READ AND SAVE THESE INSTRUCTIONS

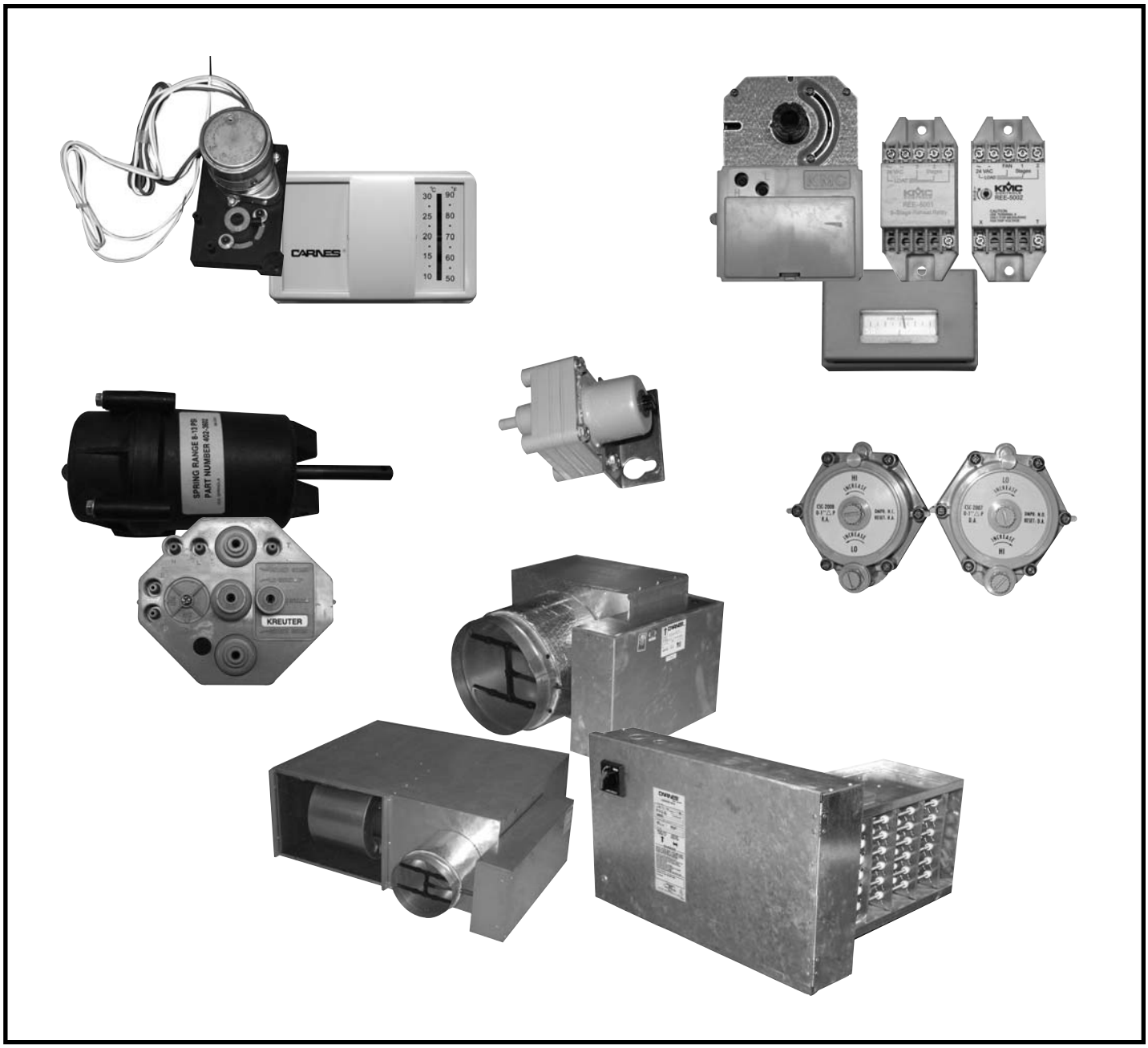
CARNES®

INSTALLATION and OPERATION MANUAL FOR

VAV TERMINAL UNITS

ALL-IN-ONE IOM

CARNES COMPANY 448 S. Main St., P. O. Box 930040, Verona, WI 53593-0040 Phone: (608)845-6411 Fax: (608)845-6504 www.carnes.com



SUPERSEDES 20256-D

20256-E

TABLE OF CONTENTS

THROTTLING UNITS

Models AVCD, AVWE, AVED, ABBD, ABWD, ADCC and ADCD

INSPECT UNIT

UNPACKING AND INSPECTION

1. Open shipping carton or crate and check for concealed shipping damage. Report damage immediately to the carrier that delivered the unit.
2. Inspect the unit for loose or missing components.
3. Optional accessories may be packed within the unit or in the same shipping carton.

GENERAL

1. Each VAV unit and accessory is shipped with an identification label showing the Carnes order number, unit item number from the order, unit model number, maximum and minimum CFM settings on terminal units with pressure independent control options, and unit tagging (or mark).

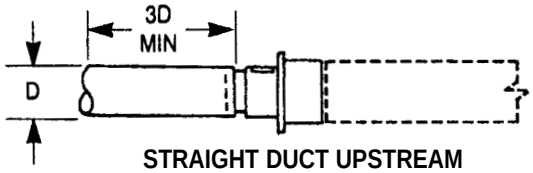
CARNES®
CARNES COMPANY, VERONA, WI
ORDER ITEM
MODEL
MAX. CFM/MIN. CFM
MARK

INSTALLATION

MOUNTING

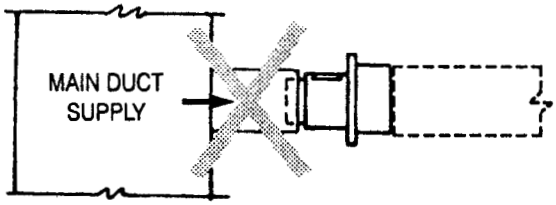
1. Units are to be supported in a horizontal and level position. For convenience, it is suggested that the units be installed prior to installation of the ceiling tile grid system.
2. Avoid abrupt transitions or duct turns at the inlet of the unit that would alter the cross-section area.
3. A minimum of **three** duct diameters of straight duct upstream of inlet sensor is recommended. (i.e., 6" inlet dia. = 18" or more straight upstream duct.) *Figure 1*
4. Close coupling the terminal unit inlet to the side of the main duct is **NOT** recommended. *Figure 2*
5. The control unit must be mounted such that the velocity sensor is at the inlet of the terminal unit, upstream of the damper blade.
6. Dual duct units may have a velocity sensor mounted downstream at the discharge opening. The dual duct unit should be mounted with the two inlets upstream of the damper blades.
7. The diameter of the inlet duct in inches must be equal to the listed inlet collar diameter of the terminal unit.
8. A minimum clearance of six inches (6") is required at the top discharge opening (by-pass) on Models ABB and ABW.
9. All control enclosures require adequate clearance to allow for field adjustments and service.
10. Terminal units may be provided with optional hanger brackets which are suitable for supporting the terminal unit by wire hangers or threaded rods.
11. Strap hangers may be used for supporting the units when hanger brackets are not provided.

