

## Dual Duct Models with TITUS II and IIA Pneumatic Controls Installation, Operation, and Maintenance Manual

### Adjusting Minimum and Maximum Air Flow for Units with Two Inlet Sensors

#### A. Maximum Flow Adjustment for Direct Acting Thermostat

1. Be sure the minimum LO air flow limit is zero on hot and cold deck controller.
2. To adjust the cold deck maximum CFM:
  - a. Apply 15-25 PSI to the thermostat connection on the cold deck controller. Place a manometer gauge across balancing tees at the cold deck inlet.
  - b. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7) no adjustment is necessary.
  - c. If adjustment is necessary, use the adjusting tool stored in the face of the controller (Titus II only) or a standard flat blade screwdriver.
  - d. Rotate the maximum HI knob slowly. A delay in response time has been deliberately built into the controls to avoid hunting. Allow several seconds for the controls to react and the system to stabilize. Rotate the knob until the gauge shows the required differential pressure.

NOTE: If the actuator fails to respond, see Guide to Service Procedures.

3. To adjust the hot deck maximum CFM:

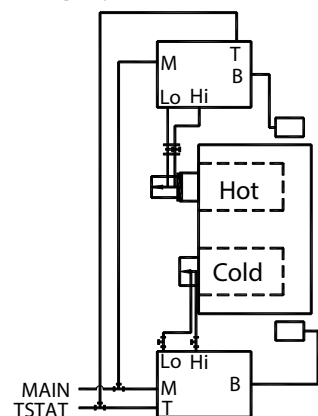


Figure 1. Piping Diagram

- a. Apply 0 PSI to the thermostat connection on the cold deck controller. That is, leave it open to the atmosphere. Place a manometer gauge across balancing tees at the cold deck inlet.
- b. Repeat Steps B, C and D above.

#### B. Maximum Flow Adjustment for Reverse Acting Thermostat

1. To adjust the cold deck maximum CFM:
  - a. Apply 0 PSI to the thermostat connection on the cold deck controller. That is, leave it open to the atmosphere. Place a manometer gauge across balancing tees at the cold deck inlet.
  - b. Repeat steps B, C and D above.
2. To adjust the hot deck maximum CFM:
  - a. Apply 15-25 PSI to the thermostat connection on the hot deck. Place the manometer gauge across balancing tees at the hot deck inlet.
  - b. Repeat steps B, C and D above.

#### C. Minimum Flow Adjustment for Either Thermostat

1. Place a 0-30 PSI pressure gauge in the line between the TITUS II Controller and the damper actuator on the cold deck.

2. Place a manometer gauge across the balancing tees on the hot deck inlet.
3. Adjust the thermostat pressure (Pressure reducing valve recommended) until the cold deck damper just closes:
  - a. If the damper in the cold deck is normally open, the pressure gauge should read approximately 10 PSI with standard 5-10 PSI actuator.
  - b. If the damper in the cold deck is normally closed, the pressure gauge should read approximately 5 PSI with standard 5-10 PSI actuator.
4. Refer to Page 6 and 7 for the differential pressure corresponding to the desired minimum air flow (CFM).
5. Adjust the reset start point dial on the hot deck until the manometer gauge across the balancing tees on the hot deck reads the desired differential pressure.

#### D. After Flow Rates are Adjusted

1. Replace the thermostat connection at the controller, if it has been removed during the adjustment process.
2. Remove the manometer gauge and replace the caps on the tees in the HI and LO tubes.

NOTE: The controller will not operate if these caps are left off.

3. Return the adjustment tool to its socket in the face of the controller.
4. Replace the covers over the controllers.

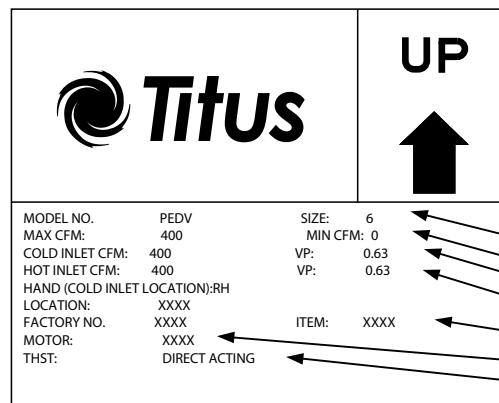


Figure 2. Control Box Label

- ← Inlet Size, Inches
- ← Minimum CFM
- ← Cold Deck Max Velocity Pressure, Inches WG
- ← Hot Deck Max Velocity Pressure, Inches WG
- ← Same as Number as on Packing List
- ← Actuator Mfr.
- ← Thermostat Action

