

# TEMPERATURE REGULATORS

## W91/W94 Series

Self-Operated Temperature Regulators

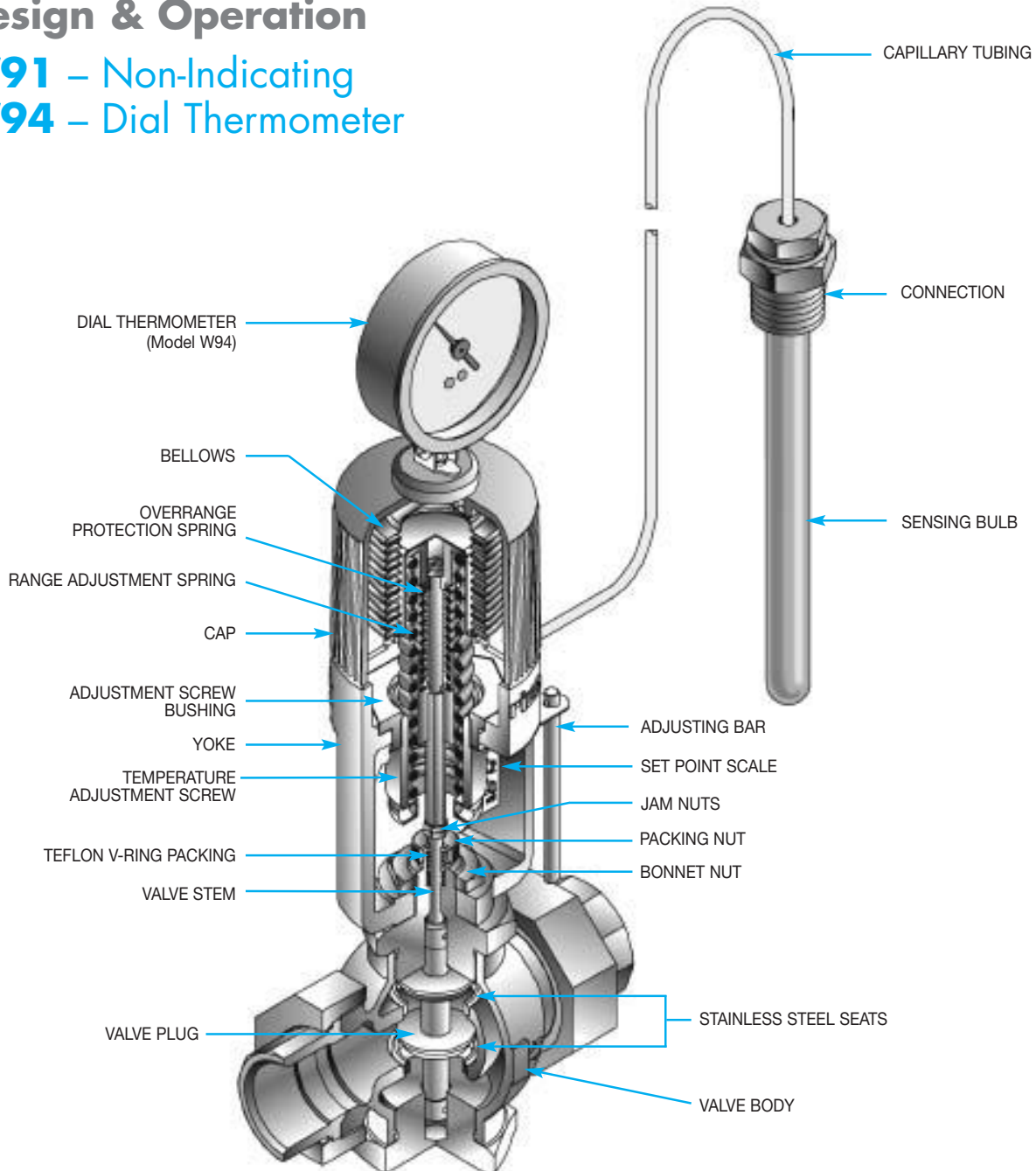
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### Design & Operation

W91 – Non-Indicating

W94 – Dial Thermometer

DIRECT-OPERATED  
REGULATING VALVES



### 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 blue epoxy.

# TEMPERATURE REGULATORS

## W91/W94 Series Self-Operated Temperature Regulators

### Design & Operation

#### Description

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.

#### Principles 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 a bellows within the unit's actuator housing to expand. As the bellows expands, it compresses a return spring while simultaneously moving the valve stem downward to stroke the valve. When the process temperature decreases (or in the event of thermal system failure), the return spring will move the valve stem upward to the "out" position. The choice of valve action (stem **In-To-Close for Heating** or stem **In-To-Open for Cooling**) will determine the system failure position.

#### Direct-Acting – HEATING

Direct-Acting actuators are designed to move the valve stem closed (**in-to-close**) as the control signal (temperature) increases.

#### Reverse-Acting – COOLING

Reverse-Acting actuators are designed to move the valve stem open (**in-to-open**) as the control signal (temperature) increases.

#### Selecting a Temperature Regulator

The **W91/W94** Temperature Regulator is recommended for controlling the flow 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 or electrically powered Control Valve should be specified. Please consult the Control Valves section of this catalog.

#### Actuator

The actuator consists of the following assemblies: housing, bellows and spring return, and thermal system. Two actuator models are available:

- **Model W91** is non-indicating.
- **Model W94** is equipped with an integral dial thermometer to indicate sensing bulb temperature.

