

# Regulators

## Pressure Regulating Valve

**O-Series**  
Direct-Operated

Model	<b>O-Series</b>
Service	<b>Steam, Air, Water &amp; Other Liquids</b>
Sizes	<b>3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"</b>
Connections	<b>NPT</b>
Body Material	<b>Cast Iron</b>
Seat & Disc	<b>Hardened 420 Stainless Steel</b>
Diaphragm (for Steam)	<b>Phosphor Bronze - Steam</b>
Diaphragm (for Liquid or Air)	<b>Viton - Water, Air &amp; Oil (300°F max)</b>
<b>Max Inlet Pressure</b>	<b>250 PSIG</b>
<b>Min Inlet Pressure</b>	<b>15 PSIG</b>
<b>Max Differential Pressure</b>	<b>125 PSI</b>
<b>Min Differential Pressure</b>	<b>15 PSI</b>

### Design Pressure/Temperature Rating – PMA/TMA

NPT 250 PSIG @ 450°F



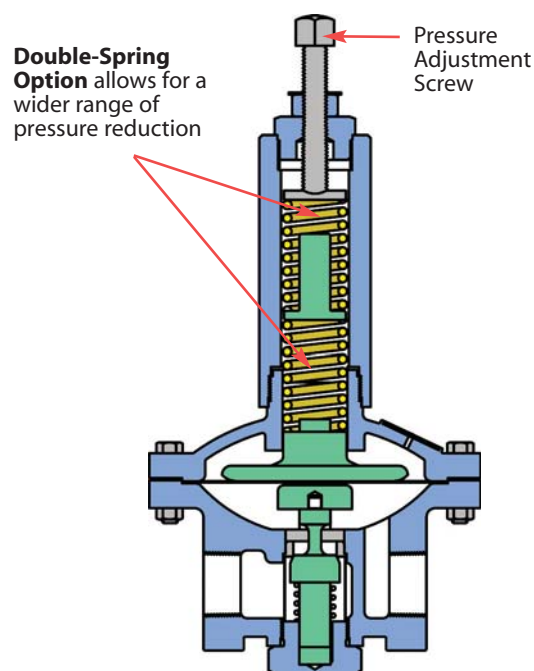
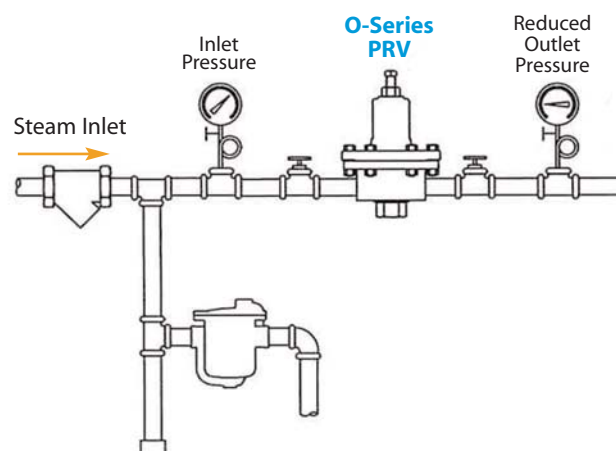
PRESSURE  
Regulators

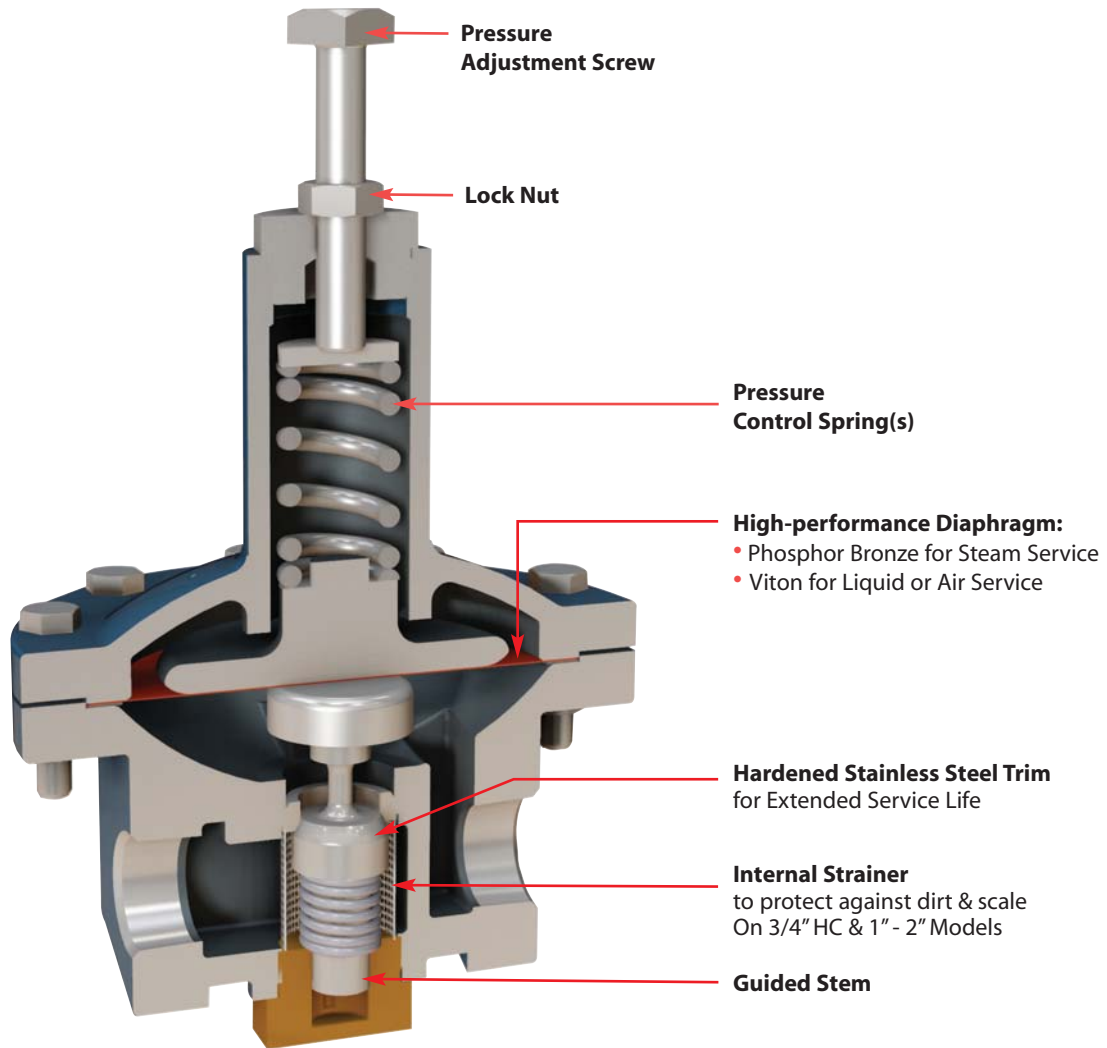
### Typical Applications

The **O-Series** direct-operated pressure regulators with heavy duty cast iron bodies and internal strainer are suitable for a wide range of applications in the low-to-moderate flow range. Applications include small heaters, humidifiers, various hospital equipment, tire molds, as well as many other general uses. This style of regulator does not require an external sensing line. Set pressure is controlled by turning an adjustment screw with lock nut that increases or decreases spring force above the diaphragm. Several spring ranges are available, depending upon the downstream pressure that needs to be maintained. O-Series contains hardened stainless steel seat and disc for extended service life. Phosphor Bronze Diaphragm specifically designed for Steam service is considered a preferred choice over Stainless Steel diaphragms which are prone to work-hardening and potential cracking. Viton diaphragms are specifically designed for water, air, gases and other liquid service and have a working temperature range up to 300°F.

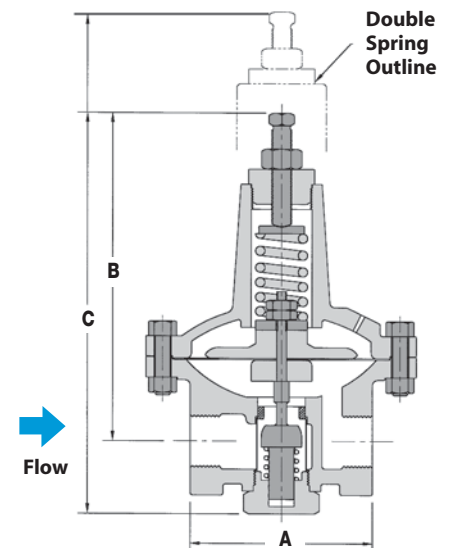
### Features & Options

- Hardened stainless steel seat and disc for extended service life (55 Rc)
- Phosphor Bronze diaphragm for Steam Service
- Viton diaphragm for up to 300°F for Water, Oil & Air Service
- Double spring available for extended outlet pressure range
- Integral stainless steel strainer on 3/4" HC, 1", 1 1/4", 1 1/2" & 2"





DIMENSIONS & WEIGHTS – inches					
Size	A	B	C		Weight (lbs)
			Single Spring	Double Spring	
3/8"	4 1/4	6 1/2	8	-	8
1/2"	3 5/8	6 1/2	8	-	8
3/4"	3 5/8	6 1/2	8	-	8
3/4" HC	3 5/8	8	10	12 1/2	15
1"	4 1/2	8 1/2	10 1/2	13	18
1 1/4"	4 1/2	8 1/2	10 1/2	13	18
1 1/2"	6 1/2	8 3/4	12	14 1/2	40
2"	6 1/2	8 3/4	12	14 1/2	40



### How to Size/Order

From the Capacity chart, find the inlet pressure and required regulator outlet pressure. Follow across chart to nearest capacity (steam, air, water) that meets or slightly exceeds demand requirements. Follow vertically up to determine appropriate size. When exact application values are not shown, interpolate between values. Select a model with the spring range that accommodates the required outlet set pressure.

#### Example:

Application: 200 lbs/hr of 100 PSIG Steam reduced to 30 PSIG  
 Model Code: **O-12-N-14-B** (1/2" O-Series, 10-50 PSIG spring range, NPT with Bronze Diaphragm for Steam)



		SINGLE Spring Only			Available with either SINGLE or DOUBLE Pressure Adjustment Spring(s)														
CAPACITIES		– Steam (lbs/hr); *Air (SCFM); *Water (GPM)																	
		Inlet/Outlet Pressures (PSIG)																	
Inlet Press.	Outlet Press.	3/8", 1/2", 3/4"			3/4" HC **			1"			1 1/4"			1 1/2"			2"		
		Steam	Air	Water	Steam	Air	Water	Steam	Air	Water	Steam	Air	Water	Steam	Air	Water	Steam	Air	Water
15	2	46	26	6	92	51	11	130	73	16	145	81	18	180	100	22	199	111	25
	5	38	21	4	75	42	9	106	59	13	119	66	14	147	82	18	163	91	19
20	5	65	36	8	130	72	15	184	102	22	205	114	25	254	141	30	281	156	34
	10	61	34	6	123	69	13	174	97	18	194	109	20	241	134	25	266	149	27
	15	45	25	4	90	51	9	128	72	13	143	80	14	177	99	18	196	109	19
30	5	83	46	10	167	93	20	236	131	28	264	147	32	327	181	39	362	201	43
	10	83	46	10	167	93	18	236	131	25	264	147	28	327	181	35	362	201	39
	20	71	40	6	142	79	13	201	112	18	225	126	20	278	155	25	308	172	27
50	5	121	67	13	242	134	27	342	190	38	382	212	42	473	263	53	523	291	58
	25	121	67	10	242	134	20	342	190	28	382	212	32	473	263	39	523	291	43
	40	87	49	6	174	97	13	247	138	18	276	154	20	341	191	25	377	211	27
100	30	214	119	17	428	238	33	607	337	47	678	376	53	839	466	66	928	515	73
	50	214	119	14	428	238	28	607	337	40	678	376	45	839	466	55	928	515	61
	70	195	109	11	275	154	18	390	218	25	436	244	28	540	301	35	597	333	39
125	30	261	145	19	522	290	39	739	410	55	826	458	62	1021	567	76	1130	627	84
	50	261	145	17	522	290	35	739	410	49	826	458	55	1021	567	68	1130	627	75
	70	261	145	15	522	290	30	739	410	42	826	458	47	1021	567	58	1130	627	64
	100	201	112	10	402	225	20	569	318	28	636	355	32	787	440	39	871	486	43
150	30	307	171	22	615	341	44	871	484	62	974	540	69	1204	668	86	1332	740	95
	50	307	171	20	615	341	40	871	484	57	974	540	63	1204	668	78	1332	740	87
	70	307	171	18	615	341	36	871	484	51	974	540	57	1204	668	70	1332	740	78
	100	298	166	14	596	333	28	844	471	40	943	527	45	1167	652	55	1291	721	61
	120	239	133	11	478	267	22	677	378	31	756	422	35	935	523	43	1035	578	47
200	30	401	222	26	802	445	52	1135	630	74	1269	705	83	1570	871	102	1737	964	113
	50	401	222	24	802	445	49	1135	630	69	1269	705	78	1570	871	96	1737	964	106
	70	401	222	23	802	445	46	1135	630	65	1269	705	72	1570	871	89	1737	964	99
	100	401	222	20	802	445	40	1135	630	57	1269	705	63	1570	871	78	1737	964	87
250	50	494	274	28	988	549	57	1400	777	80	1565	869	90	1935	1074	111	2141	1189	123
	70	494	274	27	988	549	54	1400	777	76	1565	869	85	1935	1074	105	2141	1189	116
	125	494	274	22	988	549	45	1400	777	63	1565	869	71	1935	1074	88	2141	1189	97

\* Air and water capacities are based on using elastomeric diaphragms.

\*\* 3/4" HC is high-capacity version of standard 3/4" valve.

Note: For capacities of other gases multiply the air capacities by the following factors: Argon–0.85 CO<sub>2</sub>–0.81 Helium–2.69 Nitrogen–1.02

# Regulators

## Pressure Regulating Valve

**O-Series**  
Direct-Operated

### Pressure Regulating Valves for

**Steam:** Phosphor Bronze Diaphragm

**Water, Oil, Air:** Viton Diaphragm

The **O-Series** with Cast Iron body and Hardened Stainless internals, is our most popular and economical solution for reducing pressure in STEAM systems. It is also suitable for Air, Water, Oil as well as other Liquids and Gases. When used on STEAM Applications, the valve must be specified with a Phosphor Bronze Diaphragm (Suffix Code **B**). When used on Air, Water & Oil or other Liquid Applications, the valve must be specified with a Viton Diaphragm (Suffix Code **V**).

#### Important Application Note:

- Use Phosphor Bronze Diaphragms for Steam.
- Use Viton diaphragms for Water, Air and Oil Applications.

Phosphor Bronze Diaphragms may fracture if used on Liquid Service. Use for Steam Only.

#### Diaphragm Code:

**B** - Phosphor Bronze for Steam Service

**V** - Viton (300 °F Max) for Air & Other Liquids

#### Example Model Codes:

- 1) **O-13-N-14-B**  
(O-Series, 3/4" NPT, 10-50 PSI, Single Spring, **Phosphor Bronze Diaphragm**)
- 2) **O-13-N-14-V**  
(O-Series, 3/4" NPT, 10-50 PSI, Single Spring, **Viton Diaphragm**)

Size/ Connection NPT	Reduced Pressure Range (PSI)	STEAM	Water • Oil • Air	Weight lbs
		Model Code	Model Code	
<b>SINGLE SPRING</b>		<b>STEAM</b>	<b>Water • Oil • Air</b>	
3/8"	0-10	O-11-N-13-B	O-11-N-13-V	10
	10-50	O-11-N-14-B	O-11-N-14-V	10
	40-100	O-11-N-09-B	O-11-N-09-V	10
	100-200	O-11-N-10-B	O-11-N-10-V	10
1/2"	0-10	O-12-N-13-B	O-12-N-13-V	10
	10-50	O-12-N-14-B	O-12-N-14-V	10
	40-100	O-12-N-09-B	O-12-N-09-V	10
	100-200	O-12-N-10-B	O-12-N-10-V	10
3/4"	0-10	O-13-N-13-B	O-13-N-13-V	10
	10-50	O-13-N-14-B	O-13-N-14-V	10
	40-100	O-13-N-09-B	O-13-N-09-V	10
	100-200	O-13-N-10-B	O-13-N-10-V	10
<b>SINGLE SPRING</b>		<b>STEAM</b>	<b>Water • Oil • Air</b>	
3/4" HC	0-10	OHC-13-N-0003-B	OHC-13-N-0003-V	15
	10-30	OHC-13-N-0004-B	OHC-13-N-0004-V	15
	30-50	OHC-13-N-0005-B	OHC-13-N-0005-V	15
	40-85	OHC-13-N-0006-B	OHC-13-N-0006-V	15
1"	0-10	O-14-N-0007-B	O-14-N-0007-V	19
	10-30	O-14-N-0008-B	O-14-N-0008-V	19
	30-50	O-14-N-0009-B	O-14-N-0009-V	19
	40-85	O-14-N-0010-B	O-14-N-0010-V	19
1 1/4"	0-10	O-15-N-0007-B	O-15-N-0007-V	18
	10-30	O-15-N-0008-B	O-15-N-0008-V	18
	30-50	O-15-N-0009-B	O-15-N-0009-V	18
	40-85	O-15-N-0010-B	O-15-N-0010-V	18
1 1/2"	0-10	O-16-N-0008-B	O-16-N-0008-V	47
	10-30	O-16-N-0009-B	O-16-N-0009-V	47
	30-50	O-16-N-0010-B	O-16-N-0010-V	47
	40-85	O-16-N-0011-B	O-16-N-0011-V	47
2"	0-10	O-17-N-0008-B	O-17-N-0008-V	48
	10-30	O-17-N-0009-B	O-17-N-0009-V	48
	30-50	O-17-N-0010-B	O-17-N-0010-V	48
	40-85	O-17-N-0011-B	O-17-N-0011-V	48
<b>DOUBLE SPRING</b>		<b>STEAM</b>	<b>Water • Oil • Air</b>	
3/4" HC	0-75	OHC-13-N-0708-B	OHC-13-N-0708-V	19
	30-130	OHC-13-N-0809-B	OHC-13-N-0809-V	19
1"	0-75	O-14-N-0809-B	O-14-N-0809-V	22
	30-130	O-14-N-0910-B	O-14-N-0910-V	22
1 1/4"	0-75	O-15-N-0809-B	O-15-N-0809-V	22
	30-130	O-15-N-0910-B	O-15-N-0910-V	22
1 1/2"	0-75	O-16-N-0809-B	O-16-N-0809-V	48
	30-130	O-16-N-0910-B	O-16-N-0910-V	48
2"	0-75	O-17-N-0809-B	O-17-N-0809-V	48
	30-130	O-17-N-0910-B	O-17-N-0910-V	48

PRESSURE  
Regulators

# Regulators

## Pressure Regulating Valve

**B-Series**  
Direct-Operated

Model	<b>B-Series</b>	
Service	<b>Water, Air, Oil, Other Gases &amp; Liquids</b>	
Sizes	1/2", 3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 4"	
Connections	NPT, 125# FLG, 250# FLG	
Body Material	1/2" - 2 1/2"	Bronze
	3" & 4"	Cast Iron
Disc & Diaphragm	Viton - 300°F max	
Max Inlet Pressure	250 PSIG	
Min Inlet Pressure	10 PSIG	
Max Differential Pressure	125 PSI	
Min Differential Pressure	20% of Inlet Pressure	

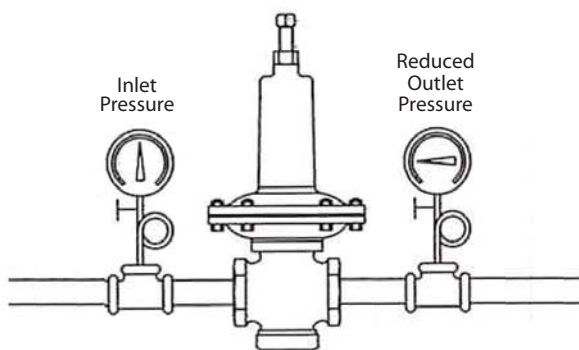


### Design Pressure/Temperature Rating – PMA/TMA

NPT	250 PSIG	@ 400°F
125# FLG	125 PSIG	@ 450°F
250# FLG	250 PSIG	@ 450°F

### Typical Applications

The **B-Series** direct-operated pressure regulators with balanced valve trim are used for reducing pressure in air and water systems. These regulators are commonly found in industrial plants, apartment buildings, water supply systems, schools and underground water distribution systems. The soft-seated elastomeric Viton disc has an operating temperature up to 300°F and will produce a Class V shutoff. No external sensing line is required with this style of regulator.



