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## Series 2000 Temperature Regulator Sizes 1/2" through 2"

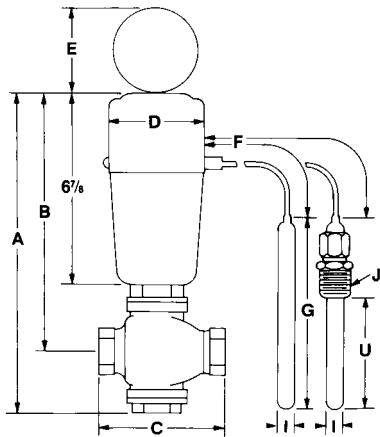
The Spence Series 2000 Temperature Regulator is available with single or double seat in direct or reverse acting. It is also available with two seat areas for three way mixing.

### VALVE RATINGS (Maximum Inlet Conditions)

Valve Ends ASME/ANSI	Pressure PSIG (bar)	Temperature °F (°C)
Class 250 NPT	250 (17.2)	406 (207)

### MODELS

- Type 2010 — Single Seat, Direct Acting
- Type 2020 — Single Seat, Reverse Acting
- Type 2030 — Double Seat, Direct Acting
- Type 2040 — Double Seat, Reverse Acting
- Type 2050 — Three-way Mixing



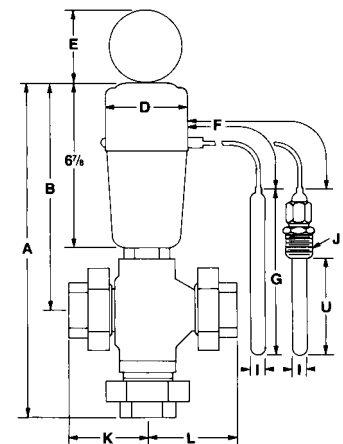
**SERIES 2000 DIRECT  
& REVERSE ACTING**

### DIRECT & REVERSE ACTING DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)

Size	Type No.	Dimensions						Ft	Shipping Weight (Approx.)
		A	B	C	D	E			
1/2" (A, B, C, D, E) 1/2, 3/4	2010	9 3/4 (248)	8 1/2 (216)	5 1/2 (140)	3 1/2 (89)	2 13/16 (71)	8 Ft.	10 (4.5)	
	2020								
1/2" 3/4"	2030	12 7/16 (316)	9 3/4 (248)	7 3/16 (182)	3 1/2 (89)	2 13/16 (71)	8 Ft.	13 (5.9)	
	2040								
1"	2010	12 7/16 (316)	9 3/4 (248)	7 3/16 (182)	3 1/2 (89)	2 13/16 (71)	8 Ft.	13 (5.9)	
	2020								
1 1/4" 1 1/2" 2"	2030	12 7/8 (327)	9 31/32 (253)	8 15/16 (227)	3 1/2 (89)	2 13/16 (71)	8 Ft.	20 (9.1)	
	2040							25 (11)	
								30 (14)	

### TYPE 2050 THREE WAY DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)

Size	Dimensions							Shipping Weight (Approx.)
	A	B	D	F†	K	L	E	
1/2" 3/4" 1"	13 7/8 (352)	9 3/4 (248)	3 1/2 (89)	8 Ft.	3 5/16 (84)	3 5/8 (92)	2 13/16 (71)	12 (5.5)
								12 (5.5)
								13 (5.9)
1 1/4" 1 1/2"	14 21/32 (372)	9 31/32 (253)	3 1/2 (89)	8 Ft.	4 1/8 (105)	4 11/16 (119)	27 (12)	
2"	14 7/8 (378)	9 31/32 (253)	3 1/2 (89)	8 Ft.	4 3/16 (106)	4 7/8 (124)	33 (15)	



**TYPE 2050 THREE WAY**

### COPPER BULB DIMENSIONS\* inches (mm)

Bulb Sizes	G	U	I			J (NPT)
			Plain	Union	Well	
Small	13 3/8 (340)	10 1/2 (267)	5/8 (16)	5/8 (16)	3/4 (19)	3/4 or 1
Large	15 5/8 (397)	12 1/2 (317)	1 (25)	1 (25)	1 1/8 (29)	1
Extra Large	19 (483)	16 (406)	1 (25)	1 (25)	1 1/8 (29)	1

\*For Stainless Steel and Coated Bulb Dimensions, consult factory.

SD 1520C/0611

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## PRODUCT IDENTIFICATION

Each Spence Series 2000 Regulator may be properly identified in the field.

Valve size— (1/2" through 2") is stamped on the raised pads on each side of the valve body.

Direct or Reverse Acting—defined by the letter "D" for direct acting and "R" for reverse acting cast on the end of the valve body

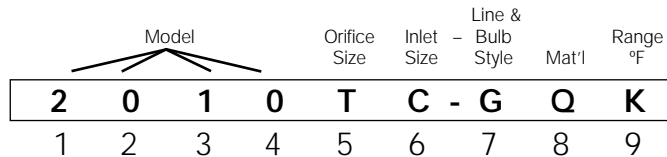
screwed into the bonnet/frame assembly.

