Applications Guide

General Information

CSC–2000 Series Overview

The CSC–2000s are differential-pressure (ΔP), sub-master controllers with adjustable minimum and maximum airflow settings. A master controller, typically a room thermostat, resets the CSC velocity setpoint.

CSC–2000s are available as direct acting for normally open VAV terminal units, and reverse acting for normal closed VAV terminal units. Each unit is equipped with separate adjustment knobs for minimum and maximum airflow settings. CSC–2001/2002s are equipped with 0–10 reference dials, while all others have blind adjustments. Calibrate all models using standard airflow measuring equipment.

The spring range of the actuator does not matter to the controller. However, sufficient main air is required to provide the actuator with enough force to operate the damper/linkage.

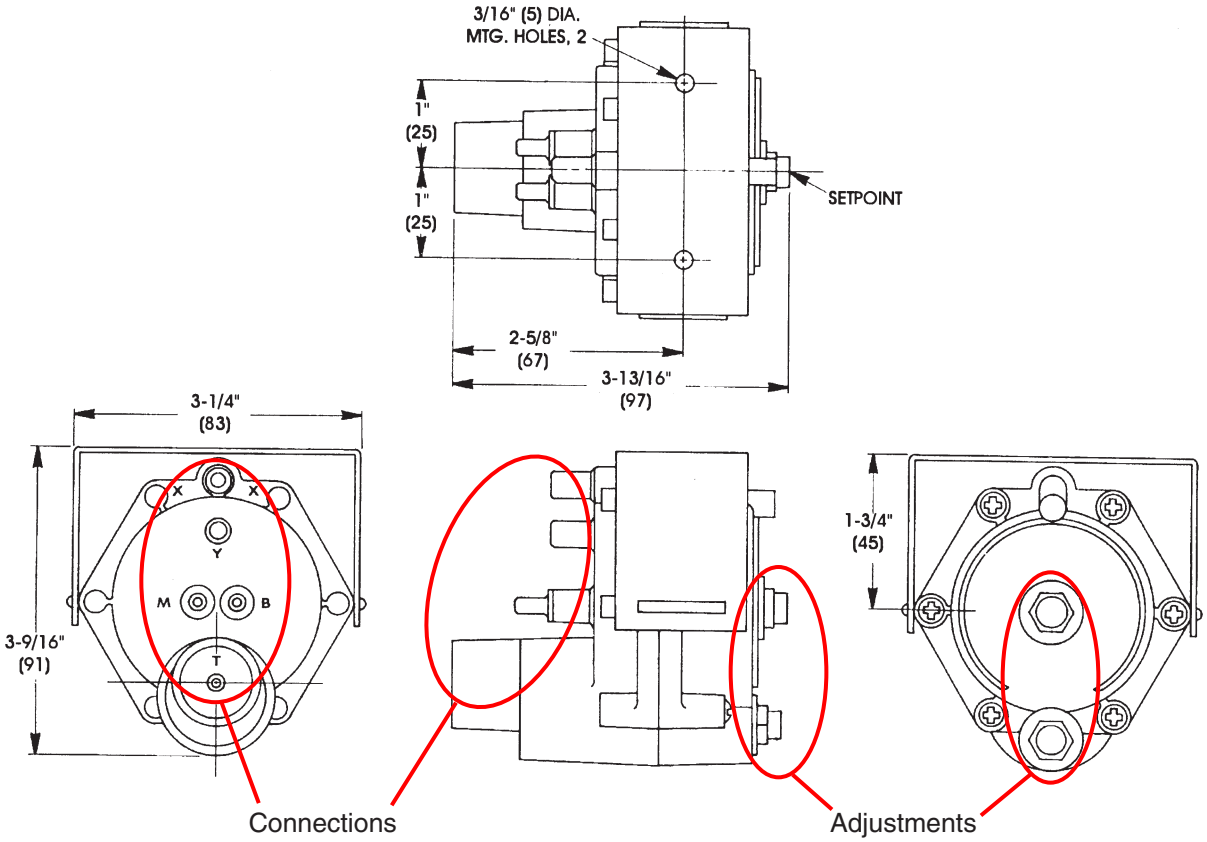
Any sequencing with other controllers, valves, or pneumatic-electric relays must be sequenced with the controller's reset range, **not** the actuator's spring range.

These controllers are typically used on single-duct applications but may be found in dual-duct applications. When working on dual-duct applications it may be necessary to work on one duct at a time while closing off the other.

The CSC–2000 series controllers are position sensitive. See the Mounting section for the proper vertical/horizontal orientation for the different models.

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.

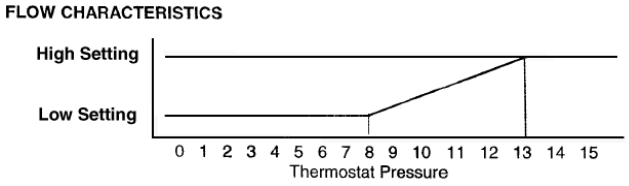


Models and Specifications

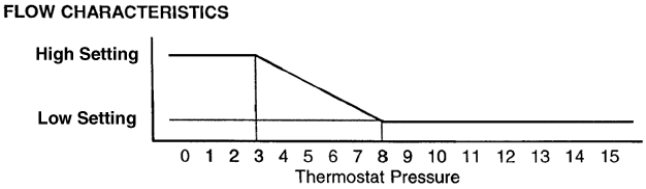
Output Sensitivity	0 to 1" range unit, 5 psig/0.02" wg (35 kPa/5 Pa) 0 to 2" range units, 5 psig/0.04"wg (35 kPa/10 Pa)
Main Air Pressure	15 to 30 psig (103 to 207 kPa)
Max. Signal Pressure	6" wg (1493 Pa) applied to either port (X or Y)
Material	ABS (beige or gray) UL Flame Class 94 HB
Output Capability	0 to supply pressure
Weight	7.5 oz. (213 grams)
Temperature Limits	
Operating	40° to 120° F (4° to 49° C)
Shipping	–40° to 140° F (–40° to 60° C)

