 | 110 | | 75 | 120 | - | - | 185 | 106 | 331 |
| 4" | 150# FLG | HB1000F-201 | 170 | | 40 | 65 | - | - | 100 | 56 | 180 |
| 1/2" | 300# FLG | HB1000F-123 | 5 | 50 | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 3/4" | 300# FLG | HB1000F-133 | 6.5 | | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 1" | 300# FLG | HB1000F-143 | 10 | | 315 | 515 | 145 | 720 | - | 430 | 720 |
| 1 1/2" | 300# FLG | HB1000F-163 | 22 | | 170 | 270 | 75 | 430 | - | 220 | 665 |
| 2" | 300# FLG | HB1000F-173 | 42 | | 85 | 140 | 40 | 225 | - | 115 | 350 |
| 2 1/2" | 300# FLG | HB1000F-183 | 70 | 100 | 100 | 160 | - | - | 245 | 140 | 435 |
| 3" | 300# FLG | HB1000F-193 | 110 | | 75 | 120 | - | - | 185 | 106 | 331 |
| 4" | 300# FLG | HB1000F-203 | 170 | | 40 | 65 | - | - | 100 | 56 | 180 |

* Shut-off pressure limited by flange class rating.

**Special High Thrust Actuator available for increased shut-off pressures on 2 1/2" - 4" valve bodies; Consult factory.**

**† To complete Full Model Code, Must Specify: Trim, Packing, Actuator and Control Signal Type**

Example (Air-to-Open): **HB1000F-12N-PA1-00**
Example (Air-to-Close): **HB1000F-12N-PA2-00**

## Model Code Configuration Chart

**2-Way VALVE BODY**

| Model | Code | Trim Style | Code | Seat Type | Code | Packing | Code | Port Type |
|---|---|---|---|---|---|---|---|---|
| HB1 | 0 | Equal Percentage | 0 | Metal Seat Stainless | 0 | Teflon | F | Full Port |
| | 1 | Linear | 1 | Soft Seat Teflon | 1 | Graphite | R | Reduced |
| | | | C.F. | Elastomers EPDM | | | | |
| | | | C.F. | Viton | | | | |

**CONNECTION**

| Code | Size | Code | Connection |
|---|---|---|---|
| 12 | 1/2" | N | NPT |
| 13 | 3/4" | 1 | 150# FLG |
| 14 | 1" | 3 | 300# FLG |
| 16 | 1 1/2" | 6 | 600# FLG |
| 17 | 2" | B | BSP |
| 18 | 2 1/2" | P | PN16 |
| 19 | 3" | Q | PN25 |
| 20 | 4" | | |

**ACTUATOR - 50 in² (PSIG)**

| Code | Actuator | Code | Control Signal | Bench Set |
|---|---|---|---|---|
| PA1 | Air-to-Open- *(Fail-Closed)* | 00 | 3-15 | 8-15 |
| | | 05 | 3-15 | 5-15 |
| | | 10 | 3-21 | 12-21 |
| PA2 | Air-to-Close- *(Fail-Open)* | 00 | 3-15 | 3-8 |

**ACTUATOR - 100 in²**

| Code | Actuator | Code | Control Signal | Bench Set |
|---|---|---|---|---|
| PB1 | Air-to-Open- *(Fail-Closed)* | 00 | 3-15 | 8-15 |
| | | 11 | 3-23 | 13-23 |
| PB2 | Air-to-Close- *(Fail-Open)* | 00 | 3-15 | 3-8 |

| Options | Code |
|---|---|
| Other Elastomer Trim | C.F. |
| Positioner Mounting Kit: | W-KIT-NP-HB-ATO/ATC |
| Direct Mount I/P Transducer | TA901 |
| Direct Mount Air Filter/Regulator | TA987 |
| Air Filter/Regulator Mounting Kit: | W-KIT-TA987-HB (50in² act.) |
| | W-KIT-TA987-HB-L (100in² act.) |
| Stainless Steel 50 in² Actuator | C.F. |
| Solenoid valve for pneumatic On/Off operation. | C.F. |
| Handwheel for Actuator | C.F. |

CONTROL VALVES

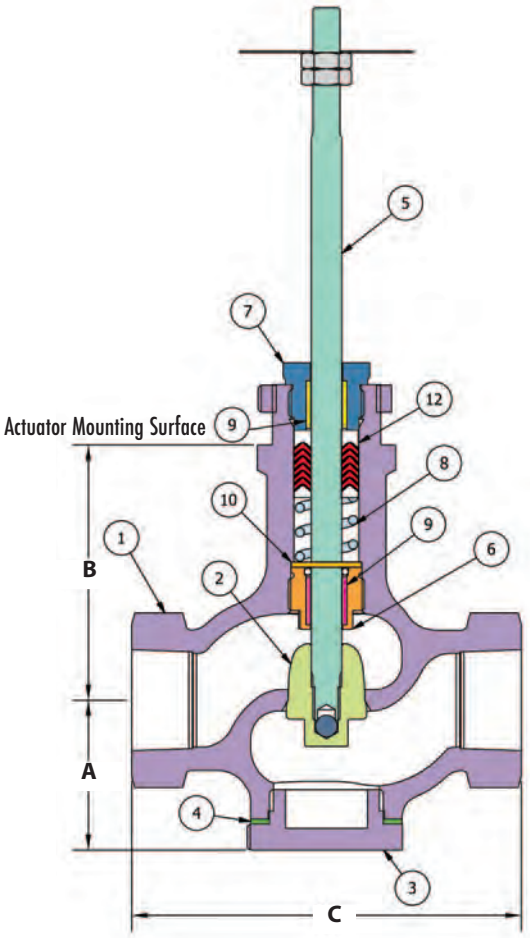
# 2-Way Valve with Pneumatic Actuator

for HEATING • COOLING • FLUID TRANSFER • Steam, Air, & Water

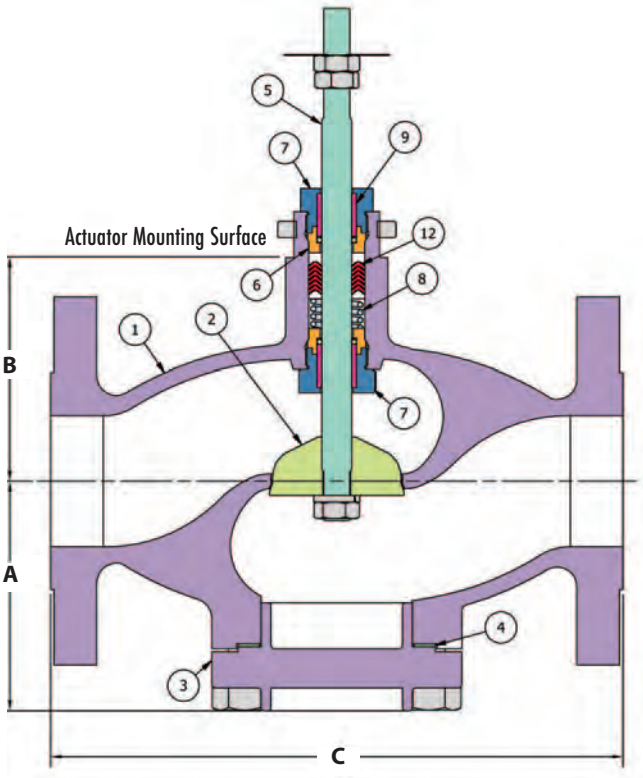
2-Way • 1/2" – 4"



## 1/2" to 2" Threaded & Flanged




## 2½" to 4" Flanged




| Item | Description | Material |
|---|---|---|
| 1 | Body | 316 Stainless Steel |
| 2 | Valve Plug* | Hardened Stainless Steel |
| 3 | Body Plug | 316 Stainless Steel |
| 4 | Body Gasket* | 303 Stainless Steel |
| 5 | Stem* | 316 Stainless Steel |
| 6 | Lower Seal Bushing | 303 Stainless Steel |
| 7 | Gland Nut | 303 Stainless Steel |
| 8 | Stem Seal Spring* | 302 Stainless Steel |
| 9 | Guide Bushing* | Rulon 641 / PTFE |
| 10 | Washer / Retainer | 303 Stainless Steel |
| 12 | V-ring Stem Seals* | PTFE |

* Recommended Spare Parts

| Size | A | B | C NPT | C 150# | C 300# | Weight (lbs) NPT | 150# | 300# |
|---|---|---|---|---|---|---|---|---|
| 1/2" | 1.76 | 2.95 | 4.50 | 7.25 | 7.75 | 3.5 | 6 | 7 |
| 3/4" | 1.76 | 2.95 | 4.50 | 7.25 | 7.75 | 3.5 | 7 | 9 |
| 1" | 1.74 | 2.95 | 4.50 | 7.25 | 7.75 | 5.5 | 10 | 13 |
| 1½" | 2.15 | 2.95 | 5.00 | 8.75 | 9.25 | 6.8 | 14 | 19 |
| 2" | 2.31 | 2.95 | 6.00 | 10 | 10.5 | 10 | 21 | 25 |
| 2½" | 4.38 | 4.25 | – | 10.88 | 11.5 | – | 41 | 46 |
| 3" | 5.56 | 4.25 | – | 11.75 | 12.5 | – | 65 | 74 |
| 4" | 6.19 | 4.25 | – | 13.88 | 14.5 | – | 92 | 112 |

## MAXIMUM FLOW COEFFICIENT ($C_V$)

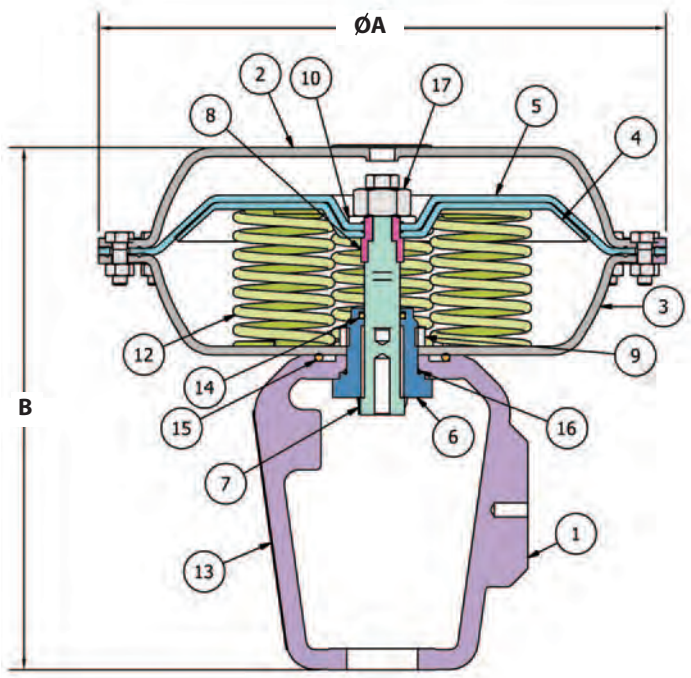
| Valve Body Size | 1/2" (Reduced Port) | 1/2" | 3/4" | 1" | 1½" | 2" | 2½" | 3" | 4" |
|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | 5 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |

# 2-Way Valve with Pneumatic Actuator

for HEATING • COOLING • FLUID TRANSFER • Steam, Air, & Water

2-Way • 1/2" – 4"

## Pneumatic Actuator 50 in²

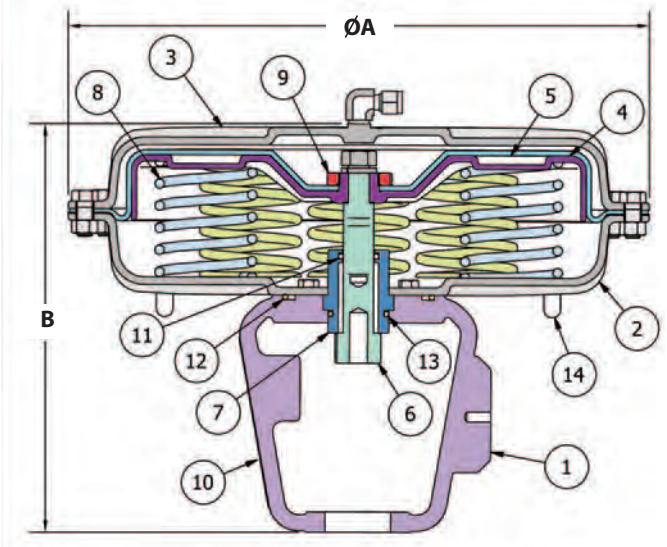



### Pneumatic Actuator 50 in²

| Item | Description | Material |
|---|---|---|
| 1 | Yoke | Stainless steel |
| 2** | Upper diaphragm case | Epoxy painted steel |
| 3** | Lower diaphragm case | Epoxy painted steel |
| 4 | Diaphragm plate | Nickel plated steel |
| 5* | Diaphragm | Nylon reinforced Neoprene |
| 6 | Upper guide bush | Stainless Steel / Bronze |
| 7 | Lower actuator stem | Stainless steel |
| 8 | Upper actuator stem | Stainless steel |
| 9 | Ring nut | Stainless steel |
| 10 | Diaphragm washer | Stainless steel |
| 11 | Position indicator disc | Stainless steel |
| 12* | Spring** | Stainless steel |
| 13 | Nameplate | Stainless steel |
| 14* | Stem O-ring | Viton |
| 15* | Yoke O-ring | Viton |
| 16* | Upper guide O-ring | Viton |
| 17 | Hex nut Stainless | Steel |

* Recommended Spare Parts
** Available in Stainless Steel
Optional Actuator Handwheel for manual Adjustment. C.F.

## Pneumatic Actuator 100 in²




### Pneumatic Actuator 100 in²

| Item | Description | Material |
|---|---|---|
| 1 | Yoke | Stainless steel |
| 2 | Lower diaphragm case | Stainless steel |
| 3 | Upper diaphragm case | Stainless steel |
| 4 | Diaphragm plate | Stainless steel |
| 5* | Diaphragm | Nylon reinforced Neoprene |
| 6 | Spindle | Stainless steel |
| 7 | Guide bushing Assembly | Stainless Steel / Bronze |
| 8* | Spring (x8) | Stainless steel |
| 9 | Diaphragm nut | Stainless steel |
| 10 | Nameplate | Stainless steel |
| 11* | Spindle O-ring | Viton |
| 12* | Yoke O-ring | Viton |
| 13* | Guide O-ring | Viton |
| 14 | Thread Protector | Viton |

* Recommended Spare Parts

| Actuator Size | A | B | Weight (lbs) |
|---|---|---|---|
| 50 in² | 10.00 | 9.25 | 18 |
| 100 in² | 14.38 | 10.00 | 50 |

**Special High Thrust Actuator available for increased shut-off pressures on 2 1/2" - 4" valve bodies; Consult factory.**

# 3-Way Valve with Pneumatic Actuator

## for MIXING & DIVERTING • Water & Other Liquids

**3-Way • 1/2" – 4"**

Valve Design conforms to ANSI/ASME B 16.34

| Models | **HB 3-Way Valve with Pneumatic Actuator** |
|---|---|
| Service | Steam, Air, Water |
| Sizes | **1/2" - 4"** |
| Connections | **NPT, 150# FLG, 300# FLG** |
| Body Material | **316 Stainless Steel** |
| Plug and Seat Material | **Stainless Steel (Std.)** |
| PMO Max. Operating Pressure | 720 PSIG @ 100˚F |
| TMO Max. Operating Temperature | 450˚F @ 497 PSIG |
| Min Operating Temperature | -20˚F |
| Max Air Supply Pressure | 50 PSIG |
| Max Ambient Temperature | 280˚F |
| Min Ambient Temperature | -20˚F |

| DESIGN PRESSURE/TEMPERATURE RATING – PMA/TMA | | |
|---|---|---|
| NPT | 497 PSIG | @ 450˚F |
| 150# FLG | 182 PSIG | @ 450˚F |
| 300# FLG | 497 PSIG | @ 450˚F |

**3-WAY VALVES ARE NOT FOR USE WITH STEAM**

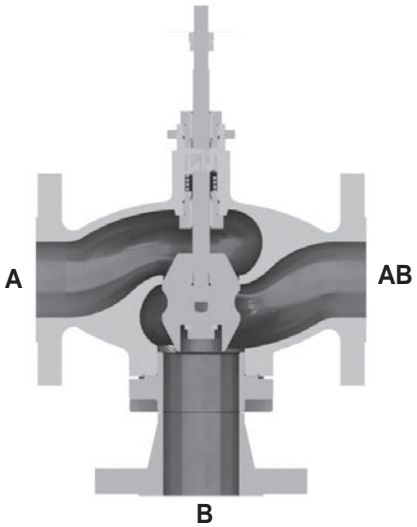
| TECHNICAL INFORMATION | |
|---|---|
| Seat Type | Metal Seat |
| | Soft-Seat |
| Leakage Rating | ANSI/FCI-70-2 Class IV, VI |
| Rangeability | 50:1 |
| Travel (1/2" - 2" Body) | 3/4" |
| (2 1/2" - 4" Body) | 1 1/8" |
| Body Design Rating | ASME 150/300 |
| Diaphragm Design | Semi-rolling, Multi-spring |
| Action Options | Fail Open |
| | Fail Closed |
| | Field Reversible |
| Positioner Mounting | IEC 60534-6-1 (NAMUR) |

### Typical Applications

The **HB Series 3-Way** valves are used for **mixing** two separate liquid streams, or for **diverting** the flow of a single liquid stream (bypass). In order to produce a consistent flow for stable operation, the pressure drop across both flow paths (inlet to outlet) must be nearly equal. The valve plug is constructed of stainless steel for extended service life. A Teflon plug option is available for increased shut-off tightness or for water or glycol type service, up to a maximum of 450˚F.

### Description & Operation

A control valve is comprised of an actuator mounted to a valve. The valve modulates flow through movement of a valve plug in relation to the port(s) located within the valve body. The valve plug is attached to a valve stem, which, in turn, is connected to the actuator. The pneumatic actuator directs the movement of the stem as dictated by the external control device.