Direction of Flow—signified by an arrow cast on the valve.

Single or Double Seated—cast on each side of the valve body directly above the raised rectangular pad stamped with the valve size.

## PRODUCT IDENTIFICATION

### SERIES 2000 TEMPERATURE REGULATOR CODE SELECTION CHART



<b>Model -</b> Position 1, 2, 3 & 4 2010 = Single Seat, Direct Acting 2020 = Single Seat, Reverse Acting 2030 = Double Seat, Direct Acting 2040 = Double Seat, Reverse Acting 2050 = Three Way
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<b>Orifice -</b> Position 5 A B C D E T = Standard
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<b>Inlet Size -</b> Position 6 C = 1/2 D = 3/4 E = 1 F = 1¼ G = 1½ H = 2
<b>Line &amp; Bulb Style -</b> Position 7 G = Indicating N = Non-indicating

<b>Material<sup>†</sup> -</b> Position 8 Q = Copper Bz Armor 8' R = Copper Bz Armor 15' N = Copper Bz Armor 25' P = Copper Bz Armor 40' T = SS Unarmored 8' V = SS Unarmored 15' W = SS Unarmored 25' X = SS Unarmored 40' Z = Other
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<b>Range °F -</b> Position 9 A = 15/50 B = 15/75 C = 45/115 D = 45/145 E = 65/140 F = 65/170 J = 120/200 K = 120/230 L = 240/310 M = 240/340 N = 280/375 P = 280/415 Z = Other
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† For SS Armored Thermal Assembly Material, add (-TV) at the end of the code (ex.: 2010TC-NTH-TV)  
 † Small bulb standard for J-1 range and higher.  
 Extra large bulb standard for D range and lower.  
 Large bulb standard for E and F range

### FLOW AND PRESSURE RATINGS psig (bar)

Size	Single Seat 2010, 2020		Double Seat 2030,2040		Three Way 2050				
	Flow Coefficient C <sub>v</sub>	Max. Upstream Pressure	Flow Coefficient C <sub>v</sub>	Max. Upstream Pressure	Flow Coefficient C <sub>v</sub>	Max. Difference Between Inlet Pressures*			
1/2"C	.40	250 (17.2)	N/A						
1/2"D	1.00								
1/2"E	1.80								
1/2"A	3.29								
1/2"B	4.29	200 (13.8)	250 (17.2)						
1/2"T	5.22	140 (9.7)					7.93	5.22	140 (9.7)
3/4"T	6.85	90 (6.2)					10.4	6.85	90 (6.2)
1"T	9.15	65 (4.5)					12.9	9.15	65 (4.5)
1¼"T	14.3	40 (2.8)					20.6	14.3	40 (2.8)
1½"T	15.1	30 (2.1)					24.8	15.1	30 (2.1)
2"T	17.2	20 (1.4)					33.0	17.2	20 (1.4)

#### CAUTION!

*The piping system must be adequately designed and supported to prevent extraordinary loads to the pressure equipment.*

**Warning:** Injury or death can occur due to failure to completely isolate valve from all sources of pressure before beginning disassembly. Do not proceed until valve has been completely isolated from process stream and vented to atmosphere.

## OPERATING PRINCIPLE

A Spence Series 2000 Temperature Regulator controls the flow of the media passing through its valve by responding to temperature changes at the temperature bulb. The valve is made up of two assemblies: the valve body and the thermal system assemblies. The thermal system of the Series 2000 Temperature Regulator consists of a temperature probe (bulb), pressure chamber (bellows) and a length of tubing (capillary) which connects the two. A liquid is sealed inside the thermal system. For each temperature range, a specific liquid is used.

On temperature increase, the vapor pressure of the liquid in the bulb increases, forcing liquid into the capillary and bellows and increases the pressure exerted on the bellows. On temperature decrease, the vapor pressure of the liquid in the bulb decreases, withdrawing liquid from the bellows which reduces the pressure exerted on the bellows.

A balance is established between the force exerted by the bellows and the counteracting range spring force. On bellows pressure increase, the bellows volume expands, the compression of the range spring increases and the stem moves downward. On bellows pressure decrease, the bellows volume compresses, the range spring expands and the stem moves upward.

For a direct acting valve, an increase in bulb temperature closes the valve (heating). For a reverse acting valve, an increase in bulb temperature opens the valve (cooling).

### 2050 Three Way Valve

The 2050 three way valve meets most mixing or diverting application requirements. When used for mixing, the forces developed by the two inlet flows oppose each other and create a balanced environment. On temperature increase, the bellow shall force the disc (plug) to close the bottom inlet of the valve (hot fluid), at the same time the other side inlet of the valve (cold fluid) shall be opened until the temperature is balanced again. See Fig 2

When used for diverting, the forces developed by the two outlet flows oppose each other and create a balanced environment. On temperature increase, the bellow shall force the disc to close the bottom outlet of the valve and open the side outlet of the valve until temperature is balanced again.

