

### Double Seat - Balanced Valve - Bronze (Type DB) or Stainless Steel Trim (Type DS)

#### VALVE DESCRIPTION

The Powers #11 Double Seat Balanced Valve Regulator (Bronze or Stainless Steel trim) is a self-actuating control valve which automatically controls high temperature fluids at high pressures without the use of external power. Adjust the set point and the rugged self-operating #11 Regulator controls the flow of heating or cooling medium (water or steam) to maintain a constant temperature.

The instrument has a vapor pressure thermal system containing a thermally responsive fluid. This thermal system rapidly senses temperature changes at the bulb and accordingly positions the valve plug, to regulate the flow of the heating or cooling medium to maintain a desired temperature. The thermal system features a two-ply brass bellows with six reinforcing ribs on the bellows head and thick capillary tubing walls to ensure long operating life.

The Powers #11 DS and DB Regulators feature:

- A double seated valve for handling high capacities
- A valve stem of highly polished corrosion resistant grade 316L stainless steel to decrease friction and reduce hysteresis
- An adjusting nut mounted on ball bearings and a set point adjusting rod to ease set point adjustments
- A set point reference scale to aid temperature adjustments

#### OPERATION

A bulb is connected to a bellows containing a thermally responsive fluid. The bulb is inserted into fluid you are trying to control (process fluid) to sense its temperature. The Regulator set point is adjusted to allow sufficient flow of heating or cooling medium (water or steam) through the valve to keep the process fluid at the desired temperature.

#### Direct Acting (heating application)

**(A)** When the temperature of the process fluid drops below the set point, the temperature of the thermally responsive fluid decreases, which decreases the vapor pressure in the bulb/bellows. The force of the resulting vapor pressure is less than the spring force, so the bellows contract and the spring extends, which raises the valve plug up from its seat. This increases the flow of the heating medium (water or steam), which raises the temperature of the process fluid.

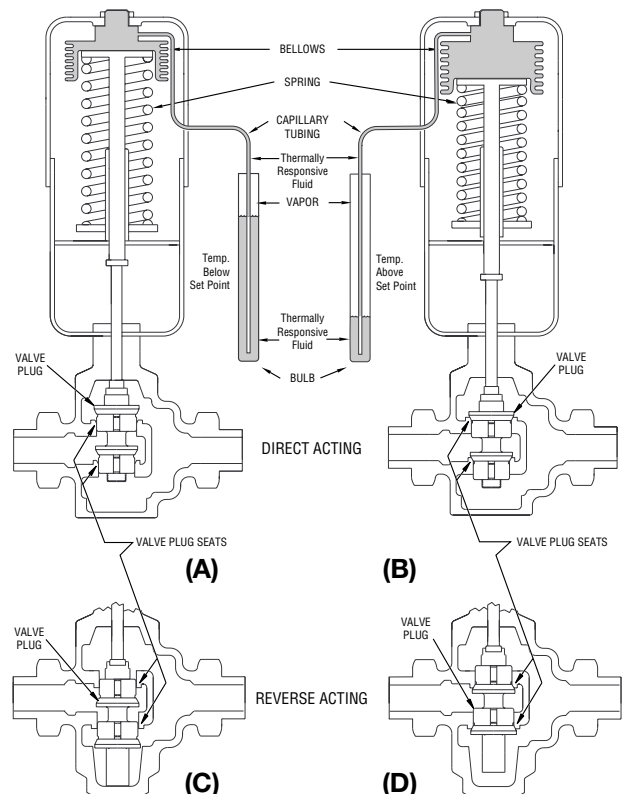
**(B)** As the process fluid temperature increases toward or beyond the desired set point, the temperature of the thermally responsive fluid in the bulb increases, which causes the vapor pressure to increase. This expands the bellows, compresses the spring, and moves the valve plug down and closer to its seat, to reduce or stop the flow of the heating medium.

#### Reverse Acting (cooling application)

**(C)** When the temperature of the process fluid rises toward or above the set point, the temperature of the thermally responsive fluid increases, which increases vapor pressure in the bulb/bellows. The resulting force of the vapor pressure is greater than the spring force, so the spring contracts and the bellows expand to push the valve plug downward,

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away from its seat. This increases the flow of the cooling medium, which lowers the temperature of the process fluid.

**(D)** As the process fluid temperature decreases toward or below the desired set point, the temperature of the thermally responsive fluid decreases, causing the vapor pressure to decrease. This contracts the bellows and expands the spring to pull the valve plug up towards its seat, to reduce or stop the flow of the cooling medium.

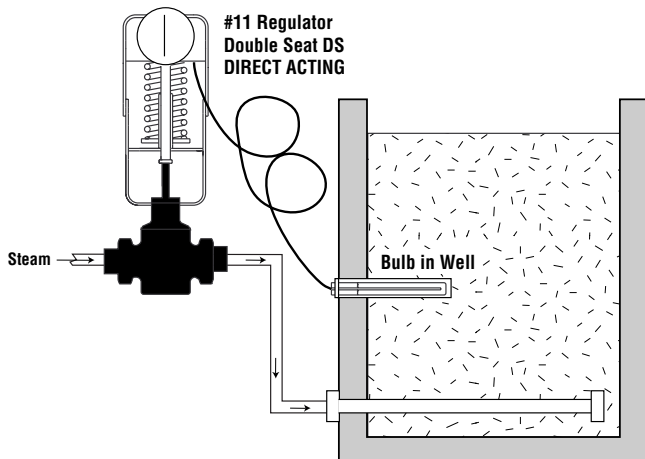
## SPECIFICATIONS

		Valve Sizes	
		1", 1-1/4", 1-1/2", 2"	2-1/2", 3", 4"
Physical Specs	Valve Plug Travel	See Tables on page 10	See Tables on page 10
	Effective Bellows Area	7.8 sq. in. (50.3 sq. cm)	7.8 sq. in. (50.3 sq. cm)
	Body Material	Bronze	Cast Iron
	Body Rating	ANSI Class 250	ANSI Class 125
	Connections	Double Female Union w/NPT threads	Flanged Ends
	Style	Double Seat	Double Seat
	Max. Body Temperature	400°F (204°C)	350°F (177°C)
Operating Specs	Temperature Range	See order code on page 15	See order code on page 15
	Controlled Medium	Steam or Water	Steam or Water
	Max. Differential Pressure	See Tables on page 4	See Tables on page 4
	Max. Allowable Overheat Temp.	25°F (14°C) above range	25°F (14°C) above range
	Max. Well Safe Pressure	See Table on page 11	See Table on page 11
	Max. Body Pressure	250 psi (1724 kPa)	125 psi (862 kPa)
	Shipping Weight	See Table on page 10	See Table on page 10
	Flow Characteristics	Linear	Linear
	Shutoff Class Rating	ANSI Class II	ANSI Class II
	Leakage	0.5% rated valve capacity	0.5% rated valve capacity

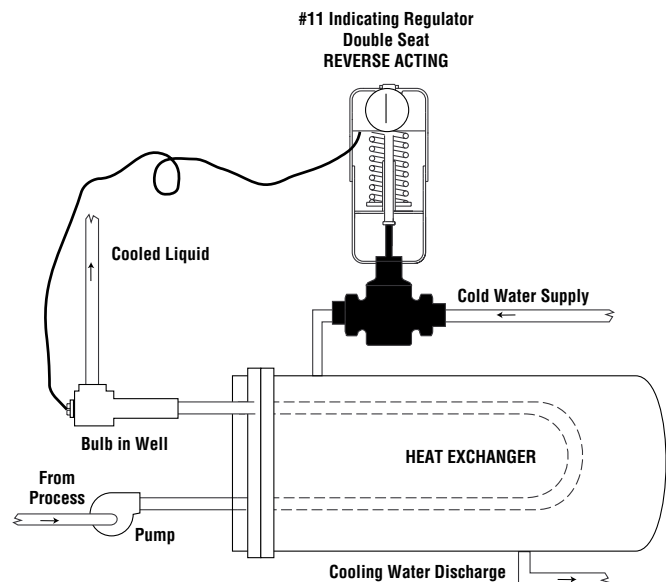
## APPLICATIONS

Powers #11 Balanced Valve Regulators are used to automatically control hot or cold fluids at pressures up to 125 psi. The self-actuated regulator can easily be installed in any convenient location. Among its applications are: hot water systems, fuel oil heaters, heat exchangers, air drying rooms, and many industrial processes. Below are two typical applications.

Balanced valve regulators are well suited to heating applications where the steam inlet pressure is under 125 psig and good shutoff is not required.



**Quench Tank Application (Heating)**



**Heat Exchanger Application (Cooling)**

## SIZING AND SELECTION

Proper sizing of the Regulator is essential for correct system operation. An undersized Regulator will not allow sufficient flow at maximum load. An oversized Regulator may cycle and will not utilize the full valve stroke for efficient modulation of flow. This results in poor control and shortened valve life (quicker deterioration of valve plug and seat). For these reasons, the correct sizing of the Regulator for actual expected conditions is considered essential for good control.

NOTE: For best valve performance, select a bulb that contains your process set point in the upper third of its temperature range (see page 14).

Size the #11 Regulator for actual rather than maximum

conditions. **Do not** size according to piping conditions; piping systems are designed for different criteria than process controls. Refer to Powers document AE-1—"Valve Selection and Sizing"—for further recommendations.

