

## Bulb Thermostats & Return Air Thermostats General Instructions

### APPLICATION

For on-off control of media temperature in ducts, tanks, liquid lines, etc.

### SPECIFICATIONS

**Setpoint Dial Range:** Dial plate is marked as °F on one side and °C on the other. See Table-2 for specific ranges.

**Sensing Element:** Liquid-filled copper.

**Differential:** See Table-2.

**Dual Bulb Units:** One bulb senses the controlled media; the second bulb senses the outside air temperature. The temperature of the controlled media increases as outside air temperature decreases.

**Ambient Temperature Limits:**

**Case,**

**Shipping** -40 to 160°F (-40 to 71°C).

**Operating** -40 to 150°F (-40 to 65°C); except return air bulb unit, -40 to 140°F (-40 to 60°C).

**Bulb,** See Table-2.

**Electrical Switch:** Snap action SPDT, one per stage.

**Ratings,** See Table-1.

**Connections:** Coded screw terminals.

**Cover:** All metal with 1/2" to 3/4" conduit openings.

**Case Locations:** NEMA Type 1 indoor only.

**Mounting:** Case can be mounted in any position. See ACCESSORIES for bulb mounting kits (order separately).

**Dimensions:**

**Case,** 4-5/8" high x 2-1/4" wide x 2" deep (117 mm x 57 mm x 51 mm)

**Element and Capillary,** See Table-2.

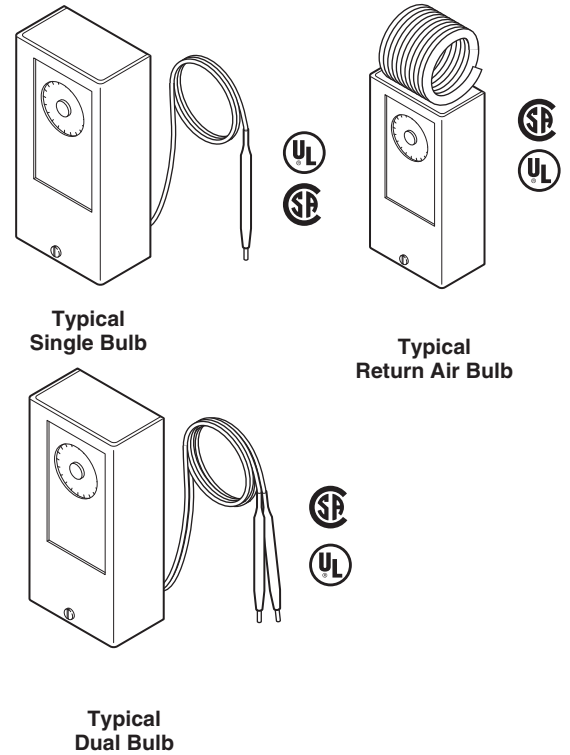
### ACCESSORIES

AT-201	Copper bulb well requires AT-209
AT-203	Stainless steel bulb well requires AT-209
AT-206	Copper bulb well
AT-208	Duct mounting kit
AT-209	Bulb mounting kit
AT-210	Concealed adjustment plate
AT-211	Outside bulb shield

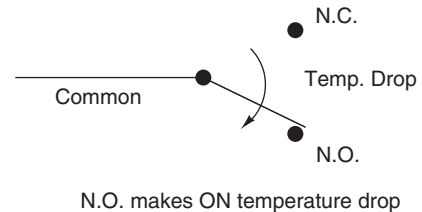
**Table-1 Maximum Electrical Rating  
(All units except TC-4115\*)**

Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)			
Single Stage	22	22	22
Two Stage	16	16	8.0

\* TC-4115 for TAC System 8000 and applications requiring less than one (1) amp. Electrical Rating: 1.0 amp at 24 Vac; 0.25 amp at 24 Vdc.



### Typical Single Stage



### Typical Two Stage

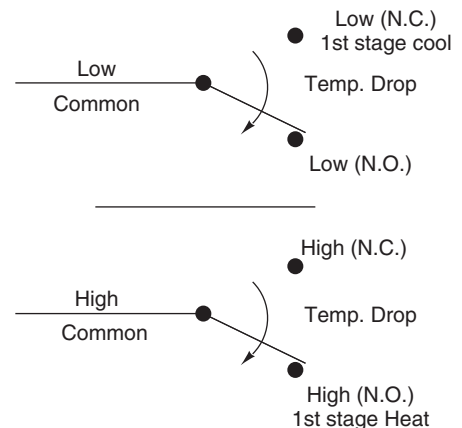


Figure-1 Switch Action and Terminal Identification.

