

February 2024

2000 Series Temperature Regulator

WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result property damage and personal injury or death.

The 2000 Series Temperature Regulator must be installed, operated and maintained in accordance with federal, state and local codes, rules and regulations and Emerson Process Management Regulator Technologies, Inc. instructions.

If the valve vents gas or a leak develops in the system, service to the unit may be required. Failure to correct issue could result in a hazardous condition.

Installation, operation and maintenance procedures performed by unqualified personnel may result in improper adjustment and unsafe operation. Either condition may result in equipment damage or personal injury. Only a qualified person shall install or service the 2000 Series Temperature Regulator.

WARNING

CALIFORNIA PROPOSITION 65

This product can expose you to chemicals including lead, nickel and cobalt, which is known to the State of California to cause cancer, birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.



Figure 1. 2000 Series Temperature Regulator

Introduction

Scope of the Manual

This instruction manual covers operation, installation, maintenance and troubleshooting for 2000 Series Temperature Regulator.

Product Description

The 2000 Series is a self-operated temperature regulator available with single or double seat in direct or reverse acting. It is also available with two seat areas for three-way mixing. This regulator provides economical temperature control of a storage heater and open topped tank heater.

2000 Series

Specifications

The Specifications section gives some general specifications for the 2000 Series Temperature Regulator. The nameplates give detailed information for a specific pilot as built in the factory.

Available Configurations

- 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

Body Sizes

See Table 1

End Connection Style

NPT Union

Maximum Inlet Temperature⁽¹⁾

415°F / 213°C

Maximum Inlet Pressure⁽¹⁾

250 psig / 17.2 bar

Pressure Ratings⁽¹⁾

See Table 1

Bulb Ranges⁽¹⁾

See Table 5

Bulb Materials

- Copper Bronze
- Stainless steel

Fills

- Iso-Butane
- Ethylene-Glycol
- N-Butane
- Reclaimed R-123
- N-Propyl-Alcohol
- Toluene

1. The pressure/temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.

Table 1. 2000 Series Flow and Pressure Ratings

SIZE, NPS / DN	ORIFICE	MAXIMUM UPSTREAM PRESSURE, PSIG / BAR		MAXIMUM DIFFERENCE BETWEEN INLET PRESSURE, PSIG / BAR
		Single Seat, Types 2010 and 2020	Double Seat, Types 2030 and 2040	Three-way, Type 2050
1/2 / 15	C	250 / 17.2	N/A	N/A
1/2 / 15	D			
1/2 / 15	E			
1/2 / 15	A			
1/2 / 15	B	200 / 13.8	250 / 17.2	140 / 9.7
1/2 / 15	T	140 / 9.7		90 / 6.2
3/4 / 20	T	90 / 6.2		65 / 4.5
1 / 254	T	65 / 4.5		40 / 2.8
1-1/4 / 32	T	40 / 2.8		30 / 2.1
1-1/2 / 40	T	30 / 2.1		20 / 1.4
2 / 50	T	20 / 1.4		

Principle of Operation

The 2000 Series 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 2000 Series 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.

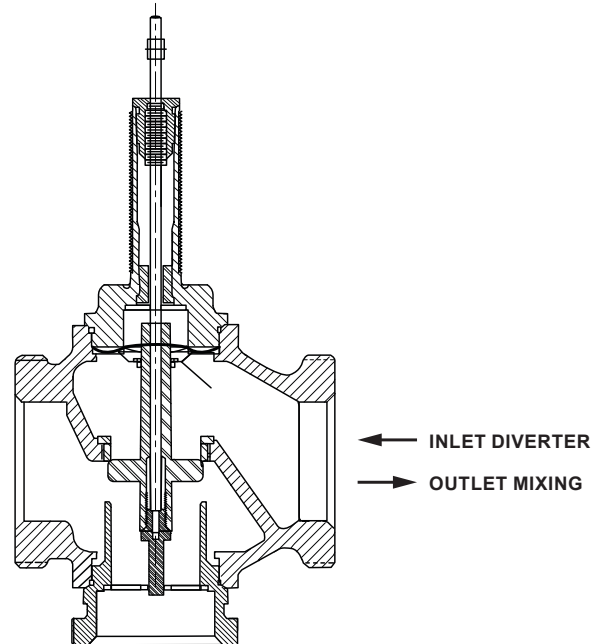


Figure 2. 2000 Series Temperature Regulator Operation

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).

