

**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.

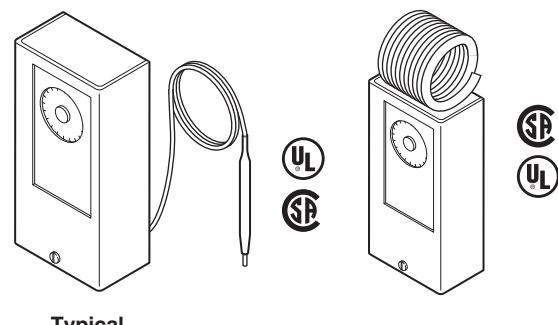
ACCESSORIES

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*)**

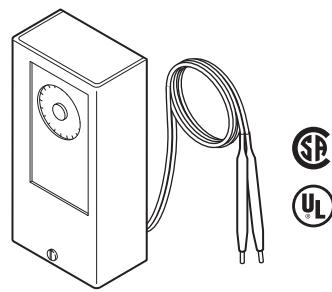
Switch Rating (50/60 Hz)	24V	120V	240V
Full Load Amps	9.8	9.8	8.0
Locked Rotor Amps	58.8	58.8	48.0
Pilot Duty VA	60	360	360
Non-Inductive Amps (Resistive)			
Single Stage	22	22	22
Two Stage	16	16	8.0

* 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.



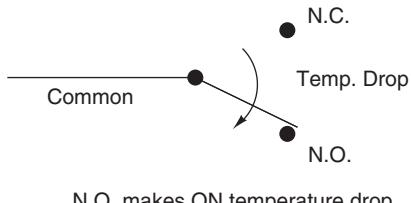
Typical
Single Bulb

Typical
Return Air Bulb



Typical
Dual Bulb

Typical Single Stage



N.O. makes ON temperature drop

Typical Two Stage

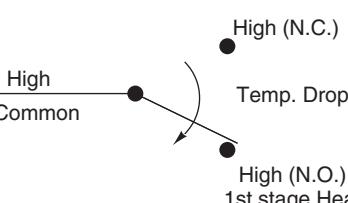
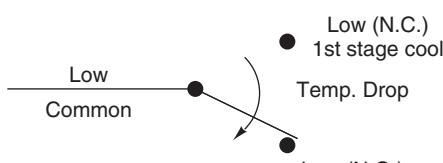


Figure-1 Switch Action and Terminal Identification.

Table-2 Specifications.

Part Number	Type	Setpoint Adjustment Range °F (°C)	Dual ^a 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) 10 (3) Armored	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		100 to 260 (38 to 127)		20 (6)				-40 to 310 (-40 to 154)		
TC-4112		-40 to 120 (-40 to 49)		6 (1.8)				-40 to 170 (-40 to 77)		
TC-4115 ^b		100 to 260 (38 to 127)		10 (3) Armored				-40 to -310 (-40 to 154)		
TC-4121		190 to 350 (88 to 176)		10 (3) Armored				-40 to 400 (-40 to 204)		
TC-4122		70 to 120 (21 to 49)	1:1-1/2 ^c 1:1	30 (9) Each Bulb	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-4123		70 to 120 (21 to 49)		30 (9) 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-4151	Two Stage Single Bulb	50 to 90 (10 to 32)	6 (1.8) 10 (3) Armored	None	Coiled 2-1/2 x 2 (64 x 51)		Fixed 2 (1)	-40 to 145 (-40 to 63)		
TC-4211		-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		100 to 260 (38 to 127)		10 (3) Armored				-40 to 310 (-40 to 154)		
TC-4222		190 to 350 (88 to 176)		10 (3) Armored				-40 to 400 (-40 to 204)		
TC-4223		70 to 120 (21 to 49)	1:1-1/2 ^c 1:1	30 (9) Each Bulb	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-4251		70 to 120 (21 to 49)		30 (9) 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-4252	Two Stage Dual 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)	120 to 270 120 to 220 —	-40 to 145 (-40 to 63)		
TC-4266		50 to 90 (10 to 32)		None	Coiled 2-1/2 x 2 (64 x 51)		120 to 255 120 to 210 —	120 to 240 120 to 200 —		

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

^b See Electrical Rating.