### Features & Options

- Diaphragm, disc and cup packing in Viton for 300°F service
- Balanced pressure regulator allows accurate control even when incoming pressure fluctuates
- Valve has a Class V shut-off rating due to the "soft-seated" Viton disc

**Note:**  
Flange selection may reduce pressure/temperature ratings.

Size/Connection	Model Code *	Body Material	Weight lbs
<b>VITON Diaphragm &amp; Disc (300°F Max)</b>			
1/2" NPT	<b>B-12-N-X-V</b>	Bronze	8
3/4" NPT	<b>B-13-N-X-V</b>	Bronze	8
1" NPT	<b>B-14-N-X-V</b>	Bronze	9
1 1/4" NPT	<b>B-15-N-X-V</b>	Bronze	13
1 1/2" NPT	<b>B-16-N-X-V</b>	Bronze	15
2" NPT	<b>B-17-N-X-V</b>	Bronze	21
2 1/2" NPT	<b>B-18-N-X-V</b>	Bronze	27
3"	125# FLG	<b>B-19-F125-X-V</b>	Cast Iron
	250# FLG	<b>B-19-F250-X-V</b>	Cast Iron
4"	125# FLG	<b>B-20-F125-X-V</b>	Cast Iron
	250# FLG	<b>B-20-F250-X-V</b>	Cast Iron

X=Spring Code (reference Spring Selection Table).

### Example Model Code:

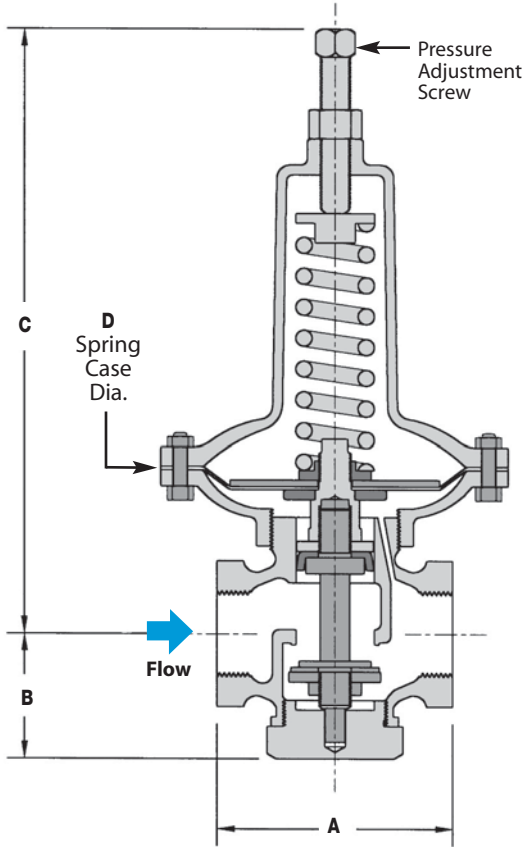
**B-13-N-2-V** (B-Series, 3/4" NPT, 20-70 PSI Spring Range)

### B Series Spring Selection Table

Reduced Outlet Pressure (PSI)	Spring #	Code = X
1 - 12	#4	<b>4</b>
5 - 35	#3	<b>3</b>
20 - 70	#2	<b>2</b>
40 - 125	#1	<b>1</b>

**Note:** Reduced Outlet Pressure 1–12 PSI (Code **4**) available in 1/2", 3/4", and 1" sizes only.





Size	Face-to-Face			B	C	D Spring Case Dia. (in.)
	A					
	NPT Threaded	125# Flanged	250# Flanged			
1/2", 3/4"	3 <sup>3</sup> / <sub>8</sub>			1 <sup>7</sup> / <sub>8</sub>	9	5
1"	3 <sup>5</sup> / <sub>8</sub>			2 <sup>1</sup> / <sub>4</sub>	9 <sup>1</sup> / <sub>2</sub>	5
1 <sup>1</sup> / <sub>4</sub> "	4 <sup>1</sup> / <sub>4</sub>			2 <sup>3</sup> / <sub>8</sub>	10 <sup>1</sup> / <sub>2</sub>	6 <sup>3</sup> / <sub>4</sub>
1 <sup>1</sup> / <sub>2</sub> "	4 <sup>3</sup> / <sub>4</sub>			2 <sup>1</sup> / <sub>2</sub>	10 <sup>3</sup> / <sub>4</sub>	6 <sup>3</sup> / <sub>4</sub>
2"	5 <sup>7</sup> / <sub>8</sub>			3 <sup>3</sup> / <sub>8</sub>	11 <sup>5</sup> / <sub>8</sub>	6 <sup>3</sup> / <sub>4</sub>
2 <sup>1</sup> / <sub>2</sub> "	6 <sup>1</sup> / <sub>2</sub>			4 <sup>1</sup> / <sub>4</sub>	12 <sup>3</sup> / <sub>4</sub>	6 <sup>3</sup> / <sub>4</sub>
3"		10 <sup>1</sup> / <sub>4</sub>	11	4 <sup>1</sup> / <sub>2</sub>	21 <sup>1</sup> / <sub>2</sub>	9 <sup>1</sup> / <sub>4</sub>
4"		13	13 <sup>5</sup> / <sub>8</sub>	5 <sup>3</sup> / <sub>4</sub>	23	9 <sup>1</sup> / <sub>4</sub>

**How to Size/Order**

From the Capacity chart, find the inlet pressure and required regulator outlet pressure. Follow across chart to nearest capacity (water, air) that meets or slightly exceeds demand requirements. Follow vertically up to determine appropriate size. When exact application values are not shown, interpolate between values. From the spring range chart, select the spring range that accommodates the required outlet set pressure.

**Example:**

Application: 35 GPM of 70 PSIG Water reduced to 20 PSIG  
Model Code: **B-14-N-3-V** (B-Series, 1" NPT, 5-35 PSIG spring range)

CAPACITIES		Inlet/Outlet Pressures (PSIG)																	
Inlet Press.	Outlet Press.	1/2"		3/4"		1"		1 <sup>1</sup> / <sub>4</sub> "		1 <sup>1</sup> / <sub>2</sub> "		2"		2 <sup>1</sup> / <sub>2</sub> "		3"		4"	
		Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air
10	5	5.5	25	10	45	13	60	22	100	33	150	55	250	88	400	132	600	176	800
	20	9.8	48	18	86	23	114	39	190	59	285	98	475	156	760	234	1140	312	1520
	30	8.0	43	14	77	19	102	32	170	48	255	80	425	128	680	192	1020	256	1360
20	15	5.5	30	10	54	13	72	22	120	33	180	55	300	88	480	132	720	176	960
	30	12.5	68	23	122	30	162	50	270	75	405	125	675	200	1080	300	1620	400	2160
	40	11.3	63	20	113	27	150	45	250	68	375	113	625	180	1000	270	1500	360	2000
30	20	8.0	48	14	86	19	114	32	190	48	285	80	475	128	760	192	1140	256	1520
	50	16.8	98	30	176	40	234	67	390	101	585	168	975	268	1560	402	2340	536	3120
	70	12.5	88	23	158	30	210	50	350	75	525	125	875	200	1400	300	2100	400	2800
50	40	8.0	63	14	113	19	150	32	250	48	375	80	625	128	1000	192	1500	256	2000
	70	19.3	128	35	230	46	306	77	510	116	765	193	1275	308	2040	462	3060	616	4080
	100	15.8	125	28	225	38	300	63	500	95	750	158	1250	252	2000	378	3000	504	4000
70	50	11.3	95	20	171	27	228	45	380	68	570	113	950	180	1520	270	2280	360	3040
	100	21.0	175	38	315	50	420	84	700	126	1050	210	1750	336	2800	504	4200	672	5600
	125	17.5	165	32	297	42	396	70	660	105	990	175	1650	280	2640	420	3960	560	5280
100	70	13.8	135	25	243	33	324	55	540	83	810	138	1350	220	2160	330	3240	440	4320
	125	24.3	213	44	383	58	510	97	850	146	1275	243	2125	388	3400	582	5100	776	6800
	150	21.5	213	39	383	52	510	86	850	129	1275	215	2125	344	3400	516	5100	688	6800
125	100	12.5	140	23	252	30	336	50	560	75	840	125	1400	200	2240	300	3360	400	4480
	150	27.5	250	50	450	66	600	110	1000	165	1500	275	2500	440	4000	660	6000	880	8000
	200	25.0	250	45	450	60	600	100	1000	150	1500	250	2500	400	4000	600	6000	800	8000
150	100	17.5	205	32	369	42	492	70	820	105	1230	175	2050	280	3280	420	4920	560	6560
	125	12.5	153	23	275	30	366	50	610	75	915	125	1525	200	2440	3000	3660	400	4880
	200	28.5	325	51	585	68	780	114	1300	171	1950	285	3250	456	5200	684	7800	912	10400
200	100	25.0	263	45	473	60	630	100	1050	150	1575	250	2625	400	4200	600	6300	800	8400
	125	21.5	223	39	401	52	534	86	890	129	1335	215	2225	344	3560	516	5340	688	7120
	250	30.8	403	55	725	74	966	123	1610	185	2415	308	4025	492	6440	738	9660	984	12880
250	125	28.0	393	50	707	67	942	101	1570	168	2355	280	3925	448	6280	672	9420	896	12560

Note: For capacities of other gases multiply the air capacities by the following factors: Argon-0.85 CO<sub>2</sub>-0.81 Helium-2.69 Nitrogen-1.0

Model	<b>455 Series</b>
Service	<b>Steam, Air &amp; Other Gases</b>
Sizes	<b>1/2", 3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3", 4"</b>
Connections	<b>NPT, 125# FLG, 250# FLG</b>
Body Material	<b>1/2"– 1 1/2" SS Body/Brass Stuffing Box 2"– 4" Cast Iron</b>
Seat & Disc	<b>Stainless Steel</b>
Diaphragm	<b>Neoprene/Nylon</b>
Max Inlet Pressure	<b>250 PSIG</b>
Min Inlet Pressure	<b>5 PSIG</b>
Max Differential Pressure	<b>125 PSI</b>
Min Differential Pressure	<b>20% of Inlet Pressure</b>

### Design Pressure/Temperature Rating – PMA/TMA

NPT	250 PSIG	@ 400°F
125# FLG	125 PSIG	@ 450°F
250# FLG	250 PSIG	@ 450°F



**Note:**  
Flange selection may reduce pressure/temperature ratings.

Size/Connection	Model Code *	Body Material	Weight lbs
<b>STEAM Applications - 455</b>			
1/2" NPT	<b>455-12-N-X</b>	Bronze	15
3/4" NPT	<b>455-13-N-X</b>	Bronze	15
1" NPT	<b>455-14-N-X</b>	Bronze	15
1 1/4" NPT	<b>455-15-N-X</b>	Bronze	18
1 1/2" NPT	<b>455-16-N-X</b>	Bronze	18
2" NPT	<b>455-17-N-X</b>	Cast Iron	75
	125# FLG <b>455-17-F125-X</b>	Cast Iron	75
2" 250# FLG	<b>455-17-F250-X</b>	Cast Iron	75
	125# FLG <b>455-18-F125-X</b>	Cast Iron	105
2 1/2" 250# FLG	<b>455-18-F250-X</b>	Cast Iron	105
	125# FLG <b>455-19-F125-X</b>	Cast Iron	125
3" 250# FLG	<b>455-19-F250-X</b>	Cast Iron	125
	125# FLG <b>455-20-F125-X</b>	Cast Iron	175
4" 250# FLG	<b>455-20-F250-X</b>	Cast Iron	175

X=Spring Code (reference Spring Selection Table).

### 455 Spring Selection Table

Size	Reduced Outlet Pressure (PSI)	Spring Case Dia. (in.)	Spring #	Code = X
1/2" – 1 1/2"	1 - 6	6	#5	<b>65</b>
	5 - 20	6	#3	<b>63</b>
	15 - 45	6	#2	<b>62</b>
	40 - 70	6	#1	<b>61</b>
2" – 4"	60 - 125	5	#1	<b>51</b>
	1 - 6	13	#4	<b>134</b>
	5 - 20	9	#4	<b>94</b>
	15 - 45	9	#3	<b>93</b>
2" – 4"	40 - 70	7	#3	<b>73</b>
	60 - 125	7	#2	<b>72</b>

### Typical Applications

The **455 Series** direct-operated pressure regulating valves are used for pressure reduction applications on steam, air and other gases. Balanced seat and disc design allows these valves to be used in applications with low inlet pressure; down to 5 PSIG. Unlike pilot-operated valves, the 455 does not contain any small pilot orifices and are therefore less susceptible to issues caused by dirt and pipe scale. The 455-Series is installed using an external sensing line which is connected several feet downstream of the valve. Placing the pressure sensing location out of range of valve discharge turbulence makes it more accurate in controlling downstream pressure.

### Features

- Operates with minimum inlet pressure of 5 PSIG
- Stainless steel internals
- Excellent for use in steam systems that contain excessive amounts of pipe scale and other contaminants
- Pressure balanced valve & seat for more precise control of downstream pressure

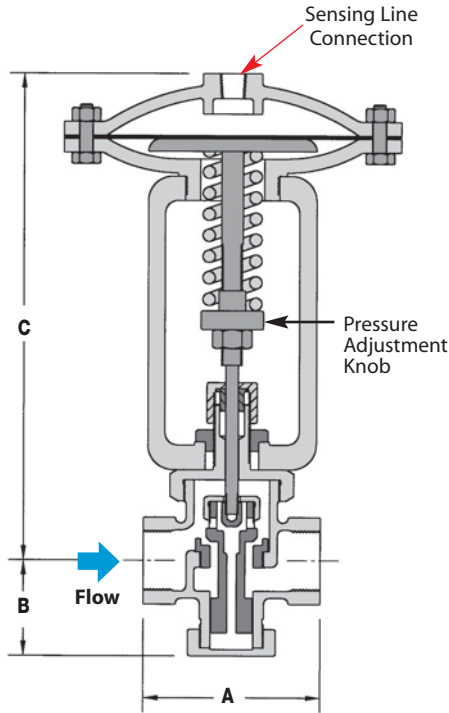
### Options & Notes:

#### Must Specify Spring Code when Ordering:

Use the 455 Spring Selection Table to specify the proper spring(s) based on valve size and reduced pressure range by Replacing the "X" with Spring Code from chart.

#### Example Model Codes:

- 1) **455-15-N-65**  
(455 Series, 1 1/4" NPT, 1-6 PSIG outlet pressure)
- 2) **455-18-F125-73**  
(455 Series, 2 1/2" 125# Flanged, 40-70 PSIG outlet pressure)



Size	Face-to-Face A			B	C	Sensing Line Connection NPT
	NPT Threaded	125# Flanged	250# Flanged			
1/2"	4 1/4			2 3/8	10 1/4	1/4"
3/4"	4 1/4			2 3/8	10 1/4	1/4"
1"	4 1/8			2 3/8	10 1/4	1/4"
1 1/4"	5			3 1/8	10 3/4	1/4"
1 1/2"	5 1/4			3 3/8	11	1/4"
2"	9 1/2	10 3/8	10 7/8	5 3/4	18 1/2	3/8"
2 1/2"		10 5/8	11 1/4	6 1/4	18 3/4	3/8"
3"		10 7/8	11 5/8	7 1/8	19 1/4	3/8"
4"		12 1/2	13 1/8	8 1/4	20	3/8"

**How to Size/Order**

From the Capacity chart, find the inlet pressure and required regulator outlet pressure. Follow across chart to nearest capacity (steam) that meets or slightly exceeds demand requirements. Follow vertically up to determine appropriate size. When exact application values are not shown, interpolate between values. From the spring range chart, select the spring range that accommodates the required outlet set pressure.

**Example:**

Application: 1000 lbs/hr of 20 PSIG Steam reduced to 5 PSIG  
Model Code: **455-16-N-65** (455-Series, 1 1/2" NPT, 1-6 PSIG spring range)

PRESSURE Regulators

CAPACITIES – Steam (lbs/hr); Water (GPM)		Inlet/Outlet Pressures (PSIG)																	
Inlet Press.	Outlet Press.	1/2"		3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"	
		Steam	Water	Steam	Water	Steam	Water	Steam	Water	Steam	Water	Steam	Water	Steam	Water	Steam	Water	Steam	Water
5	2	53	4.3	95	7.8	191	15.6	276	22.5	403	33.0	572	47.0	890	73.0	1166	95.0	1484	121
10	2	95	7.1	171	12.7	342	25.0	494	37.0	722	54.0	1026	76.0	1596	119	2090	156	2660	198
	5	73	5.6	131	10.1	263	20.0	380	29.0	555	42.0	788	60.0	1226	94.0	1606	123	2044	157
20	0-5	157	9.7	283	17.4	565	35.0	816	50.0	1193	75.0	1696	105	2638	163	3454	213	4396	271
	10	125	7.9	225	14.2	450	28.0	650	41.0	950	60.0	1350	85.0	2100	133	2750	174	3500	221
30	0-10	200	11.2	360	20.1	720	40.0	1040	58.0	1520	85.0	2160	121	3360	188	4400	246	5600	313
	20	145	7.9	261	14.2	522	28.0	754	41.0	1102	60.0	1566	85.0	2436	133	3190	174	4060	221
	25	107	5.6	193	10.1	385	20.0	556	29.0	813	42.0	1156	60.0	1798	94.0	2354	123	2996	157
50	0-20	295	13.7	531	24.6	1062	49.0	1534	71.0	2242	104	3186	148	4956	230	6490	301	8260	383
	30	245	11.2	441	20.1	882	40.0	1274	58.0	1862	85.0	2646	121	4116	188	5390	247	6860	313
	40	185	7.9	333	14.2	666	28.0	962	41.0	1406	60.0	1998	85.0	3108	133	4070	174	5180	221
75	0-30	402	16.8	724	30.2	1447	60.0	2090	87.0	3055	127	4342	181	6754	282	8844	369	11256	470
	50	327	12.5	589	22.5	1177	45.0	1700	65.0	2485	95.0	3532	135	5494	210	7194	275	9156	350
	60	255	9.7	459	17.4	918	35.0	1326	50.0	1938	74.0	2754	105	4284	163	5610	213	7140	271
100	0-50	522	17.7	940	31.8	1879	64.0	2714	92.0	3967	134	5638	191	8770	297	11484	389	14616	495
	60	455	15.8	819	28.5	1638	57.0	2366	82.0	3458	120	4914	171	7644	266	10010	348	12740	443
	80	325	11.2	585	20.1	1170	40.0	1690	58.0	2470	85.0	3510	121	5460	188	7150	246	9100	313
125	0-60	635	20.2	1143	36.3	2286	73.0	3302	105	4826	153	6858	218	10668	339	13970	443	17780	564
	70	575	18.5	1035	33.4	2070	67.0	2990	96.0	4370	141	6210	200	9660	311	12650	408	16100	519
	100	420	12.5	756	22.5	1512	45.0	2184	65.0	3192	95.0	4536	135	7056	210	9240	275	11760	350
150	0-70	750	22.4	1350	40.2	2700	80.0	3900	116	5700	170	8100	241	12600	376	16500	492	21000	626
	100	612	17.7	1102	31.8	2203	64.0	3182	92.0	4651	134	6610	191	10282	297	13464	389	17136	495
	125	435	12.5	783	22.5	1566	45.0	2262	65.0	3306	95	4698	135	7308	210	9570	275	12180	350
200	0-100	977	25.0	1759	45.0	3517	90.0	5080	130	7425	190	10552	270	16414	420	21494	550	27356	700
	125	850	21.7	1530	39.0	3060	78.0	4420	113	6460	165	9180	234	14280	364	18700	476	23800	606
250	0-125	1180	28.0	2124	50.3	4248	101	6136	145	8968	212	12744	302	19824	470	25960	615	33040	783

Note: Air in SCFM (Standard Cubic Feet per Minute) = Steam (lbs/hr) x 0.36



Model	<b>403 Series</b>
Service	<b>Steam &amp; Air</b>
Sizes	<b>1/2" - 4"</b>
Connections	<b>NPT, 150# FLG, 300# FLG</b>
Body Material	<b>Ductile Iron</b>
Seat & Disc	<b>Hardened 420 Stainless Steel (55 Rc)</b>
<b>Max Inlet Pressure</b>	<b>450 PSIG</b>
<b>Min Inlet Pressure</b>	<b>20 PSIG</b>
<b>Max Differential Pressure</b>	<b>250 PSI</b>
<b>Min Differential Pressure</b>	<b>15% of Inlet Pressure (10 PSI min)</b>

### Design Pressure/Temperature Rating – PMA/TMA

NPT	450 PSIG @ 650°F
150# FLG	150 PSIG @ 566°F
300# FLG	450 PSIG @ 650°F



### Typical Applications

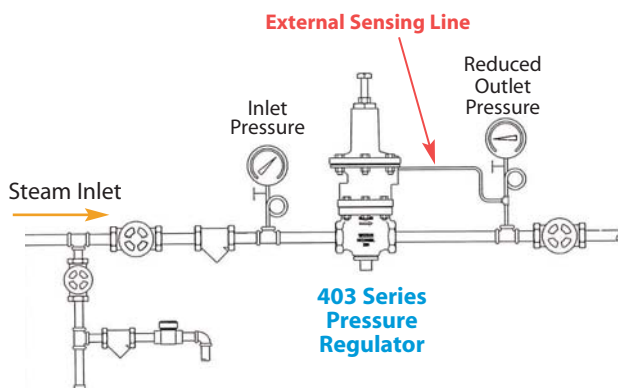
The **403 Series** pilot-operated (piston-actuated) pressure regulating valves are used for pressure reduction on steam mains and other process equipment. Pilot-operated regulators will maintain a constant and accurate downstream pressure regardless of fluctuations in supply pressure or usage. These regulators can be supplied with an optional internal sensing line which simplifies installation. Piston-actuated regulators are more compact than Diaphragm-actuated regulators. The 403 Series contains all stainless steel internals for high-pressure applications up to 450 PSIG. The Double-Spring option is available for a wider range of reduced pressures.

