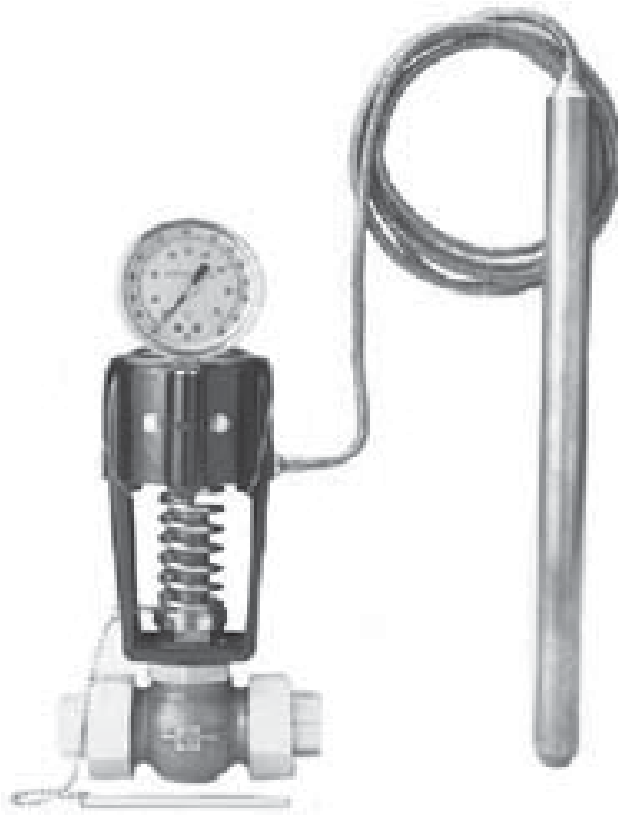


March 2024

# Spence 2000 Series Temperature Regulator



*Figure 1. 2000 Series Temperature Regulator*

## Features

- Positionable Temperature Indicator
- Overtemperature Protection
- Thermal System
- Extra Long Adjustment Spring
- Packing Assembly
- Epoxy Coated Compact Single Piece Channel Frame
- Full Scale Adjustment

## Introduction

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<sup>(1)</sup>

415°F / 213°C

### Maximum Inlet Pressure<sup>(1)</sup>

250 psig / 17.2 bar

### Pressure Ratings<sup>(1)</sup>

See Table 1

### Bulb Ranges<sup>(1)</sup>

See Table 3

### Bulb Materials

Copper Bronze  
Stainless steel

### Fills

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

### Approximate Weights

See Tables 4 to 6

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

| TYPE                               | ORIFICE,<br>In. / mm | INLET SIZE<br>NPS / DN | LINE AND<br>BULB STYLE | BULB MATERIAL <sup>(1)(2)</sup>              | RANGE <sup>(3)(4)</sup><br>°F / °C |
|------------------------------------|----------------------|------------------------|------------------------|----------------------------------------------|------------------------------------|
| 2010 = Single seat, Direct-acting  | A = 1/2 / 12.7       | C = 1/2 / 15           | G = Indicating         | Q = Copper Bronze Armor 8 ft / 2.4 m         | C = 45 to 115 / 7.2 to 46          |
| 2020 = Single seat, Reverse-acting | B =                  | D = 3/4 / 20           | N = Non-indicating     | R = Copper Bronze Armor 15 ft / 4.6 m        | D = 45 to 145 / 7.2 to 63          |
| 2030 = Double seat, Direct-acting  | C =                  | E = 1 / 25             |                        | N = Copper Bronze Armor 25 ft / 7.6 m        | E = 65 to 140 / 18 to 60           |
| 2040 = Double seat, Reverse-acting | D =                  | F = 1-1/4 / 32         |                        | P = Copper Bronze Armor 40 ft / 12.2 m       | F = 65 to 170 / 18 to 77           |
| 2050 = Three-way                   | E =                  | G = 1-1/2 / 40         |                        | T = Stainless steel Unarmored 8 ft / 2.4 m   | J = 120 to 200 / 49 to 93          |
|                                    | T = 5/8 / 16 mm      | H = 2 / 50             |                        | V = Stainless steel Unarmored 15 ft / 4.6 m  | K = 120 to 230 / 49 to 110         |
|                                    |                      |                        |                        | W = Stainless steel Unarmored 25 ft / 7.6 m  | L = 240 to 310 / 116 to 154        |
|                                    |                      |                        |                        | X = Stainless steel Unarmored 40 ft / 12.2 m | M = 240 to 340 / 116 to 171        |
|                                    |                      |                        |                        | Z = Others                                   | N = 280 to 375 / 138 to 191        |
|                                    |                      |                        |                        |                                              | P = 280 to 415 / 138 to 213        |
|                                    |                      |                        |                        |                                              | Z = Others                         |