The table below illustrates the appropriate model for each application. If replacing a CSC–2001-22 or CSC–2002-22 (now obsolete), use the CSC–2001, CSC–2002, CSC–2003, or CSC–2004 and mount appropriately.

Direct Acting BEIGE units (CSC–2001/2003/2007/2009/2017) are designed for normally open dampers with direct-acting thermostats for cooling and reverse-acting thermostats for heating.



Reverse Acting GRAY units (CSC–2002/2004/2008/2010/2018) are designed for normally closed dampers with reverse-acting thermostats for cooling and direct-acting thermostats for heating.



Direct Acting (Beige Controllers) for Normally Open Dampers

Model	Thermostat Required		Setpoint Range		Reset Pressure Band	Air Consumption	0–10 Molded Dial
	For Cooling	For Heating	Minimum	Maximum			
CSC-2001	Direct Acting	Reverse Acting	0 to 1.0" wg (249 Pa)	Min. plus 1" wg (249 Pa)	8 ±0.5 to 13 psig (55 ±3.5 to 90 kPa)	14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	Yes
CSC-2003						14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	No molded plastic dial—has paper label instead
CSC-2007						11.5 scim @ 20 psig (3.1 mL/s @ 138 kPa)	
CSC-2009			0 to 2.0" wg (498 Pa)	Min. plus 2" wg (498 Pa)		14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	
CSC-2017						11.5 scim @ 20 psig (3.1 mL/s @ 138 kPa)	

Reverse Acting (Gray Controllers) for Normally Closed Dampers

Model	Thermostat Required		Setpoint Range		Reset Pressure Band	Air Consumption	0–10 Molded Dial
	For Cooling	For Heating	Minimum	Maximum			
CSC-2002	Reverse Acting	Direct Acting	0 to 1.0" wg (249 Pa)	Min. plus 1" wg (249 Pa)	3 ±0.5 to 8 psig (21 ±3.5 to 55 kPa)	14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	Yes
CSC-2004						14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	No molded plastic dial—has paper label instead
CSC-2008						11.5 scim @ 20 psig (3.1 mL/s @ 138 kPa)	
CSC-2010			0 to 2.0" wg (498 Pa)	Min. plus 2" wg (498 Pa)		14.4 scim @ 20 psig (3.93 mL/s @ 138 kPa)	
CSC-2018						11.5 scim @ 20 psig (3.1 mL/s @ 138 kPa)	

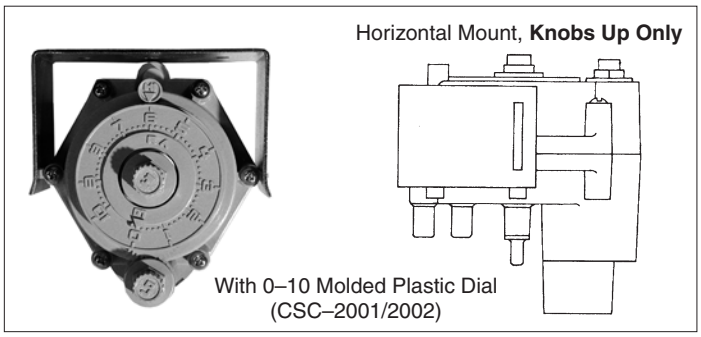
Mounting

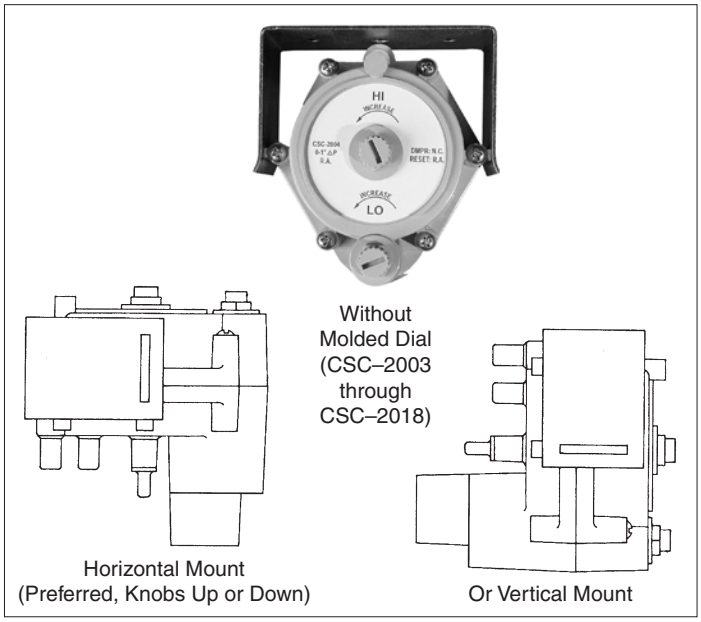
As close to the flow sensor pickup as is feasible, fasten the mounting bracket to the mounting surface with two self-threading screws in the two 3/16 in. (5 mm) holes. (Make sure to leave enough room to make connections.)

