

Control Valves



HB Series Control Valve
(with Pneumatic Actuator)



HB Series Control Valve
(with Electric Actuator)

The **HB Control Valve** with Electric Actuator is a robust user-friendly alternative to pneumatic actuators. Actuator is ideal for installations where pneumatic lines are not present.

Fail-safe Mode: Super capacitors are used to drive the valve fully-closed or open in the event of power loss to the actuator. This replaces common back-ups such as springs with limited thrust or batteries with a limited life span.

Fast Response Time: Fully-open or close in approximately 6 seconds making them ideal for instantaneous and semi-instantaneous water heaters.

Integral Positioner: accepts 4-20 mA or 0-10 VDC control signal.



HEAT MISER
Watson McDaniel's
Instantaneous Hot Water
Heating Systems
(shown with HB Control Valve)



Control Valves

Control Valves & Control Loop Components

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.).

The failure mode of the valve should be considered if the air signal controlling the actuator becomes interrupted. For example: For heating applications with steam, a **Normally-Closed/Air-To Open (ATO)** Valve should be selected. If the air signal to the actuator is interrupted, the valve will close in a fail-safe position. For cooling applications with water, a **Normally-Open/Air-To Close (ATC)** should be selected.

Ensure the maximum Close-off Pressure of the valve exceeds the inlet pressure. This is necessary to guarantee the valve assembly will overcome the forces generated in the valve body from the fluid pressure, allowing the valve to open and close properly and completely.

The **Pneumatic Actuator** accepts an industry-standard air pressure range of 3–15 PSIG, which allows the valve to fully open and fully close and modulate in between.

The **Electric Actuator** features a 6-8 second actuator time (fully-open to fully-closed), super capacitors which allow Fail-Safe operation in the event of a power loss, and an integral positioner which accepts 4-20 mA or 0-10 VDC control signal. Ideal for instantaneous water heaters.



CA2000
Valve Positioner



TA901
I/P Transducer



TA987
Air Filter/
Regulator



TR890
Electronic
PID Controller



Electronic
Temperature
Sensor

CONTROL
VALVES

Control Valves

Page No.

HB-Series 2-Way & W910TB 3-Way Control Valves

288-297

HB-Series 2-Way Valves

288

W910TB 3-Way Valves

293

HB-Series & W910TB: Capacity Charts

296

Controllers & Sensors

Introduction: Control Loop Operation & Components

298

TR890 Series Electronic PID Controller

302

TA901 Series Electropneumatic I/P Transducer

304

TA987 Air Filter/ Regulator (for TA901 Pneumatic Control Device)

305

Electronic Temperature Sensors (RTD or Thermocouple)

306

Thermowells (for Temperature Sensors)

307

HB Series Control Valve with Pneumatic Actuator

Models	HB Series
Service	Steam, Air, Water
Sizes	1/2", 3/4", 1", 1 1/2", 2"
Connections	NPT, 150# FLG, 300# FLG
Body Material	316 Stainless Steel
Plug and Seat Material	Stainless Steel
PMA Max. Operating Pressure	720 PSIG @ 100°F
TMA Max. Operating Temperature	450°F @ 497 PSIG
Min Operating Temperature	-20°F
Max Air Supply Pressure	40 PSIG
Max Ambient Temperature	280°F
Min Ambient Temperature	-20°F

DESIGN PRESSURE/TEMPERATURE RATING – PMA/TMA

NPT	300 PSIG @ 450°F
150# FLG	150 PSIG @ 450°F
300# FLG	300 PSIG @ 450°F



These Control Valve feature all 316 Stainless Steel bodies and trim for use with Steam, Water, Glycol and other chemically compatible fluids.

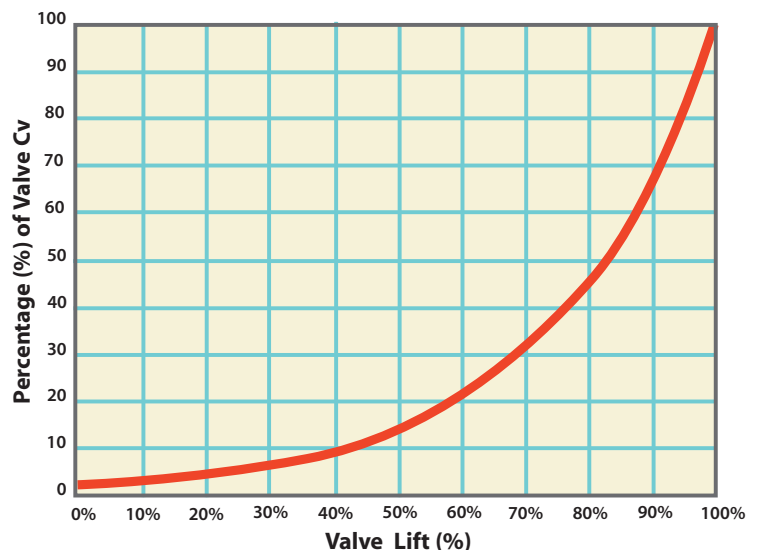
The **HB Series** is a high performance, general service control valve designed using Computational Fluid Dynamics (CFD) for high control accuracy, optimized flow characteristics and extended service life. These control valves, with stainless steel bodies, are equipped with a contoured plug design to withstand the rigorous nature of steam service and are compatible with many fluids and environments. Modern manufacturing techniques and modular construction allows these stainless steel valves to be extremely cost-effective in comparison 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 HB Series is available with both pneumatic or electric actuation.

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

- Electric Actuators
- 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



HB Series Control Valve with Pneumatic Actuator

MATERIALS • Pneumatic Actuator		
14	Yoke	Stainless steel
15	Lower actuator stem	Stainless steel
16	Upper diaphragm case	Epoxy painted steel
17	Diaphragm plate	Nickel plated steel
18	Diaphragm*	Nylon reinforced Neoprene
19	Lower diaphragm case	Epoxy painted steel
20	Upper guide bush	SS/Bronze Impregnated
21	Upper actuator stem	Stainless steel
22	Nameplate	Stainless steel
23	Hex nut	Stainless steel
24	Stem O-ring*	Viton
25	Yoke O-ring*	Viton
26	Upper guide O-ring*	Viton
27	Ring nut*	Stainless steel
28	Diaphragm washer	Stainless steel
29	Springs†	Stainless steel
30	Position indicator disc	Stainless steel
33/34	Hex bolt & nut	Grade 5 steel zinc plated