1. For stainless steel Armored Thermal Assembly Material, add (-TV) at the end of the code (ex.: 2010TC-NTH-TV)

2. Small bulb standard for J-1 range and higher.

3. Extra large bulb standard for D range and lower.

4. Large bulb standard for E and F range

Example:

|   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | 1 | 0 | T | C | - | G | Q | K |
|---|---|---|---|---|---|---|---|---|---|

Description: Type 2010 Single seat, direct-acting temperature regulator with standard orifice, 1/2 in. / 12.7 mm inlet and an indicating line and bulb style, material is Copper Bronze Armor 8 ft / 2.4 m with 120 to 230°F / 49 to 110°C temperature range.

## Product Identification

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

- Valve size — (NPS 1/2 to 2 / DN 15 to 50) 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.

**Table 1. 2000 Series Flow and Pressure Ratings**

| SIZE,<br>NPS / DN | ORIFICE | SINGLE SEAT<br>TYPES 2010 AND 2020 |                                             | DOUBLE SEAT<br>TYPES 2030 AND 2040 |                                             | THREE-WAY<br>TYPE 2050           |                                                                |
|-------------------|---------|------------------------------------|---------------------------------------------|------------------------------------|---------------------------------------------|----------------------------------|----------------------------------------------------------------|
|                   |         | Flow Coefficient, C <sub>v</sub>   | Maximum<br>Upstream Pressure,<br>psig / bar | Flow Coefficient, C <sub>v</sub>   | Maximum<br>Upstream Pressure,<br>psig / bar | Flow Coefficient, C <sub>v</sub> | Maximum Difference<br>Between Inlet<br>Pressure,<br>psig / bar |
| 1/2 / 15          | C       | 0.40                               | 250 / 17.2                                  | N/A                                | N/A                                         | N/A                              | N/A                                                            |
| 1/2 / 15          | D       | 1.00                               |                                             |                                    |                                             |                                  |                                                                |
| 1/2 / 15          | E       | 1.80                               |                                             |                                    |                                             |                                  |                                                                |
| 1/2 / 15          | A       | 3.29                               |                                             |                                    |                                             |                                  |                                                                |
| 1/2 / 15          | B       | 4.29                               | 200 / 13.8                                  | 7.93                               | 250 / 17.2                                  | 5.22                             | 140 / 9.7                                                      |
| 1/2 / 15          | T       | 5.22                               | 140 / 9.7                                   |                                    |                                             |                                  |                                                                |
| 3/4 / 20          | T       | 6.85                               | 90 / 6.2                                    |                                    |                                             |                                  |                                                                |
| 1 / 254           | T       | 9.15                               | 65 / 4.5                                    |                                    |                                             |                                  |                                                                |
| 1-1/4 / 32        | T       | 14.3                               | 40 / 2.8                                    |                                    |                                             |                                  |                                                                |
| 1-1/2 / 40        | T       | 15.1                               | 30 / 2.1                                    |                                    |                                             |                                  |                                                                |
| 2 / 50            | T       | 17.2                               | 20 / 1.4                                    | 33.0                               |                                             | 17.2                             | 20 / 1.4                                                       |

**Table 2. Approximate Temperature Equivalents for Various Scale Settings**

| REGULATOR<br>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<br>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.

