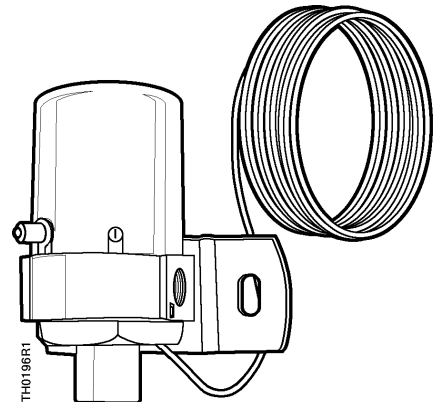


## Powers™ Controls

### TH 357 Limitem Remote Bulb Thermostat



#### Description

The TH 357 Limitem is a gradual-direct acting thermostat for air temperature control. This pneumatically operated instrument senses a temperature and passes on a pneumatic signal whose pressure is proportional to the temperature sensed. The sensing element is liquid filled, and is available in remote and averaging bulb styles.

#### Features

- Two-valve design eliminates wasting air
- Rapid response to temperature change
- Adjustable sensitivity

#### Application

The TH 357 Limitem can be used to control air temperatures in a variety of air handling units. Typical applications are as primary controller for an air handling unit or a low limit control.

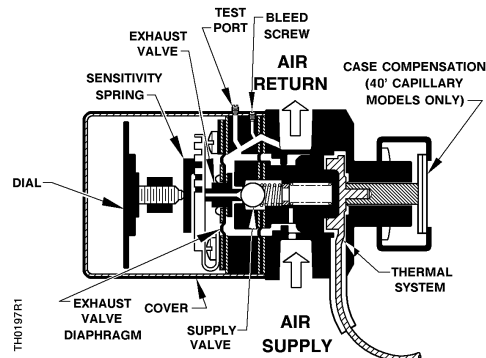
**Table 1. Product Numbers.**

| Specifications               |                                 |                                       |                  |                            |   |                |
|------------------------------|---------------------------------|---------------------------------------|------------------|----------------------------|---|----------------|
| Sensing Element              | Operating Range                 | Bulb                                  | Capillary        | Max. Ambient Temp. of Bulb | Sensitivity Adjustable                      | Product Number |
| Liquid Filled Remote Bulb    | 20 to 100°F<br>(-6.7 to 37.8°C) | 3/8 in. x 4.0 in.<br>(0.95 x 10.2 cm) | 8.0 ft (2.4 m)   | 201°F<br>(94°C)            | 1/3 to 3-1/2 psi/°F<br>(4 to 43 kPa per °C) | 357-0003       |
|                              | 120 to 230°F<br>(48.9 to 110°C) | 3/8 in. x 4.0 in.<br>(0.95 x 10.2 cm) | 40.0 ft (12.2 m) | 261°F<br>(127°C)           | 1/3 to 2-1/4 psi/°F<br>(4 to 28 kPa per °C) | 357-0005       |
| Liquid Filled Averaging Bulb | 35 to 145°F<br>(1.7 to 62.8°C)  | 3/32 in. x 15 ft<br>(0.24 x 457 cm)   | 40.0 ft (12.2 m) | 210°F<br>(99°C)            | 1/3 to 2-1/4 psi/°F<br>(4 to 28 kPa per °C) | 357-0004       |
|                              | 35 to 145°F<br>(1.7 to 62.8°C)  | 3/32 in. x 8 ft<br>(0.24 x 244 cm)    | 0.5 ft (15 cm)   | 211°F<br>(99.4°C)          | 1/3 to 3-1/2 psi/°F<br>(4 to 43 kPa per °C) | 357-0001       |