**Table-2 Specifications.**

Part Number	Type	Setpoint Adjustment Range °F (°C)	Dual <sup>a</sup> Bulb Ratio	Dimensions		Differential °F (°C)	Safe Bulb Temperature Range °F (°C)				
				Capillary Copper ft. (m)	Bulb Copper in. (mm)						
					Indoor			Outdoor			
TC-4111	Single Stage Single Bulb	-40 to 120 (-40 to 49)		6 (1.8)	3/8 x 4 (9.5 x 102)	Factory Set 3 (2) Adj. 3 to 16 (2 to 9)	-40 to 170 (-40 to 77)				
TC-4111-020				20 (6)							
TC-4112		100 to 260 (38 to 127)		6 (1.8)					3/8 x 4 (9.5 x 102)	Factory Set 3 (2) Adj. 3 to 16 (2 to 9)	-40 to 310 (-40 to 154)
TC-4115 <sup>b</sup>		-40 to 120 (-40 to 49)									-40 to 170 (-40 to 77)
TC-4121				100 to 260 (38 to 127)							10 (3) Armored
TC-4122		190 to 350 (88 to 176)		-40 to 400 (-40 to 204)							
TC-4123											
TC-4151	Single Stage Dual Bulb	70 to 120 (21 to 49)	1:1-1/2 <sup>c</sup>	30 (9)	3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)	Factory Set 3 (2) Adj. 1-1/2 to 10 (1 to 5)				Total of indoor and outdoor temperatures must not exceed 280 (138)
TC-4152			1:1	Each Bulb	3/8 x 4 (9.5 x 102)	3/8 x 4 (9.5 x 102)	Factory Set 3 (2) Adj. 3 to 16 (2 to 9)				
TC-4166	Single Stage Return Air Bulb	50 to 90 (10 to 32)		None	Coiled 2-1/2 x 2 (64 x 51)		Fixed 2 (1)	-40 to 145 (-40 to 63)			
TC-4211	Two Stage Single Bulb	-40 to 120 (-40 to 49)		6 (1.8)	3/8 x 4 (9.5 x 102)		Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 2 to 10 (1 to 5)	-40 to 170 (-40 to 77)			
TC-4221				10 (3) Armored				-40 to 310 (-40 to 154)			
TC-4222		100 to 260 (38 to 127)						-40 to 400 (-40 to 204)			
TC-4223		190 to 350 (88 to 176)									
TC-4251	Two Stage Dual Bulb	70 to 120 (21 to 49)	1:1-1/2 <sup>c</sup>	30 (9)	3/8 x 4 (9.5 x 102)	3/8 x 5-1/2 (9.5 x 140)	Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 1.5 to 6.5 (1 to 4)	Total of indoor and outdoor temperatures must not exceed 280 (138)			
TC-4252			1:1	Each Bulb	3/8 x 4 (9.5 x 102)	3/8 x 4 (9.5 x 102)	Per Stage Fixed 3 (2) Between Stages Set 3 (2) Adj. 2 to 10 (1 to 5)				
TC-4266	Two Stage Return Air Bulb	50 to 90 (10 to 32)		None	Coiled 2-1/2 x 2 (64 x 51)		Each Stage Fixed 2 (1) Between Stages Set 3 (2) Adj. 1 to 5 (0.5 to 3)	-40 to 145 (-40 to 63)			

<sup>a</sup> First number of reset ratio typically indicates outdoor air temperature change required to increase the setpoint by the second number.

<sup>b</sup> See Electrical Rating.

<sup>c</sup> For 1-1/2:1 ratio, reverse bulbs and use extra dial supplied with unit.