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## Design & Operation

### 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.

### Thermal System Assembly

The thermal system (sensing bulb and capillary tubing) is available in copper (for best heat transfer) or 316 stainless steel (for corrosive applications) and can be ordered with a variety of protective coverings, including Teflon or stainless steel spiral armor. Capillary tubing lengths can be specified from 8 to 52 feet.

### Integral Dial Thermometer

The integral dial thermometer (Model **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" dialface and can be rotated and tilted for maximum readability.

### 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. The nominal range should be selected so that the set point falls within the recommended working span for the specified valve style and action. Models **W91/W94** include an overrange 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. Please consult the Control Valves section of this catalog.

#### Sensing Bulb Installation:

Care must be taken to ensure that entire length of the sensing bulb is immersed into the medium at the sensing location. Partial immersion will result in faulty control. When the sensing bulb is installed into a pipeline, constant flow must be continued through the line in order to maintain an active thermal signal to the bulb. Should a closed valve cause stoppage of flow to the bulb, a reduced bypass flow must be installed to maintain the thermal signal.

The sensing bulb is designed to be installed in either a horizontal position or a vertical position with the tip down. If the tip must be installed upwards, please specify when ordering, as a special bulb construction is required.

# TEMPERATURE REGULATORS

## W91/W94 Series

### Self-Operated Temperature Regulators

## Design & Operation

### Accuracy (continued)

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.

### Valve

**W91/W94** Temperature Regulators are available with a wide variety of globe valves in various styles, materials, connections and sizes.

### Style

**W91/W94** Regulator Valves are offered in single-seated, double-seated and three-way designs:

- **Single-Seated Balanced Valves** are designed for heating applications where tighter shut-off is required. The leakage rate is approximately 0.1% of the maximum capacity.
- **Double-Seated Balanced Valves** are designed for cooling applications where a slight amount of leakage is normally acceptable. Since temperature fluctuations may cause expansion and contraction across the seats, tight shut-off is not always possible. The leakage rate can be up to approximately 0.5% of the maximum capacity.
- **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.

3-Way Valves are of the Sleeve-Type (common port on the bottom). This type is most commonly used for diverting applications; however, due to its design it can also be used for mixing applications. The Sleeve-Type design is constructed with an O-ring around the sleeve. This O-ring is suitable for water or glycol type service, up to a maximum of 300°F. A higher temperature O-ring for use with other fluids, such as oil, or for temperatures up to 410°F, is available. Consult factory.

### Thermowell

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. A thermowell will also facilitate the removal of the sensing bulb and thermal system from the operating process. Thermowells are available in a variety of connection styles, materials and lengths.

**CAUTION:**  
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 at the set point and provides no power to tightly seat the valve plug. A separate power driven or hand actuated valve is required to ensure tight shut-off when necessary.

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

**Note:** to ensure minimum response time, Heat Transfer Paste should be applied to the sensing portion of the bulb before installation.

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REGULATING VALVES

# TEMPERATURE REGULATORS

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### Self-Operated Temperature Regulators

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## Design & Operation

### Action

Single-Seated Valves are available as stem In-To-Close (Normally Open) for Heating applications. Double-Seated Valves are available as stem In-To-Open (Normally Closed) for Cooling applications. 3-Way Valves can be plumbed for either mixing or diverting service.

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

### Body & Material and Connection

W91/W94 Temperature Regulators are available with bronze and cast iron valve bodies with Union, Flanged and Threaded connections.

### Trim

Valve trim is composed of the stem and plug assembly, and the seats within the ports. Single and double-seated bronze bodied 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 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.

### 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 undue wear of the plug and seat. The valve coefficient ( $C_v$ ) 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. Please consult the Valve Selection section of this catalog.

#### Valve Coefficient ( $C_v$ ):

The rated valve coefficient is used to describe the relative flow capacity of the valve based on standard test conditions. Please refer to the Valve Selection Section for detailed information.