## Adjusting Minimum and Maximum Air Flow for Units with Hot Inlet Sensor and Cold Discharge Sensor

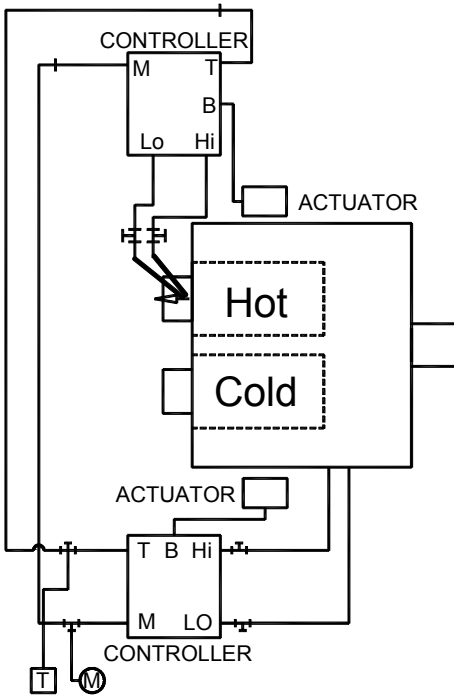


Figure 3. Variable Air Volume Piping Diagram

### A. Direct Acting Thermostat Air Flow Adjustment

- Hot inlet controller. Be sure the hot inlet damper assumes a fully closed position during cooling conditions. Apply 15-25 PSI pressure to the thermostat connection of the hot inlet controller. If the hot inlet damper does not fully close, adjust LO air flow knob until the damper closes. Allow several seconds for the controls to react to system pressure and stabilize.

To adjust hot deck maximum CFM:

- Apply zero PSI to the thermostat connection on the hot deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- If the manometer gauge reading matches the required differential pressure from the calibration curve (Page 6 and 7), no adjustment is necessary.
- If adjustment is necessary, use the adjusting tool stored in the face of the controller (Titus II only) or a standard flat-blade screwdriver.
- Rotate the maximum HI knob slowly. A delay in response time has been deliberately built into the controls to avoid hunting. Allow several seconds from controls to react and the system to stabilize. Rotate the knob until the gauge shows the required differential pressure.

To adjust Min./Mix CFM on cold controller / discharge sensor:

- Apply 8.0 PSI pressure to the thermostat connection of the cold deck controller.
- If Min./Mix CFM equals zero. The cold inlet damper should assume a closed position. If not, adjust minimum LO knob on the cold inlet controller until the damper closes.
- If Min./Mix CFM is a non-zero value, place a manometer gauge across the balancing tees of the cold deck inlet. If the pressure matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- If adjustment is necessary, rotate the minimum LO knob until the gauge shows the required differential pressure.

To adjust cold deck maximum CFM:

- Apply 15-25 PSI pressure to the cold deck controller. Place a manometer gauge across the balancing tees at the cold deck inlet.
- If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- If adjustment is necessary, rotate the maximum HI knob slowly. Rotate the knob until the gauge reads the required differential pressure from the curve.

**NOTE: If the actuator fails to respond, see Guide to Service Procedures.**

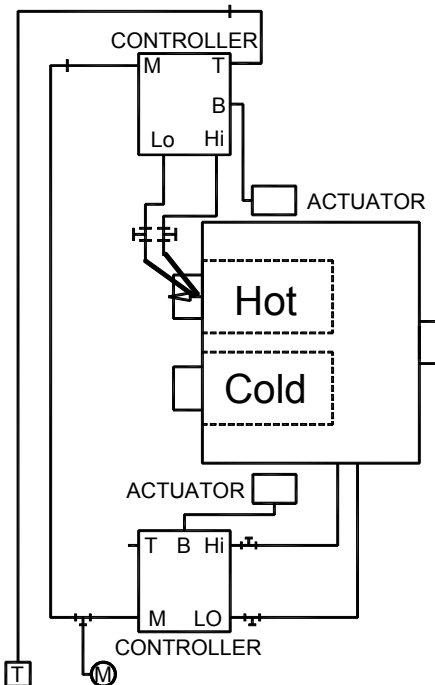


Figure 4. Constant Air Volume Piping Diagram

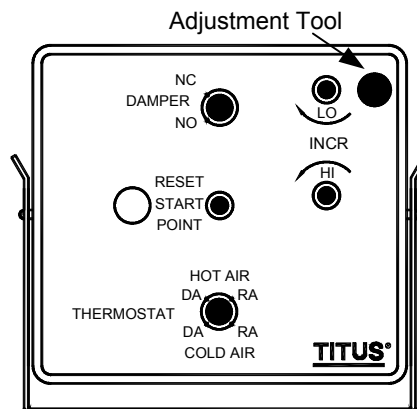


Figure 5. Titus II Controller

Table 1. Thermostat Switch Settings

<b>DA/Cold RA/Hot</b>	8-13 PSI Reset Span 0-8 PSI Min CFM / LO Dial 13-25 PSI Max CFM / HI Dial
<b>RA/Cold DA/Hot</b>	3-8 PSI Reset Span 0-3 PSI Max CFM / HI Dial 8-25 PSI Min CFM / LO Dial

## Hot Inlet Sensor Calibration

2. Cold inlet controller / discharge sensor. For Constant Air Volume.

To adjust until Total CFM:

- a. If the desired (VP) is less than 0.5 inches W.G., set the thermostat switch on the control to DA/COLD. If greater than 0.5", set switch to RA/COLD.
- b. Apply zero PSI pressure to the thermostat connection on the cold deck controller. Place a manometer gauge across the balancing tees at the cold deck inlet.
- c. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate LO knob for DA or HI knob for RA until the gauge reads the required differential pressure from the curve.