### Features & Options

- Pilot-operated regulators minimize outlet pressure fluctuations even when load varies
- Internal Sensing option (If requested, the regulator can be modified to internally sense pressure, eliminating the need for an external sensing line)
- Ductile Iron body to handle increased pressure and temperature
- Hardened stainless steel seat and disc (55 Rc)

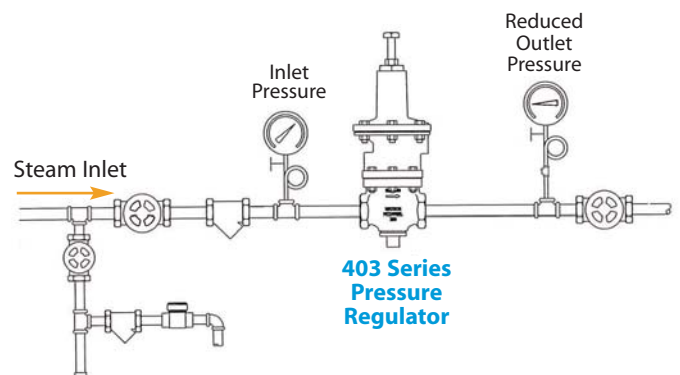
### Pressure Reducing Station with External Sensing Line

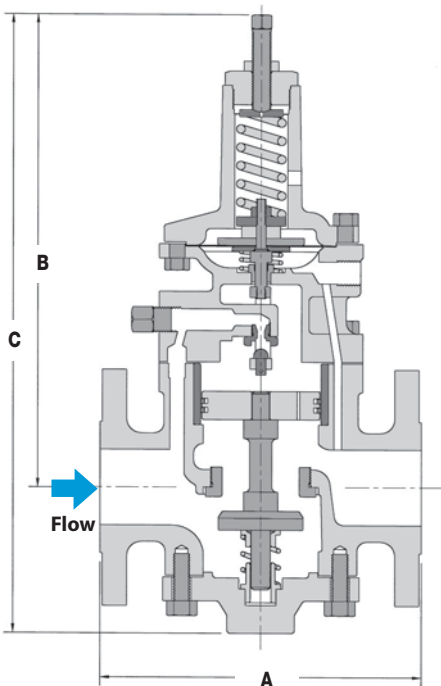
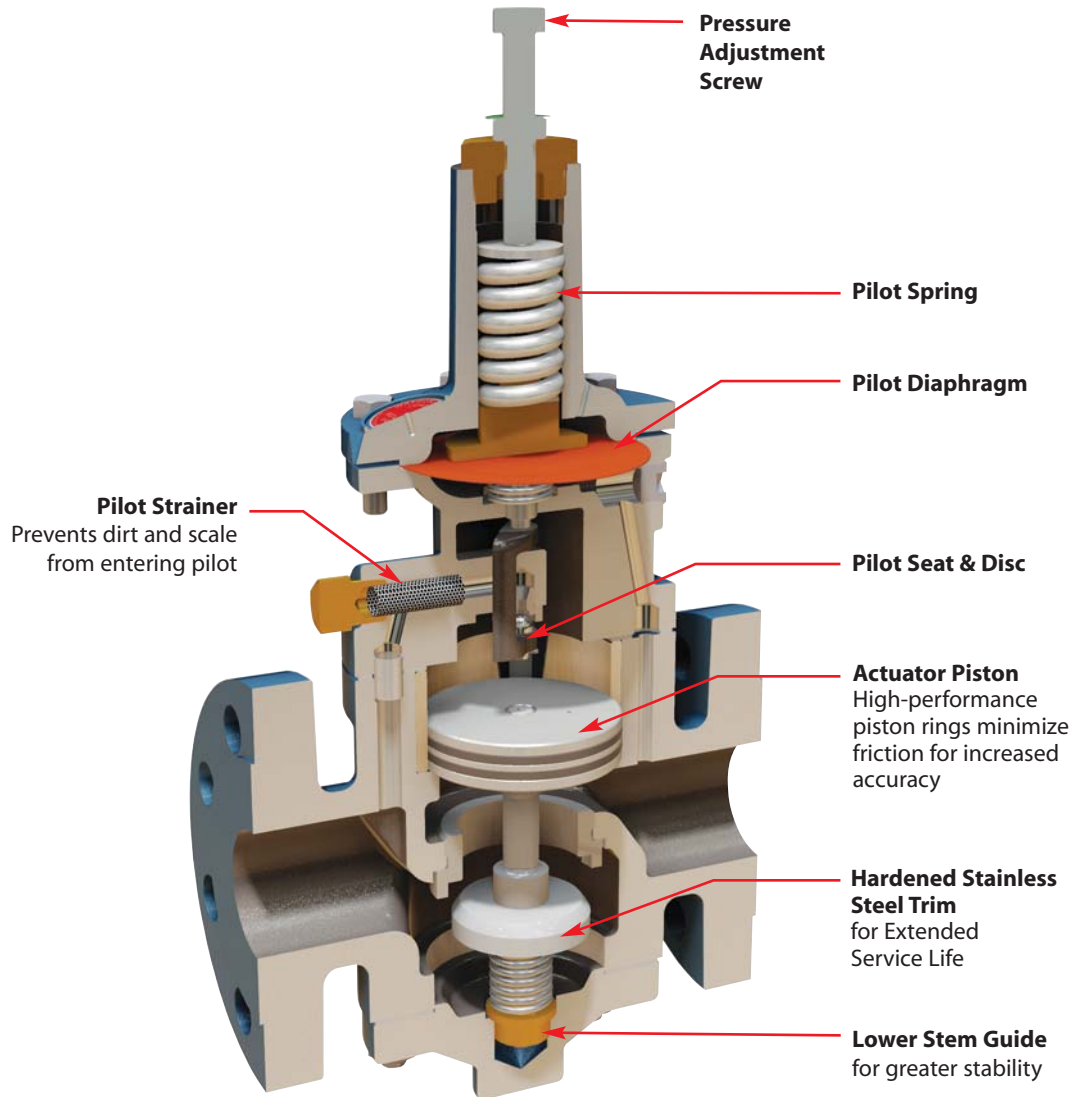
**External Sensing (standard)**  
(requires sensing line)



### Pressure Reducing Station with Internal Sensing Line

**Internal Sensing Option**  
(Specially drilled internal sensing path eliminates the need for an external sensing line)





**DIMENSIONS** – inches

Size	Face-to-Face A			Centerline to Top B		Overall Height C	
	NPT Threaded	150# Flanged	300# Flanged	Single Spring	Double Spring	Single Spring	Double Spring
1/2"	4 1/2			12	14 3/8	14 3/8	16 3/4
3/4"	4 1/2			12	14 3/8	14 3/8	16 3/4
1"	4 1/2			12	14 3/8	14 3/8	16 3/4
1 1/4"	8 3/16			12 3/4	15 1/8	16 1/8	18 1/2
1 1/2"	8 3/16			12 3/4	15 1/8	16 1/8	18 1/2
2"	8 3/4	8 1/4	8 3/4	13	15 3/8	17 1/8	19 1/2
2 1/2"		9 1/8	9 3/4	13 3/4	16 1/8	18 1/4	20 5/8
3"		9 3/4	10 1/2	14 3/4	16 1/8	19 3/4	22 1/8
4"		13 1/2	14	16	18 3/8	24	26 3/8

### How to Size/Order

From the Capacity chart, find the inlet pressure and required regulator outlet pressure. Follow across chart to nearest capacity (steam, air) that meets or slightly exceeds demand requirements. Follow vertically up to determine appropriate size. When exact application values are not shown, interpolate between values. From the spring range chart, select the spring range that accommodates the required outlet set pressure. Specify Internal or External (remote) Pressure sensing.

#### Example:

Application: 12,500 lbs/hr of 300 PSIG Steam reduced to 125 PSIG  
 Model Code: **403-17-N-0010-R** (2" 403 Series Valve, 100-200 PSIG spring range, with external sensing)

**Note:** Flange selection may reduce pressure/temperature ratings.

Size/Connection	Model Code *	Weight lbs
<b>REMOTE Pressure Sensing - Requires External Sensing Line</b>		
1/2" NPT	<b>403-12-N-X-R</b>	20
3/4" NPT	<b>403-13-N-X-R</b>	20
1" NPT	<b>403-14-N-X-R</b>	20
1 1/4" NPT	<b>403-15-N-X-R</b>	37
1 1/2" NPT	<b>403-16-N-X-R</b>	38
NPT	<b>403-17-N-X-R</b>	54
2" 150# FLG	<b>403-17-F150-X-R</b>	54
300# FLG	<b>403-17-F300-X-R</b>	56
2 1/2" 150# FLG	<b>403-18-F150-X-R</b>	66
300# FLG	<b>403-18-F300-X-R</b>	69
3" 150# FLG	<b>403-19-F150-X-R</b>	88
300# FLG	<b>403-19-F300-X-R</b>	96
4" 150# FLG	<b>403-20-F150-X-R</b>	174
300# FLG	<b>403-20-F300-X-R</b>	182
<b>INTERNAL Pressure Sensing - No Sensing Line Required</b>		
1/2" NPT	<b>403-12-N-X-I</b>	20
3/4" NPT	<b>403-13-N-X-I</b>	20
1" NPT	<b>403-14-N-X-I</b>	20
1 1/4" NPT	<b>403-15-N-X-I</b>	37
1 1/2" NPT	<b>403-16-N-X-I</b>	38
NPT	<b>403-17-N-X-I</b>	54
2" 150# FLG	<b>403-17-F150-X-I</b>	54
300# FLG	<b>403-17-F300-X-I</b>	56
2 1/2" 150# FLG	<b>403-18-F150-X-I</b>	66
300# FLG	<b>403-18-F300-X-I</b>	69
3" 150# FLG	<b>403-19-F150-X-I</b>	88
300# FLG	<b>403-19-F300-X-I</b>	96
4" 150# FLG	<b>403-20-F150-X-I</b>	174
300# FLG	<b>403-20-F300-X-I</b>	182

X = Spring Code (reference Spring Selection Table).



### 403 Spring Selection Table

Reduced Outlet Pressure PSI	Spring #	Code = X	Color
<b>SINGLE Spring Ranges</b>			
0 to 10	#13	<b>0013</b>	Blue & yellow
10 to 50	#14	<b>0014</b>	Black & yellow
40 to 100	#9	<b>0009</b>	Red & yellow
100 to 200	#10	<b>0010</b>	Green & blue
<b>DOUBLE Spring Ranges</b>			
30 to 125	#14 & #9	<b>1409</b>	Red & yellow Black & yellow
50 to 200	#9 & #10	<b>0910</b>	Red & yellow Green & blue

Note: For 200 - 280 PSI use Bellville washers (Code = **0015**)

#### Notes:

#### Must Specify Spring Code when Ordering:

Use the 403 Spring Selection Table to specify the proper spring(s) based on reduced pressure range by replacing the "X" with Spring Code from chart.

Internal Sensing (not available with 0-10 PSI range)

#### Pressure Sensing Codes:

Code R - Remote Pressure Sensing  
 Code I - Internal Pressure Sensing

#### Example Model Code:

1) **403-15-N-0014-R**  
 (403 Series, 1 1/4" NPT, 10-50 PSI, Remote Pressure Sensing)

<b>CAPACITIES</b> – Steam (lbs/hr); Air (SCFM)																	
		Inlet/Outlet Pressures (PSIG)															
Inlet Press.	Outlet Press.	1/2", 3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"	
		Steam	Air	Steam	Air	Steam	Air	Steam	Air	Steam	Air	Steam	Air	Steam	Air	Steam	Air
20	0-10	175	60	425	145	600	204	850	289	1300	442	2750	935	3850	1309	4900	1666
30	0-10	270	88	655	213	924	300	1309	425	2002	650	4235	1375	5929	1925	7546	2450
	20	203	67	493	162	696	228	986	323	1508	494	3190	1045	4466	1463	5684	1862
50	0-20	385	130	935	315	1320	444	1870	629	2860	962	6050	2035	8470	2849	10780	3626
	30	343	116	833	281	1176	396	1666	561	2548	858	5390	1815	7546	2541	9604	3234
100	0-50	690	231	1675	561	2364	792	3349	1122	5122	1716	10835	3630	15169	5082	19306	6468
	60	637	214	1547	519	2184	732	3094	1037	4732	1586	10010	3355	14014	4697	17836	5978
	80	455	151	1105	366	1560	516	2210	731	3380	1118	7150	2365	10010	3311	12740	4214
125	0-60	865	287	2100	697	2964	984	4199	1394	6422	2132	13585	4510	19019	6314	24206	8036
	70	805	270	1955	655	2760	924	3910	1309	5980	2002	12650	4235	17710	5929	22540	7546
	100	588	196	1428	476	2016	672	2856	952	4368	1456	9240	3080	12936	4312	16464	5488
150	0-70	1019	343	2474	833	3492	1176	4947	1666	7566	2548	16005	5390	22407	7546	28518	9604
	100	858	287	2083	697	2940	984	4165	1394	6370	2132	13475	4510	18865	6314	24010	8036
	125	609	214	1479	519	2088	732	2958	1037	4524	1586	9570	3355	13398	4697	17052	5978
200	0-100	1337	445	3247	1080	4584	1524	6494	2159	9932	3302	21010	6985	29414	9779	37436	12446
	150	1001	333	2431	808	3432	1140	4862	1615	7436	2470	15730	5225	22022	7315	28028	9310
	175	739	245	1794	595	2532	840	3587	1190	5486	1820	11605	3850	16247	5390	20678	6860
250	0-125	1652	550	4012	1335	5664	1884	8024	2669	12272	4082	25960	8635	36344	12089	46256	15386
	175	1358	452	3298	1097	4656	1548	6596	2193	10088	3354	21340	7095	29876	9933	38024	12642
	200	1138	378	2763	918	3900	1296	5525	1836	8450	2808	17875	5940	25025	8316	31850	10584
300	0-150	2016	665	4896	1615	6912	2280	9792	3230	14976	4940	31680	10450	44352	14630	56448	18620
	200	2016	665	4896	1615	6912	2280	9792	3230	14976	4940	31680	10450	44352	14630	56448	18620
	250	1250	417	3035	1012	4284	1428	6069	2023	9282	3094	19635	6545	27489	9163	34986	11662
400	0-200	2657	875	6452	2125	9108	3000	12903	4250	19734	6500	41745	13750	58443	19250	74382	24500
	280	2146	711	5211	1726	7356	2436	10421	3451	15938	5278	33715	11165	47201	15631	60074	19894
450	0-225	2975	984	7225	2389	10200	3372	14450	4777	22100	7306	46750	15455	65450	21637	83300	27538
	280	2975	984	7225	2389	10200	3372	14450	4777	22100	7306	46750	15455	65450	21637	83300	27538

Note: For capacities of other gases multiply the air capacities by the following factors: Argon-0.85 CO<sub>2</sub>-0.81 Helium-2.69 Nitrogen-1.02

**PRESSURE**  
Regulators

Model	R Series	10691 Series*
Service	Liquids	Liquids
Sizes	1/2" – 3"	1/2", 3/4", 1"
Connections	NPT	NPT
Body	Bronze	Bronze
Seat Material	Bronze	Bronze
Disc Material	Stainless Steel (1/2" – 1 1/2") Bronze (2" – 3")	EPDM* Optional Viton or Teflon
Max Inlet Pressure	300 PSIG	300 PSIG

\* **10691-Series** Relief Valves use a soft elastomeric disc for tight shut-off. Available in 1/2", 3/4" & 1" sizes only.

### Design Pressure/Temperature Rating – PMA/TMA

NPT 300 PSIG @ 180°F



### Description

The **R-Series** & the **10691-Series** Back Pressure & Relief Valves relieve upstream pressure in a variety of processes. **R-Series** has a stainless steel disc and the **10691-Series** has a soft elastomeric disc for tight shut-off. These valves automatically maintain desired maximum pressure in a vessel or system by relieving excess pressure into lower pressure return line or to atmosphere. Ideally suited for use as pump bypass control valve by maintaining constant pump discharge pressures. Used as a continuously operating valve or for protection against intermittent overpressure conditions.

**NOT TO BE USED ON STEAM.**

### Typical Applications

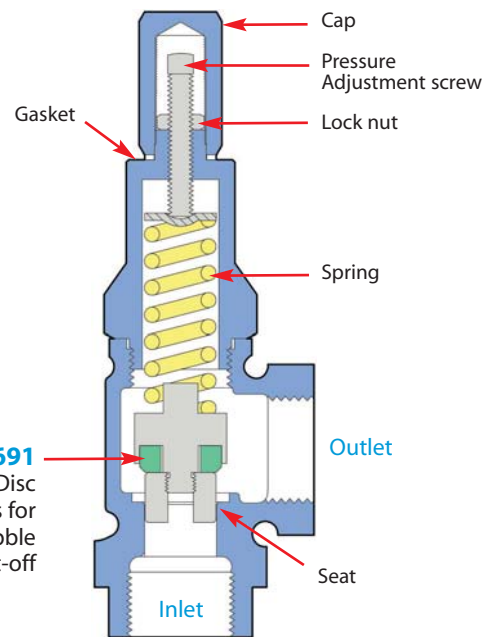
The **R-Series** & **10691 Series** Back Pressure Relief Valves are used in the following applications:

- Water pump bypass for irrigation, sprinkler systems on golf courses, fountains and fire protection systems
- Fuel oil pump bypass on commercial systems or large residential systems

Note: Not to be used as a safety relief valve on steam systems.

### Features & Options

- Four Springs – easily interchanged to cover pressures from 1 to 300 PSIG
- Heavy-duty bronze valve body
- 10691 Series has EPDM Seat for tight shut-off (1/2" - 1")



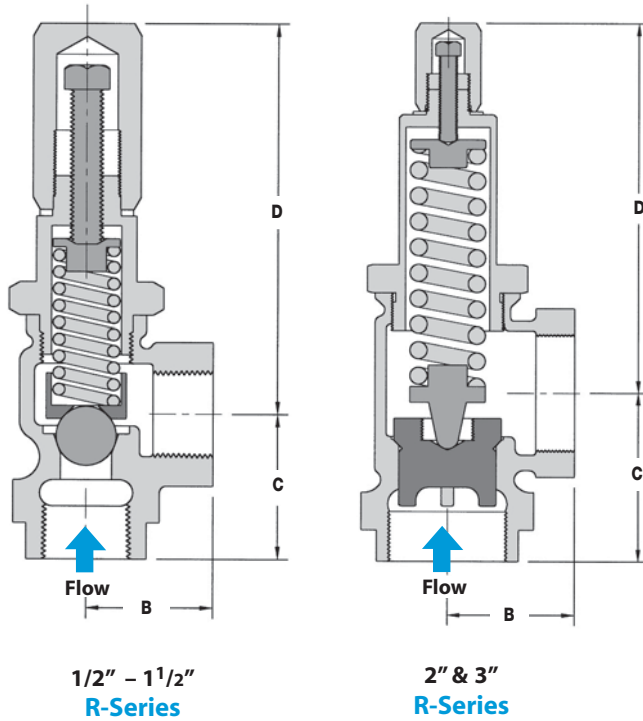
1/2" – 1"  
**10691-Series**

**Model 10691** has a Soft Disc which allows for Class VI bubble tight shut-off

### Pressure Adjustments

To adjust set pressure of valve, remove top cap, loosen lock nut and adjust pressure by rotating adjustment screw. Rotating the screw clockwise increases the compression on the spring thereby increasing the set pressure. Rotating the screw counter-clockwise lowers the set pressure. Tighten the lock nut and replace top cap and gasket.