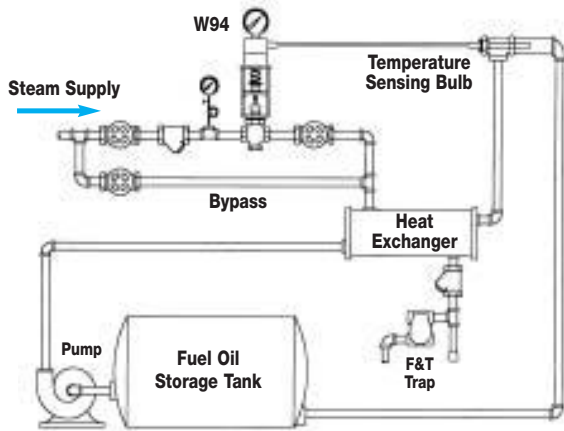
# TEMPERATURE REGULATORS

## W91/W94 Series

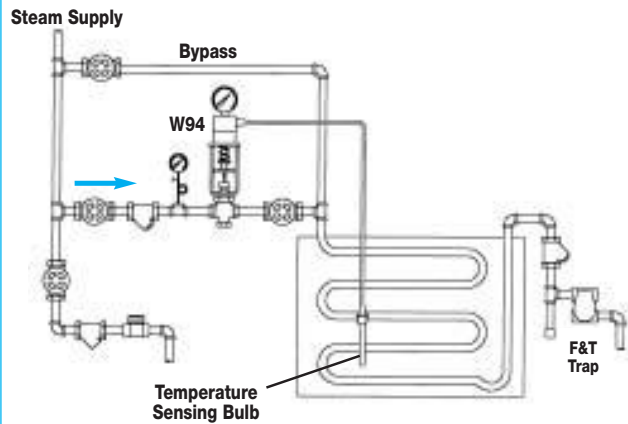
Self-Operated Temperature Regulators

### Typical Applications for Temperature Regulators

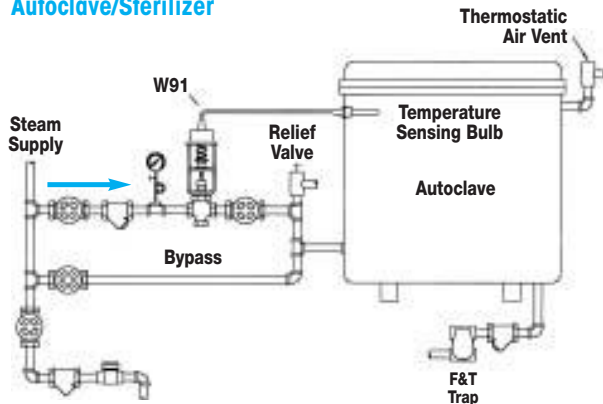
W94 Heating Fuel Oil To Proper Temperature



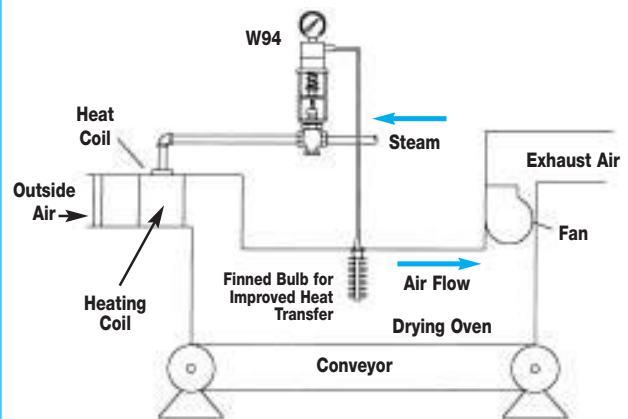
W94 Elevating Temperature Of A Plating Or Finishing Tank



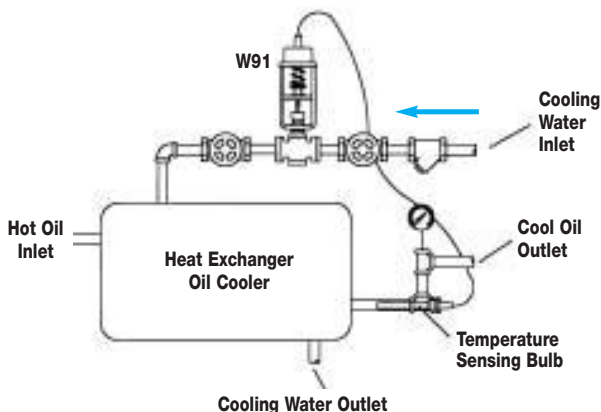
W91 Used for Regulating Steam Flow In An Autoclave/Sterilizer