**Table-3 Ratio Selection Table.**

Outdoor Temperature in °F	Ratio	Change in Water Temperature for Different Ratios as Outdoor Temperature Drops from 70°F to Design Temperature					
		Dial Set at 70°F	Dial Set at 80°F	Dial Set at 90°F	Dial Set at 100°F	Dial Set at 110°F	Dial Set at 120°F
-30	1 to 1-1/2	70 to 220	80 to 230	90 to 240	100 to 250	110 to 260	120 to 270
	1 to 1	70 to 170	80 to 180	90 to 190	100 to 200	110 to 210	120 to 220
	1-1/2 to 1	70 to 137	80 to 147	90 to 157	100 to 167	—	—
-20	1 to 1-1/2	70 to 205	80 to 215	90 to 225	100 to 235	110 to 245	120 to 255
	1 to 1	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1-1/2 to 1	70 to 130	80 to 140	90 to 150	100 to 160	—	—
-10	1 to 1-1/2	70 to 190	80 to 200	90 to 210	100 to 220	110 to 230	120 to 240
	1 to 1	70 to 150	80 to 160	90 to 170	100 to 180	110 to 190	120 to 200
	1-1/2 to 1	70 to 123	80 to 133	90 to 143	100 to 153	—	—
0	1 to 1-1/2	70 to 175	80 to 185	90 to 195	100 to 205	110 to 215	120 to 225
	1 to 1	70 to 140	80 to 150	90 to 160	100 to 170	110 to 180	120 to 190
	1-1/2 to 1	70 to 117	80 to 127	90 to 137	100 to 147	—	—
+10	1 to 1-1/2	70 to 160	80 to 170	90 to 180	100 to 190	110 to 200	120 to 210
	1 to 1	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1-1/2 to 1	70 to 110	80 to 120	90 to 130	100 to 140	—	—
+20	1 to 1-1/2	70 to 145	80 to 155	90 to 165	100 to 175	110 to 185	120 to 195
	1 to 1	70 to 120	80 to 130	90 to 140	100 to 150	110 to 160	120 to 170
	1-1/2 to 1	70 to 103	80 to 113	90 to 123	100 to 133	—	—
+30	1 to 1-1/2	70 to 130	80 to 140	90 to 150	100 to 160	110 to 170	120 to 180
	1 to 1	70 to 110	80 to 120	90 to 130	100 to 140	100 to 150	120 to 160
	1-1/2 to 1	70 to 97	80 to 107	90 to 117	100 to 127	—	—

°C = (°F - 32) 5/9.

## DUAL BULB SELECTION

On the dual bulb units, indoor and outdoor bulbs are determined by the ratio selected (see Table-2). Ratio refers to the outdoor air temperature change compared to the water temperature change. The dial setpoint is the water temperature setpoint when the outdoor temperature is 70°F.

To select ratio, it is necessary to know only: (1) outdoor design temperature, (2) maximum water temperature at outdoor design temperature, and (3) desired water temperature at 70°F outdoors. Use Table-3 to determine the required ratio based on this information and set the dial per item (3).

**Note:** If a 1-1/2:1 ratio is selected, the extra dial supplied with the unit must be used.

**Example:** Select ratio for an installation with a -10°F design temperature and estimated supply water temperature of 75°F at 70°F outdoors and 125°F at -10°F outdoors. From Table-3, -10°F for 1-1/2:1 ratio, note by interpolation (70°F to 123°F with dial at 70°F, 80°F to 133°F with dial at 80°F) that water temperature varies from 75°F to 128°F as outdoor temperature drops from 70°F to -10°F.

For this application, the 1-1/2:1 ratio should be selected. The extra dial supplied with the unit would be used, and the dial set at 75°F.

## PRE-INSTALLATION

### Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

### Required Installation Items

- Wiring diagram
- Tools (not provided):
  - Volt-ohm meter
  - Room temperature thermometer on °F or °C
  - Appropriate screwdriver(s) for cover, terminals and mounting screws
  - Appropriate drill and drill bit for mounting screws

## INSTALLATION

### Caution:

1. Installer must be a qualified, experienced technician.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. Make all connections in accordance with the electrical wiring diagrams, and in compliance with national and local codes. *Use copper conductors only.*
4. Do not exceed ratings of the device.
5. Avoid locations where excessive moisture, corrosive fumes or vibrations are present.

## Location

Locate the device allowing proper distance to the bulb location. The case can be mounted in any position. Refer to Figure-2 for case dimensions.