**Maximum Operating Pressure Differential (differential for fluid flow):** In order for the process medium to flow, a pressure drop must exist across the valve. "Pressure differential" is the difference in valve pressure between the inlet and outlet under flow conditions. The greater the differential, the greater the flow at any given plug position.

Though the regulator should be sized for actual conditions, you need to know the available differential at maximum flow. For optimum control, take as much differential as possible across the valve.

## WATER CAPACITIES

Use a pressure drop of at least 25% of inlet pressure when sizing valves for water applications.

**CAUTION:** Do not exceed maximum pressure differentials for given valve sizes. The **maximum differential** is the pressure the valve has against it at shutoff. Too large a differential can cause valve chatter and/or prevent shutoff.

### WATER CAPACITIES --- GPM

Valve Size	Available Sizing Pressure Differential --- PSI																Maximum $\Delta p$ - PSI	
	Cv	2	4	6	8	10	15	20	25	30	40	50	60	80	100	125	Bronze	SS
1"	13.5	19	27	33	38	43	52	60	68	74	85	95	105	121	135	151	50	150
1-1/4"	22	31	44	54	62	70	85	98	110	120	139	156	170	197	220	246	50	150
1-1/2"	28	40	56	69	79	89	108	125	140	153	177	198	217	250	280	313	50	150
2"	53	75	106	130	150	168	205	237	265	290	335	375	411	474	530	593	50	125
2-1/2"	77	109	154	189	218	243	298	344	385	422	487	544	596	-	-	-	50	80
3"	105	148	210	257	297	332	407	470	525	575	664	742	813	-	-	-	50	80
4"	145	205	290	355	410	459	562	648	725	794	917	1025	1123	-	-	-	50	80

### WATER CAPACITIES --- L/S

Valve Size	Available Sizing Pressure Differential --- kPa																Maximum $\Delta p$ - kPa	
	7	15	30	45	60	75	100	125	150	200	250	350	450	550	650	750	Bronze	SS
1"	0.9	1.3	1.8	2.2	2.5	2.8	3.2	3.6	4	4.6	5.1	6.1	6.9	7.6	8.3	8.9	345	1034
1-1/4"	1.4	2	2.9	3.5	4.1	4.6	5.3	5.9	6.5	7.5	8.4	9.9	11	12	13	14	345	1034
1-1/2"	1.8	2.6	3.7	4.5	5.2	5.8	6.7	7.5	8.2	9.5	11	13	14	16	17	18	345	1034
2"	3.4	4.9	7	8.5	9.9	11	13	14	16	18	20	24	27	30	32	35	345	862
2-1/2"	4.9	7.2	10	12	14	16	18	21	23	26	29	35	39	-	-	-	345	552
3"	6.7	9.8	14	17	20	22	25	28	31	36	40	47	54	-	-	-	345	552
4"	9.2	13	19	23	27	30	35	39	43	49	55	65	74	-	-	-	345	552

## STEAM CAPACITIES

Use a pressure drop of 50% of absolute inlet pressure (gauge pressure + 15 psi) for steam applications.

### STEAM CAPACITIES --- LBS./HR.

Valve	Inlet Pressure - PSIG																							
	2		5				10				15				25				50					
Size	Available Sizing Pressure Differential - PSI																							
	1	2	1	2	3	5	2	4	6	8	10	2	5	10	15	2	5	10	15	20	10	15	20	32.5
1"	161	225	176	245	296	372	276	382	457	516	563	304	468	630	732	353	547	747	881	958	980	1174	1326	1572
1-1/4"	263	366	286	400	483	606	450	623	746	841	917	495	762	1027	1192	575	891	1217	1436	1562	1596	1914	2161	2563
1-1/2"	335	466	364	509	614	771	573	792	949	1070	1167	630	970	1307	1517	732	1134	1549	1828	1987	2032	2436	2750	3261
2"	634	882	690	963	1163	1460	1084	1500	1796	2026	2209	1193	1836	2474	2872	1385	2147	2932	3459	3762	3846	4611	5206	6173
2-1/2"	920	1281	1002	1398	1690	2121	1574	2179	2609	2943	3210	1733	2667	3594	4173	2012	3119	4260	5026	5465	5587	6698	7564	8969
3"	1255	1747	1366	1907	2304	2892	2147	2971	3558	4013	4377	2363	3637	4901	5690	2743	4253	5809	6853	7453	7619	9134	10314	12230
4"	1733	2413	1887	2634	3182	3993	2965	4103	4914	5542	6044	3263	5022	6768	7858	3789	5873	8022	9464	10292	10522	12614	14243	16890

**CAUTION:** Do not exceed maximum pressure differentials for given valve sizes. The **maximum differential** is the pressure the valve has against it at shutoff. Too large a differential can cause valve chatter and/or prevent shutoff.

Valve	Inlet Pressure - PSIG												Maximum Δp PSI	
	75				100				125	150	175	200		
Size	Available Sizing Pressure Differential - PSI												Bronze	SS
	10	25	35	45	10	25	35	57.5	70	82.5	95	107.5		
1"	1167	1761	2015	2187	1328	2027	2338	2801	3415	4029	4644	5258	50	150
1-1/4"	1902	2870	3284	3564	2164	3303	3811	4565	5566	6567	7568	8569	50	150
1-1/2"	2420	3653	4180	4535	2754	4203	4850	5809	7083	8357	9631	10905	50	150
2"	4581	6915	7912	8585	5213	7956	9181	10996	13408	15819	18231	20642	50	150
2-1/2"	6655	10046	11495	12472	-	-	-	-	-	-	-	-	50	125
3"	9075	13699	15676	17008	-	-	-	-	-	-	-	-	50	80
4"	12533	18918	21647	23487	-	-	-	-	-	-	-	-	50	80

Always use Stainless Steel trim above 50 psig Inlet Pressure

### STEAM CAPACITIES --- KG./HR.

Valve	Inlet Pressure - kPa																							
	15		30				70				100				175				350					
Size	Available Sizing Pressure Differential - kPa																							
	5	15	5	10	15	30	5	10	15	35	70	10	25	50	100	10	25	50	100	140	10	50	150	250
1"	63	107	67	94	114	156	77	108	131	194	258	117	181	248	324	137	214	296	397	448	176	385	627	753
1-1/4"	103	174	109	153	185	254	125	175	213	315	420	190	295	404	529	224	349	482	647	730	287	627	1021	1228
1-1/2"	131	221	139	194	236	323	159	223	271	401	534	242	376	514	673	285	444	613	823	930	365	799	1300	1562
2"	247	418	263	368	446	612	301	422	513	760	1012	459	711	972	1274	539	841	1161	1558	1760	692	1512	2460	2957
2-1/2"	359	608	382	535	648	889	437	614	746	1104	1470	667	1034	1412	1851	784	1222	1686	2263	2557	1005	2196	3574	4296
3"	489	829	521	729	884	1212	596	837	1017	1505	2004	909	1409	1926	2523	1068	1666	2299	3086	3486	1370	2995	4873	5859
4"	676	1145	719	1007	1221	1674	823	1155	1404	2079	2767	1255	1946	2660	3485	1475	2300	3175	4261	4814	1892	4135	6730	8090

Valve	Inlet Pressure - kPa												Maximum Δp kPa	
	500				700				850	1000	1200	1400		
Size	Available Sizing Pressure Differential - kPa												Bronze	SS
	70	175	250	301	70	175	250	401	476	551	651	751		
1"	525	791	910	971	611	932	1084	1294	1537	1779	2102	2425	345	1034
1-1/4"	856	1289	1483	1583	995	1519	1767	2109	2504	2899	3425	3952	345	1034
1-1/2"	1089	1640	1887	2015	1267	1933	2249	2685	3187	3689	4359	5029	345	1034
2"	2061	3105	3573	3814	2398	3659	4257	5082	6033	6984	8252	9520	345	1034
2-1/2"	2995	4510	5191	5541	-	-	-	-	-	-	-	-	345	862
3"	4084	6151	7078	7556	-	-	-	-	-	-	-	-	345	552
4"	5640	8494	9774	10434	-	-	-	-	-	-	-	-	345	552

Always use Stainless Steel trim above 350 kPa Inlet Pressure

## PRODUCT IDENTIFICATION

A red label should be on the front face of the thermal system, *Figure 1*. This label contains information required to properly maintain, service and order parts for this product.

<b>NO.11 REGULATOR</b>		PRODUCT NO. 595-	
POWERS PROCESS CONTROLS Skokie, IL 60076      Mississauga, Ontario		-	
TEMPERATURE RANGE	BODY STYLE	SIZE	ACTION
°F   °C			
TO CHANGE TEMPERATURE SETTING TURN ADJ. SCREW LOWER ← → HIGHER	BULB MAT.	HEAD RANGE	BULB STYLE
		CAP. LENGTH	DATE CODE

1. PRODUCT LABEL

If there is no label, look for a white label on the inside of the thermal system legs (*Figure 2A*) or the valve body vertical yoke (*Figure 2B*). When replacing the original thermal assembly or valve body, secure the old red label onto the valve or thermal system or ink the number onto the body.