The CSC–2000 series are position sensitive:

- **The minimum and maximum flow limits must be set (calibrated) in the same position the controller will be mounted.**
- The **CSC–2001/2002 (with 0–10 molded plastic dials)** must be mounted **horizontally with dial adjustment knobs facing up**.
- The **CSC–2003 through CSC–2018 (no molded dials)** may be **mounted horizontally (preferred)**, with the adjustment knobs up or down, **or mounted vertically** (the diaphragm inside must be in a horizontal or vertical plane)**.**

NOTE: If replacing a CSC–2001-22 or CSC–2002-22 (designed for vertical mount and now obsolete), use the CSC–2001 or CSC–2002 as appropriate and mount dials face up or use the CSC–2003 or CSC–2004 as appropriate and mount vertically or horizontally.





Connections

All Units

For all models of the CSC–2000 Series use 1/4 in. (6 mm) O.D. "FR" tubing for the following connections:

1. Connect the main air supply to port "M".
2. Connect the actuator to port "B".
3. Connect the thermostat to port "T".

Beige Units

Use **3/8** in. O.D. "FR" tubing **with a maximum length of 24 in.** to connect:

1. High pressure to port "X".
2. Low pressure to port "Y".

Gray Units

Use **3/8** in. O.D. "FR" tubing **with a maximum length of 24 in.** to connect:

1. Low pressure to port "X".
2. High pressure to port "Y".

⚠ CAUTION

Pneumatic devices must be supplied with clean, dry control air. Any other medium (e.g., oil or moisture contamination) will cause the device to fail.

Adjustments, Calibration, and Operation of BEIGE Controllers

Adjustments and Calibration

1. Check that there is 0 psi at the "T" Port.
2. Use a flow hood or "tee" a Magnehelic® (or equivalent) differential pressure gauge between the controller and the ΔP pick-up.
3. **The "LO" flow setting limit (center knob) must be set first.** Temporarily adjust the thermostat for a branch pressure lower than the 8 psig reset start point (minimum cooling); typically 6 psig or less is best. Removing the thermostat branch line would be another acceptable method. Adjust the "LO" knob (center knob) clockwise to increase or counterclockwise to decrease ΔP limit. Normally one-half turn will cause a 0.1 ΔP change. Allow for reaction time. Depending on actuator size and position, timing will vary. To position an actuator/damper from closed to open may take several minutes.

NOTE: If the "LO" flow setting limit must be set at "0" (zero minimum), do not turn the "LO" knob fully counterclockwise. The knob will adjust three to four full turns after a zero minimum is reached. Turning the "LO" knob fully counterclockwise will result in a negative reset condition. This means that when the controller is beginning to reset at 8 psig from the thermostat, it must first overcome the negative adjustment and will not begin to reset until a higher thermostat reset pressure is reached. This negative reset will also reduce the effective range of the controller by reducing the high end and narrowing the reset span. If a zero minimum is required, adjust the "LO" knob until the controller just begins to crack the damper open, then back-off **one-fourth** turn and verify zero airflow.

4. The "HI" flow setting limit (outer knob) must be set after the "LO". Temporarily adjust the thermostat for a branch pressure higher than the 13 psig reset stop point (maximum cooling); typically 17 psig or greater is best. Removing the thermostat branch line and teeing-in to the main air line would be another acceptable method. Adjust the "HI" knob (outer knob) clockwise to increase or counterclockwise to decrease ΔP limit. Nominally one-half turn will cause a 0.1 ΔP change. Allow for reaction time.
5. Recheck the "LO" and the "HI" settings at least twice, verify settings, and fine tune each time if necessary. This procedure will remove internal component tensions and confirm settings.
6. Reconnect the thermostat branch line if necessary, and adjust the thermostat to the desired room temperature setpoint.

NOTE**:** The "HI" adjustment limits the travel of the reset mechanism. Therefore, the reset span will be less than 5 psig, the upper limit being less than 13 psig.

NOTE**:** Always make adjustments in the same plane/orientation as the one in which the unit will operate.

NOTE: No routine maintenance is required. Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long-term dependability.

NOTE: For information about GRAY controllers see the Adjustments, Calibration, and Operation of GRAY Controllers section.

Pressure Independent Operation

Differential pressure is sensed via a ΔP pickup mounted upstream of the damper (VAV terminal inlet). The ΔP pickup is a dual pressure pickup sensing both high pressure and low pressure. The high pressure is connected to the "X" port and the low pressure is connected to the "Y" port. These two pressures are compared across the static diaphragm, which takes a position relative to the difference of the two pressures, the force of the LO limit adjustment spring in the upper chamber, and the force of the HI limit adjustment spring in the lower chamber.

Turning the "LO" knob clockwise (to increase) relaxes the LO limit adjustment spring, placing a lesser downward force on the diaphragm, reducing the pressure at the "B" port, and increasing airflow through the VAV terminal. Turning the "HI" knob adjustment spring counterclockwise positions the HI limit stop downward, limiting the travel of the piston cup, limiting the amount of reset, and setting the maximum airflow through the VAV terminal.

When the "HI" knob is turned fully counterclockwise, the HI limit will equal the LO limit, and the controller will function as a constant volume controller.