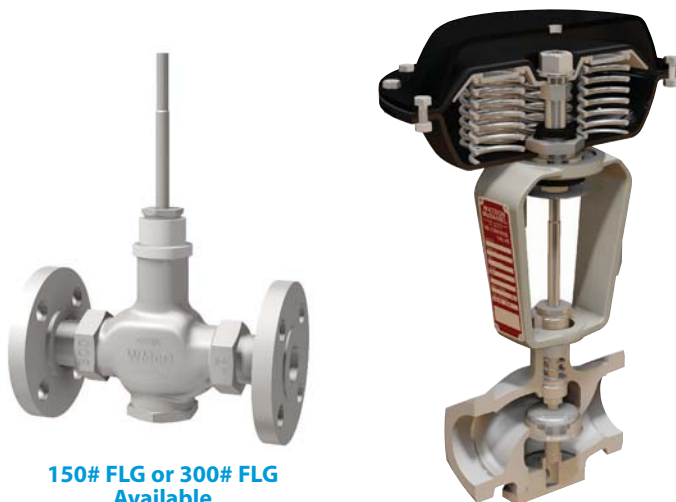
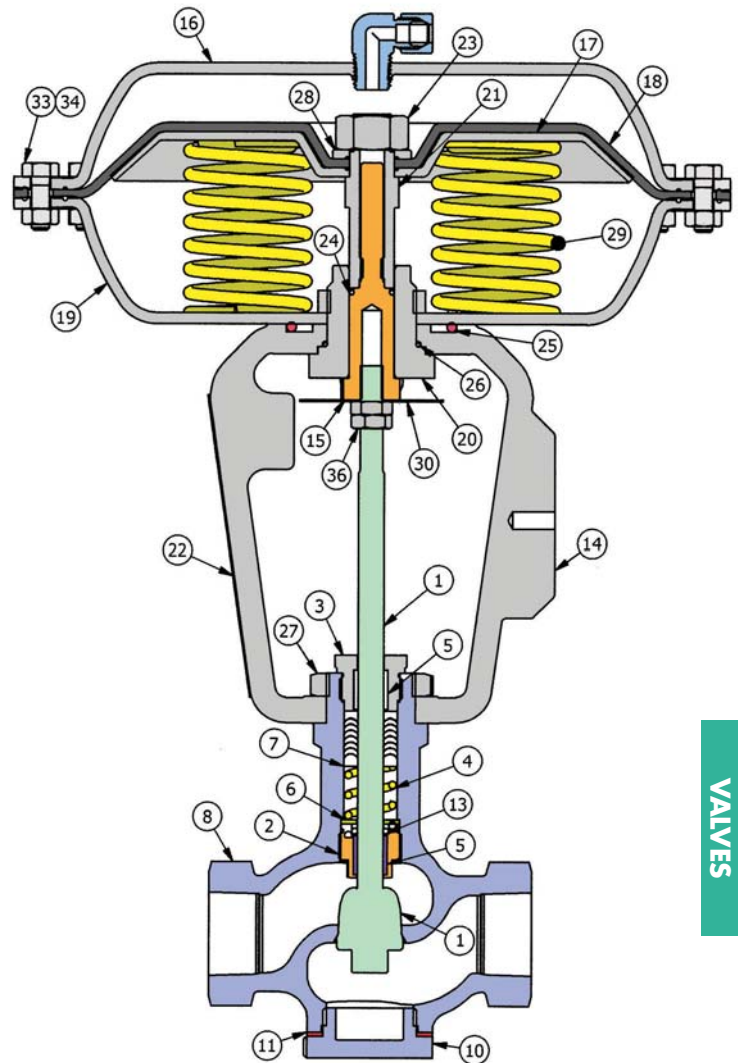
† Air-To-Open Actuator: 6 Actuator Springs

† Air-To-Close Actuator: 3 Actuator Springs

Diaphragm Area = 47 in²

MATERIALS • Valve Body		
1	Stem & Plug Assembly*	Stem: 316 SS, Plug: 303 SS
2	Lower Seal Bushing	303 Stainless Steel
3	Gland Nut	303 Stainless Steel
4	Stem Seal Spring*	302 Stainless Steel
5	Guide Bushing*	Rulon 641
6	Washer	303 Stainless Steel
7	V-ring Stem Seals*	PTFE
8	Body	316 Stainless Steel
10	Body Plug	316 Stainless Steel
11	Body Gasket*	303 Stainless Steel
13	Packing O-Ring	PTFE

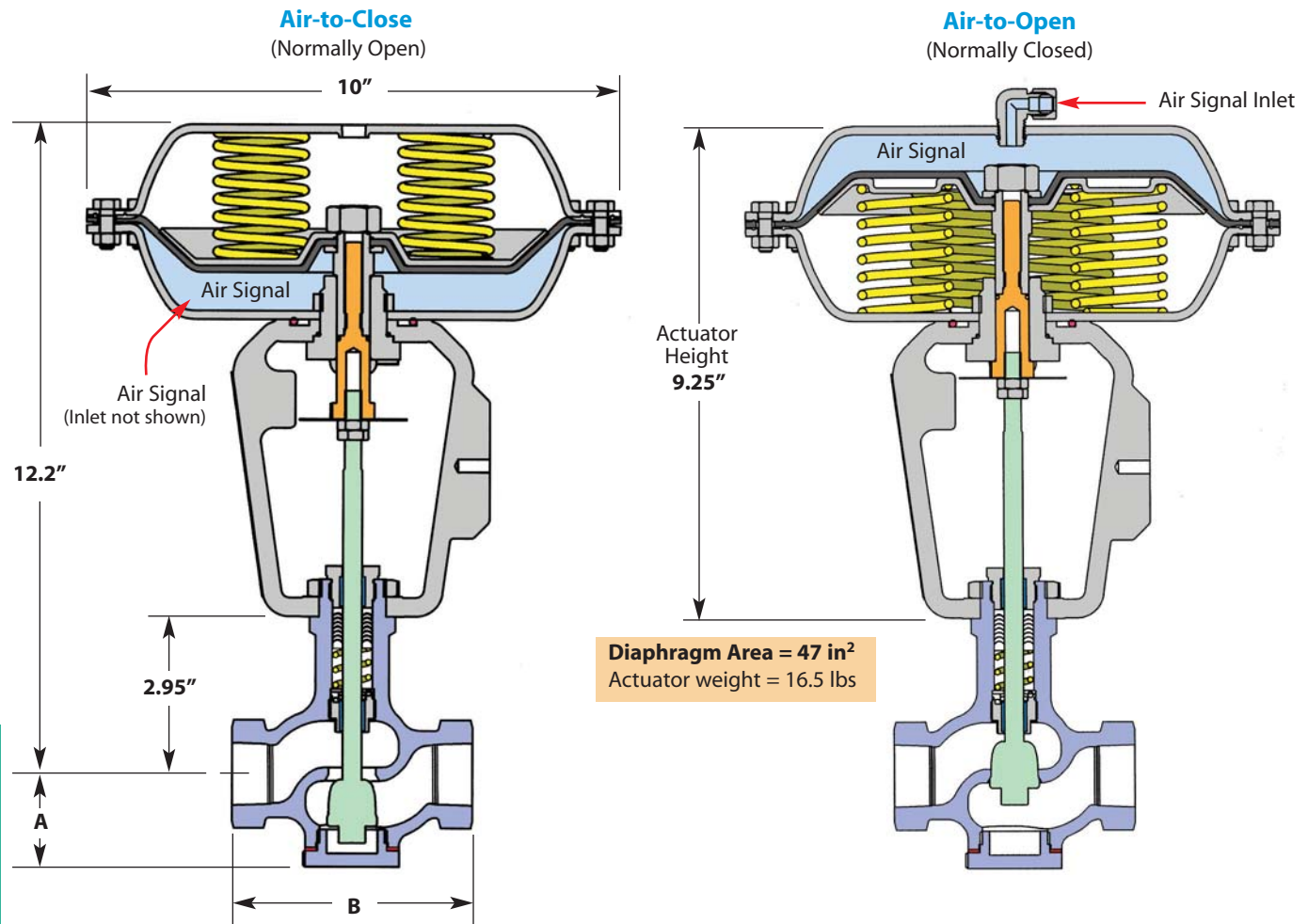
* Available as part of a spares kit.



150# FLG or 300# FLG Available

Technical Information	
Plug Design	Contoured
Flow Characteristics	Equal Percentage
Leakage Rating	ANSI/FCI 70-2 Class IV
Rangeability	50:1
Travel	3/4"
Actuator Area	47 sq. in.
Body Design Rating	Class 300
Primary Stem Seals	PTFE Live-Loaded V-Ring
Diaphragm Design	Semi-Rolling
Design	Multi-Spring Diaphragm
Action (field-reversible)	Air-to-Open Air-to-Close
Positioner Mounting	IEC 60534-6-1 (NAMUR)
Stem Wiper	O-Ring