POWERS PROCESS CONTROLS		
THERMAL SYSTEM		
PRODUCT NUMBER		
PARTS NO.	MODEL	DATE

2A. THERMAL SYSTEM LABEL

POWERS PROCESS CONTROLS		
LOWER ASSEMBLY		
PRODUCT NO.		
TYPE: DISC. ACT.:		
PARTS NO.	MODEL	DATE

2B. VALVE BODY LABEL

## INSTALLATION

### TOOLS NEEDED

- Straight slot screwdriver
- 5/16" open end wrench
- 3/8" open end wrench
- 7/16" open end wrench
- 13/16" open end wrench
- 1-3/8" open end wrench

### POSITION VALVE

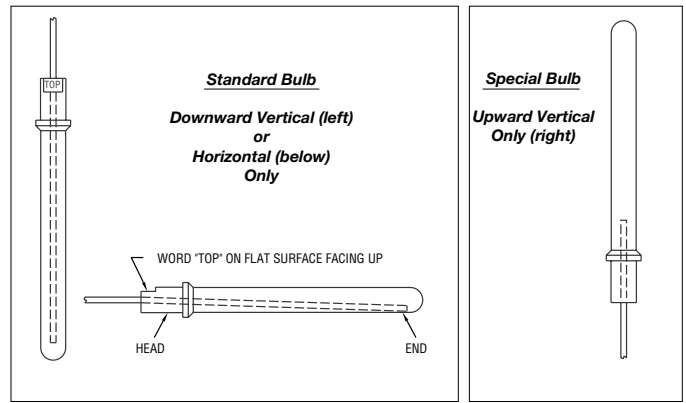
1. To insure proper system operation, thoroughly flush all piping and valves to rid them of all scale, dirt and debris.
2. Select valve location with sufficient clearance to allow maintenance. Install valve in line. The direction of the arrows on the valve body must match the direction of the water or steam flow.

For best results, we recommend installing the valve in a horizontal line, and in the upright position with bellows head above valve. The valve may also be installed in any position within 90° of upright.

### INSTALL BULB

3. *Figure 3A* shows proper bulb orientation. *Figure 3B* shows the special bulb needed for upwards vertical positioning.
4. *Figure 4*. For any position, fully immerse the bulb in the flow of the medium.

These instructions are for D style bulbs - for installation of other styles, refer to tag attached to bulb.

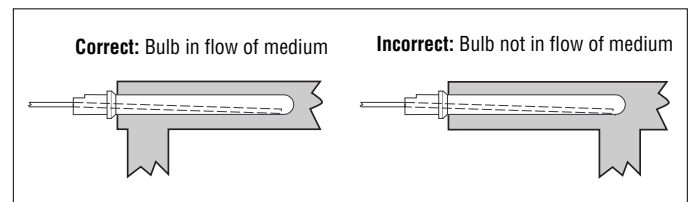


3A. BULB ORIENTATION

3B. SPECIAL BULB

5. **Without a well:** Remove bushing from the bulb and screw it into the tank. Insert the thermostatic bulb through the bushing and tighten the union nut.

**With a well:** Do not use bushing. Screw well into tank, insert bulb directly into well, and tighten union nut.



4. BULB POSITION

### ADJUST CAPILLARY TUBING

6. Coil the extra capillary, and position away from regulator operation where it is subjected to room temperature only.

**WARNING:** DO NOT kink, cut, sever or file the tubing. DO NOT disconnect tubing from bulb or bellows assembly. This can render the thermal system inoperable and result in severe process overheating.

### ADJUST SET POINT

All regulators are factory set to control near mid-range operating temperature.

7. When adjusting the set point, make certain the heating or cooling medium is flowing through the valve and is at the operating pressure of the system.

8. *Figure 5*. Make all set point temperature changes by inserting the temperature adjustment rod into one of the holes of the adjusting nut assembly. (Use the temperature adjustment setting scale only for reference)



5. ADJUSTING SET POINT

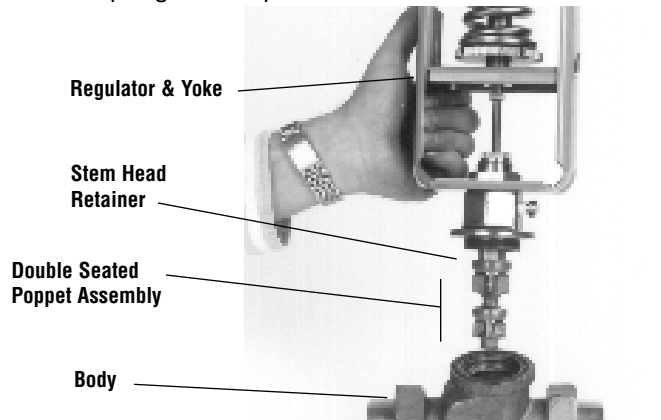
**To Raise the set point:** Turn rod left to right (counter-clockwise from top).

**To Lower the set point:** Turn rod right to left (clockwise from top).

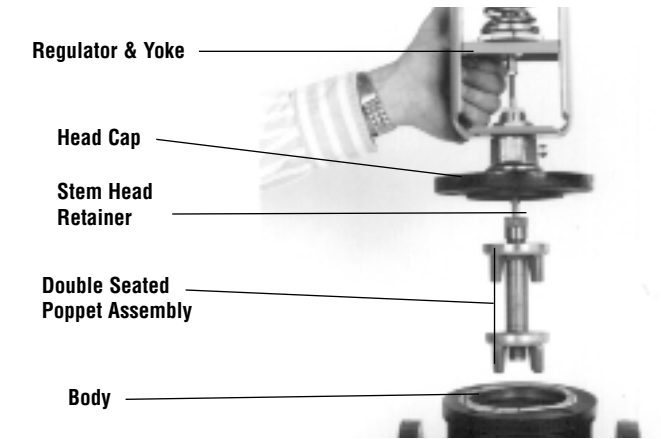
**DA: To only replace the valve plug**

1. Before disassembly, the **bulb must be cooled** 30°F (16°C) below the lowest point on the thermal system range, and **flow through the valve must be stopped**.
2. *Figure 5.* Relieve all pressure on the spring by turning adjusting nut assembly [31] fully right to left (clockwise from top).
3. *Figure 6A.* **1" to 2" valves:** Use 1-3/8" wrench to loosen lock nut [11]. Then, use 1-3/8" wrench to unscrew bonnet [20] from valve body [26]. **DO NOT ALLOW** the regulator top to rotate.

Lift up regulator top.



6A. (DA, 1" TO 2") LIFT OFF REGULATOR FROM VALVE BODY



6B. (DA, 2-1/2" TO 4") LIFT OFF REGULATOR FROM VALVE BODY

*Figure 6B.* **2-1/2" to 4" valves:** Use the 13/16" wrench to loosen and remove the four hex head cap screws [28] and top cap [29b] from the valve body.

Lift up regulator top.

5. Remove stem retainer [22] and replace poppet assembly [24]

6. **1" to 2" valves:** Install a new gasket [21] between bonnet and valve body.  
**2-1/2" to 4" valves:** Install a new gasket [21] between the top cap and valve body for a tight seal.
7. Replace bonnet and stem into valve body.
8. With valve plug firmly seated, screw stem extension [4] to the dimension shown in *Figure 15* and tighten into place with hex nut [12].
9. Assemble in reverse order.

**DA/RA: To fully disassemble regulator from valve**

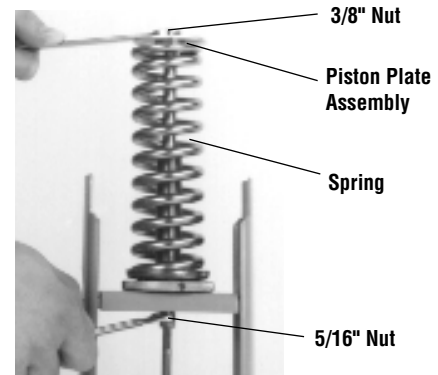
1. Before disassembly, the **bulb must be cooled** 30°F (16°C) below the lowest point on the thermal system range, and **flow through the valve must be stopped**.
2. *Figure 5.* Relieve all pressure on the spring by turning adjusting nut assembly [31] fully right to left (clockwise from top).
3. *Figure 7.* Remove housing bolts [6] and nuts [7] and temperature adjustment setting scale [8] and lift off thermal system [1] (housing, bellows, capillary, and bulb).



7. REMOVE HOUSING AND THERMAL SYSTEM

4. *Figure 8.* Using one 3/8" wrench and one 5/16" wrench, carefully loosen and remove piston plate assembly [2,3] from the stem extension [4].

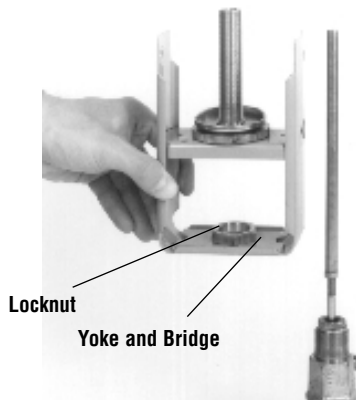
Lift off spring [19].



8. REMOVE PISTON PLATE/SPRING



5. *Figure 9.* Use 1-3/8" wrench to unscrew lock nut [11] and lift off the yoke and bridge assembly [9].