Figure 1



STRAIGHT DUCT UPSTREAM

Figure 2



CLOSE COUPLING NOT RECOMMENDED

CAUTION: *Do not install hangers so as to impair the movement or performance of control components.*

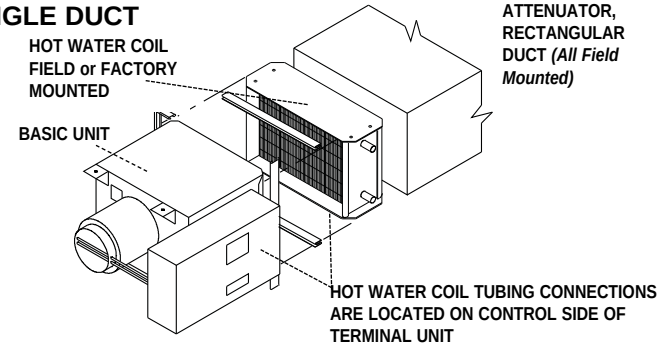
CAUTION: *Do not install hangers with screws into the uninsulated coil casing. Permanent coil damage may result.*

CAUTION: *Do not install hangers so as to impair or restrict the movement of the slide balancing damper on By-Pass terminal units. (Models ABB & ABW).*

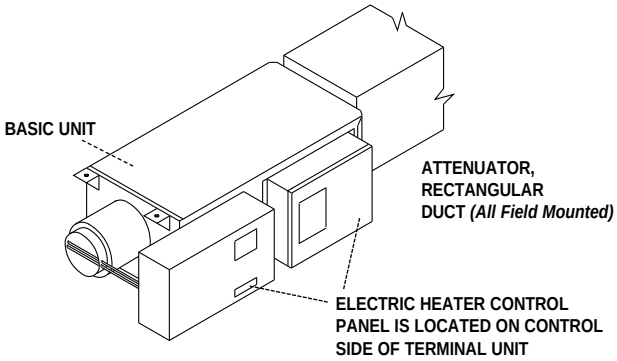
DUCT CONNECTIONS

1. Units are provided with slip and drive discharge duct connections.
2. It is suggested that discharge ductwork be lined with a minimum of 1/2" thick, 1-1/2 lb. density fiberglass insulation with an erosion resistant surface in accordance with NFPA 90A (non-residential type air conditioning and ventilating systems) to provide both thermal and acoustical insulation.
3. Attenuators are field mounted with slip and drive cleats provided by others.
4. Sealing of duct work to preclude air leaks should be done in accordance with the job specifications.
5. It is recommended that flexible ductwork connected to the inlet be secured using compression band. Rigid duct should be slipped over the inlet, secured in place with sheet metal screws, and sealed in accordance with the job specifications.

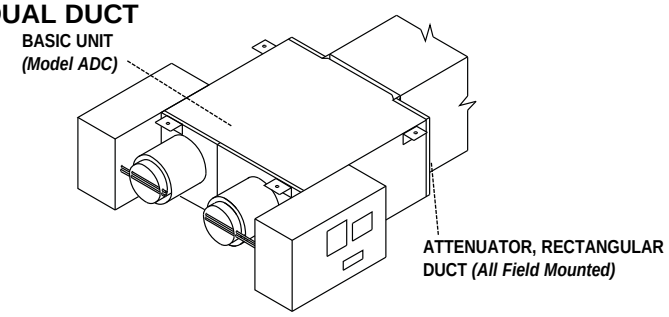
SINGLE DUCT



SINGLE DUCT WITH ELECTRIC REHEAT



DUAL DUCT



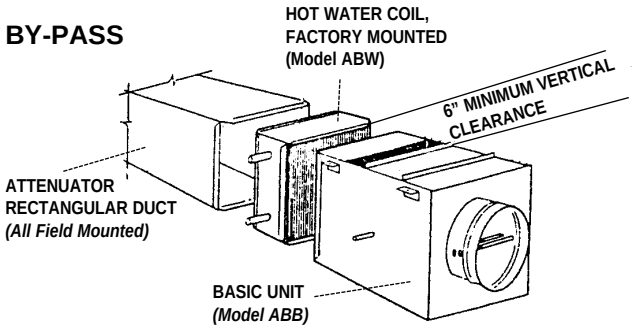
BALANCING THE MODELS ABB and ABW BY-PASS TERMINAL UNITS

I. SYSTEM BALANCING

Prior to setting design flow conditions at each unit the by-pass slide dampers must be balanced against downstream duct resistance.

1. Adjust all thermostats for full cooling so that there is a maximum air flow to the zone.
2. Using the two air flow pressure taps at each unit, green (high pressure) and yellow (low pressure), read and record the air flow pressure to the zone (this value may be in excess of design flow requirements).
3. After this reading has been taken, adjust the thermostat for full heat (full by-pass position).
4. When unit is in full by-pass position, adjust the by-pass slide damper so that the pressure reading is the same as it was for full cooling to the zone.
5. Continue this procedure at each ABB and ABW unit.

BY-PASS



II. SYSTEM DESIGN FLOWS

Once the by-pass slide dampers have been balanced, then the zone design flow conditions can be set.

1. Again, adjust zone thermostats to full cool (maximum air flow to the zone).
2. Adjust actuator to the maximum CFM as measured at the diffusers.
3. Adjust zone thermostat to full heat (minimum air flow to zone).
4. Adjust actuator to the minimum CFM as measured at the diffusers.
5. Continue this procedure at each ABB and ABW unit.