HB Series Control Valve with Pneumatic Actuator



HB Control Valve Selection

Air-To-CLOSE (Normally OPEN)										
Model HB	Size Connection (NPT)	C _v		Close-Off Pressure (PSI ΔP)		A	NPT B	FLG #150 B	FLG #300 B	Approximate Weight
		Full Port	Reduced Port	No Positioner / Positioner	Positioner					
HB-12-N-ATC	1/2"	5.0	3.5	300	300	1.76	4.5	7.25	7.75	22 lbs [10 kg]
HB-13-N-ATC	3/4"	6.5	3.5	300	300	1.76	4.5	7.25	7.75	22 lbs [10 kg]
HB-14-N-ATC	1"	10	7	300	300	1.74	4.5	7.25	7.75	24 lbs [11 kg]
HB-16-N-ATC	1 1/2"	22	17.5	230	300	2.15	5.0	8.75	9.25	26 lbs [12 kg]
HB-17-N-ATC	2"	42	32	120	300	2.31	6.0	10	10.5	29 lbs [13 kg]
Air-To-OPEN (Normally CLOSED)										
HB-12-N-ATO	1/2"	5.0	3.5	300	300	1.76	4.5	7.25	7.75	22 lbs [10 kg]
HB-13-N-ATO	3/4"	6.5	3.5	300	300	1.76	4.5	7.25	7.75	22 lbs [10 kg]
HB-14-N-ATO	1"	10	7	300	300	1.74	4.5	7.25	7.75	24 lbs [11 kg]
HB-16-N-ATO	1 1/2"	22	17.5	170	225	2.15	5.0	8.75	9.25	26 lbs [12 kg]
HB-17-N-ATO	2"	42	32	85	135	2.31	6.0	10	10.5	29 lbs [13 kg]

Model Code Configuration Chart

Models	Code	Size	Code	Connection Type	Actuator
HB	Full Port	12 1/2"	N	NPT	ATC Air-to-Close
HBR	Reduced Port	13 3/4"	F150	150# FLG	ATO Air-to-Open
		14 1"	F300	300# FLG	
		16 1 1/2"			
		17 2"			

HB Series Control Valve with Pneumatic Actuator



Type 2000 Valve Positioner
(Pneumatic or Electro-Pneumatic)

Type 2000 Valve Positioners (Pneumatic and Electro-Pneumatic) are mechanical devices designed to provide enhanced control, stability, and shut-off capability in extreme flow applications. The positioner, which is mounted to the valve's yoke assembly and linked to the valve stem, receives a signal from an external control source, compares the control signal to the actual position of the valve plug, and then sends a corrected signal to the valve's actuator, thereby positioning the valve plug for optimum flow modulation.



Type 2000 Valve Positioner
(Pneumatic or Electro-Pneumatic)

Type-2000	Pneumatic	Electro-Pneumatic
Input Signal	3-15 PSI	4-20 mA
Supply Pressure	145 PSI maximum	21.8 - 145 PSI
Linearity Error	0.7 % full span	<1.0% of full span
Hysteresis	0.4 % full span	<0.6% of full span
Repeatability	0.3 % full span	<0.5% of full span
Pressure Gain	750 P-out/P-in	750 P-out/P-in
Flow Capacity	SCFM	SCFM
@20 PSI	9.5	9.5
@87 PSI	28.3	28.3
@145 PSI	47.1	47.1
Air Consumption	SCFM	SCFM
@20 PSI	0.18	0.2
@87 PSI	0.53	0.6
@145 PSI	0.88	1.0
Impedance		260 Ohms at 70° F
Loop Load		5.2 Volts at 70° F
Port Size	1/4" NPT; Gauge Ports 1/8" NPT	1/2" NPT
Temperature Range	-40° F – 185° F	
Media	Oil-free Instrument Air Filtered to 40 micron	
Enclosure	NEMA 4X	

CONTROL VALVES

Valve Positioner Model Code Configuration

Example Model : **CA2000L1C3N**

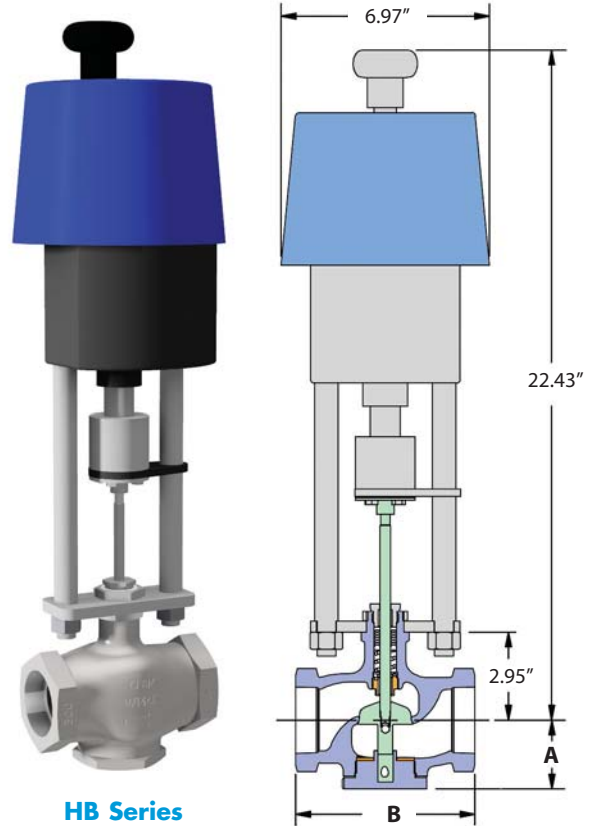
Model	Positioner Type	Indicator	Code
CA2000L1C3	Pneumatic	None (Standard Linear)	N
CA2010L1C3	Electro-Pneumatic	Dome (Option)	D
CA2020L1C3	Explosion-Proof		

HB Series Control Valve with Electric Actuator

The **HB Series Control Valve with Electric Actuator** is a robust, user-friendly alternative to the standard pneumatic actuator on the HB Series Control Valve. With fast and precise movement, this actuator is designed to handle a broad range of applications including instantaneous and semi-instantaneous water heaters. Ideal for installations where pneumatic lines are not present or are prohibitive.

WMEA Electric Actuator Specifications

Power Supply	115VAC	24VAC	24VDC
Nominal Current (A)	0.66	3.15	2
Max Current (A)	0.86	4.1	2.6
Max Power Consumption (W)	57	53	48
Force	1,100 lbs		
Stem Velocity	0.088 - 0.177 in/sec		
Nominal 3/4" Travel Time	6 - 8 sec		
Duty Cycle, IEC 60034-1,8	S2 30min S4 50% ED @ 77°F		
Ambient Temperature	-4 to 140°F		
Shut-off Pressure (1/2" to 2" HB)	300 psig		
Actuator Weight	17.6 lbs		



HB Series Control Valve
(with Electric Actuator)

(For valve dimensions refer to HB Selection Chart)

Features and Benefits

- **Fast Response:** These actuators respond extremely fast and will fully open or close the HB Control Valve in approximately 6 seconds making them ideal for instantaneous and semi-instantaneous water heaters. Typical signal response time is 2-3 seconds.
- **Fail-Safe Mode:** Super capacitors are used to drive the valve fully-closed or open in the event of power loss to the actuator. This replaces common back-ups such as springs with limited thrust or batteries with a limited life span.
- **High Stem Thrust:** Allows close-off of all HB valves sizes against the full rating of 300 psig.
- **Integral Positioner:** Accepts 4/0-20mA or 2/0-10 VDC control signals, eliminating the need for a separate I/P transducer.
- **Field-Configurable:** Using a PC, the actuator can be field-configured for minimum closing position, maximum opening position, fail-open, fail-close or stay-put failure mode in the event of power loss.

Options & Associated Control Loop Accessories

- USB Kit for parameter customization
- PID Electronic Controllers (TR890 Series)
- Thermocouples
- RTD's
- Pressure Transmitters

Additional Technical Information

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

Model Code Configuration Chart

Models		Code	Size	Code	Connection Type	Actuator		Power	
HB	Full Port	12	1/2"	N	NPT	EFC	Fail-Closed	24V	24VAC/DC
HBR	Reduced Port	13	3/4"	F150	150# FLG	EFO	Fail-Open	115V	115VAC
		14	1"	F300	300# FLG				
		16	1 1/2"						
		17	2"						

Control Valves

3-Way Valve

W910TB

for MIXING & DIVERTING • Water & Other Liquids

Models	W910TB
Service	Water, Other Liquids
Sizes	1/2", 3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 4"
Connections	Union Ends, 125# Flanged 250# Flanged (optional)
Body Material	1/2" – 2" Bronze 2 1/2" – 4" Cast Iron
Seat Material	Stainless Steel
Max Inlet Pressure	250 PSIG

DESIGN PRESSURE/TEMPERATURE RATING – PMA/TMA

Union Ends 250 PSIG @ 450°F
125# FLG 125 PSIG @ 450°F

Typical Applications

W910TB 3-way Pneumatically-Actuated control valve can be used for mixing or diverting and are actuated by a 3-15 PSIG instrument air signal placed to the top of the actuator housing that will modulate the position of the valve.