# 2000 Series

**Table 3. 2000 Series Bulb Ranges**

| BULB RANGE |            |            |            | 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 |

## 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. 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

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

### Valve Body

The 2000 Series 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.

1. Place strainer and steam trap ahead of the valve to protect the valve from damaging effects of dirt, scale, foreign material and condensate.
2. A manual shut off valve should be placed before and after the valve.
3. 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. Additional recommended installation diagrams can be found in the Spence Designer's Guide.

4. To avoid stresses on the valve or unions, cut the connecting pipes to the exact length required and should be in correct alignment.
5. To connect the valve, remove the union ends from the valve body and attach them to the nipples on each side of the valve.
6. 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.

## 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.

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

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.

## 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.

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.

# 2000 Series

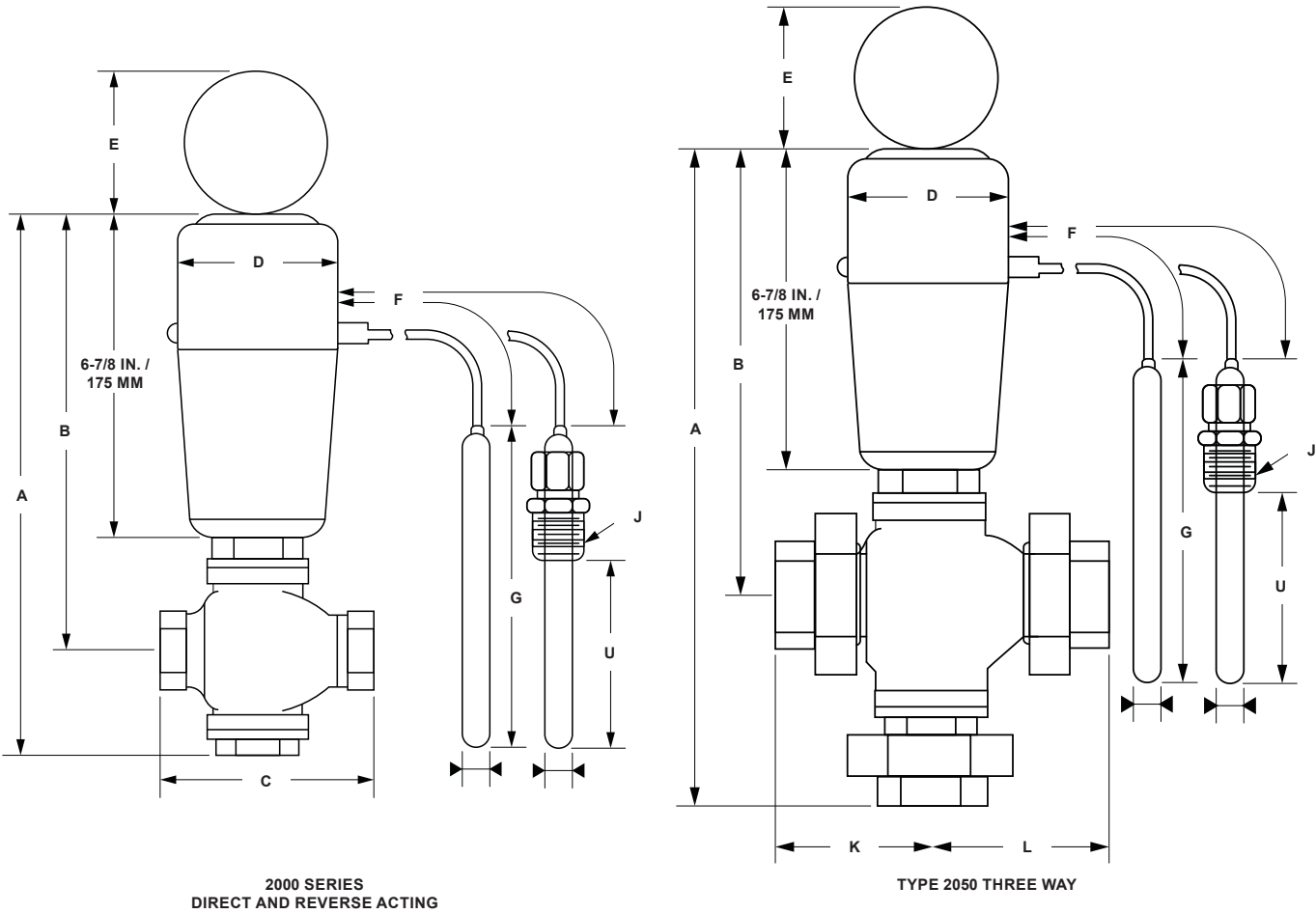


Figure 2. 2000 Series Dimensions and Weights

Table 4. Types 2010, 2020, 2030 and 2040 Direct and Reverse-acting Temperature Regulator Dimensions and Weights

| TYPE                      | SIZE               |               | DIMENSION |     |         |     |         |     |       |    |         |    |    |     | SHIPPING WEIGHT |           |
|---------------------------|--------------------|---------------|-----------|-----|---------|-----|---------|-----|-------|----|---------|----|----|-----|-----------------|-----------|
|                           |                    |               | A         |     | B       |     | C       |     | D     |    | E       |    | F  |     |                 |           |
