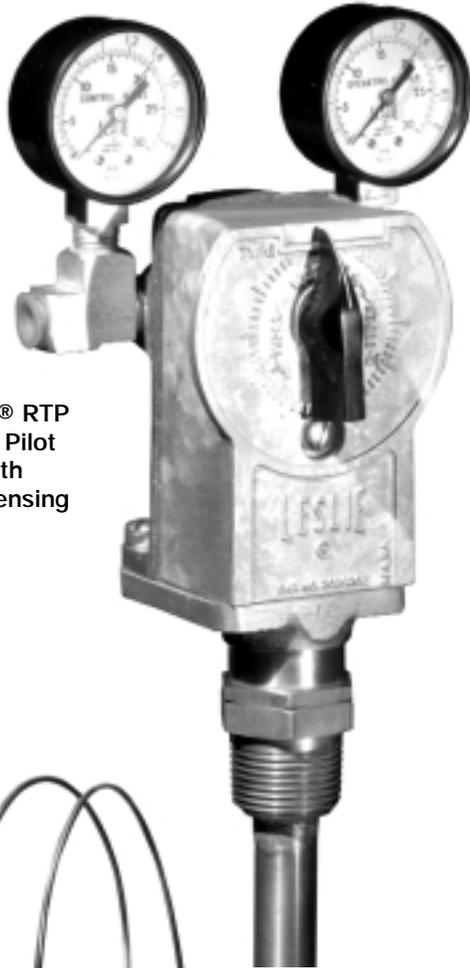


# PROPO-MATIC® TEMPERATURE PILOT CONTROLLER

INSTRUMENTATION



Propo-Matic® RTP Temperature Pilot Controller with bi-metallic sensing element.



Propo-Matic® BP Temperature Pilot Controller with liquid filled thermo-element and calibrated dial.

- **Inexpensive to Install**
- **Low Cost Operation**
- **Stable Reliable Control**
- **Tough, Durable Instruments**

Propo-Matic® Temperature pilot controllers are thermomechanical devices that precisely sense changes in temperature and translate the changes into air or hydraulic outputs for operating a control valve or other system equipment.

A Propo-Matic® pilot controller, together with a Lifetime control valve is ideally applied to systems where pneumatic or hydraulic control is required to obtain maximum reliability and economy.

## Propo-Matic® PILOT CONTROLLER FUNCTIONS

Propo-Matic® Temperature pilot controllers perform three basic functions:

### 1. SENSING OR MEASUREMENT

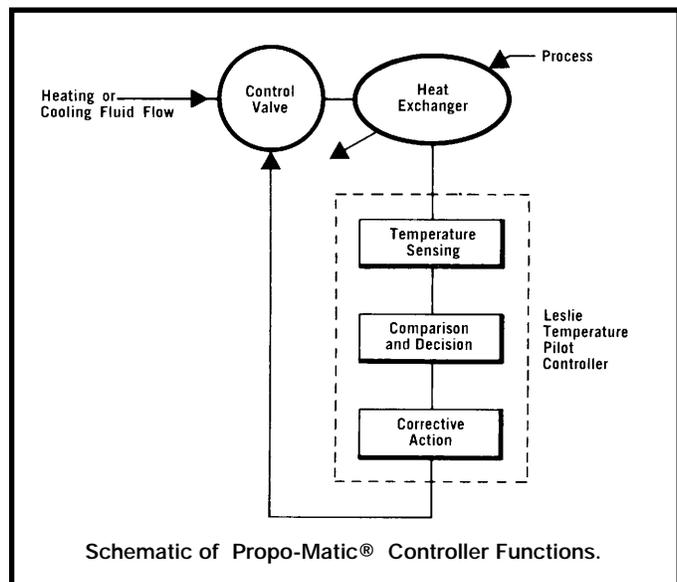
The temperature to be controlled is precisely measured by either a bi-metallic or a liquid filled thermo-element.

### 2. COMPARISON AND DECISION

The controller mechanically compares the sensed temperature with the required set point and “decides” what corrective action is required.

### 3. CORRECTIVE ACTION

The controller transmits a corrective pneumatic or hydraulic signal to a secondary system, control valve or other final control element. This adjusts the flow of the heating or cooling fluid medium to maintain the controlled variable within the desired control band.



# PROPO-MATIC® TEMPERATURE PILOT CONTROLLER

## SAVE ON INSTALLATION

Propo-Matic® temperature pilot controllers are quick, easy and economical to install. No special costly or complicated piping is required. They are also suitable for outdoor installations without the need for enclosure or special weather protection.