Type 2050 Three-way Valve (Figure 3)

The Type 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 disk (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.

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 disk 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.

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 2000 Series 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.

CAUTION

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

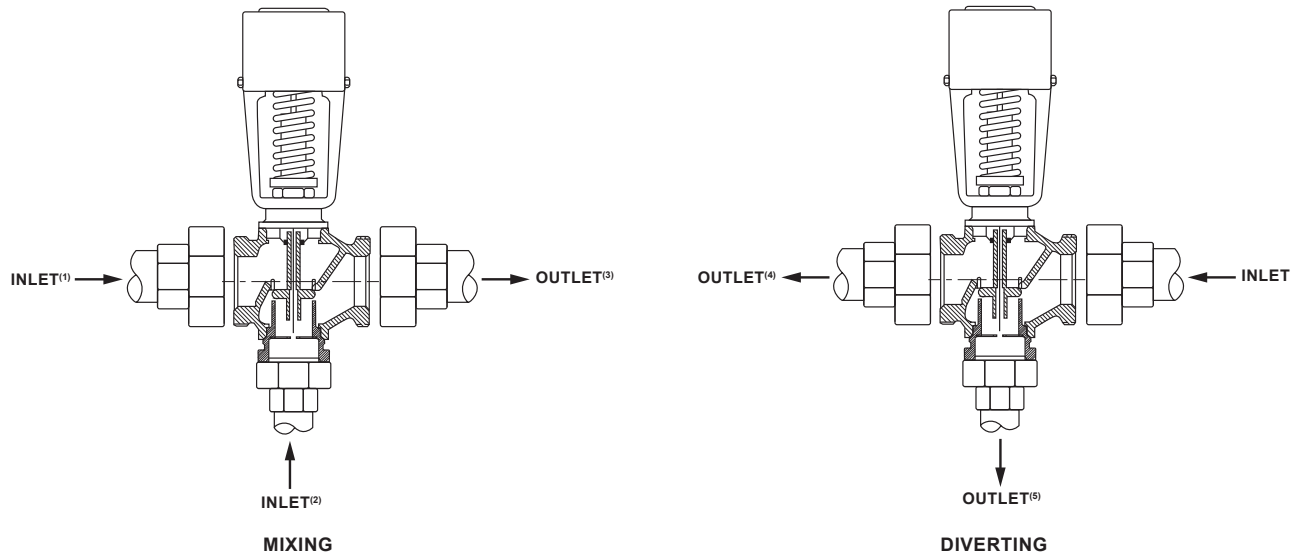


Figure 3. Type 2050 Three-way Valve

Valve Body (Figure 4)

1. Place the 2000 Series Temperature Regulator in the direction of the arrow cast on the valve body so that the heating or cooling media will flow through it.
2. Place strainer and steam trap ahead of the valve to protect the valve from the damaging effects of dirt, scale, foreign material and condensate.
3. Place a manual shut off valve before and after the valve.
4. Place a bypass line with a manual shut off valve around the valve for manual operation if the valve is out of service. Additional recommended installation diagrams can be found in the Spence Designer's Guide.
5. To avoid stresses on the valve or unions, cut the connecting pipes to the exact length required and should be in correct alignment.
6. To connect the valve, remove the union ends from the valve body and attach them to the nipples on each side of the valve.
7. 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.

Note

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 2000 Series), without a union bushing, are used in open tanks, ovens, drying, rooms, kilns, etc. Install the bulb vertically, pointing downward and held securely by suitable straps and clamps. If the application requires that the bulb be held in a horizontal position, the free end of the bulb must not be higher than the fixed end.

1. Cold fluid inlet opens with increase in temperature rise.
2. Hot fluid inlet closes with increase in temperature rise.
3. Mixed fluid
4. Opens with increase in temperature rise.
5. Closes with increase in temperature rise.