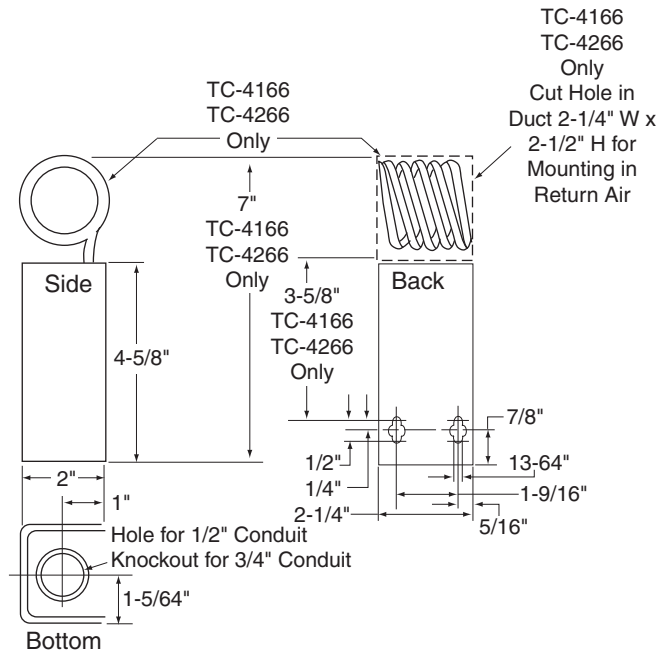


Figure-2 Case Dimensions.

## Procedure for Remote Bulb Mounting

### Air Bulb Models — Mounting in Return Air Duct

1. Remove cover and provide two holes for #10 round head screws using the housing as the template or by using the dimensions shown in Figure-2.
2. Partially insert the mounting screws in the screw holes. Fit the housing over the screws, slide housing down on the screws and tighten the screws.

### Air Bulb Models — Mounting Outside of Return Air Duct

1. Prepare duct for mounting by cutting hole and providing mounting screw holes per Figure-2.
2. Fabricate a cover as shown in Figure-3.
3. Carefully roll bulbs toward back of unit and insert through 2-1/4" x 2-1/2" (57 mm x 64 mm) hole.
4. Remove cover and attach unit to duct with #10 screws.
5. Attach cover over 2-1/4" x 2-1/2" (57 mm x 64 mm) hole.

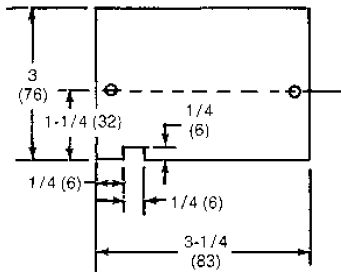


Figure-3 Field Supplied Duct Hole Cover Plate.

### Duct and Outdoor Mounting

Maximum insertion length is 6 inches.

**Duct:** Install bulb with AT-208 kit as shown in Figure-4.

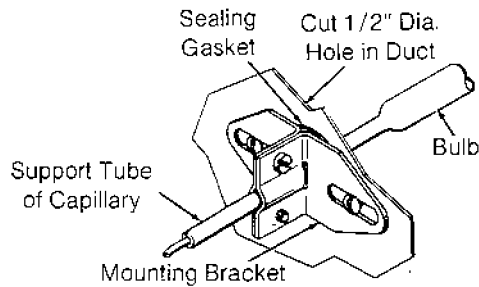


Figure-4 Duct Mounting with AT-208.

**Outdoor:** Install with AT-211 kit as shown in Figure-5.

1. Mount bulb to outside wall or surface with bulb clip.
2. Place shield over bulb and fasten to mounting surface.

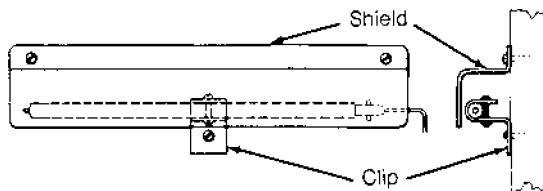


Figure-5 Outdoor Mounting with AT-211.

### Bulb Mounting — Liquid Line and Tank

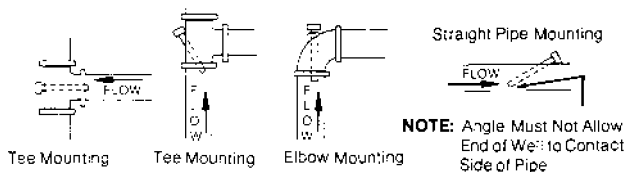


Figure-6 Bulb Mounting for Liquid Line and Tank.

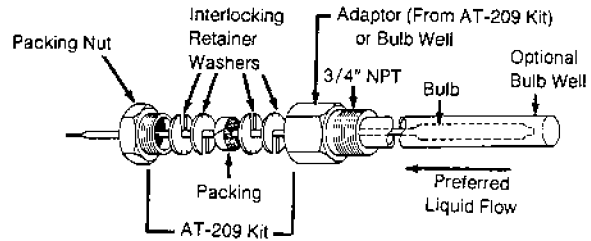


Figure-7 AT-201 or AT-203 Installation.