### B. Reverse Acting Thermostat Air Flow Adjustment

1. Hot inlet controller. Be sure the hot inlet damper assumes a fully closed position during cooling conditions. Apply 0 PSI pressure to the thermostat connection of the hot inlet controller. If the hot inlet damper does not fully close, adjust LO air flow knob until the damper closes. Allow several seconds for the controls to react to system pressure and stabilize.

To adjust hot deck maximum CFM.

- a. Apply 15-25 PSI to the thermostat connection on the hot deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- b. If the manometer gauge reading matches the required differential pressure from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, use the adjusting tool stored in the face of the controller (Titus II only) or a standard flat-blade screwdriver.

- d. Rotate the maximum HI knob slowly. A delay in response time has been deliberately built into the controls to avoid hunting. Allow several seconds for controls to react and the system to stabilize. Rotate the knob until the gauge shows the required differential pressure.

**NOTE: If the actuator fails to respond, see Guide to Service Procedures .**

2. Cold inlet controller / discharge sensor. For Variable Air Volume.

To adjust Min./Mix CFM:

- a. Apply 8.0 PSI pressure to the thermostat connection of the cold deck controller.
- b. If min./mix CFM equals zero, the cold inlet damper should assume a closed position. If not, adjust minimum LO knob on the cold inlet controller until the damper closes.
- c. If min./mix CFM is a non-zero value, place a manometer gauge across the balancing tees of the cold deck inlet . If the pressure matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate the minimum LO knob until the gauge shows the required differential pressure.

To adjust cold deck maximum:

- a. Apply 0 PSI pressure to the thermostat connection on the cold deck controller. Place a manometer gauge across the balancing tees at the cold deck inlet.
- b. If the manometer gauge differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, rotate the maximum HI knob slowly. Rotate the knob until the gauge reads the required differential pressure from the curve.

3. Cold inlet controller / discharge sensor. For Constant Air Volume.

To adjust unit Total CFM:

- a. If the desired (VP) is less than 0.5 inches W.G., set the thermostat switch on the control to DA/COLD. If greater than 0.5", set switch to RA/COLD.
- b. Apply zero PSI pressure to the thermostat connection on the cold deck controller. Place a manometer gauge across the inlet.
- c. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate LO knob for DA or HI knob for RA until the gauge reads the required differential pressure from the curve.

### C. After Flow Rates are Adjusted

1. Replace the thermostat connection at the controller, if it has been removed during the adjustment process.
2. Remove the differential pressure gauge and replace the caps on the tees in the HI and LO tubes.

**NOTE: The controller will not operate if these caps are left off.**

3. Return the adjustment tool to its socket in the face of the controller.
4. Replace the covers over the controllers.

## Adjusting Minimum and Maximum Air Flow for Units with Cold Inlet Sensor and Hot Discharge Sensor

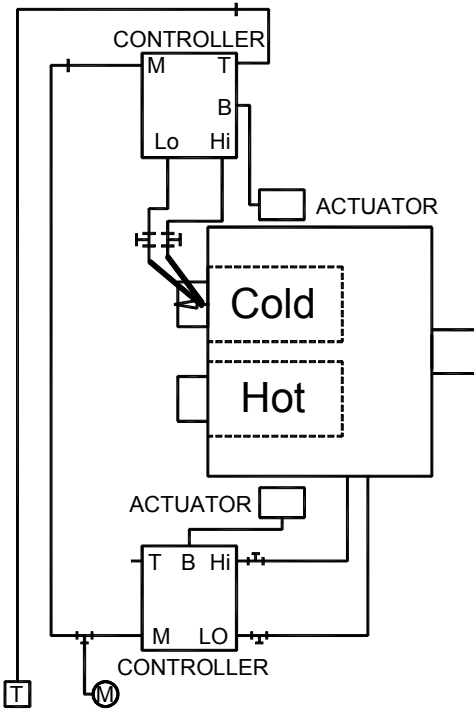


Figure 6. Constant Air Volume Piping Diagram

### A. Direct Acting Thermostat Air Flow Adjustment

1. Cold inlet controller. Be sure the cold inlet damper assumes a fully closed position during heating conditions. Apply 0 PSI pressure to the thermostat connection of the cold inlet controller. If the cold inlet damper does not fully close, adjust LO air flow knob until the damper closes. Allow several seconds for the controls to react to system pressure and stabilize.