## SAVE ON MAINTENANCE

The simple designs leave virtually nothing to get out of order. There are no delicate linkages, packed stems, flapper nozzles, bourdon tubes or electric probes to adjust or maintain. Reliability is assured.

## MOISTURE-PROOF DUST-PROOF WEATHER-PROOF SPARK-PROOF DESIGN

Because of the simple design of Propo-Matic® temperature pilot controllers, hardly anything can go wrong with them. Most outdoor temperature pilot controller installations do not require an enclosure or special weather protection. Propo-Matic® temperature pilot controllers work under a wide variety of adverse ambient conditions. These "non-sparking" instruments will keep on working — even in hazardous environments.

## CHOICE OF LIQUID-FILLED OR BI-METALLIC SENSING ELEMENT TYPES



Bi-metallic type temperature pilot controller, Type RTP-2.

Propo-Matic® temperature pilot controllers can be classified into two general types: Those with bi-metallic thermo-elements and those with liquid-filled thermo elements. The bi-metallic element types (designated Types R or D) are of sturdy bronze and stainless steel construction and mount directly at the point of thermal measurement. The liquid-filled thermal element designs (designated Types B or BP) are light weight aluminum and can be mounted remotely in any convenient location. Both types provide precise, accurate, stable control; high dependability and low maintenance. The comparison chart below shows major selection considerations.



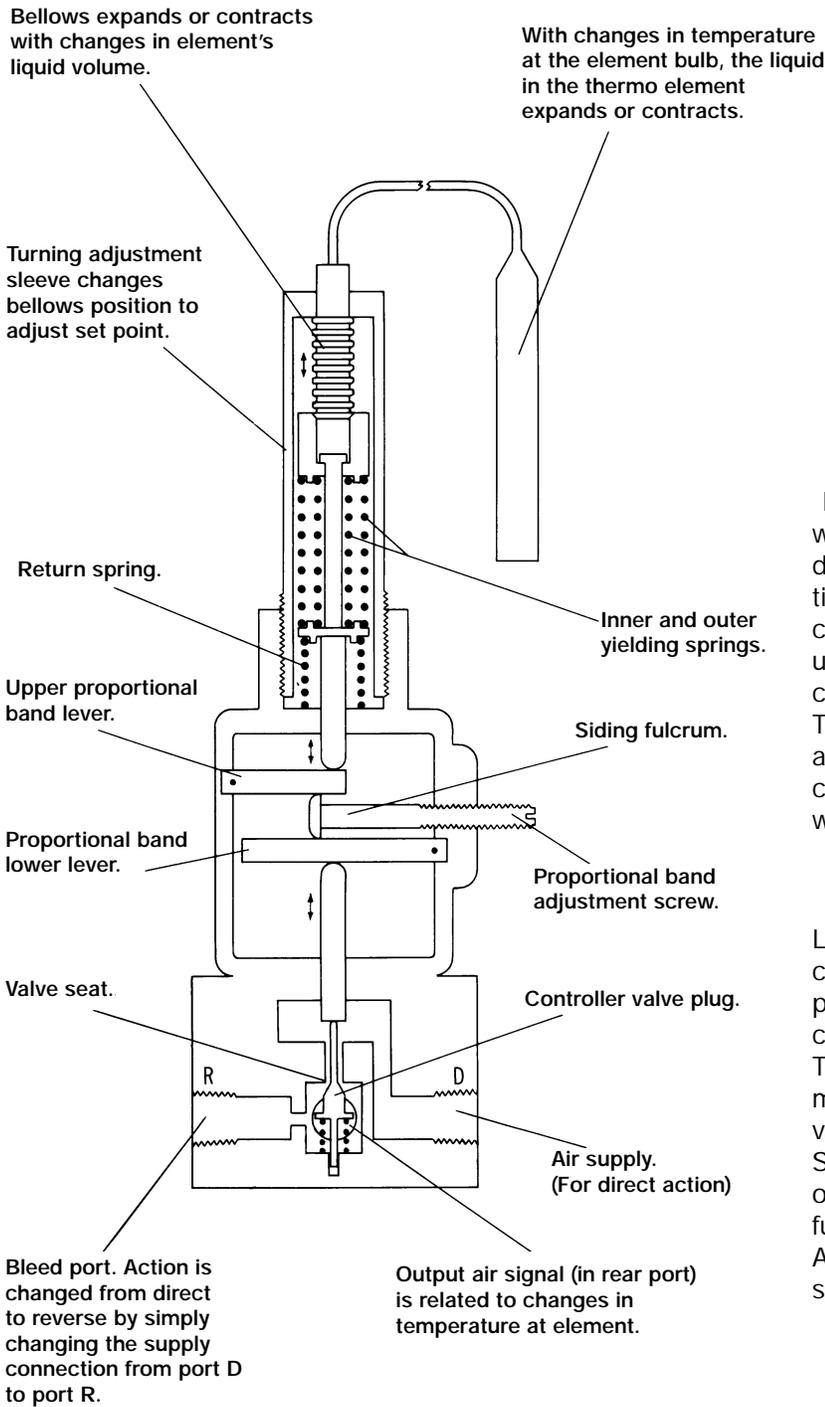
Liquid-filled temperature pilot controller, Type BP-2.