**Mixing:**
Ports "A" and "B" are Inlets
Port "AB" is Outlet

**Diverting:**
Port "AB" is Inlet
Ports "A" and "B" are Outlets

**3-Way Valve**
**2 1/2" – 4"**
shown with Optional Positioner and Filter/Regulator

CONTROL VALVES

# 3-Way Valve with Pneumatic Actuator

**3-Way • 1/2" – 4"**

I/P = Close-Off Pressures using I/P Transducer Only
w/Pos. = Close-Off Pressures with Positioner

| Size | Connection | Partial Valve Model Code † | | Actuator in² | Max Close-Off Pressure (PSI△P) | | | | | | Weight lbs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Standard Actuator Range (PSIG) | | Optional Actuator Range (PSIG) | | | | |
| | | Full Port | Cv | | 3-15 PSIG Signal 6-11 PSIG Bench | | 3-22 PSIG Signal 13-22 PSIG Bench | | 3-22 PSIG Signal 13-22 PSIG Bench | | |
| | | | | | I/P | w/ Positioner | I/P | w/ Positioner | I/P | w/Positioner | |
| 1/2" | NPT | HB1300F-12N | 5 | 50 | 220 | 425 | - | - | - | - | 23 |
| 3/4" | NPT | HB1300F-13N | 6.5 | | 220 | 425 | - | - | - | - | 23 |
| 1" | NPT | HB1300F-14N | 10 | | 220 | 425 | - | - | - | - | 25 |
| 1 1/2" | NPT | HB1300F-16N | 22 | | 110 | 215 | - | - | - | - | 29 |
| 2" | NPT | HB1300F-17N | 42 | | 55 | 110 | - | - | - | - | 36 |
| 1/2" | 150# FLG | HB1300F-121 | 5 | 50 | 220 | 275* | - | 275* | - | - | 25 |
| 3/4" | 150# FLG | HB1300F-131 | 6.5 | | 220 | 275* | - | 275* | - | - | 25 |
| 1" | 150# FLG | HB1300F-141 | 10 | | 220 | 275* | - | 275* | - | - | 29 |
| 1 1/2" | 150# FLG | HB1300F-161 | 22 | | 110 | 215 | - | 275* | - | - | 36 |
| 2" | 150# FLG | HB1300F-171 | 42 | | 55 | 110 | - | 220 | - | - | 43 |
| 2 1/2" | 150# FLG | HB1300F-181 | 70 | 100 | 59 | 118 | - | - | 245 | 245 | 100 |
| 3" | 150# FLG | HB1300F-191 | 110 | | 44 | 90 | - | - | 185 | 185 | 124 |
| 4" | 150# FLG | HB1300F-201 | 170 | | 22 | 47 | - | - | 100 | 100 | 156 |
| 1/2" | 300# FLG | HB1300F-123 | 5 | 50 | 220 | 425 | - | 720 | - | - | 26 |
| 3/4" | 300# FLG | HB1300F-133 | 6.5 | | 220 | 425 | - | 720 | - | - | 26 |
| 1" | 300# FLG | HB1300F-143 | 10 | | 220 | 425 | - | 720 | - | - | 31 |
| 1 1/2" | 300# FLG | HB1300F-163 | 22 | | 110 | 215 | - | 430 | - | - | 39 |
| 2" | 300# FLG | HB1300F-173 | 42 | | 55 | 110 | - | 220 | - | - | 52 |
| 2 1/2" | 300# FLG | HB1300F-183 | 70 | 100 | 59 | 118 | - | - | - | 245 | 108 |
| 3" | 300# FLG | HB1300F-193 | 110 | | 44 | 90 | - | - | - | 185 | 138 |
| 4" | 300# FLG | HB1300F-203 | 170 | | 22 | 47 | - | - | - | 100 | 186 |

* Shut-off pressure limited by flange class rating.

**† To complete Full Model Code, Must Specify: Trim, Packing, Actuator and Control Signal Type**



Example (Fail-Closed A-Port): **HB1300F-12N-PA1-31**
Example (Fail-Closed B-Port): **HB1300F-12N-PA2-31**

**Model Code Configuration Chart**

**3-Way VALVE BODY**

| Model | Code | Trim Style | Code | Seat Type | Code | Packing | Code | Port Type |
|---|---|---|---|---|---|---|---|---|
| HB1 | 3 | 3-Way | 0 | Metal Seat Stainless | 0 | Teflon | F | Full Port |
| | | | | | 1 | Graphite | | |
| | | | 1 | Soft Seat Teflon | | | | |

**CONNECTION**

| Code | Size | Code | Connection |
|---|---|---|---|
| 12 | 1/2" | N | NPT |
| 13 | 3/4" | 1 | 150# FLG |
| 14 | 1" | 3 | 300# FLG |
| 16 | 1 1/2" | 6 | 600# FLG |
| 17 | 2" | B | BSP |
| 18 | 2 1/2" | P | PN16 |
| 19 | 3" | Q | PN25 |
| 20 | 4" | | |

**ACTUATOR - 50 in² (PSIG)**

| Code | Actuator | Code | Control Signal | Bench Set |
|---|---|---|---|---|
| PA1 | Fail-Closed "A" Port | 31 | 3-15 | 6-11 |
| | | 32 | 3-22 | 13-22 |
| PA2 | Fail-Closed "B" Port | | | |

**ACTUATOR - 100 in²**

| | | | | |
|---|---|---|---|---|
| PB1 | Fail-Closed "A" Port | 31 | 3-15 | 6-11 |
| PB2 | Fail-Closed "B" Port | 11 | 3-23 | 13-23 |

Note: 3-Way Valve Actuator action is as follows:
PA1/PB1- Fails with Stem Retracted
PA2/PB2- Fails with Stem Extended

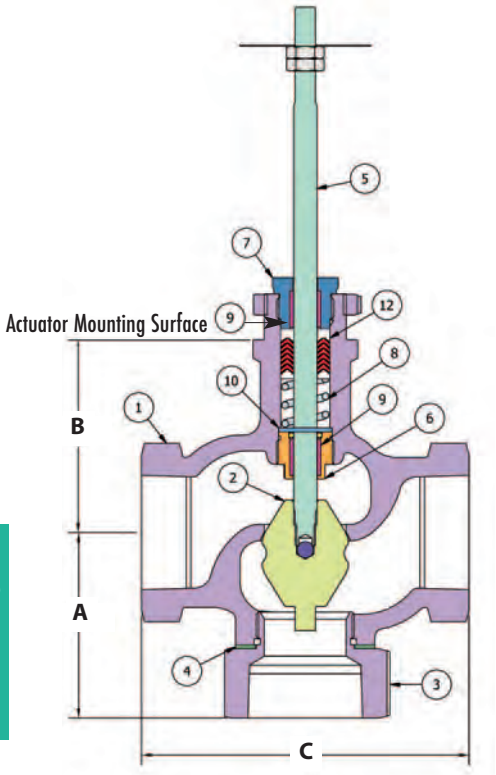
| Options | Code |
|---|---|
| Other Elastomer Trim | C.F. |
| Positioner Mounting Kit: | W-KIT-NP-HB-AT0/ATC |
| Direct Mount I/P Transducer | TA901 |
| Direct Mount Air Filter/Regulator | TA987 |
| Air Filter/Regulator Mounting Kit: | W-KIT-TA987-HB (50in² act.) |
| | W-KIT-TA987-HB-L (100in² act.) |
| Stainless Steel 50 in² Actuator | C.F. |
| Solenoid valve for pneumatic On/Off operation. | C.F. |
| Handwheel for Actuator | C.F. |

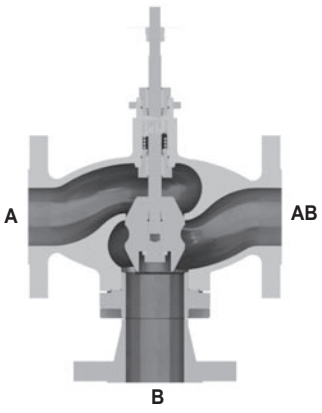
for MIXING & DIVERTING • Water & Other Liquids

3-Way • 1/2" – 4"

# 3-Way for Mixing or Diverting

**1/2" to 2"**
**Threaded & Flanged**

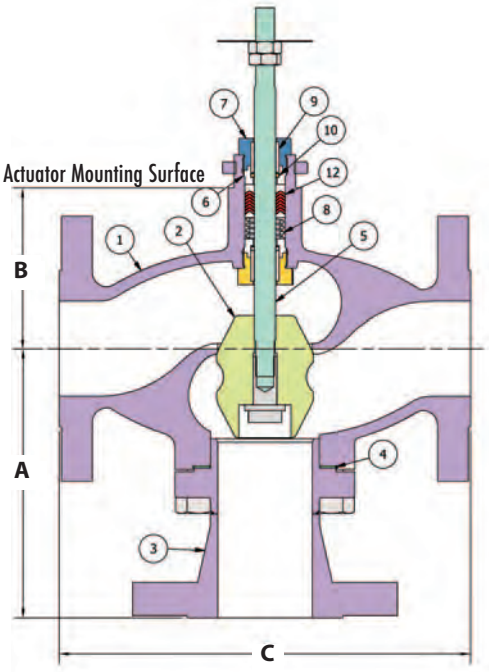



**Mixing:**
Ports "A" and "B" are Inlets
Port "AB" is Outlet

**Diverting:**
Port "AB" is Inlet
Ports "A" and "B" are Outlets

**2 1/2" to 4"**
**Flanged**




| Item | Description | Material |
|---|---|---|
| 1 | Body | 316 Stainless Steel |
| 2 | Valve Plug* | Hardened Stainless Steel |
| 4 | Body Gasket* | 303 Stainless Steel |
| 5 | Stem* | 316 Stainless Steel |
| 6 | Lower Seal Bushing | 303 Stainless Steel |
| 7 | Gland Nut | 303 Stainless Steel |
| 8 | Stem Seal Spring* | 302 Stainless Steel |
| 9 | Guide Bushing* | Rulon 641 / PTFE |
| 10 | Washer | 303 Stainless Steel |
| 12 | V-ring Stem Seals* | PTFE |

* Recommended Spare Parts

| Size | A NPT | B | A 150 | A 300 | C NPT | C 150# | C 300# | Weight (lbs) NPT | Weight (lbs) 150# | Weight (lbs) 300# |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/2" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 4 | 8.5 | 9 |
| 3/4" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 4 | 8.5 | 9 |
| 1" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 5.5 | 12 | 13.5 |
| 1 1/2" | 2.84 | 2.95 | 4.3 | 4.3 | 5.00 | 8.75 | 9.25 | 7 | 18.5 | 22 |
| 2" | 3.19 | 2.95 | 5 | 5 | 6.00 | 10 | 10.5 | 11 | 26 | 35 |
| 2 1/2" | – | 4.25 | 7.13 | 7.38 | – | 10.88 | 11.5 | – | 50 | 58 |
| 3" | – | 4.25 | 8.32 | 8.5 | – | 11.75 | 12.5 | – | 74 | 88 |
| 4" | – | 4.25 | 9.19 | 9.5 | – | 13.88 | 14.5 | – | 106 | 136 |

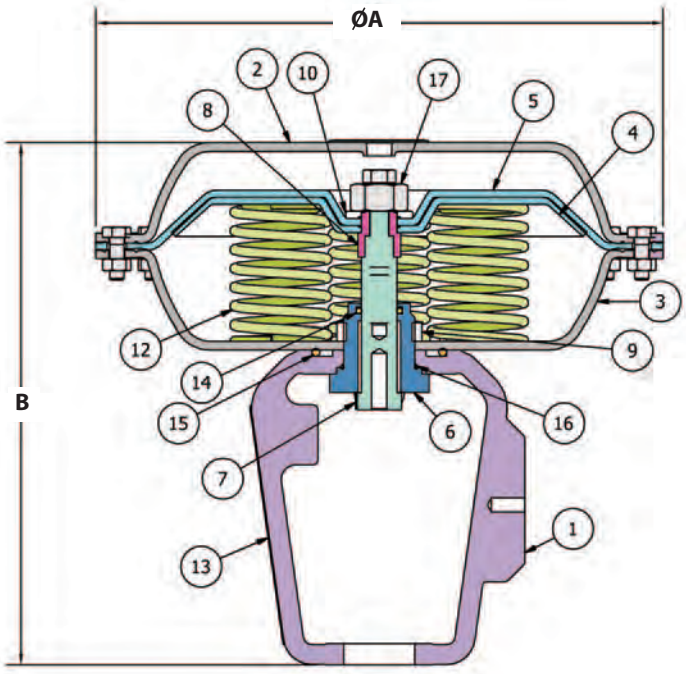
## MAXIMUM FLOW COEFFICIENT ($C_V$)

| Valve Body Size | 1/2" (Reduced Port) | 1/2" | 3/4" | 1" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | 5 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |

for MIXING & DIVERTING • Water & Other Liquids

3-Way • 1/2" – 4"

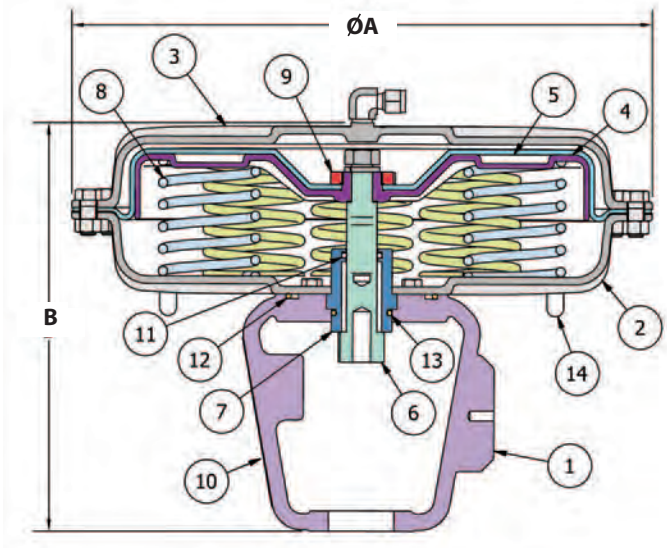
## Pneumatic Actuator 50in²




| Item | Description | Material |
|---|---|---|
| 1 | Yoke | Stainless steel |
| 2** | Upper diaphragm case | Epoxy painted steel |
| 3** | Lower diaphragm case | Epoxy painted steel |
| 4 | Diaphragm plate | Nickel plated steel |
| 5* | Diaphragm | Nylon reinforced Neoprene |
| 6 | Upper guide bush | Stainless Steel / Bronze |
| 7 | Lower actuator stem | Stainless steel |
| 8 | Upper actuator stem | Stainless steel |
| 9* | Ring nut | Stainless steel |
| 10 | Diaphragm washer | tainless steel |
| 11 | Position indicator disc | Stainless steel |
| 12* | Spring** | Stainless steel |
| 13 | Nameplate | Stainless steel |
| 14* | Stem O-ring | Viton |
| 15* | Yoke O-ring | Viton |
| 16* | Upper guide O-ring | Viton |
| 17 | Hex nut Stainless | Steel |

* Recommended Spare Parts
** Available in Stainless Steel
Optional Actuator Handwheel for manual Adjustment. C.F.

## Pneumatic Actuator 100in²




| Item | Description | Material |
|---|---|---|
| 1 | Yoke | Stainless steel |
| 2 | Lower diaphragm case | Stainless steel |
| 3 | Upper diaphragm case | Stainless steel |
| 4 | Diaphragm plate | Stainless steel |
| 5* | Diaphragm | Nylon reinforced Neoprene |
| 6 | Spindle | Stainless steel |
| 7 | Guide bushing Assembly | Stainless Steel / Bronze |
| 8* | Spring (x8) | Stainless steel |
| 9 | Diaphragm nut | Stainless steel |
| 10 | Nameplate | Stainless steel |
| 11* | Spindle O-ring | Viton |
| 12* | Yoke O-ring | Viton |
| 13* | Guide O-ring | Viton |
| 14 | Thread Protector | Viton |

* Recommended Spare Parts

| Actuator Size | A | B | Weight (lbs) |
|---|---|---|---|
| 50 in² | 10.00 | 9.25 | 18 |
| 100 in² | 14.38 | 10.00 | 50 |

**Special High Thrust Actuator available for increased shut-off pressures on 2-1/2" - 4" valve bodies; Consult factory.**

# for 2-Way or 3-Way Pneumatically-Actuated Valves

## Valve Positioners (Electro-Pneumatic)

The **CE100 Series Electro-Pneumatic Positioners** improve control accuracy and increase maximum close-off pressure capability of the valve. The Positioner is mounted to the valve's yoke assembly and linked to the valve stem. It receives a transduced air signal or direct electrical signal from the electronic controller and compares the control signal to the actual position of the valve plug. The Positioner then sends a corrected air signal to the valve's actuator, thereby positioning the valve plug for optimum flow modulation.