To adjust cold deck maximum CFM:

- a. Apply 15-25 PSI to the thermostat connection on the cold deck controller. Place a manometer gauge across the balancing tees at the cold deck inlet.
- b. If the manometer gauge reading matches the required differential pressure from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, use the adjusting tool stored in the face of the controller (Titus II only) or a standard flat-blade screwdriver.
- d. Rotate the maximum HI knob slowly. A delay in response time has been deliberately built into the controls to avoid hunting. Allow several seconds from controls to react and the system to stabilize. Rotate the knob until the gauge shows the required differential pressure.

To adjust Min./Mix CFM on hot controller / discharge sensor:

- a. Apply 8.0 PSI pressure to the thermostat connection of the cold deck controller.
- b. If Min./Mix CFM equals zero. The hot inlet damper should assume a closed position. If not, adjust minimum LO knob on the hot inlet controller until the damper closes.
- c. If Min./Mix CFM is a non-zero value, place a manometer gauge across the balancing tees of the hot deck inlet. If the pressure matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate the minimum LO knob until the gauge shows the required differential pressure.

To adjust hot deck maximum CFM:

- a. Apply 0 PSI pressure to the thermostat connection on the hot deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- b. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, rotate the maximum HI knob slowly. Rotate the knob until the gauge reads the required differential pressure from the curve.

**NOTE: If the actuator fails to respond, see Guide to Service Procedures.**

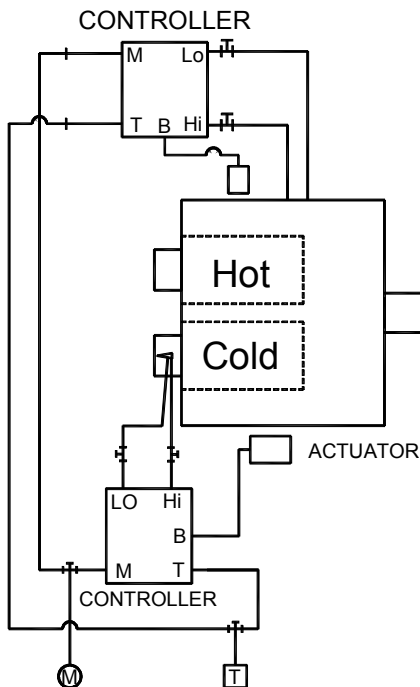


Figure 7. Variable Air Volume Piping Diagram

## Cold Inlet Sensor Calibration

2. Hot inlet controller / discharge sensor. For Constant Air Volume.

To adjust until Total CFM:

- a. If the desired (VP) is less than 0.5 inches W.G., set the thermostat switch on the control to DA/COLD. If greater than 0.5", set switch to RA/COLD.
- b. Apply zero PSI pressure to the thermostat connection on the hot deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- c. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate LO knob for DA or HI knob for RA until the gauge reads the required differential pressure from the curve.

### B. Reverse Acting Thermostat Air Flow Adjustment

1. Cold inlet controller. Be sure the cold inlet damper assumes a fully closed position during non-cooling conditions. Apply 15-25 PSI pressure to the thermostat connection of the cold inlet controller. If the cold inlet damper does not fully close, adjust LO air flow knob until the damper closes. Allow several seconds for the controls to react to system pressure and stabilize.

To adjust cold deck maximum CFM.

- a. Apply 0 PSI to the thermostat connection on the cold deck controller. Place a manometer gauge across the balancing tees at the cold deck inlet.
- b. If the manometer gauge reading matches the required differential pressure from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, use the adjusting tool stored in the face of the controller (Titus II only) or a standard flat-blade screwdriver.

- d. Rotate the maximum HI knob slowly. A delay in response time has been deliberately built into the controls to avoid hunting. Allow several seconds for controls to react and the system to stabilize. Rotate the knob until the gauge shows the required differential pressure.

**NOTE: If the actuator fails to respond, see Guide to Service Procedures .**

2. Hot inlet controller / discharge sensor. For Variable Air Volume.

To adjust Min./Mix CFM:

- a. Apply 8.0 PSI pressure to the thermostat connection of the hot deck controller.
- b. If min./mix CFM equals zero, the hot inlet damper should assume a closed position. If not, adjust minimum LO knob on the hot inlet controller until the damper closes.
- c. If min./mix CFM is a non-zero value, place a manometer gauge across the balancing tees of the hot deck inlet. If the pressure matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate the minimum LO knob until the gauge shows the required differential pressure.

To adjust hot deck maximum:

- a. Apply 15-25 PSI pressure to the thermostat connection on the hot deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- b. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- c. If adjustment is necessary, rotate the maximum HI knob slowly. Rotate the knob until the gauge reads the required differential pressure from the curve.