For diverting service, simply rotate the valve installation. The diverter inlet is the outlet mixing. See Fig 2.

## RECOMMENDED INSTALLATION

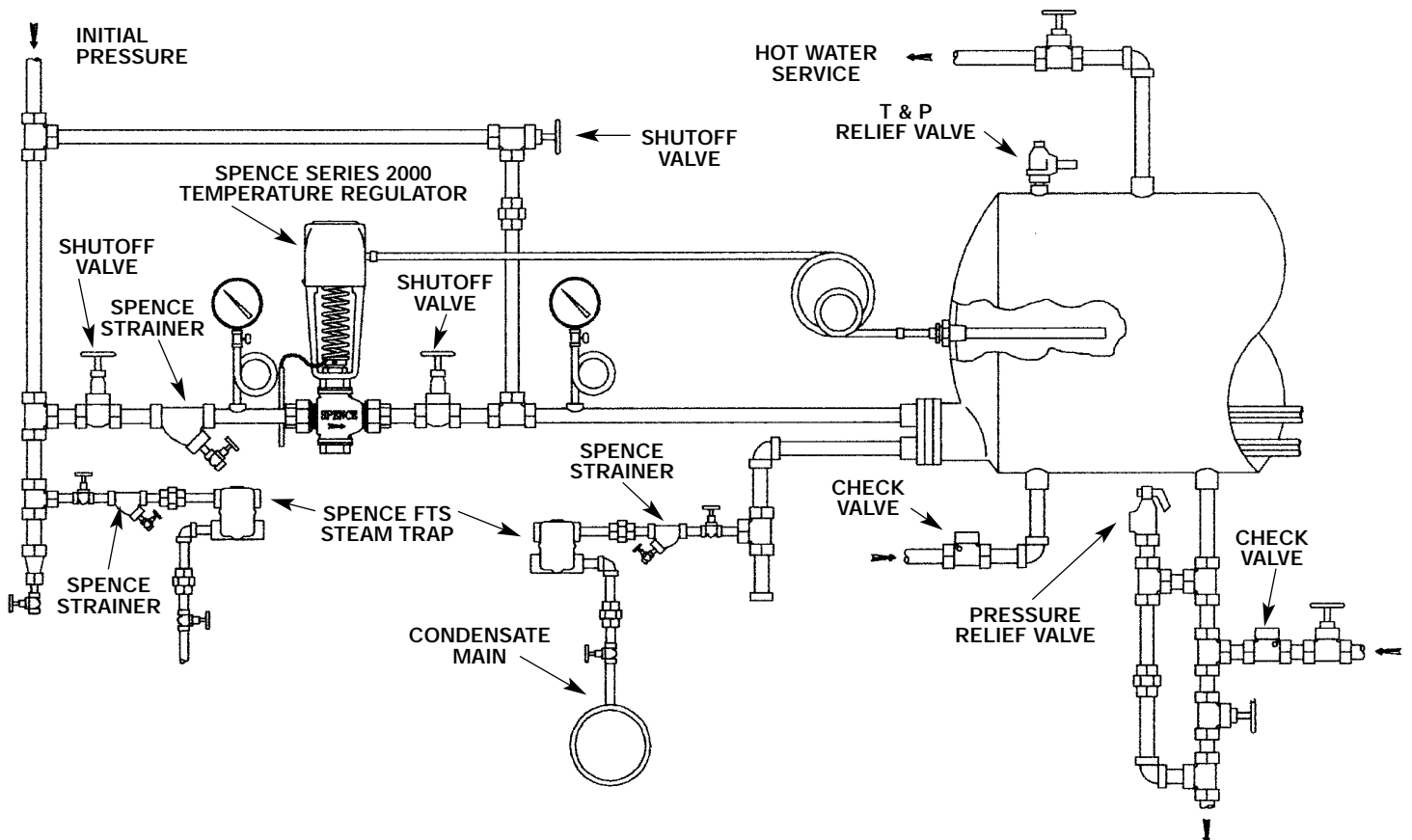
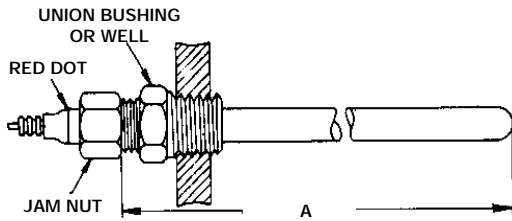
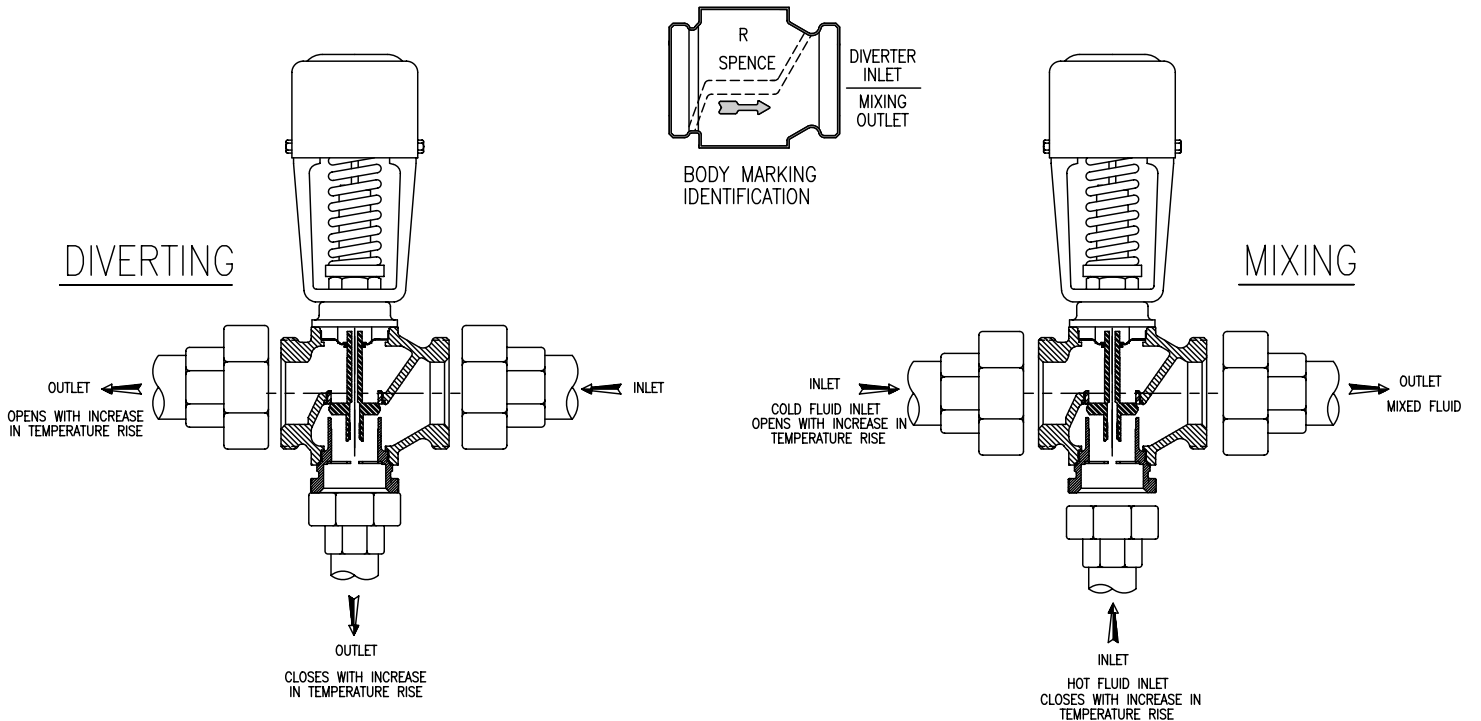