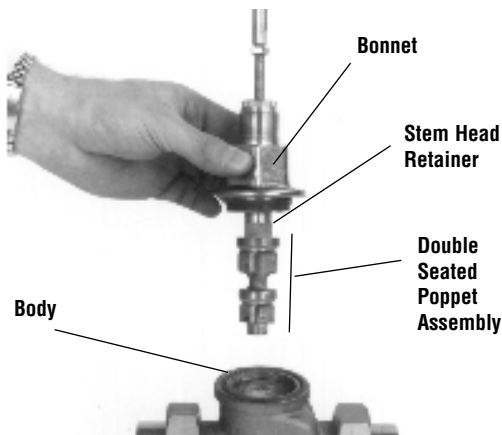


9. LIFT OFF YOKE AND BRIDGE

**DA: To replace packing**

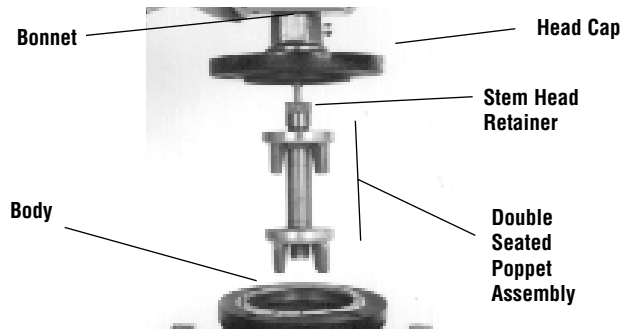
Follow steps 1-5, **To fully disassemble regulator from valve.**

6. *Figure 10A.* **1" to 2":** Loosen and remove bonnet [20] from valve body [26].



10A.. (DA, 1" TO 2") REMOVE BONNET FROM VALVE

- Figure 10B.* **2-1/2" to 4":** Loosen and remove bonnet [20] from valve body [26].



10B. (DA, 2-1/2" TO 4") REMOVE BONNET FROM VALVE

7. Carefully pull out poppet [24] and stem assembly [30]. Check the stem. It must have a polished surface that is free of roughness and pitting. Replace any parts if necessary.

8. *Figure 13.* Remove packing gland [14], and all packing components [15a-15e].
9. Clean packing chamber, taking care not to scratch seating surfaces. Be sure chamber is free of dirt and grease.

10. **1" to 2" valves:** Install a new gasket [21] between bonnet and valve body. Replace bonnet [20] and stem [30] into valve body.

**2-1/2" to 4" valves:** Replace bonnet [20] and stem [30] into valve

**NOTE:** You must replace the bonnet and stem before attempting to insert the packing. Otherwise, you may tear the packing rings.

11. For standard packing kits, install the parts as shown in *Figure 13.*

Slide part(s) [15e], followed by [15d] and [15c] over the stem. Gently push them into the packing chamber.

**NOTE:** Some kits do not include all the listed packing parts (see page 12), but the order for part installation is the same.

12. **For EP V-rings,** lubricate the rings first. Slide each V-ring [15b] over the stem and carefully push it into the packing chamber.

13. Place the packing gland spacer [15a] on top of the bonnet.

14. Thread the packing gland assembly [14] into the bonnet. Tighten the gland assembly against the spacer.

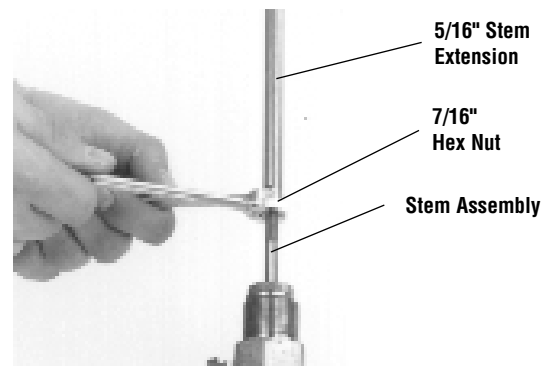
15. **With valve plug firmly seated** (stem in full down position) screw stem extension [4] to the dimension shown in *Figure 15* and tighten into place with hex nut [12].

16. Assemble the remaining parts in reverse order.

**RA: To replace the valve plug / replace the packing**

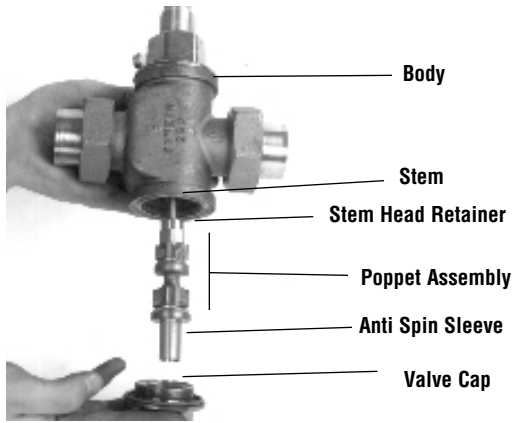
Follow steps 1-5, **To fully disassemble regulator from valve.**

6. *Figure 11.* Use a 5/16" wrench on the flats of the stem extension [4] and a 7/16" wrench on the hex nut [12] to loosen and remove them.



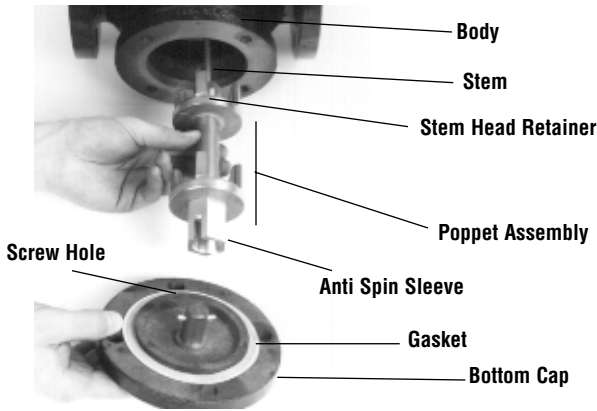
11.(RA) DISCONNECT STEM EXTENSION FROM STEM

7. *Figure 12A. 1" to 2" valves:* Loosen and remove valve cap.



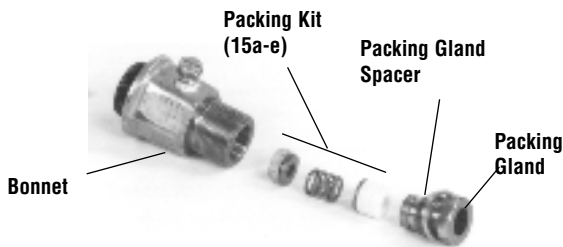
12A. (RA, 1" TO 2" ) REMOVE VALVE CAP

*Figure 12B. 2-1/2" to 4" valves:* Loosen and remove the four bottom cap screws and the bottom cap [29].



12B (RA, 2-1/2" TO 4" ) REMOVE BOTTOM CAP/SCREWS

8. Pull out poppet [24] and stem assembly [30]. Check the stem. It must have a polished surface that is free of roughness and pitting. Replace any parts if necessary.
9. Unscrew plug from the stem retainer and replace.
10. *Figure 13.* Remove packing gland [14], and all packing components [15a-15e].



13. PACKING COMPONENTS

10. Clean packing chamber, taking care not to scratch seating surfaces. Be sure chamber is free of dirt and grease.
12. Insert plug and stem in valve body.

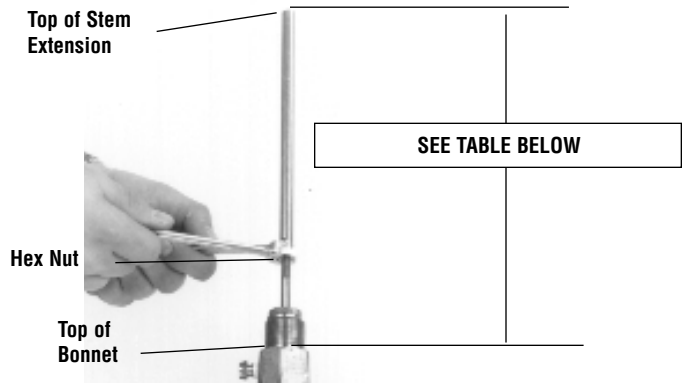
**NOTE:** You must replace the plug and stem before attempting to insert the packing. Otherwise, you may tear the packing rings.

13. **1" to 2" valves:** Screw valve cap into place and tighten.
- 2-1/2" to 4" valves:** Install a new gasket [21] between the bottom cap and body. Hold the bottom cap in place and secure with the four cap screws.
14. For standard packing kits, install the parts as shown in *Figure 13.*

Slide part(s) [15e], followed by [15d] and [15c] over the stem. Gently push them into the packing chamber.

**NOTE:** Some kits do not include all the listed packing parts (see page 12), but the order for part installation is the same.

15. **For EP V-rings,** lubricate the rings first. Slide each V-ring [15b] over the stem and carefully push it into the packing chamber.
16. Place the packing gland spacer [15a] on top of the bonnet.
17. Thread the packing gland assembly [14] into the bonnet. Tighten the gland assembly against the spacer.
18. *Figure 14.* **With poppet firmly seated** (see chart below for position), screw stem extension to the dimension given and tighten into place with hex nut.