HOT WATER COIL CONNECTIONS

Hot water coils are factory mounted to the control unit with coil connections on the same side of the terminal units as the damper controls.

1. Hot water coil casings are uninsulated. Insulation requirements must be field applied with material supplied by others.

2. Water supply valve should be installed on the bottom coil connection. (Coil shall fill from the bottom.)

3. Coil tubes are suitable for sweat connections to the field water pipe system.

4. Hot water coils may be reversed in the field by removing the slip and drive cleats and rotating the coil water connections to the other side and reinstalling the slip and drive cleats.

CAUTION: Plumbing heat sink methods should be used when soldering near existing joints.

ELECTRIC DUCT HEATER CONNECTIONS

Electric duct heaters may be shipped attached or loose from the terminal unit.

1. When shipped factory mounted to the terminal unit, the electric heater control panel is on the same side of the terminal unit as the damper controls.

2. When shipped loose for field mounting, the electric heater should be mounted as indicated by the "AIR-FLOW" arrow and the "UP" arrow on the electric heater control panel cover.

3. Electric duct heater casings are uninsulated. Insulation requirements must be field applied with material supplied by others.

CAUTION: Do not mount electric heaters upside down. Heater will not function properly and may overheat causing a serious fire hazard.

CAUTION: Maximum heater discharge temperature must not exceed 125°F to avoid nuisance tripping. Discharge Temperature = [(KW x 3160) / CFM] + Entering Air Temperature.

ELECTRICAL CONNECTIONS

CAUTION: All sources of supply power must be disconnected before working on this equipment. More than one disconnect may be required to de-energize equipment.

1. Electric duct heater wiring should be done in accordance with local codes and job specifications.

2. Follow the wiring/piping diagram found on the side of the unit or the inside of the electric heater control panel cover.

3. Supply connections must be made using wires rated for 75°C minimum. DO NOT USE ALUMINUM CONDUCTORS.

4. If supply connections are for 250 volts or greater, all wiring must be insulated for 600V.

5. All field and factory made connections should be checked for tightness before operation.

6. Size wiring conductors for 125% of rated combined load.

$$\text{Single Phase Line Current} = \frac{\text{KW} \times 1000}{\text{Voltage}}$$

$$\text{Three Phase Line Current} = \frac{\text{KW} \times 1000}{1.73 \times \text{Voltage}}$$

7. The following table shows the maximum current for the supply overcurrent protection device.

Maximum Unit Amperage	Maximum Overcurrent Device Rating
12	15
16	20
20	25
24	30
28	35
32	40
36	45
40	50
48	60

FAN POWERED TERMINAL UNITS

CONSTANT VOLUME *(Series)*

MODEL AC

INTERMITTENT VOLUME *(Parallel)*

MODEL AS

CAUTION:	*Completely Read All Instructions Prior To Attempting To Assemble, Install, Operate, Or Repair This Product!*

INSPECT UNIT

UNPACKING AND INSPECTION

1. Open shipping carton or crate and check for concealed shipping damage. Report damage immediately to the carrier that delivered the shipment.
2. Inspect the unit for loose or missing components.
3. Optional accessories may be packed within the unit or in the same shipping carton or crate.

INSTALLATION

CAUTION:	*This Product Includes Vibration Producing Components. When Supporting Or Suspending Units, Use Good Industry Practice and Materials Suitable For Vibration Producing Equipment.*

GENERAL

1. Units are to be supported in a horizontal and level position. For convenience, it is suggested that units be installed prior to installation of the ceiling tile grid system.
2. Sufficient working space must be provided as per paragraph 110-16 of N. E. C.
3. Allow sufficient space for the removal of air filters and for the efficient flow of air into the secondary air inlet.
4. Avoid abrupt transitions or duct turns at the inlet of the unit that would alter the inlet cross-sectional area.
5. It is preferred that the installer attempt to obtain a minimum of three (3) inlet diameters of straight duct ahead of the terminal unit inlet to achieve optimum control accuracy.

DUCT CONNECTIONS

1. Units are provided with either slip and drive or flanged discharge duct connections depending upon model type.
2. It is suggested that discharge ductwork be lined with a minimum of 1/2” thick, 1-1/2 lb. density fiberglass insulation with an erosion resistant surface in accordance with NFPA 90A (non-residential type air conditioning and ventilating systems) to provide both thermal and acoustical insulation.
3. Sealing of ductwork to preclude air leaks should be done according to the job specifications.
4. It is recommended that units be **supported from underneath** using trapeze hangers and vibration isolators. Flexible connections are recommended for all connecting ductwork and electrical conduit to preclude the transmission of vibration noise.
5. It is recommended that flexible ductwork connected to the primary air inlet be secured using a compression band. Rigid duct should be slipped over the unit inlet, secured in place with sheet metal screws, and sealed according to the job specifications.

ELECTRICAL INSTALLATION

CAUTION:	*All Sources Of Supply Power Must Be Disconnected Before Working On This Equipment. More Than One Disconnect May Be Required To De-Energize Equipment.*

1. Follow the wiring/piping diagram found on the inside of the fan unit control enclosure cover.
2. Supply connections must be made using wires rated for 75°C minimum. **DO NO USE ALUMINUM CONDUCTORS.**
3. If supply connections are for 250 volts or greater, all wiring must be insulated for 600V.

4. Size supply conductors for 125% of rated combined load (fan motor FLA + heater current).

For electric heater use:

$$\text{Single phase Line Current} = \frac{\text{KW} \times 1000}{\text{Voltage}}$$

$$\text{Three phase Line Current} = \frac{\text{KW} \times 1000}{1.73 \times \text{Voltage}}$$

5. The following table shows the maximum current for 75°C Copper wire in conduit. Values are based on the 1984 N.E.C. Table 310-16 including note 8.

COMBINED LOAD MAXIMUM UNIT AMPERAGE		MINIMUM WIRE SIZES AWG/MCM
1 — 3 conductors	4 — 6 conductors	
12.0	9.6	14
16.0	12.8	12
24.0	19.2	10
40.0	32.0	8
48.0	38.4	6
- -	48.0	4

6. If not supplied as part of this unit, install a line disconnect and fusing or a circuit breaker in accordance with N. E. C.
7. The following table shows the maximum over current rating for wire servicing unit.