An increase in airflow is sensed via the increase in ΔP across the static diaphragm, positioning the static diaphragm closer to the nozzle, increasing the "B" port pressure to the actuator, and decreasing airflow until the static diaphragm comes into balance at the desired ΔP setpoint.

A decrease in airflow is sensed via the decrease in ΔP across the static diaphragm, positioning the static diaphragm away from the nozzle, decreasing the "B" port pressure to the actuator, and increasing airflow until the static diaphragm comes into balance at the desired ΔP setpoint.

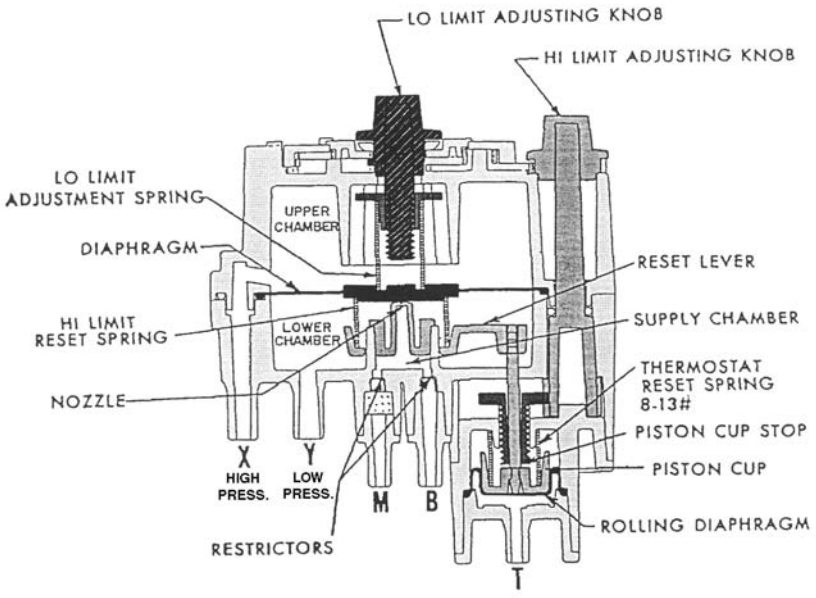
Reset Operation

With sufficient airflow and a thermostat signal connected to the "T" port of less than 8 psig, the controller will position the actuator to regulate airflow at the LO limit setting. In this state, the static diaphragm is balanced over the nozzle through the forces of the opposing springs and forces of the high and low pressures.

When the thermostat signal increases above 8 psig, the piston cup will begin to position the reset lever upward, increasing the force of the HI limit spring, positioning the static diaphragm away from the nozzle, opening the damper for greater airflow, and requiring a higher ΔP to rebalance the static diaphragm.

The ΔP setpoint of the controller has been reset upwards with the increasing thermostat signal. The stroke of the piston cup is limited via the HI limit knob. Lowering the HI limit will reduce the top end of the reset span, narrowing the reset span. At each new ΔP setpoint, as dictated by the thermostat signal, the static diaphragm will again balance.

DIRECT ACTING RESET
VOLUME CONTROLLER
CSC-2000 SERIES
(BEIGE CONTROLLERS)



(CSC-2001 SHOWN)

Adjustments, Calibration, and Operation of GRAY Controllers

Adjustments and Calibration

1. Check that there is 0 psi at the "T" Port.
2. Use a flow hood or "tee" a Magnehelic® (or equivalent) differential pressure gauge between the controller and the ΔP pick-up.
3. **The "HI" flow setting limit (center knob) must be set first.** Temporarily adjust the thermostat for a branch pressure lower than the 3 psig reset start point (maximum cooling); typically 1 psig or less is best. Removing the thermostat branch line would be another acceptable method. Adjust the "HI" knob (center knob) counterclockwise to increase or clockwise to decrease ΔP limit. Normally one-half turn will cause a 0.1 ΔP change. Allow for reaction time. Depending on actuator size and position, timing will vary. To position an actuator/damper from closed to open may take several minutes.
4. The "LO" flow setting limit must be set after the "HI". Temporarily adjust the thermostat for a branch pressure higher than the 8 psig reset stop point (minimum cooling); typically 12 psig or greater is best. Removing the thermostat branch line and teeing-in to the main air line would be another acceptable method. Adjust the "LO" knob (outside knob) counterclockwise to increase or clockwise to decrease ΔP limit. Normally one-half turn will cause a 0.1 ΔP change. Allow for reaction time.
5. Recheck the "HI" and the "LO" settings at least twice, verify settings, and fine tune each time if necessary. This procedure will remove internal component tensions and confirm settings.
6. Reconnect the thermostat branch line if necessary, and adjust the thermostat to the desired room temperature setpoint.

NOTE**:** The "LO" adjustment limits the travel of the reset mechanism. Therefore, the reset span will be less than 5 psig, the upper limit being less than 8 psig.

NOTE**:** Always make adjustments in the same plane/orientation as the one in which the unit will operate.

NOTE: No routine maintenance is required. Each component is designed and manufactured for reliability and performance. Careful installation and use will ensure long-term dependability.

Pressure Independent Operation

Differential pressure is sensed via a ΔP pickup mounted upstream of the damper (VAV terminal inlet). The ΔP pickup is a dual pressure pickup sensing both high pressure and low pressure. The low pressure is connected to the "X" port and the high pressure is connected to the "Y" port. These two pressures are compared across the static diaphragm, which takes a position relative to the difference of the two pressures, the force of the HI limit adjustment spring in the upper chamber, and the force of the LO limit adjustment spring in the lower chamber.