3. Hot inlet controller / discharge sensor. For Constant Air Volume.

To adjust unit Total CFM:

- a. If the desired (VP) is less than 0.5 inches W.G., set the thermostat switch on the control to DA/COLD. If greater than 0.5", set switch to RA/COLD.
- b. Apply zero PSI pressure to the thermostat connection on the cold deck controller. Place a manometer gauge across the balancing tees at the hot deck inlet.
- c. If the manometer gauge reading matches the required differential from the calibration curve (Page 6 and 7), no adjustment is necessary.
- d. If adjustment is necessary, rotate LO knob for DA or HI knob for RA until the gauge reads the required differential pressure from the curve.

### C. After Flow Rates are Adjusted

1. Replace the thermostat connection at the controller, if it has been removed during the adjustment process.
2. Remove the differential pressure gauge and replace the caps on the tees in the HI and LO tubes.

**NOTE: The controller will not operate if these caps are left off.**

3. Return the adjustment tool to its socket in the face of the controller.
4. Replace the covers over the controllers.

### AeroCross™ Multi-Point Inlet Sensor

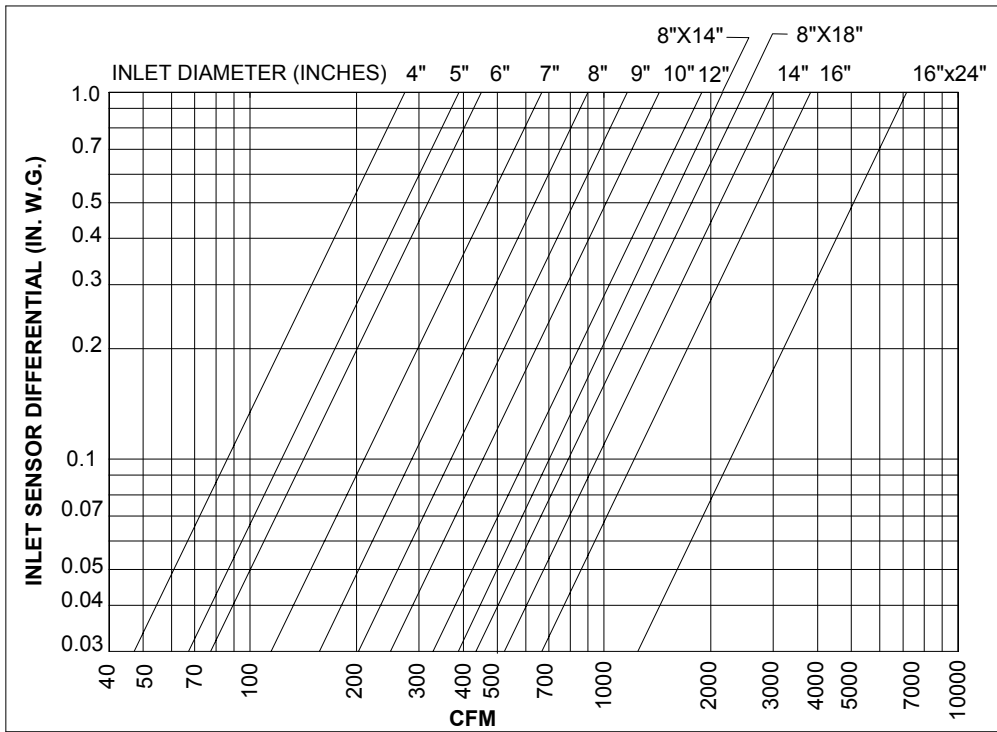


Table 2. AeroCross™ K-Factors

Terminal Size	K-Factor (CFM)
04	273
05	390
06	448
07	667
08	904
09	1167
10	1436
12	1891
14	3015
16	3839
8x14	2106
8x18	2498
40(16x24)	7176