MAXIMUM SUPPLY UNIT AMPERAGE	MAXIMUM OVERCURRENT RATING
12	15
16	20
20	25
24	30
28	35
32	40
36	45
40	50
48	60

8. All field and factory made connections should be checked for tightness before operation.
9. The unit must be wired so as to provide a fan relay interlock to preclude heater operation unless air is flowing over the heater. An interlock is factory wired if heaters are factory attached.

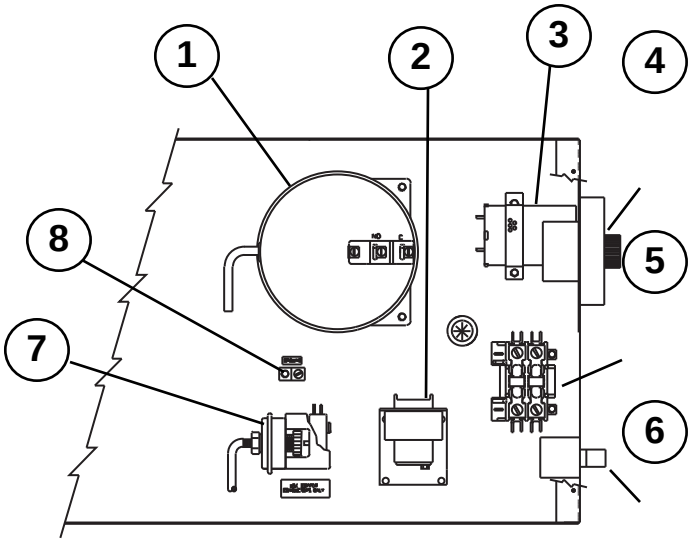
FAN UNIT CONTROLS *(See Figure 1)*

The following is a list of components located in the fan unit control panel. The figure at the right is to aid in component identification. Not all components are required for every control option and unit type.

1. Air Flow Switch. (Constant Volume Units)
2. Control Transformer. (Electronic/DDC Units)
3. Fan Motor Capacitor(s).
4. SCR Fan Speed Control.
5. Fan Motor Relay.
6. Fan Motor Disconnect Switch.
7. Pressure/Electric Switch. (Pneumatic Units)
8. Ground Lug.

Contact your local Carnes Representative for replacement parts.

CAUTION: *Severe Electrical Shock May Occur. Disconnect All Sources Of Supply Power Before Working On This Equipment. More Than One Disconnect May Be Required To De-Energize Equipment For Servicing.*



FAN UNIT CONTROL PANEL
Figure 1

BALANCING AND MAINTENANCE

DANGER:	*Severe Electrical Shock May Occur. Disconnect All Sources Of Supply Power Before Working On This Equipment. More Than One Disconnect May Be Required To De-Energize Equipment For Servicing.*

SETTING SECONDARY (HEATING) AIR FLOW

CONSTANT VOLUME (AC UNITS)

1. Adjust room thermostat to call for full cool. (Damper should open to the maximum CFM setting of the controller).
2. Remove secondary air filter if provided.
3. Tape a piece of cardboard onto the secondary air inlet. Size the cardboard 1/2" less than the height and 1/2" less than the width of the secondary inlet opening allow it to swing freely when taped in place. *(Figure 2)*
4. Adjust fan speed control (SCR) until the cardboard taped onto the secondary inlet hangs vertically indicating a balance between primary inlet air and discharge air CFM.
5. Remove the cardboard from secondary inlet. Replace filter if provided.
6. Fan CFM **MUST NOT BE LESS** than the maximum cooling CFM. Overloading the fan could cause motor damage and primary air to be forced out of the secondary inlet.

INTERMITTENT VOLUME (AS UNITS)

1. Adjust room thermostat to call for full heat. (Damper should close to minimum CFM setting on the controller).
2. Adjust fan speed control (SCR) to design CFM as measured at the diffusers.

ROUTINE MAINTENANCE *(To be done at least once a year)*

1. Check all field and factory made electrical and pneumatic connections for tightness.
2. Clean all air filters. Throw-away air filters may be ordered through your local Carnes Representative. Aluminum mesh air filters may be washed in warm soapy water.
3. Check compressed air supply for clean, dry and oil free compressed air.

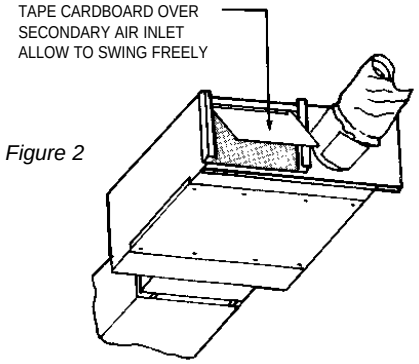


Figure 2

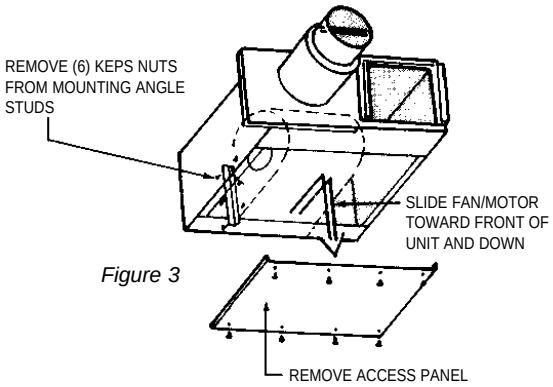


Figure 3

4. Fan motors are permanently lubricated not requiring annual service. If a fan wheel becomes out of balance due to dust or debris or if the fan motor should need replacing, follow the procedure outlined below.

FAN/MOTOR REMOVAL

1. Remove screws holding access panel in place.
2. Remove keps nuts from the mounting angle studs located on either side of the fan housing. *(See Figure 3)*
3. Disconnect fan motor wires from inside of the fan unit control panel.
4. Slide the fan/motor sub-assembly out through the access opening.
5. Reverse procedure for re-installation.