Turning the "HI" knob counterclockwise (to increase) compresses the HI limit adjustment spring, placing a greater downward force on the diaphragm, increasing the pressure at the "B" port, and increasing air through the VAV terminal. Turning the "LO" knob adjustment spring counterclockwise positions the LO limit stop downward, limiting the travel of the piston cup, limiting the amount of reset, and setting the minimum airflow through the VAV terminal.

When the "LO" knob is turned fully counterclockwise, the LO limit will equal the HI limit, and the controller will function as a constant volume controller.

An increase in airflow is sensed via the increase in ΔP across the static diaphragm, positioning the static diaphragm away from the nozzle, decreasing the "B" port pressure to the actuator, and decreasing airflow until the static diaphragm comes into balance at the desired ΔP setpoint.

A decrease in airflow is sensed via the decrease in ΔP across the static diaphragm, positioning the static diaphragm closer to the nozzle, increasing the "B" port pressure to the actuator, and increasing airflow until the static diaphragm comes into balance at the desired ΔP setpoint.

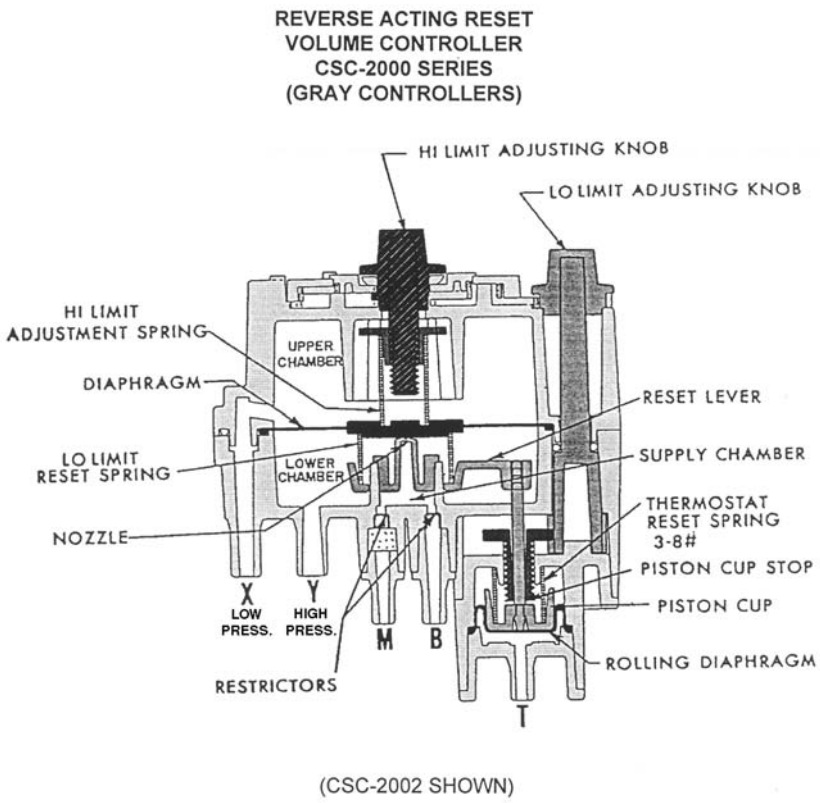
Reset Operation

With sufficient airflow and a thermostat signal connected to the "T" port of less than 3 psig, the controller will position the actuator to regulate airflow at the HI limit setting. In this state, the static diaphragm is balanced over the nozzle through the forces of the opposing springs and forces of the high and low pressures.

When the thermostat signal increases above 3 psig, the piston cup will begin to position the reset lever upward, increasing the force of the LO limit spring, positioning the static diaphragm away from the nozzle, closing the damper for less airflow, and requiring a lower ΔP to rebalance the static diaphragm.

The ΔP setpoint of the controller has been reset downwards with the increasing thermostat signal. The stroke of the piston cup is limited via the LO limit knob. Raising the LO limit will reduce the top end of the reset span, narrowing the reset span. At each new ΔP setpoint, as dictated by the thermostat signal, the static diaphragm will again balance.

NOTE: For information about BEIGE controllers see the Adjustments, Calibration, and Operation of BEIGE Controllers section.



(CSC-2002 SHOWN)

Troubleshooting

Subcooling and Overheating

The CSC-2000 series are **position sensitive**. See the Mounting section.

If the controller is calibrated in a position other than the final mounting position, the calibration (minimum and maximum flow limits) will be off.