FIGURE 1

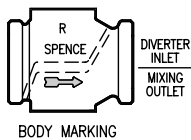
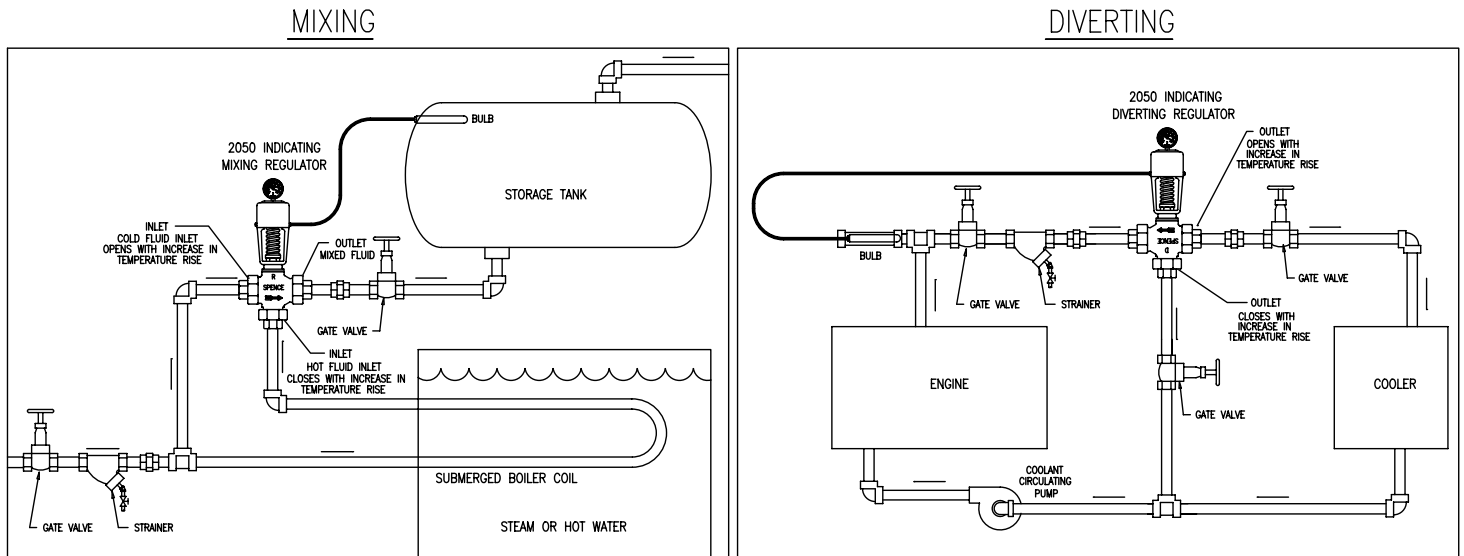
# RECOMMENDED INSTALLATION FOR 2050 SERIES