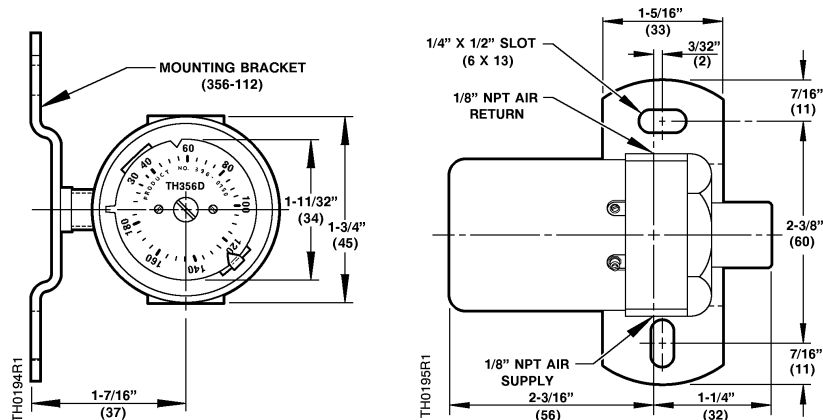
|                       |  |                  |
|-----------------------|--|------------------|
| <b>Specifications</b> | Operating range  | See Table 1      |
|                       | Control Action   | Direct           |
|                       | Temperature response   | 0.5°F (0.3°C)    |
|                       | Maximum supply air pressure  | 30 psi (207 kPa) |
|                       | Maximum ambient temperature of case  | 180°F (82°C)     |
|                       | Air connection   | 1/8-inch NPT     |
|                       | Shipping weight  | 2 lbs (0.9 kg)   |
|                       | Dimensions   | See Figure 2     |
| <b>Accessories</b>    | Mounting flange  | 808-412          |
|                       | Remote bulb holder   | 808-517          |
|                       | Copper well  | 134-061          |
|                       | Coil clip  | 356-115          |
|                       | Capillary clip (box of 100)  | 357-001          |
|                       | Replacement gauges   |                  |
|                       | 0 to 30 psi (bottom)   | P142-308         |
|                       | 0 to 30 psi/O to 200 kPa (back)  | P142-373         |
| <b>Operation</b>      | <p>As temperature increases, the liquid within the thermal system expands and moves the supply valve body away from the ball valve, causing a gradual increase of air pressure in the return line. (The ball is closed against the exhaust valve while the supply valve is open, preventing constant air waste.) Increased pressure in the return air chamber causes the exhaust valve to compress the sensitivity spring. When the temperature decreases, the ball is moved away from the exhaust seat simultaneously closing against the supply valve. Both valves are closed when the control is satisfied.</p> |                  |
|                       | <p>As the temperature decreases, the liquid within the thermal system contracts. Return air pressure moves the supply and the ball valve away from the exhaust valve, gradually reducing the return line air through the exhaust port. Lower pressure in the return air chamber reduces the force against the exhaust valve. The sensitivity spring expands and the exhaust valve moves gradually toward the ball valve reducing the return air waste.</p>   |                  |
|                       | <p>The throttling range is changed by moving the sensitivity spring to a new position. Sensitivity is most gradual 1/3psi/1°C or (4 kPa/°C) when the open end of the spring is under the adjusting screw. Factory setting is at the center of the sensitivity spring. When changing the sensitivity adjustment, care should be exercised so as not to cock or distort the exhaust valve diaphragm. Any change to the spring's position affects calibration and requires resetting of the dial.</p>   |                  |

**Operation,  
continued**

The return line vent, factory set for  $1/2$  CIM ( $0.27$  to  $0.55\text{cm}^3/\text{s}$ ), prevents the air from being trapped in the return line when the Limitem is piloted from a room thermostat.

**Figure 1. Operation.****Installation****Mounting the TH 357  
Limitem body.**  
(See Figure 2.)

- A 1/8-inch NPT opening in the Limitem body is provided for mounting.
- The mounting bracket (No. 356-112 furnished with thermostat) may be attached to any flat surface and the thermostat body threaded onto the protruding pipe nipple.
- When metal tubing is used for the supply and return air lines, this tubing may also serve to support the body of the thermostat.