### AT-201 or AT-203 Installation (see Figures-6 and 7):

1. Install bulb well or adaptor from AT-209 into 3/4" FNPT opening.
2. Place packing nut, washers and packing from AT-209 over bulb support section and insert bulb well or AT-209 adaptor.
3. Push interlocking washers and packing into well or adaptor and tighten packing nut until firmly sealed.

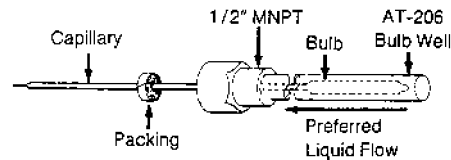


Figure-8 AT-206 Installation.

### AT-206 Installation (see Figures-6 and 8):

1. Install AT-206 bulb well into 1/2" FNPT opening.
2. Place packing (included with AT-206) over bulb support section and insert bulb into well.
3. Push packing into nut on well using a screwdriver.

### Concealed Setpoint and Lock Cover Screw

Order AT-210 concealed adjustment kit separately.

1. Peel off adhesive film from the concealed adjustment plate and place into the recess of cover.
2. Remove screw from cover.
3. Install lock cover screw provided with AT-210.

**Table-4 Bulb Mounting Installation Hardware And Application Limitations.**

Part Number	Description	Mounting Fitting	Insertion Size in. (mm)	Application Limitations at 250°F (121°C) Fluid Temperature <sup>a</sup>		Installation per Figure
				Max. Recommended Velocity fps (m/s)	Max. Recommended Static Press. psig (kPa)	
AT-201 <sup>b</sup>	Copper Bulb Well	3/4" MNPT	1/2 (13) dia. O.D. 9-1/2 (241) long	11 (3.3)	250 (1728)	7
AT-203 <sup>b</sup>	Stainless Steel Bulb Well			20 (6.1)	500 (3448)	
AT-206	Copper Bulb Well	1/2" MNPT	1/2 (13) dia. O.D. 4-1/2 (114) long	11 (3.3)	250 (1728)	8

<sup>a</sup> Max. recommended fluid temperature is 350 F (177°C).  
<sup>b</sup> Requires AT-209.

**WIRING**

The thermostat has one 1/2" to 3/4" conduit opening in the bottom of the housing. Terminal coding and switch action are shown in Figures-9 and 10.

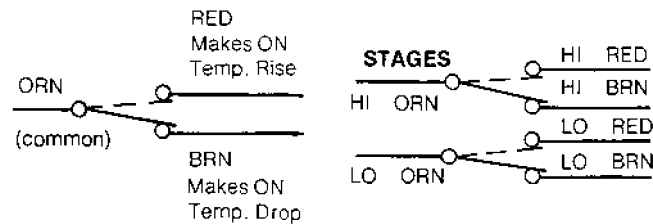


Figure-9 Terminal Coding and Switch Action.

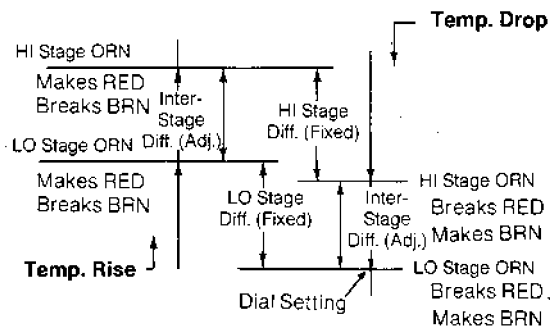


Figure-10 Two Stage Switch Sequence.

**TYPICAL APPLICATIONS**

Figures-11 and 12 show typical heating and cooling applications for single stage units. Figures-13 and 14 show typical heating and cooling applications for two stage units.

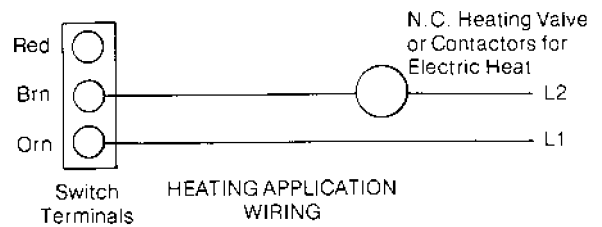


Figure-11 Typical Heating Application for Single Stage Units.

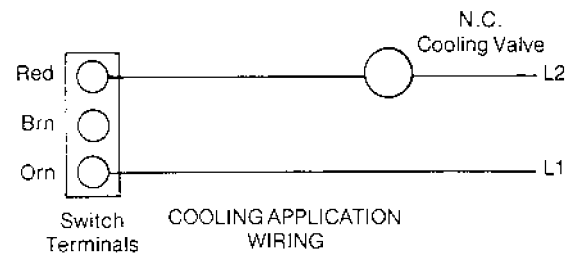


Figure-12 Typical Cooling Application for Single Stage Units.