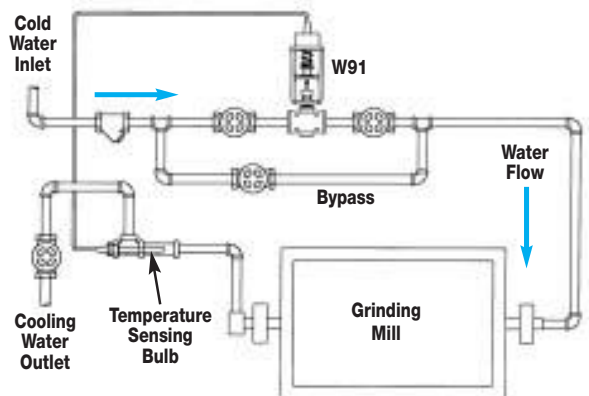
W94 Used In A Drying Oven Application



W91 Used to Reduce Oil Temperature In A Heat Exchanger



W91 Used To Control Water Flow In A Grinding Mill For Temperature Reduction



DIRECT-OPERATED REGULATING VALVES

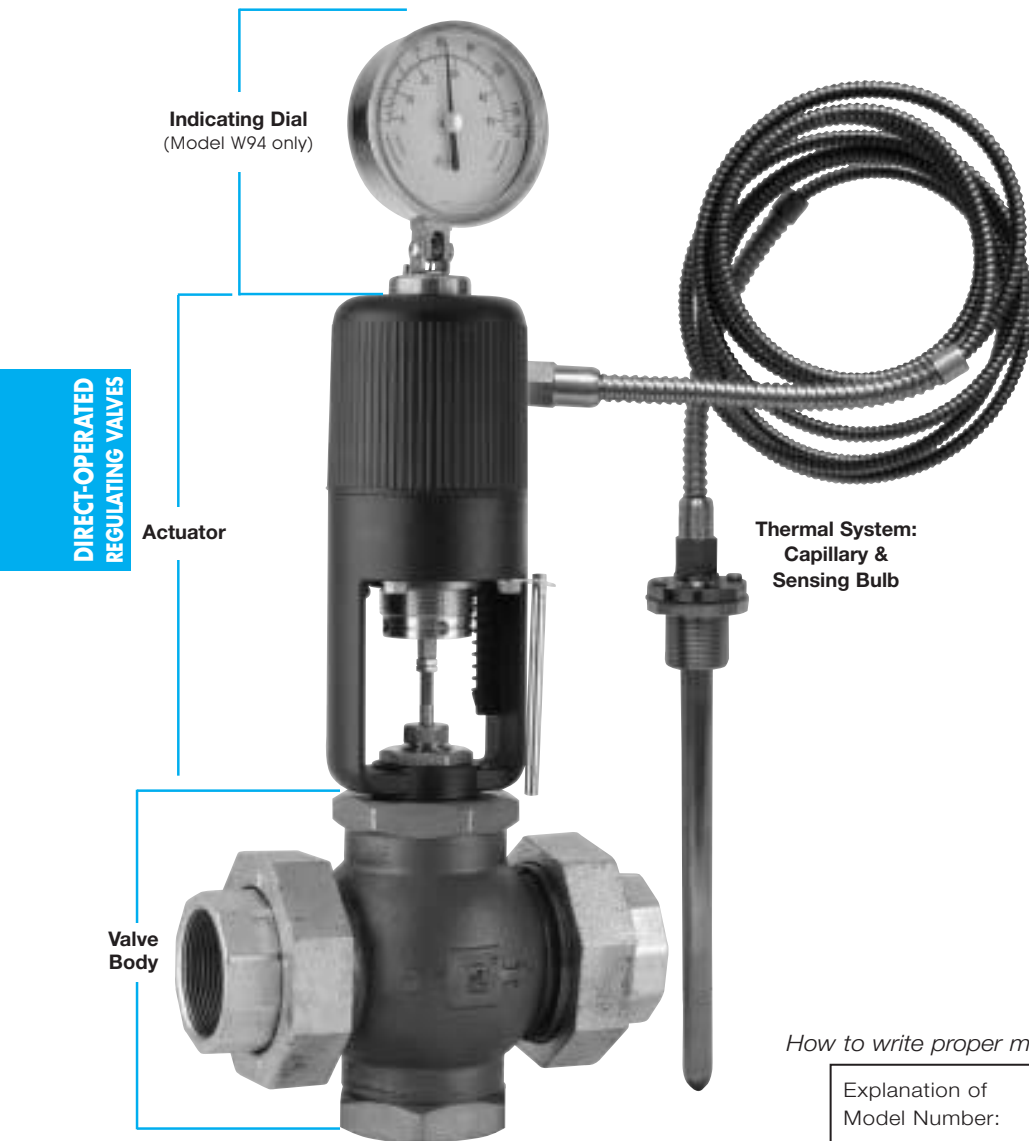


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## W91/W94 Series

### Self-Operated Temperature Regulators

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- ▶ Self-Operating Design
- ▶ Indicating & Non-Indicating Models Available
- ▶ Heavy Duty Die Cast Aluminum Housing
- ▶ 1/2" thru 4" Valve Sizes
- ▶ Fully Enclosed Bellows
- ▶ Internal Overrange protection

The **W91 & W94** Self-Operating Temperature Regulators are the preferred choice of original equipment manufacturers, mechanical contractors and specifying engineers. These regulators 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 overrange protection.

- ▶ Model **W91** (without indicating dial) features a lower profile and should be specified where space constraints may be an issue.
- ▶ Model **W94** (with indicating dial) will allow the operator to verify the process temperature and to aid in temperature adjustment.

#### Thermowells:

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. A thermowell will also facilitate the removal of the sensing bulb and thermal system from the operating process.

How to write proper model number:

Explanation of Model Number:	<b>W91</b>	<b>06</b>	<b>08</b>	<b>S15</b>	<b>175-13</b>
	model	temp. range	cap. length	bulb type	valve body
Model Number:	<b>W910608S15175-13</b>				

#### HOW TO ORDER

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

Note: Thermowells are ordered separately.  
See page 175 for model numbers & lengths.

# TEMPERATURE REGULATORS

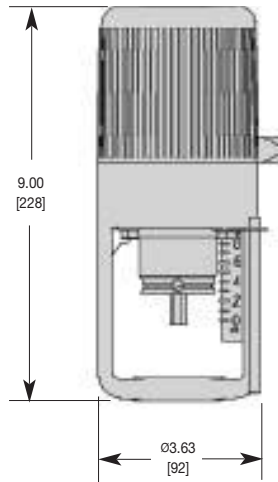
## W91/W94 Series

### Self-Operated Temperature Regulators

Model	<b>W91/W94</b>
Service	<b>Water, Steam, Other Liquids</b>
Sizes	<b>1/2" – 4"</b>
Connections	<b>Threaded, Union Ends, 125# FLG 250# FLG (optional)</b>
Body Material	<b>1/2" – 1 1/2" Bronze/Stainless Steel 2" Cast Iron (Direct-acting) 2" Bronze (Reverse-acting) 2 1/2" – 4" Cast Iron</b>
Seat Material	<b>Stainless Steel</b>
Max. Inlet Pressure	<b>250 PSIG</b>