DIMENSIONS & WEIGHTS – inches				
Size	B	C	D	Weight (lbs)
1/2"	1 1/8	1 1/2	3 5/8	1.5
3/4"	1 3/8	1 3/4	5 1/2	2
1"	1 5/8	2 1/4	6	3
1 1/4"	1 7/8	2 1/2	5 9/16	6
1 1/2"	2 3/16	2 3/4	6 5/8	8
2"	2 1/2	3 5/16	7 3/8	10
3"	3 1/2	4 3/4	9 7/8	25

Note: Model 10691 available only in sizes 1/2" thru 1".

**Spring Selection Table**

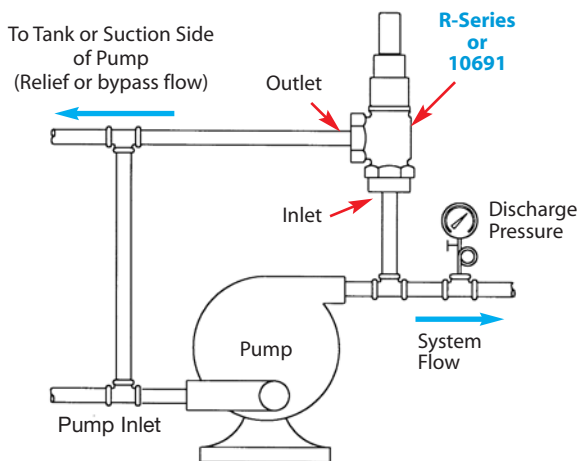
Relief Pressure (PSI)	Spring #	Spring Color
1 - 6	#4*	yellow
5 - 35	#3	silver
25 - 100	#2	blue
75 - 300	#1	red

\* 1/2" – 1 1/2" R-Series type only.  
Not available on 2" & 3" models.

**PRESSURE**  
**Regulators**

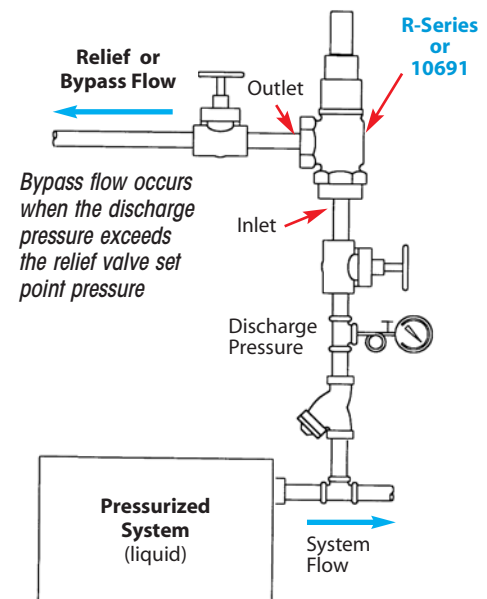
**How it Works**

The Relief Valve is actuated by the system pressure on the inlet side of the valve. Valve loading is provided by a spring. The adjustment is done by removing the cap and rotating the screw clockwise or counter-clockwise. Spring load balances against the opening force of the upstream (or relief) pressure. Valve will open at the slightest increase in pressure above the spring set point, and will close when the excess pressure has been relieved. The higher the system pressure is above the relief set point pressure, the more flow the valve will pass. It is therefore typical to specify the maximum capacity of a back pressure relief valve at 10% and 20% over set pressure.



A Relief Valve allows water to recirculate through the pump even when the discharge valve on the pump is completely closed. As a rule, a minimum of 20% of the pump capacity must recirculate to prevent overheating of the pumped liquid.

**Protection Against Over-pressure Condition**



# Regulators

## Relief & Back Pressure Valves

# R & 10691 Series

### Water, Oil & Other Liquids

#### Options & Notes:

##### Factory Setting of Relief Pressure Option:

Specify Set-Pressure when ordering. Add desired factory set pressure to the end of the model code. See Example below:

##### R-Series Example Model Code with Set-Pressure Option:

**R-12-N-2**, Set at 50 PSIG

(R Series, 1/2" NPT, 25-100 PSIG Spring Range, with a Factory Set Relief Pressure of 50 PSIG)

##### 10691 Example Model Code with Set-Pressure Option:

**10691-14-N-2-E**, Set at 75 PSIG

(10691 Series, 1" NPT, 25-100 PSIG Spring Range, EPDM disc, with a Factory Set Relief Pressure of 75 PSIG)

##### 10691-Series

Disc Material: standard in EPDM (Suffix Code E)

Also available in: Teflon (Suffix Code T)  
& Viton (Suffix Code V)

Size/ Connection NPT	Model Code R-Series	Model Code 10691 Series EPDM Disc	Relief Pressure Range (PSI)	Weight lbs
1/2"	R-12-N-4	NA	1-6	1.5
	R-12-N-3	10691-12-N-3-E	5-35	1.5
	R-12-N-2	10691-12-N-2-E	25-100	1.5
	R-12-N-1	10691-12-N-1-E	75-300	1.5
3/4"	R-13-N-4	NA	1-6	2.5
	R-13-N-3	10691-13-N-3-E	5-35	2.5
	R-13-N-2	10691-13-N-2-E	25-100	2.5
	R-13-N-1	10691-13-N-1-E	75-300	2.5
1"	R-14-N-4	NA	1-6	3.3
	R-14-N-3	10691-14-N-3-E	5-35	3.3
	R-14-N-2	10691-14-N-2-E	25-100	3.3
	R-14-N-1	10691-14-N-1-E	75-300	3.3
1 1/4"	R-15-N-4		1-6	4.5
	R-15-N-3		5-35	4.5
	R-15-N-2		25-100	4.5
	R-15-N-1		75-300	4.5
1 1/2"	R-16-N-4		1-6	6.3
	R-16-N-3		5-35	6.3
	R-16-N-2		25-100	6.3
	R-16-N-1		75-300	6.3
2"	R-17-N-3		5-35	10.3
	R-17-N-2		25-100	10.3
	R-17-N-1		75-300	10.3
3"	R-19-N-3		5-35	25.0
	R-19-N-2		25-100	25.0
	R-19-N-1		75-300	25.0

The Relief Valve remains closed until the **Set-Pressure** is reached. When the Set-Pressure is met or exceeded, the spring will compress, allowing the valve to open and flow to occur. It is standard practice to publish flow values at 10% and 20% over the **Set-Pressure**.

**Example: A 1" valve set at 50 PSIG will pass 3.1 GPM if the system pressure exceeds the set point by 20%.**

The **R Series & 10691** Relief Valve water capacities at inlet pressures of 10% and 20% over **Set-Pressure**:

CAPACITIES – Water (GPM)								
At 10% Over Set Pressure								
Spring Range	Set Pressure (PSIG)	1/2" (PSIG)	3/4"	1"	1 1/4"	1 1/2"	2"	3"
1-6	3	1.2	2.2	3.2	4.3	5.4	-	-
5-35	10	0.3	0.4	0.4	0.5	0.5	0.6	0.7
5-35	20	0.6	0.7	0.8	1.0	1.1	1.3	1.6
25-100	50	1.0	1.3	1.6	1.8	2.2	2.6	3.2
25-100	75	1.4	1.9	2.3	2.8	3.4	4.0	5.0
75-300	100	1.9	2.5	3.2	3.8	4.6	5.4	6.9
75-300	200	3.4	4.4	5.8	6.9	8.2	9.7	12.3
At 20% Over Set Pressure								
1-6	3	2.2	3.4	4.6	5.8	7.1	-	-
5-35	10	0.6	0.8	1.1	1.3	1.4	1.8	2.2
5-35	20	1.4	1.9	2.4	3.0	3.4	4.1	4.8
25-100	50	1.8	2.0	3.1	3.8	4.4	5.4	6.4
25-100	75	2.3	3.2	4.0	4.8	5.6	6.9	8.1
75-300	100	3.6	4.2	5.0	6.3	7.0	7.3	8.9
75-300	200	6.5	7.6	9.0	11.2	12.4	13.1	16.0

# Regulators

## Relief & Back Pressure Valves

# 3040 Series

Water, Air, Oil & Other Liquids

Model	<b>3040 Series</b>
Service	<b>Water, Oil, other Liquids, Air</b>
Sizes	<b>1/2", 3/4", 1", 1 1/4", 1 1/2", 2"</b>
Connections	<b>NPT, 125# FLG, 250# FLG</b>
Body Material	<ul style="list-style-type: none"> <li>• 1/2" - 1 1/2" NPT, SS Body, Bronze Diaphragm Chamber</li> <li>• 2" NPT, Cast Iron Body</li> <li>• 2" FLG, Cast Iron Body</li> </ul>
Seat Material	<b>Stainless Steel</b>
Disc Material	<b>Viton - 300°F max</b>
Diaphragm	<b>Viton - 300°F max</b>
<b>Max Inlet Pressure</b>	<b>250 PSIG</b>

### Design Pressure/Temperature Rating – PMA/TMA

NPT	300 PSIG	@ 200°F
125# FLG	125 PSIG	@ 200°F
250# FLG	250 PSIG	@ 200°F

### Typical Applications

The **3040 Series** Back Pressure Valves relieve upstream pressure in a variety of processes. Automatically maintains desired maximum pressure in a vessel or system by relieving excess pressure into lower pressure return line or to atmosphere. Ideally suited for use as pump bypass control valve by maintaining constant pump discharge pressures. Used as a continuously operating valve or for intermittent protection against over-pressure conditions.

### Features & Options

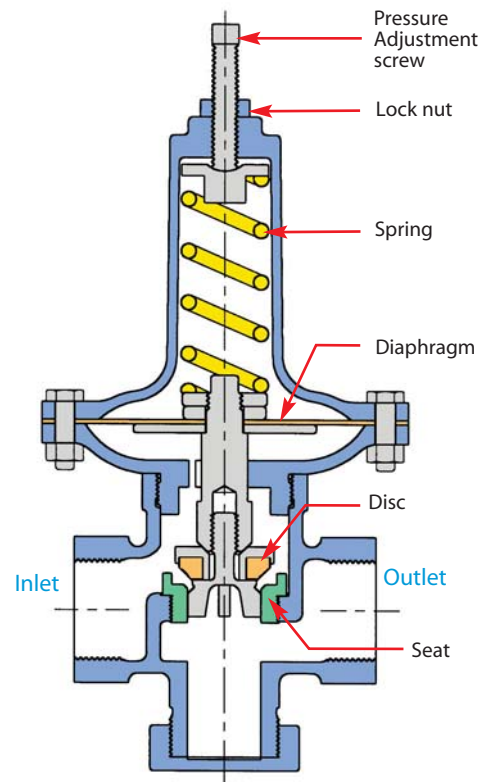
- Fast response
- Viton Trim for 300°F service
- Soft "Seat" for tight shut-off

### Pressure Adjustments

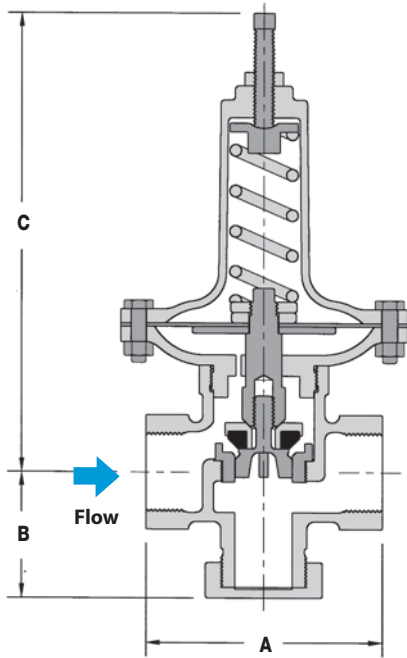
Rotating the adjustment screw clockwise increases the compression on the spring, thereby increasing the set-pressure. Rotating the adjustment screw counter-clockwise lowers the set-pressure. Tighten the locknut after adjustment.



PRESSURE  
Regulators



Water, Air, Oil & Other Liquids

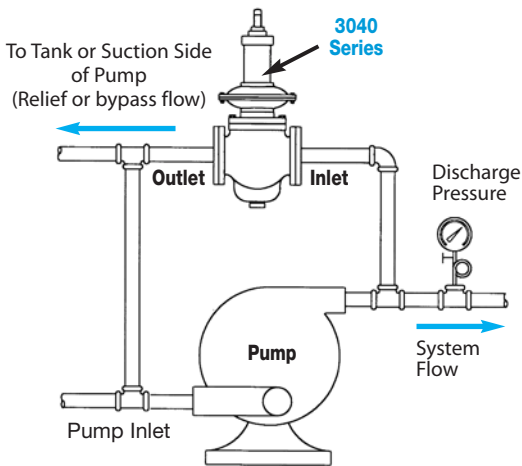


Size Threaded	Face-to-Face A			B	C
	NPT Flanged	125# Flanged	250#		
1/2"	4 1/8	—	—	2 5/16	9
3/4"	4 1/8	—	—	2 5/16	9
1"	4 1/8	—	—	2 5/16	9
1 1/4"	4 13/16	—	—	3 1/4	12 3/4
1 1/2"	5 3/16	—	—	3 1/2	13 1/4
2"	9 1/2	10 3/8	10 7/8	5 1/2	16 3/4

How it Works

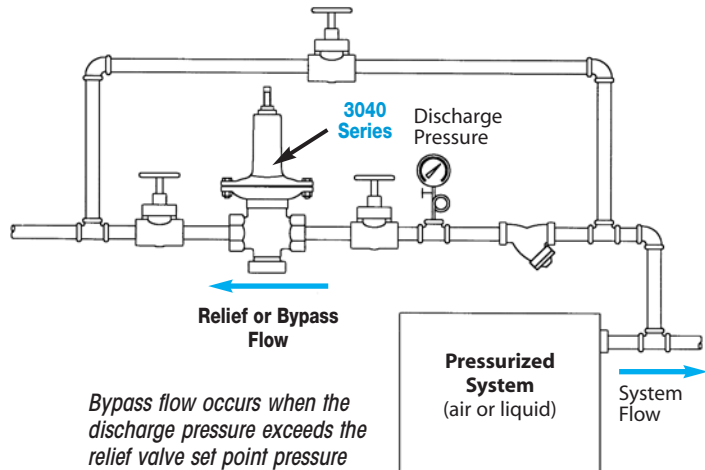
The 3040 Series Back Pressure Valve senses upstream pressure acting on the underside of the diaphragm through a port in the bottom diaphragm case. An increase in the upstream pressure above the set point will compress the spring and allow the valve to open. The spring will close the valve as the upstream pressure decreases to the set-point.

The higher the system pressurizes above the relief set-point pressure, the more flow the valve will pass. It is therefore typical to specify the maximum capacity of a back pressure relief valve at 10% & 20% over set-pressure.



A Relief Valve allows water to recirculate through the pump even when the discharge valve on the pump is completely closed. As a rule, a minimum of 20% of the pump capacity must recirculate to prevent overheating of the pumped liquid.

Protection Against Over-Pressure Condition



Bypass flow occurs when the discharge pressure exceeds the relief valve set point pressure

Water, Air, Oil & Other Liquids

3040 Series Spring Selection Table

Relief Pressure (PSI)	Spring #	Code = X
1 - 12	#4	4
5 - 35	#3	3
20 - 70	#2	2
40 - 125	#1	1

Note: Relief Pressure 1-12 PSI (Code 4) available in 1/2", 3/4", and 1" sizes only.

Size/Connection	Model Code *	Body Material	Weight lbs
<b>Viton Diaphragm &amp; Disc (300°F Max)</b>			
1/2" NPT	3040-12-N-X-V	Bronze	8
3/4" NPT	3040-13-N-X-V	Bronze	8
1" NPT	3040-14-N-X-V	Bronze	9
1 1/4" NPT	3040-15-N-X-V	Bronze	15
1 1/2" NPT	3040-16-N-X-V	Bronze	16
2" NPT	3040-17-N-X-V	Cast Iron	48
2" 125# FLG	3040-17-F125-X-V	Cast Iron	53
2" 250# FLG	3040-17-F250-X-V	Cast Iron	56

X=Spring Code. (reference Spring Selection Table)

Example Model Code:

1) **3040-15-N-3-V**  
(3040 Series, 1 1/4" NPT, 5-35 PSIG Relief Pressure)

PRESSURE Regulators

**Note:** The Relief Valve remains closed until the **Set-Pressure** is reached. When the Set-Pressure is met or exceeded, the spring will compress, allowing the valve to open and flow to occur. It is standard practice to publish flow values at 10% and 20% over the **Set-Pressure**.

**Example:** A 1" valve set at 50 PSIG will pass 35.6 GPM of water or 409 SCFM of air if the system pressure exceeds the set-point by 20%.

The 3040 Series Relief Valve water and air capacities at inlet pressures of 10% and 20% over **Set-Pressure**:

CAPACITIES – Water (GPM)							
At 10% Over Set Pressure							
Spring Range (PSIG)	Set Pressure (PSIG)	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
1-12	5	4.0	8.0	10.0	–	–	–
5-35	10	5.7	11.4	14.3	29	43	71
5-35	20	8.1	16.2	20.3	41	61	101
20-70	50	12.7	25.4	31.8	64	95	159
40-125	75	15.6	31.2	39.0	78	117	195
40-125	100	18.0	36.0	45.0	90	135	225
40-125	125	20	40	50	100	150	250
At 20% Over Set Pressure							
1-12	5	4.4	8.8	11.2	–	–	–
5-35	10	6.3	12.5	16.0	32	47	79
5-35	20	8.9	17.8	22.7	45	67	113
20-70	50	14.0	27.0	35.6	71	105	177
40-125	75	17.2	34.3	43.7	87	129	217
40-125	100	19.8	39.6	50.4	101	149	250
40-125	125	22	44	56	112	166	278

CAPACITIES – Air (SCFM)						
At 10% Over Set Pressure						
1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	
31	55	111	–	–	–	
39	70	141	203	297	422	
56	100	201	290	424	603	
106	191	381	551	805	1144	
148	266	532	768	1123	1596	
190	341	682	986	1441	2047	
231	416	833	1203	1758	2499	
At 20% Over Set Pressure						
32	57	113	–	–	–	
41	73	146	211	308	438	
59	106	212	306	447	635	
114	204	409	591	863	1226	
159	287	573	828	1210	1719	
205	369	737	1065	1556	2212	
250	451	901	1302	1903	2704	





# Direct-Operated Regulators Temperature Regulators



TEMPERATURE  
Regulators



**W91 • Non-Indicating**  
**W94 • Indicating - Dial Thermometer**

For **Heating** with Steam  
for **Cooling** with Water  
**Mixing/Diverting** for Liquids

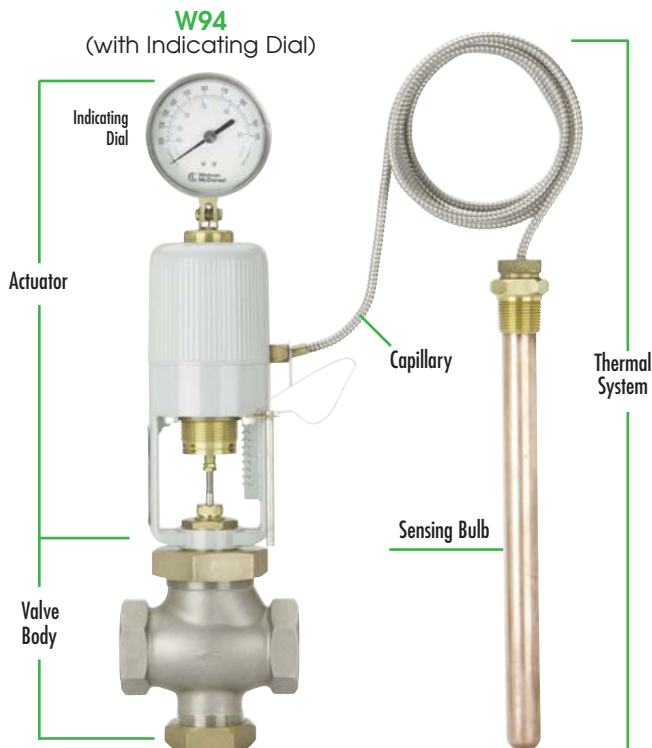
**Description & Selection**

The **W91/W94** Self-Operating Temperature Regulator is a mechanically operated device designed to regulate system temperature by modulating the flow of a heating or cooling fluid in response to temperature changes; requires no external power source. They are recommended for controlling temperature on relatively stable systems, where small valve stroke modulations will correct temperature drift. Where sudden or large load changes, or rapid temperature changes occur, a pneumatically-actuated Control Valve should be considered. Please consult the Control Valve Section of this catalog.