Apparent Hunting and Negative Pressure

In the CSC-2000 series of controller, under some conditions such as low airflows, unexpected signals might be observed because of inadequate capacity of the airflow sensor tubing and/or sensor:

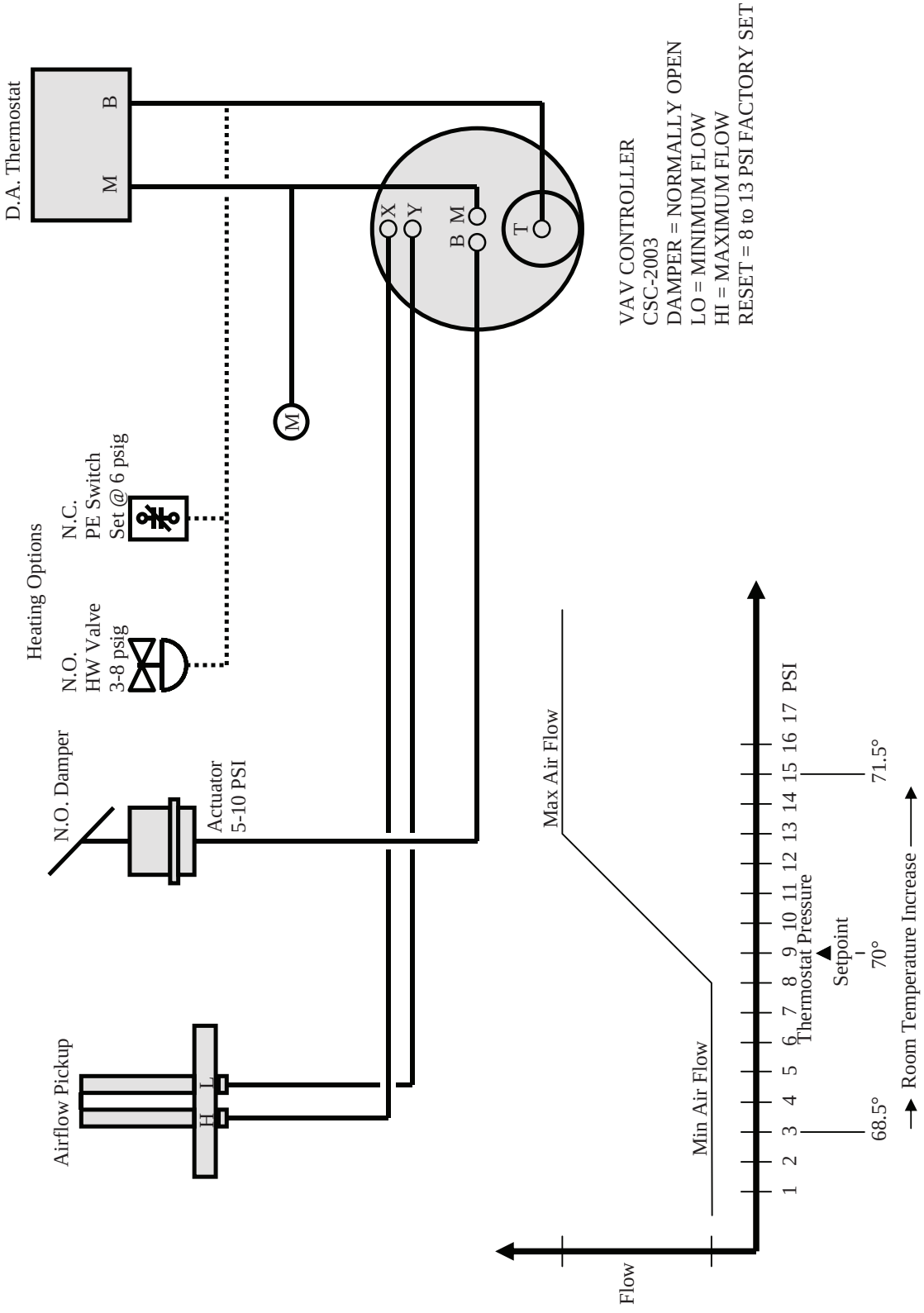
- When calibrating these controllers and the VAV damper blade is completely closed, it is possible to see a small negative pressure on a Magnehelic® (or equivalent) differential pressure gauge (up to a –0.1).
- At very low airflows, under certain conditions, the controller may appear as if it is hunting.

Although it might seem something is wrong with the controller on the VAV box, the controller could be working fine and external issues need to be corrected.