## Temperature Pilot Controller Comparison Chart

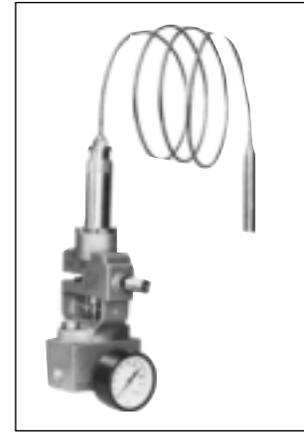
CONSIDERATION	BI-METALLIC ELEMENT BASIC TYPES R - D	LIQUID-FILLED ELEMENT TYPES B - BP							
Controller Construction	All bronze and stainless steel construction, they last for decades.	Husky light weight aluminum body. Optional calibrated dial available.							
Element Construction	Invar and brass, monel or stainless steel element offers maximum protection against thermal element damage.	Compact liquid-filled bulb flexible bellows in the pilot are connected by capillary tubing. Optional armor is available where extra protection is required.							
Operating Medium	Air or noncorrosive gas. Water or other noncorrosive liquid of low viscosity may be used on RQ and DQ types.	Air or noncorrosive gas.							
Initial Cost	Initial cost of bi-metallic type is slightly higher than liquid-filled element types.								
Thermo Element Selection (°F)	32-400 300-600	70-120 100-150 120-170 150-200	170-220 220-270 20-120 70-170	220-320 270-370 50-250 50-400					
Representative Characteristics Adjustable Proportional Band Types	°F change for 3-15 psi output with 20 psi supply pressure		pressure °F change for 3-15 psi output with 20 psi supply pressure						
	Values shown are for Brass Tubes. Add 30% for S ST Tubes.		50°F Span		100°F Span		200°F Span		
	14" Bulb		7" Bulb						
	Min. Band	Max. Band	Min. Band	Max. Band	Min. Band	Max. Band	Min. Band	Max. Band	
	8	30	15	50	4.1	16.4	8.2	32.8	16.4
Element Changeability	Not changeable		Easily changed in field. All elements are interchangeable.						
Maximum Loading Pressure	60 psi.		90 psi.						
Mounting and ease of adjustment	Mounting contiguous to process; must be adjusted at point of thermal insertion.		Remote mounting permits adjustment in convenient location.						
Space Requirements	Clearance dimensions usually exceed those of BP Types.		Smaller bulb length simplifies installation in close quarters.						
Allowable Override	Limited only by materials of construction.		25% to 100% of Span, depending on range.						

# PROPO-MATIC® WITH LIQUID FILLED THERMO-ELEMENTS

INSTRUMENTATION



Type BP-2 Adjustable Proportional Band Temperature Pilot Controller

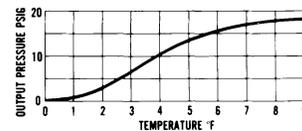


Adjustable Proportional Band Type BP-2

Propo-Matic® temperature pilot controllers with liquid-filled thermo-elements have been designed to convert temperature to a proportional pneumatic signal in temperature control systems. The output signal can be used to operate a control valve, or the unit can be used as a temperature transmitter. The controller is a simple, accurate, reliable and rugged device. You select from a wide choice of element ranges and spans, each with a simple means of set point adjustment.

## HOW IT OPERATES

Liquid fill in the thermo-element expands and contracts with changes in temperature, producing a corresponding expansion and contraction of the element bellows. The motion produced is proportional to the measured temperature and operates the pilot valve through an adjustable lever (BP-2). Since the input air is metered through a fixed orifice, the pressure of the output air is a function of the opening of the pilot valve. Action of these pilots is reversible by simply switching supply and exhaust connections.