## LOCATING JAM NUT ON BULB

Bulb	Diameter	A
Small	5/8	11 7/8
Large	1	13 7/8
Extra Long	1	17 3/8

FIGURE 2



# INSTALLATION

Warning: Failure of the thermal system or foreign material lodged between the valve's closure members can lead to an over-temperature and/or an over-pressure condition which may cause injury and/or property damage. Never install a Spence Series 2000 Temperature Regulator in a system, which does not have a properly installed, code approved temperature and pressure safety valve or other approved safety device. These devices must be suitable for the equipment and processes involved and in conformance to applicable codes.

## VALVE BODY

The Spence Series 2000 Temperature Regulator should be placed so that the heating or cooling media will flow through it the direction of the arrow cast on the valve body. A Spence Strainer and a Spence FTS Steam trap should be placed ahead of the valve to protect the valve from damaging effects of dirt, scale, foreign material and condensate. A manual shut off valve should be placed before and after the valve. A bypass line with a manual shut off valve should be place around the valve for manual operation if the valve is out of service. See the Figure 1 for a recommended installation diagram. Additional recommended installation diagrams can be found in the Spence Regulator Handbook.

To avoid stresses on the valve or unions, the connecting pipes should be cut to the exact length required and should be in correct alignment. To connect the valve, remove the union ends from the valve body and attach them to the nipples on each side of the valve. When tightening the unions to the valve always use two wrenches. "Never use the valve frame for leverage." The valve should be installed in the vertical position with the thermal assembly on top.

## BULB

The location of the bulb should be chosen carefully so that the temperature of the media around the bulb or well will be representative of the entire body of fluid being heated or cooled. Important: For all applications where the bulb is mounted in the horizontal position the red dot on the bulb must be facing upward. When large volumes of oil are being heated it may be necessary to place the bulb near the heating coils to avoid dangerous hot spots which would result if the bulb was remote for the heating coils.

Plain bulbs (standard for Series 2000), without a union bushing, are used in open tanks, ovens, drying, rooms, kilns, etc. The bulb on these installations should be suspended vertically, pointing downward, and held securely by suitable straps or clamps. If the

application requires that the bulb be held in a horizontal position, the free end of the bulb must not be higher that the fixed end, and the red dot on the bulb must be upward.

## UNION BUSHINGS

When a union bushing is required for the bulb the union bushing is ordered and shipped separate from the valve. The union bushing consists of three parts: the bushing, sleeve and jam nut. Attach the bushing tightly to the equipment. Slide the jam nut and sleeve on the bulb and locate them at a distance as shown in Figure 2. This distance should be maintained during installation and use. This distance will allow for the entire effective length of the bulb to be totally immersed in the media. Insert the bulb into the bushing making sure first that the insertion depth corresponds to Figure 2 and tighten the jam nut to secure the bushing to the bulb.

## WELLS

When a well is required for the bulb the well is ordered and shipped separate from the valve. The well consists of three parts: the cylinder, sleeve and jam nut (a separate union bushing is not required). Attach the cylinder tightly to the equipment. Slide the jam nut and sleeve on the bulb and locate them at a distance as shown in Figure 2. The bulb should be coated with a heat conducting media such as a mixture of graphite and glycerin or high temperature grease. This improves the speed of response of the regulator. Insert the bulb into the well making sure first that the insertion depth corresponds to Figure 2. After the bulb is inserted, position it so that the red dot on the bulb is upward, then tighten the jam nut to secure the bulb to the well.

## REPLACEMENT THERMAL SYSTEMS

The vapor pressure in some systems is too high at ordinary ambient temperatures to permit removal of the shipping block without damage to the bellows. To reduce the vapor pressure to within safe limits, the complete system (bulb, line and bellows) must be cooled as specified in Figure 3.