**Figure 2. Mounting and Dimensions of the TH 357 Remote and Averaging Bulb Limitem.****Mounting the TH 357  
Limitem Bulb**

- When mounting the bulb through a metal surface, protect the bulb by using a mounting flange No. 356-079 with a rubber grommet.

**Remote bulb**

- Use a remote bulb holder No. 808-517 to support the remote bulb. See Figure 3. The holder may be shortened to fit small ducts.
- When the bulb is mounted in a unit ventilator, use coil clip No. 356-115 to support the bulb in the air stream close to the coil. See Figures 4 and 5.
- When installing the remote bulb in a pipeline, use copper well No. 134-061.

## Installation, continued

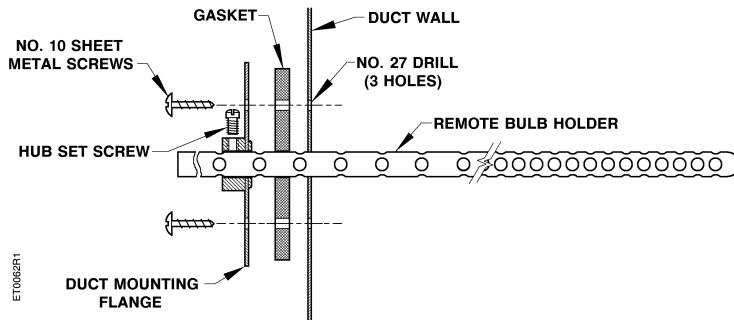


Figure 3. Remote Bulb Holder Kit No. 808-517.

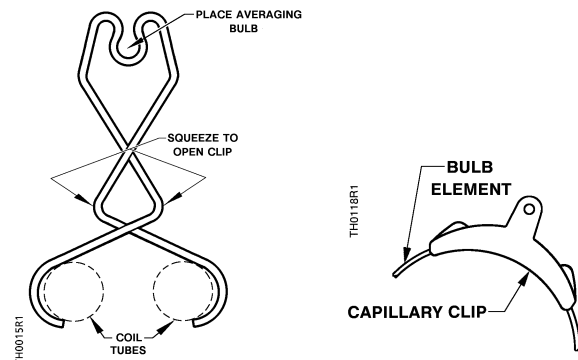


Figure 4. Clips.

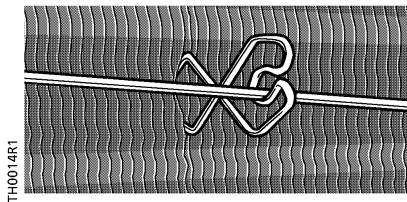


Figure 5. Clip Mounted on Coil.

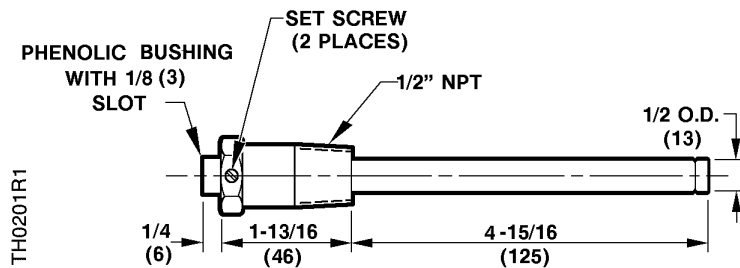


Figure 6. Copper Well 134-061.

### Averaging bulb mounting

Averaging bulbs require some means of support for the bulb and capillary.

- Use a coil clip, Part No. 356-115 (Figures 4 and 5) or a capillary clip, Part No. 357-001 (Figure 4), to support the bulb if there is easy access to the coil.
- For duct mounting where access to the coil is limited, see Figure 7. Use flange No. 808-412 and a length of 3/8 inch (9.5 mm) O.D. hard copper tube to expose the bulb to the air leaving the coil within the duct.