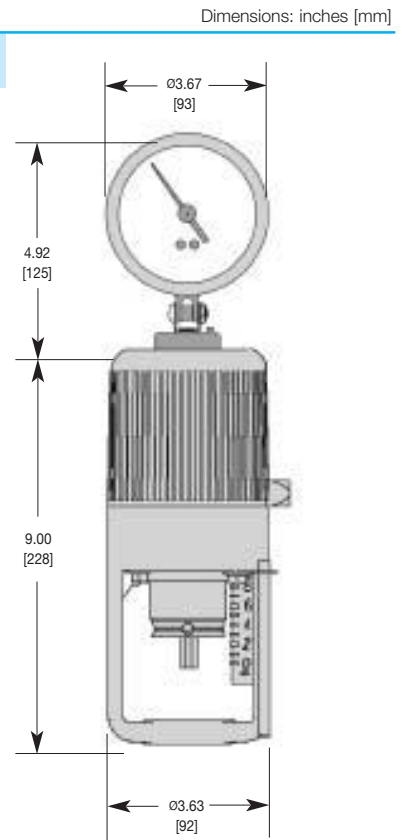
### W91

#### Non-Indicating Actuator



### W94

#### Indicating Actuator



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### Specifications

#### Actuator Models

**W91** - Non-Indicating  
**W94** - Indicating Dial

#### Dial Thermometer

3 1/2" dial, stainless steel case, swivel and angle adjustment (Model W94 only)

#### Housing

Die cast aluminum, epoxy powder coated blue finish

#### Bellows

High pressure brass, corrosion resistant, tin plated finish

#### Overrange Protection

Upper range limit +100°F for temporary situations

#### Approximate Shipping Weight

##### Actuator

W91 6.0 lbs [2.7 kg]  
W94 6.6 lbs [3.0 kg]

##### Valve

See Valve Selection tables



# TEMPERATURE REGULATORS

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### Self-Operated Temperature Regulators

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#### 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
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

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

DIRECT-OPERATED REGULATING VALVES

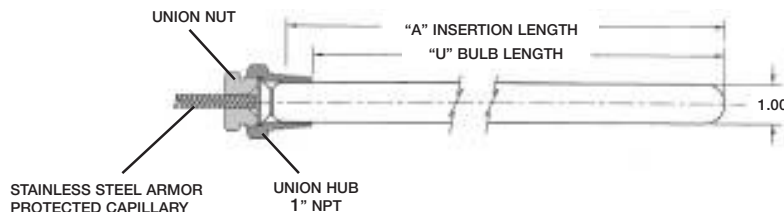
#### Bulb & Capillary Style

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

Other Options available. Consult Factory.

#### Bulb Installation: (refer to diagram below)

The 1" NPT Union Hub is not physically attached to the bulb. The 1" NPT Union Hub is threaded into a tank or vessel. The bulb slides thru the 1" NPT Union Hub and is held in place and sealed with the Union Nut, which freely turns on the stainless steel armor protected capillary. When using a Thermowell, the 1" NPT Union Hub is discarded and the Union Nut threads into the Thermowell.



# TEMPERATURE REGULATORS

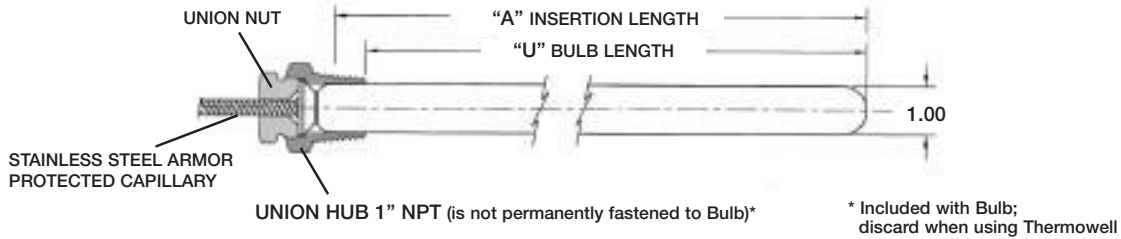
## W91/W94 Series

### Self-Operated Temperature Regulators

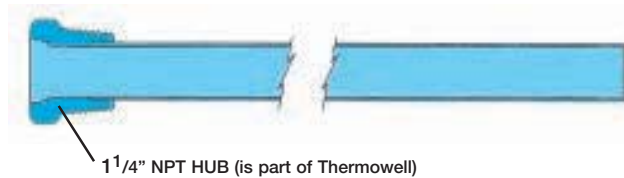
#### Thermowell Selection

Dimensions (inches)

#### BULB

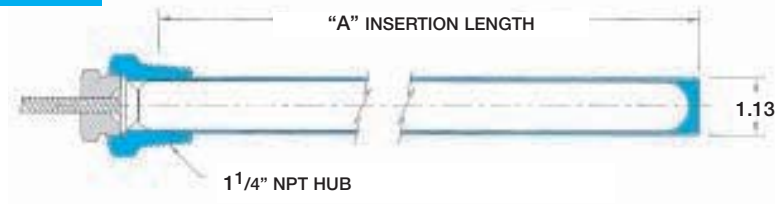


#### THERMOWELL



**Note:** to ensure minimum response time, Heat Transfer Paste should be applied to the sensing portion of the bulb before installation.

#### BULB inside THERMOWELL



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. A thermowell will also facilitate the removal of the sensing bulb and thermal system from the operating process. Because the sensing bulb is isolated from the fluid, this allows the sensing bulb to be removed without having to drain the liquid below the bulb insertion point.