$$CFM = K \sqrt{\Delta P}$$

$$\Delta P = \left(\frac{CFM}{K}\right)^2$$

Figure 8. AeroCross™ Sensor Calibration Curves

### Original Titus Multi-Point Inlet Sensor (for use with units shipped before April 1, 2002)

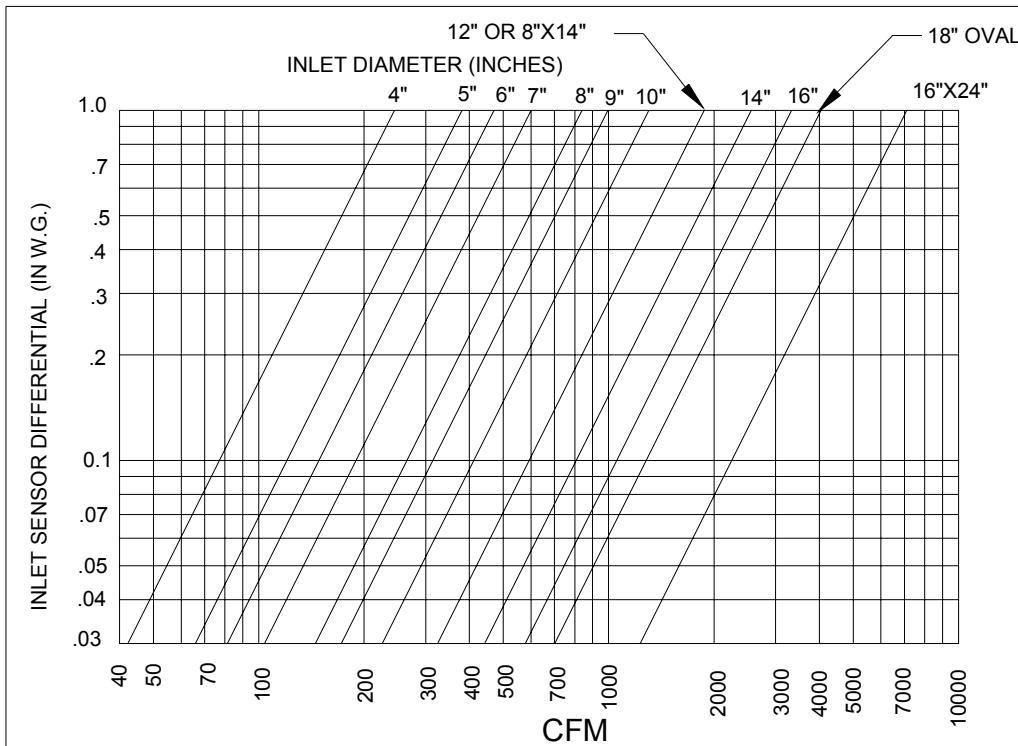


Table 3. Original Sensor K-Factors

Terminal Size	K-Factor (CFM)
04	269
05	404
06	474
07	625
08	881
09	1094
10	1371
12	1931
14	2795
16	3677
40(16x24)	7784

$$CFM = K \sqrt{\Delta P}$$

$$\Delta P = \left(\frac{CFM}{K}\right)^2$$

Figure 9. Original Sensor Calibration Curves

### AeroCross™ Multi-Point Discharge Sensor

Table 4. AeroCross™ K-Factors for Dual Duct Discharge Sensors

Terminal Size	K-Factor (CFM)
04	240
05	384
06	538
07	733
08	997
09	1254
10	1640
12	2619
14	3808
16	4810