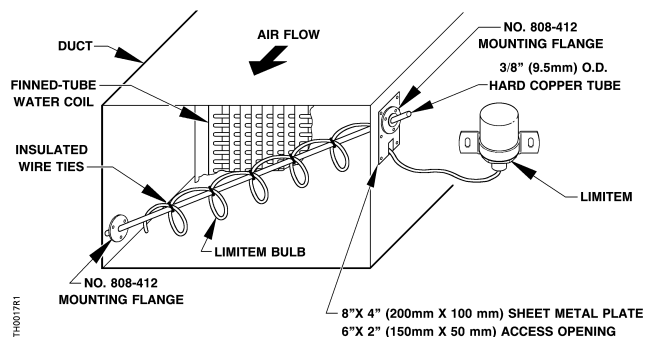
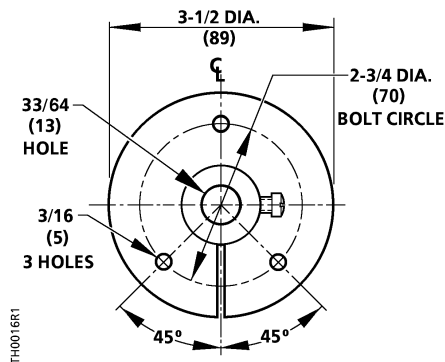


Figure 7. Installation of TH 357 Averaging Bulb in a Duct.

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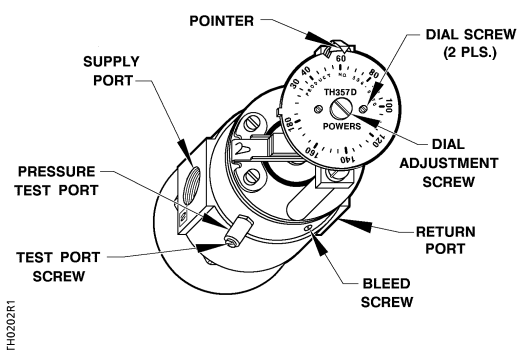
**Calibration****To change setpoint**

1. Remove the cover.
  2. With a screwdriver, turn dial adjustment screw (Figure 8) to change to the desired setpoint.
- 

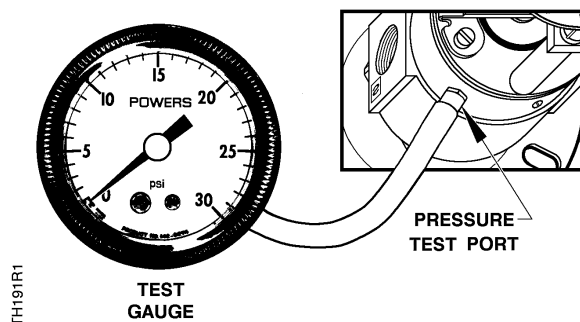
**To calibrate**

1. Using a test thermometer, accurately measure the temperature at the bulb.
  2. Set the dial to the bulb temperature by turning the dial adjustment screw with a screwdriver.
- NOTE:** You must use a screwdriver. Do not attempt to change the dial by rotating it with your hand.
3. If a permanent return air gauge is not installed, use the pressure test port. See Figure 8 for its location.
  4. Loosen the test port screw about 1/2 turn, and slip a 3/16-inch I.D. rubber hose connected to the test gauge over the pressure test port. See Figure 9.
  5. If the return pressure does not read 7 to 8 psi (48-55 kPa) turn the dial adjustment screw with a screwdriver until pressure is 7 to 8 psi (48-55 kPa).
  6. Loosen the dial screws and turn dial until the temperatures at the bulb and dial are identical. Tighten the screws.

The thermostat is now calibrated and setpoint may be changed as desired.