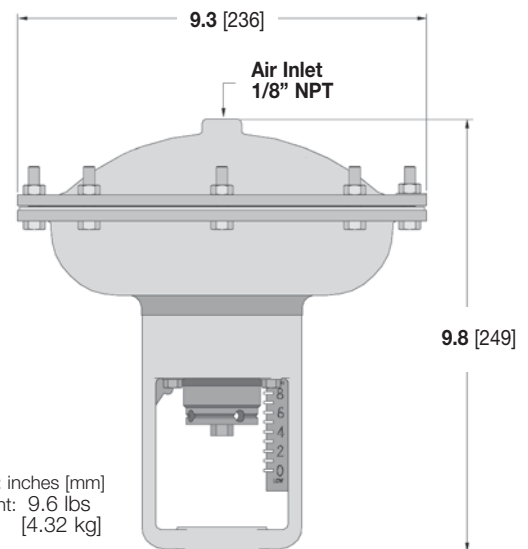
3-way valves are used for mixing two flows together, or for diverting a flow to or around a device (bypass). In order to produce a consistent flow quantity for stable operation, the pressure drop across both flow paths (inlet to outlet) must be nearly equal. The sleeve type design is constructed with an O-ring around the sleeve. The O-ring is suitable for water or glycol type service, up to a maximum of 300°F. A higher temperature O-ring for use with other fluids, such as oil or for temperatures up to 410°F, is available. Consult factory.

Principle of 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.



NOT FOR USE WITH STEAM



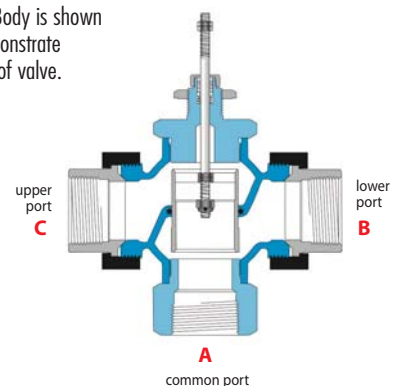
CONTROL VALVES

W910TB Actuator Specifications

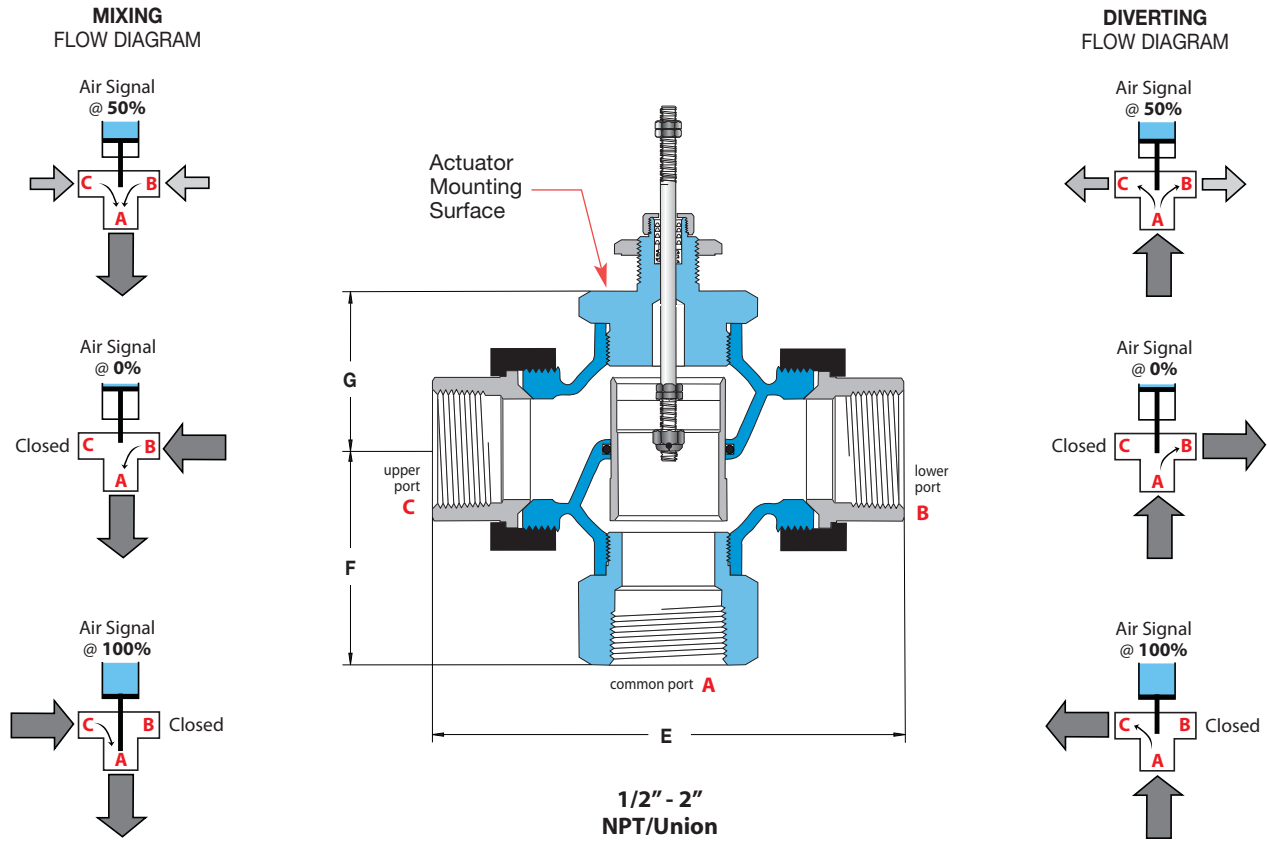
Actuator Housing	Die cast aluminum, epoxy powder coated blue finish.
Setting Scale	Integral to housing
Adjustment Screw	Brass
Spring	Cadmium plated
Pressure Plate	Aluminum
Diaphragm	Nylon reinforced EPDM
Air Pressure to Diaphragm	30 PSIG maximum
Air Connection	1/8 " NPT Female
Operating Temperature	Ambient: -40°F (-40°C) to 180°F (82°C) Process Flow: -40°F (-40°C) to 410°F (210°C)

3-WAY VALVE • Bronze - NPT

Valve Body is shown to demonstrate action of valve.



for Mixing or Diverting



CONTROL VALVES

CAUTION: 3-Way Valves are not designed for use in steam applications.

To properly control the mixing of two flows, inlet pressures at ports B and C should be as equal as possible.

Specifications

Body Material	Trim Material	Trim Style	Connection	Pressure & Temperature Rating
Bronze	Bronze	Modified Linear	NPT with Malleable Iron Union Ends	250 PSIG @ 300°F (149°C)

Valve Body Selection

Mixing or Diverting									
Valve Body Number	Actuator & Valve Model #	Size (NPT)	C _v	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt.	
					E	F	G		
A18	W910TB-A18	1/2"	2.8	250	4.8 [122]	1.8 [46]	1.8 [46]	13 lbs [5.9 kg]	
A25	W910TB-A25	3/4"	5.6	250	5.6 [142]	2.3 [58]	2.3 [58]	15 lbs [6.8 kg]	
A34	W910TB-A34	1"	8.4	250	6.0 [152]	2.3 [58]	2.3 [58]	16 lbs [7.2 kg]	
A45	W910TB-A45	1 1/4"	15	250	7.2 [183]	2.8 [71]	2.6 [66]	19 lbs [8.6 kg]	
A56	W910TB-A56	1 1/2"	21	250	7.7 [196]	3.5 [89]	2.6 [66]	21 lbs [9.5 kg]	
A67	W910TB-A67	2"	33	250	8.6 [218]	4.1 [104]	3.1 [79]	26 lbs [11.8 kg]	

All dimensions are inches [mm].