Valve Action	Stem Setting Dimension (See Above)		
	Valve Size		
	1"-2-1/2"	3"	4"
DA (Stem DOWN)	10-1/8" (+1/32, -0) [257mm (+.79, -0)]	10" (+1/32, -0) [254mm (+.79, -0)]	9-7/8" (+1/32, -0) [251mm (+.79, -0)]
RA (Stem UP)	10-11/32" (+0, -1/32) [263mm (+0, -.79)]	10-11/32" (+0, -1/32) [263mm (+0, -.79)]	10-11/32" (+0, -1/32) [263mm (+0, -.79)]

14. STEM EXTENSION DIMENSIONS

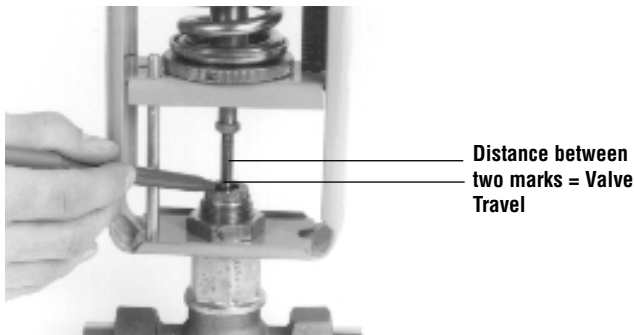
19. Assemble in reverse order.



## TESTING THE THERMAL SYSTEM

If the valve is not responding to temperature change, test the thermal system.

1. Stop the flow of fluid through the line.
2. **DA:** Raise the temperature of the bulb above the set point temperature by placing it in a container of hot water. This will cause the plug to fully seat.  
**RA:** Raise the temperature of the bulb above the set point temperature by placing it in a container of hot water. This will cause the plug to fully open.
3. *Figure 15.* With the valve plug in the desired position, use a felt tip pen to mark the position of the packing gland assembly on the stem.



15. VALVE TRAVEL

4. **DA:** Place the bulb in a pan of cool water. Cool the bulb 30°F (16°C) below set point so the valve is fully open.  
**RA:** Place the bulb in a pan of cool water. Cool the bulb to or beyond the set point so the valve plug is seated.
5. Use the pen to mark the new position of the packing gland assembly on the stem.
6. The distance between the marks is the valve plug travel. This should correspond with the TRAVEL value in the VALVE DIMENSIONS table on page 10. **No movement or only partial movement indicates the thermal system is defective and should be replaced with a new system.**

**WARNING:**

Failure of the #11's thermal system will cause a heating valve to full open and a cooling valve to full close. If either of these valve states results in an unsafe process condition, a high-limit shutdown device, such as a Powers Aqua Sentry, should be used.

## PREVENTIVE MAINTENANCE

**WARNING: Failure of the thermal system will result in a constant rise in temperature (or constant high temperature) of the fluid which you are trying to control.**

Once every three months, inspect the Regulator as follows:

1. Visually check for leaks from the valve body joints, piping-to-valve connections, packing and stem areas
2. Visually check for excessive corrosion on the regulator, including the bellows, capillary, bulb, thermal system legs, bridge, and yoke. Also check for excessive corrosion on the valve body.
3. Perform the instructions in **Testing the Thermal System**. Less than full valve travel may indicate a leak in the bellows, capillary, or bulb, or other problems. This may result in excessive temperature in the process.
4. Test the temperature adjusting nut assembly for freedom of movement (see **Adjust Set Point** for instructions).
5. Remove bulb from the process fluid and check for excessive corrosion, or erosion that may weaken the bulb and/or cause thermal system failure.

## TROUBLESHOOTING

### • Erratic temperature control (valve cycles too hot/cold)

1. Valve sized incorrectly. Verify valve selection.
2. Regulator is controlling at incorrect set point. Refer to **Adjust Set Point**.
3. Bulb is poorly positioned and/or oriented, and will not control the actual temperature of the heating/cooling medium. Refer to **Install Bulb**.
4. Incorrect type of bulb is being used. See Table on page 11.
5. The valve stem is sticking. Lubricate the stem.
6. The valve stem is bent. Refer to **Maintenance** for disassembly instructions and replace.
7. Packing gland assembly too tight. Loosen packing gland nut.
8. Faulty or incorrect steam traps. Replace with correct steam trap.
9. Very wet steam. Install a high pressure steam trap just ahead of the valve to drain off condensate that collects in the steam line.

### • Regulator does not shut off

1. Pressure differential is greater than allowable pressure drop. Refer to **Water Capacities** and **Steam Capacities** tables.
2. Plug and/or seat is worn. Refer to **Maintenance**. Replace seat and/or valve body plug.
3. Foreign material between the plug and seat. Refer to **Maintenance**. Clean.
4. Bulb is poorly positioned and/or oriented, and will not control the actual temperature of the heating/cooling medium. Refer to **Install Bulb**.
5. Incorrect type of bulb is being used. See Table on page 11.
6. Valve sized incorrectly, causing wire drawing and leakage. Refer to **Sizing Information**.
7. Packing gland assembly is too tight, locking valve stem. Loosen packing gland assembly and lubricate if desired.
8. Bent valve stem; need to replace. Refer to **Maintenance** for disassembly instructions.
9. Thermal system failure. Refer to **Testing the Thermal System**.
10. Temperature adjusting nut assembly raised too high. Refer to **Adjust Set Point**.

### • Regulator controlling at too low a temperature

1. Temperature adjusting nut assembly raised too high. Refer to **Adjust Set Point**.
1. Pressure differential is greater than allowable pressure drop. Refer to **Water Capacities** and **Steam Capacities** tables.

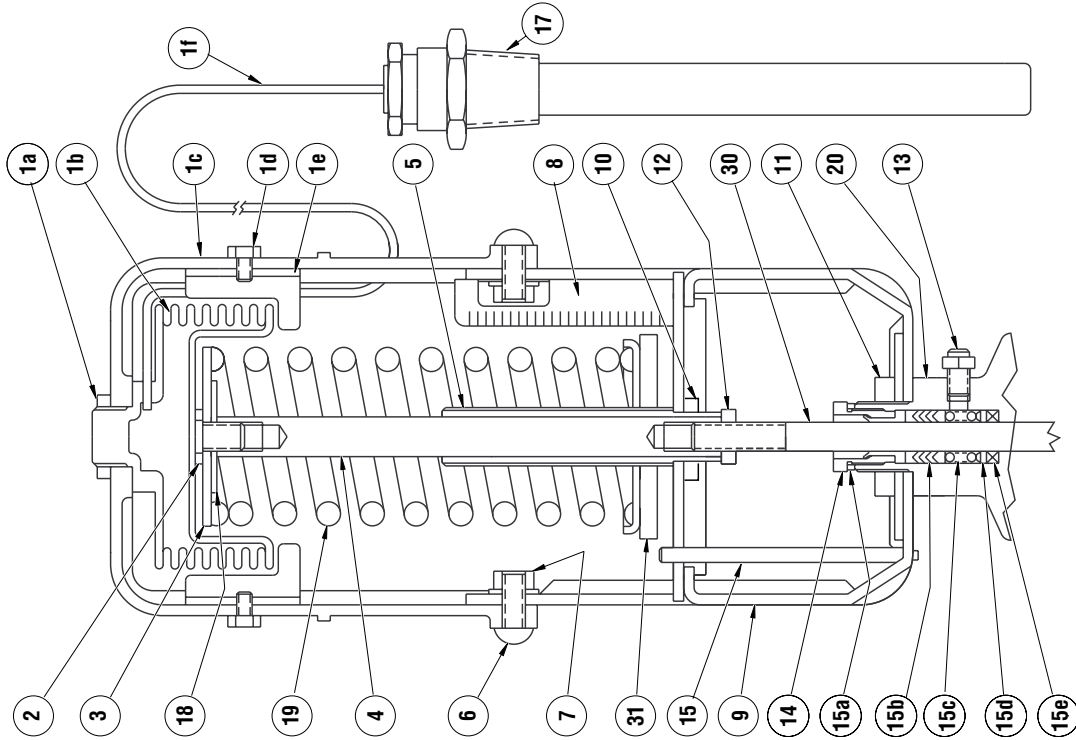
### • Valve "chatters"

1. Regulator installed with the flow of the control medium in reverse of arrow direction on valve body.
2. Pressure differential too high, refer **Water Capacities** and **Steam Capacities** tables for correct range.
3. Trapped condensate in line. Install a steam trap just ahead of the regulator to drain off condensate that collects in the steam line.