|                           | NPS                | DN            | In.       | mm  | In.     | mm  | In.     | mm  | In.   | mm | In.     | mm | ft | m   | lbs             | kg        |
| 2010 and 2020             | 1/2 and 3/4        | 15 and 20     | 9-3/4     | 248 | 8-1/2   | 216 | 5-1/2   | 140 | 3-1/2 | 89 | 2-13/16 | 71 | 8  | 2.4 | 10              | 4.5       |
| 2030 and 2040             | 1/2 and 3/4        | 15 and 20     | 12-7/16   | 316 | 9-3/4   | 248 | 7-3/16  | 182 | 3-1/2 | 89 | 2-13/16 | 71 | 8  | 2.4 | 13              | 5.9       |
| 2010, 2020, 2030 and 2040 | 1                  | 25            | 12-7/16   | 316 | 9-3/4   | 248 | 7-3/16  | 182 | 3-1/2 | 89 | 2-13/16 | 71 | 8  | 2.4 | 13              | 5.9       |
|                           | 1-1/4, 1-1/2 and 2 | 32, 40 and 50 | 12-7/8    | 327 | 9-31/32 | 253 | 8-15/16 | 227 | 3-1/2 | 89 | 2-13/16 | 71 | 8  | 2.4 | 20 25 30        | 9.1 11 14 |

**Table 5. Type 2050 Three-way Temperature Regulator Dimensions and Weights**

| SIZE            |               | DIMENSION |     |         |     |       |    |    |     |        |     |         |     |         |    | SHIPPING WEIGHT |                   |
|-----------------|---------------|-----------|-----|---------|-----|-------|----|----|-----|--------|-----|---------|-----|---------|----|-----------------|-------------------|
|                 |               | A         |     | B       |     | D     |    | F  |     | K      |     | L       |     | E       |    |                 |                   |
| NPS             | DN            | In.       | mm  | In.     | mm  | In.   | mm | ft | m   | In.    | mm  | In.     | mm  | In.     | mm | lbs             | kg                |
| 1/2, 3/4 and 1  | 15, 20 and 25 | 13-7/8    | 352 | 9-3/4   | 248 | 3-1/2 | 89 | 8  | 2.4 | 3-5/16 | 84  | 3-5/8   | 92  | 2-13/16 | 71 | 12<br>12<br>13  | 5.5<br>5.5<br>5.9 |
| 1-1/4 and 1-1/2 | 32 and 40     | 14-21/32  | 372 | 9-31/32 | 253 | 3-1/2 | 89 | 8  | 2.4 | 4-1/8  | 105 | 4-11/16 | 119 |         |    | 27              | 12                |
| 2               | 50            | 14-7/8    | 378 | 9-31/32 | 253 | 3-1/2 | 89 | 8  | 2.4 | 4-3/16 | 106 | 4-7/8   | 124 |         |    | 33              | 15                |