**Figure 8. Limitem Cover Removed.**



**Figure 9. Using the Pressure Test Port.**

## Sensitivity Adjustment

The sensitivity adjustment is factory set with the sensitivity spring tab in position 6 of the spring retainer. This is approximately mid span of the sensitivity. Move the sensitivity spring to a lower slot number for more gradual setting. Move the sensitivity spring to a higher slot number for more positive setting. See Table 2.

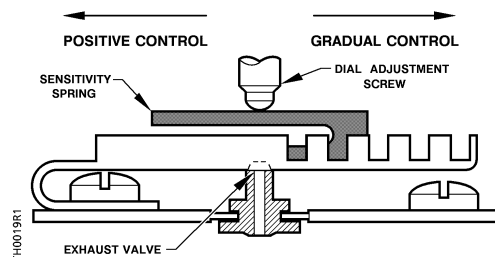
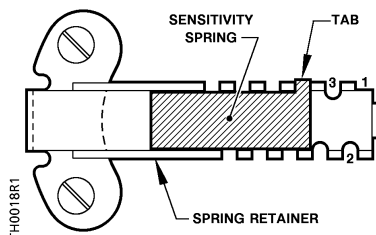
To change the sensitivity:

1. Loosen the dial screws. (Figure 8)
2. Loosen the dial adjustment screw.
3. Lightly press, but do not bend, the spring retainer. (Figure 10.)
4. Move the sensitivity spring to the new position. (Figure 10.) Table 2 gives the sensitivity spring tab location and the corresponding sensitivity value.

**NOTE:** The tab may be installed in either side of the spring retainer.

5. Make sure that the dial adjustment screw point touches the sensitivity spring.
6. Recalibrate the unit.
7. If you need to adjust again, allow five minutes for the control cycle to settle before repeating the steps above.

| Table 2. |                    |                  |
|----------|--------------------|------------------|
| Slot No  | Sensitivity psi/°F |                  |
|          | Remote Bulb        | Rmt Bulb 40' Cap |
| 1        | 0.33               | 0.33             |
| 2        | 0.60               | 0.54             |
| 3        | 1.03               | 0.76             |
| 4        | 1.39               | 0.97             |
| 5        | 1.74               | 1.18             |
| 6        | 2.09               | 1.40             |
| 7        | 2.44               | 1.61             |
| 8        | 2.79               | 1.82             |
| 9        | 3.15               | 2.03             |
| 10       | 3.5                | 2.29             |
| 11       | 3.5                | 2.29             |



**Figure 10. Sensitivity Spring Setting.**

**Troubleshooting**

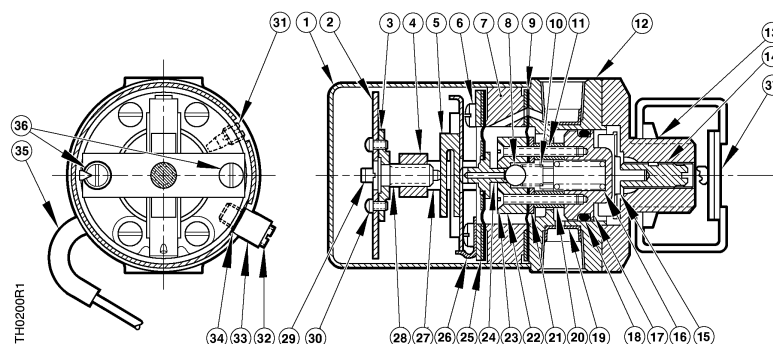
If the limitem fails to operate properly, use Table 3 as a troubleshooting guide. Make certain the thermostat receives 18 to 30 psi (124 to 207 kPa) of clean, dry, oil-free supply air. Also, use a test gauge with a length of 3/16-inch I.D. rubber hose to measure the return pressure at the test port if permanent gauges are not available.

**Service**

The limitem cannot be serviced. Replace the thermostat if inoperative after checking the troubleshooting table.