### • Constant rise in process fluid temperature

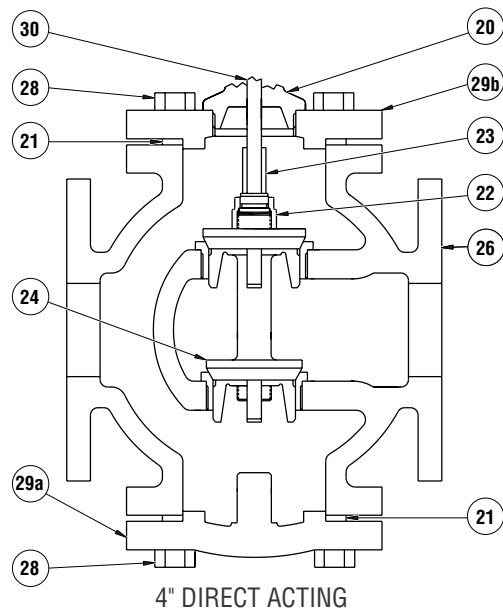
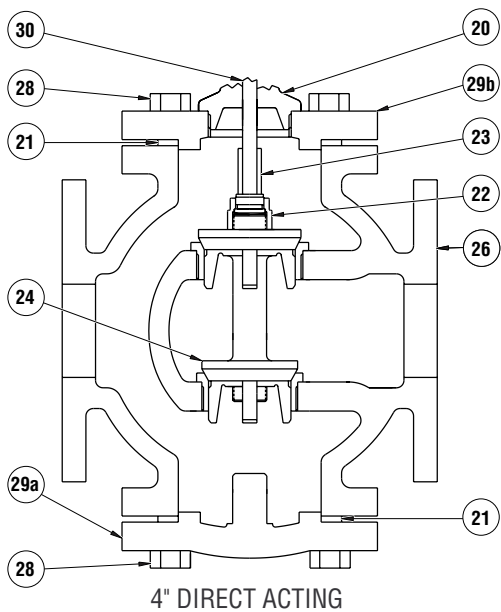
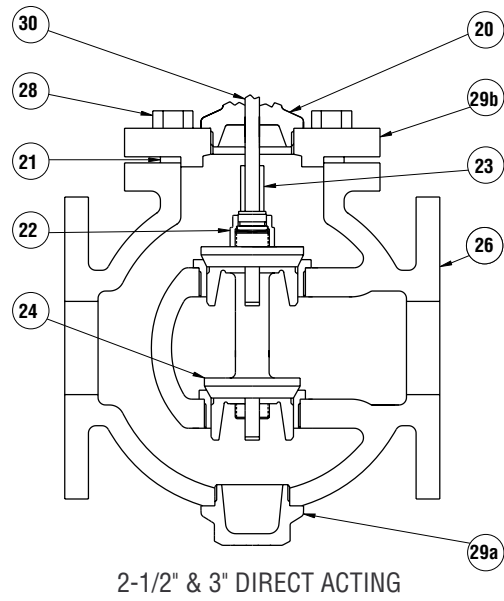
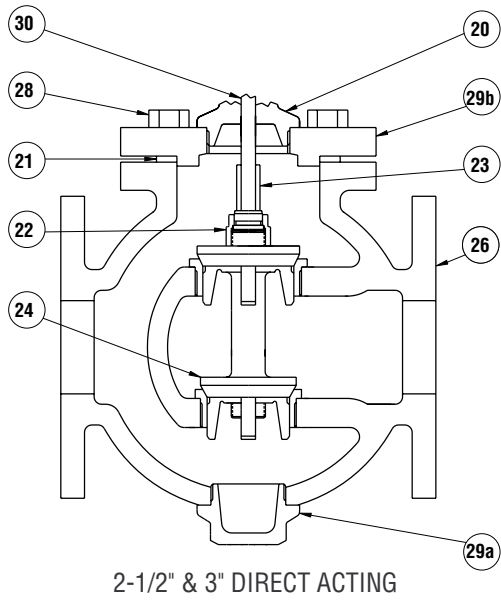
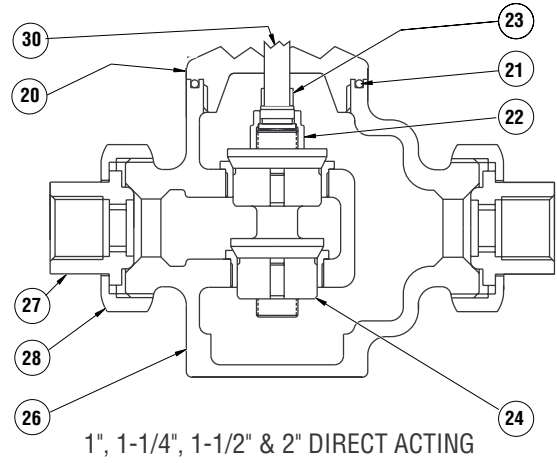
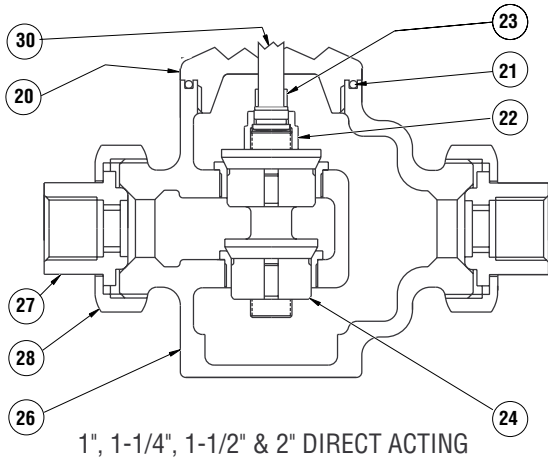
1. **DA (Heating Valve):** A constant rise in temperature may indicate the thermal system is leaking charge and/or the valve has failed in a partially or fully open position. This would allow a constant flow of heating medium, which would overheat the fluid which you are trying to control.
2. **RA (Cooling Valve):** A constant rise in temperature may indicate the thermal system is leaking charge, and or the valve has failed in a partially or fully closed position. This would slow or stop the flow of cooling medium which would overheat the fluid which you are trying to control.

**PARTS**



REGULATOR PARTS	DIRECT & REVERSE ACTING						Qty	Material
	1"	1-1/4"	1-1/2"	2"	2-1/2"	4"		
1a-f Thermal System	Refer to Order Code							
1a Locknut			(Included in Thermal System)				1 Brass	
1b Thermal Motor/Bellows			(Included in Thermal System)				2 Aluminum	
1c Housing			(Included in Thermal System)				1 Al & Steel	
1d Screw			(Included in Thermal System)				2 Zn plated Steel	
1e Bellows Stop			(Included in Thermal System)				1 Cu	
1f Bulb/Capillary Assembly			(Included in Thermal System)				1 SS	
2 Piston Plate Retaining Screw			590 816				1 Zn plated Steel	
3 Piston Plate Washer			590 815				1 Brass	
4 Stem Extension			590808B				1 Brass	
5** Spring Adjustment Screw			590 807				1 Zn plated Steel	
6 Screw			030546J				2 Cd plated Steel	
7 Hex Nut 5/16 - 18			041225K				1 Aluminum	
8 Temp. Adj. Setting Scale			590 813				1	
** Lower Housing Assembly			590 859				1	
9** Yoke and Bridge Assembly			Not sold as individual Part				1	
10** Nut, hex			041167J				1 Zn plated Steel	
11 Nut, hex			041 125				1 Brass	
12 Locknut			628 008				1 Brass	
13 Pipe Plug			403 007				1 Brass	
13 Stem Lubricator Kit			590184A				1 Brass	
14 Packing Gland Assembly			590 763				1 Brass	
15a-e Packing Kits			Refer to Accessory Kits on page 16				1	
15a Packing Spacer			(Included in Packing Kit)				1	
15b Packing Set			(Included in Packing Kit)				1	
15c Packing Spring			(Included in Packing Kit)				1	
15d Packing Washer			(Included in Packing Kit)				1	
15e Packing Ring			(Included in Packing Kit)				1	
16 Temp. Adj. Rod			590 820				1 Cd plated Steel	
17 1" Tank Fitting			705 005				1 Brass	
17 1-1/4" Tank Fitting			705 006				1 Bronze	
18 Spring Guide Washer		590 814	595 503				1 Steel	
19 Spring		590 821	-				1 Zn plated Steel	
19 Spring, inner		-	595 501				1 Zn plated Steel	
19 Spring, outer		-	595 502				1 Zn plated Steel	
31** Temp. Adj. Nut Assembly			590 829				1	

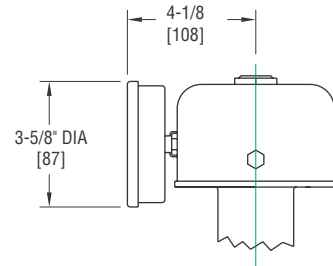
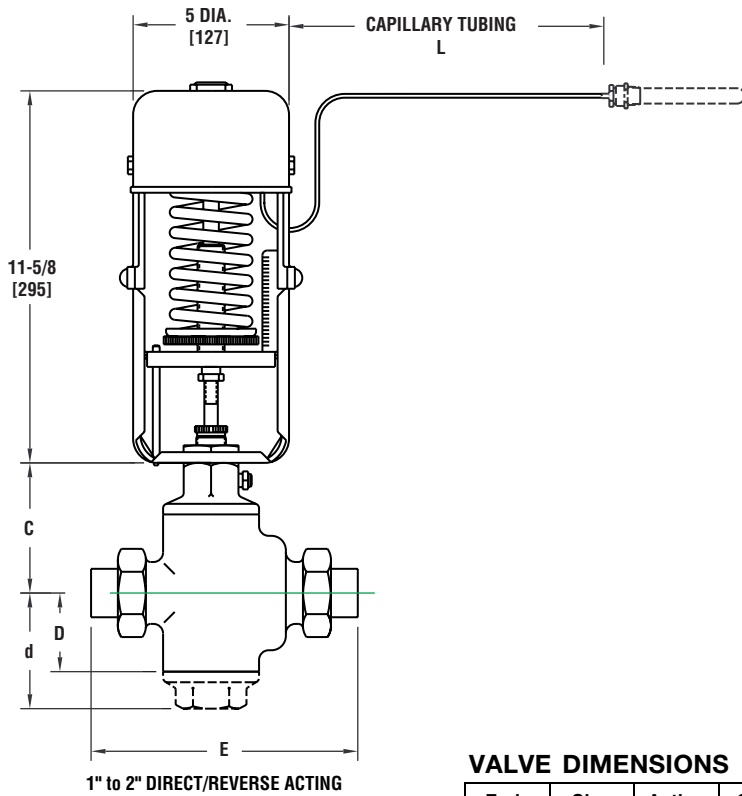
**PARTS**