The **Electro-Pneumatic Positioner** receives an electrical 4-20 mA signal directly from the PID Controller and therefore eliminates the need for a separate I/P Transducer.

| | Electro-Pneumatic **CE100** |
|---|---|
| Input Signal | 4-20 mA |
| Supply Air Pressure | 20 to 100 PSIG |
| Action | Single-Acting |
| Air Connection | 1/4" NPT (Gauge 1/8" NPT) |
| Electrical Connection | 1/2" NPT |
| Pressure Gauges | Included |
| Cam | Linear Characteristics |
| Ambient Temperature | -4° to 185° F (-20° - 83° C) |
| Enclosure Material | Die Cast Aluminum |
| Enclosure Rating | IP65 (dust and drip-proof) |
| Weight | 4.8 lbs. (2.2 kg) |
| Optional Explosion Protection | ATEX: D = Gas Ex d<br>P = Gas/Dust Ex d<br>E = Gas Ex ia |
| Linear Error | 0.7% full span |
| Hysteresis | 0.4% full span |
| Repeatability | 0.3% full span |
| Media | Oil-free instrument Air Filtered to 5 micron |
| Flow Capacity | SCFM |
| @20 PSI | 9.5 |
| @87 PSI | 28.3 |
| Air Consumption | SCFM |
| @20 PSI | 0.2 |
| @87 PSI | 0.6 |

**HB-Series Control Valve**
**shown with**
**CE100 Positoner**
**and TA987 Air/Filter Regulator**

CONTROL VALVES

**CE100 Electro-Pneumatic Positioner Options**

| Type | Model Code | Features | Weight lbs. | Explosion Protection Options | |
|---|---|---|---|---|---|
| | | | | Suffix Code | Description |
| Standard | CE100 | Electro-Pneumatic | 5 | -D | ATEX: Gas Ex d |
| | | | | -P | ATEX: Gas/Dust Ex d |
| | | | | -E | ATEX: Gas Ex ia |

# V100 Series Pneumatic & Electro-Pneumatic Positioners

## for 2-Way or 3-Way Pneumatically-Actuated Valves


### Valve Positioners (Pneumatic or Electro-Pneumatic)

The **V100 Series** Valve Positioners (Pneumatic/Electro-Pneumatic) offer enhanced features ideal for applications where extreme accuracy is required. Designed to mount to a pneumatically-actuated control valve to improve control accuracy and increase maximum close-off pressure capability of the valve.

The **V100P Pneumatic Positioner** receives a 3-15 PSIG air signal normally taken from an I/P Transducer.

The **V100E Electro-Pneumatic Positioner** receives an electrical 4-20 mA signal directly from the PID Controller and therefore eliminates the need for a separate I/P Transducer.


**HB-Series Control Valve**
**shown with V100E Positoner with Gauge Blocks and Gauges (included) and optional Stainless Steel 50in² Actuator**

| | Pneumatic V100P | Electro-Pneumatic V100E |
|---|---|---|
| Input Signal | 3-15 PSI (0.2 - 1.0 Bar) | 4-20 mA |
| Supply Air Pressure | 145 PSI maximum | 20 to 145 PSIG |
| Action | Single-Acting | Single-Acting |
| Air Connection | 1/4" NPT (Gauge 1/8" NPT) | 1/4" NPT (Gauge 1/8" NPT) |
| Electrical Connection | N / A | 1/2" NPT |
| Pressure Gauges | Included | Included |
| Cam | Linear Characteristics | Linear Characteristics |
| Ambient Temperature | -40˚ to 185˚ F (-40˚ - 85˚ C) | -40˚ to 185˚ F (-40˚ - 85˚ C) |
| Enclosure Material | Die Cast Aluminum with Polyester Epoxy Coating | Die Cast Aluminum with Polyester Epoxy Coating |
| Enclosure Rating | NEMA 4X / IP66 | NEMA 4X / IP66 |
| Weight | 3.5 lbs. (1.6 kg) | 3.8 lbs. (1.7 kg) |
| Optional Explosion Protection | Consult Factory | Refer to Options Chart Below |
| Linear Error | 0.7% full span | |
| Hysteresis | 0.4% full span | |
| Repeatability | 0.3% full span | |
| Media | Oil-free instrument Air Filtered to 5 micron | |
| Flow Capacity | SCFM | |
| @20 PSI | 9.5 | |
| @87 PSI | 28.3 | |
| Air Consumption | SCFM | SCFM |
| @20 PSI | 0.18 | 0.2 |
| @87 PSI | 0.53 | 0.6 |

CONTROL VALVES

### V100 Pneumatic & Electro-Pneumatic Positioner Options

| Type | Model Code | Features | Weight lbs. | Options | |
|---|---|---|---|---|---|
| | | | | Suffix Code | Description |
| Standard Positioners | V100E | Electro-Pneumatic | 5 | V250001 | (2) SPDT Mechanical Switches |
| | V100P | Pneumatic | 5 | | |
| Optional | V100-EX | Electro-Pneumatic (Explosion-Proof) | 5 | V250001 | (2) SPDT Mechanical Switches |
| | V100-EX-ATEX | Electro-Pneumatic (Explosion-Proof w/ ATEX Approval) | 5 | | |
| | V100-EX-IS | Electro-Pneumatic (Intrinsically Safe) | 5 | V250007 | 4-20mA Feedback |
| | V100-EX-10V | Electro-Pneumatic (0-10V 1/P) | 5 | | |

## for 2-Way or 3-Way Pneumatically-Actuated Valves

**HB-Series Control Valve**

**shown with MVP3500 Positoner with Gauge Blocks (inlcuded) optional Stainless Steel 50in² Actuator**



The **MVP3500** is a digital positioner that mounts to the pneumatic actuator of control valves to improve accuracy and increase maximum close-off pressure capability of the valve. Digital positioners use piezo-electric valves for the air supply which limit leakage, making them much more efficient than electro-pneumatic positioners.

Set-up and calibration are also greatly simplified by the use of local push-buttons and LCD, eliminating the need for expensive handheld devices for basic set up and calibration. The **MVP3500** comes standard with 4-20mV feedback, Hart communication, gauge blocks and gauges.

The **MVP3600** is an Explosion-Proof model.

| SPECIFICATIONS | |
|---|---|
| **Model** | **MVP3500**  |
| Signal | 4-20mA |
| Feedback | 4-20mA |
| Supply Pressure | 22 - 101 PSIG |
| Air Consumption | .020 SCFM |
| Ambient Temperature Range | -40˚ - 158˚F |
| Rotation Range | 30˚ - 120˚F |
| Linear Stroke Range | 0.39 - 3.94 in. |
| Characteristics Curves | Linear, 1:30, 30:1, Custom |
| Deadband | 0.1% - 10% Adjustable |
| Communication | HART |
| Enclosure Rating | IP65 |
| Air Connections | 1/4" NPT |
| Electrical Connections | 1/2" NPT |
| Explosion Protection | Ex ia IIC T4-T6 Ga<br>Ex iaD 20 T80˚C/T95˚C/T130˚C |
| | **MVP3600** |
| | ATEX:<br>Ex d IIC T4 - T6 Ga<br>Ex td A21 IP65 T80˚C / T90˚C / T105˚C |

**HB Series "SMART" Positioner Options**

| Model Code | Features | Weight lbs. | Options | |
|---|---|---|---|---|
| | | | Model Code | Description |
| MVP3500L-10H-KF0-M00-EWM | Standard Digital (Single-Action), 4-20mV Feedback - Included: HART Communication, Gauge Blocks & Gauges. | 5 | All Options Included | |
| MVP3600L-1PH-F0-M00-EWM | Explosion Protection Digital (Single-Action), 4-20mV Feedback Included: HART Communication, Gauge Blocks & Gauges. | 5 | | |

## for 2-Way or 3-Way Pneumatically-Actuated Valves

**HB-Series Control Valve**

**shown with**
**D400 Positoner**
**with Gauge Blocks (inlcuded)**
**optional Stainless Steel**
**50in² Actuator**

The **D400** is a digital positioner with Intrinsically-Safe or Explosion-Proof options. These positioners are designed to be highly accurate and efficient in a wide range of application environments. HART communication and 4-20mA feedback are available as options.

| SPECIFICATIONS | |
|---|---|
| **Model** | **D400**  |
| Signal | 4-20mA |
| Feedback | Optional 4-20mA |
| Supply Pressure | 22 - 90 PSIG |
| Air Consumption | .015 SCFM |
| Ambient Temperature Range | -40˚ - 185˚F |
| Rotation Range | 250˚ - 120˚F |
| Linear Stroke Range | 0.4 - 4.0 in. |
| Characteristics Curves | Linear ,Eq %, 1:25, 1:50<br>50:1, Custom |
| Deadband | 0.1% - 10% Adjustable |
| Communication | Optional HART |
| Enclosure Rating | NEMA 4X / IP65 |
| Air Connections | 1/4" NPT |
| Electrical Connections | 1/2" NPT |
| | **D400-IS** (Intrinsically Safe) |
| | ATEX: II 2G EEx ib IIC T6<br>II 2G EEx ia IIC T6<br>II 3G EEx n A II T6<br>II 2D IP 6X T 46˚C<br>IECEX: EXIB IIC T6 |
| | **D400-EX** (Explosion-Proof) |
| | ATEX: II 2G EEx ib IIC T6<br>IECEX: EXIB IIC T6 |

CONTROL VALVES

**HB Series "SMART" Positioner Options**

| Model Code | Features | Weight lbs. | Options | |
|---|---|---|---|---|
| | | | Suffix Code | Description |
| D400 | Standard Digital (Single-Action) - No Communication | 5 | -H | Hart Communication |
| D400-IS | Digital (Intrinsically Safe) - No Communication | 5 | V240007 | Single Gauge Block |
| D400-EX | Digital Explosion-Proof - No Communication | 5 | -FB | 4-20mV Feedback |
| | | | -HFB | Hart Communication & Feedback |

Other Options Available; Contact Factory

# Electric Actuators for 2-Way or 3-Way

| Models | 2 & 3-Way Valves with E -Series or SK-Series Electric Actuators |
|---|---|
| Service **2-Way Valve** | Steam, Air, Water |
| Service **3-Way Valve** | Liquid ONLY **(NO STEAM)** |
| Sizes | **1/2" - 4"** |
| Connections | **NPT, 150# FLG, 300# FLG** |
| Body Material | **316 Stainless Steel** |
| Plug and Seat Material | **Stainless Steel (Std.)** |
| PMO Max. Operating Pressure | 720 PSIG @ 100˚F |
| TMO Max. Operating Temperature | 450˚F @ 497 PSIG |
| Min Operating Temperature | -20˚F |
| Max Air Supply Pressure | 50 PSIG |
| Max Ambient Temperature | Actuator Dependent |

**EC**
Super Capacitor

**ES**
Spring Return

**SKD**
Spring Return

| DESIGN PRESSURE/TEMPERATURE RATING – PMA/TMA | | |
|---|---|---|
| NPT | 497 PSIG | @ 450˚F |
| 150# FLG | 182 PSIG | @ 450˚F |
| 300# FLG | 497 PSIG | @ 450˚F |

The **HB Series** Stainless Steel 2-Way & 3-Way Control Valves with **Electric Actuators** are a robust, user-friendly alternative to the Pneumatically-Actuated unit. They are ideal for installations where an instrument air source is not available or when the benefits for electric actuation are preferred.

Electric Actuators utilize either **Super Capacitors** or **Spring Return** which allow for the valve to fail in either the fully-open or fully-closed position in the event of power loss or signal failure.

The **EC Model** using Super Capacitor should be selected when Ultra-fast response times are needed such as in instantaneous hot water heater applications. The **EC Model Actuator** will cycle from Open to Close in approximately 6 seconds.

The **ES Model** using Spring Return are an economical choice when medium response times are sufficient. They have Fail-Open and Fail-Close options as well as 24 VDC service.

## TECHNICAL INFORMATION

| | |
|---|---|
| Plug Design | Equal Percentage |
| | Linear |
| | Soft-Seat |
| Leakage Rating | ANSI/FCI-70-2 Class IV, VI |
| Rangeability | 50:1 |
| Travel (1/2" - 2" Body) | 3/4" |
| (2 1/2" - 4" Body) | 1 1/8" |
| Body Design Rating | ASME 150/300 |
| Action Options | Fail Open* |
| | Fail Closed |
| Actuator Options | Fast-acting, Super Capacitors |
| | On-Off, Spring Return |

* 2-way HB-Series with SK-Series Actuators are Fail-Closed only.

Valve Design conforms to ANSI/ASME B 16.34

The **SK Series Electric Actuators** are used for general purpose applications where medium response times are sufficient. They are an economical choice for **Heating, Boiler Feed Water** applications as well as **On/Off HVAC Steam Control**.

SK Actuators Fail Closed, typically not used for Cooling applications.

| | E-Series | | | SK-Series | | |
|---|---|---|---|---|---|---|
| **Fail-Safe Operator** | Capacitor | | Spring | Spring | | |
| **Actuator** | EC10 | EC | ES | SKB | SKC | SKD |
| **Voltage** | 115VAC / 24VAC / 24VDC | | | 24VAC* | | |
| **Max Ambient Temp** | 140˚F | | | 130˚F | | 122˚F |
| **Enclosure Rating** | IP65 | | | IP54 / NEMA 1 | | |
| **Stroke (in)** | 1.97 | 1.97 | 1.57 | 0.75 | 1.50 | 0.75 |
| **Thrust (lbs)** | 2,248 | 1,011 | 449 | 629 | | 224 |
| **Cycle Time open (s)** | 15 | 8 | 120 | 120 | 120 | 60 |
| **Cycle Time close (s)** | 15 | 8 | 90 | 15 | 20 | 15 |
| **Weight (lbs)** | 22 | 18 | 12.4 | 18.9 | 22.5 | 8.5 |

* 115VAC service available with optional power adapter.

# Electric Actuators for 2-Way or 3-Way

| Size | Connection | Valve Model Code | Cv | E-Series Actuator: EC Super Capacitor | E-Series Actuator: EC10 Super Capacitor | E-Series Actuator: ES Spring Return | SK-Series Actuator: SKD STANDARD | SK-Series Actuator: SKB | SK-Series Actuator: SKC |
|---|---|---|---|---|---|---|---|---|---|
| | | Full Port | | Max Close-Off Pressure (PSI△P) | | | | | |
| 1/2" | NPT | HB1000F-12N | 5 | 720 | N/A | 605 | 290 | 720 | 720 |
| 3/4" | NPT | HB1000F-13N | 6.5 | 720 | N/A | 605 | 290 | 720 | 720 |
| 1" | NPT | HB1000F-14N | 10 | 720 | N/A | 605 | 290 | 720 | 720 |
| 1 1/2" | NPT | HB1000F-16N | 22 | 720 | N/A | 315 | 150 | 450 | 450 |
| 2" | NPT | HB1000F-17N | 42 | 380 | N/A | 160 | 75 | 280 | 230 |
| 1/2" | 150# FLG | HB1000F-121 | 5 | 275* | N/A | 275* | 275* | 275* | 275* |
| 3/4" | 150# FLG | HB1000F-131 | 6.5 | 275* | N/A | 275* | 275* | 275* | 275* |
| 1" | 150# FLG | HB1000F-141 | 10 | 275* | N/A | 275* | 275* | 275* | 275* |
| 1 1/2" | 150# FLG | HB1000F-161 | 22 | 275* | N/A | 275* | 150 | 275* | 275* |
| 2" | 150# FLG | HB1000F-171 | 42 | 275* | N/A | 160 | 75 | 230 | 230 |
| 2 1/2" | 150# FLG | HB1000F-181 | 70 | 175 | 380 | 74 | N/A | N/A | 108 |
| 3" | 150# FLG | HB1000F-191 | 110 | 134 | 290 | 54 | N/A | N/A | 80 |
| 4" | 150# FLG | HB1000F-201 | 170 | 72 | 160 | 29 | N/A | N/A | 43 |
| 1/2" | 300# FLG | HB1000F-123 | 5 | 720 | N/A | 605 | 290 | 720 | 720 |
| 3/4" | 300# FLG | HB1000F-133 | 6.5 | 720 | N/A | 605 | 290 | 720 | 720 |
| 1" | 300# FLG | HB1000F-143 | 10 | 720 | N/A | 605 | 290 | 720 | 720 |
| 1 1/2" | 300# FLG | HB1000F-163 | 22 | 720 | N/A | 315 | 150 | 450 | 450 |
| 2" | 300# FLG | HB1000F-173 | 42 | 380 | N/A | 160 | 75 | 230 | 230 |
| 2 1/2" | 300# FLG | HB1000F-183 | 70 | 175 | 380 | 74 | N/A | N/A | 108 |
| 3" | 300# FLG | HB1000F-193 | 110 | 134 | 290 | 54 | N/A | N/A | 80 |
| 4" | 300# FLG | HB1000F-203 | 170 | 72 | 160 | 29 | N/A | N/A | 43 |

* Shut-off pressure limited by flange class rating.

CONTROL VALVES

**To complete Full Model Code, Must Specify: Trim, Packing, Port, Actuator, Power Supply and Control Signal Type**

Example: (Spring-Fail Closed): **HB1000F-12N-ESA10**
Example: (Spring-Fail Open): **HB1000F-12N-ESB10**

## Model Code Configuration Chart

**HB Series; 1/2" - 4", Electrically-Actuated, 2-Way or 3-Way Valve Bodies**

### VALVE BODY Selection

| Model | Code | Trim Style* |
|---|---|---|
| HB1 | 0 | Equal Percentage (2-way) |
| | 1 | Linear (2-way) |
| | 3 | 3-Way |

| Code | Seat Type |
|---|---|
| 0 | Metal Seat Stainless Steel |
| 1 | Soft Seat Teflon |
| | Elastomers |
| C.F | EPDM |
| C.F. | Viton |

| Code | Packing |
|---|---|
| 0 | Teflon |
| 1 | Graphite |

| Code | Port Type |
|---|---|
| F | Full Port |
| R | Reduced Port |

### CONNECTION

| Code | Size |
|---|---|
| 12 | 1/2" |
| 13 | 3/4" |
| 14 | 1" |
| 16 | 1 1/2" |
| 17 | 2" |
| 18 | 2 1/2" |
| 19 | 3" |
| 20 | 4" |

| Code | Connection |
|---|---|
| N | NPT |
| 1 | 150# FLG |
| 3 | 300# FLG |
| 6 | 600# FLG |
| B | BSP |
| P | PN16 FLG |
| Q | PN25 FLG |

* Note: For 2-Way Valves Equal Percentage trim style should be used for steam service. Linear trim style should be used for water service.