Allow the system to cool for a period of at least 15 minutes before removing the shipping block. Then, assemble the bellows to the regulator frame as quickly as possible after removal from the cooler so that it will have no chance to warm up. The bulb should remain in the cold bath while the bellows is being assembled.

After the bellows is assembled to the frame, the bulb and bellows may warm up without damaging the bellows.

For Systems with Ranges starting at	Cool System to	Suggested Cooling Means
90°F to 110°F	50°F or lower	Tap water mixed with ice as needed
65°F to 85°F	32°F or lower	Crushed ice mixed with water
45°F to 60°F	10°F or lower	Crushed ice mixed with plenty of salt
-15°F to 40°F	-35°F or lower	Alcohol and "dry ice"

FIGURE 3

## ADJUSTMENT

Unless otherwise specified, the regulator is shipped from the factory with the adjustment nut at its lowest position and must therefore be raised to the desired control setting. When the temperature, for which the regulator has been set, is reached, it will be maintained automatically. After the installation is completed, preset the regulator according to Figure 3.

The operating range of the regulator is indicated on the nameplate. The setting scale is stamped on the side of the frame and is graduated 0 to 10 representing the limits of the operating range. This is an arbitrary scale, since it must necessarily vary for different temperature ranges. Figure 4 gives the approximate temperature equivalent for all scale settings in each temperature range. The values are not absolute and will vary from one regulator to another because of manufacturing tolerances. On initial starting, the controlled temperatures may overshoot slightly, then drop back. Allow sufficient time for the process to stabilize before checking the controlled temperature and making fine adjustments. The arm extending out from the adjusting nut indicates the temperature setting.

To change the temperature setting, turn the adjusting nut up if a higher temperature is desired and down if a lower temperature is desired. The adjusting pin needed for this purpose is chained to the end of the indicating arm.

On regulators equipped with a temperature indicator, the orientation of the indicator may be changed by loosening the bracket retaining screws and rotate the indicator a maximum of 180°F in either direction.

All Series 2000 Regulators are provided with a safety spring which will prevent the bellows from expanding (even though the valve has reached the end of its travel) and draining the bulb of its fill.

This prevents a buildup in vapor pressure which would damage the bellows.

There is, however, a limiting temperature applicable to each thermostat fill used. It is the temperature above which the chemistry of the fill will decompose. This limiting temperature is, therefore, the maximum allowable temperature on Series 2000 Regulators supplied with bulbs as indicated in Figure 5.

### APPROXIMATE TEMPERATURE EQUIVALENTS FOR VARIOUS SCALE SETTINGS

Regulator Setting	Range, °F							
	-15/50	-15/75	45/115	45/145	65/140	65/170	240/310	240/340
0	*	*	*	*	*	*	*	*
1	-15	-12	45	50	65	70	236	240
2	-3	5	58	70	80	91	250	267
3	8	22	72	87	92	108	265	281
4	18	35	81	102	103	125	275	296
5	26	45	92	114	114	137	285	308
6	34	55	101	124	124	147	295	318
7	40	63	108	135	131	158	303	329
8	47	77	115	143	138	167	310	337
9	53	80	122	152	145	177	317	347
10	58	86	129	158	157	183	322	353

Regulator Setting	Range, °C							
	-26/10	-26/24	7.2/46	7.2/63	18/60	18/77	116/154	116/171
0	*	*	*	*	*	*	*	*
1	-26	-24	7	10	18	21	113	116
2	-19	-15	14	21	27	33	121	131
3	-13	-6	22	31	33	42	129	138
4	-8	2	27	39	39	52	135	147
5	-3	7	33	46	46	58	141	153
6	1	13	38	51	51	64	146	159
7	4	17	42	57	55	70	151	165
8	8	25	46	62	59	75	154	169
9	12	27	50	67	63	81	158	175
10	14	30	54	70	69	84	161	178

\* Control points at these settings are slightly below the low end of the regulator range.

FIGURE 4

Bulb Ranges				Maximum Allowable Temperature		
Short °F	Long °F	Short °C	Long °C	Fill	°F	°C
-15/50	-15/75	925/10	-25/20	Propane	450	230
45/115	45/145	10/45	10/60	Isobutane	450	230
65/140	65/170	20/60	20/75	Butane	450	230
90/165	90/195	35/70	35/90	Ethyl/Chloride	300	150
120/200	120/230	50/90	50/110	Isopentane	300	150
240/310	240/340	115/155	115/170	N-Propyl Alcohol	350	175

FIGURE 5

## STARTUP

After the installation, be certain all shutoff valves are closed and the valve is pre-adjusted according to Figure 4. Crack open the inlet shutoff valve. Blow down the strainer upstream of the valve. Let blow for several minutes, particularly on new installations.

Gradually open the downstream shutoff valve. Gradually open the inlet shutoff valve carefully watching the temperature and adjust the valve to achieve the desired set point.