#### THERMOWELLS - Model Numbers & Lengths

Brass Model No.	Stainless Steel Model No.	Nominal Length	"A" INSERTION LENGTH (in.)		Capillary Length in Feet
			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	20.00	24

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

# TEMPERATURE REGULATORS

## W91/W94 Series

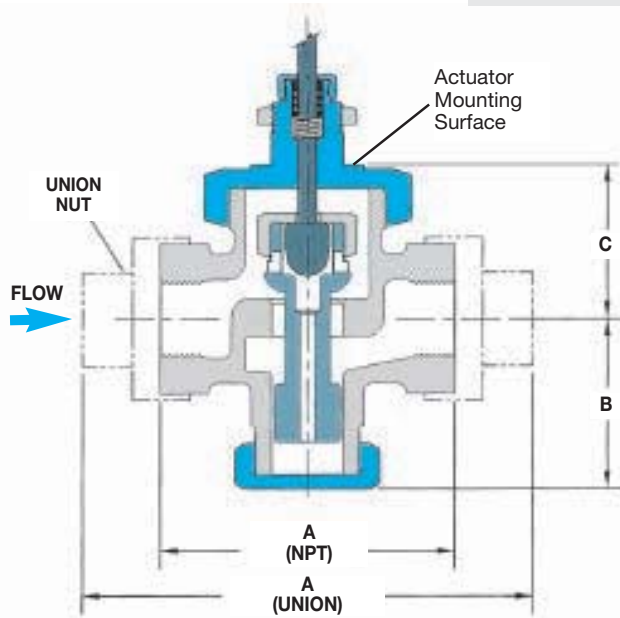
Single Seated Valve Bodies

# HEATING

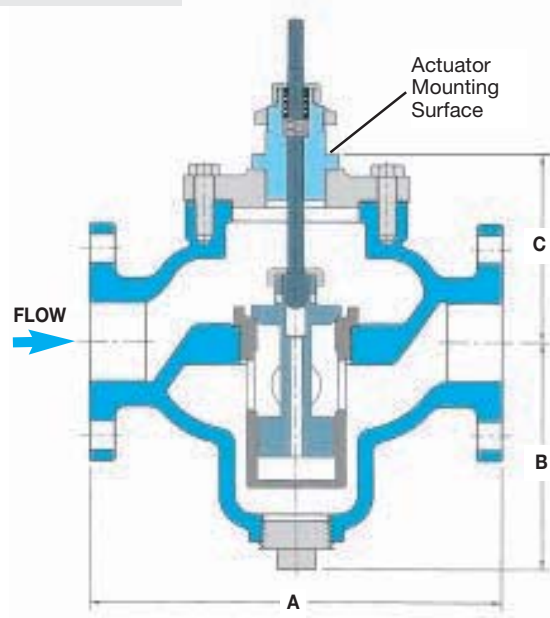
Single Seat • 1/2" – 4"

Dimensions in inches

### Stem In-To-Close for Heating



**THREADED & UNION**



**FLANGED**

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### Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
1/2" - 1 1/2" Bronze/Stainless	Stainless Steel	Threaded or Malleable Iron Union Ends	125 PSI @ 450°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		
175-12-N	175-12-U	1/2"	3.2	250	4.125	x	x	6.50	2.375	2.12	14 [6.35]	
175-13-N	175-13-U	3/4"	6.3	250	4.125	x	x	6.50	2.375	2.12	14 [6.35]	
175-14-N	175-14-U	1"	10.8	200	4.125	x	x	7.00	2.375	2.12	14 [6.35]	
175-15-N	175-15-U	1 1/4"	15.9	200	4.81	x	x	7.50	3.25	2.50	17 [7.7]	
175-16-N	175-16-U	1 1/2"	22.4	200	5.19	x	x	8.00	3.50	2.69	18 [8.2]	
175-17-N		2"	33.1	150	9.50	x	x	x	5.75	4.75	50 [22.7]	
FLANGED				Valve Type								
125#	250#			Standard	Special							
175-17-125	175-17-250	2"	33.1	150	-	x	10.375	10.875	x	5.75	4.75	80 [36.3]
175-18-125	175-18-250	2 1/2"	47.5	65	150	x	10.625	11.25	x	7.00	5.00	96 [43.6]
175-19-125	175-19-250	3"	68.2	50	150	x	10.875	11.625	x	8.00	5.75	110 [49.9]
175-20-125	175-20-250	4"	109.5	40	150	x	10.50	13.125	x	8.75	6.50	160 [72.6]

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

# TEMPERATURE REGULATORS

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### Capacity Chart for Single Seated Valves

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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"
	175-12	175-13	175-14	175-15	175-16	175-17	175-18	175-19	175-20
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 chart on previous page)

DIRECT-OPERATED REGULATING VALVES

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

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"
	175W-12	175W-13	175W-14	175W-15	175W-16	175W-17	175W-18	175W-19	175W-20
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							

**Note:** When 175 Type Single Seated Valves are used with water, add **W** to the Valve Body Number.

**Example:**  
175-17-N becomes 175W-17-N

**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)

# TEMPERATURE REGULATORS

## W91/W94 Series

### Steam Required for Heating Water

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**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°