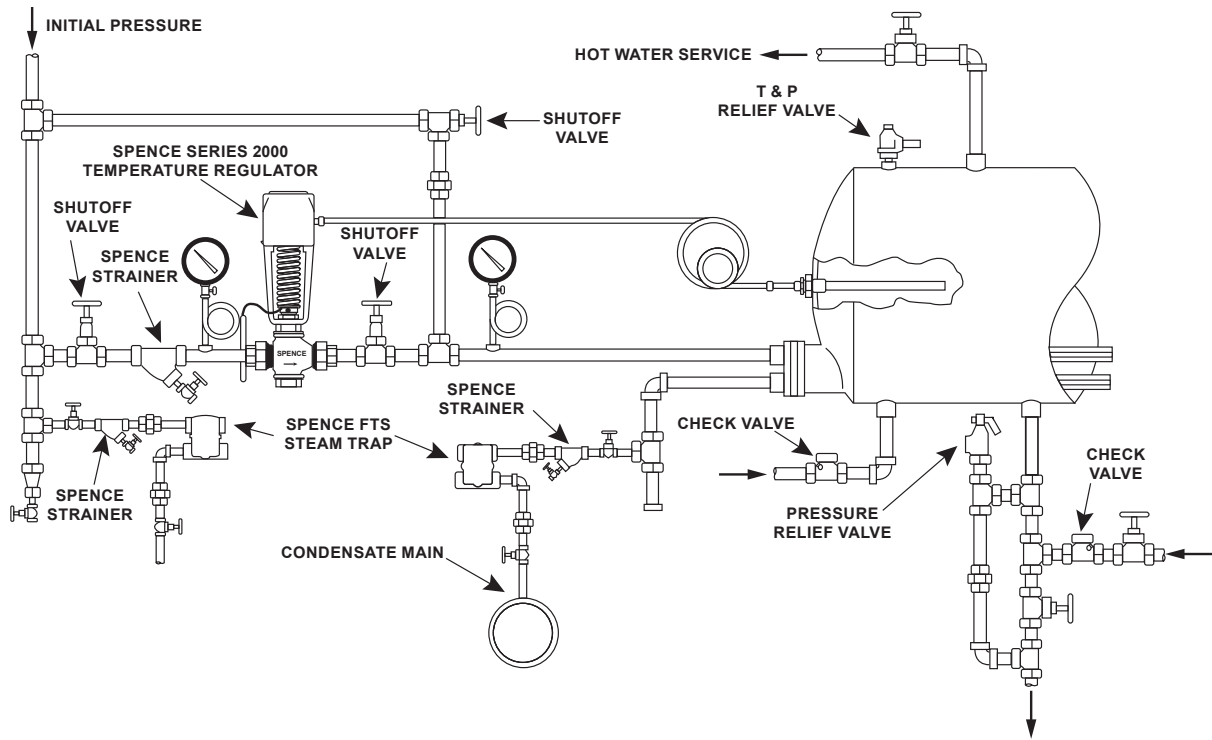


Figure 4. 2000 Series Temperature Regulator Installation

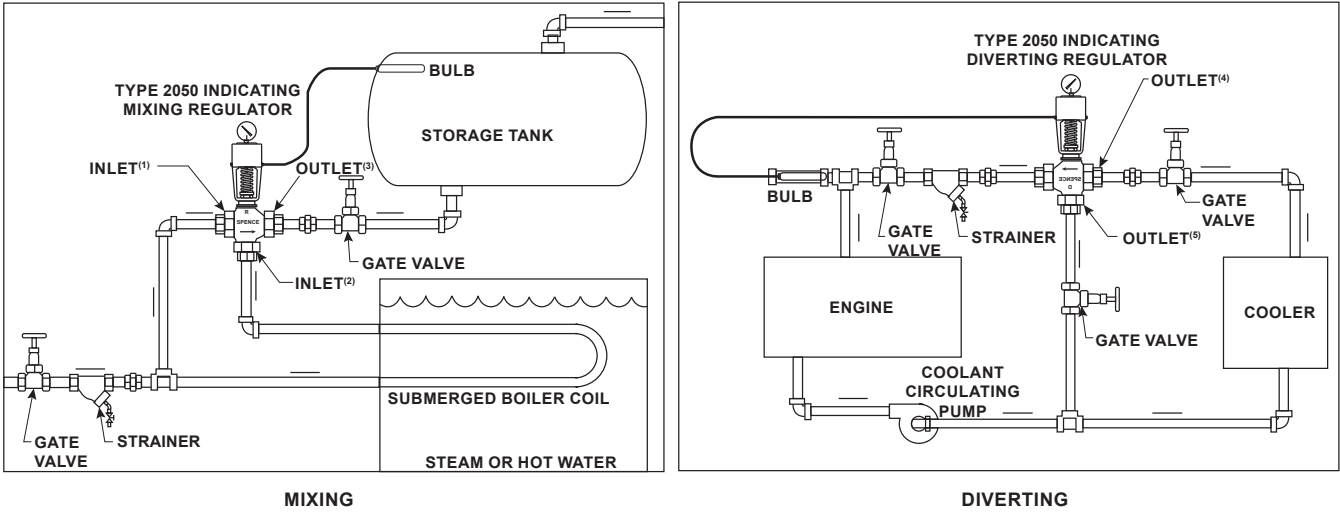


Figure 5. 2050 Series Temperature Regulator Installation

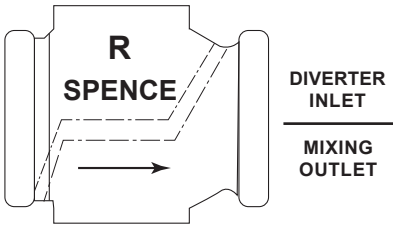


Figure 6. Body Marking Identification

- 1. Cold fluid inlet opens with increase in temperature rise.
- 2. Hot fluid inlet closes with increase in temperature rise.
- 3. Mixed fluid
- 4. Opens with increase in temperature rise.
- 5. Closes with increase in temperature rise.

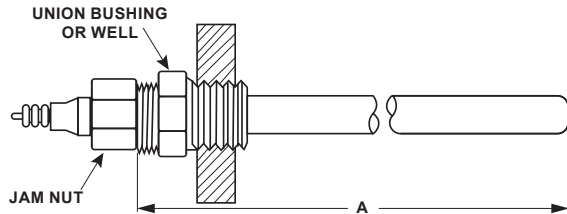


Figure 7. Bulb

Union Bushings (Figure 7)

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.

1. Attach the bushing tightly to the equipment.
2. Slide the jam nut and sleeve on the bulb and locate them at a distance. 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.
3. Insert the bulb into the bushing making sure that the insertion depth is correct and tighten the jam nut to secure the bushing to the bulb.

Wells (Figure 7)

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).

1. Attach the cylinder tightly to the equipment.
2. Slide the jam nut and sleeve on the bulb and locate them at a certain distance. 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.
3. Insert the bulb into the well making sure that the insertion depth is correct.
4. After the bulb is inserted, tighten the jam nut to secure the bulb to the well.

Table 2. Location of Jam Nut on Bulb

BULB	DIAMETER, In. / mm	A, In. / mm
Small	5/6 / 21.2	11-7/8 / 302
Large	1 / 25.4	13-7/8 / 352
Extra long	1 / 25.4	17-3/8 / 441

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 within safe limits, the complete system (bulb, line and bellows) must be cooled. See Table 3.

1. Allow the system to cool for a period of at least 15 minutes before removing the shipping block.
2. 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.