**Principle of Operation**

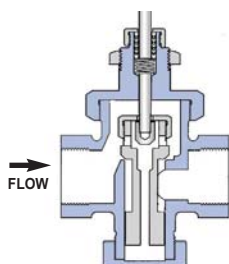
The **W91/W94** Temperature Regulator is a fully self-contained unit requiring no external power source (i.e., compressed air or electricity). Regulation takes place when the sensing element (bulb) of the thermal system is exposed to changes in temperature. The thermal system is charged with a predetermined amount of vapor fill, which, when heated, will cause the bellows within the unit's actuator housing to expand.

The valve action is either **In-To-Close for Heating** or **In-To-Open for Cooling**.



TEMPERATURE Regulators

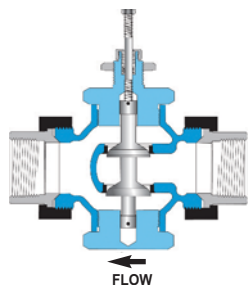
**HEATING**  
Normally Open  
(in-to-close)



**Normally Open Valves** are used for **HEATING**, so the valve stem closes (**in-to-close**) as the control signal (temperature) increases.

**Single-Seated Balanced Valves** are used for Heating Applications (normally steam) where tighter shut-off is required. Leakage rate is approximately 0.01% of the maximum capacity (Class IV shut-off).

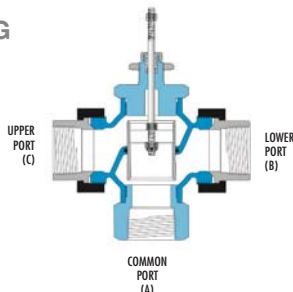
**COOLING**  
Normally Closed  
(in-to-open)



**Normally Closed Valves** are used for **COOLING**, so the valve stem opens (**in-to-open**) as the control signal (temperature) increases.

**Double-Seated Balanced Valves** are used for Cooling Applications where larger flow rates of water are frequently required, and a small leakage rate through the valve is normally acceptable. Leakage rate can be up to 0.5% of the maximum valve capacity (Class II shut-off).

**MIXING & DIVERTING**  
3-Way Valves

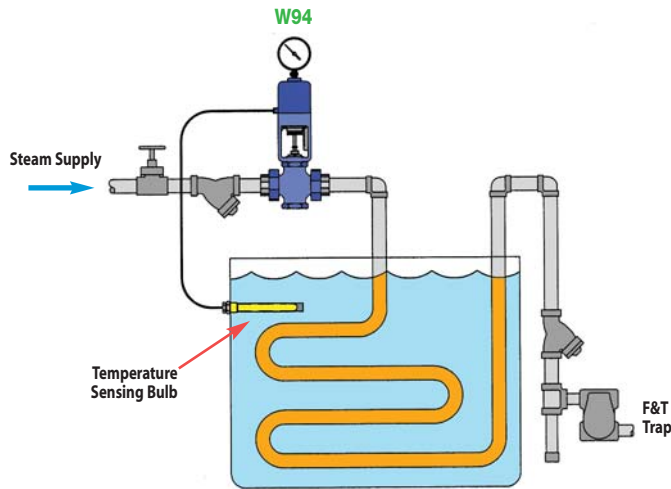


**3-Way Valves** are used for mixing two flows together, or for diverting a flow to or around a device (bypass). In order to produce consistent flow quantity for stable operation, the pressure drop across both flow paths (inlet to outlet) must be nearly equal. The Sleeve-Type (common port on the bottom) is most commonly used for diverting applications; however, due to its design, it can also be used for mixing applications (NOT for steam use). It is also suitable for water or glycol type service, up to a maximum temperature 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.

## Introduction

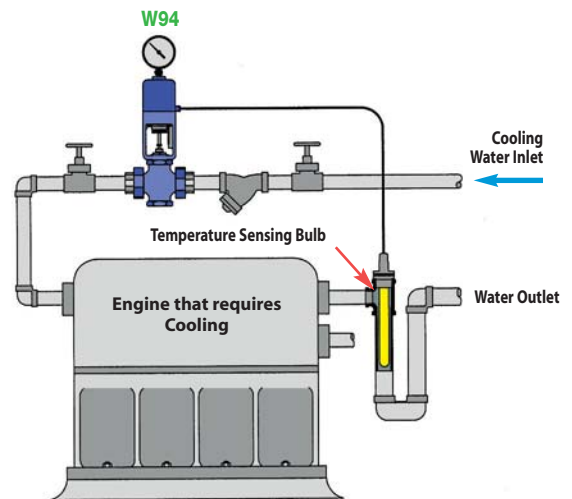
### HEATING

**Regulating Temperature of a Plating or Finishing Tank**  
 Valve Body determines the action of the Regulator  
 For Heating: use **Normally Open Valve Body (in-to-close)**



### COOLING

**Using Water to Cool Engine**  
 Valve Body determines the action of the Regulator  
 For Cooling: use **Normally Closed Valve Body (in-to-open)**



TEMPERATURE  
Regulators

## Components of a Self-Operated Temperature Regulator



**Model W91 Actuator** is Non-indicating (without temperature indicating dial).



**Model W94 Actuator** is equipped with an integral dial thermometer to indicate sensing bulb temperature. The W94 displays the temperature at the sensing bulb. This allows for easy adjustment of the temperature set-point, as well as continuous monitoring of the application, without the installation of an additional thermometer.

The thermometer has a 3 1/2" diameter dial face and can be rotated and tilted for maximum readability.

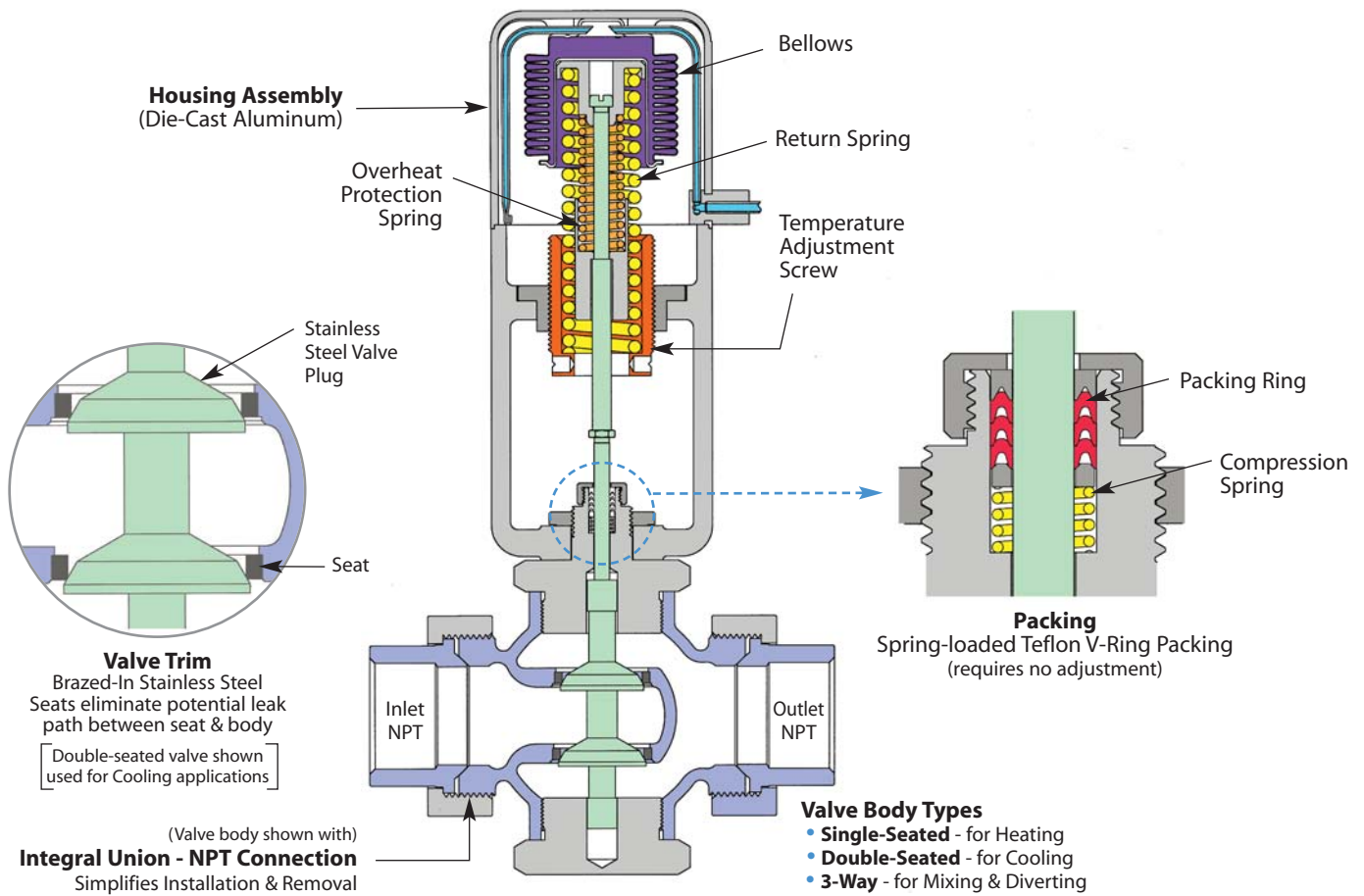
The **Sensing Bulb and Capillary** are available in either Copper (for best heat transfer) or Stainless Steel (for corrosive applications). The capillary tubing is protected by stainless steel flexible armor to resist damage during handling and installation. The sensing bulb is also available with an optional Teflon or Kynar coating; used for special corrosive applications such as plating tanks where stainless steel may not be acceptable.

Capillary lengths up to 24 feet are considered standard; non-standard lengths up to 52 feet are available. Longer capillary lengths require longer bulb length to contain the additional actuating fluid required (see selection chart).



### Valve Body

Single-seated balanced valves are used on heating applications (most commonly steam) where tight shut-off is required. Double-seated valves are used on cooling applications because of the high flow rates often required. The balanced double-seated design also allows the temperature actuator to operate with higher differential pressures than would be possible using single-seated non-balanced valves. 3-way valves are used for mixing and diverting applications.



TEMPERATURE  
Regulators

**Actuator Housing Assembly**

The housing consists of a cap and yoke constructed from precision die cast aluminum. This assembly ensures permanent alignment with the valve body, while protecting the bellows assembly. The yoke includes a set-point scale used to reference the setting of the temperature adjustment screw. The entire housing is finished in a corrosion resistant, baked grey epoxy.

**Actuator Bellows & Spring Return Assembly**

The accordion type bellows is corrosion resistant to provide accurate response for the life of the regulator. An adjusting bar is provided to turn the brass temperature adjustment screw, which compresses or expands the range adjustment spring, thereby setting the control-point of the unit.

**Valve Body & Connection Type**

W91/W94 Temperature Regulators available with NPT connection, Integral Union (with NPT connection) and Flanged.

**Valve Trim**

Valve Trim is composed of the plug and seat(s). Single and double-seated valves employ a stainless steel, tapered plug for enhanced modulation. The valve plug is both top and bottom guided to ensure positive seating alignment. 3-Way valves use a stainless steel sleeve and brass seating surface to change flow direction within the body.

**Packing**

Valves feature a self-energizing (spring-loaded) Teflon V-Ring packing, which reduces leakage around the valve stem. V-Ring packing is spring loaded to maintain proper compression and does not require manual adjustment.



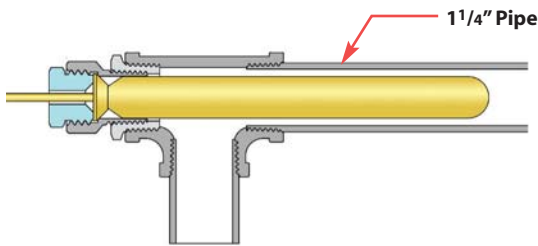
## Introduction • Design & Operation Sensing Bulb & Thermowells

### Sensing Bulb

#### Sensing Bulb Installation

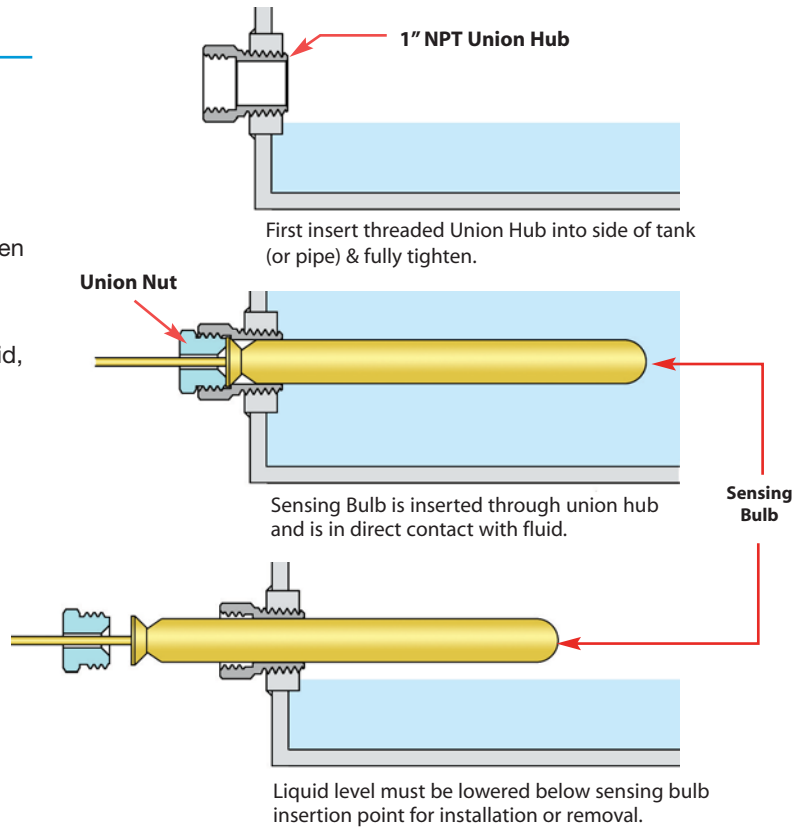
Care must be taken to ensure that the entire length of the sensing bulb is immersed into the medium at the sensing location. Partial immersion of sensing bulb in the process fluid can result in faulty control.

The sensing bulb is designed to be installed in either a horizontal or vertical orientation (with the tip down). If the tip must be installed upwards, please specify when ordering, as a special bulb construction is required. The sensing bulb material is available in either copper (best heat transfer) or stainless steel (corrosion resistant) and must be compatible with the process fluid, or an optional thermowell can be used for complete isolation of the sensing bulb from the process fluid.



#### Installed in Pipe Line:

Drawing shows Sensing Bulb installed in a 1" NPT pipe fitting. 1 1/4" is minimum pipe size for adequate clearance around sensing bulb.



TEMPERATURE  
Regulators

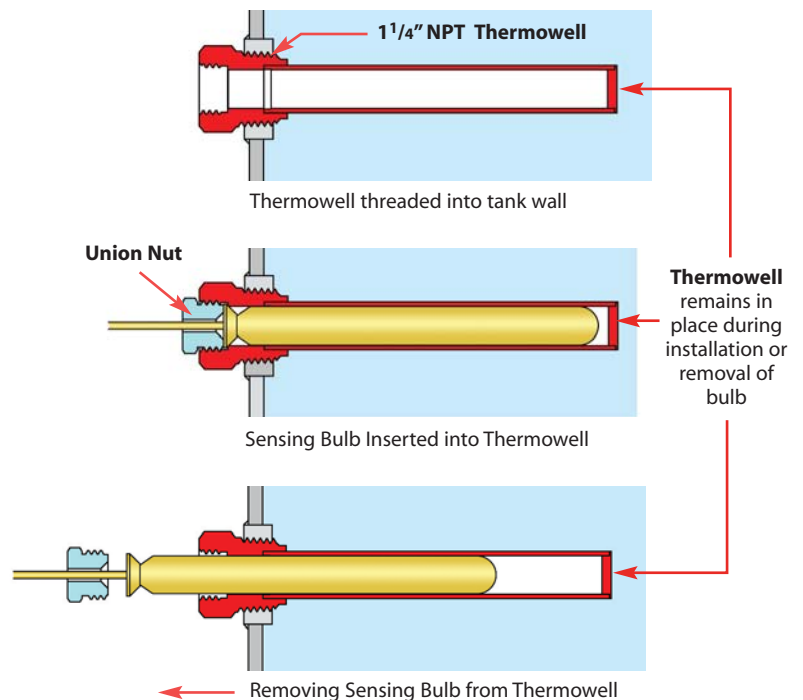
### Sensing Bulb with Thermowell

#### Thermowell (isolates sensing bulb from process fluid)

Thermowells isolate the sensing bulb from the process fluid. For applications in which the process media may be corrosive or contained under excessive pressure, the use of a thermowell is required to prevent damage to the sensing bulb. A thermowell also allows the removal of the sensing bulb without having to drain liquid from the system. Thermowells are available in either brass (best heat transfer) or stainless steel (for corrosive applications). The 1 1/4" NPT hub of the thermowell can be installed into the side of a tank or female pipe connection, depending on the application. Three different length thermowells are available to match sensing bulb lengths.

To ensure minimum response time, Heat Transfer Paste (supplied with thermowell) should be applied to the sensing bulb prior to installation.

Thermowell remains installed into tank or pipeline; therefore, liquid does not require draining when replacing sensing bulb.



**Typical Applications for Temperature Regulators for Heating & Cooling**

**Temperature Range**

Nominal ranges from 20°F (-10°C) through 440°F (225°C) are available. The nominal range defines the entire temperature range of the unit. The service conditions and choice of valve style and action will determine the actual operating range (recommended working span) of the unit. Using the valve in the recommended working span improves temperature response time of the system. The nominal range should be selected so that the set-point falls within the recommended working span for the specified valve style and action. They include an over-range protection spring, which allows the sensing bulb to be heated 100°F above the upper limit of the unit's nominal range for system cleaning or temporary situations.

**Accuracy**

The W91/W94 Temperature Regulator is a "set-and-forget" regulating device. Once the proper control-point setting has been achieved, the unit requires virtually no adjustments and very little maintenance. Control-point accuracy is dependent upon the sensing bulb location, load change size and speed, and valve size. The sensing bulb must be installed in an area within the process that is most representative of overall process conditions. Care should be taken not to locate the bulb in close proximity to the valve, as the regulator might respond to temperature changes before the process has had time to reach the control-point. Where sudden or large load changes occur, a pneumatically or electrically-powered Control Valve should be specified. Consult the Control Valves section of this catalog.

Valve sizing also plays a major part in regulator performance. A valve that is too small will not be able to provide the desired capacity during peak load conditions, while a valve that is too large may overshoot the control-point and operate with the valve plug too close to the seat, resulting in undue wear of the plug and seat. As part of a well-designed system, a properly sized valve (operating in the 60-90% open position) can control to within 2 to 5 °F.

**Size**

The proper sizing of a regulating valve is one of the most important factors in its selection. A valve that is too small will not be able to provide the desired capacity during peak load conditions, while a valve that is too large may overshoot the control-point and operate with the valve plug too close to the seat, resulting in premature wear of the plug and seat. The valve coefficient (Cv) is used to determine the maximum capacity of a valve. From this value, a valve body with the appropriate port size can be selected. Port sizes from 1/8" through 4" and connection sizes from 1/2" through 4" are available. Consult the Valve Selection section of this catalog.

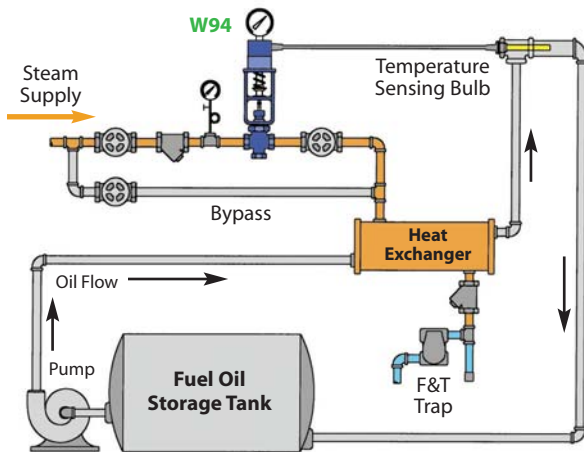
**Close-Off**

Temperature Regulators are not considered shut-off valves. A pressure surge may force a single-seated valve plug open. The W91/W94 Temperature Regulator is a balanced equilibrium system and may not provide the force necessary to tightly seat the valve plug. A separate power-driven or hand-actuated valve is required to ensure tight shut-off when necessary.