DIRECT-OPERATED REGULATING VALVES

**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 BTU Load is Known	Capacity of steam required (lbs/hr)	= $\frac{\text{BTU}}{1000}$
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)	= $\frac{\text{GPM} \times \text{Temp Rise } ^\circ\text{F}}{2}$
When Heating Fuel Oil with Steam	Capacity of steam required (lbs/hr)	= $\frac{\text{GPM} \times \text{Temp Rise } ^\circ\text{F}}{4}$
When Heating Air with Steam Coils	Capacity of steam required (lbs/hr)	= $\frac{\text{CFM} \times \text{Temp Rise } ^\circ\text{F}}{900}$

# TEMPERATURE REGULATORS

## W91/W94 Series

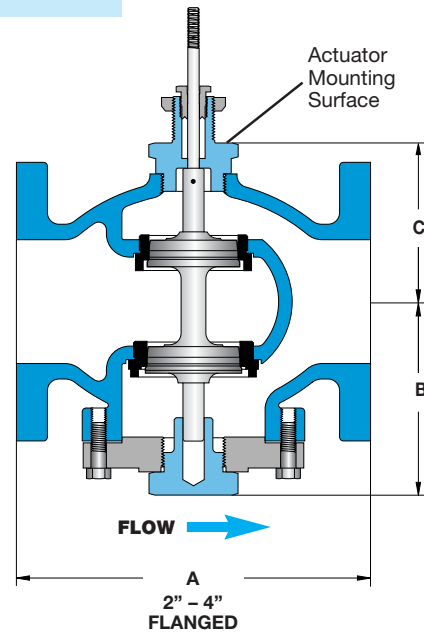
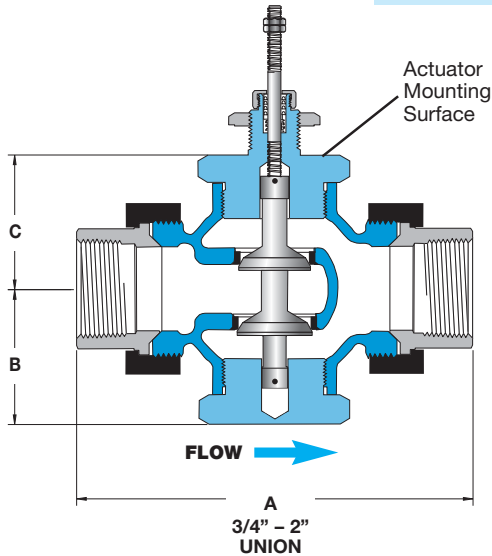
Double Seated Valve Bodies

COOLING

Dimensions in inches [mm]

Double Seat • 3/4" – 4"

Stem In-To-Open  
for Cooling



DIRECT-OPERATED  
REGULATING VALVES

### Specifications

Body Material	Trim Material	Trim Style 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	
A24	3/4	3/4"	8	250	5.6 [142]	2.3 [58]	2.3 [58]	5.0 lbs [2.25 kg]
A33	1	1"	12	250	6.0 [152]	2.3 [58]	2.3 [58]	6.1 lbs [2.75 kg]
A44	1 1/4	1 1/4"	21	250	7.2 [183]	2.6 [66]	2.6 [66]	10.1 lbs [4.55 kg]
A55	1 1/2	1 1/2"	30	250	7.7 [196]	2.6 [66]	2.6 [66]	11.1 lbs [5.00 kg]
A66	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	
B74	2 1/2"	2 1/2"	69	65	7.8 [198]	4.8 [122]	5.4 [137]	45 lbs [20 kg]
B79	3"	3"	90	50	9.0 [229]	5.0 [127]	5.6 [142]	70 lbs [32 kg]
B84	4"	4"	196	40	11.4 [290]	6.3 [160]	6.5 [165]	100 lbs [45 kg]



# TEMPERATURE REGULATORS

## W91/W94 Series

### Capacity Chart for Double Seated Valves

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## COOLING

### 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"
	A24 ITO Cv = 8	A33 ITO Cv = 12	A44 ITO Cv = 21	A55 ITO Cv = 30	A66 ITO Cv = 47	B74 ITO Cv = 69	B79 ITO Cv = 90	B84 ITO 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			