ELECTRIC DUCT HEATERS

Models: AX, AY - FOR TERMINAL UNITS

AESA, AEFA, APSA, APFA - CUSTOM HEATERS

MAINTENANCE INSTRUCTIONS FOR CARNES ELECTRIC DUCT HEATERS

APPLICATION INFORMATION

1. Follow the procedure given on the reverse side of this sheet to find the minimum air velocity for safe operation. At least this minimum velocity must be provided at all points over the heater face area. Failure to meet this requirement may result in serious damage or nuisance thermal cutout tripping.
2. The maximum air inlet temperature for open coil heaters is 100°F, and for finned tubular heaters, 80°F.
3. The heater must be located at least 48" from any grilles, registers, filters, abrupt duct size changes, humidifiers, air conditioning or air handling units, or any other change or obstructions in the duct which may result in nonuniform airflow. Duct elbows or turns must be located at least 4' from the inlet of the heater and 2' from the outlet of the heater. Sufficient working space must be provided per paragraph 110-26 of the NEC.
4. These duct heaters are not intended for installation in series in the airstream; the heaters are designed for use only as a single unit within a duct.

MECHANICAL INSTALLATION

1. Heater terminal outlet box should not be enclosed. Heaters with expanded metal terminal box covers must be installed in a position where air passing out of the terminal box does not enter into confined areas of the building structure (such as space behind a false ceiling, a hollow space in a wall, etc.).
2. All heaters are suitable for installation with zero spacing between the duct and combustible surfaces.
3. The heater must be installed in the correct position as shown by the arrows in the terminal box.
4. Sufficient clearance for convention cooling must be allowed for all heaters with built-in INDEECO Controls Power Controllers. Provide at least 5 inches of free air space above and below cooling fins extending from heater terminal box.
5. The air duct should be installed in accordance with the standards of the National Fire Protection Association for installation of air conditioning and ventilating systems of other than residence type (Pamphlet No. 90A) and residence type warm air heating and air conditioning systems (Pamphlet No. 90B).
6. For proper operation of heaters equipped with a built-in airflow switch, a minimum of .07" WC of static pressure is required in the duct system and the velocity pickup tube for the airflow switch must be pointed in the proper direction. When the heater is installed on the downstream or positive pressure side of the air moving fan, the arrow on the mounting flange of the pickup tube must point in the same direction as the airflow. When the heater is installed on the upstream or negative pressure side of the air moving fan, the arrow must point in the direction opposite to the airflow. If incorrectly installed, remove the two screws holding the pickup tube in place, rotate 180° and reinstall. See separate instruction sheet for installation of heaters supplied with a remote pickup tube.

FOR FLANGE TYPE HEATERS ONLY: (See Fig. No. 1)

7. Provide flanges on the duct to match the heater flanges, both on the entering and leaving air sides.
8. Attach the duct flanges to the heater flanges with bolts, sheet metal screws or slip and drive connectors when the heater has matching connectors for this purpose.

FOR SLIP-IN TYPE HEATERS ONLY: (See Fig. No. 2)

9. Cut a hole in the side of the duct to accommodate the body of the heater (excluding terminal box). This hole should be 1/8" larger than the heater frame.
10. Slip the heater into the duct and attach the back of the terminal box to the duct with sheet metal screws.

FOR HEATERS TO BE INSTALLED IN FIBER GLASS DUCTS:

11. Note that the fiber glass duct material itself must be UL listed.

FOR HEATERS TO BE INSTALLED IN INTERIOR INSULATED DUCTS:

12. All slip-in type heaters are suitable for installation in ducts with up to 1" of interior insulation as long as they have been sized for the dimensions inside the insulation. The heaters are not suitable for insulation depths of greater than 1" unless a special construction has been ordered. Flange type heaters are only suitable for installation in insulated ducts if specially ordered for this application.

ELECTRICAL INSTALLATION

13. Follow the wiring diagram on the inside of the terminal box.
14. Supply connections must be made with copper wiring rated for 75°C minimum. Use aluminum wire only when specifically called for on accompanying wiring diagram.
15. If supply connections are for 250 volts or greater, all wiring must be insulated for 600 volts.
16. When making line connections to heater element terminals FOR FINNED TUBULAR DUCT HEATERS ONLY, apply a 1/4" wrench to flat section of terminal immediately below threads. Otherwise damage to terminal may result.
17. Supply conductors for heaters rated less than 50 KW, must be sized at 125% of rated load. On heaters rated 50 KW and more, the supply conductors may be sized at 100% of rated load, if indicated on the wiring diagram. The line current for either a single or three phase load is calculated as follows:

$$\text{Single Phase Line Current} = \frac{\text{KW} \times 1000}{\text{Voltage}}$$

$$\text{Three Phase Line Current} = \frac{\text{KW} \times 1000}{\text{Voltage} \times 1.73}$$

18. The following table shows the maximum current for 75°C. Copper wire with not more than 3 conductors in a raceway. It is based on the National Electrical Code Table 310-16. The amperages shown are for 125% and 100% wire sizing. If there are more than 3 conductors in a raceway, derate these amperages per Table 310-15(b)(2)(a).

AMPS		WIRE SIZE	AMPS		WIRE SIZE	AMPS		WIRE SIZE
125%	100%	AWG/MCM	125%	100%	AWG/MCM	125%	100%	AWGMCM
12		14	80	100	3	184	230	4/0
16		12	92	115	2	204	255	250
24		10	104	130	1	228	285	300
40	50	8	120	150	0	248	310	350
52	65	6	140	175	2/0	268	335	400
68	85	4	160	200	3/0	304	380	500

19. When connecting heaters with more than one stage, wire stage No. 1 so that it is the first stage on and the last stage off. Heaters with built-in PE switches must follow this rule also. The stage number will be indicated on the front of each PE switch.

20. The heater must be wired so that it cannot operate unless air is flowing over it. This can be accomplished by using a built-in airflow switch, a built-in fan relay or any of several other methods. See the accompanying wiring diagram for the method used with this heater and provide appropriate interlock wiring as illustrated.
21. National Electrical Code and Underwriters Laboratories require the heater manufacturer to supply 1) over-current protection where heater total current exceeds 48 amperes and 2) any contactors required for proper functioning of temperature limiting controls. Where these devices are not included in the heater terminal box of a UL listed heater, they are supplied in a remote UL listed panel board shown on the wiring diagram.
22. If not supplied as part of this heater, install a line disconnect switch or main circuit breaker in accordance with the National Electrical Code. Depending upon the heater's location and accessibility, a built-in disconnect switch may meet this requirement.
23. All electrical connections in the heater, including both field and factory made connections, should be checked for tightness before operating the heater. In addition, after a short period of operation, all connections should again be checked for tightness.
24. If heater is wired to a heating-cooling thermostat, use a thermostat with isolating circuits to prevent possible interconnection of Class 2 outputs.