TEMPERATURE  
Regulators

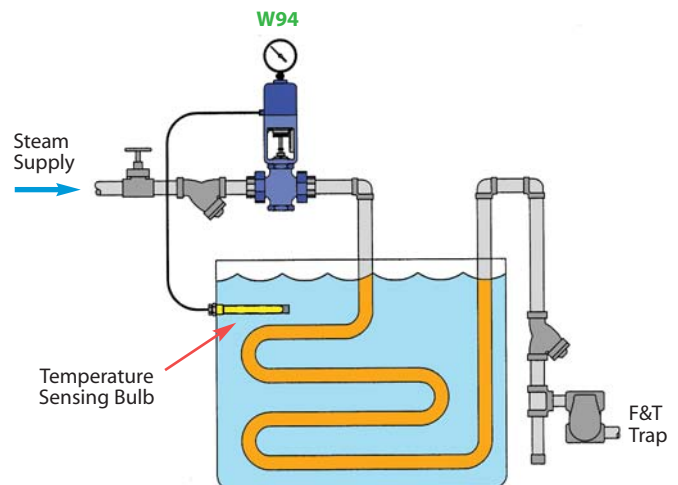
**W94 Heating Fuel Oil to Proper Temperature**

When the Sensing Bulb is mounted remotely from the actual point of heating (as shown) the Circulation Pump MUST continue to run so that the sensing bulb can sample the product temperature in the heat exchanger. Without product circulation, the temperature control valve will never shut off and the oil will be overheated



**W94 Elevating Temperature of a Plating or Finishing Tank**

Sensing bulb should be properly placed inside tank for best temperature consistency. An optional Thermowell (Stainless Steel or Brass) may slightly reduce temperature sensitivity. However, it will isolate sensing bulb and allow for its removal without draining the tank.

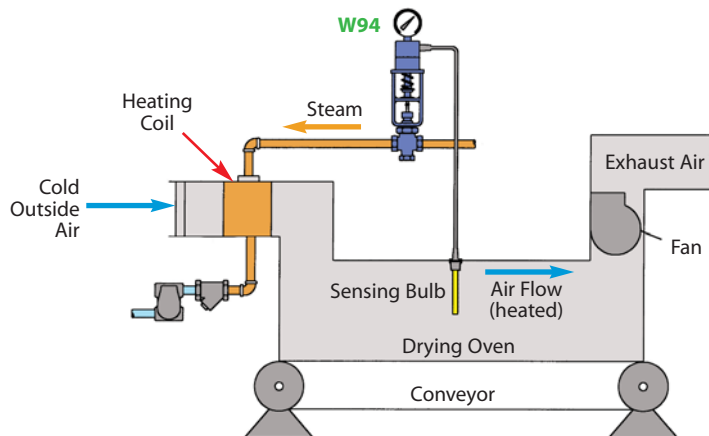


## Introduction

### Typical Applications for Temperature Regulators for Heating & Cooling

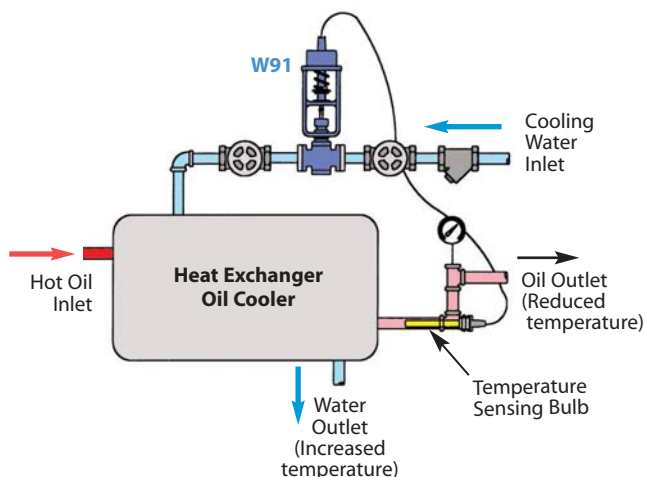
TEMPERATURE Regulators

#### W94 Used in a Drying Oven Application



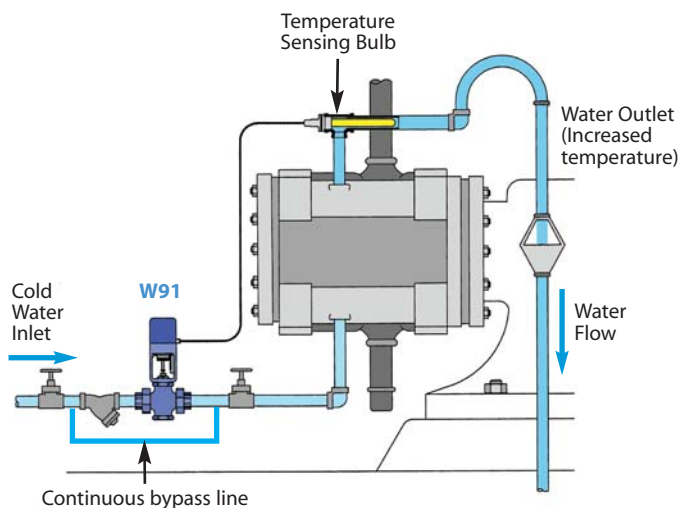
**W94** Valve used to regulate the temperature of the air flow through an air heating duct. The sensing bulb is installed toward the end of the heating duct and will sense the temperature of the air flowing past the heating coils. When air temperature is below the set point, the valve will open to allow more steam through to the coils to heat the air passing through the duct. Once the desired air temperature is achieved, the valve will begin to modulate closed to maintain the air temperature.

#### W91 Used to Reduce Oil Temperature In a Heat Exchanger



**W91** Cooling valve controlling the flow of water through a heat exchanger to maintain the temperature of oil that is gaining heat by some process. The valve automatically shuts off when not required, greatly reducing cooling water usage. The source of the cooling water may be a well or city water supply and it can be circulated or dumped to drain. A 3-way valve may be used on cold water chiller systems so flow can be diverted from going through the heat exchanger when not required.

#### W91 Used to Control Water Flow to Air Compressor for Cooling Purposes



When the Sensing Bulb is mounted remotely from the actual point of Cooling (as shown), the water **MUST** continue to flow so that the sensing bulb can sample the product temperature of the unit being cooled. Without continuous water flow, the temperature control valve will never turn on, causing the unit to overheat. The bypass line provides a minimum continuous flow when temperature set point is achieved and the valve is closed.

# Direct-Operated Regulators Temperature Regulators

# W91/W94 Series

For Heating & Cooling

Model	<b>W91 (No Indicating Dial)</b> <b>W94 (Temperature Indicating Dial)</b>
Service	<b>Water, Steam, Other Liquids</b>
Sizes	<b>1/2" – 4"</b>
Connections	<b>Threaded, Union Ends, 125# FLG</b> <b>250# FLG (optional)</b>
Body Material	<b>1/2" – 1 1/2"</b> Bronze/Stainless Steel <b>2"</b> Cast Iron (Direct-acting) <b>2"</b> Bronze (Reverse-acting) <b>2 1/2" – 4"</b> Cast Iron
Seat Material	<b>Stainless Steel</b>
Max Inlet Pressure	<b>250 PSIG</b>



TEMPERATURE Regulators

## Typical Applications

The **W91** & **W94** Self-Operating Temperature Regulators are the preferred choice of original equipment manufacturers, mechanical contractors and specifying engineers. They require no external power source and are ideal for regulating the temperature of tanks, process streams and various types of industrial equipment. The Actuator is noted for its rugged die-cast aluminum housing, fully-enclosed bellows assembly and internal over-temperature range protection.

### Model W91

**Non-Indicating** (without indicating dial) features a lower profile and should be specified where space constraints may be an issue.

### Model W94

**Temperature Indicating** (with indicating dial) will allow the operator to verify the process temperature and to aid in temperature adjustment.

## Features

- Self-Operating (no external power source required)
- Temperature Indicating & Non-Indicating models available
- Heavy Duty Die-Cast Aluminum Housing
- 1/2" thru 4" Valve Sizes
- Fully Enclosed Bellows
- Temperature Over-range protection spring to protect thermal system

## Specifications

<b>Dial Thermometer:</b>	3 1/2" dial, stainless steel case, swivel and angle adjustment (Model W94 only)
<b>Housing:</b>	Die-cast aluminum, epoxy powder coated grey finish
<b>Bellows:</b>	High-pressure brass, corrosion resistant, tin plated finish
<b>Temperature Over-range Protection:</b>	Protects Thermal System from damage up to 100°F over high limit of range

## Temperature Regulator Valve Action

Application	Stem Action	Normal (Fail) Position
Heating	In-To-Close	Normally Open
Cooling	In-To-Open	Normally Closed

## How to write proper model number:

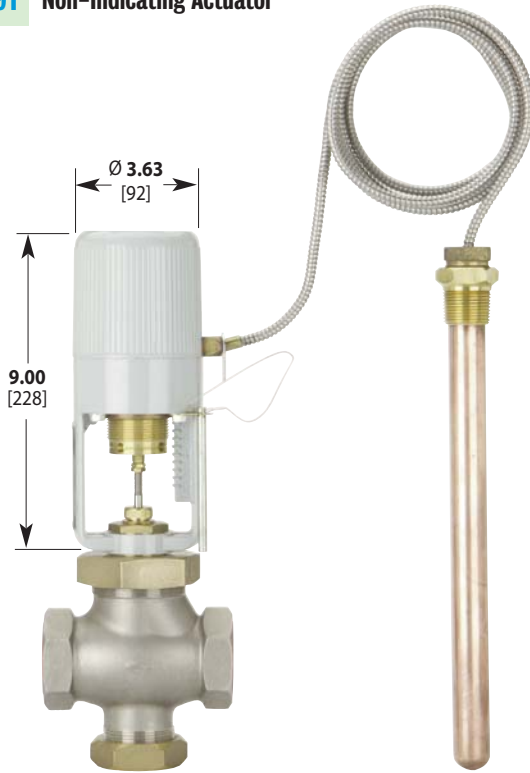
<b>Explanation of Model Number:</b>	<b>W91</b> Model	<b>06</b> Temp. Range	<b>08</b> Cap. Length	<b>S15</b> Bulb Type	<b>H13N</b> Valve Body
<b>Model Number:</b>	<b>W91-06-08-S15-H13N</b>				

## Model Code Configuration

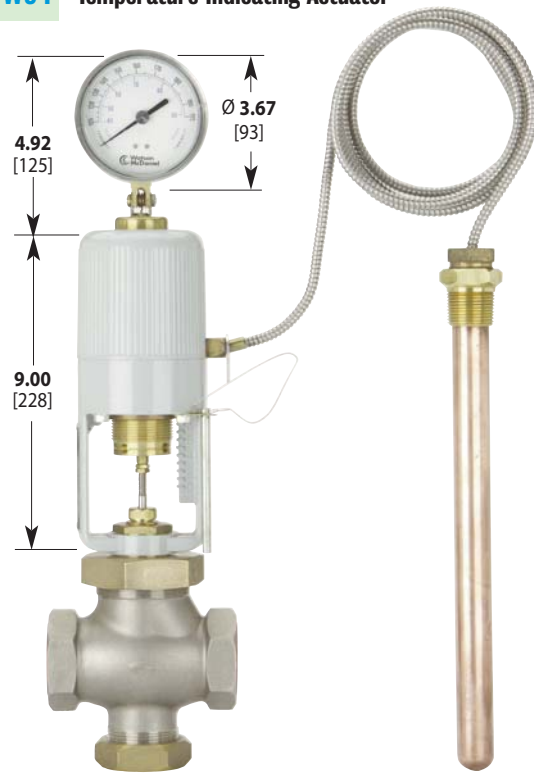
Models	Temperature Range	Capillary Length	Sensing Bulb	Valve Body Selection
<b>W91</b> Non-Indicating	<b>01 – 14</b> Refer to Temperature Range Chart	<b>08</b> 8 Feet (standard)	<b>S15</b> Brass bulb (standard)	Refer to Valve Body Section <i>(Omit this selection if purchasing Actuator only)</i>
<b>W94</b> Indicating Dial		<b>12</b> 12 Feet		
		<b>16</b> 16 Feet	<b>S16</b> Stainless bulb	
		<b>20</b> 20 Feet		
		<b>24</b> 24 Feet		

Note: Thermowells are ordered separately. See Thermowell & Bulb Connections page.

**W91** Non-Indicating Actuator



**W94** Temperature Indicating Actuator



Dimensions: inches [mm]  
Actuator Weight: 6 lbs.

TEMPERATURE  
Regulators

**Description of Working Span**

The recommended working span typically falls within the upper third of the nominal range. Single-Seat In-To-Close, all Double-Seat, and all 3-Way valves have a recommended working span in this part of the nominal range. Using the valve in the recommended working span improves temperature response time of the system.

**Temperature Range Chart**

W91 & W94 Actuators				
Range Code	Nominal Range		Recommended Working Span *	
01	20 to 70 °F	-10 to 20 °C	40 to 65 °F	5 to 20 °C
02	40 to 90 °F	5 to 30 °C	65 to 85 °F	20 to 30 °C
03	30 to 115 °F	0 to 45 °C	85 to 110 °F	30 to 45 °C
04	50 to 140 °F	10 to 60 °C	110 to 135 °F	45 to 60 °C
05	75 to 165 °F	25 to 70 °C	135 to 160 °F	60 to 70 °C
06	105 to 195 °F	40 to 90 °C	160 to 190 °F	70 to 90 °C
07	125 to 215 °F	55 to 100 °C	190 to 210 °F	90 to 100 °C
09	155 to 250 °F	70 to 120 °C	210 to 245 °F	100 to 120 °C
10	200 to 280 °F	95 to 135 °C	245 to 275 °F	120 to 135 °C
11	225 to 315 °F	110 to 155 °C	275 to 310 °F	135 to 155 °C
12	255 to 370 °F	125 to 185 °C	305 to 365 °F	155 to 185 °C
13	295 to 420 °F	145 to 215 °C	365 to 415 °F	185 to 215 °C
14	310 to 440 °F	155 to 225 °C	415 to 435 °F	215 to 225 °C

\*Note: The recommended working span typically falls within the upper third of the nominal range.

**SENSING BULB & CAPILLARY Selection**

**Sensing Bulb Selection & Installation:**

The sensing bulb and capillary are available in Copper (best heat transfer properties) or Stainless Steel (for corrosive applications). Copper has better heat transfer properties than stainless steel and should always be chosen for better temperature control unless used in corrosive service. The length of the sensing bulb is dependent upon the capillary length required (see chart). Longer capillary lengths require a longer length sensing bulb to operate the regulator. For installation, the Union Hub is threaded into a tank or piping system. The bulb slides through the Union Hub and is held in place by the Union Nut which spins freely around the armored capillary and threads into the Union Hub. The angled surface of the sensing bulb forms a metal-to-metal seal on the inner edge of the Union Hub to prevent leakage of the process fluid.

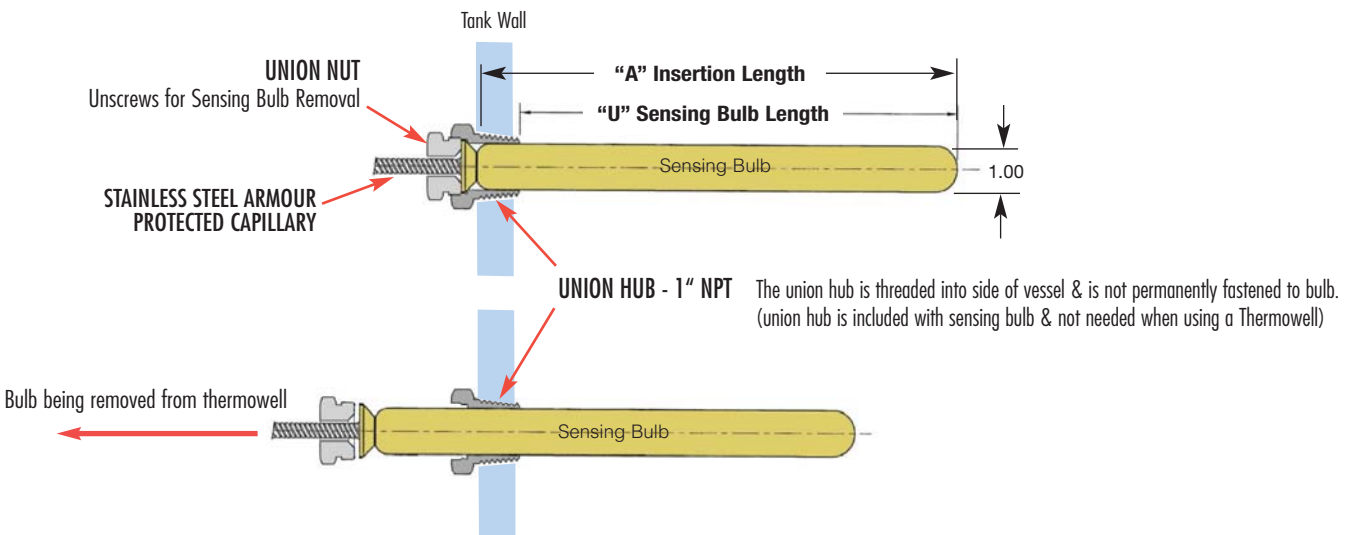
**Thermowell Option (ordered separately)**

A thermowell isolates the sensing bulb from the process fluid. It can be used to remove the sensing bulb while the system is filled with fluid or to protect the sensing bulb from corrosive liquids or excessive system pressures (see following page).

TEMPERATURE Regulators

Sensing Bulb & Capillary						
ORDER CODE	Sensing Bulb Material	Capillary Tubing Material	Capillary Length in Ft.			
			8, 12, 16	20	24	
S15	Copper (Brass Union Hub)	Copper with Stainless Steel Spiral Armour	A	13"	16"	20"
			U	12.25"	15.25"	19.25"
S16	Stainless Steel (Stainless Steel Union Hub)	Stainless Steel with Stainless Steel Spiral Armour	A	13"	16"	20"
			U	12.25"	15.25"	19.25"

Other Options available. Consult Factory.





**SENSING BULB inside OPTIONAL THERMOWELL**

**Thermowell Option (ordered separately)**

Thermowells isolate and protect the sensing bulb from the process fluid, and are available in either Brass (best heat transfer) or Stainless Steel (for corrosive applications). Thermowells allow for sensing bulb removal and replacement without having to drain liquid from the system. To maintain the best temperature control, always use a Copper Sensing bulb as opposed to a Stainless Steel sensing bulb. For corrosive applications, Stainless Steel thermowells (with a copper sensing bulb) can be used. Thermowells are also recommended for applications with excessive system pressures or extremely turbulent flow to protect the sensing bulb from damage.