Typical response curve B or BP type pilot controllers

# PROPO-MATIC® WITH LIQUID FILLED THERMO-ELEMENTS

## ADJUSTABLE PROPORTIONAL BAND

Throttling-type automatic temperature control systems operate on either a fixed or variable amount of change in the controlled temperature. Since the control response or controller output is proportional to the amount of change, the terms "throttling range" and "proportional band" are used here to refer to the amount of controlled variable temperature change required to provide sufficient controller output change to fully stroke the final control element.

The temperature pilot controllers with adjustable proportional band provide for field adjustment of the pilot controller response characteristic by varying amount of output signal change per degree of controlled temperature change to match the needs of the system and to achieve stability.

Type BP-2 pilot controllers can, therefore, be used where the required band is unknown or does not coincide with any of the fixed bands.

## CALIBRATED DIALS

Propo-Matic® temperature pilot controllers with liquid filled thermo-elements are available with optional calibrated dials (Fahrenheit or centigrade) for quick, easy and dependable temperature readjustments are necessary and for process work, it replaces the standard adjusting sleeve. Pilot controllers fitted with calibrated dials have "C" added to the class designation e.g. BPC-2.



TEMPERATURE RANGE	
(1)	20 - 120°F
	50 - 150°F
	50 - 250°F
	70 - 120°F
	70 - 170°F
	120 - 170°F
(2)	120 - 220°F
	170 - 220°F
	170 - 270°F
	220 - 270°F
(2)	49 - 104°C
(1)	- 7 - 49°C

(1) & (2) EQUIVALENT Available Calibrated Dial Ranges

## LIQUID FILLED THERMO-ELEMENTS

Robust, low cost liquid filled temperature sensing elements unscrew in moments for change of range or bulb material. No calibration is required. No messy gas or vapor pressure system to fill; no costly factory returns.

These powerful, incompressible liquid-filled thermo-elements provide positive repeatable positioning unobtainable with compressible vapor pressure or gas-filled types. Stem movement is truly proportional to temperature change at the bulb.

## OPERATING CHARACTERISTICS

Maximum Air Consumption CFM	BP TYPES			
	REVERSE ACTING		DIRECT ACTING	
	Minimum <sup>2</sup> Band °F to Reduce Output to 2 PSI	Maximum <sup>3</sup> Band °F to Reduce Output to 2 PSI	Min. Band °F to Increase Output to Maximum PSI	Max. Band °F to Increase Output to Maximum PSI
.23-.28	7	28	7.2	28.8
.25-.32	9	35	8.2	32.8
.32-.41	11	44	9.5	38.
.39-.50	14	56	11.	44.
.54-.68	16	64	14.1	56.4
.75-.96	18	72	16.4	65.6

1. Other spans up to 200°F and other ranges are also available on order.
2. In narrowest band position with 100° span element.
3. In widest band position with 100° span element.  
For 50° span element divide proportional band figures shown above by 2.  
For 200° span element multiply proportional band figures shown above by 2.

## ELEMENT SPECIFICATIONS

Maximum Working Pressure of Thermo-Element Bulb	Standard Ranges <sup>1</sup> (Maintained in Stock)		
	50 <sup>1</sup> Spans	100 <sup>1</sup> Spans	200 <sup>1</sup> Spans
With Stuffing Box Installation	20-70	20-120	50-250
	70-120	50-150	
With Bulb Casing	120-170	70-170	
	170-220	120-220	
	220-270	170-270	

## STANDARD TUBING

Heavy gauge copper flexible tubing, nickel plated is standard. .316 stainless steel is furnished in lengths of 5' or 10' and longer as an optional extra.

## SPECIAL TUBING

Armored brass or stainless steel tubing for extra protection is available in standard ranges and lengths.

## BULBS

Brass bulbs, nickel plated or 18-8 stainless steel bulbs are 4" long for 100° spans. (The 100° span element is standard.) Other ranges and various lengths of capillary tubing are available in 10 foot increments. Armored capillary tubing and or coated elements are available where required.

## STANDARD BULB CASINGS

Standard bulb casings are available in two sizes: 4-13/16" long (No. 2) and 93/4" long (No. 30). Both casings have 5/8" outside diameter and 1/2" pipe thread. They are furnished in brass, carbon steel, monel and 316 stainless steel for maximum working pressure of 400 psi.