^c 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 1 to 1 1-1/2 to 1	70 to 220 70 to 170 70 to 137	80 to 230 80 to 180 80 to 147	90 to 240 90 to 190 90 to 157	100 to 250 100 to 200 100 to 167	110 to 260 110 to 210 —	120 to 270 120 to 220 —
	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 205 70 to 160 70 to 130	80 to 215 80 to 170 80 to 140	90 to 225 90 to 180 90 to 150	100 to 235 100 to 190 100 to 160	110 to 245 110 to 200 —	120 to 255 120 to 210 —
	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 190 70 to 150 70 to 123	80 to 200 80 to 160 80 to 133	90 to 210 90 to 170 90 to 143	100 to 220 100 to 180 100 to 153	110 to 230 110 to 190 —	120 to 240 120 to 200 —
0	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 175 70 to 140 70 to 117	80 to 185 80 to 150 80 to 127	90 to 195 90 to 160 90 to 137	100 to 205 100 to 170 100 to 147	110 to 215 110 to 180 —	120 to 225 120 to 190 —
	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 160 70 to 130 70 to 110	80 to 170 80 to 140 80 to 120	90 to 180 90 to 150 90 to 130	100 to 190 100 to 160 100 to 140	110 to 200 110 to 170 —	120 to 210 120 to 180 —
	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 145 70 to 120 70 to 103	80 to 155 80 to 130 80 to 113	90 to 165 90 to 140 90 to 123	100 to 175 100 to 150 100 to 133	110 to 185 110 to 160 —	120 to 195 120 to 170 —
+30	1 to 1-1/2 1 to 1 1-1/2 to 1	70 to 130 70 to 110 70 to 97	80 to 140 80 to 120 80 to 107	90 to 150 90 to 130 90 to 117	100 to 160 100 to 140 100 to 127	110 to 170 100 to 150 —	120 to 180 120 to 160 —

$$^{\circ}\text{C} = ({}^{\circ}\text{F} - 32) \frac{5}{9}$$

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.

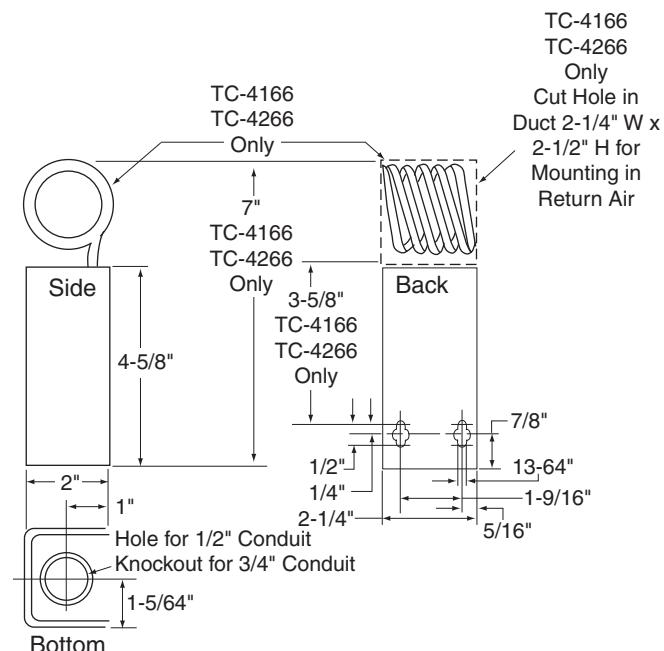


Figure-2 Case Dimensions.

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.

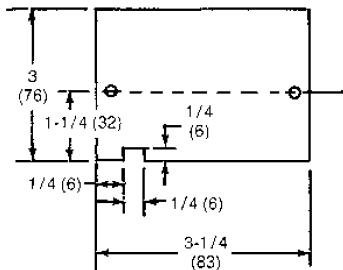


Figure-3 Field Supplied Duct Hole Cover Plate.

Duct and Outdoor Mounting

Maximum insertion length is 6 inches.

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

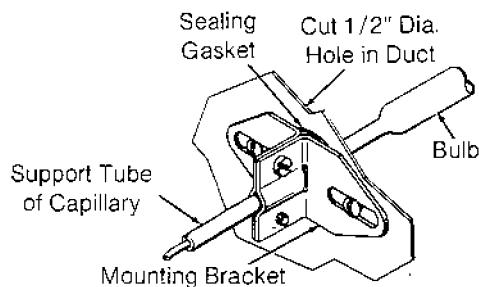


Figure-4 Duct Mounting with AT-208.

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.

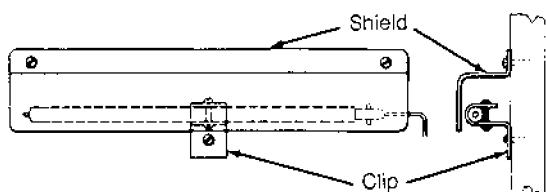


Figure-5 Outdoor Mounting with AT-211.

Bulb Mounting — Liquid Line and Tank

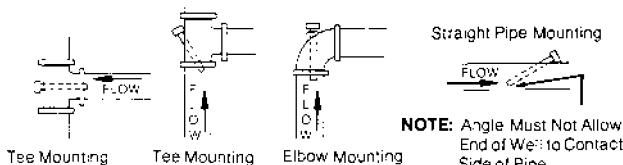


Figure-6 Bulb Mounting for Liquid Line and Tank.

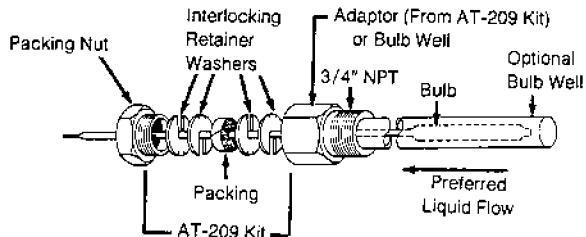


Figure-7 AT-201 or AT-203 Installation.

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.