$$CFM = K \sqrt{\Delta P}$$

$$\Delta P = \left(\frac{CFM}{K}\right)^2$$

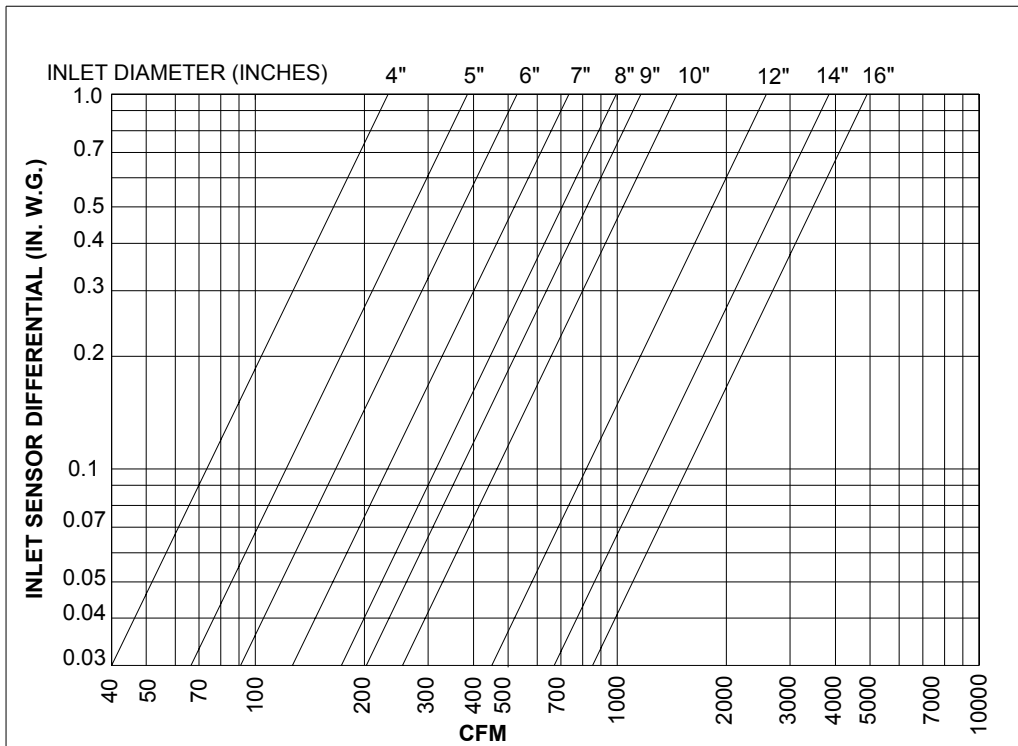


Figure 10. AeroCross™ Sensor Calibration Curves

### Original Titus Multi-Point Discharge Sensor (for use with units shipped before April 1, 2002)

Table 5. Original Sensor K-Factors for Dual Duct Discharge Sensors

Terminal Size	K-Factor (CFM)
04	236
05	406
06	504
07	714
08	935
09	1281
10	1675
12	2428
14	3647
16	4607