Control Valves

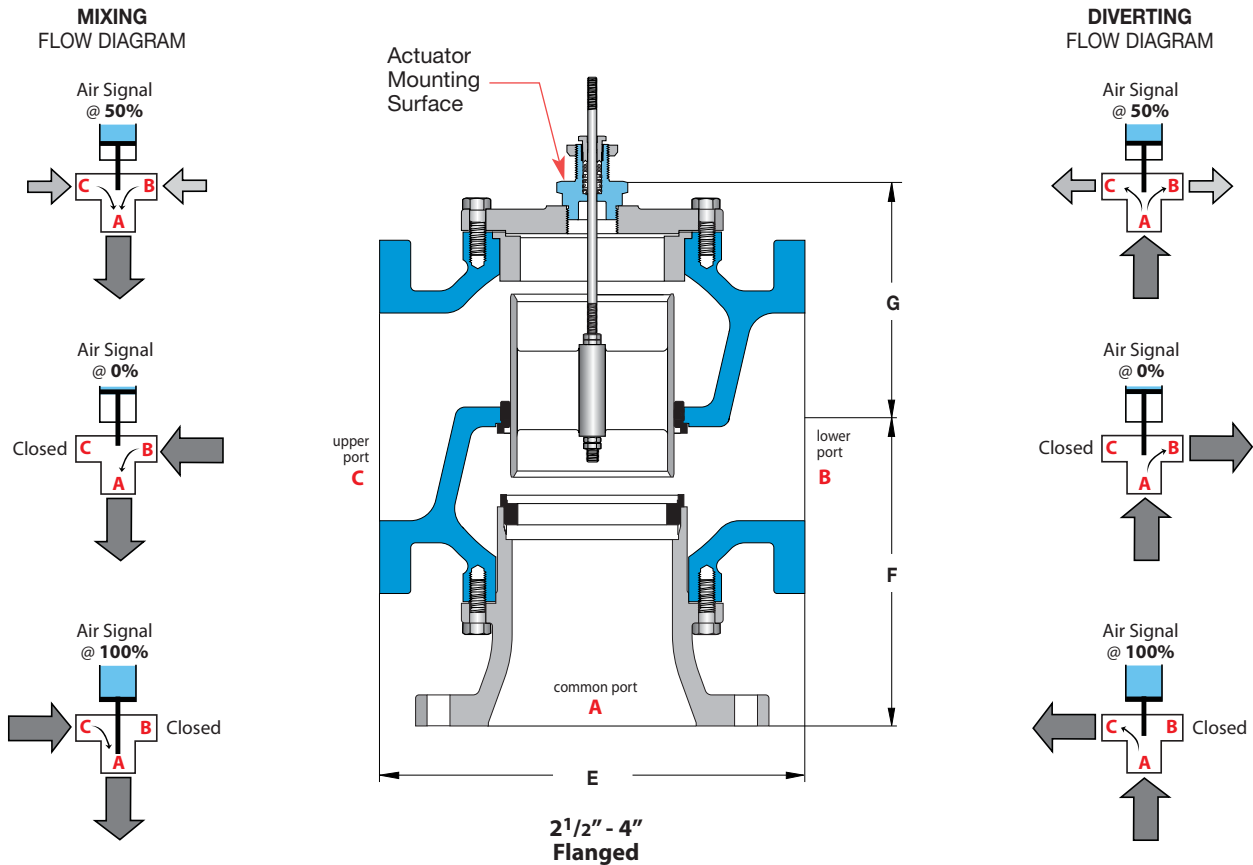
3-Way Valve Bodies - CAST IRON

for MIXING & DIVERTING • Water & Other Liquids

W910TB

3-Way • 2 1/2" - 4"

for Mixing or Diverting



CONTROL VALVES

CAUTION: 3-Way Valves are not designed for use in steam applications.

To properly control the mixing of two flows, inlet pressures at ports B and C should be as equal as possible.

Specifications

Body Material	Trim Material	Trim Style	Connection	Pressure & Temperature Rating
Cast Iron	Bronze	Modified Linear	125# Flanged	125 PSIG @ 300°F (149°C)

Valve Body Selection

Mixing or Diverting								
Valve Body Number	Actuator & Valve Model #	Size (FLG)	C _v	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt.
					E	F	G	
B75	W910TB-B75	2 1/2"	58	125	9.0 [229]	7.1 [180]	5.2 [132]	62 lbs [28 kg]
B80	W910TB-B80	3"	72	125	10.0 [254]	8.0 [203]	6.0 [152]	80 lbs [36 kg]
B85	W910TB-B85	4"	102	125	13.0 [330]	10.0 [254]	6.9 [175]	140 lbs [64 kg]

All dimensions are inches [mm].

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"
C _v Factors			3.5	5.0	6.5	10	22	42
Orifice Size (in)			0.88	0.88	0.88	0.88	1.25	1.75
5	4	1	48	68	89	136	300	573
	0	5	96	137	178	274	602	1149
	-4	9	114	162	211	325	714	1363
	-8	13	119	170	220	339	746	1424
10	9	1	53	76	99	153	336	641
	5	5	110	156	203	313	689	1315
	0	10	138	197	255	393	865	1651
	-7	17	148	211	274	422	929	1773
15	10	5	122	174	226	348	765	1460
	5	10	156	223	290	447	983	1876
	0	15	172	246	320	492	1082	2066
	-5	20	177	252	328	505	1110	2119
20	15	5	133	189	246	379	833	1591
	10	10	173	247	321	494	1088	2076
	5	15	194	277	361	555	1221	2330
	-3	23	205	293	381	587	1291	2464
30	25	5	152	217	282	434	955	1822
	15	15	232	331	431	663	1459	2785
	5	25	260	371	482	742	1631	3115
	0	30	262	375	487	750	1649	3149
50	40	10	250	357	464	714	1570	2997
	30	20	324	463	601	925	2035	3886
	15	35	370	529	687	1057	2326	4440
	7	43	376	537	697	1073	2361	4507
80	70	10	307	438	570	877	1929	3682
	50	30	472	675	877	1350	2970	5670
	30	50	534	763	992	1525	3356	6407
	17	63	544	777	1010	1554	3418	6526
100	85	15	406	580	754	1160	2552	4872
	60	40	586	837	1089	1675	3684	7034
	40	60	643	918	1193	1836	4039	7710
	23	77	655	936	1217	1872	4119	7864
125	110	15	452	645	839	1290	2838	5418
	85	40	668	954	1240	1908	4199	8015
	50	75	782	1117	1452	2233	4913	9380
	31	94	794	1135	1475	2270	4993	9532
150	130	20	560	800	1040	1600	3519	6718
	100	50	800	1143	1485	2285	5027	9598
	70	80	904	1291	1678	2582	5680	10844
	40	110	933	1333	1733	2666	5865	11196
175	150	25	666	952	1237	1903	4187	7994
	115	60	931	1329	1728	2659	5850	11167
	75	100	1052	1503	1953	3005	6612	12622
	48	127	1072	1531	1990	3062	6736	12859
200	175	25	713	1018	1324	2037	4481	8554
	130	70	1061	1515	1970	3031	6668	12730
	90	110	1183	1690	2196	3379	7434	14192
	56	144	1210	1729	2247	3457	7606	14521
250	225	25	798	1140	1482	2281	5017	9578
	170	80	1273	1819	2364	3637	8002	15276
	120	130	1443	2062	2680	4124	9072	17319
	73	177	1487	2125	2762	4249	9348	17846
300	270	30	951	1359	1766	2718	5979	11414
	200	100	1535	2193	2850	4385	9648	18418
	140	160	1723	2461	3199	4922	10828	20672
	89	211	1765	2521	3277	5042	11093	21177

CAPACITIES – Water (GPM)								
Inlet Pressure (PSIG)	Outlet Pressure (PSIG)	ΔP PSI	Reduced Port 1/2"	1/2"	3/4"	1"	1 1/2"	2"
C _v Factors			3.5	5.0	6.5	10	22	42
Orifice Size (in)			0.88	0.88	0.88	0.88	1.25	1.75
5	4	1	3.5	5.0	6.5	10	22	42
	0	5	7.8	11	15	22	49	94
10	7	3	6.1	8.7	11	17	38	73
	5	5	7.8	11	15	22	49	94
15	10	5	7.8	11	15	22	49	94
	5	10	11	16	21	32	70	133
30	25	5	7.8	11	15	22	49	94
	15	15	14	19	25	39	85	163
50	40	10	11	16	21	32	70	133
	30	20	16	22	29	45	98	188
80	70	10	11	16	21	32	70	133
	50	30	19	27	36	55	120	230
100	85	15	14	19	25	39	85	163
	65	35	21	30	38	59	130	248
125	110	15	14	19	25	39	85	163
	85	40	22	32	41	63	139	266
150	130	20	16	22	29	45	98	188
	100	50	25	35	46	71	156	297
200	175	25	18	25	33	50	110	210
	130	70	29	42	54	84	184	351
250	225	25	18	25	33	50	110	210
	170	80	31	45	58	89	197	376
300	270	30	19	27	36	55	120	230
	200	100	35	50	65	100	220	420
	134	166	45	64	84	129	283	540

Note: 1) Capacities based on 70°F water (SG = 1.00).
 2) Capacities based on 100% of C_v.