25a. If the are inside of the sheet metal directly surrounding the heating element section is more than 1" smaller in length and/or width than the duct in which the duct heater is installed, the KW per square foot of duct area should be calculated as the heater nameplate KW divided by the area inside the sheet metal enclosure directly around the heating elements.

25b. If the heating elements are divided into several sections with uncoiled resistance wire between two or more coiled sections, maximum KW per sq. ft. should be calculated as follows:

$$\frac{\text{Heater nameplate KW}}{\text{Number of heated sections x area of one heated section}}$$

INSTALLATION DRAWINGS

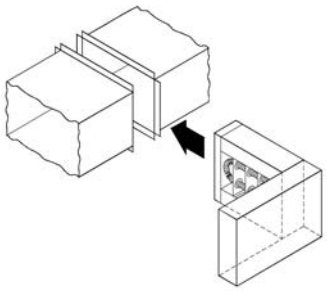


Fig. 1 - Installation drawing of flanged heater.

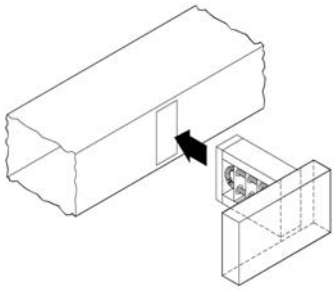


Fig. 2 - Installation drawing of slip-in heater.

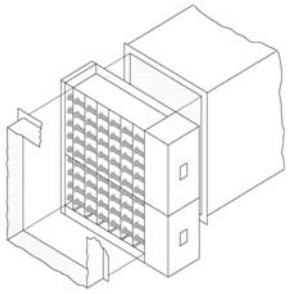


Fig. 3 - Installation drawing of two stacked sections in a duct.

AIRFLOW REQUIREMENTS

Calculate KW per square foot of duct area as: $\frac{\text{heater nameplate KW}}{\text{duct area (Sq.Ft.)}}$ (see#26)

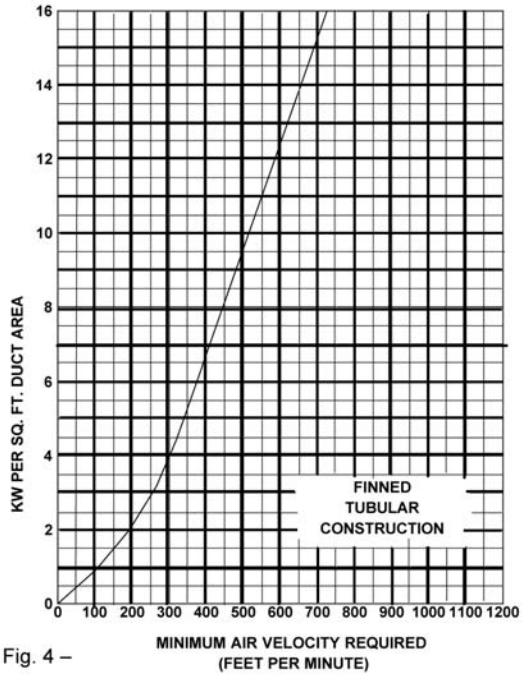


Fig. 4 –

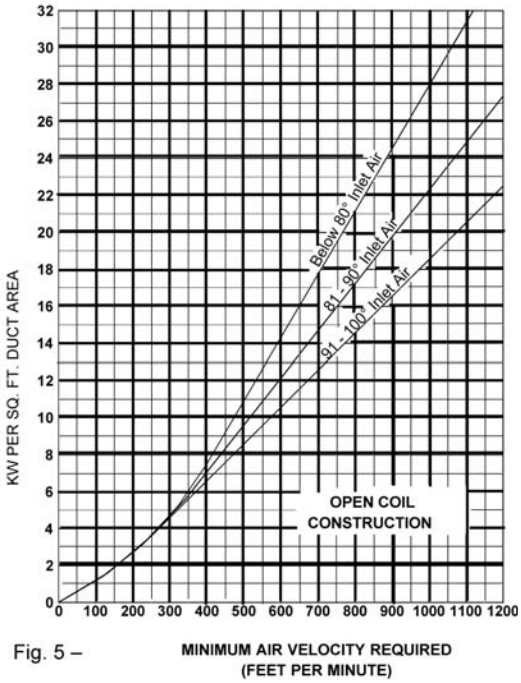


Fig. 5 –

OPERATION & MAINTENANCE
NOTICE: ALL SOURCES OF SUPPLY MUST BE DISCONNECTED BEFORE WORKING ON THIS EQUIPMENT

To operate this heater make sure all associated control equipment is on, energize main supply disconnect and set controlling thermostat above ambient temperature. This heater is equipped with automatic and manual reset temperature limiting controls. If it fails to operate, make sure manual resets are operative by pushing reset buttons.

The only routine maintenance required is to check all electrical connections, including field and factory made connections, for tightness at least once each year or operating season. In addition, of course, any filters in the airstream must be kept clean so that adequate airflow is maintained.

PNEUMATIC PRESSURE DEPENDENT CONTROLS

Control Options

(CA, CM)

CALIBRATION

A signal is sent directly from the thermostat to the unit damper actuator without any provisions made for duct pressure changes within the operating range of the terminal unit.

GENERAL

1. Refer to the calibration chart on the unit. Read the pressure differential required for that unit to deliver the desired CFM. (The unit can be found on the Carnes identification label).

2. Remove the caps from the high and low sensor signal tubes located at the inlet.

3. Connect a differential pressure gauge or incline manometer to the sensor tubes. The high pressure side of the gauge to the sensor tube having the sensing holes facing upstream (total pressure signal) and the low pressure side of the gauge to the sensor tube having the sensing holes facing downstream (static pressure signal).

PNEUMATIC CONTROLS

As a standard, the terminal unit is supplied with a Carnes 8-13 psi pneumatic damper actuator. Optional adjustment stops may be supplied for airflow balancing.