## MAINTENANCE

The adjusting nut of each regulator is permanently lubricated before leaving the factory, and the valve stem is equipped with a spring loaded Teflon packing gland assembly so that no maintenance should be required for the life of the regulator.

The valve stem is set and locked at the factory in a permanent position to give the valve its proper travel. No adjustment should

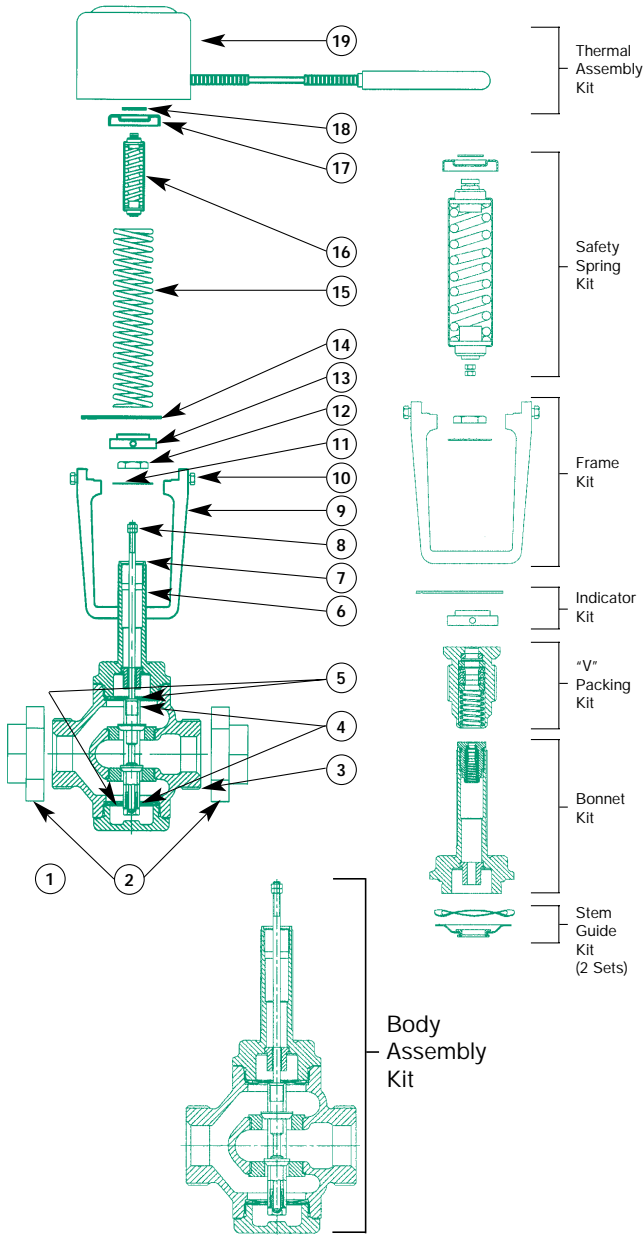
be made on the valve stem after the regulator leaves the factory.

The Spence Strainer protects the valve disc and seat of the regulator from the destructive effects of scale, etc. The strainer should be blown out at regular intervals by removing the plug. For quick blowouts, a hand valve may be installed on the strainer in place of the plug.

## TROUBLESHOOTING

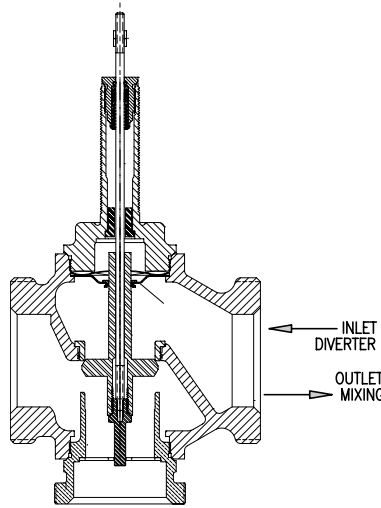
PROBLEM	VALVE TYPE	POSSIBLE CAUSES
Valve does not close	Single Seat, Direct Acting          Double Seat, Direct Acting	<ul style="list-style-type: none"> <li>a. Leakage through valve—     note allowable leakage rate</li> <li>b. Sediment trapped under seat—     strainer required</li> <li>c. Upstream pressure too high—     check catalog for recommended maximum pressure</li> <li>d. Location of bulb in process—               <ul style="list-style-type: none"> <li>1. Red dot must be in upward position</li> <li>2. Change location of bulb (bulb located in "cold spot") poor process agitation</li> </ul> </li> <li>e. Dead system—     leak in temperature system</li> <li>f. Reverse acting used where direct acting is required</li> </ul> See above (except c)
Valve does not open	Single Seat, Direct Acting	<ul style="list-style-type: none"> <li>a. Incorrect range setting—     Adjust range spring screw</li> <li>b. Direct acting used where reverse acting is required</li> <li>c. Location of bulb in process—               <ul style="list-style-type: none"> <li>1. Red dot must be in upward position</li> <li>2. Change location of bulb</li> </ul> </li> <li>d. Range °C instead of °F</li> </ul>
Erratic Action (Snap action or wide temperature control band)	Single Seat	<ul style="list-style-type: none"> <li>a. Valve installed with flow reversed</li> </ul>
Poor Temperature Control	All	<ul style="list-style-type: none"> <li>a. Location of bulb in process—               <ul style="list-style-type: none"> <li>1. Red dot must be in upward position</li> <li>2. Change location of bulb</li> </ul> </li> <li>b. Oversized valve—               <ul style="list-style-type: none"> <li>1. Proper size valve will enhance temperature control</li> <li>2. Oversize valve give high temperature overshoot</li> </ul> </li> <li>c. Valve installed with flow reversed (single seat only)</li> <li>d. Bellows and line hotter than bulb (requires dual fill - ranges A - D)</li> </ul>