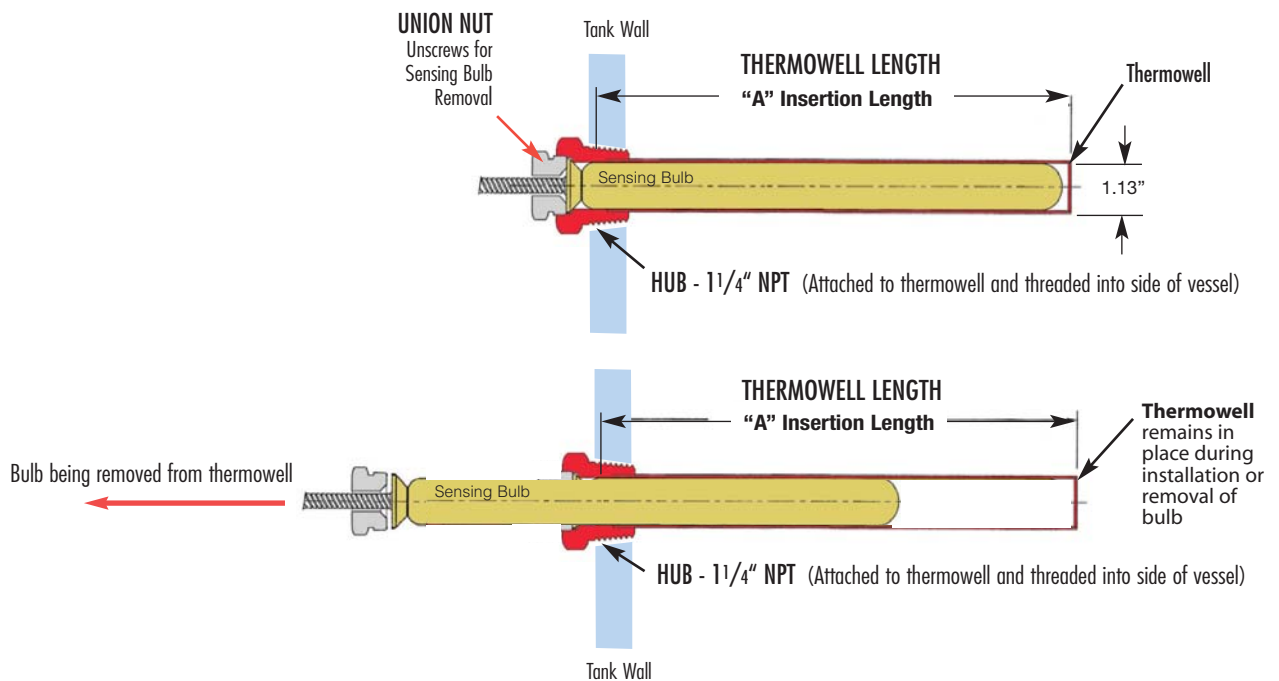
Thermowell Length must be selected based on the length of the sensing bulb. The sensing bulb length is based on the length of the Capillary used in the Thermal System. Longer capillary lengths require a longer sensing bulb to hold the additional actuator fluid inside the sensing bulb. Reference Sensing Bulb Chart for sensing bulb length.

**THERMOWELLS - Model Numbers & Lengths**

Brass Model Code	Stainless Steel Model Code	Nominal Length	"A" INSERTION LENGTH (in.)		Capillary Length (Ft.)
			BULB	THERMOWELL	
536-S2	536-S6	13"	12.25	13.00	8, 12 or 16
536-SE2	536-SE6	16"	15.25	16.00	20
536-WE2	536-WE6	20"	19.25	24	

- Notes:
- 1) Other connections and lengths may be available, consult factory.
  - 2) External pressure rating on Copper is 500 PSI max.
  - 3) External pressure rating on 316 SS is 1000 PSI max.

The Thermowell isolates the sensing bulb from the process liquid and allows for easy and safe removal of the sensing bulb. For applications in which the process media may be corrosive or contained under pressure, the use of a thermowell is required to prevent damage to the sensing bulb. For corrosive applications, use a stainless steel thermowell & copper sensing bulb. To ensure minimum response time, Heat Transfer Paste should be applied to the sensing bulb prior to installation into the thermowell.



TEMPERATURE Regulators

## HEATING

Model Codes in Chart are for complete Temperature Regulators.  
This includes the Valve Body and Thermal Actuator with standard copper bulb and 8 ft. capillary.



### W91

Non-Indicating Type Actuator  
with valve body

**X** = Temperature Range  
**08** = Capillary Length 8ft.  
**S15** = Copper Bulb

Connection		PMO (PSI)
1/2" NPT	Standard Body	W91-X-08S15-H12N 250
	with Integral Union	W91-X-08S15-H12U 250
3/4" NPT	Standard Body	W91-X-08S15-H13N 250
	with Integral Union	W91-X-08S15-H13U 250
1" NPT	Standard Body	W91-X-08S15-H14N 200
	with Integral Union	W91-X-08S15-H14U 200
1 1/4" NPT	Standard Body	W91-X-08S15-H15N 200
	with Integral Union	W91-X-08S15-H15U 200
1 1/2" NPT	Standard Body	W91-X-08S15-H16N 200
	with Integral Union	W91-X-08S15-H16U 200
2" NPT	Standard Body	W91-X-08S15-H17N 150
2"	*Flanged with Standard Actuator	W91-X-08S15-H17F125 150
2 1/2"		W91-X-08S15-H18F125 65
3"		W91-X-08S15-H19F125 50
4"		W91-X-08S15-H20F125 40
2 1/2"	*Flanged with High-Force Actuator	W91H-X-08S15-H18F125 150
3"		W91H-X-08S15-H19F125 150
4"		W91H-X-08S15-H20F125 150

### W94

Indicating Type Actuator  
with valve body

**X** = Temperature Range  
**08** = Capillary Length 8ft.  
**S15** = Copper Bulb

	PMO (PSI)	Weight (lbs)
W94-X-08S15-H12N	250	21
W94-X-08S15-H12U	250	21
W94-X-08S15-H13N	250	21
W94-X-08S15-H13U	250	21
W94-X-08S15-H14N	200	21
W94-X-08S15-H14U	200	21
W94-X-08S15-H15N	200	24
W94-X-08S15-H15U	200	24
W94-X-08S15-H16N	200	25
W94-X-08S15-H16U	200	25
W94-X-08S15-H17N	150	57
W94-X-08S15-H17F125	150	57
W94-X-08S15-H18F125	65	65
W94-X-08S15-H19F125	50	80
W94-X-08S15-H20F125	40	105
N/A	-	96
N/A	-	118
N/A	-	60

\* 250# Flange available. Consult Factory. The Special High-Force Actuator will allow the valve to be operated at a higher operating pressure.

### Model Configuration Chart

Note: Thermowells for Models W91/W94 are ordered separately.

Models	Temperature Range = X	Capillary Length	Sensing Bulb	Valve Body Selection
W91 Non-Indicating W94 Indicating Dial W91H High-Force	<b>01 - 14</b> (Refer to Temperature Range Chart)	<b>08</b> 8 Feet (std) <b>12</b> 12 Feet <b>16</b> 16 Feet <b>20</b> 20 Feet <b>24</b> 24 Feet	<b>S15</b> Copper Bulb (std) (with Brass Union Hub)  <b>S16</b> Stainless Steel Bulb (with SS Union Hub)	Included in Model Code in above chart.

W91      05 (75 - 165°F)      12      S15      H15N (1 1/4" NPT)

Range Code	Nominal Temperature Range *	
01	20 - 70°F	10 - 20°C
02	40 - 90°F	5 - 30°C
03	30 - 115°F	0 - 45°C
04	50 - 140°F	10 - 60°C
05	75 - 165°F	25 - 70°C
06	105 - 195°F	40 - 90°C
07	125 - 215°F	55 - 100°C
09	155 - 250°F	70 - 120°C
10	200 - 280°F	95 - 135°C
11	225 - 315°F	110 - 155°C
12	255 - 370°F	125 - 185°C
13	295 - 420°F	145 - 215°C
14	310 - 440°F	155 - 225°C

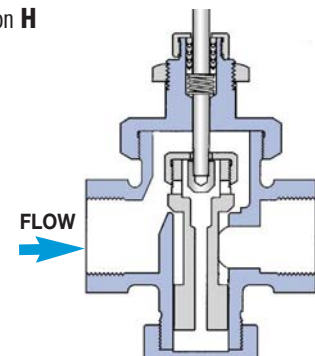
\* The recommended working span falls within the upper third of the nominal range.

Example Model Code configured: **W91-05-12-S15-H15N**

(W91, 75-165 °F Temp. Range, 12 ft. capillary, Std. Copper Sensing Bulb, 1 1/4" NPT Valve Body)

Valve bodies used for HEATING have designation **H**  
(Example: **H15N**)

**Normally Open**  
(IN-TO-CLOSE)  
Single-seated  
Balanced Valve with  
Class IV shut-off



HEATING

# Direct-Operated Regulators Single-Seated Valve Bodies

# W91/W94 Series

for Temperature Regulators

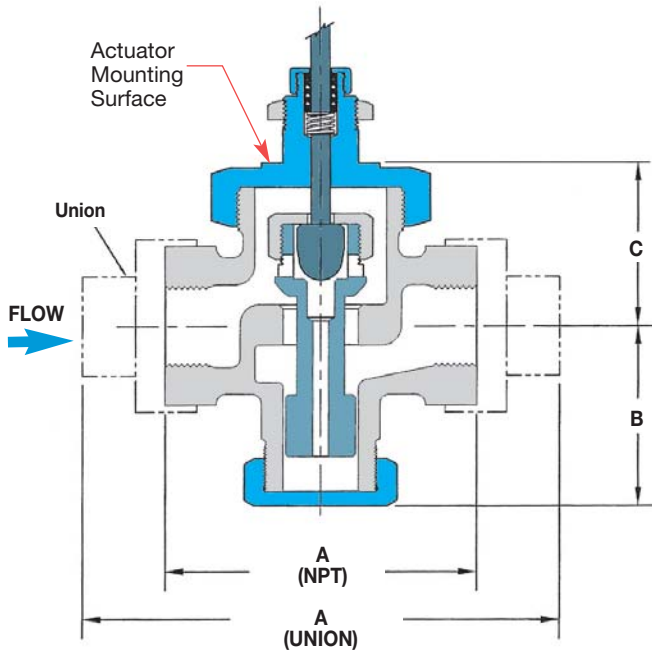
Single Seat • 1/2" – 4"

**HEATING**

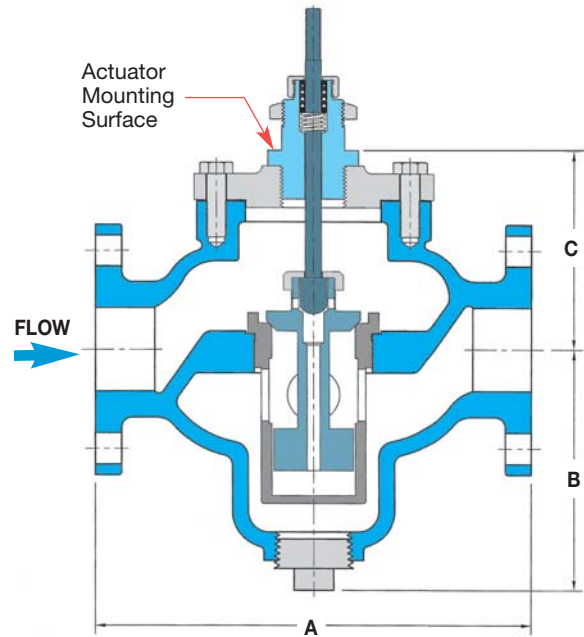
NORMALLY OPEN

Stem In-To-Close  
for HEATING

Dimensions in inches



**THREADED & UNION**



**FLANGED**

TEMPERATURE  
Regulators

## Valve Body Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
1/2" - 1 1/2" Stainless/Bronze	Stainless Steel	Threaded or Malleable Iron Union Ends	250 PSI @ 410°F
2" Cast Iron	Stainless Steel	Threaded	250 PSI @ 450°F
2" - 4" Cast Iron	Stainless Steel	125# Flanged	125 PSI @ 450°F
		250# Flanged	250 PSI @ 450°F

## Valve Body Selection

Valve Body Number (In-To-Close Heating)		Size Connection	Capacity Cv	Maximum Close-Off Pressure (PSI ΔP)	Dimensions						Approx. Ship. Wt. (lbs) [kg]	
NPT	Union				A Threaded	A 125# FLG	A 250# FLG	A Union	B	C		
H12N	H12U	1/2"	3.2	250	4.125	x	x	6.50	2.375	2.12	14 [6.35]	
H13N	H13U	3/4"	6.3	250	4.125	x	x	6.50	2.375	2.12	14 [6.35]	
H14N	H14U	1"	10.8	200	4.125	x	x	7.00	2.375	2.12	14 [6.35]	
H15N	H15U	1 1/4"	15.9	200	4.810	x	x	7.50	3.250	2.50	17 [7.7]	
H16N	H16U	1 1/2"	22.4	200	5.190	x	x	8.00	3.500	2.69	18 [8.2]	
H17N	-	2"	33.1	150	9.500	x	x	x	5.750	4.75	50 [22.7]	
FLANGED		Size Connection	Capacity Cv	Valve Type								
125#	250#			Standard	Special*	A	A	A	A	B	C	
H17F125	H17F250	2"	33.1	150	-	x	10.375	10.875	x	5.75	4.75	80 [36.3]
H18F125	H18F250	2 1/2"	47.5	65	150	x	10.625	11.250	x	7.00	5.00	96 [43.6]
H19F125	H19F250	3"	68.2	50	150	x	10.875	11.625	x	8.00	5.75	110 [49.9]
H20F125	H20F250	4"	109.5	40	150	x	10.500	13.125	x	8.75	6.50	160 [72.6]

Notes: For 2 1/2" - 4" sizes, consult factory for proper actuators.

\* With High-Force Actuator, which allows the valve to operate at a higher differential pressure.

for Temperature Regulators

HEATING

CAPACITIES — Steam (lbs/hr)		SINGLE-SEATED VALVES							
Inlet Pressure (PSIG)	Size & Valve Body Number								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
	H12	H13	H14	H15	H16	H17	H18	H19	H20
1	91	180	309	454	640	946	1357	1949	3129
3	103	203	348	512	722	1066	1530	2197	3527
5	115	226	387	570	803	1187	1703	2445	3926
10	144	283	486	715	1007	1488	2135	3066	4922
15	173	341	584	859	1211	1789	2568	3686	5919
20	202	398	682	1004	1415	2090	3000	4307	6915
25	231	455	780	1149	1618	2392	3432	4928	7912
30	260	513	879	1294	1822	2693	3864	5548	8908
40	319	627	1075	1583	2230	3295	4729	6790	10,901
50	377	742	1272	1872	2638	3898	5593	8031	12,894
60	435	857	1468	2162	3045	4500	6458	9272	14,887
70	493	971	1665	2451	3453	5102	7322	10,513	16,880
80	552	1086	1861	2740	3861	5705	8187	11,755	18,873
90	610	1200	2058	3030	4268	6307	9051	12,996	20,866
100	668	1315	2255	3319	4676	6910	9916	14,237	22,859
125	814	1602	2746	4043	5695	8416	12,077	17,340	27,841
150	959	1888	3237	4766	6714	9922	14,238	20,443	32,823
175	1105	2175	3729	5490	7734				
200	1250	2462	4220	6213	8753				
250	1542	3035							

**Note:** Verify that Maximum Close-Off Pressure for 2" - 4" models does not exceed max rating for selected Valve Body Number and Type (refer to Valve Body Number in chart).

**Notes:** 1) For reduced-port 1/2" valves, consult factory. 2) All steam capacities based on Critical Drop (Choked Flow).

TEMPERATURE Regulators

**Note:** When used with water, add **W** to the Valve Body Number.

**Example:**  
H17N becomes HW17N

**Note:** Verify that Maximum Close-Off Pressure for 2" - 4" models does not exceed max rating for selected Valve Body Number and Type (refer to Valve Body Number chart on previous page)

CAPACITIES — Water (GPM)		SINGLE-SEATED VALVES							
Pressure (PSI ΔP)	Size & Valve Body Number								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
	HW12	HW13	HW14	HW15	HW16	HW17	HW18	HW19	HW20
1	3.2	6.3	11	16	22	33	48	68	110
3	5.5	11	19	28	39	57	82	118	190
5	7.2	14	24	36	50	74	106	152	245
10	10	20	34	50	71	105	150	216	346
15	12	24	42	62	87	128	184	264	424
20	14	28	48	71	100	148	212	305	490
25	16	32	54	80	112	166	238	341	548
30	18	35	59	87	123	181	260	374	600
40	20	40	68	101	142	209	300	431	693
50	23	45	76	112	158	234	336	482	774
60	25	49	84	123	174	256	368	528	848
70	27	53	90	133	187	277	397	571	916
80	29	56	97	142	200	296	425	610	979
90	30	60	102	151	213	314	451	647	1039
100	32	63	108	159	224	331	475	682	1095
125	36	70	121	178	250	370	531	762	1224
150	39	77	132	195	274	405	582	835	1341
175	42	83	143	210	296				
200	45	89	153	225	317				
250	51	100							

Steam flow required through a temperature regulator (lbs/hr)  
to heat a specified number of gallons of water per hour (gal/hr)

**TABLE 1 - Steam Flow Required in Pounds Per Hour (lbs/hr)**

Temp Increase (°F)	Gallons of Water per Hour To Be Heated												Temp Increase (°F)
	25	50	100	200	300	500	700	1000	2000	4000	10,000	20,000	
5°	1	2	4	8	12	21	29	41	83	166	415	830	5°
10°	2	4	8	16	25	41	58	83	166	332	830	1660	10°
15°	3	6	12	25	37	62	87	124	249	498	1245	2490	15°
20°	4	8	17	33	50	83	116	166	332	664	1660	3320	20°
25°	5	10	20	42	62	104	145	207	415	830	2075	4150	25°
30°	6	12	25	50	75	124	174	249	498	996	2490	4980	30°
40°	8	16	33	66	100	166	232	332	664	1328	3320	6640	40°
50°	10	21	42	83	124	207	290	415	830	1660	4150	8300	50°
60°	12	25	50	100	149	249	348	498	996	1992	4980	9960	60°
70°	15	29	58	116	174	290	407	581	1162	2324	5810	11,620	70°
80°	17	33	67	133	199	332	465	664	1328	2656	6640	13,280	80°
90°	19	38	75	149	224	373	523	747	1494	2988	7470	14,940	90°
100°	21	42	83	166	249	415	581	830	1660	3320	8300	16,600	100°
115°	24	48	95	191	286	477	668	955	1909	3818	9544	19,088	115°
130°	27	54	108	216	324	539	755	1079	2158	4316	10,790	21,580	130°
145°	30	60	120	241	361	601	842	1200	2400	4812	12,030	24,060	145°
160°	33	66	133	266	398	664	929	1328	2656	5312	13,280	26,560	160°
175°	36	72	145	290	436	726	1017	1452	2900	5810	14,524	29,048	175°
200°	41	83	166	332	498	830	1162	1660	3320	6640	16,600	33,200	200°
225°	47	94	187	374	560	934	1307	1867	3735	7470	18,680	37,360	225°
250°	52	104	207	415	622	1037	1452	2075	4150	8300	20,750	41,500	250°

TEMPERATURE Regulators

**HEATING WATER:** The amount of steam required to heat water can be found using chart above.  
**Example:** To heat 1000 gallons per hour of water from 40°F to 140°F (Temp. increase 100°F) requires 830 lbs/hr of steam.

**HEATING FUEL OIL:** The amount of steam required to heat fuel oil is half of that to heat water. Use half the value found in chart above.  
**Example:** To heat 1000 gallons per hour of fuel oil from 40°F to 140°F (Temp. increase 100°F) requires 415 lbs/hr of steam.

**Capacity Formulas for Steam Loads**

When Heat Load or Heat Transfer Rate (E) is Known	Capacity of steam required (lbs/hr)	=	$\frac{E \text{ (Btu/hr)}}{1000}$
When Square Feet Equivalent Direct Radiation (EDR) is Known	Capacity of steam required (lbs/hr)	=	$\frac{\text{Sq. ft. of EDR}}{4}$
When Heating Water with Steam	Capacity of steam required (lbs/hr)	=	$\frac{\text{GPM} \times \text{Temp Rise (°F)}}{2}$
When Heating Fuel Oil with Steam	Capacity of steam required (lbs/hr)	=	$\frac{\text{GPM} \times \text{Temp Rise (°F)}}{4}$
When Heating Air with Steam Coils	Capacity of steam required (lbs/hr)	=	$\frac{\text{CFM} \times \text{Temp Rise (°F)}}{900}$

Note: Above formulas based on steam containing approximately 1000 Btu's of Latent Heat per pound.

## COOLING

Model Codes in Chart are for complete Temperature Regulators.  
This includes the Valve Body and Thermal Actuator with standard copper bulb and 8 ft. capillary.



### W91

Non-Indicating Type Actuator  
with valve body

**X** = Temperature Range  
**08** = Capillary Length 8 ft.  
**S15** = Copper Bulb

Connection		PMO (PSI)
3/4" NPT with Integral Union	<b>W91-X-08S15-C13U</b>	250
1" NPT with Integral Union	<b>W91-X-08S15-C14U</b>	250
1 1/4" NPT with Integral Union	<b>W91-X-08S15-C15U</b>	250
1 1/2" NPT with Integral Union	<b>W91-X-08S15-C16U</b>	250
2" NPT with Integral Union	<b>W91-X-08S15-C17U</b>	250
2 1/2" 125# FLG	<b>W91-X-08S15-C18F125</b>	65
3" 125# FLG	<b>W91-X-08S15-C19F125</b>	50
4" 125# FLG	<b>W91-X-08S15-C20F125</b>	40



### W94

Indicating Type Actuator  
with valve body

**X** = Temperature Range  
**08** = Capillary Length 8 ft.  
**S15** = Copper Bulb

	PMO (PSI)	Weight
<b>W94-X-08S15-C13U</b>	250	12
<b>W94-X-08S15-C14U</b>	250	13
<b>W94-X-08S15-C15U</b>	250	17
<b>W94-X-08S15-C16U</b>	250	18
<b>W94-X-08S15-C17U</b>	250	24
<b>W94-X-08S15-C18F125</b>	65	55
<b>W94-X-08S15-C19F125</b>	50	80
<b>W94-X-08S15-C20F125</b>	40	105

### Model Configuration Chart

Note: Thermowells for Models W91/W94 are ordered separately.