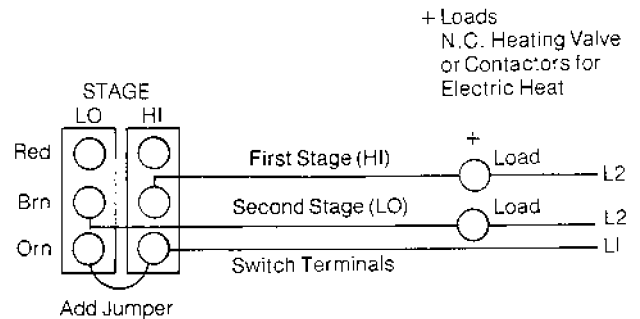


Figure-13 Typical Heating Application for Two Stage Units.

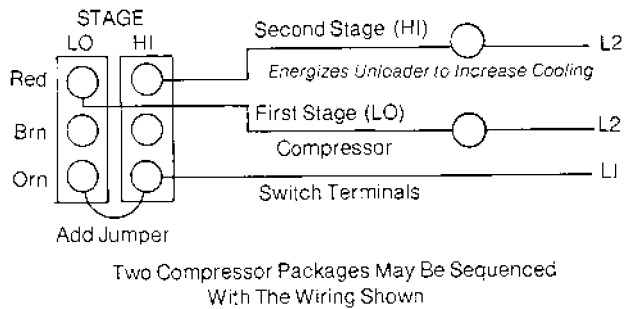


Figure-14 Typical Cooling Application for Two Stage Units.

## CHECKOUT

After installing a thermostat, make an initial check of the switching action. Verify the switch action by listening to the switch contacts.

1. Turn the setpoint dial to a temperature above ambient. This should cause the thermostat to switch, making orange to brown.
2. Turn the setpoint dial setting down gradually. Orange to brown must break, making orange to red.
3. Compare the differential of the device to the differential shown on the performance charts by turning the dial. The differential of the device is the difference in dial reading between the make of orange to brown and the make of orange to red on single switch units.

## ADJUSTMENTS

### Setpoint

Screwdriver adjustment. Scales dual marked °F on front and °C on back. To change scale, remove spring retaining ring, select scale and replace retaining ring.

### Differential

The differential is adjustable by turning the adjuster located on the side of the device (see Figure-15).

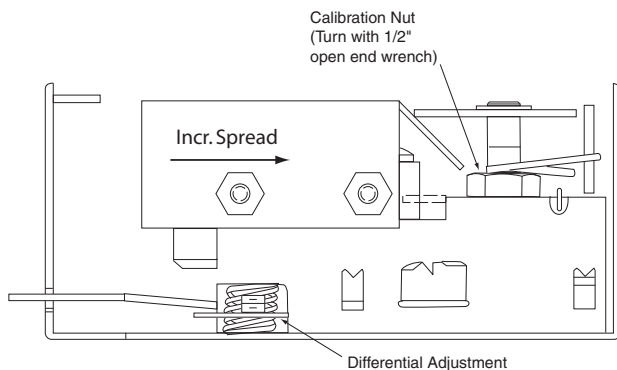


Figure-15 Adjustments.

**Single Stage:** Each line represents approximately 3°F (2°C) change.

**Two Stage:** Each notch represents approximately 2°F (1°C) change between stages. (Differential per switch is fixed.)

To adjust interstage differential:

1. Disconnect power to unit.
2. Remove cover.
3. Turn adjustor to approximately desired position.
4. Check out by turning dial and noting dial readings where switch contacts make.
5. After changing interstage differential, recalibrate. See CALIBRATION.

## CALIBRATION

1. With all power disconnected, soak bulb(s) for 10 minutes at known temperature (must be 70°F for dual bulb).
2. Turn dial and note where switch contacts make.
3. Turn dial midway between click points.
4. Turn the calibration nut (located under dial) until the temperature of the bulb is indicated on the dial (see Figure-15).

**Note:** On two stage units follow above procedure. LO switch is first stage on cooling applications. HI switch is first stage on heating applications.

## MAINTENANCE

Regular maintenance of the total system is needed to assure sustained optimum performance. Thermostats should be periodically inspected for dirt or blockage of air over the elements.

## REPAIR

Field repair is not recommended. Replace defective device.