ITO = In-to-Open

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REGULATING VALVES

# TEMPERATURE REGULATORS

## W91/W94 Series

BRONZE

3-Way Valve Bodies

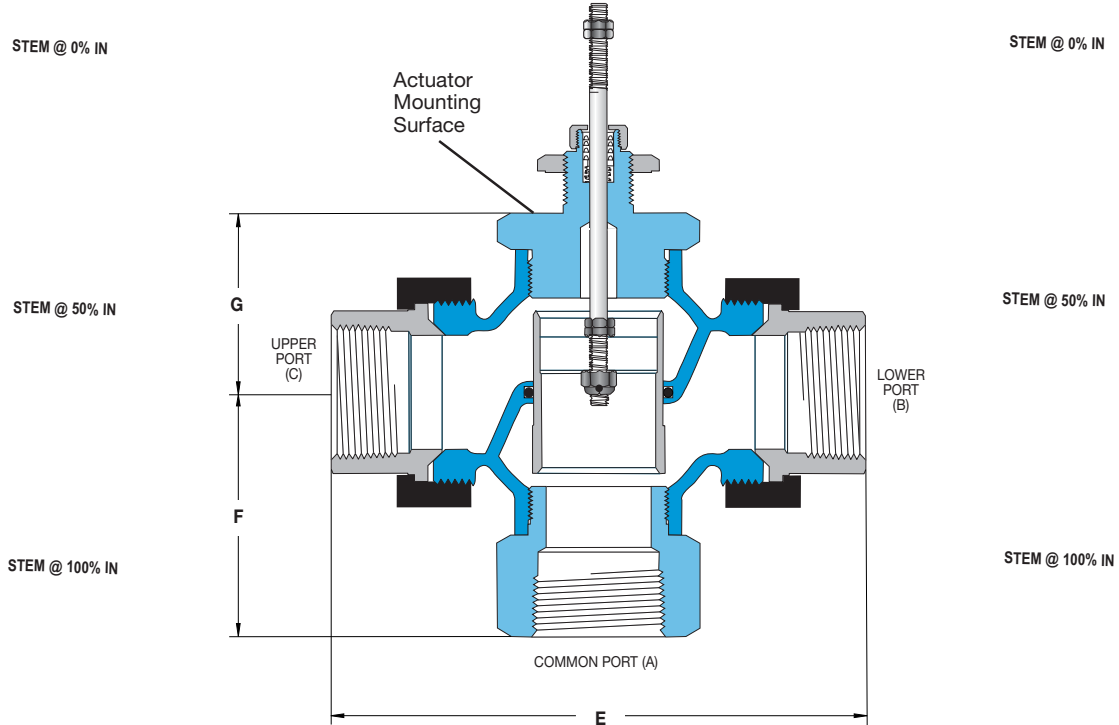
Dimensions in inches [mm]

3-Way • 1/2" – 2"

### for Mixing or Diverting

MIXING FLOW DIAGRAM

DIVERTING FLOW DIAGRAM



DIRECT-OPERATED  
REGULATING VALVES

**CAUTION:** 3-Way Valves are not designed for use in steam applications. To properly control the mixing of two flows, inlet pressures at ports B and C should be as equal as possible.

### Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
Bronze	Bronze	Threaded with Malleable Iron Union Ends	250 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]

# TEMPERATURE REGULATORS

## W91/W94 Series

3-Way Valve Bodies

CAST IRON

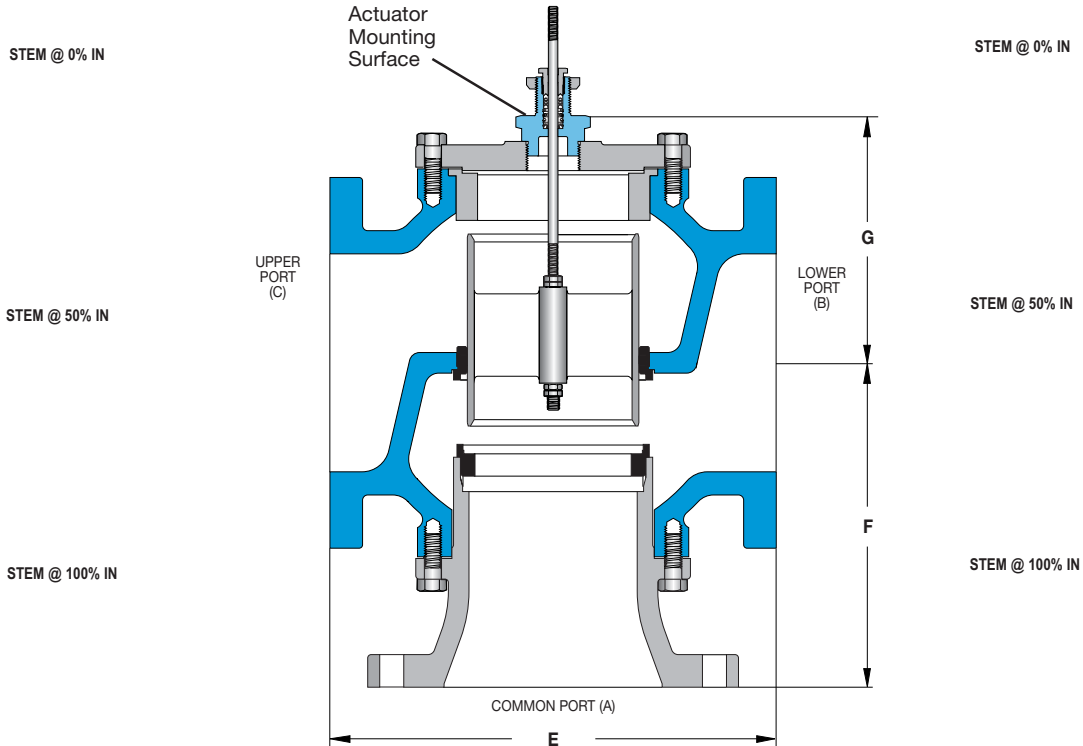
3-Way • 2 1/2" – 4"

Dimensions in inches [mm]

### for Mixing or Diverting

MIXING FLOW DIAGRAM

DIVERTING FLOW DIAGRAM



DIRECT-OPERATED  
REGULATING VALVES

**CAUTION:** 3-Way Valves are not designed for use in steam applications. To properly control the mixing of two flows, inlet pressures at ports B and C should be as equal as possible.

### Specifications

Body Material	Trim Material	Connection	Pressure & Temperature Rating
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	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]

# TEMPERATURE REGULATORS

## W91/W94 Series

### Capacity Chart for 3-Way Valves

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.

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