## HIGH PRESSURE CASINGS

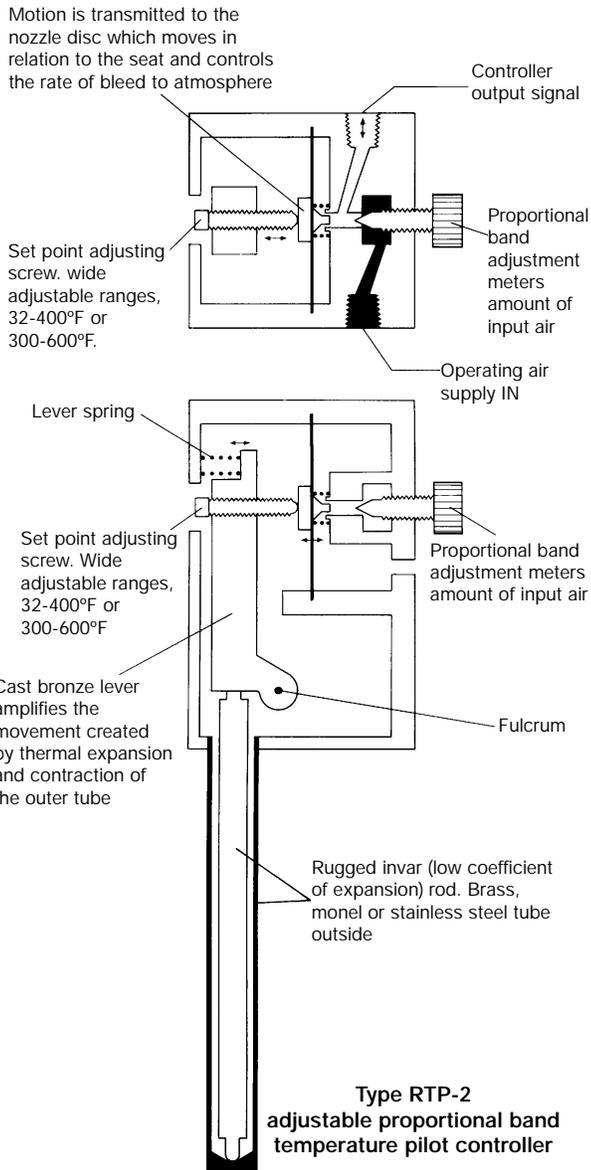
High pressure carbon steel or 316 stainless steel casings are available for maximum working pressures to 2000 psi. Extension neck casings that permit full exterior insulation of the tank or oven are also available.

## STUFFING BOXES

Stuffing boxes are available in brass or 316 stainless steel.

# PROPO-MATIC® WITH BI-METALLIC THERMO-ELEMENTS

INSTRUMENTATION



## Adjustable Proportional Band Types

Types DTP and DTHP, Direct Acting  
Types RTP and RTHP, Reverse Acting



Propo-Matic® temperature pilot controllers with bi-metallic sensing elements are simple pneumatic devices with either fixed or adjustable proportional band. These extremely sturdy controllers sense temperature variations and produce pneumatic output signals used to operate control valves for either heating or cooling service. They will respond to minute, definite temperature deviations and give accurate, stable control. They are unaffected by moisture or oil in the air supply that fouls ordinary instruments. Because bi-metallic temperature pilot controllers combine accuracy, speed of response and dependability, they make "control-station" operation practical in a wide variety of applications.

## HOW IT OPERATES (Adjustable Proportional Band Type)

Temperature changes are sensed by the bi-metal element (tube and Invar steel rod) which is immersed in the fluid to be controlled. The tube (fixed at one end) expands and contracts with temperature changes. Since there is a difference in the coefficient of expansion between the tube and the invar rod, temperature changes at the tube create movement of the rod. The movement is transmitted and amplified by a lever which contacts the diaphragm assembly. The movement repositions the nozzle disc, increasing or decreasing the air flow exhausted to atmosphere. Since the exhaust orifice is in series with a fixed (manually adjusted) orifice, the intermediate air pressure is a function of (and proportional to) the nozzle disc position and measured temperature. The proportional band or the temperature change required for the output pressure of the pilot to go from minimum to maximum is determined by the manual adjustment of the proportional band screw. Set point (temperature at which pilot controls) is determined by the setting of the adjustment screw.