**Table 3. Troubleshooting Chart.**

| Complaint   | Check   |                                  | Probable Cause                                | Corrective Action  |
|---|---|----------------------------------|---|--|
|   | Supply air Pressure   |                                  | Low Pressure                                  | As Required  |
| Return Line pressure stays at approx. zero            | Depress exhaust valve   | If return is still zero psi      | Defective valve assembly                      | Replace thermostat   |
|   |   | If return pressure increases     | Out of calibration or damaged sensing element | 1. Recalibrate<br>2. With 6 to 9 psi return pressure, vary temperature at the bulb. If no change in return pressure, replace thermostat. |
| Return Line pressure stays at approx. supply pressure | Using a screwdriver, rotate set point dial counterclockwise to the limit stop | If return pressure remains high  | Defective valve assembly                      | Replace thermostat   |
|   |   | If return pressure drops to zero | Out of calibration                            | Recalibrate  |
| Excessive air leakage from exhaust valve              | Supply and return line connection   |                                  | Connections are interchanged                  | Reverse the supply and return connections  |
| Temperature cycles rapidly                            | Sensitivity setting   |                                  | Improper setting                              | Move the sensitivity spring to a more gradual (lower #) slot setting. See <i>Sensitivity Adjustment</i> .                                |
| Temperature wanders from control point                | Sensitivity setting   |                                  | Improper setting                              | Move the sensitivity spring to a more positive (higher #) slot setting. See <i>Sensitivity Adjustment</i> .                              |



**Figure 11. Construction of the Remote Bulb Limitem.**

**Table 4. Parts List.**

| Item | Part                             | Qty | Part Number |
|------|----------------------------------|-----|-------------|
| 1    | Cover                            | 1   | —           |
| 2    | Dial                             | 1   | —           |
| 3    | Lock Plate                       | 1   | —           |
| 4    | Bridge                           | 1   | —           |
| 5    | Sensitivity Spring               | 1   | —           |
| 6    | #6-32 x 1-3/8" Lg.Fil. Hd. screw | 4   | —           |
| 7    | Housing Ring                     | 1   | —           |
| 8    | Ball                             | 1   | —           |
| 9    | Lower Diaphragm                  | 1   | —           |
| 10   | Spring                           | 1   | —           |
| 11   | #3-48 x 3/4" Lg.Fil. Hd. screw   | 2   | —           |
| 12   | Body                             | 1   | —           |
| 13   | Flange                           | 1   | —           |
| 14   | Adjustment Screw                 | 1   | —           |
| 15   | Sensing Element                  | 1   | —           |
| 16   | Bias Spring                      | 1   | —           |
| 17   | Element Retainer                 | 1   | —           |
| 18   | "O" Ring                         | 1   | —           |
| 19   | Screen Filter                    | 2   | —           |
| 20   | Lower Spacer                     | 2   | —           |

**Table 4. Parts List, Continued.**

| Item | Part                                     | Qty | Part Number |
|------|--|-----|-------------|
| 21   | Retaining Ring                           | 1   | —           |
| 22   | Supply Valve                             | 1   | —           |
| 23   | Sealing Gasket                           | 2   | —           |
| 24   | Exhaust Valve & Diaphragm Assembly       | 1   | —           |
| 25   | Diaphragm Ring                           | 1   | —           |
| 26   | Retaining Spring                         | —   | —           |
| 27   | Upper Spacer                             | 2   | —           |
| 28   | Dial Adjustment Screw                    | 1   | —           |
| 29   | Pointer                                  | 1   | —           |
| 30   | Dial Screws                              | 2   | —           |
| 31   | Bleed Screw                              | 1   | —           |
| 32   | Test Plug                                | 1   | —           |
| 33   | Test Valve Body                          | 1   | —           |
| 34   | Valve Gasket                             | 1   | —           |
| 35   | Sleeve                                   | 1   | —           |
| 36   | #6-32 x 1-7/8" Lg.Fil. hd. machine screw | 2   | —           |
| 37   | Bimetal (40 ft capillary models)         | 2   | —           |

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