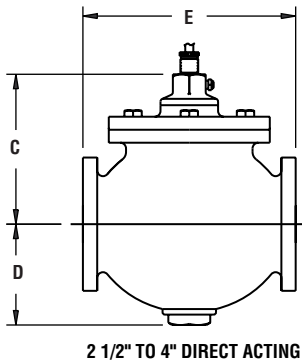
VALVE PARTS		DIRECT ACTING							Qty	Material
Item	Description	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"		
20-30	Valve Assembly	Refer to Order Code							1	
20	Bonnet	594 499	594 499	594 468	594 456	590 137	590 137	590 137	1	Brass
21	O-ring	084 008	084 008	084 009	084 010	-	-	-	1	Silicone
	Gasket (non asbestos)	-	-	-	-	612 055	612 055	-	1	Gasketing
	Gasket (non asbestos)	-	-	-	-	-	-	612 055	2	Material*
22	Stem Head Retainer	603 012	603 012	603 012	-	-	-	-	1	Brass
	Stem Head Retainer	-	-	-	612 100	612 100	612 100	612 100	1	416 SS
23	Spacer Bushing (DB)	609019C	609 019	609019A	609019C	-	-	-	1	Brass
	Spacer Bushing (DS)	609019C	609019C	609019C	609019A	-	-	-	1	Brass
23	Valve Stop Sleeve (DB)	-	-	-	-	609019D	609019E	609019J	1	Brass
	Valve Stop Sleeve (DS)	-	-	-	-	609019D	609019E	609019J	1	Brass
24	Poppet Assy. (DB)	603 003	604 003	605 003	594 354	613 045	613 045	617 037	1	(see Specs)
	Poppet Assy. (DS)	591 948	591 949	91 950	591 951	613 025	613 025	617 041	1	(see Specs)
26	Body/Seat Assy. (DB)	594 509	594 494	594 482	594 461	616 030	616 032	617 031	1	(see Specs)
	Body/Seat Assy. (DS)	594 511	594 496	594 483	594 463	616 031	616 033	617 032	1	(see Specs)
27	Union Tail Piece	609 003	610 003	611 003	-	-	-	-	2	Brass
	Union Tail Piece	-	-	-	590 233	-	-	-	2	Bronze
28	Union Nut	609 004	610 004	611 004	590 234	-	-	-	2	Bronze
28	Screw	-	-	-	-	035 163	035 163	-	4	SS
	Screw	-	-	-	-	-	-	035 163	8	SS
29	Valve Cap	-	-	-	-	(see valve assembly)		-	1	(see Specs)
29a	Blind Cap	-	-	-	-	-	-	613 052	1	Iron
29b	Top Cap	-	-	-	-	700 073	700 073	700 073	1	Iron
30	Stem Assembly	594816E	594816E	594816E	594817A	591817C	591817B	591817D	1	

VALVE PARTS		REVERSE ACTING							Qty	Material
Item	Description	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"		
20-30	Valve Assembly	Refer to Order Code							1	
20	Bonnet	594 499	594 499	594 468	594 456	700 102	700 102	590 137	1	Brass
21	O-ring	084 008	084 008	084 009	084 010	-	-	-	2	Silicone
21	Gasket	-	-	-	-	612 055	612 055	612 055	2	*
22	Stem Head Retainer	603 012	603 012	603 012	-	-	-	-	1	Brass
	Stem Head Retainer	-	-	-	612 100	612 100	612 100	612 100	1	416 SS
23	Valve Stop Sleeve (DB)	601 090	601 091	601 093	590 328	-	-	-	1	Brass
	Valve Stop Sleeve (DS)	601 090	601 091	601 092	590 329	-	-	-	1	Brass
23a	Anti-Spin Sleeve (DB)	-	-	-	-	700 189	700 189	700 189	1	Zn pltd Steel
	Anti-Spin Sleeve (DS)	-	-	-	-	700 317	700 317	700 317	1	SS
23b	Dowel Pin	-	-	-	-	700 188	700 188	700 188	1	Cd pltd Steel
23c	Screw (1/4-20 x 1/4)	-	-	-	-	034 389	034 389	034 389	1	Steel
24	Poppet Assy. (DB)	603 003	604 003	605 003	594 354	613 045	613 045	617 037	1	
	Poppet Assy. (DS)	591 948	591 949	591 950	591 951	613 025	613 025	617 041	1	
26	Body/Seat Assy. (DB)	594 510	594 495	594 484	594 462	616 030	616 032	617 031	1	
	Body/Seat Assy. (DS)	594 512	594 497	594 485	594 464	616 031	616 033	617 032	1	
27	Union Tail Piece	609 003	610 003	611 003	-	-	-	-	2	Brass
	Union Tail Piece	-	-	-	590 233	-	-	-	2	Bronze
28	Union Nut	609 004	610 004	611 004	590 234	-	-	-	2	Bronze
28	Screw	-	-	-	-	035 163	035 163	-	4	SS
	Screw	-	-	-	-	-	-	035 163	8	SS
29	Valve Cap	594 510	591 781	594 472	594 466	-	-	-	1	Brass
29a	Blind Cap	-	-	-	-	613 049	613 050	613 052	1	Iron
29b	Top Cap	-	-	-	-	-	-	700 073	1	Iron
30	Stem Assembly	594816E	594816E	594816E	594817A	591817C	591817D	591817E	1	

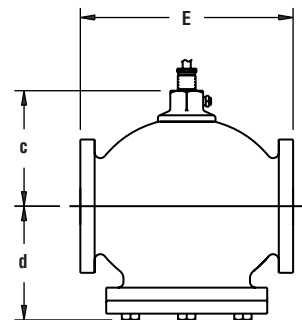
# DIMENSIONS



Optional Indicating Head



2 1/2" TO 4" DIRECT ACTING



2 1/2" TO 4" REVERSE ACTING

## VALVE DIMENSIONS

Ends	Size	Action	C * /c ** (in)	D * /d ** (in)	E (in)	Travel (in)	Actual Wt. (Lbs)	
							Non-Ind.	Indicating
Double Union	1"	DA	3 3/8	2 1/8	6 3/4	3/16	22	24
		RA	3 3/8	2 3/4	6 3/4	1/4	22	24
	1-1/4"	DA	3 5/8	2 1/2	7	1/4	24	26
		RA	3 5/8	3	7	1/4	24	26
	1-1/2"	DA	3 3/4	2 5/8	8	1/4	26	28
		RA	3 3/4	3 1/4	8	1/4	26	28
2"	DA	4 7/8	3 5/8	9 5/8	3/8	36	39	
	RA	4 7/8	4 3/8	9 5/8	5/16	36	39	
Flanged	2-1/2"	DA	6 5/8	4 3/8	9 1/8	3/8	85	87
		RA	5	5 3/8	9 1/8	5/16	85	87
	3"	DA	6 7/8	4 3/8	9 1/8	7/16	85	-
		RA	5 1/16	5	9 1/8	7/16	85	-
4"	DA	6 7/8	5 3/8	10 3/4	9/16	110	-	
	RA	6 7/8	5 3/8	10 3/4	9/16	110	-	

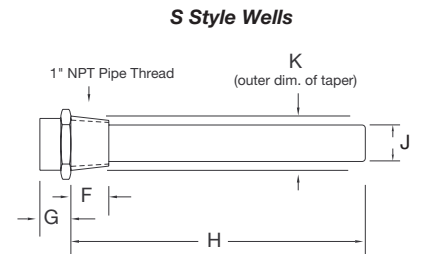
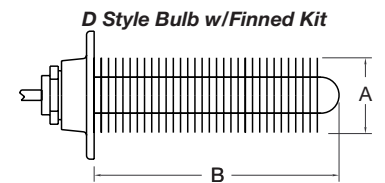
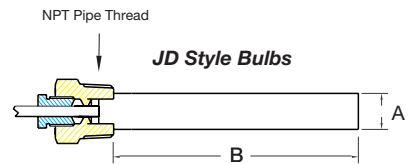
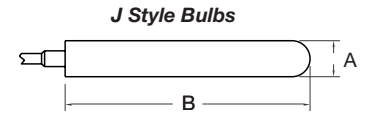
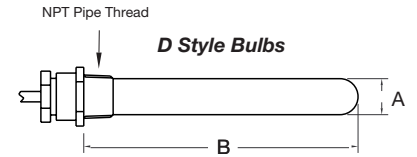
Ends	Size	Action	C * /c ** (mm)	D * /d ** (mm)	E (mm)	Travel (mm)	Actual Wt. (Kg)	
							Non-Ind.	Indicating
Double Union	1"	DA	86	54	171	5	10	11
		RA	86	70	171	6	10	11
	1-1/4"	DA	92	64	178	6	11	12
		RA	92	76	178	6	11	12
	1-1/2"	DA	95	67	203	6	12	13
		RA	95	83	203	6	12	13
2"	DA	124	92	244	10	16	18	
	RA	124	111	244	8	16	18	
Flanged	2-1/2"	DA	168	111	232	10	39	39
		RA	127	137	232	8	39	39
	3"	DA	175	111	232	11	39	-
		RA	129	127	232	11	39	-
4"	DA	175	137	273	14	50	-	
	RA	175	137	273	14	50	-	