$$CFM = K \sqrt{\Delta P}$$

$$\Delta P = \left(\frac{CFM}{K}\right)^2$$

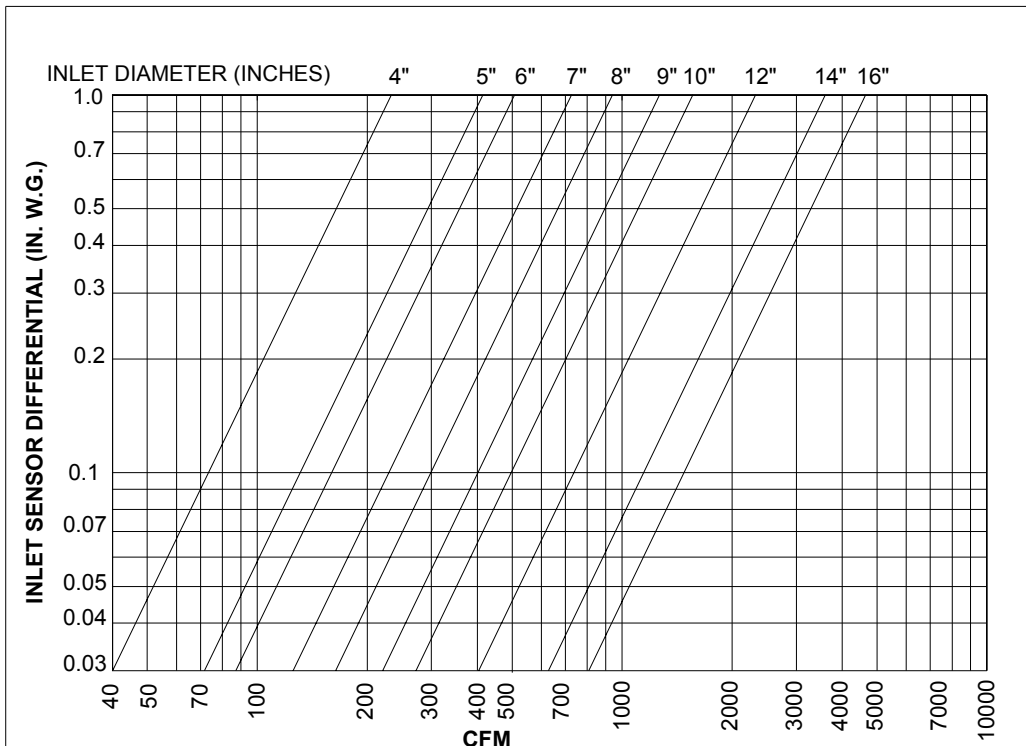


Figure 11. Original Sensor Calibration Curves

## Guide to Service Procedures

<p>Actuator will not stroke. (Generally any setting of the damper compatibility selector on the face of the controller).</p>	<ol style="list-style-type: none"> <li>1. Leak in the control line between the controller and the actuator.</li> <li>2. Leak in the actuator.</li> <li>3. Insufficient main air supply pressure.</li> <li>4. Faulty controller.</li> <li>5. Pneumatic thermostat and main air line connections are reversed at the controller.</li> <li>6. Control lines from the sensor to the controller are reversed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair the leak.</li> <li>2. Apply 15-25 PSI air from the main air supply to the actuator. The actuator should stroke. Pinch the air supply line. If the actuator retracts, it is leaking. Replace the actuator and contact your TITUS distributor.</li> <li>3. The controller must receive compressed air from the main supply at 15-25 PSI. Be sure all connections are as shown in Figure 9.</li> <li>4. If the controller appears to be faulty, contact your Titus distributor.</li> <li>5. See Figure 9. The Thermostat must be connected to Port T and the main air to Port M.</li> <li>6. See Figure 9. Make the connections as shown.</li> </ol>
<p>Actuator will not stroke. (Normally open setting of the damper compatibility selector on the face of the controller.)</p>	<ol style="list-style-type: none"> <li>1-6 as above.</li> <li>7. Rubber caps on HI or both balancing tees are missing.</li> <li>8. HI control line or the HI passage of the sensor is plugged.</li> <li>9. Damper compatibility selector on the face of the controller is set wrong.</li> <li>10. Low differential pressure at the sensor.</li> </ol>	<ol style="list-style-type: none"> <li>1-6 as above.</li> <li>7. Replace the caps on the balancing tees.</li> <li>8. Clean out the passage or control line</li> <li>9. Set the damper compatibility selector to match the action of the damper.</li> <li>10. Increase the air flow rate to the terminal inlet if necessary.</li> </ol>
<p>Actuator will not stroke. (Normally closed setting of the damper compatibility selector on the face of the controller).</p>	<ol style="list-style-type: none"> <li>1-6 as above.</li> <li>7. Rubber cap on the LO balancing tee is missing.</li> <li>8. LO control line or the LO passage in the sensor is plugged.</li> </ol>	<ol style="list-style-type: none"> <li>1-6. As above.</li> <li>7. Replace the cap</li> <li>8. Clean out the passage or control line.</li> </ol>
<p>Actuator remains fully stroked at all times. (Normally open setting of the damper compatibility selector on the face of the controller).</p>	<ol style="list-style-type: none"> <li>1. Faulty controller.</li> <li>2. Rubber cap on the LO balancing tee is missing.</li> <li>3. LO control line or the LO passage of the sensor is plugged.</li> </ol>	<ol style="list-style-type: none"> <li>1. If the controller appears to be faulty, contact your Titus products distributor.</li> <li>2. Replace the cap.</li> <li>3. Clean out the passage or control line.</li> </ol>
<p>Actuator remains fully stroked at all times. (Normally open setting of the damper compatibility selector on the face of the controller).</p>	<ol style="list-style-type: none"> <li>1. Faulty controller.</li> <li>2. Control lines from the sensor to the controller are reversed.</li> <li>3. Rubber caps on HI or both balancing tees are missing.</li> <li>4. HI control line or the HI passage of the sensor is plugged.</li> <li>5. Damper compatibility selector on the face of the controller is set wrong.</li> <li>6. Low differential pressure at the sensor.</li> </ol>	<ol style="list-style-type: none"> <li>1. If the controller appears to be faulty, contact your Titus products distributor.</li> <li>2. See Figure 9. Make the connections as shown.</li> <li>3. Replace the caps on the balancing tees.</li> <li>4. Clean out the passage or control line.</li> <li>5. Set the damper compatibility selector to match the action of the damper.</li> <li>6. Increase the air flow rate to the terminal inlet if necessary.</li> </ol>
<p>Inaccurate or erratic air flow control.</p>	<ol style="list-style-type: none"> <li>1. Poor inlet duct connection.</li> <li>2. Leakage in the duct work.</li> <li>3. Assembly mounted in a non-level position or upside down.</li> <li>4. Controller adjustment dials are not set correctly.</li> <li>5. Low velocity pressure in the inlet duct.</li> <li>6. Thermostat compatibility selector on the face of the controller is set wrong.</li> <li>7. Thermostat is out of calibration.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check inlet duct for blockage or kinks.</li> <li>2. Repair the leakage.</li> <li>3. Control must be horizontal <math>\pm 10</math> degrees.</li> <li>4. See "Adjusting the Minimum and Maximum Air flow".</li> <li>5. Increase the air flow rate to the terminal inlet if necessary.</li> <li>6. Set the thermostat compatibility selector to match the action of the thermostat.</li> <li>7. Turn the thermostat adjusting dial through its full travel. The air pressure signal delivered by the thermostat to Port T on the back of the controller must vary from 0 to main air supply pressure (15-25 PSI). If this pressure range is not correct, recalibrate the thermostat or consult your Titus products distributor.</li> </ol>



## Replacement Parts

### Actuators

Krueter MCP-8031 (5-10PSI)	10058501
Johnson D-3062 (5-10PSI)	10058601

### Actuator Crank Arms

Krueter	30192002
Johnson	30192006

### Actuator Mounting Plate-RH/LH

70560301

### Controllers

Titus II	70500001
Titus IIA	10065001

### Room Thermostats

Std. DA one pipe	10182203
Std. RA one pipe	10182204
Std. DA two pipe	10182201
Std. RA two pipe	10182202
Restrictor Tee (.005)	41410174
Restrictor Inline (.0063)	41410164

### Pneumatic Controller Mounting Bracket

Titus II, IIA, III	70382901
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### Controller Box

Enclosure (Titus II, IIA, III)	70073401
Cover (Titus II, IIA, III)	70073501

### AeroCross™ Flow Sensor

4", 5"	3151520001
6"	3151520002
7"	3151520003
8"	3151520004
9"	3151520005
10"	3151520006
12"	3151520007
14"	3151520008
16"	3151520009