### EC ACTUATOR -Super Capacitor Fail-Safe

| Code | Actuator |
|---|---|
| ECA | Capacitor-Fail-Closed |
| EC10A | |
| ECB | Capacitor-Fail-Open |
| EC10B | |

| Code | Power Supply |
|---|---|
| 1 | 115 VAC |
| 2 | 24 VAC/DC |

| Code | Control Signal |
|---|---|
| 0 | 4-20mA |
| 1 | 0-10V |
| 2 | 0-20mA |
| 3 | 2-10V |
| 4 | 12-20mA |
| 6 | Split-range |

### ES ACTUATOR - Spring Fail-Safe

| Code | Actuator |
|---|---|
| ESA | Spring-Fail-Closed |
| ESB | Spring-Fail-Open |

| Code | Power Supply |
|---|---|
| 1 | 115 VAC |
| 2 | 24 VAC/DC |

| Code | Control Signal |
|---|---|
| 0 | 4-20mA |
| 1 | 0-10V |
| 2 | 0-20mA |
| 3 | 2-10V |

### SK ACTUATOR - Spring Fail-Safe

| Code | Actuator |
|---|---|
| SKD62UA | |
| SKB62UA | |
| SKC62UA | |

SK Actuators are standard 24VAC with 4-20mA control signal. For 115VAC, add Power Adapter. 0-10V control signal option can be field set.

**Failure Mode on SK Actuators**:
2-Way Valves Fail-Closed.
3-Way Valves close-off the "A" Port.

## ELECTRIC ACTUATOR OPTIONS

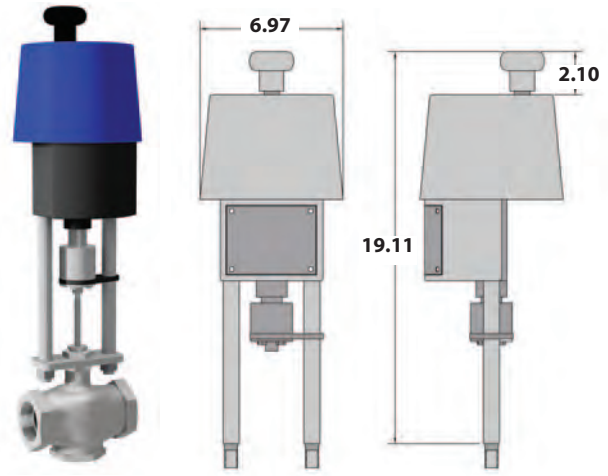
| EC Series | | ES Series | SK Series | |
|---|---|---|---|---|
| Heating Resistor for protection in cold outdoor climates | Contact Factory | None | Weather Shield Assembly Kit for outdoor use. UL Listed to meet NEMA 3R rating. | Contact Factory |
| Communication Kit for field adjustments, data access, etc. | EC-COMM-KIT | | 115 VAC Power Adapter | 266010 |
| Transformer for 230 VAC Service | Contact Factory | | | |

# E-Series Electric Actuators for 2-Way or 3-Way

## EC/EC10 Electric Actuator

Uses Super Capacitors as the Fail-Safe Operator

**Extrememly Fast Acting**

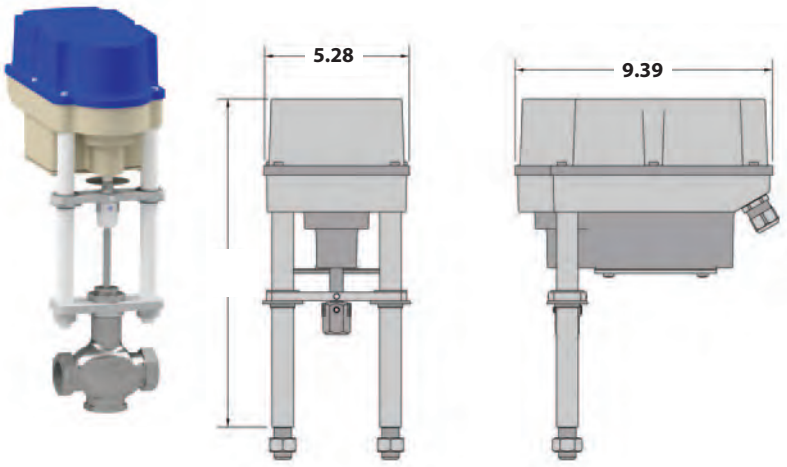



The **EC/EC10 Electric Actuator** are used for High-performance applications such as instantaneous hot water heaters.

## ES Electric Actuator

Uses a Spring as the Fail-Safe Operator

**Reduced Response Time & Close-Off Pressures**




The **ES Electric Actuator** are used where high-speed actuation is not required.

CONTROL VALVES

| Actuator Specifications | EC | | | EC10 | | | ES | |
|---|---|---|---|---|---|---|---|---|
| **Power Supply** | **115VAC** | **24VAC** | **24VDC** | **115VAC** | **24VAC** | **24VDC** | **115VAC** | **24VAC** | **24VDC** |
| **Force** | 1,100 lbs | | | 2,248 lbs | | | 448 lbs | | |
| **Velocity** | 0.177 in/sec | | | 0.067 in/sec | | | 0.012 in/sec | | |
| **Nominal 1" Travel Time** | **8 sec** | | | **15 sec** | | | **60 sec** | | |
| **Nominal Current (A)** | 0.66 | 3.15 | 2 | .84 | 4 | 2.5 | 0.14 | .35 | |
| **Max Current (A)** | 0.86 | 4.1 | 2.6 | 1.1 | 5.3 | 3.3 | 0.14 | .35 | |
| **Max Power Consumption** | 57 | 53 | 48 | 78 | 73 | 61 | 9 | 9 | |
| **Duty Cycle, IEC 60034-1, 8** | S2 30 min S4 50% ED @ 77° F | | | | | | S2 30min S4-1200c/h-50%ED | | |

| | |
|---|---|
| Motor Protection | Electric motor current monitoring with safety cut-off |
| Set Value Feedback | 0 (4)-20mA or 0 (2)-10V selectable, split range operation |
| Binary Control | 24V for On/Off Control (1s min pulse duration) |
| Valve Positioner Function | Integrated positioner, deadband adjustable from 0.5 to 5%, shutoff min. |
| Automatic Start-up | Recognizing the end position(s) and autoscaling set and feedback values |
| Internal Fault Monitoring | Torque, set value, temperature, power supply, positioning deviation, etc. |
| Diagnostics Function EC-Series ONLY | Stores accumulated operation data (motor & total run time, number of starts) and data of current values (set value, feedback value, torque, temp, and error message |
| Communication Interface | USB interface with Software / enables parameter adjustments |
| Cable Glands | 2x M20x1.5 & 1x M16x1.5 |

| Options for EC |
|---|
| Transformer for 230 VAC Service |
| Limit Switch |
| Heater Element |

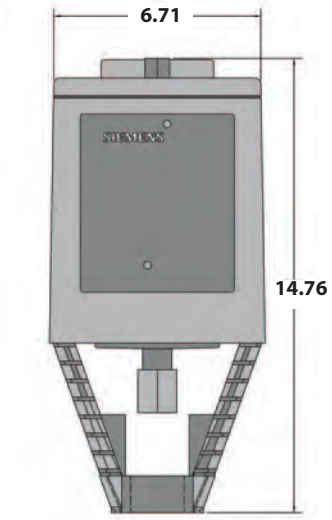
**The EC Actuator can be factory set or field configurable (with COMM-KIT) as follows:**

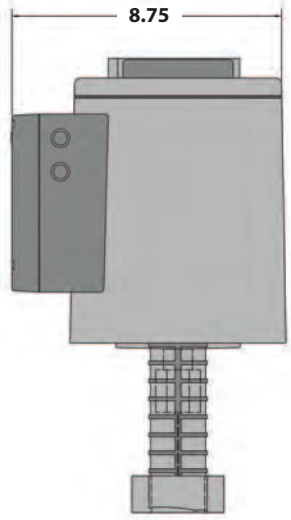
- Stroke adjustment
- Stroke velocity
- Response time
- Fail-safe direction and position
- Flow characteristic (i.e. equal %, linear, quick open)

# SK-Series Electric Actuators for 2-Way or 3-Way

## SKB • SKC • SKD

### Electric Actuators




The **SK Series Electric Actuator**s are a robust choice for **Boiler Feed Water** applications as well as **On/Off HVAC Steam Control** applications where ***Fail-Closed is required***. For general purpose applications, where medium response times are sufficient. In the event of a signal failure, the stem of the SK Actuator retracts. Therefore the Failure Mode of a 2-Way valve is closed and a 3-Way valve will close off the "A" port.

| Actuator Specifications | SKB | SKC | SKD |
|---|---|---|---|
| Power Supply | 24VAC | | |
| Force | 629 lbs | | 224 lbs |
| Velocity | 0.006 in/s | 0.013 in/s | 0.025 in/s |
| Nominal 1" Travel Time | 120 | 60 | 30 |
| Nominal Current (A) | .5 | .84 | .5 |
| Max Current (A) | .5 | .84 | .5 |
| Max Power Consumption (W) | 12 | 20 | 12 |
| Agency Certification | UL873, CE 89/336/EEC | | |

**Option:**

Power Adapter for 115 VAC Service

## Actuator Selection

### SKD Series

Standard for 1/2" to 2" valve bodies where a 30 second stroke time is prefereable.

### SKC Series

Standard for 2½" to 4" valve bodies and also when higher shut-off pressures are required for 1/2" to 2" valve bodies.

### SKB Series

Option for higher shut-off pressure applications where increased stroke time can be tolerated.

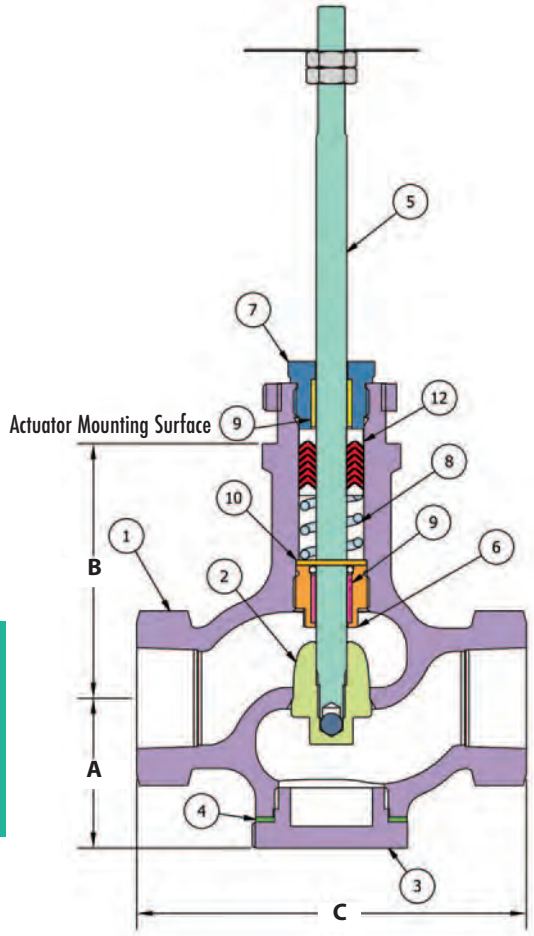
# 2-Way Valves with Electric Actuators

for HEATING • COOLING • FLUID TRANSFER • Steam, Air, & Water

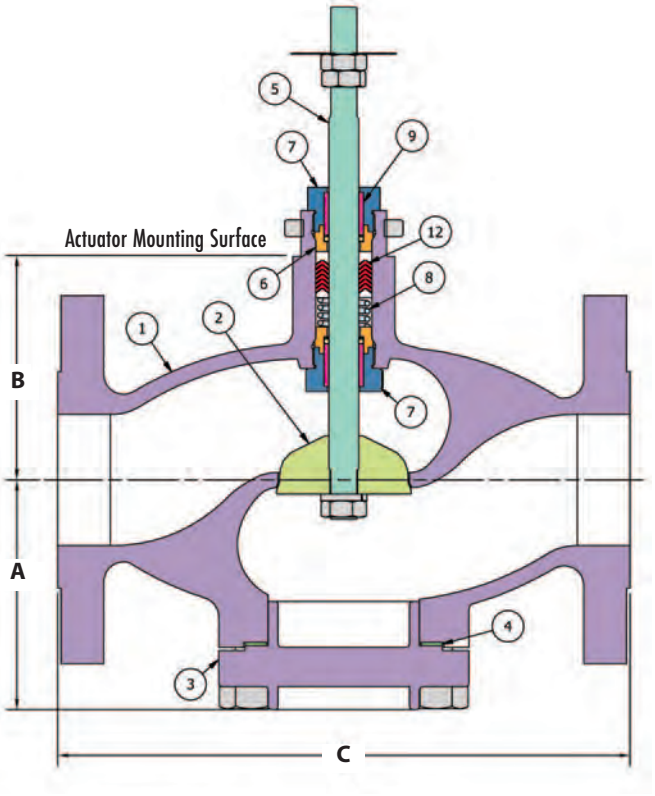
2-Way • 1/2" – 4"



## 1/2" to 2" Threaded & Flanged




## 2½" to 4" Flanged




| Item | Description | Material |
|---|---|---|
| 1 | Body | 316 Stainless Steel |
| 2 | Valve Plug* | Hardened Stainless Steel |
| 3 | Body Plug | 316 Stainless Steel |
| 4 | Body Gasket* | 303 Stainless Steel |
| 5 | Stem* | 316 Stainless Steel |
| 6 | Lower Seal Bushing | 303 Stainless Steel |
| 7 | Gland Nut | 303 Stainless Steel |
| 8 | Stem Seal Spring* | 302 Stainless Steel |
| 9 | Guide Bushing* | Rulon 641 / PTFE |
| 10 | Washer | 303 Stainless Steel |
| 12 | V-ring Stem Seals* | PTFE |

* Recommended Spare Parts

| Size | A | B | C NPT | C 150# | C 300# | Weight (lbs) NPT | Weight (lbs) 150# | Weight (lbs) 300# |
|---|---|---|---|---|---|---|---|---|
| 1/2" | 1.76 | 2.95 | 4.50 | 7.25 | 7.75 | 3.5 | 6 | 7 |
| 3/4" | 1.76 | 2.95 | 4.50 | 7.25 | 7.75 | 3.5 | 7 | 9 |
| 1" | 1.74 | 2.95 | 4.50 | 7.25 | 7.75 | 5.5 | 10 | 13 |
| 1½" | 2.15 | 2.95 | 5.00 | 8.75 | 9.25 | 6.8 | 14 | 19 |
| 2" | 2.31 | 2.95 | 6.00 | 10 | 10.5 | 10 | 21 | 25 |
| 2½" | 4.38 | 4.25 | - | 10.88 | 11.5 | - | 41 | 46 |
| 3" | 5.56 | 4.25 | - | 11.75 | 12.5 | - | 65 | 74 |
| 4" | 6.19 | 4.25 | - | 13.88 | 14.5 | - | 92 | 112 |

Insulation Blankets; Contact Factory

Note: Insulation blankets are recommended for electrically actuated valves when steam supply pressure exceeds 55 PSIG or fluid temperature 300 ° F and above.

## MAXIMUM FLOW COEFFICIENT ($C_V$)

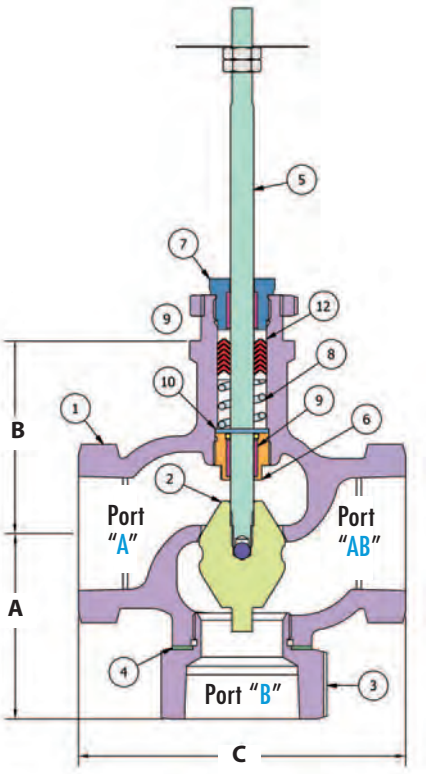
| Valve Body Size | 1/2" (Reduced Port) | 1/2" | 3/4" | 1" | 1½" | 2" | 2½" | 3" | 4" |
|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | 5 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |

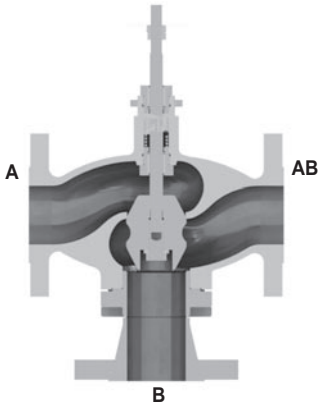
for MIXING & DIVERTING • Liquid ONLY (NO STEAM)

3-Way • 1/2 – 4"

# 3-Way for Mixing or Diverting

**1/2" to 2"**
**Threaded & Flanged**

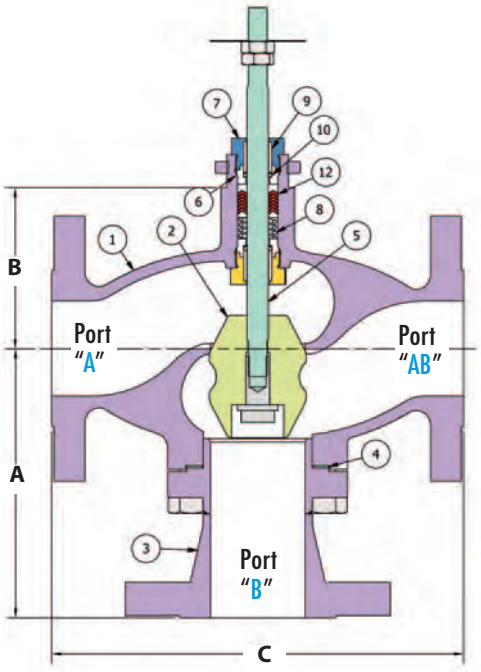



**Mixing:**
Ports "A" and "B" are Inlets
Port "AB" is Outlet

**Diverting:**
Port "AB" is Inlet
Ports "A" and "B" are Outlets

**2 1/2" to 4"**
**Flanged**




| Item | Description | Material |
|---|---|---|
| 1 | Body | 316 Stainless Steel |
| 2 | Valve Plug* | Hardened Stainless Steel |
| 4 | Body Gasket* | 303 Stainless Steel |
| 5 | Stem* | 316 Stainless Steel |
| 6 | Lower Seal Bushing | 303 Stainless Steel |
| 7 | Gland Nut | 303 Stainless Steel |
| 8 | Stem Seal Spring* | 302 Stainless Steel |
| 9 | Guide Bushing* | Rulon 641 / PTFE |
| 10 | Washer | 303 Stainless Steel |
| 12 | V-ring Stem Seals* | PTFE |

* Recommended Spare Parts

| Size | A NPT | B | A 150 | A 300 | C NPT | C 150# | C 300# | Weight (lbs) NPT | Weight (lbs) 150# | Weight (lbs) 300# |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/2" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 4 | 8.5 | 9 |
| 3/4" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 4 | 8.5 | 9 |
| 1" | 2.31 | 2.95 | 4 | 4 | 4.50 | 7.25 | 7.75 | 5.5 | 12 | 13.5 |
| 1 1/2" | 2.84 | 2.95 | 4.3 | 4.3 | 5.00 | 8.75 | 9.25 | 7 | 18.5 | 22 |
| 2" | 3.19 | 2.95 | 5 | 5 | 6.00 | 10 | 10.5 | 11 | 26 | 35 |
| 2 1/2" | - | 4.25 | 7.13 | 7.38 | - | 10.88 | 11.5 | - | 50 | 58 |
| 3" | - | 4.25 | 8.32 | 8.5 | - | 11.75 | 12.5 | - | 74 | 88 |
| 4" | - | 4.25 | 9.19 | 9.5 | - | 13.88 | 14.5 | - | 106 | 136 |

Insulation Blankets; Contact Factory

Note: Insulation blankets are recommended for electrically-actuated valves when fluid temperature 300 ° F and above.