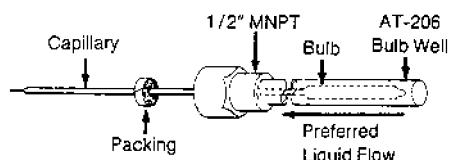


Figure-8 AT-206 Installation.

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 ^a		Installation per Figure
				Max. Recommended Velocity fps (m/s)	Max. Recommended Static Press. psig (kPa)	
AT-201 ^b	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 ^b	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

^a Max. recommended fluid temperature is 350 F (177°C).

^b 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.

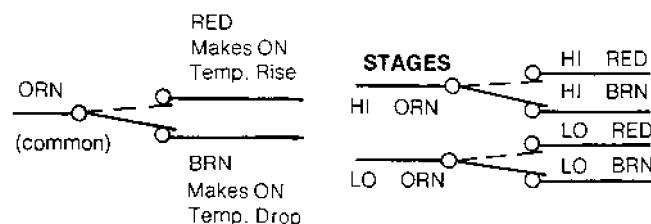


Figure 9 Terminal Coding and Switch Action.

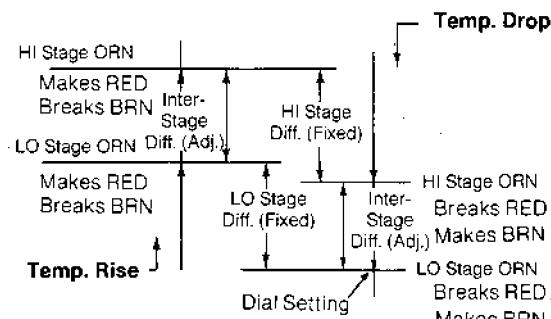


Figure 10 Two Stage Switch Sequence.

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.

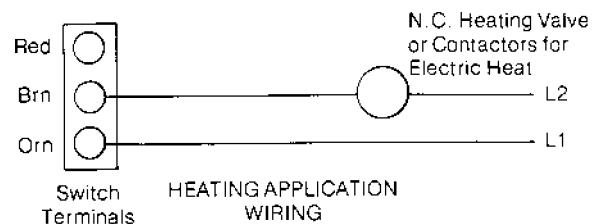


Figure 11 Typical Heating Application for Single Stage Units.

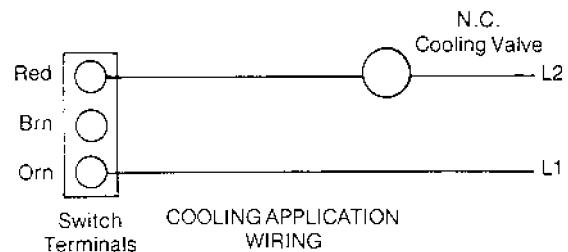


Figure 12 Typical Cooling Application for Single Stage Units.

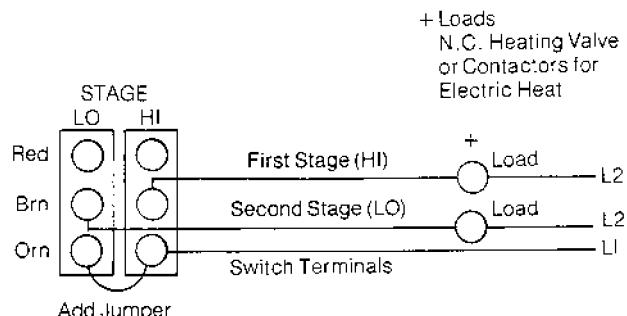


Figure 13 Typical Heating Application for Two Stage Units.

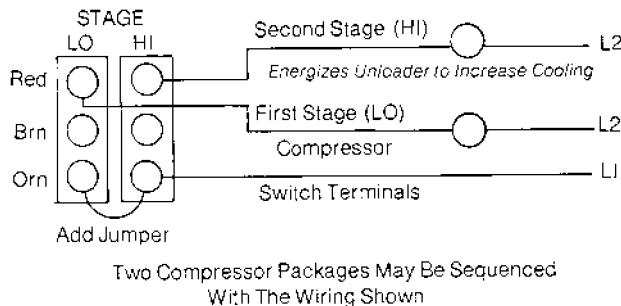


Figure-14 Typical Cooling Application for Two Stage Units.

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 adjustor located on the side of the device (see Figure-15).

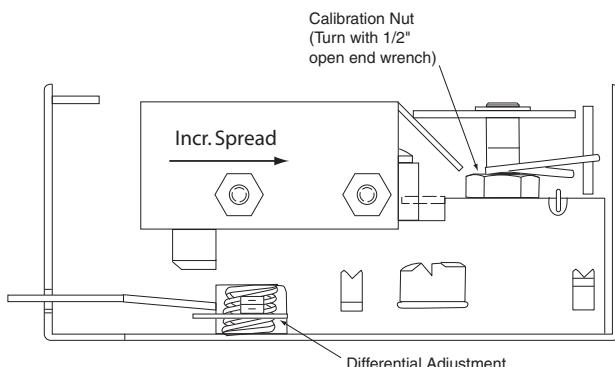


Figure-15 Adjustments.

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.