# REPLACEMENT PART KITS



## PARTS LIST

ITEM #	PART NAME
1	Complete Valve
2	Union Ends
3	Body Assembly
4	Stem Guide
5	Washer, Wave Spring
6	Bonnet
7	"V" Packing Ass'y
8	Nuts
9	Frame
10	Mounting Screws
11	Lock Washer
12	Frame Locking Nut
13	Adjusting Nut
14	Indicator Ass'y.
15	Adjusting Spring
16	Safety Spring Ass'y.
17	Guide
18	E-Ring
19	Thermal System Assembly



## KITS LIST (All Valves & Sizes)

KIT NAME	MATERIAL	PART #
"V" Packing Kit	Bronze/Teflon	2819
Safety Spring Kit	Bronze/Steel	2815
Frame Kit	Steel	2814
Indicator Kit	Steel/SS	2811
Adjusting Spring - Gold (Short Range)	Steel	2812
Adjusting Spring - Silver (Long Range)	Steel	2813
Thermal System Indicating - 8'	Bronze	GO*
Thermal System Indicating - 8'	SS	GT*
Thermal System Indicating - 15'	Bronze	GR*
Thermal System Indicating - 15'	SS	GV*
Thermal System Non-Indicating - 8'	Bronze	NO*
Thermal System Non-Indicating - 8'	SS	NT*
Thermal System Non-Indicating - 15'	Bronze	NR*
Thermal System Non-Indicating - 15'	SS	NV*

\*See Model Number Code on page 2 to add appropriate letter for temperature range.

## KITS LIST

KIT NAME	MATERIAL	VALVE SIZE										
		1/2 A	1/2 B	1/2 C	1/2 D	1/2 E	1/2 T	3/4 T	1 T	1 1/4 T	1 1/2 T	2 T
Union End Kit - Single Seat	Cast Iron	2822	2822	2822	2822	2822	2822	2823	2826	2827	2828	2829
Union End Kit - Double Seat	Cast Iron	—	—	—	—	—	2824	2825	2826	2827	2828	2829
Union End Kit - 3-Way	Cast Iron	—	—	—	—	—	2830	2831	2832	2833	2834	2835
Body Assembly Kit - 2010	Bronze	2010AC	2010BC	2010CC	2010DC	2010EC	2010TC	2010TD	2010TE	2010TF	2010TG	2010TH
Body Assembly Kit - 2020	Bronze	2020AC	2020BC	2020CC	2020DC	2020EC	2020TC	2020TD	2020TE	2020TF	2020TG	2020TH
Body Assembly Kit - 2030	Bronze	—	—	—	—	—	2030TC	2030TD	2030TE	2030TF	2030TG	2030TH
Body Assembly Kit - 2040	Bronze	—	—	—	—	—	2040TC	2040TD	2040TE	2040TF	2040TG	2040TH
Body Assembly Kit - 2050	Bronze	—	—	—	—	—	2050TC	2050TD	2050TE	2050TF	2050TG	2050TH
Stem Guide Kit	Steel/Monel	2820	2820	2820	2820	2820	2820	2820	2820	2821	2821	2821
Bonnet Ass'y Kit - Single Seat	Bronze	2818	2818	2818	2818	2818	2818	2818	2816	2817	2817	2817
Bonnet Ass'y Kit - Double Seat	Bronze	—	—	—	—	—	2816	2816	2816	2817	2817	2817
Bonnet Ass'y Kit - 3-Way	Bronze	—	—	—	—	—	2816	2816	2816	2817	2817	2817

*It is solely the responsibility of the system designer and the user to select products and materials suitable for their specific application requirements and to ensure proper installation, operation and maintenance of these products. Assistance shall be afforded with the selection of the materials based on the technical information supplied to Leslie Controls, Inc.; however, the system designer and user retain final responsibility. The designer should consider applicable Codes, material compatibility, product ratings and application details in the selection and application. Improper selection, application or use of the products described herein can cause personal injury or property damage. If the designer or user intends to use the product for an application or use other than originally specified, he must reconfirm that the selection is suitable for the new operating conditions.*