## MAXIMUM FLOW COEFFICIENT ($C_V$)

| Valve Body Size | 1/2" (Reduced Port) | 1/2" | 3/4" | 1" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
|---|---|---|---|---|---|---|---|---|---|
| | 3.5 | 5 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |

CONTROL VALVES

# STEAM

## CAPACITIES – Steam (lbs/hr)

| Inlet Pressure (PSIG) | Outlet Pressure (PSIG) | ΔP PSI | Reduced Port 1/2" | 1/2" | 3/4" | 1" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $C_V$ Factors | | 3.5 | 5.0 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |
| | Orifice Size (in) | | 0.88 | 0.88 | 0.88 | 0.88 | 1.25 | 1.75 | 2.5 | 2.88 | 3.88 |
| 5 | 4 | 1 | 48 | 68 | 89 | 136 | 300 | 573 | 955 | 1501 | 2320 |
| | 0 | 5 | 96 | 137 | 178 | 274 | 602 | 1149 | 1915 | 3009 | 4650 |
| | -4 | 9 | 114 | 162 | 211 | 325 | 714 | 1363 | 2272 | 3570 | 5518 |
| | -8 | 13 | 119 | 170 | 220 | 339 | 746 | 1424 | 2374 | 3730 | 5765 |
| 10 | 9 | 1 | 53 | 76 | 99 | 153 | 336 | 641 | 1068 | 1678 | 2593 |
| | 5 | 5 | 110 | 156 | 203 | 313 | 689 | 1315 | 2191 | 3443 | 5321 |
| | 0 | 10 | 138 | 197 | 255 | 393 | 865 | 1651 | 2751 | 4324 | 6682 |
| | -7 | 17 | 148 | 211 | 274 | 422 | 929 | 1773 | 2955 | 4643 | 7176 |
| 15 | 10 | 5 | 122 | 174 | 226 | 348 | 765 | 1460 | 2433 | 3824 | 5909 |
| | 5 | 10 | 156 | 223 | 290 | 447 | 983 | 1876 | 3127 | 4913 | 7593 |
| | 0 | 15 | 172 | 246 | 320 | 492 | 1082 | 2066 | 3444 | 5412 | 8364 |
| | -5 | 20 | 177 | 252 | 328 | 505 | 1110 | 2119 | 3532 | 5550 | 8578 |
| 20 | 15 | 5 | 133 | 189 | 246 | 379 | 833 | 1591 | 2652 | 4167 | 6440 |
| | 10 | 10 | 173 | 247 | 321 | 494 | 1088 | 2076 | 3460 | 5438 | 8404 |
| | 5 | 15 | 194 | 277 | 361 | 555 | 1221 | 2330 | 3883 | 6103 | 9431 |
| | -3 | 23 | 205 | 293 | 381 | 587 | 1291 | 2464 | 4106 | 6453 | 9972 |
| 30 | 25 | 5 | 152 | 217 | 282 | 434 | 955 | 1822 | 3037 | 4773 | 7377 |
| | 15 | 15 | 232 | 331 | 431 | 663 | 1459 | 2785 | 4641 | 7293 | 11271 |
| | 5 | 25 | 260 | 371 | 482 | 742 | 1631 | 3115 | 5191 | 8157 | 12606 |
| | 0 | 30 | 262 | 375 | 487 | 750 | 1649 | 3149 | 5248 | 8247 | 12745 |
| 50 | 40 | 10 | 250 | 357 | 464 | 714 | 1570 | 2997 | 4995 | 7850 | 12132 |
| | 30 | 20 | 324 | 463 | 601 | 925 | 2035 | 3886 | 6476 | 10177 | 15728 |
| | 15 | 35 | 370 | 529 | 687 | 1057 | 2326 | 4440 | 7399 | 11628 | 17970 |
| | 7 | 43 | 376 | 537 | 697 | 1073 | 2361 | 4507 | 7511 | 11804 | 18242 |
| 80 | 70 | 10 | 307 | 438 | 570 | 877 | 1929 | 3682 | 6136 | 9643 | 14903 |
| | 50 | 30 | 472 | 675 | 877 | 1350 | 2970 | 5670 | 9450 | 14850 | 22950 |
| | 30 | 50 | 534 | 763 | 992 | 1525 | 3356 | 6407 | 10678 | 16780 | 25932 |
| | 17 | 63 | 544 | 777 | 1010 | 1554 | 3418 | 6526 | 10876 | 17091 | 26413 |
| 100 | 85 | 15 | 406 | 580 | 754 | 1160 | 2552 | 4872 | 8121 | 12761 | 19722 |
| | 60 | 40 | 586 | 837 | 1089 | 1675 | 3684 | 7034 | 11723 | 18422 | 28470 |
| | 40 | 60 | 643 | 918 | 1193 | 1836 | 4039 | 7710 | 12851 | 20194 | 31209 |
| | 23 | 77 | 655 | 936 | 1217 | 1872 | 4119 | 7864 | 13107 | 20596 | 31831 |
| 125 | 110 | 15 | 452 | 645 | 839 | 1290 | 2838 | 5418 | 9030 | 14190 | 21930 |
| | 85 | 40 | 668 | 954 | 1240 | 1908 | 4199 | 8015 | 13359 | 20993 | 32443 |
| | 50 | 75 | 782 | 1117 | 1452 | 2233 | 4913 | 9380 | 15634 | 24567 | 37968 |
| | 31 | 94 | 794 | 1135 | 1475 | 2270 | 4993 | 9532 | 15887 | 24965 | 38582 |
| 150 | 130 | 20 | 560 | 800 | 1040 | 1600 | 3519 | 6718 | 11197 | 17595 | 27192 |
| | 100 | 50 | 800 | 1143 | 1485 | 2285 | 5027 | 9598 | 15996 | 25137 | 38847 |
| | 70 | 80 | 904 | 1291 | 1678 | 2582 | 5680 | 10844 | 18074 | 28402 | 43893 |
| | 40 | 110 | 933 | 1333 | 1733 | 2666 | 5865 | 11196 | 18661 | 29324 | 45319 |
| 175 | 150 | 25 | 666 | 952 | 1237 | 1903 | 4187 | 7994 | 13323 | 20936 | 32356 |
| | 115 | 60 | 931 | 1329 | 1728 | 2659 | 5850 | 11167 | 18612 | 29248 | 45201 |
| | 75 | 100 | 1052 | 1503 | 1953 | 3005 | 6612 | 12622 | 21037 | 33058 | 51089 |
| | 48 | 127 | 1072 | 1531 | 1990 | 3062 | 6736 | 12859 | 21432 | 33679 | 52049 |
| 200 | 175 | 25 | 713 | 1018 | 1324 | 2037 | 4481 | 8554 | 14257 | 22404 | 34625 |
| | 130 | 70 | 1061 | 1515 | 1970 | 3031 | 6668 | 12730 | 21216 | 33340 | 51425 |
| | 90 | 110 | 1183 | 1690 | 2196 | 3379 | 7434 | 14192 | 23654 | 37170 | 57444 |
| | 56 | 144 | 1210 | 1729 | 2247 | 3457 | 7606 | 14521 | 24202 | 38031 | 58775 |
| 250 | 225 | 25 | 798 | 1140 | 1482 | 2281 | 5017 | 9578 | 15964 | 25086 | 38770 |
| | 170 | 80 | 1273 | 1819 | 2364 | 3637 | 8002 | 15276 | 25259 | 40008 | 61830 |
| | 120 | 130 | 1443 | 2062 | 2680 | 4124 | 9072 | 17319 | 28865 | 45359 | 70100 |
| | 73 | 177 | 1487 | 2125 | 2762 | 4249 | 9348 | 17846 | 29744 | 46740 | 72235 |
| 300 | 270 | 30 | 951 | 1359 | 1766 | 2718 | 5979 | 11414 | 19023 | 29894 | 46199 |
| | 200 | 100 | 1535 | 2193 | 2850 | 4385 | 9648 | 18418 | 30697 | 48238 | 74549 |
| | 140 | 160 | 1723 | 2461 | 3199 | 4922 | 10828 | 20672 | 34454 | 54142 | 83674 |
| | 89 | 211 | 1765 | 2521 | 3277 | 5042 | 11093 | 21177 | 35296 | 55465 | 85718 |

Note: The Steam Capacity Chart is based on ISA Standard 75.01.01-2007 (60534-2-1 Mod). It assumes pipe sizes equal to the size of the valve ports, with no attached fittings.

CONTROL VALVES

## Sizing & Capacity Chart

# WATER

| CAPACITIES – Water (GPM) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet Pressure (PSIG) | Outlet Pressure (PSIG) | ΔP PSI | Reduced Port 1/2" | 1/2" | 3/4" | 1" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
| | | $C_V$ Factors | 3.5 | 5.0 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |
| | | Orifice Size (in) | 0.88 | 0.88 | 0.88 | 0.88 | 1.25 | 1.75 | 2.5 | 2.88 | 3.88 |
| 5 | 4 | 1 | 3.5 | 5.0 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |
| | 0 | 5 | 7.8 | 11 | 15 | 22 | 49 | 94 | 157 | 246 | 380 |
| 10 | 7 | 3 | 6.1 | 8.7 | 11 | 17 | 38 | 73 | 121 | 191 | 294 |
| | 5 | 5 | 7.8 | 11 | 15 | 22 | 49 | 94 | 198 | 311 | 481 |
| | 0 | 10 | 11 | 16 | 21 | 32 | 70 | 133 | 251 | 246 | 380 |
| 15 | 10 | 5 | 7.8 | 11 | 15 | 22 | 49 | 94 | 157 | 246 | 380 |
| | 5 | 10 | 11 | 16 | 21 | 32 | 70 | 133 | 221 | 348 | 538 |
| | 0 | 15 | 14 | 20 | 26 | 39 | 86 | 165 | 275 | 432 | 668 |
| 30 | 25 | 5 | 7.8 | 11 | 15 | 22 | 49 | 94 | 157 | 246 | 380 |
| | 15 | 15 | 14 | 19 | 25 | 39 | 85 | 163 | 271 | 426 | 658 |
| | 7 | 23 | 17 | 24 | 31 | 48 | 106 | 203 | 338 | 531 | 821 |
| 50 | 40 | 10 | 11 | 16 | 21 | 32 | 70 | 133 | 221 | 348 | 528 |
| | 30 | 20 | 16 | 22 | 29 | 45 | 98 | 188 | 313 | 492 | 760 |
| | 16 | 34 | 20 | 29 | 38 | 58 | 128 | 244 | 407 | 640 | 898 |
| 80 | 70 | 10 | 11 | 16 | 21 | 32 | 70 | 133 | 221 | 348 | 538 |
| | 50 | 30 | 19 | 27 | 36 | 55 | 120 | 230 | 383 | 602 | 931 |
| | 30 | 50 | 25 | 35 | 46 | 70 | 155 | 296 | 493 | 775 | 1198 |
| 100 | 85 | 15 | 14 | 19 | 25 | 39 | 85 | 163 | 271 | 426 | 658 |
| | 65 | 35 | 21 | 30 | 38 | 59 | 130 | 248 | 414 | 651 | 1006 |
| | 40 | 60 | 27 | 39 | 50 | 78 | 171 | 326 | 543 | 853 | 1319 |
| 125 | 110 | 15 | 14 | 19 | 25 | 39 | 85 | 163 | 271 | 426 | 658 |
| | 85 | 40 | 22 | 32 | 41 | 63 | 139 | 266 | 443 | 696 | 1075 |
| | 52 | 73 | 30 | 43 | 56 | 86 | 188 | 360 | 600 | 492 | 760 |
| 150 | 130 | 20 | 16 | 22 | 29 | 45 | 98 | 188 | 313 | 492 | 760 |
| | 100 | 50 | 25 | 35 | 46 | 71 | 156 | 297 | 495 | 778 | 1202 |
| | 63 | 87 | 33 | 47 | 60 | 93 | 205 | 391 | 651 | 1023 | 1581 |
| 200 | 175 | 25 | 18 | 25 | 33 | 50 | 110 | 210 | 350 | 550 | 850 |
| | 130 | 70 | 29 | 42 | 54 | 84 | 184 | 351 | 586 | 920 | 1422 |
| | 87 | 113 | 37 | 53 | 69 | 106 | 234 | 446 | 744 | 1169 | 1806 |
| 250 | 225 | 25 | 18 | 25 | 33 | 50 | 110 | 210 | 350 | 550 | 850 |
| | 170 | 80 | 31 | 45 | 58 | 89 | 197 | 376 | 626 | 984 | 1521 |
| | 111 | 139 | 41 | 59 | 77 | 118 | 260 | 495 | 826 | 1298 | 2006 |
| 300 | 270 | 30 | 19 | 27 | 36 | 55 | 120 | 230 | 383 | 602 | 931 |
| | 200 | 100 | 35 | 50 | 65 | 100 | 220 | 420 | 700 | 1100 | 1700 |
| | 134 | 166 | 45 | 64 | 84 | 129 | 283 | 540 | 901 | 1415 | 2187 |

Notes: 1) Capacities based on 70°F water (SG = 1.00).
2) Capacities based on 100% of Cv.
3) Maximum capacities are based on pressure drop at constant cavitation at 70°F.
4) Cavitation adapters available to prevent cavitation.

## HB Series Mixing & Diverting (3-Way Valves)

**CAPACITIES – Water (GPM)** **3-WAY VALVES**

Inlet pressures should be within 5% of each other. Specify if service is for other than water.

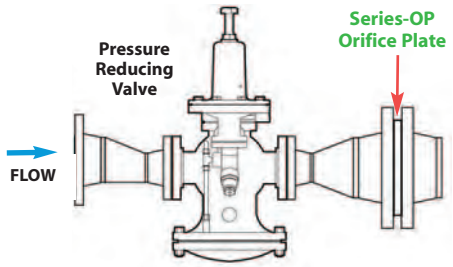
| Pressure Drop (PSI△P) | Size, Body Number & Coefficient (Cv) 1/2" Cv = 5 | 3/4" Cv = 6.5 | 1" Cv = 10 | 1 1/2" Cv = 22 | 2" Cv = 42 | 2 1/2" Cv = 70 | 3" Cv = 110 | 4" Cv = 170 |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 6.5 | 10 | 22 | 42 | 70 | 110 | 170 |
| 3 | 8.7 | 11.3 | 17.3 | 38 | 73 | 121 | 191 | 294 |
| 5 | 11.2 | 15 | 22 | 49 | 94 | 157 | 246 | 380 |
| 10 | 15.8 | 21 | 32 | 70 | 133 | 221 | 348 | 538 |
| 15 | 19 | 25 | 39 | 85 | 163 | 271 | 426 | 658 |
| 20 | 22 | 29 | 45 | 98 | 188 | 313 | 492 | 760 |
| 25 | 25 | 33 | 50 | 110 | 210 | 350 | 550 | 850 |
| 30 | 27 | 36 | 55 | 120 | 230 | 383 | 602 | 931 |
| 40 | 32 | 41 | 63 | 139 | 266 | 443 | 696 | 1075 |
| 50 | 35 | 46 | 71 | 156 | 297 | 495 | 778 | 1202 |
| 60 | 39 | 50 | 77 | 170 | 325 | 542 | 852 | 1317 |
| 70 | 42 | 54 | 84 | 184 | 351 | 586 | 920 | 1422 |
| 80 | 45 | 58 | 89 | 197 | 376 | 626 | 984 | 1521 |
| 90 | 47 | 62 | 95 | 209 | 398 | 664 | 1044 | 1613 |
| 100 | 50 | 65 | 100 | 220 | 420 | 700 | 1100 | 1700 |
| 125 | 56 | 73 | 112 | 246 | 470 | 783 | 1230 | 1901 |
| 150 | 61 | 80 | 122 | 269 | 514 | 857 | 1347 | 2082 |
| 175 | 66 | 86 | 132 | 291 | 556 | 926 | 1455 | 2249 |
| 200 | 71 | 92 | 141 | 311 | 594 | 990 | 1556 | 2404 |
| 225 | 75 | 98 | 150 | 330 | 630 | 1050 | 1650 | 2550 |
| 250 | 79 | 103 | 158 | 348 | 664 | 1107 | 1739 | 2688 |

Notes: 1) Capacities based on 70°F water (SG = 1.00).
2) Capacities based on 100% of Cv.
3) Maximum capacities are based on pressure drop at constant cavitation at 70°F.
4) Cavitation adapters available to prevent cavitation.