## HEATING OR COOLING ACTION

PILOT TYPE	CONTROL VALVE ACTION	
	Heating Service	Cooling Service
Direct Acting DT, DTHP, etc.	Normally Open	Normally Closed
Reverse Acting RTP, RTHP, etc.	Normally Closed	Normally Open

## OPERATING CHARACTERISTICS

Characteristic	TYPE RQ		TYPE DTP, RTP, DTHP <sup>1</sup> , RTHP <sup>1</sup>			
	7" Tube	14" Tube	7" Tube		14" Tube	
			Min. Band <sup>2</sup>	Max. Band <sup>2</sup>	Min. Band <sup>2</sup>	Max. Band <sup>2</sup>
Proportional Band 20 psi supply 3-15 psi output	13.3°F	8.0°F	15°F	50°F	8°F	30°F
Proportional Band 60 psi supply 3-57 psi output	—	—	13°F	59°F	6.5°F	29.5°F
Averaging Loading Capacity 20 psi supply 3-15 psi output	1.26 cfm air .336 gpm water	1.26 cfm air .336 gpm water	.06 cfm air	.72 cfm air	.06 cfm air	.72 cfm air
Adjustable Range	Types DQ, DTP, RQ, RTP 32-400°F		Types DTHP, RTHP 300-600°F			
Supply Pressure	20-30 psi		20-60 psi			
Maximum Static Pressure	Brass Tube 500 psi, Monel Tube 550 psi, SS Tube 600 psi					
Resolution Sensitivity	½°F					

1. DTHP and RTHP available with 7" tube only.

2. Values shown are for Brass Tubes. Add approx. 30% for SS Tubes.

# PROPO-MATIC® WITH BI-METALLIC THERMO-ELEMENTS

## STURDY CONSTRUCTION

Propo-Matic® temperature pilot controllers far surpass all other makes and types of controllers in resistance to damage, wear, or malfunction. They have passed the most severe shock tests with flying colors and are approved for use in a variety of vital and demanding services on both naval and commercial ships.

## ADJUSTABLE PROPORTIONAL BAND

Throttling type automatic temperature control systems operate on either a fixed or variable amount of change in the controlled temperature. Since the control response or controller output is fundamentally proportional to the amount of change, the terms "throttling range" and "proportional band" are used here to refer to the amount of controlled variable temperature change required to provide sufficient controller output change to fully stroke the final control element.

The basic fixed band temperature pilot controller is suitable for a wide variety of temperature control applications. Most relatively stable large volume temperature control systems without significant system lags can be controlled by this basic fixed band design.

The temperature pilot controllers with adjustable proportional band provide for field adjustment of the pilot response characteristic by varying amount of output signal change per degree of controlled temperature change to match the needs of the system and achieve stability.

The bi-metallic type pilot controllers with adjustable proportional band is unknown or does not coincide with any of the fixed band pilots.

## EASY ADJUSTMENT OF THE PROPORTIONAL BAND

Adjustable proportional band, a means for providing added stability in sensitive systems, has been simplified in RTP and DTP type Propo-Matic® temperature pilot controllers to a single knob adjustment. Turning the knob clockwise narrows the band; turning the knob counter-clockwise widens the band.



## SET POINT REFERENCE DIAL

Propo-Matic® temperature pilot controllers with bi-metallic thermo-elements have a reference dial for fast temperature resetting without waiting for the equipment to heat up. A helpful feature where two or more temperatures are frequently set.



## PROPO-MATIC® ORDERING INFORMATION

### HOW TO SPECIFY TEMPERATURE PILOT CONTROLLERS

#### BI-METALLIC ELEMENT TYPES

Temperature controller shall be a positive, double-acting, pneumatic (or liquid) relay actuated by a bi-metallic element capable of fast response to temperature change without the use of fins. It shall be designed to permit installation in any position.

When adjustable proportional band is required the controller shall have a single knob adjustment for changing the proportional band.

#### LIQUID-FILLED THERMO-ELEMENT TYPES

Temperature controller shall be a self-contained non-sparking design directly operated by a completely filled liquid thermo-element consisting of a small bulb and a bellows unit. A yield spring shall prevent overstressing of the bellows for over-range protection of 25% to 100% of span. Body shall be machined from aluminum bar stock. Pilot stem shall be sealed with a low friction self-sealing single ring which requires no adjustment. Easy replacement of thermo elements shall be possible without removing the controller from the line.

### HOW TO ORDER

When ordering temperature controllers, include the following data:

1. Type of pilot controller.
2. Service: Heating or cooling.
3. Range of adjustment.
4. Minimum and maximum temperature and pressure on tube or bulb.
5. Operating medium to be used and pressure available (clean air, gas, water or light oil).
6. Accessories available — air loader or air loading panel; length of 5/16" O.D. copper tubing and compression fittings.
7. Pilot controller action required (direct) or (reverse).
8. Materials for corrosive services.