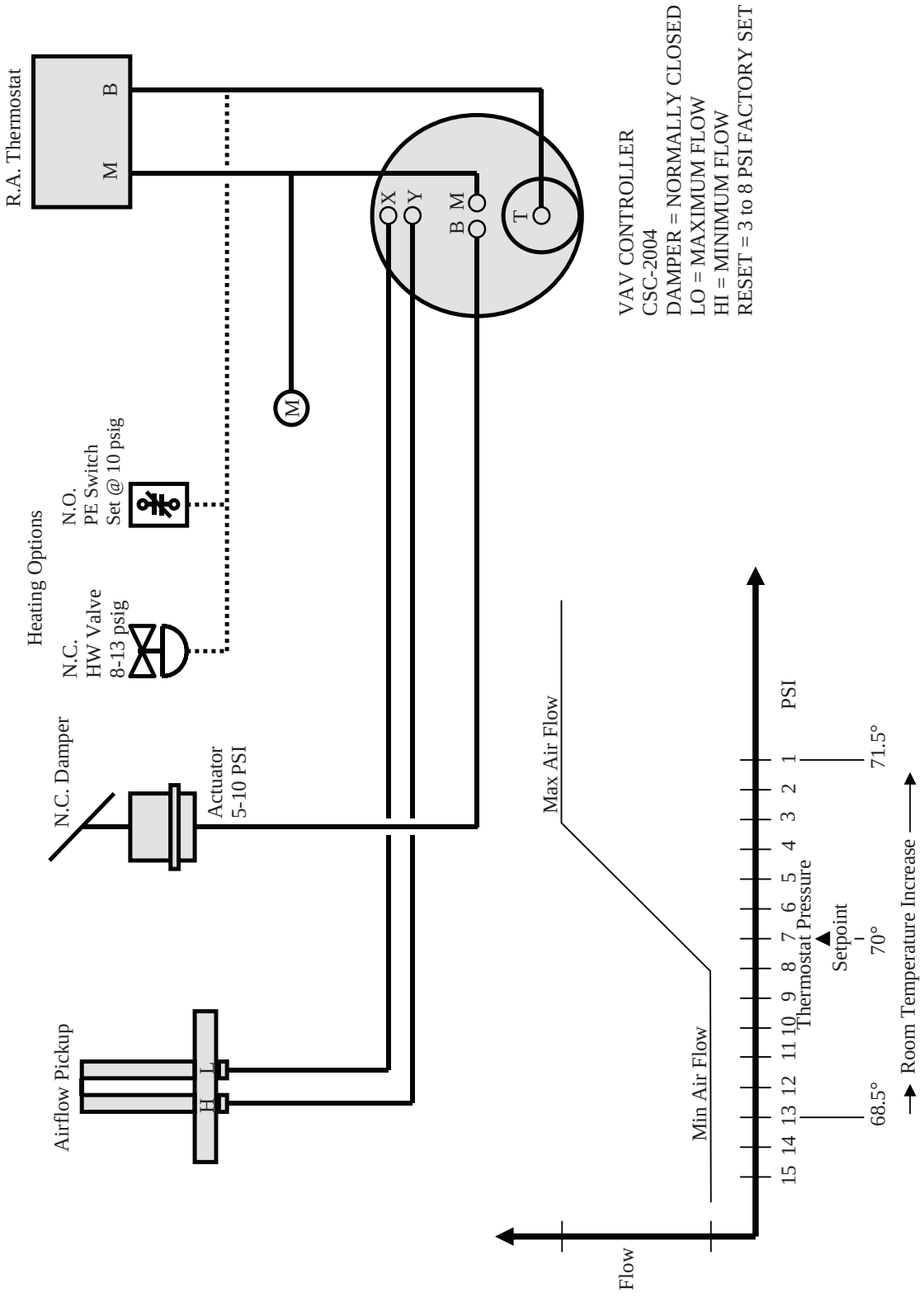
To minimize this effect, always use 3/8 in. tubing for the "X" and "Y" ports and keep the tubing lengths as short as possible. If the sensor has 1/4 in. fittings, use 3/8 in. tubing and adapters at the sensor.

Some older style flow sensors may have restrictive openings for the low pressure pickup. Replacement of the flow sensor pickup may be necessary.

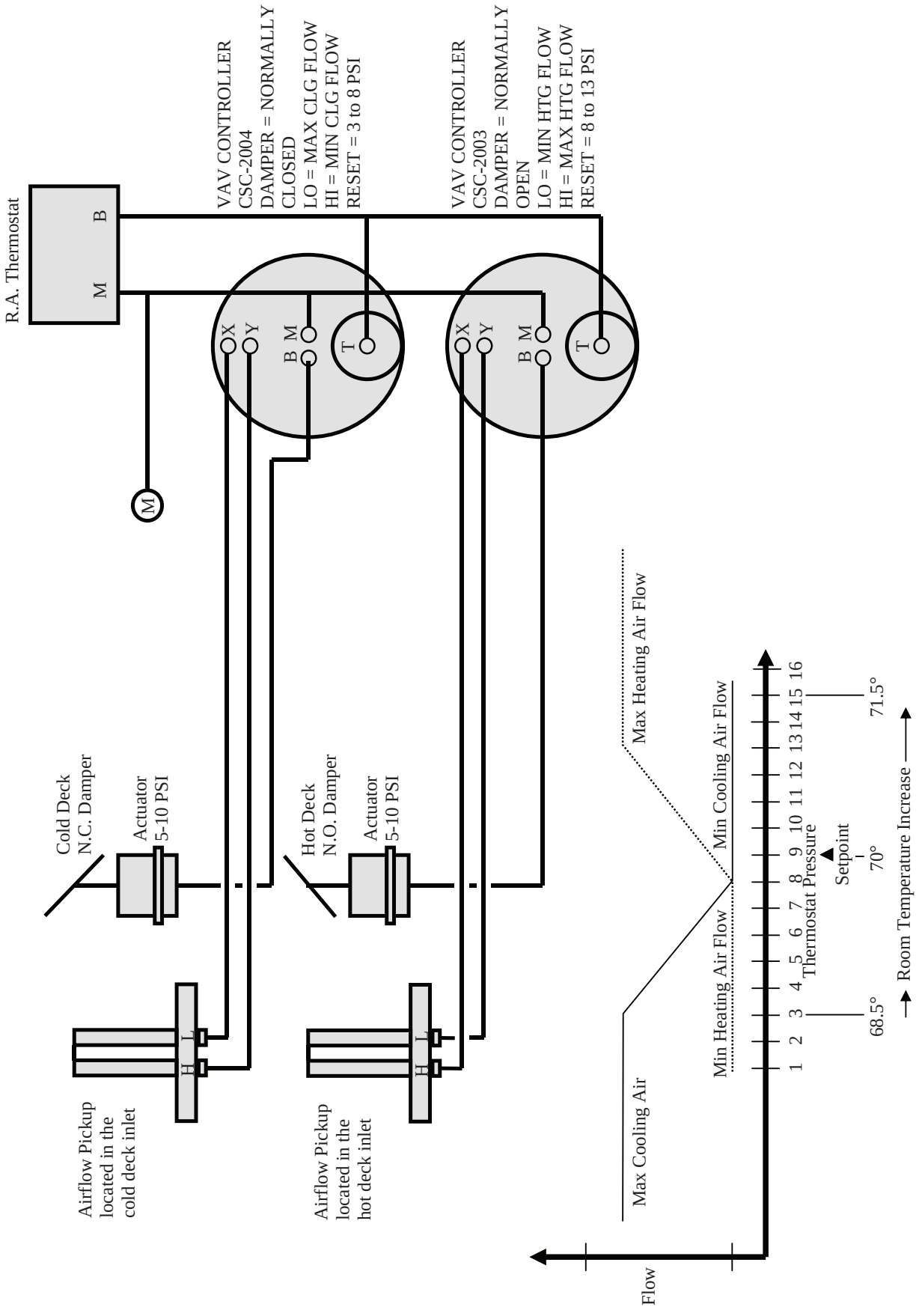
Single Duct Cooling, N.O. Damper, D.A. Thermostat