## Orifice Plates

**Noise Reduction Capability: 5-10+ dBA**

The **Series OP** Orifice Plate with its drilled orifice pattern is installed after the pressure regulating valve to smooth out turbulence caused by the pressure drop across the regulator. Typical noise reduction levels of 5-10 dBA; higher possible. Manufactured from SA-105 Carbon Steel, 304 SST, or 316 SST.




**Helpful Selection Information**

All Orifice Plates are custom designed to optimize noise attenuation and control. They are sized in conjunction with PRVs. Therefore, the following information is required for proper selection: Steam Inlet Pressure to PRV, Reduced Outlet Pressure, and Load/Capacity (lb/hr).

| X = Material | ## = Number of Holes | 0.000 = Diameter of Holes |
|---|---|---|
| 1 = A105 CS | Factory Determined | Factory Determined |
| 2 = 304 SST* | | |
| 3 = 316 SST* | | |

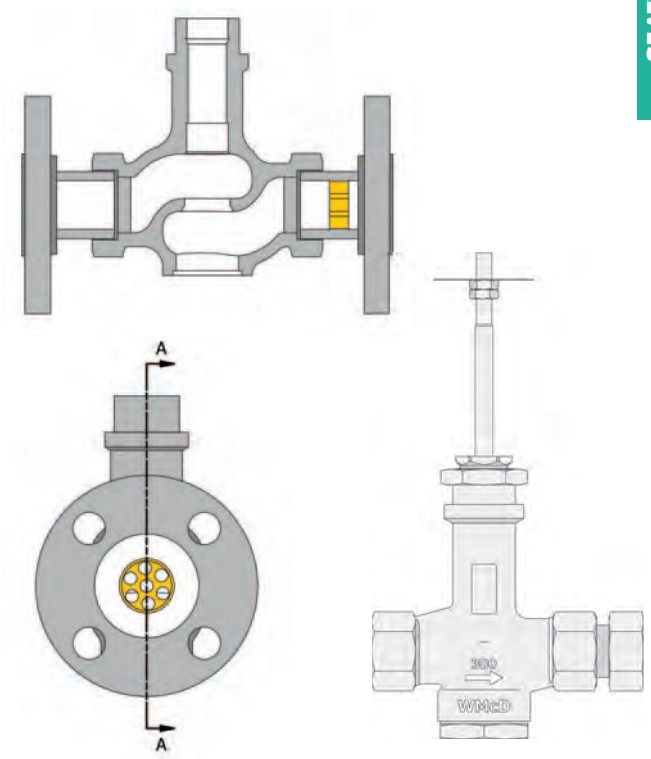
Notes: 1) Other sizes and flange connections available; Consult Factory.
2) Orifice Plates may be available for other valves; Consult Factory.
* Consult Factory for SST pricing.

## Cavitation Adapters

**Cavitation is a condition found in liquid flow through a control valve. The two stage process occurs during the rapid formation and collapse of vapor cavities or bubbles. When the flow through the valve orifice causes a pressure drop below the liquid vapor pressure the cavities form. When the pressure in the valve recovers above the liquid vapor pressure, the vapor bubbles collapse and the energy from the implosion can cause premature wear on the valve near the plug and seat. Cavitation can cause noise, vibration, and damage to control valves.**

| Valve Size | Valve Cv | Adapter Cv | Combo Cv | Adapter* Part No. | Overall Length |
|---|---|---|---|---|---|
| 1/2 R | 3.5 | 3.6 | 2.7 | CA121 | 5.5 |
| | | 2.4 | 2.2 | CA122 | |
| | | 1.6 | 1.9 | CA123 | |
| 1/2 | 5 | 3.6 | 3.2 | CA121 | 5.5 |
| | | 2.4 | 2.8 | CA122 | |
| | | 1.6 | 2.5 | CA123 | |
| 3/4 | 6.5 | 7.6 | 5.3 | CA131 | 5.5 |
| | | 5.5 | 4.5 | CA132 | |
| | | 13.1 | 3.9 | CA133 | |
| 1 | 10 | 13.1 | 8.6 | CA141 | 5.6 |
| | | 9.5 | 7.3 | CA142 | |
| | | 7.0 | 6.4 | CA143 | |
| 1 1/2 | 22 | 30.4 | 19.6 | CA161 | 6 |
| | | 18.9 | 15.3 | CA162 | |
| | | 12.0 | 12.7 | CA163 | |
| 2 | 42 | 52.3 | 35.3 | CA171 | 7.1 |
| | | 38.7 | 30.3 | CA172 | |
| | | 28.1 | 26.3 | CA173 | |

Note: Cavitation Adapters available for valve sizes 2 1/2" -4"; Consult factory.
* Specify end connection: NPT, 150# or 300# FLG.

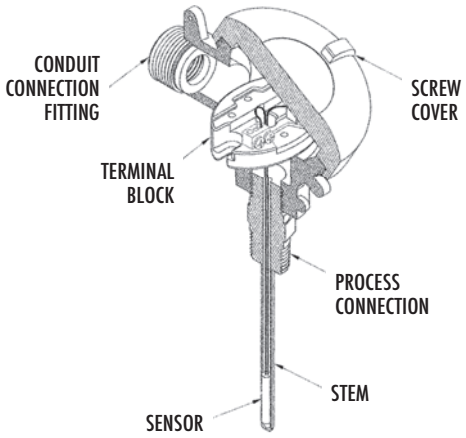


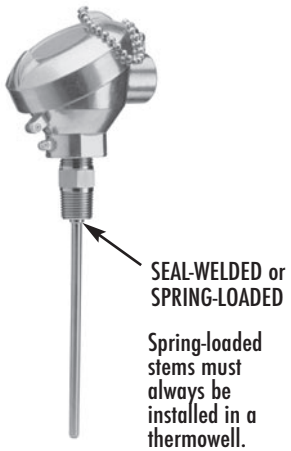

CONTROL VALVES

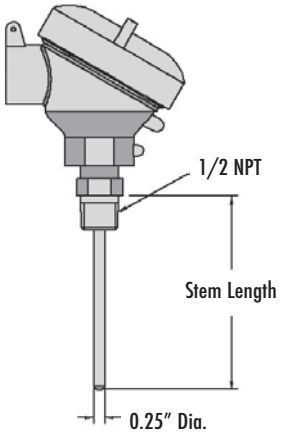
# Understanding a Control Loop

## Sensor for Temperature Control (Thermocouple or RTD)

Electronic Temperature Sensors are available with both Type J and Type K Thermocouples, as well as RTD sensors. A thermocouple (T/C) is made from two dissimilar metals that generate electrical voltage directly with changes in temperature. An RTD (Resistance Temperature Detector) is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner. The weatherproof head provides a conduit connection and can be used to house a transmitter (optional). The stem is either welded directly to the 1/2" NPT threaded connection, or is spring-loaded.




CONTROL VALVES

## Stem (Sheath)

All Thermocouples and RTDs are furnished with a 316 stainless steel stem, with the internal wiring packed in powdered ceramic. The screw head cover style is available in two stem types: welded and spring loaded. The welded stem is suitable for use in liquid applications. The spring-loaded stem is designed to bottom out inside a thermowell, providing maximum heat sensitivity. Spring-loaded stems are not pressure tight and may allow process media to escape; therefore, they must always be installed in a thermowell.

The insertion length (U) of a thermocouple or RTD represents its depth into the process vessel or thermowell. Thermocouples and RTDs are available in standard U-lengths from 2" to 24". Other lengths are available upon special order; consult factory.

### TR890
**Series Controller**

The user-interface which allows adjustment of the set point and controls the electrical signals received from the sensor and outputted to the I/P Transducer. The TR893 is the most common controller model due to its larger, more user-friendly size.

### NANODAC
**Series Controller**

The NANODAC Series is a PID Controller with added features such as data recording and Modbus Communication. (BACnet is optional.) Standard features include (4) universal analog inputs, (2) 4-20mA outputs, (3) mechanical 2A relays, and 110-230VAC power supply. 24VAC/DC and other options available; Consult factory.

### TA901
**Electropneumatic (I/P) Transducer**

An electro-pneumatic transducer that converts an electrical signal (4-20 mA) from the Controller to an air signal (3-15 PSI) for supply to the top of the actuator of the control valve.

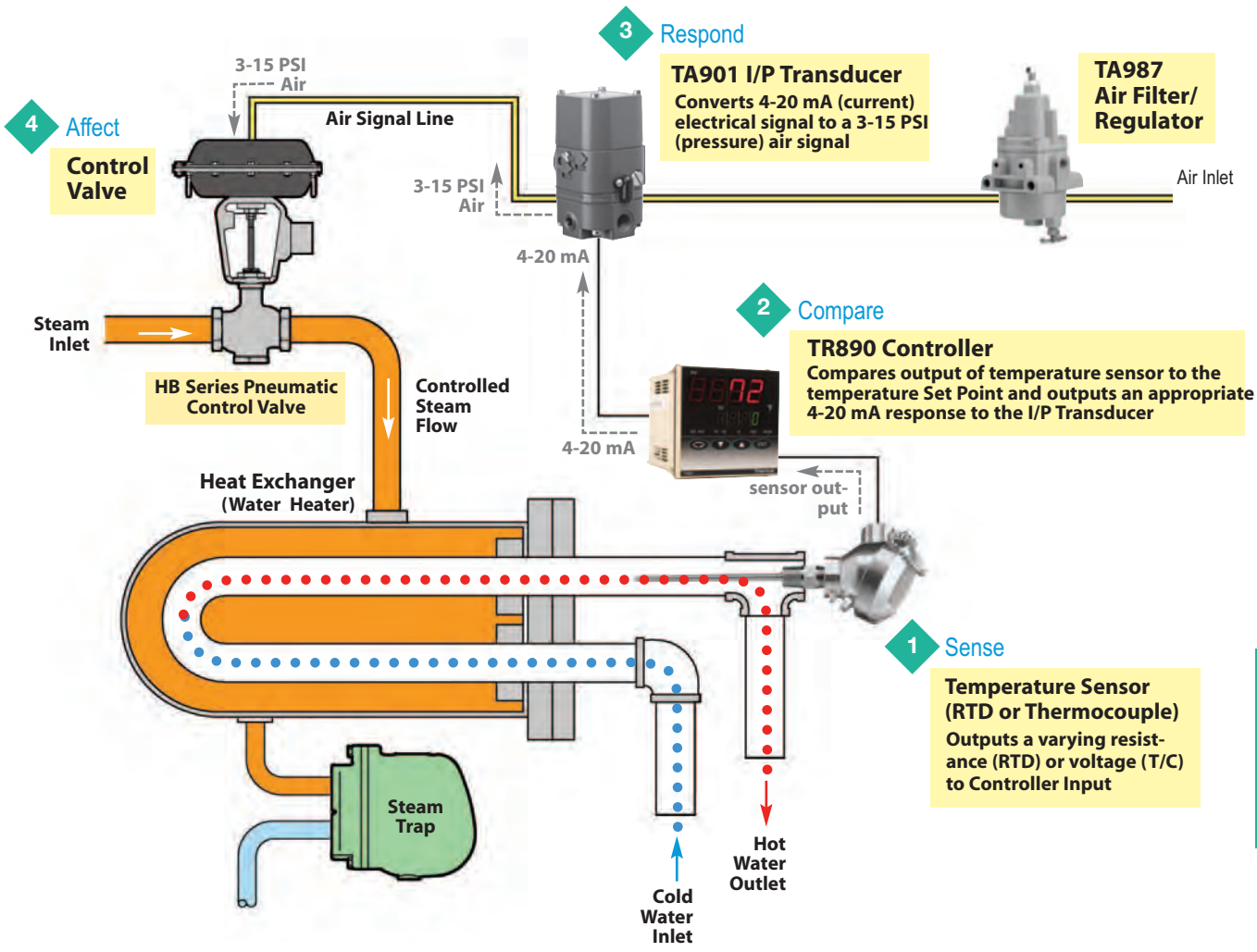
### TA987
**Air Filter/Regulator**

This device is recommended for filtering and regulating the pressure of plant compressed air to the inlet of the I/P Transducer, which ensures the delivery of clean, dry air at the proper pressure to the pneumatic actuator.

## Introduction

# Understanding a Control Loop

### Heat Exchanger (Instantaneous Water Heater)




### Control Loop

A control loop is a process management system designed to maintain a process variable at a desired set point. Each step in the loop works in conjunction with the others to manage the system. Once the set point has been established, the control loop operates using a four-step process.

**1 Sense**
Measure the current condition of the process using a sensor, which can be a thermocouple or RTD transmitter.

**2 Compare**
Evaluate the measurement of the current condition against the set point using an electronic PID controller.

**3 Respond**
Reacts to any error that may exist between the measured temperature value and the temperature set point by generating a corrective pneumatic signal.

**4 Affect**
Actuate the control valve that will produce a change in the process variable.

The loop continually cycles through the steps, affecting the process variable (water temperature) in order to maintain the desired temperature set point.

# Design and Operation of an Electronic PID Controller

## Description

A controller is a comparative device that receives an input signal from a measured process variable, compares this value with that of a predetermined control point value (set point), and determines the appropriate amount of output signal required by the final control element to provide corrective action within a control loop.

## Principle of Operation (Electronic PID Controller)

An electronic sensor (thermocouple, RTD or transmitter) installed at the measurement location continuously sends an input signal to the controller. At set intervals, the controller compares this signal to a predefined set point. If the input signal deviates from the set point, the controller sends a corrective electric output signal to the control element. This electric signal must be converted to a pneumatic signal when used with an air operated valve, such as a Watson McDaniel HB Series Control Valve. The conversion can be made using a Watson McDaniel TA901 I/P Transducer, which converts a 4 to 20 mA electric signal to a 3 to 15 PSI air signal. As an option, a Valve Positioner such as the Watson McDaniel CE100 may be used to send an air signal to the Control Valve. These Positioners can be controlled with a 3-15 psi air signal from a Pneumatic Controller or a 4-20 mA signal from a PID Controller.

## Features (Electronic PID Controller)

Watson McDaniel Electronic Controllers have full auto-tuning and PID capabilities, and offer a host of available options, including user selectable inputs, outputs and ranges.

**PID Control** is a feature of Watson McDaniel TR890 & Nanodac Electronic Controllers. PID combines the proportional, integral and derivative functions into a single unit.

- **Proportional (P)** — Proportional control reacts to the size of the deviation from set point when sending a corrective signal. The size of the corrective signal can be adjusted in relation to the size of the error by changing the width of the proportional band. A narrow proportional band will cause a large corrective action in relation to a given amount of error, while a wider proportional band will a cause smaller corrective action in relation to the same amount of error.

- **Integral (I)** — Integral control reacts to the length of time that the deviation from set point exists when sending a corrective signal. The longer the error exists, the greater the corrective signal.

- **Derivative (D)** — Derivative control reacts to the speed in which the deviation is changing. The corrective signal will be proportional to the rate of change within the process.

**Auto-Tuning** will automatically select the optimum values for **P**, **I** and **D**, thus eliminating the need for the user to calculate and program these values at system startup. This feature can be overridden when so desired. On some models, the control element can be manually operated.

## Introduction

Design and Operation of an Electronic PID Controller

### Selecting an Electronic PID Controller

When selecting a PID controller, the following parameters must be specified. (Refer to the TR890 Series Electronic PID Controller Specifications and Model Coding chart on the following two pages.)

#### 1) Model (Case Size)

The Case Size selection is determined by both available and designed space, and controller features. Watson McDaniel Electronic Controllers are available in the following panel sizes:

TR891: 48 x 48 mm (1/16 DIN)
TR892: 72 x 72 mm
TR893: 96 x 96 mm (1/4 DIN)
TR894: 96 (H) x 48 (W) mm (1/8 DIN)
NANODAC: 96 x 96mm (1/4 DIN)

#### 2) Input

The Input is the measurement signal received by the controller from the sensor. One of the following three input types can be specified for the controller: 8: Universal, 4: Current or 6: Voltage. The Universal input type is switchable between Thermocouple, RTD and mV input signals.

If temperature will be measured with a thermocouple or RTD sensor, the Universal input type must be selected for the controller (Model Code Position 2 = 8). If another process variable such as PRESSURE is being measured, verify the type of output signal from that sensor. If it's 4-20 mA or 0-10 Volts then the Current or Voltage input option would be chosen, respectively.

#### 3) Control Output

The Control Output is the corrective signal transmitted from the controller to the control device. One of the following four control output types can be specified for the controller: I: 4-20 mA DC, Y: On/Off Contact, P: Solid State Relay (SSR) Driver or V: 0-10 VDC.

The most common control devices are the TA901 Electro-pneumatic (I/P) Transducer and CE100-Series Valve Positioner with built-in I/P transducer, both of which accept a 4-20 mA signal. For these devices, the 4-20 mA control output type must be selected for the controller (Model Code Position 3 = I). The TA901 or CE1 00-Series output an air signal to the actuator of the Control Valve, which is the final control element of the feedback loop.

The On/Off Contact and SSR Driver control output types are typically used to switch on AC power to a load. If the SSR Driver control output is selected, an external solid state relay (SSR) is required and can be used for activating electrical equipment with larger current requirements.

#### 4) Power Supply

The power supply requirement for the electronic controller must be specified. The available choices are: 100-240 VAC, 50/60 Hz or 24 V AC/DC, 50/60Hz.