3. After the bellows is assembled to the frame, the bulb and bellows may warm up without damaging the bellows.

Startup

1. After the installation, be certain that all shutoff valves are closed and the valve is pre-adjusted according to Table 4.
2. Crack open the inlet shutoff valve.
3. Blow down the strainer upstream of the valve. Let blow for several minutes, particularly on new installations.
4. Gradually open the downstream shutoff valve.
5. Gradually open the inlet shutoff valve carefully watching the temperature and adjust the valve to achieve the desired set point.

Table 3. Replacement Thermal Systems

FOR SYSTEMS WITH RANGES STARTING AT		COOL SYSTEM TO	SUGGESTED COOLING MEANS
90 to 110°F	32 to 43°C	50°F / 10°C or lower	Tap water mixed with ice as needed
65 to 85°F	18 to 29°C	32°F / 0°C or lower	Crushed ice mixed with water
45 to 60°F	7 to 16°C	10°F / -12°C or lower	Crushed ice mixed with plenty of salt
-15 to 40°F	-26 to 4°C	-35°F / -37°C or lower	Alcohol and "dry ice"

Table 4. Approximate Temperature Equivalents for Various Scale Settings

REGULATOR SETTING	RANGE, °F					
	45 to 115	45 to 145	65 to 140	65 to 170	240 to 310	240 to 340
0						
1	45	50	65	70	236	240
2	58	70	80	91	250	267
3	72	87	92	108	265	281
4	81	102	103	125	275	296
5	92	114	114	137	285	308
6	101	124	124	147	295	318
7	108	135	131	158	303	329
8	115	143	138	167	310	337
9	122	152	145	177	317	347
10	129	158	157	183	322	353
REGULATOR SETTING	RANGE, °C					
	7.2 to 46	7.2 to 63	18 to 60	18 to 77	116 to 154	116 to 171
0						
1	7	10	18	21	113	116
2	14	21	27	33	121	131
3	22	31	33	42	129	138
4	27	39	39	52	135	147
5	33	46	46	58	141	153
6	38	51	51	64	146	159
7	42	57	55	70	151	165
8	46	62	59	75	154	169
9	50	67	63	81	158	175
10	54	70	69	84	161	178

■ - Control points at these settings are slightly below the low end of the regulator range.