Models	Temperature Range = X	Capillary Length	Sensing Bulb	Valve Body Selection
<b>W91</b> Non-Indicating <b>W94</b> Indicating Dial	<b>01 - 14</b> (Refer to Temperature Range Chart)	<b>08</b> 8 Feet (std) <b>12</b> 12 Feet <b>16</b> 16 Feet <b>20</b> 20 Feet <b>24</b> 24 Feet	<b>S15</b> Copper Bulb (std) (with Brass Union Hub)  <b>S16</b> Stainless Steel Bulb (with SS Union Hub)	Included in Model Code in above chart.

**W91**                      **05** (75 - 165°F)                      **12**                      **S15**                      **C15U** (1 1/4" NPT)

Example Model Code configured: **W91-05-12-S15-C15U**

(W91, 75-165 °F Temp. Range, 12 ft. Capillary, Copper Sensing Bulb, 1 1/4" NPT Valve Body)

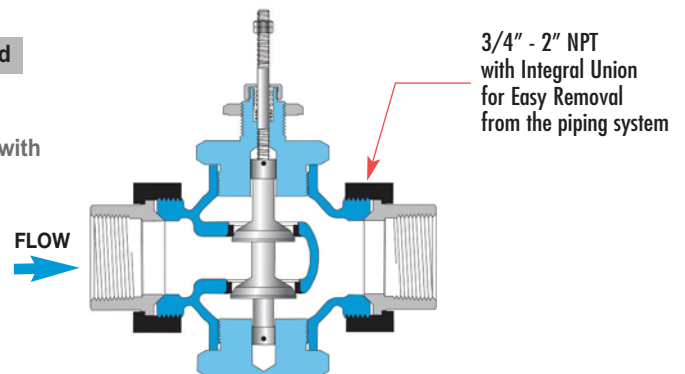
Range Code	Nominal Temperature Range *	
<b>01</b>	20 - 70°F	10 - 20°C
<b>02</b>	40 - 90°F	5 - 30°C
<b>03</b>	30 - 115°F	0 - 45°C
<b>04</b>	50 - 140°F	10 - 60°C
<b>05</b>	75 - 165°F	25 - 70°C
<b>06</b>	105 - 195°F	40 - 90°C
<b>07</b>	125 - 215°F	55 - 100°C
<b>09</b>	155 - 250°F	70 - 120°C
<b>10</b>	200 - 280°F	95 - 135°C
<b>11</b>	225 - 315°F	110 - 155°C
<b>12</b>	255 - 370°F	125 - 185°C
<b>13</b>	295 - 420°F	145 - 215°C
<b>14</b>	310 - 440°F	155 - 225°C

\* The recommended working span typically falls within the upper third of the nominal range.

Valve bodies used for COOLING have designation **C**  
(Example: **C15U**)

**Normally Closed**

(IN-TO-OPEN)  
Double-seated  
Balanced Valve with  
Class II shut-off



## COOLING



# Direct-Operated Regulators Double-Seated Valve Bodies

# W91/W94 Series

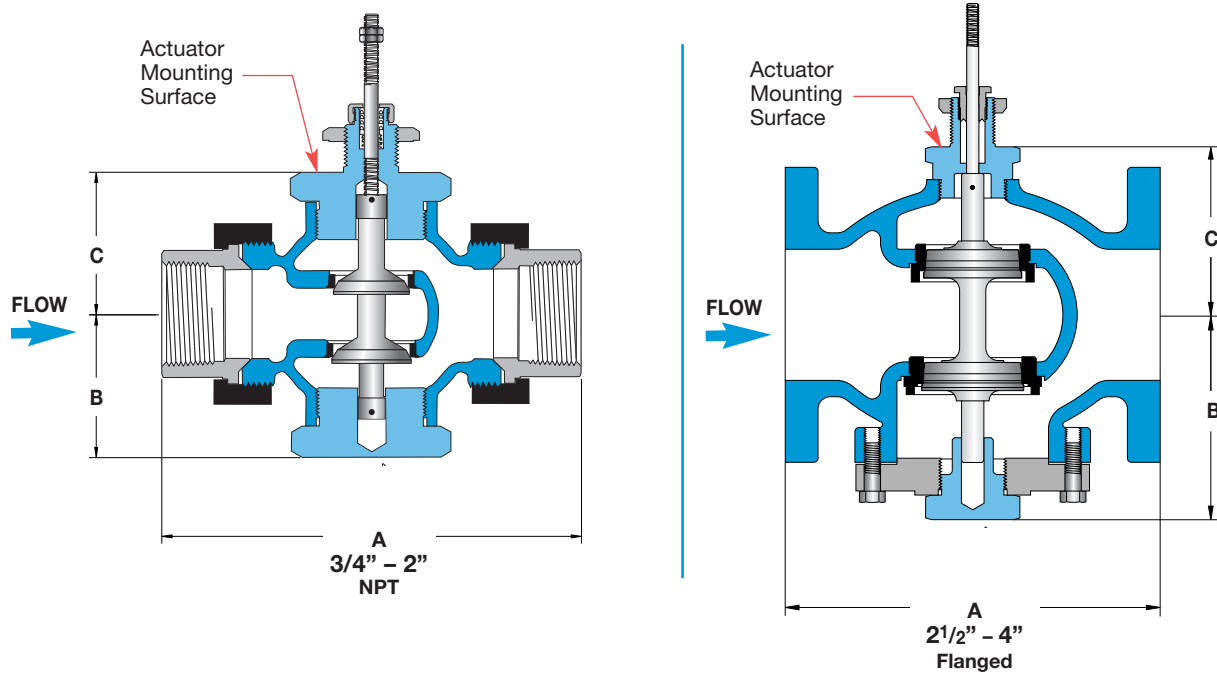
for Temperature Regulators

Double Seat • 3/4" – 4"  
**COOLING**

NORMALLY CLOSED

Stem In-To-Open  
for Cooling

Dimensions in inches [mm]



TEMPERATURE  
Regulators

## Valve Body Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
3/4" - 2" Bronze	Stainless Steel	Threaded with Malleable Iron Union Ends	250 PSI @ 410°F (210°C)
2 1/2" - 4" Cast Iron	Stainless Steel	125# Flanged	125 PSI @ 350°F (149°C)

## Valve Body Selection – Threaded

Valve Body Number (In-To-Open Cooling)	Size		Capacity C <sub>v</sub>	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt. (lbs) [kg]
	Connection (NPT)	Nominal Port			A	B	C	
C13U	3/4	3/4"	8	250	5.6 [142]	2.3 [58]	2.3 [58]	5.0 lbs [2.25 kg]
C14U	1	1"	12	250	6.0 [152]	2.3 [58]	2.3 [58]	6.1 lbs [2.75 kg]
C15U	1 1/4	1 1/4"	21	250	7.2 [183]	2.6 [66]	2.6 [66]	10.1 lbs [4.55 kg]
C16U	1 1/2	1 1/2"	30	250	7.7 [196]	2.6 [66]	2.6 [66]	11.1 lbs [5.00 kg]
C17U	2	2"	47	250	8.6 [218]	3.1 [79]	3.1 [79]	17.0 lbs [7.65 kg]

## Valve Body Selection – Flanged

Valve Body Number (In-To-Open Cooling)	Size		Capacity C <sub>v</sub>	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt. (lbs) [kg]
	Connection	Nominal Port			A	B	C	
C18F125	2 1/2"	2 1/2"	69	65	7.8 [198]	4.8 [122]	5.4 [137]	45 lbs [20 kg]
C19F125	3"	3"	90	50	9.0 [229]	5.0 [127]	5.6 [142]	70 lbs [32 kg]
C20F125	4"	4"	196	40	11.4 [290]	6.3 [160]	6.5 [165]	100 lbs [45 kg]



## MIXING & DIVERTING

Model Codes in Chart are for complete Temperature Regulators.  
This includes the Valve Body and Thermal Actuator with standard copper bulb and 8 ft. capillary.



W91		PMO (PSI)
Non-Indicating Type Actuator with valve body		
X = Temperature Range		
08 = Capillary Length 8 ft.		
S15 = Copper Bulb		
Connection		
1/2" NPT with Integral Union	W91-X-08-S15-A18	250
3/4" NPT with Integral Union	W91-X-08-S15-A25	250
1" NPT with Integral Union	W91-X-08-S15-A34	250
1 1/4" NPT with Integral Union	W91-X-08-S15-A45	250
1 1/2" NPT with Integral Union	W91-X-08-S15-A56	250
2" NPT with Integral Union	W91-X-08-S15-A67	250
2 1/2" 125# FLG	W91-X-08-S15-B75	125
3" 125# FLG	W91-X-08-S15-B80	125
4" 125# FLG	W91-X-08-S15-B85	125

W94		PMO (PSI)	Weight
Indicating Type Actuator with valve body			
X = Temperature Range			
08 = Capillary Length 8 ft.			
S15 = Copper Bulb			
W94-X-08-S15-A18	250	10	
W94-X-08-S15-A25	250	12	
W94-X-08-S15-A34	250	13	
W94-X-08-S15-A45	250	17	
W94-X-08-S15-A56	250	18	
W94-X-08-S15-A67	250	24	
W94-X-08-S15-B75	125	55	
W94-X-08-S15-B80	125	80	
W94-X-08-S15-B85	125	105	

### Model Configuration Chart

Note: Thermowells for Models W91/W94 are ordered separately.

Models	Temperature Range = X	Capillary Length	Bulb	Valve Body Selection
W91 Non-Indicating	01 - 14 (Refer to Temperature Range Chart on next page)	08 8 Feet (standard)	S15 Copper Bulb (with Brass Union Hub)	Included in Model Code in above chart.
W94 Indicating Dial		12 12 Feet		
		16 16 Feet		
		20 20 Feet		
		24 24 Feet	S16 Stainless Steel Bulb (with SS Union Hub)	

W91      05 (75 - 165°F)      12      S15      A45 (1 1/4" NPT)

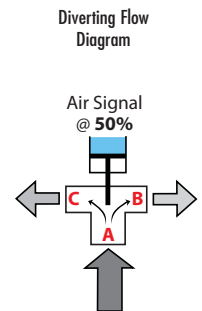
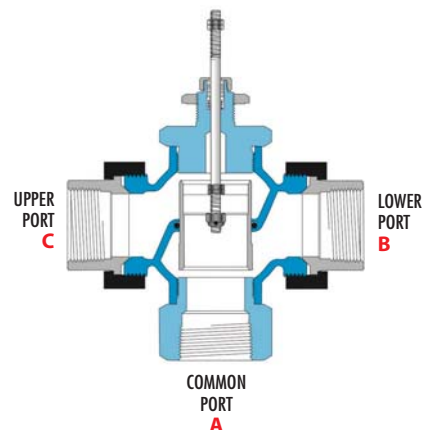
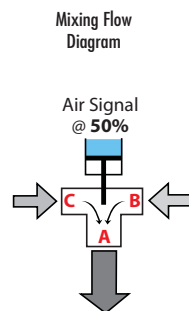
Example Model Code configured: **W91-05-12-S15-A45**

(W91, 75-165 °F Temp. Range, 12 ft. Capillary, Copper Sensing Bulb, 1 1/4" NPT Valve Body)

Range Code	Nominal Temperature Range *	
01	20 - 70°F	10 - 20°C
02	40 - 90°F	5 - 30°C
03	30 - 115°F	0 - 45°C
04	50 - 140°F	10 - 60°C
05	75 - 165°F	25 - 70°C
06	105 - 195°F	40 - 90°C
07	125 - 215°F	55 - 100°C
09	155 - 250°F	70 - 120°C
10	200 - 280°F	95 - 135°C
11	225 - 315°F	110 - 155°C
12	255 - 370°F	125 - 185°C
13	295 - 420°F	145 - 215°C
14	310 - 440°F	155 - 225°C

\* The recommended working span typically falls within the upper third of the nominal range.

### Valve Body for MIXING & DIVERTING



**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.

# Direct-Operated Regulators 3-Way Valve Bodies

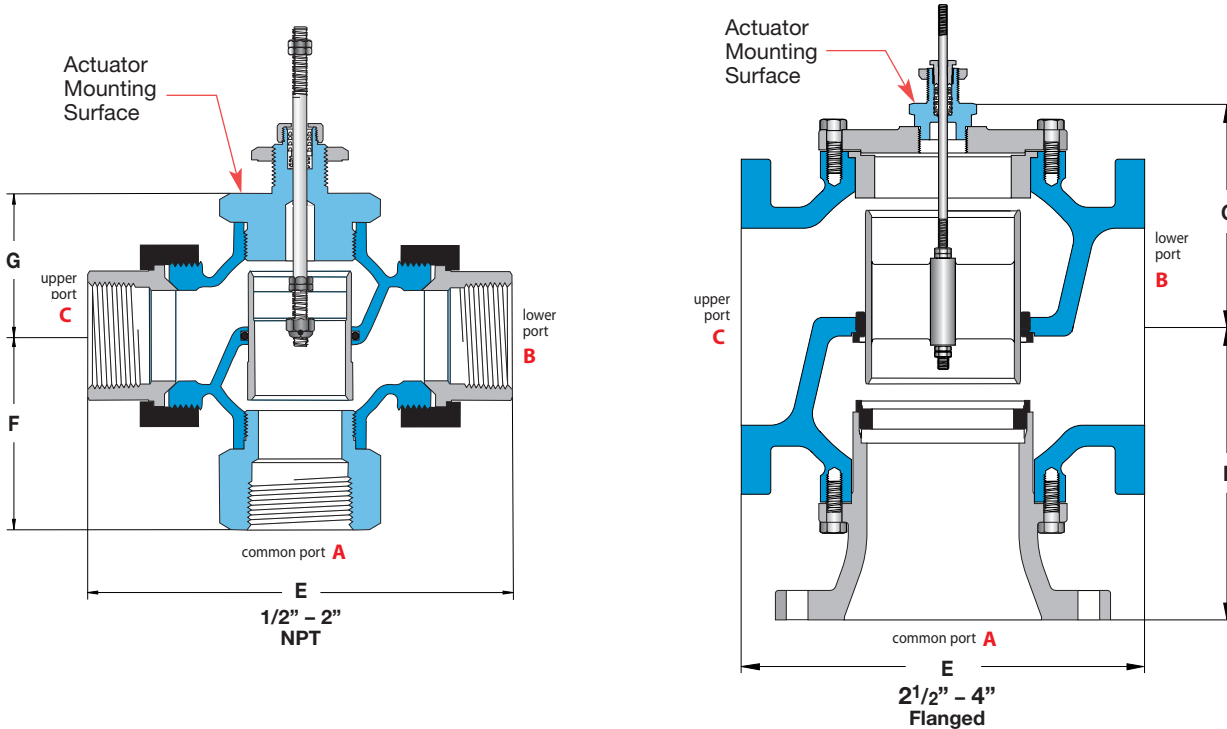
# W91/W94 Series

for Temperature Regulators

3-Way • 1/2" – 4"

Dimensions in inches [mm]

## for Mixing or Diverting



TEMPERATURE  
Regulators

**CAUTION:** Watson McDaniel 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.

### Valve Body Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
1/2" - 2" Bronze	Bronze	Threaded with Malleable Iron Union Ends	250 PSI @ 300°F (149°C)
2 1/2" - 4" Cast Iron	Bronze	125# Flanged	125 PSI @ 300°F (149°C)

### Valve Body Selection

Valve Body Number	Size		Capacity C <sub>v</sub>	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt.
	Connection (NPT)	Nominal Port			E	F	G	
A18	1/2"	1/2"	2.8	250	4.8 [122]	1.8 [46]	1.8 [46]	2.9 lbs [1.31 kg]
A25	3/4"	3/4"	5.6	250	5.6 [142]	2.3 [58]	2.3 [58]	4.7 lbs [2.12 kg]
A34	1"	1"	8.4	250	6.0 [152]	2.3 [58]	2.3 [58]	5.7 lbs [2.57 kg]
A45	1 1/4"	1 1/4"	15	250	7.2 [183]	2.8 [71]	2.6 [66]	9.5 lbs [4.28 kg]
A56	1 1/2"	1 1/2"	21	250	7.7 [196]	3.5 [89]	2.6 [66]	11.1 lbs [5.00 kg]
A67	2"	2"	33	250	8.6 [218]	4.1 [104]	3.1 [79]	16.7 lbs [7.55 kg]

### Valve Body Selection

Valve Body Number	Size		Capacity C <sub>v</sub>	Maximum Close-Off Pressure (PSI ΔP)	Dimensions			Approximate Shipping Wt.
	Connection	Nominal Port			E	F	G	
B75	2 1/2"	2 1/2"	58	125	9.0 [229]	7.1 [180]	5.2 [132]	62 lbs [28 kg]
B80	3"	3"	72	125	10.0 [254]	8.0 [203]	6.0 [152]	80 lbs [36 kg]
B85	4"	4"	102	125	13.0 [330]	10.0 [254]	6.9 [175]	140 lbs [64 kg]

for Temperature Regulators

Capacity Charts

**COOLING Double-Seated Valve Bodies**

CAPACITIES – Water (GPM)		DOUBLE-SEATED VALVES						
Pressure Drop (PSI ΔP)	Size, Valve Body Number & Coefficient (Cv)							
	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
	C13U Cv = 8	C14U Cv = 12	C15U Cv = 21	C16U Cv = 30	C17U Cv = 47	C18F125 Cv = 69	C19F125 Cv = 90	C20F125 Cv = 196
1	8	12	21	30	47	69	90	196
3	14	21	36	52	81	120	156	339
5	18	27	47	67	105	154	201	438
10	25	38	66	95	149	218	285	620
15	31	46	81	116	182	267	349	759
20	36	54	94	134	210	309	402	877
25	40	60	105	150	235	345	450	980
30	44	66	115	164	257	378	493	1074
40	51	76	133	190	297	436	569	1240
50	57	85	148	212	332	488	636	
60	62	93	163	232	364			
70	67	100	176	251	393			
80	72	107	188	268	420			
90	76	114	199	285	446			
100	80	120	210	300	470			
125	89	134	235	335	525			
150	98	147	257	367	576			
175	106	159	278	397	622			
200	113	170	297	424	665			
225	120	180	315	450	705			
250	126	190	332	474	743			

Note: Double-seated valves have In-to-Open (ITO) stem action for cooling applications.

**MIXING & DIVERTING 3-Way Valve Bodies**

CAPACITIES – Water (GPM)		3-WAY VALVES							
Pressure Drop (PSI ΔP)	Size, Valve 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.

for Temperature Regulators

Replacement Actuators

**W91**  
Non-indicating  
Replacement Actuator



**W94**  
Indicating  
Replacement Actuator



TEMPERATURE  
Regulators

Note: Thermowells for Models W91/W94 are ordered separately.

Replacement Actuator Model Configuration

Example Model Code configured: **W91-05-12-S15**

Models	Temperature Range = X	Capillary Length	Bulb
W91 W94	<b>01 – 14</b> (Refer to Temperature Range Chart)	<b>08</b> 8 Feet (std) <b>12</b> 12 Feet <b>16</b> 16 Feet <b>20</b> 20 Feet <b>24</b> 24 Feet	<b>S15</b> Copper Bulb (with Brass Union Hub)  <b>S16</b> Stainless Steel Bulb (with SS Union Hub)
W91	<b>05</b> (75 - 165°F)	<b>12</b>	<b>S15</b>

Thermowells for W91 & W94 Series Self-Operated Temperature Regulators

Capillary Length (ft.)	Bulb Length Required	Thermowell Length (in.)	Connection Size NPT	Brass Model #	Stainless Steel Model #
8', 12' or 16'	12.25"	13.0"	1 1/4"	536S2	536S6
20'	15.25"	16.0"	1 1/4"	536SE2	536SE6
24'	19.25"	20.0"	1 1/4"	536WE2	536WE6

Note: Thermowell Length chosen is based on the Length of the Capillary used in the Thermal System. (See chart above)