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

Capacity Chart

for MIXING & DIVERTING • Water & Other Liquids

W910TB 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.

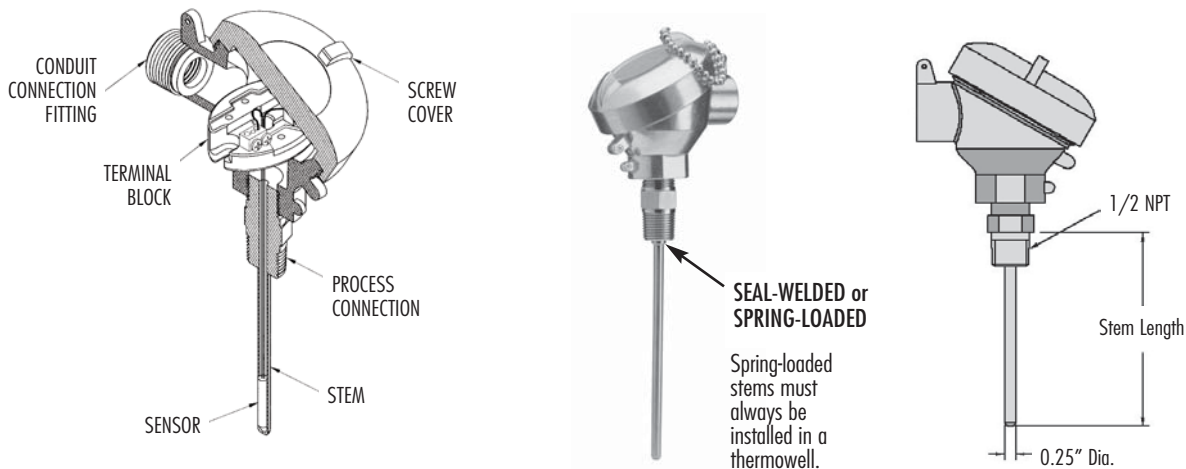
Pressure Drop (PSI ΔP)	Size, Body Number & Coefficient (Cv)								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
	A18 Cv = 2.8	A25 Cv = 5.6	A34 Cv = 8.4	A45 Cv = 15	A56 Cv = 21	A67 Cv = 33	B75 Cv = 58	B80 Cv = 72	B85 Cv = 102
1	2.8	5.6	8.4	15	21	33	58	72	102
3	4.8	10	15	26	36	57	100	125	177
5	6.3	13	19	34	47	74	130	161	228
10	8.9	18	27	47	66	104	183	228	323
15	11	22	33	58	81	128	225	279	395
20	13	25	38	67	94	148	259	322	456
25	14	28	42	75	105	165	290	360	510
30	15	31	46	82	115	181	318	394	559
40	18	35	53	95	133	209	367	455	645
50	20	40	59	106	148	233	410	509	721
60	22	43	65	116	163	256	449	558	790
70	23	47	70	125	176	276	485	602	853
80	25	50	75	134	188	295	519	644	912
90	27	53	80	142	199	313	550	683	968
100	28	56	84	150	210	330	580	720	1020
125	31	63	94	168	235	369	648	805	1140
150	34	69	103	184	257	404			
175	37	74	111	198	278	437			
200	40	79	119	212	297	467			
225	42	84	126	225	315	495			
250	44	89	133	237	332	522			

Note: Oil service or high temperature service requires special O-ring.

CONTROL VALVES

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.

**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**

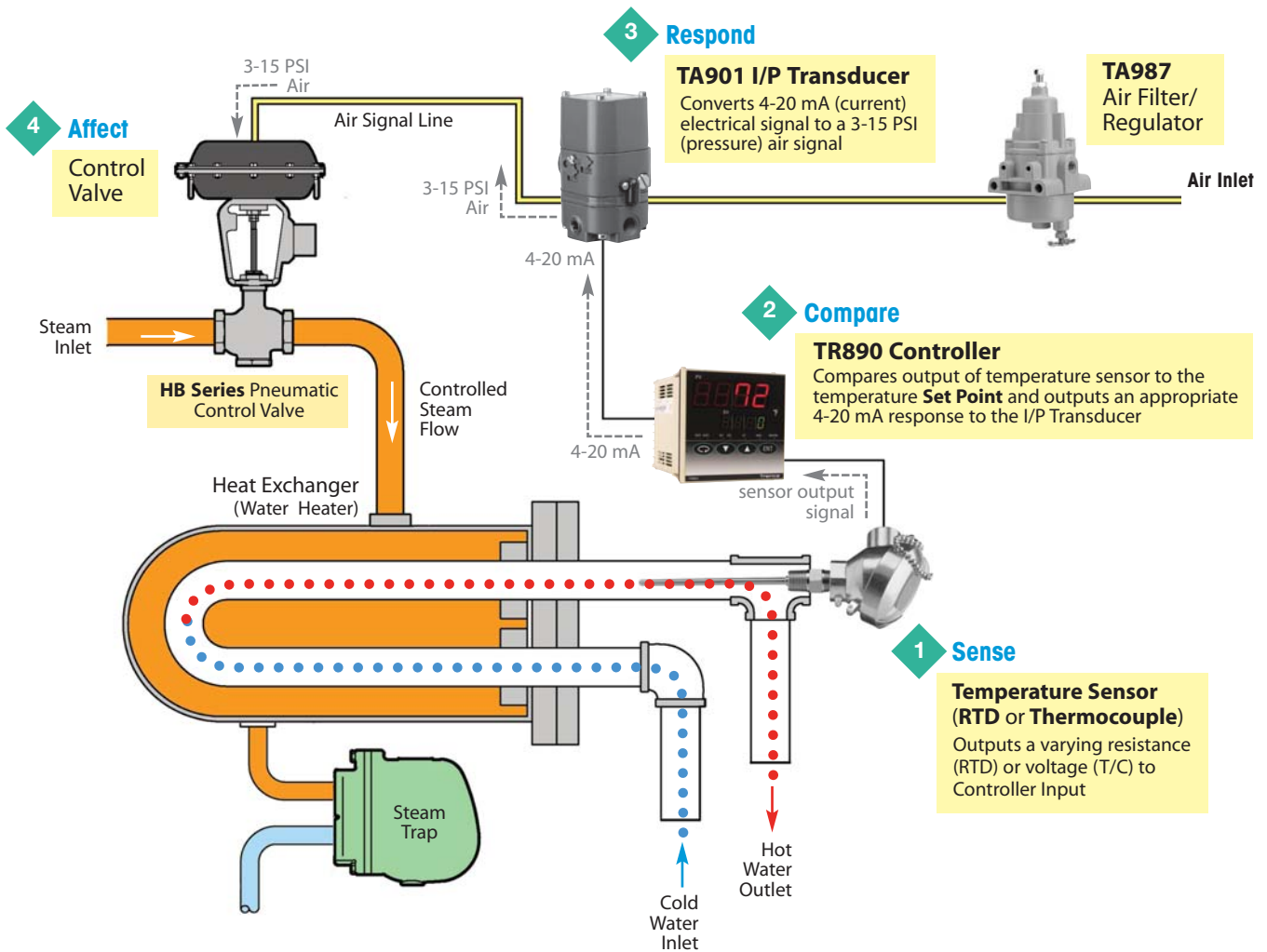


This device is recommended for filtering and regulating the pressure of plant compressed air to the inlet of the I/P Transducer, which ensures the delivery of clean, dry air at the proper pressure to the pneumatic actuator.