**Table 6. Copper Bulb Dimensions<sup>(1)</sup>**

| BULB SIZE                                                           | G      |     | U      |    | I     |    |       |    |       |    | J,<br>NPT |
|---------------------------------------------------------------------|--------|-----|--------|----|-------|----|-------|----|-------|----|-----------|
|                                                                     |        |     |        |    | PLAIN |    | UNION |    | WELL  |    |           |
|                                                                     | In.    | mm  | In.    | mm | In.   | mm | In.   | mm | In.   | mm |           |
| Small                                                               | 13-3/8 | 340 | 10-1/2 | 16 | 5/8   | 16 | 5/8   | 16 | 3/4   | 19 | 3/4 or 1  |
| Large                                                               | 15-5/8 | 397 | 1      | 25 | 1     | 25 | 1     | 25 | 1-1/8 | 29 | 1         |
| Extra Large                                                         | 19     | 483 | 1      | 25 | 1     | 25 | 1     | 25 | 1-1/8 | 29 | 1         |
| 1. For stainless steel and coated bulb dimensions, consult factory. |        |     |        |    |       |    |       |    |       |    |           |

1. For stainless steel and coated bulb dimensions, consult factory.

## Ordering Information

When ordering, complete the ordering guide on this page. Refer to the Specifications section. Review the description to the right of each specification and the information in each referenced table or figure. Specify your choice whenever a selection is offered.

## Ordering Guide

### Available Configurations (Select One)

- ☐ Type 2010
- ☐ Type 2020
- ☐ Type 2030
- ☐ Type 2040
- ☐ Type 2050

### Orifice (Select One)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Standard

### Inlet Size (Select One)

- ☐ NPS 1/2 / DN 15
- ☐ NPS 3/4 / DN 20
- ☐ NPS 1 / DN 25
- ☐ NPS 1-1/4 / DN 32
- ☐ NPS 1-1/2 / DN 40
- ☐ NPS 2 / DN 50

### Line and Bulb Style (Select One)

- ☐ Indicating
- ☐ Non-indicating

### Bulb Material (Select One)

- ☐ Copper Bronze Armor 8 ft / 2.4 m
- ☐ Copper Bronze Armor 15 ft / 4.6 m
- ☐ Copper Bronze Armor 25 ft / 7.6 m
- ☐ Copper Bronze Armor 40 ft / 12.2 m
- ☐ Stainless steel Unarmored 8 ft / 2.4 m
- ☐ Stainless steel Unarmored 15 ft / 4.6 m
- ☐ Stainless steel Unarmored 25 ft / 7.6 m
- ☐ Stainless steel Unarmored 40 ft / 12.2 m
- ☐ Others, Please specify: \_\_\_\_\_

### Temperature Range (Select One)

- ☐ 45 to 115°F / 7.2 to 46°C
- ☐ 45 to 145°F / 7.2 to 63°C
- ☐ 65 to 140°F / 18 to 60°C
- ☐ 65 to 170°F / 18 to 77°C
- ☐ 120 to 200°F / 49 to 93°C
- ☐ 120 to 230°F / 49 to 110°C
- ☐ 240 to 310°F / 116 to 154°C
- ☐ 240 to 340°F / 116 to 171°C
- ☐ 280 to 375°F / 138 to 191°C
- ☐ 280 to 415°F / 138 to 213°C
- ☐ Others, Please specify: \_\_\_\_\_

# 2000 Series

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