Table 5. 2000 Series Bulb Ranges

BULB RANGES				MAXIMUM OVER TEMPERATURE	
Short		Long			
°F	°C	°F	°C	°F	°C
45 to 115	10 to 45	45 to 145	10 to 60	450	230
65 to 140	20 to 60	65 to 170	20 to 75	450	230
120 to 200	50 to 90	120 to 230	50/ to 110	300	150
240 to 310	115 to 155	240 to 340	115 to 170	350	175
280 to 375	138 to 191	280 to 415	138 to 213	450	230

Table 6. Troubleshooting

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

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 Table 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. Table 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.

1. On initial starting, the controlled temperatures may overshoot slightly, then drop back. Allow sufficient time for the process to stabilize.
2. Check the controlled temperature and make fine adjustments. The arm extending out from the adjusting nut indicates the temperature setting.

3. 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, change the orientation of the indicator by loosening the bracket retaining screws and rotate the indicator a maximum of 180°F in either direction.

Note

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 2000 Series Regulators supplied with bulbs as indicated in Table 5.

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.

Parts Ordering

Each regulator is assigned a serial number, which can be found on the nameplate. Refer to the number when contacting your local Sales Office for technical information or when ordering parts.

When ordering replacement parts, reference the key number of each needed part as found in the following parts list. Separate kit containing all recommended spare parts is available.

Parts List

2000 Series (Figure 8)

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

2000 Series

Table 7. 2000 Series Replacement Kit Part Numbers

REPLACEMENT KIT	MATERIAL	PART NUMBER
"V" Packing Kit	Bronze or Polytetrafluoroethylene (PTFE)	WAL2819
Safety Spring Kit	Bronze or Steel	WAL2815
Frame Kit	Steel	WAL2814
Indicator Kit	Steel or Stainless steel	WAL2811
Adjusting Spring - Gold (Short Range)	Steel	WAL2812
Adjusting Spring - Silver (Long Range)	Steel	WAL2813
Thermal System Indicating - 2.4 m / 8 ft.	Bronze	GQ ⁽¹⁾
Thermal System Indicating - 2.4 m / 8 ft.	Stainless steel	GT ⁽¹⁾
Thermal System Indicating - 4.6 m / 15 ft.	Bronze	GR ⁽¹⁾
Thermal System Indicating - 4.6 m / 15 ft.	Stainless steel	GV ⁽¹⁾
Thermal System Non-Indicating - 2.4 m / 8 ft.	Bronze	NQ ⁽¹⁾
Thermal System Non-Indicating - 2.4 m / 8 ft.	Stainless steel	NT ⁽¹⁾
Thermal System Non-Indicating - 4.6 m / 15 ft.	Bronze	NR ⁽¹⁾
Thermal System Non-Indicating - 4.6 m / 15 ft.	Stainless steel	NV ⁽¹⁾

1. Refer to Type Number Code on 2000 Series Bulletin to add appropriate letter for temperature range.

Table 8. 2000 Series Replacement Kit Part Numbers

REPLACEMENT KIT	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	WAL2822	WAL2822	WAL2822	WAL2822	WAL2822	WAL2822	WAL2823	WAL2826	WAL2827	WAL2828	WAL2829
Union End Kit - Double Seat	Cast iron	----	----	----	----	----	WAL2824	WAL2825	WAL2826	WAL2827	WAL2828	WAL2829
Union End Kit - 3-Way	Cast iron	----	----	----	----	----	WAL2830	WAL2831	WAL2832	WAL2833	WAL2834	WAL2835
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®	WAL2820	WAL2820	WAL2820	WAL2820	WAL2820	WAL2820	WAL2820	WAL2820	WAL2821	WAL2821	WAL2821
Bonnet Assembly Kit - Single Seat	Bronze	WAL2818	WAL2818	WAL2818	WAL2818	WAL2818	WAL2818	WAL2818	WAL2816	WAL2817	WAL2817	WAL2817
Bonnet Assembly Kit - Double Seat	Bronze	----	----	----	----	----	WAL2816	WAL2816	WAL2816	WAL2817	WAL2817	WAL2817
Bonnet Assembly Kit - 3-Way	Bronze	----	----	----	----	----	WAL2816	WAL2816	WAL2816	WAL2817	WAL2817	WAL2817