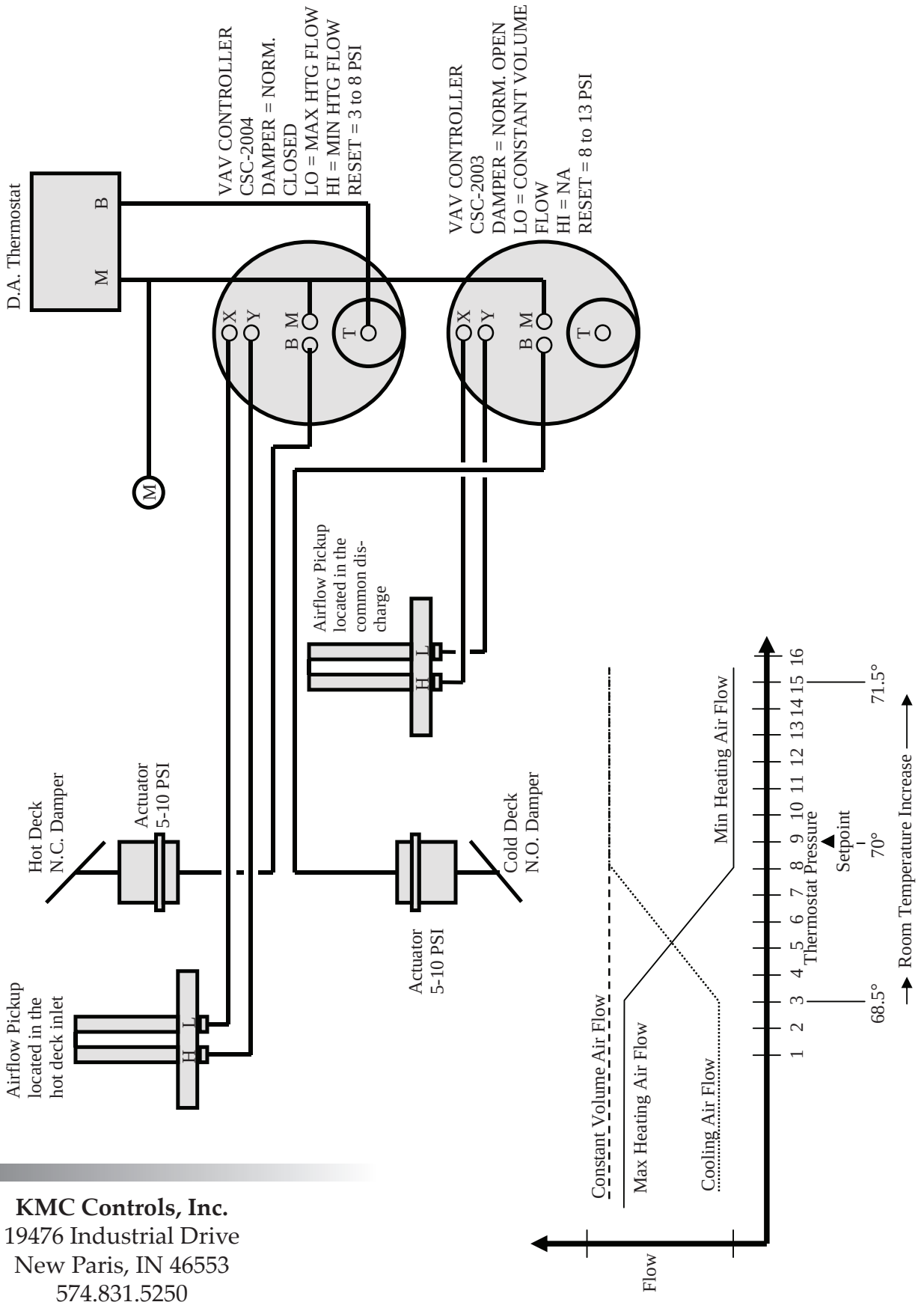
Single Duct Cooling, N.C. Damper, R.A. Thermostat



Dual Duct, N.O. Heating Damper, N.C. Cooling Damper, R.A. Thermostat



Dual Duct, Constant Volume, N.C. Heating., N.O. Cooling, D.A. Thermostat



KMC Controls, Inc.
19476 Industrial Drive
New Paris, IN 46553
574.831.5250
www.kmccontrols.com; info@kmccontrols.com