#### 5) Event Output (Option)

The Event Output is used to signal an external device when an alarm condition is detected. Various alarm types can be detected by the controller. These include deviation of the measured value from the set value, the measured value exceeding absolute limits (i.e., high and low level alarm) and heater break/loop alarm (i.e., heater current outside of normal limits). If selected as an option, the controller will have two Event Outputs. In the case of a high/low alarm, one output is used for the high level alarm and the other for the low level alarm.

#### 6) Options: Analog Output & Digital Input

The Analog Output is an optional secondary signal that transmits either the measured process value (PV), the target set value (SV) or the Control Output value from the controller to a remote data acquisition device, such as a recorder, personal computer or display unit. One of the following three analog output types can be specified for the controller: 0-10 mV DC, 4-20 mA DC or 0-10 V DC. The analog output type is independent of the measured input type or the control output type. However, the analog output type selection must be compatible with the data acquisition device input.

The Digital Input is an optional input that can be specified for the controller. The digital input functions as an On/Off switch and can be programmed to activate the Set Value Bias or Standby mode, or switch the Control Action type (i.e., to Reverse Acting or Direct Acting).

Note: The Analog Output and Digital Input combination is not available for Model TR891. Only one of these options can be selected for this model.

# TR890 Series

## Features PID & Auto-tuning

- **Multiple Sizes**
- **± 0.3% Accuracy**
- **Keyboard Programmable**
- **Reverse or Direct Acting**
- **Manual Output Override**

The **TR890 Series** Electronic PID Controller is designed for use on applications where large load changes are expected, or extreme accuracy and fast response times are needed. With full auto-tune capabilities and a large selection of available inputs, the TR890 Series is ideally suited for use with a Watson McDaniel Control Valve.

**Use of a Watson McDaniel No. TA987 Air Filter/Regulator is recommended for filtering and regulating the pressure of plant compressed air, and for delivering clean, dry air at the proper pressure to pneumatic control devices.**

**Approximate Shipping Weights:**
TR891: 0.4 lbs [0.17 kg]
TR892: 0.6 lbs [0.28 kg]
TR893: 0.7 lbs [0.33 kg]
TR894: 0.5 lbs [0.24 kg]

## Specifications

| | |
|---|---|
| **Models** | **TR891:** 48 x 48 mm (1/16 DIN)<br>**TR892:** 72 x 72 mm<br>**TR893:** 96 x 96 mm (1/4 DIN)<br>**TR894:** 96 x 48 mm (1/8 DIN) |
| **Control** | **Control Mode:** Auto-Tuning PID<br>**Action:** Reverse acting (field switchable to direct acting) |
| **Proportional Band** | Off, 0.1-999.9% Full Scale<br>Integral Time: Off, 1-6000 sec.<br>Derivative Time: Off, 1-3600 sec. |
| **Accuracy** | ± 0.3% |
| **Display** | Process Value: 4 Digit, 20 mm red LED<br>Set Value: 4 digit, 10.2 mm green LED<br>Sampling Cycle: 0.25 seconds |
| **Inputs** | **Universal:** (switchable between)<br>▶ Thermocouple: B, R, S, K, E, J, T, N, PL II, WRe5-26 (U,L (DIN 43710)<br>▶ RTD: Platinum 100 Ω, 3-Wire<br>▶ mV: (scalable) -10–10, 0-10, 0-20, 0-50, 10-50, 0-100 mV DC<br>**Current:** (scalable) 4-20, 0-20 mA<br>**Voltage:** -1–1, 0-1, 0-2, 0-5, 1-5, 0-10 VDC |
| **Control Output** | **Current:** 4-20 mA (load resistance: 600 Ω maximum)<br>**Contact:** Proportional cycle, 1-120 sec. (capacity: 240 VAC 2 A resistive / 1.2 A inductive)<br>**SSR Drive Voltage:** Proportional cycle 1-120 sec. (output rating: 12 ± 1.5 VDC / 30 mA maximum)<br>**Voltage:** 0-10 VDC<br>Load Current 2 mA max |
| **Power Requirements** | **Supply Voltage:** 100-240 VAC, 50/60 Hz **or** 24 VAC/VDC 50/60 Hz<br>**Consumption:** 100-240 VAC, 15VA<br>24 VDC, 8W<br>24 VAC, 9VA |
| **Data Storage** | Nonvolatile EEPROM memory |
| **Case Material** | Polyphenylene Oxide (PPO) |
| **Ambient Temp.** | 14°F (-10°C) to 122°F (50°C) |
| **Humidity** | Maximum: 90% RH, non-condensing |

**Event Outputs**
(Contact Capacity: 240 VAC, 1 A/resistive load)
Dual Event Outputs (High and/or Low Alarms)
Single Event Output + Heater Break Alarm (includes CT30A sensor)
Single Event Output + Heater Break Alarm (includes CT50A sensor)

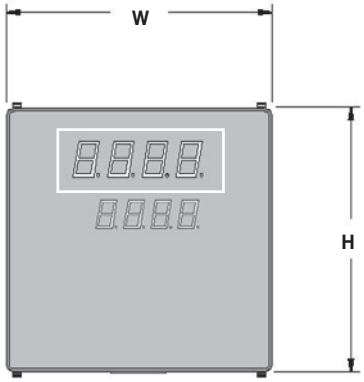
**Options:**
Analog Output: 0-10 mV DC (output resistance 10 Ω )
Analog Output: 4-20 mA DC (load resistance 300 Ω max )
Analog Output: 0-10 VDC (load current 2 mA max )

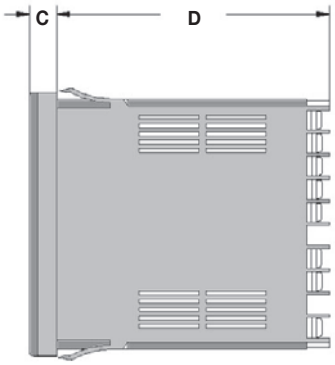
Digital Input (switch) including:
Set Value Bias setting range of -1999 - 5000, standby or DA/RA Selection
Operated by either non-voltage contact or open collector
input rated at approx. 5V DC/1mA max.

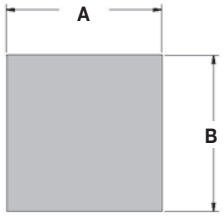
CONTROL VALVES

# TR890 Series

## Features PID & Auto-tuning




PANEL CUTOUT DIMENSIONS

### HOW TO ORDER (Model Coding)

Sample Order Number: **TR893 8 I 90 1 00**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Model | Input | Control Output | Power Supply | Event Output | Options |
| **TR891**<br>**TR892**<br>**TR893**<br>**TR894** | **8** Universal<br>**4** mA<br>**6** VDC | **I** 4-20 mA<br>**Y** On/Off Contact<br>**P** SSR Driver<br>**V** 0-10 VDC | **90** 100-240 VAC, 50/60 Hz<br>**08** 24 VAC/VDC, 50/60 Hz | **0** None<br>**1** Dual Event (high and/or low)<br>**2** Single Event (high or low) and heater break CT30A<br>**3** Single Event (high or low) and heater break CT50A<br>Event Outputs 2 or 3 require Control Outputs Y or P | **00** None<br>**30** Analog Output (0-10 mVDC)<br>**40** Analog Output (4-20 mA)<br>**60** Analog Output (0-10 VDC)<br>**08** Digital Input (switch)<br>**38** Digital Input (switch) with 0-10 mVDC* Analog Output<br>**48** Digital Input (switch) with 4-20 mA* Analog Output<br>**68** Digital Input (switch) with 0-10 VDC* Analog Output |

**Not available with Model TR891*

CONTROL VALVES

### Electronic PID Controller Dimensions – units: inches [mm]

| Model | A | B | C | D | H | W |
|---|---|---|---|---|---|---|
| TR891 | 1.77 [45] | 1.77 [45] | 0.43 [11] | 3.94 [100] | 1.89 [48] | 1.89 [48] |
| TR892 | 2.68 [68] | 2.68 [68] | 0.43 [11] | 3.94 [100] | 2.83 [72] | 2.83 [72] |
| TR893 | 3.63 [92] | 3.63 [92] | 0.43 [11] | 3.94 [100] | 3.78 [96] | 3.78 [96] |
| TR894 | 1.77 [45] | 3.63 [92] | 0.43 [11] | 3.94 [100] | 3.78 [96] | 1.89 [48] |

### Programmable Ranges

| Thermocouple Inputs | | | | | RTD Inputs | | | | Current & Voltage Inputs | |
|---|---|---|---|---|---|---|---|---|---|---|
| T/C Type | Range Code | Fahrenheit Range | Range Code | Celsius Range | Range Code | Fahrenheit Range | Range Code | Celsius Range | Range Code | Range (User-scalable Readout) |
| B* | **15** | 0° to 3300°F | **01** | 0° to 1800°C | **47** | -300° to 1100°F | **31** | -200° to 600°C | **71** | -10–10 mV |
| E | **21** | 0° to 1300°F | **07** | 0° to 700°C | **48** | -150.0° to 200.0°F | **32** | -100.0° to 100.0°C | **72** | 0-10 mV |
| J | **22** | 0° to 1100°F | **08** | 0° to 600°C | **49** | -150° to 600°F | **33** | -100.0° to 300.0°C | **73** | 0-20 mV |
| K | **18** | -150° to 750°F | **04** | -100.0° to 400.0°C | **50** | -50.0° to 120.0°F | **34** | -50.0° to 50.0°C | **74** | 0-50 mV |
| K | **19** | 0° to 1500°F | **05** | 0° to 800°C | **51** | 0.0° to 120.0°F | **35** | 0.0° to 50.0°C | **75** | 10-50 mV |
| K | **20** | 0° to 2200°F | **06** | 0° to 1200°C | **52** | 0.0° to 200.0°F | **36** | 0.0° to 100.0°C | **76** | 0-100 mV |
| L | **28** | 0° to 1100°F | **14** | 0° to 600°C | **53** | 0.0° to 400.0°F | **37** | 0.0° to 200.0°C | **81** | -1–1 V |
| N | **24** | 0° to 2300°F | **10** | 0° to 1300°C | **54** | 0° to 1000°F | **38** | 0.0° to 500.0°C | **82** | 0-1 V |
| PL II | **25** | 0° to 2300°F | **11** | 0° to 1300°C | | | | | **83** | 0-2 V |
| R | **16** | 0° to 3100°F | **02** | 0° to 1700°C | | | | | **84** | 0-5 V |
| S | **17** | 0° to 3100°F | **03** | 0° to 1700°C | | | | | **85** | 1-5 V |
| T | **23** | -300° to 400°F | **09** | -199.9° to 200.0°C | | | | | **86** | 0-10 V |
| U | **24** | -300° to 400°F | **13** | -199.9° to 200°C | | | | | **94** | 0-20 mA |
| WRe5-26 | **26** | 0° to 4200°F | **12** | 0° to 2300°C | | | | | **95** | 4-20 mA |

*Range Codes are not required for ordering, but are used for field programming.*
**750°F (400°C) falls below the accuracy range*

# NANODAC Series

## Features PID & Data-Recording

The **NANODAC Series** is a PID Controller with added features such as data recording and Modbus Communication (BACnet is optional).

Standard features include (4) universal analog inputs, (2) 4-20mA outputs, (3) mechanical 2A relays, and 100-230VAC power supply. 24VAC/DC and other options available; Consult factory.

- **3.5" TFT Color Display**
- **PID Control with Data Recording**
- **Modbus or BACnet Communication Protocol**
- **4 High-Accuracy Inputs**
- **Compact 1/4 DIN Panel Mount**

CONTROL VALVES

## Specifications

| | | |
|---|---|---|
| **Panel mounting** | | **1/4 DIN** |
| **Weight:** | **Instrument Only:** | 0.97 lbs (0.44 kg) |
| **Panel cutout dimension:** | | 92 mm x 92 mm (both -0.0 +0.08 in)<br>or 3.62 in x 3.62 in (both -0.0 +0.03 in) |
| **Depth behind panel:** | | 90 mm (3.54) excluding wiring |
| **Ambient Temperature:** | | |
| | **Operating:** | 14°F (-10°C) to 122°F (50°C) |
| | **Storage:** | -4 to 158°F (-20 to +70°C) |
| **Humidity Range** | **Operating:** | 5% to 85% RH non |
| **Condensing** | **Storage:** | 5% to 85% RH non |
| **Condensing Protection:** | | Front panel: IP65 |
| **Front panel washdown:** | | IP66, NEMA 12 (International) |
| **Behind panel :** | | IP10 (International) |
| **Shock / Vibration: T** | | o BS EN61131-2<br>(5 to 150 Hz. at 1g; 1 octave per min) |
| **Altitude:** | | <6500 ft. (<2000 meters) |
| **Atmosphere:** | | Not suitable for use in explosive or corrosive atmospheres |
| **Electrical safety:** | | BS EN61010-1 (Installation category II; Pollution degree 2) |
| **Electromagnetic compatibility Emissions:** | | |
| | **(Standard units):** | BS EN61326 Class B - Light Industrial |
| | **(Low voltage option):** | BS EN61326 Class A -Heavy Industrial |
| **Immunity:** | | BS EN61326 Industrial |

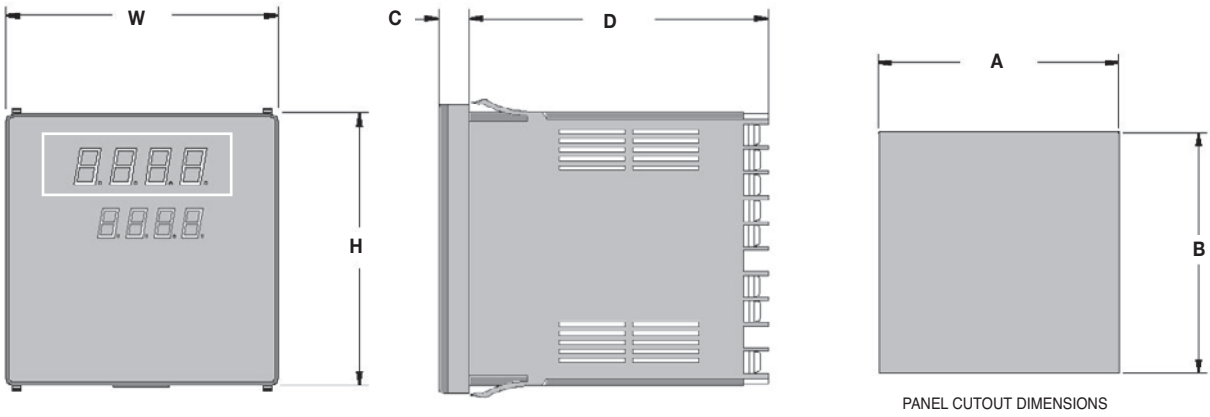
### Power Requirements:

| | |
|---|---|
| **Standard:** | 100-230 VAC ac + 10% -15% at 48 to 62 Hz |
| **Low voltage:** | 24V ac (+ 10% -15%) at 48 to 62 Hz, or<br>24V dc (+ 20% -15%) |
| **Power dissipation:** | 9W (max.) |
| **Fuse Type:** | No internal fuse fitted |
| **Interrupt protection** | |
| **Standard:** | Holdup > 10ms at 85V RMS supply voltage |
| **Low voltage:** | Holdup > 10ms at 20.4V RMS supply voltage |

### Ethernet communications:

| | |
|---|---|
| **Type:** | 10/100base T Ethernet (IEEE802.3) |
| **Protocols:** | Modbus TCP/IP master/slave, EtherNet/IP client/server |
| **Cable type:** | Category 5 |
| **Maximum length:** | 110 yards (100 meters) |
| **Termination:** | RJ45.<br>Green LED illuminated = link connected; Amber LED flashing showa link activity. |

## Features PID & Data-Recording




PANEL CUTOUT DIMENSIONS

### HOW TO ORDER (Model Coding)

Sample Order Number: **NANODAC VH C BS**

| 1 Model | 2 Power Supply | 3 Controller | 4 Communication Protocol |
|---|---|---|---|
| **NANODAC** | **VH** 100-230 VAC (+/- 15% at 48-62Hz) | **C** 2 Control Loops | **TS** Modbus TCP/IP slave<br>**BS** BACnet |

**Electronic PID Controller Dimensions** – units: inches [mm]

| A | B | C | D | H | W |
|---|---|---|---|---|---|
| 3.63 [92] | 3.63 [92] | 0.43 [11] | 3.54 [90] | 3.78 [96] | 3.78 [96] |

CONTROL VALVES

## Analog Input

**General**

**Number of Inputs:** Four dc Volts, dc mV, dc mA, dual mA (external shunt required), dual mV, dual TC†, Thermocouple, RTD (2-wire and 3-wire), Digital (Contact closure)

## Programmable I/O

**Relay Contacts**

**Contact switching power** (resistive): Max. 2A at 230V RMS ±15% Min. 100mA at 12V

**Digital Inputs - Contact closure**

**Short circuit sensing current** (source): 5.5mA (min.); 6.5mA (max.)

**DC Output**

O/P1, O/P2, O/P3 DC analogue outputs

**Current outputs**

(O/P1, O/P2 and O/P3)

**Output ranges:** Configurable within 0 to 20mA
**Load resistance:** 500Ωmax
**Calibration accuracy:** <±100µA ±1% of reading

**Voltage outputs**

(O/P3 only)

**Voltage output across terminals:** 0V (min.); 300mV (max.) Output source leakage current into short circuit: 0µA (min.); 100µA (max.)

# Electropneumatic

- 4 to 20 mA Input
- 3 to 15 PSI Output
- Intrinsically Safe
- Zero and Span Adjustments

The **TA901 Electropneumatic (I/P) Transducer** converts a milliamp current signal to a linearly proportional pneumatic output pressure. This transducer is designed for control applications that require a high degree of reliability and repeatability. The TA901 is used in the control operation of valve actuators and pneumatic valve positioners in the petrochemical, HVAC, energy management, textile, paper, and food & drug industries.