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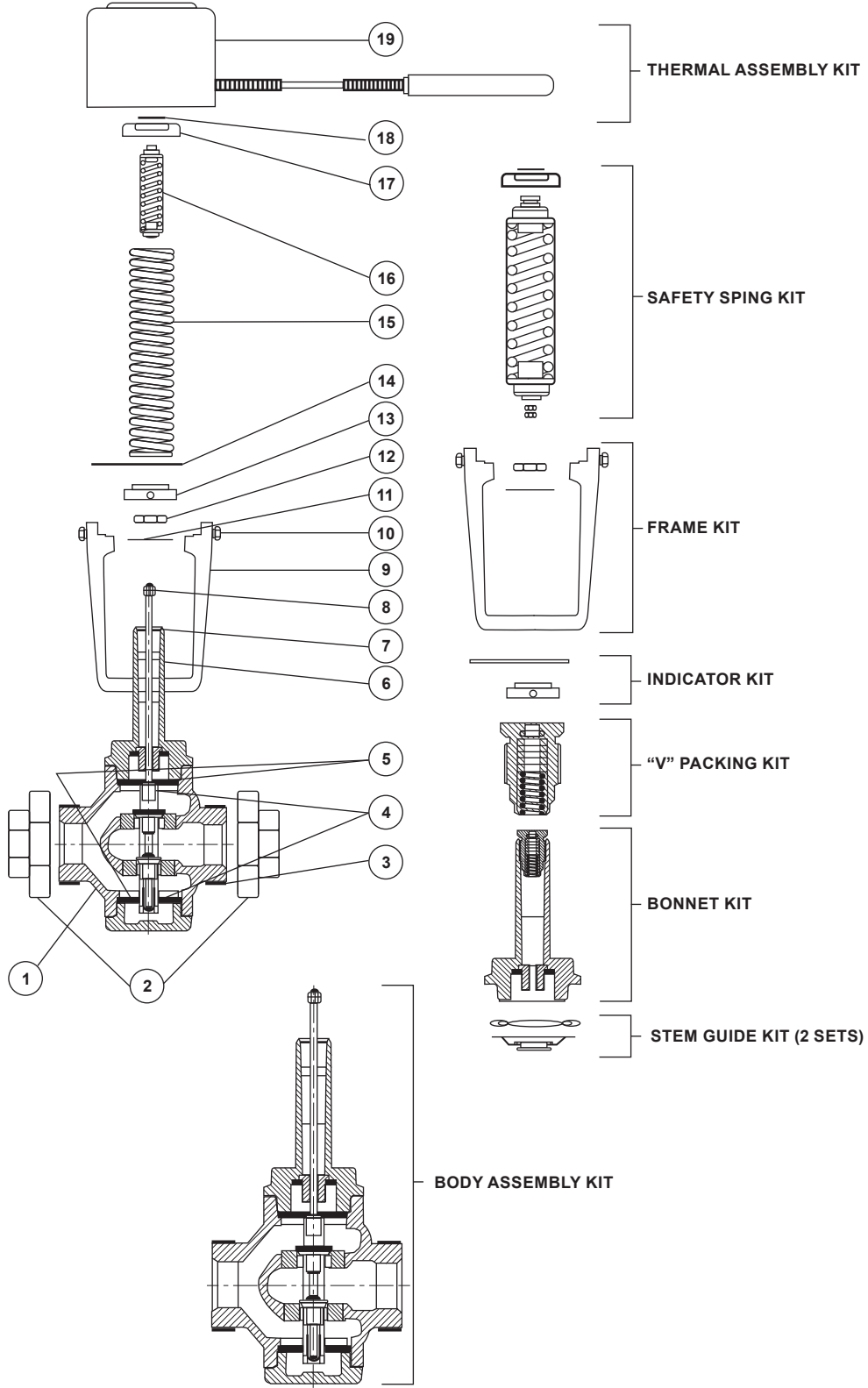


Figure 8. 2000 Series Temperature Regulator Assembly

2000 Series

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