Introduction

Understanding a Control Loop

Heat Exchanger (Instantaneous Water Heater)



CONTROL VALVES

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.



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 CA2000 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 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 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)	TR893: 96 x 96 mm (1/4 DIN)
TR892: 72 x 72 mm	TR894: 96 (H) x 48 (W) mm (1/8 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 CA2000-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 CA2000-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.



- ▶ 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.

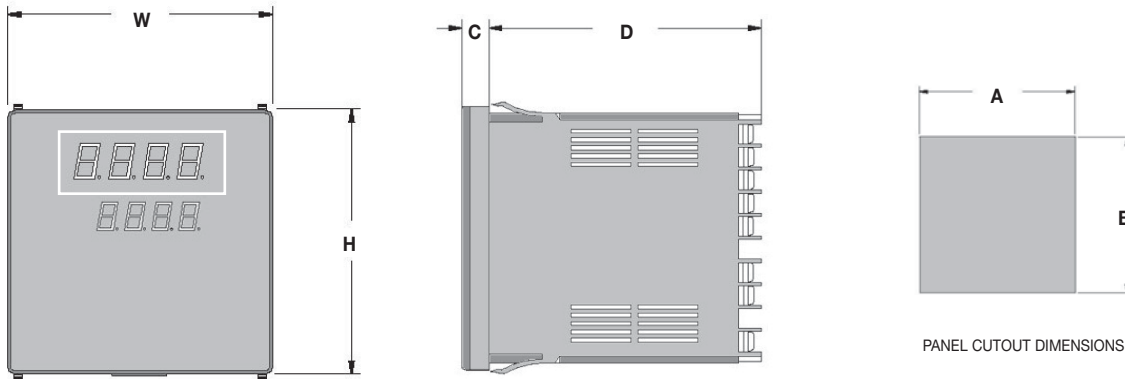
Approximate Shipping Weights:

- 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) TR892: 72 x 72 mm TR893: 96 x 96 mm (1/4 DIN) TR894: 96 x 48 mm (1/8 DIN)
Control	Control Mode: Auto-Tuning PID Action: Reverse acting (field switchable to direct acting)
Proportional Band	Off, 0.1-999.9% Full Scale Integral Time: Off, 1-6000 sec. Derivative Time: Off, 1-3600 sec.
Accuracy	± 0.3%
Display	Process Value: 4 Digit, 20 mm red LED Set Value: 4 digit, 10.2 mm green LED Sampling Cycle: 0.25 seconds
Inputs	Universal: (switchable between) ▶ Thermocouple: B, R, S, K, E, J, T, N, PL II, WRe5-26 (U,L (DIN 43710) ▶ RTD: Platinum 100 Ω, 3-Wire ▶ mV: (scalable) -10-10, 0-10, 0-20, 0-50, 10-50, 0-100 mV DC Current: (scalable) 4-20, 0-20 mA 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) Contact: Proportional cycle, 1-120 sec. (capacity: 240 VAC 2 A resistive / 1.2 A inductive) SSR Drive Voltage: Proportional cycle 1-120 sec. (output rating: 12 ± 1.5 VDC / 30 mA maximum) Voltage: 0-10 VDC Load Current 2 mA max
Power Requirements	Supply Voltage: 100-240 VAC, 50/60 Hz or 24 VAC/VDC 50/60 Hz Consumption: 100-240 VAC, 15VA 24 VDC, 8W 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 300Ω max) Analog Output: 0-10 VDC (load current 2 mA max) <u>Digital Input (switch) including:</u> 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.

Features PID & Auto-tuning



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

*Not available with Model TR891

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	Celsius Range	Range Code	Fahrenheit Range	Range Code	Celsius Range	Range Code	Range (User-scalable Readout)
B*	15	0° to 3300°F	0° to 1800°C	47	-300° to 1100°F	31	-200° to 600°C	71	-10-10 mV
E	21	0° to 1300°F	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	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	-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	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	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	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	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	0° to 1300°C					83	0-2 V
R	16	0° to 3100°F	0° to 1700°C					84	0-5 V
S	17	0° to 3100°F	0° to 1700°C					85	1-5 V
T	23	-300° to 400°F	-199.9° to 200.0°C					86	0-10 V
U	24	-300° to 400°F	-199.9° to 200°C					94	0-20 mA
WRe5-26	26	0° to 4200°F	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

CONTROL VALVES

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.**

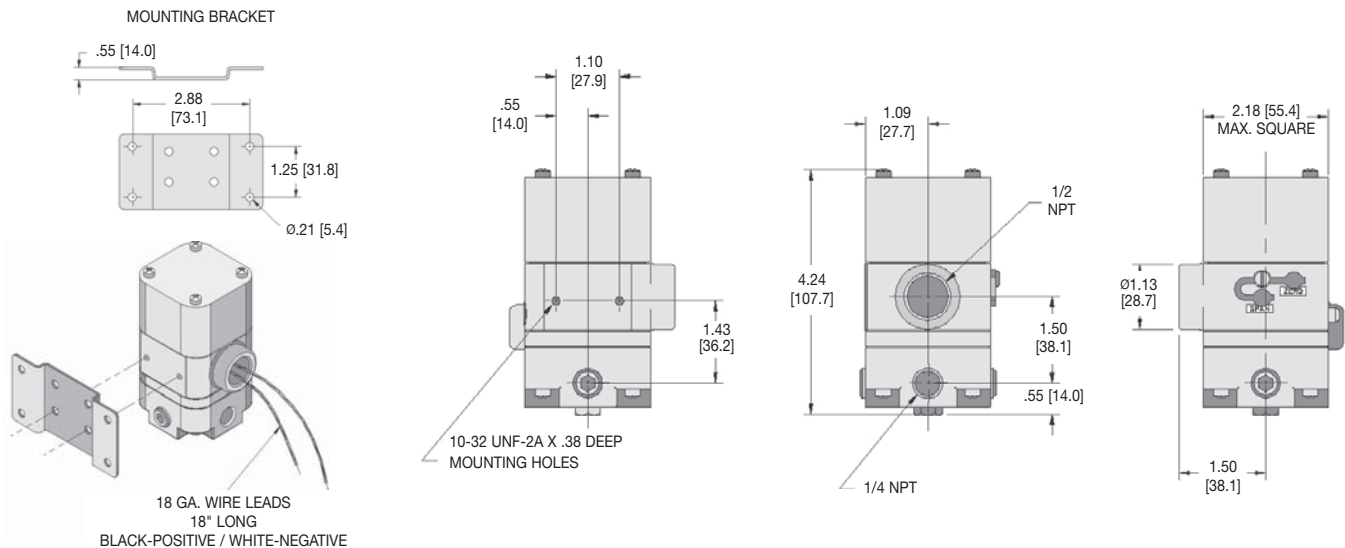
Specifications

<p>Model TA901</p> <p>Input 4-20 mA</p> <p>Output 1-17 PSIG Per ANSI/FCI 87-2 (can be calibrated to provide 1-9 PSIG or 9-17 PSIG)</p> <p>Volume Booster Built-in volume booster allows flow capacity up to 20 SCFM</p> <p>Connections Pneumatic: 1/4" NPT Electric: 1/2" NPT</p>	<p>Air Requirements Clean, oil-free, dry air filtered to 40 microns</p> <p>Minimum Supply Pressure: 3 PSIG</p> <p>Maximum Supply Pressure: 100 PSIG</p> <p>Sensitivity: < ±0.1% of span per PSIG</p> <p>Air Consumption: 0.03 SCFH typical</p> <p>Flow Rate: 4.5 SCFM at 25 PSIG supply</p> <p>Relief Capacity: 2.0 SCFM at 5 PSIG above 20 PSIG setpoint</p>	<p>Mounting Pipe, panel or bracket in a vibration-free area. Field adjustment will be required if mounted in a nonvertical position.</p> <p>Adjustment Adjustable zero and span</p> <p>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</p>	<p>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</p> <p>Ambient Temperature -20°F (-30°C) to 140°F (60°C)</p> <p>Approximate Shipping Weight 2.1 lbs [0.94 kg]</p>
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CONTROL VALVES

How to Order

Order using Item Number: **TA901**





- ▶ **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 40 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.