\* DA      \*\* RA



**BULB DIMENSIONS**

Bulb Style	Size	Material	A (in)	B (in)	Tank Ftg.	Max. Pressure - PSI	
					NPT	Shock	Non-Shock
D Fixed Union (& V-Vertical Fixed Union)	1 x 9	Copper	15/16	8	1"	175	250
		347 Stainless	15/16	8 1/16	1"	500	725
	1 x 20	Copper	15/16	19 7/8	1"	175	250
		347 Stainless	15/16	19 13/16	1"	500	725
	1-1/4 x 24	Copper	1 3/16	22 11/16	1-1/4"	150	200
J Plain Bulb*	1 x 9	347 Stainless	15/16	8 3/4	-	-	-
		Teflon Coated	15/16	8 3/4	-	-	-
	1 x 20	347 Stainless	15/16	20 1/2	-	-	-
		Teflon Coated	15/16	20 1/2	-	-	-
JD Adjustable	1 x 9	347 Stainless	15/16	8 3/4	1"	500	725
	1 x 20	347 Stainless	15/16	20 1/2	1"	500	725
G Finned Kit*	1 x 9	Copper	2	8 13/16	-	-	-
	1 x 20	Copper	2	20 15/16	-	-	-



Bulb Style	Size	Material	A (mm)	B (mm)	Tank Ftg.	Max. Pressure - kPa	
					NPT	Shock	Non-Shock
D Fixed Union (& V-Vertical Fixed Union)	1 x 9	Copper	24	203	1"	4445	6350
		347 Stainless	24	205	1"	12700	18415
	1 x 20	Copper	24	505	1"	4445	6350
		347 Stainless	24	503	1"	12700	18415
	1-1/4 x 24	347 Stainless	30	576	1-1/4"	3810	5080
J Plain Bulb*	1 x 9	347 Stainless	24	222	-	-	-
		Teflon Coated	24	222	-	-	-
	1 x 20	347 Stainless	24	521	-	-	-
		Teflon Coated	24	521	-	-	-
JD Adjustable	1 x 9	347 Stainless	24	222	1"	12700	18415
	1 x 20	347 Stainless	24	521	1"	12700	18415
G Finned Kit*	1 x 9	Copper	51	224	-	-	-
	1 x 20	Copper	51	532	-	-	-

**WELL DIMENSIONS**

Bulb Size	Well Kit #	Well Material	F (in)	G (in)	H (in)	J (in)	K (in)	Tank Ftg.	Max. Well Pressure - PSI	
								NPT	Shock	Non-Shock
1 x 9	709 193	Chrome Plated Copper	15/16	13/16	9 1/16	1	1.11	1"	175	250
	808 478	316L Stainless Steel	1 1/16	13/16	8 11/16	1 1/64	1.11	1"	450	675
	808 476	Carbon Steel	1	1 13/16	7 11/16	1 1/8	1.125	1"	1000	1500
1 x 20	709 075	Chrome Plated Copper	15/16	13/16	21 1/16	1	1.11	1"	175	250
	808 475	316L Stainless Steel	1 1/16	13/16	20 3/8	1 1/64	1.11	1"	450	675
1-1/4 x 24	709 128	Chrome Plated Copper	1 3/16	1 1/16	24	1 1/4	1.25	1-1/4"	150	200
	808 461	347 Stainless Steel	1 1/8	1 1/16	23 5/16	1 14/53	1.39	1-1/4"	360	540

Bulb Size	Well Kit #	Well Material	F (mm)	G (mm)	H (mm)	J (mm)	K (mm)	Tank Ftg.	Max. Well Pressure - kPa	
								NPT	Shock	Non-Shock
1 x 9	709 193	Chrome Plated Copper	24	21	230	25	28	1"	1207	1724
	808 478	316L Stainless Steel	27	21	221	26	28	1"	3103	4654
	808 476	Carbon Steel	25	46	195	29	29	1"	6895	10342
1 x 20	709 075	Chrome Plated Copper	24	21	535	25	28	1"	1207	1724
	808 475	316L Stainless Steel	27	21	518	26	28	1"	3103	4654
1-1/4 x 24	709 128	Chrome Plated Copper	30	27	610	32	32	1-1/4"	1034	1379
	808 461	347 Stainless Steel	29	27	592	32	35	1-1/4"	2482	3723

## ACCESSORIES

Packing kits can be ordered to replace parts in the packing assembly (See pages 12 & 13).

Kit #	Description	Valve Size	Stem Size	Usage	Parts	Lubricant
591 927	Teflon V-ring	1/2" - 2"	1/4"	Effective from 200°F-400°F Steam: 50 - 200 psi	15A, 15B 15C, 15D 15E	None
594 220	EP V-ring	1/2" - 2"	1/4"	Effective from 0°F-300°F Steam: 50 PSI maximum Water: up to maximum PSI valve rating	15A, 15B 15C, 15D 15E	Silicone required for installation (optional for service)
594 289	TFE Split Ring	1/2" - 2"	1/4"	For replacement only Effective from 40°F-366°F	15B, 15D	Silicone <b>Part #087 126</b>
591 928	Teflon V-ring	2-1/2" - 6"	3/8"	Effective from 200°F-400°F Steam: 50 - 200 psi	15A, 15B 15C, 15D 15E	None
594 221	EP V-ring	2-1/2" - 6"	3/8"	Effective from 0°F-300°F Steam: 50 PSI maximum Water: up to maximum PSI valve rating	15A, 15B 15C, 15D 15E	Silicone required for installation (optional for service)
594 290	TFE Split Ring	2-1/2" - 6"	3/8"	For replacement only Effective from 40°F-366°F	15B, 15D	Silicone <b>Part #087 126</b>

Kit #	Bulb Dims.	Width (in)	Length (in)	Description
701 549	1 x 9	2	8 13/16	G Style Finned Kit (Copper)
701 550	1 x 20	2	20 15/16	G Style Finned Kit (Copper)

Finned Bulb Kits may be added to style "D" Bulb as noted.

## TEMPERATURE RANGES/BULB SIZES

For ordering thermal systems, refer to order code, the Powers #11 Product Specification Brochure, or call Powers.

Bulb Size	Bulb Temp. Range		Order Code
	Double Seat 1" to 2-1/2"		
	Heating DA	Cooling RA	
1" x 20"	10-70°F (-12-21°C)	0-60°F (-18-16°C)	01
	55-115°F (13-46°C)	45-105°F (7-41°C)	02
	85-145°F (29-63°C)	70-130°F (21-54°C)	03
	-	90-150°F (32-66°C)	04
1" x 9"	110-170°F (43-77°C)	110-150°F (43-66°C)	05
	130-190°F (54-88°C)	-	-
	140-200°F (60-93°C)	120-180°F (49-82°C)	07
	170-230°F (77-110°C)	150-210°F (66-99°C)	08
	200-250°F (93-121°C)	185-245°F (85-118°C)	09
	230-290°F (110-143°C)	220-280°F (104-138°C)	10
	270-330°F (132-166°C)	255-315°F (124-157°C)	11

Bulb Size	Bulb Temp. Range		Order Code
	Double Seat 3" and 4"		
	Heating DA	Cooling RA	
1-1/4" x 24"	10-70°F (-12-21°C)	0-60°F (-18-16°C)	12
	55-115°F (13-46°C)	45-105°F (7-41°C)	13
	85-145°F (29-63°C)	70-130°F (21-54°C)	14
	-	90-150°F (32-66°C)	44
1" x 20"	110-170°F (43-77°C)	-	15
	130-190°F (54-88°C)	-	16
	140-200°F (60-93°C)	120-180°F (49-82°C)	17
	170-230°F (77-110°C)	150-210°F (66-99°C)	18
	200-250°F (93-121°C)	185-245°F (85-118°C)	19
	230-290°F (110-143°C)	220-280°F (104-138°C)	20
	270-330°F (132-166°C)	255-315°F (124-157°C)	21

**ORDER CODE**

	Valve Assembly				Thermal System Assembly			
<b>595-</b>								
<b>Valve Type</b>								
Double Seat Bronze Trim	DB							
Double Seat Stainless Trim	DS							
<b>Valve Sizes</b>								
1"	100							
1-1/4"	125							
1-1/2"	150							
2"	200							
2-1/2"	250							
3"	300							
4"	400							
<b>Applications</b>								
Heating	H							
Cooling	C							
<b>Bulb/Capillary Material &amp; Length</b>								
Copper 8'	C08							
Copper 15'	C15							
Copper 30'	C30							
Stainless Steel 8'	S08							
Stainless Steel 15'	S15							
Stainless Steel 30'	S30							
Teflon over Copper 15' (J Bulb Only)	T15							
Teflon over SS 15' (J Bulb Only)	O15							
<b>Bulb Size</b>								
Fixed Union (N/A Teflon)	D							
No Pipe Fittings (N/A Copper)	J							
Adj. Union (N/A Teflon)	A							
Fixed Union (D Type) Vertical	V							
<b>Head Assembly</b>								
Non-Indicating	N							
Indicating	I							
<b>Range/Bulb Size</b>								
<b>See chart on page 16</b>	##							
Select Range with Set Point in UPPER THIRD for best performance.								

For additional information on your application or equipment, please contact a Powers application engineer.

**CALIFORNIA PROPOSITION 65 WARNING**

**WARNING:** This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.  
(Installer: California law requires that this warning be given to the consumer.)

**For more information:** [www.wattsind.com/prop65](http://www.wattsind.com/prop65)

**POWERS**

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