**The TA901 I/P Transducer is tested and approved by Factory Mutual as Intrinsically Safe Class I, II and III, Division I, Groups C, D, E, F and G when installed in accordance with the Installation, Operation and Maintenance Instructions. It should be installed in a vertical position in a vibration-free area.**

**The Watson McDaniel TA987 Air Filter/Regulator is recommended for filtering and regulating the pressure of plant compressed air, and for delivering clean, dry air at the proper pressure to pneumatic control devices.**

## Specifications

**Model**
TA901

**Input**
4-20 mA

**Output**
1-17 PSIG Per ANSI/FCI 87-2 (can be calibrated to provide 1-9 PSIG or 9-17 PSIG)

**Volume Booster**
Built-in volume booster allows flow capacity up to 20 SCFM

**Connections**
Pneumatic: 1/4" NPT
Electric: 1/2" NPT

**Air Requirements**
Clean, oil-free, dry air filtered to 40 microns

Minimum Supply Pressure: 3 PSIG

Maximum Supply Pressure: 100 PSIG

Sensitivity: < ±0.1% of span per PSIG

Air Consumption: 0.03 SCFH typical

Flow Rate: 4.5 SCFM at 25 PSIG supply

Relief Capacity: 2.0 SCFM at 5 PSIG above 20 PSIG setpoint

**Mounting**
Pipe, panel or bracket in a vibration-free area. Field adjustment will be required if mounted in a nonvertical position.

**Adjustment**
Adjustable zero and span

**Accuracy**
Terminal Based Linearity: < ±0.75% of span

Repeatability: < 0.5% of span

Hysteresis: < 1.0% of span

Response Time: < 0.25 sec. @ 3-15 PSIG

**Intrinsic Safety**
Tested and approved by Factory Mutual as Intrinsically Safe Class I, II and III, Division I, Groups C, D, E, F and G when installed in accordance with Installation, Operation and Maintenance Instructions

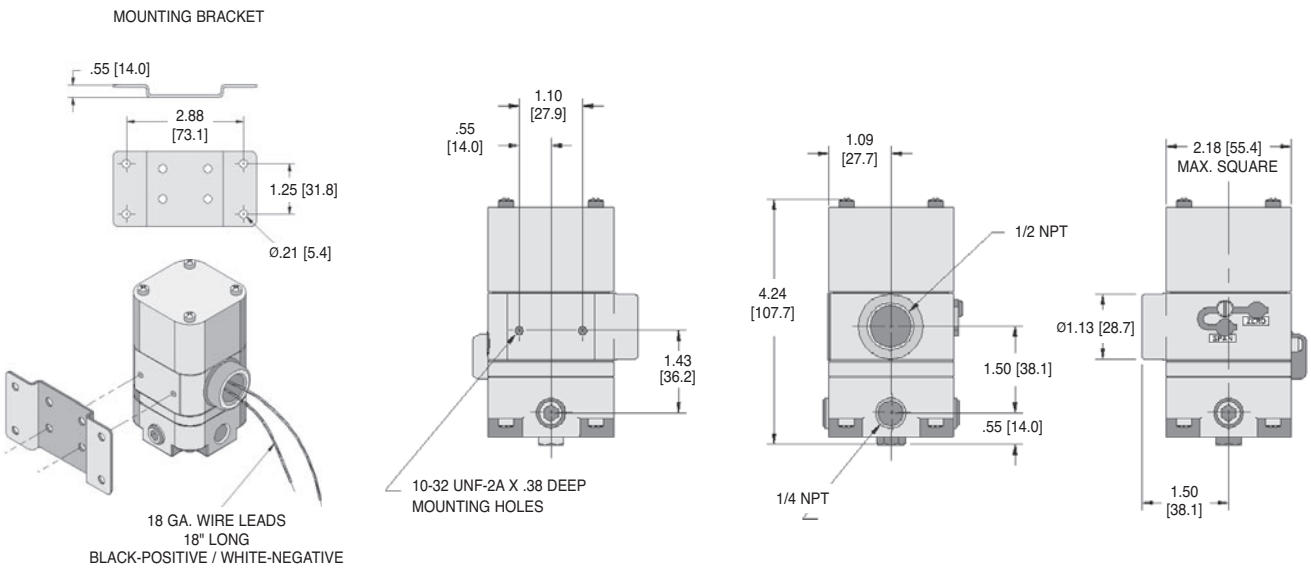
**Ambient Temperature**
-20°F (-30°C) to 140°F (60°C)

**Approximate Shipping Weight**
2.1 lbs [0.94 kg]

## How to Order

Order using Item Number: **TA901**

Unit: inches [mm].




CONTROL VALVES

# TA987

- **Cast Aluminum Housing**
- **Removable Nylon Mesh Filter**
- **Low Air Consumption**
- **Drip Well**

The **TA987 Air Filter/Regulator** is recommended for filtering and regulating the pressure of plant compressed air, and for delivering clean, dry air at the proper pressure to pneumatic control devices. Supply air enters the inlet port, passes through the filtering element, and exits through the reducing valve to the outlet port. The filtering element removes particles as small as 5 microns. A drip well is provided for the accumulation of oil and water and a drain cock is included to allow purging of the unit. The filtering element is readily accessible for cleaning by removal of the drip well bowl.

**The maximum allowable supply pressure to TA987 Air Filter/Regulator is 250 PSIG. Improper application may cause failure of the regulator, resulting in possible personal injury or property damage.**

## Specifications

### Model TA987

**Air Requirements**
Maximum Supply Pressure: 250 PSIG

Output Range
0 to 30 PSIG, adjustable

Sensitivity: 0.036 PSIG

Air Consumption: < 6 SCFH

**Air Requirements (con't.)**
Flow Rate: 20 SCFM at 100 PSIG supply/20 PSIG output

Relief Capacity: 0.1 SCFM at 5 PSIG above setpoint

Effect of Supply Pressure Variation: < 0.2 PSIG for 25 PSIG

**Filter**
Removes particles 40 microns or greater

**Port Size**
1/4" NPT

**Housing**
Cast aluminum

**Mounting**
Side, pipe, panel or through body

**Ambient Temperature**
-20°F (-30°C) to 160°F (71°C)

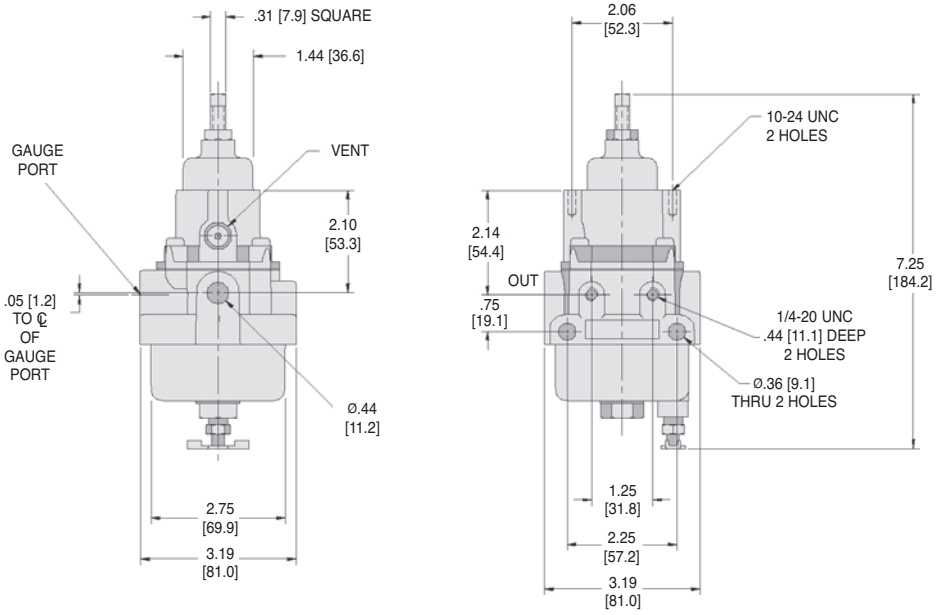
**Approximate Shipping Weight**
1.9 lbs [0.86 kg]

CONTROL VALVES

## How to Order

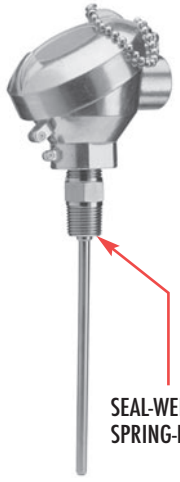
Order using Item Number: **TA987**

Units: inches [mm].



# Electronic Temperature Sensors
## RTD or Thermocouple

## Connection Head Type




- **Thermocouple or RTD**
- **Cast Aluminum Polypropylene or Stainless Steel Head**
- **Weather-Proof**
- **Welded or Spring Loaded Stem**

The Watson McDaniel **Connection Head** is available with both Type J and Type K Thermocouples, as well as RTD sensors. The weatherproof head provides a conduit connection and is available in cast aluminum (screw cover), polypropylene (flip cover) and stainless steel (screw cover). The stem is either welded directly to the 1/2" NPT threaded connection, or is spring-loaded to provide maximum sensitivity. The spring-loaded stem must always be installed in a thermowell.

**Extension wire and transmitter accessories are also available. Please consult factory.**

**For applications where the process media may be corrosive or contained under pressure, the use of a thermowell is required to prevent damage to the sensor and facilitate its removal from the process. To prevent leakage of the process media, spring loaded sensors must always be installed in a thermowell.**

### Specifications

| Sensors | Description |
|---|---|
| **TJD** | Type J (Thermocouple) |
| **TKD** | Type K (Thermocouple) |
| **TDD** | 100 Ω RTD |
| **TMD** | 1000 Ω RTD |

**Hot Junction**
T/C: Ungrounded
RTD: Platinum, 3-Wire

**Stem** 316 stainless steel, 1/4" diameter

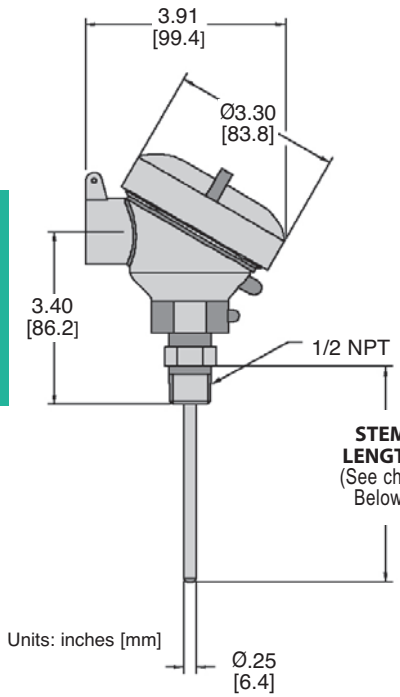
**Insulation** Ceramic

**Head** Cast aluminum, polypropylene or stainless steel

**Process Connection**
1/2" NPT welded or spring-loaded

**Conduit Connection**
3/4" NPT Female

**Approximate Shipping Weight**
1.1 lbs [0.50 kg]




### Specifications

**Thermocouple**

| Type | Color Code | Positive Lead | Negative Lead | Temperature Range |
|---|---|---|---|---|
| **J** | Black | Iron* (Fe) [white] | Constantan (Cu-Ni) [red] | 32° to 1382°F (0° to 750°C) |
| **K** | Yellow | Nickel-Chromium (Ni-Cr) [yellow] | Nickel-Aluminum* (Ni-Al) [red] | 32° to 2282°F (0° to 1250°C) |

**magnetic lead*

**RTD**

| Type | Material | Resistance @ 0°C | Temperature Coefficient | Temperature Range |
|---|---|---|---|---|
| D | Platinum (Pt) | 100 Ω | a = 0.00385 Ω/Ω/°C | -50° to 700°F (-45° to 400°C) |
| M | Platinum (Pt) | 1000 Ω | a = 0.00385 Ω/Ω/°C | -50° to 700°F (-45° to 400°C) |

### How to Order Temperature Sensors

Example Model Code: **TJD Z 04 U W A**

| Sensor Type | Stem Style | STEM LENGTH | Hot Junction | Connection | Head Material |
|---|---|---|---|---|---|
| **TJD** Type J (T/C)<br>**TKD** Type K (T/C)<br>**TDD** 100 Ω RTD<br>**TMD** 1000 Ω RTD | **Z** 316SS, 1/4" O.D. | **02** 2 1/2" Stem<br>**04** 4" Stem<br>**06** 6" Stem<br>**09** 9" Stem<br>**12** 12" Stem | **U** Ungrounded (T/C)<br>**D** 3-Wire (RTD) | **S** Spring Loaded, 1/2" NPT<br>**W** Welded, 1/2" NPT | **A** Aluminum<br>**P** Polypropylene<br>**S** Stainless Steel |

Other sensor styles available.
T/C = Thermocouple

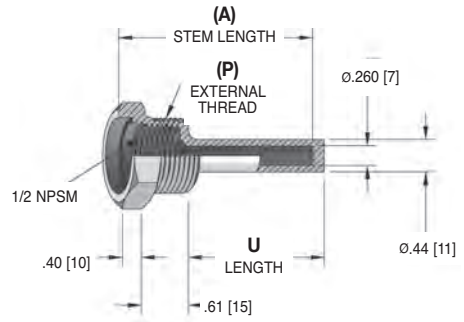
Other Lengths: Specify in inches (24" maximum)

# Thermowells
## for RTD & Thermocouple Temperature Sensors

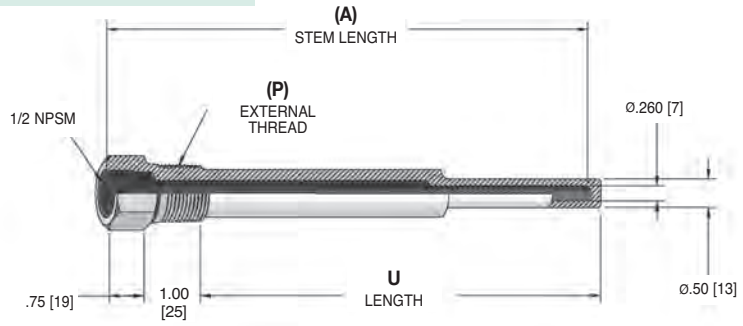
A **Thermowell** is a pressure tight receptacle designed to accept a temperature sensing element and provide a means to insert that element into a vessel or pipe. It acts as a barrier between a process medium and the sensing element of a temperature measuring device and protects against corrosive process media. A thermowell also allows the sensing element to be removed from the application while maintaining a closed system. The material chosen must be compatible with the process medium to which it is exposed.

The U-length (insertion length) of a thermowell indicates its insertion depth into a process vessel or piping system and is measured from the tip of the thermowell to the underside of the threads. Lagging extension thermowells are used on applications where insulation covers the vessel or piping system. The extension length (T-length) is the measurement between the instrument connection and process connection of the thermowell.

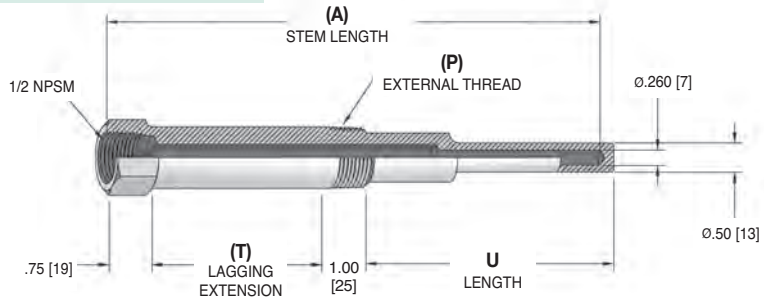
### Standard (2 1/2" - 6")




### Standard (9" - 24")




### with Lagging Extension (4" - 24")




Units inches: [mm]

CONTROL VALVES

### Lengths

| (A) Stem Length | Standard U Length | Lagging (T) Lagging Extension | Lagging U Length |
|---|---|---|---|
| **2 1/2"** | 1.75 [44] | — | — |
| **4"** | 2.50 [64] | 1.00 [25] | 1.50 [38] |
| **6"** | 4.50 [114] | 2.00 [51] | 2.50 [64] |
| **9"** | 7.50 [191] | 3.00 [76] | 4.50 [114] |
| **12"** | 10.50 [267] | 3.00 [76] | 7.50 [191] |
| **15"** | 13.50 [343] | 3.00 [76] | 10.50 [267] |
| **18"** | 16.50 [419] | 3.00 [76] | 13.50 [343] |
| **24"** | 22.50 [572] | 3.00 [76] | 19.50 [495] |

### Pressure Ratings (PSI)

| Material | Operating Temperature 70°F | 200°F | 400°F | 600°F | 800°F | 1000°F |
|---|---|---|---|---|---|---|
| **Carbon steel** | 5000 | 5000 | 4800 | 4600 | 3500 | - |
| **304 stainless steel** | 6550 | 6000 | 4860 | 4140 | 3510 | 3130 |
| **316 stainless steel** | 6540 | 6400 | 6000 | 5270 | 5180 | 4660 |

### How to Order 76-Series Thermowells

Example Model Code: **76-4JN6**

| Thermowell Model | (P) External Thread | (A) Stem Length | (T) Lagging Extension | Material |
|---|---|---|---|---|
| **76** Thermowell | **3** 1/2 NPT* | **D** 2 1/2" Stem | **A** 1" Extension (4" Stem only) | **2** Brass |
| | **4** 3/4 NPT | **G** 4" Stem | **C** 2" Extension (6" Stem only) | **5** 304SS |
| | **5** 1 NPT* | **J** 6" Stem | **E** 3" Extension (9" thru 24" Stem only) | **6** 316SS |
| | | **M** 9" Stem | **N** No Extension | |
| | | **R** 12" Stem | | |
| | | **V** 15" Stem | | |
| | | **Wa** 18" Stem | | |
| | | **Wk** 24" Stem | | |

**Not available with 2 1/2" Stem Length*

Other thermowell styles available. Please consult factory.