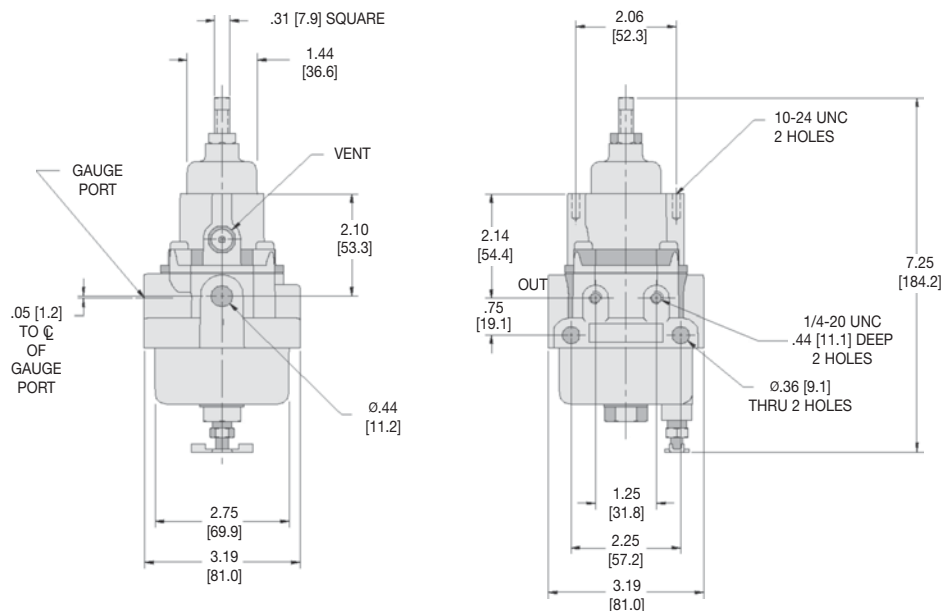
Specifications

<p>Model TA987</p> <p>Air Requirements Maximum Supply Pressure: 250 PSIG Output Range: 0 to 30 PSIG, adjustable Sensitivity: 0.036 PSIG Air Consumption: < 6 SCFH</p>	<p>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</p>	<p>Filter Removes particles 40 microns or greater</p> <p>Port Size 1/4" NPT</p> <p>Housing Cast aluminum</p>	<p>Mounting Side, pipe, panel or through body</p> <p>Ambient Temperature -20°F (-30°C) to 160°F (71°C)</p> <p>Approximate Shipping Weight 1.9 lbs [0.86 kg]</p>
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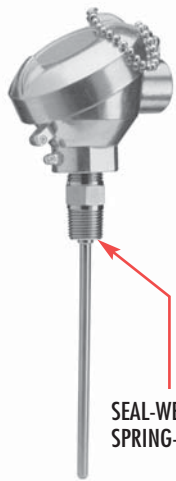
How to Order

Order using Item Number: **TA987**

Units: inches [mm].



Connection Head Type



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

SEAL-WELDED or SPRING-LOADED

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.

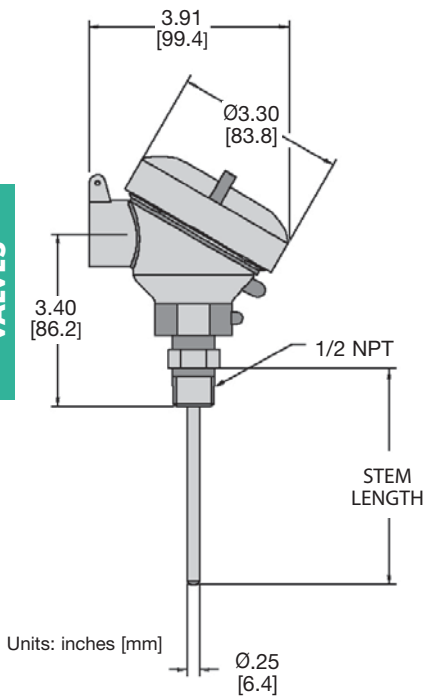
Extension wire and transmitter accessories are also available. Please consult factory.

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]	

CONTROL VALVES



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	α = 0.00385 Ω/Ω/°C	-50° to 700°F (-45° to 400°C)
M	Platinum (Pt)	1000 Ω	α = 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)	Z 316SS, 1/4" O.D.	02 2 1/2" Stem	U Ungrounded (T/C)	S Spring Loaded, 1/2" NPT	A Aluminum
TKD Type K (T/C)		04 4" Stem	D 3-Wire (RTD)	W Welded, 1/2" NPT	P Polypropylene
TDD 100 Ω RTD		06 6" Stem			S Stainless Steel
TMD 1000 Ω RTD		09 9" Stem			
		12 12" Stem			

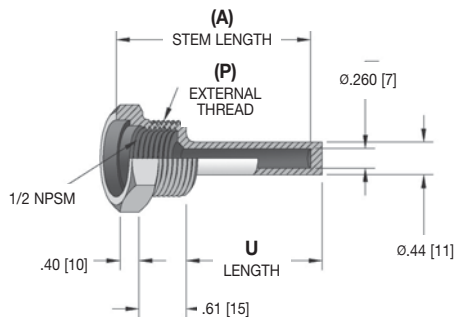
Other sensor styles available.
T/C = Thermocouple

Other Lengths: Specify in inches (24" maximum)

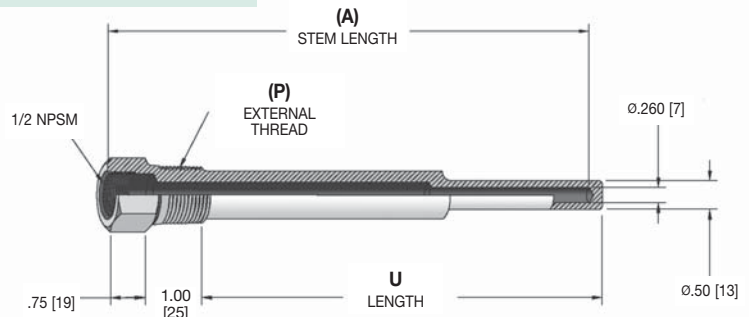
A **Thermowell** is a pressure tight receptacle designed to accept a temperature sensing element and provide a means to insert that element into a vessel or pipe. It acts as a barrier between a process medium and the sensing element of a temperature measuring device and protects against corrosive process 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.

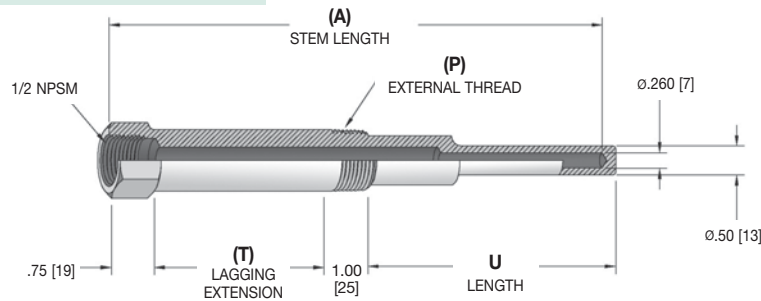
Standard (2 1/2" - 6")



Standard (9" - 24")



with Lagging Extension (4" - 24")



Units inches: [mm]

CONTROL VALVES

Lengths

(A) Stem Length	Standard U Length	Lagging U Length	
		(T) Lagging Extension	
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 21 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.