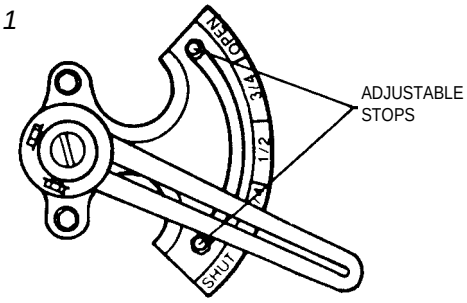
TOOLS NEEDED: 0.0" - 2.0" Pressure gauge or incline manometer, 5/16" open end wrench, 7/16" open end wrench, and a slotted screwdriver.

UNITS WITH OPTIONAL BALANCING QUADRANT *(Figure 1):*

1. Calibrate the maximum and minimum airflows by monitoring the pressure gauge and adjusting the damper stops so that the damper travel is limited to the desired maximum and minimum airflows.

2. Disconnect pressure gauge and replace sensor tube caps.

Figure 1



UNITS WITHOUT OPTIONAL BALANCING QUADRANT:

CAUTION: *Do not attempt to limit the maximum CFM on units without the balancing quadrant. Severe damage could occur at excessive control air pressures. Only a minimum CFM limit can be set. The minimum airflow limit should be chosen so that the damper is no more than 50% open.*

1. Adjust thermostat for full heat (minimum airflow).

2. Loosen the 5/16" damper setscrew and calibrate the minimum airflow by monitoring the pressure gauge and adjusting the damper so that the damper travel is limited to the desired minimum airflow.

3. Tighten the damper setscrew, disconnect the pressure gauge and replace sensor tube caps.

REVERSING RELAY ADJUSTMENT

For those applications that require a reversing relay:

- Direct acting thermostat and normally open damper.
- Reverse acting thermostat and normally closed damper.
- Dual duct units with adjustable mixing sequences.

Reversing relays are factory set for nominal “sum” of 16 psi. A thermostat pressure of 8 psi applied to port “3” (or “S”) yields 8 psi output of port “1” (or “B”). The output pressure decreases as the input thermostat pressure is increased and the output pressure increases as the input thermostat pressure is decreased. The “sum” of the input and output pressures always totals 16 psi.

To check or re-set the reversing relay, the following procedure is recommended.

TOOLS NEEDED: (2) 0 psi - 30 psi air gauges and a slotted screwdriver.

1. Connect a 20 psi main control air supply to port “M” of the reversing relay. *(Figure 2)*

2. Monitor the input pressure at port “3” (or “S”) and the output pressure at port “1” (or “B”) with 0 - 30 psi gauges.

3. Adjust the black adjustment screw, located on the end opposite of the port connections, to increase or decrease the “sum” value of the reversing relay.

4. Increasing the input-output “sum” moves the curve to the right on the airflow chart and decreasing the input-output “sum” moves the curve to the left on the airflow chart. *(Figure 3)*

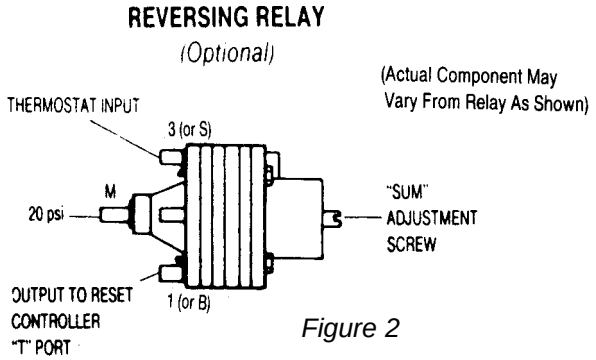


Figure 2

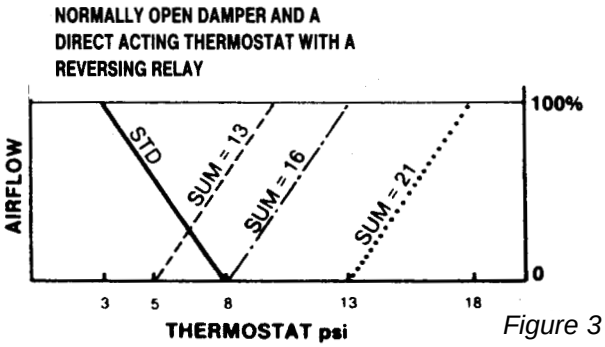


Figure 3

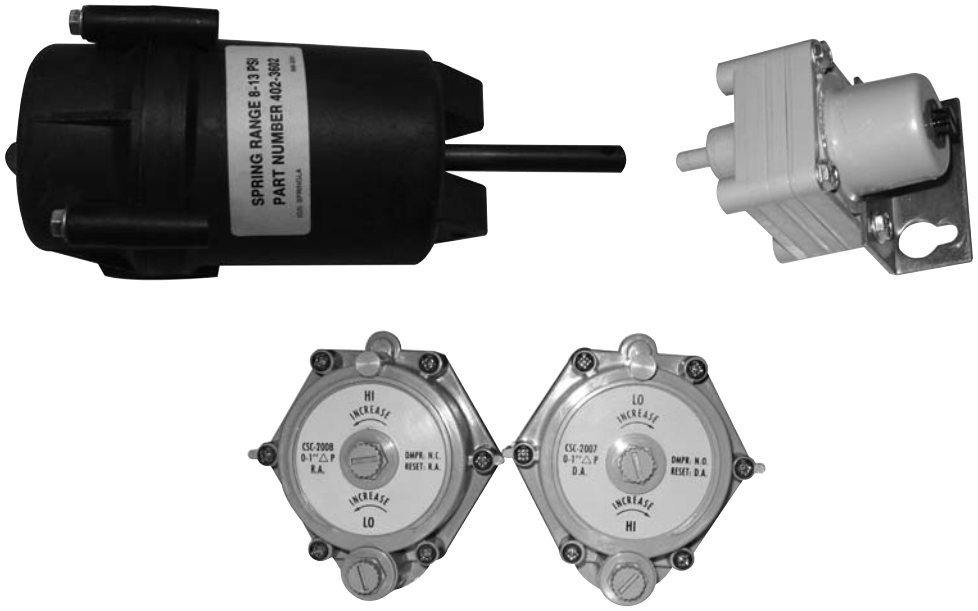
TROUBLESHOOTING PNEUMATIC CONTROLS:

SYMPTOM	PROBABLE CAUSE	CORRECTION
Damper actuator will not stroke	*1. Leak in the control line.*	1. Replace tubing.
	2. Leak in the actuator.	2. Apply 13-20 psi air to the actuator with a squeeze bulb. 2A. If actuator does not stroke, manually move linkage. If it is jammed, see 4 or 5 below. If the actuator still does not stroke, replace actuator. 2B. If actuator strokes but does not remain fully stoked or bleeds faster than pressure can build, replace actuator.
	3. Incorrect calibration.	3. Refer to calibration procedure.
	4. Damper linkage jammed or binding.	4. Adjust linkage for free operation.
	5. Debris inside terminal unit.	5. Disconnect duct and remove debris from inside.
Damper actuator remains full stroked at all times	*1. Incorrect calibration.*	1. Refer to calibration procedure.
	2. Debris inside terminal unit.	2. Disconnect duct and remove debris from inside.
Low airflow through box on call for max. CFM	*1. Thermostat not set for maximum CFM.*	1. Adjust thermostat to call for full cooling.
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low, increase the system static.
	3. Incorrect calibration.	3. Refer to calibration procedure.
	4. Debris inside terminal unit.	4. Disconnect duct and remove debris from inside.
Low airflow through box	*1. Low inlet static pressure.*	1. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low, increase the system static.
	2. Incorrect calibration.	2. Refer to calibration procedure.
	3. Debris inside terminal unit	3. Disconnect duct and remove debris from inside.

PNEUMATIC PRESSURE INDEPENDENT CONTROLS

Control Option

(CE)



GENERAL

Unless otherwise specified, the terminal unit is supplied with a Carnes OEM reset constant volume controller and a Carnes 8-13 psi pneumatic damper actuator.

The air consumption of each controller is 15 SCIM (0.008 SCFM) excluding the room thermostat. Air consumption of the controller plus the reversing relay is 30 SCIM (0.016 SCFM) excluding the room thermostat

CALIBRATION

Where conditions exist that require field calibration of adjustment of the reset controller, the following procedure is recommended.

TOOLS NEEDED: 0.0" - 2.0" Pressure gauge or incline manometer and a 1/4" nut driver.

It may be necessary to remove an optional controls enclosure cover to access the control components. Remove the 1/4" sheet metal screws on the control components. Replace the cover and sheet metal screws upon completion of calibration.

1. Remove the caps from the high and low sensor signal tubes located on the opposite side of the inlet as the green and yellow tubing connections.
2. Connect the pressure gauge or incline manometer to the sensor tubes. The high pressure side of the gauge to the same sensor tube as the green controller tubing connection (total pressure signal) and the low pressure side of the gauge to the same sensor tube as the yellow controller tubing connection (static pressure signal).
3. Refer to the calibration chart for pressure setting at a required CFM and unit size.

CAUTION: *CFM adjustments are to be made with fingers only! Knobs break if over-tightened.*

NORMALLY OPEN DAMPER - BEIGE CONTROLLER (Figure 1)

The BEIGE reset controller is suitable for use with a direct acting thermostat (DANO). When the controller is provided with a reversing relay, the beige controller is suitable for use with a reverse acting thermostat (RANO).

4. Set zone temperature to full heating. Adjust minimum airflow by turning the CFM knob stamped "LO" located in the center of the beige controller. Turn clockwise to increase airflow and counterclockwise to decrease airflow.
5. Set the zone temperature to full cooling. Adjust maximum airflow by turning the CFM knob stamped "HI" located on the outer rim of the beige controller. Turn clockwise to increase airflow and counterclockwise to decrease airflow.

(BEIGE, Normally Open Damper Controller Shown)

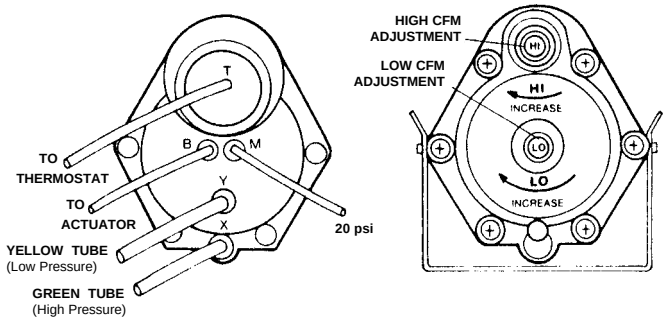


Figure 1

PNEUMATIC PRESSURE INDEPENDENT CONTROLS

NORMALLY CLOSED DAMPER - GREY CONTROLLER (Figure 2)

The GREY reset controller is suitable for use with a reverse acting thermostat (RANC). When the controller is provided with a reversing relay, the grey controller is suitable for use with a direct acting thermostat (DANC).

4. Set the zone thermostat to full cooling. Adjust maximum air flow by turning the CFM know stamped "HI" located in the center of the grey controller. Turn counter-clockwise to increase airflow and clockwise to decrease airflow.

5. Set the zone thermostat to full heating. Adjust minimum airflow by turning the CFM knob stamped "LO" located on the outer rim of the grey controller. Turn counter-clockwise to increase airflow and clockwise to decrease airflow.

6. Remove pressure gauge or manometer, replace sensor caps and adjust thermostat to desired setpoint temperature. Some setting time may be required for the terminal unit to respond properly to the controller after the replacement of the sensor caps or adjustment of the thermostat.

(GREY, Normally Closed Damper Controller Shown)

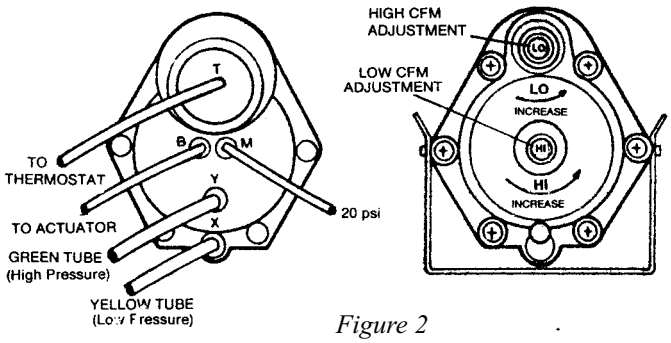


Figure 2

REVERSING RELAY ADJUSTMENT

For those applications that require a reversing relay:
--Direct acting thermostat and normally closed damper.
--Reverse acting thermostat and normally open damper.
--Dual duct units with adjustable mixing sequences.

Reversing relays are factory set for nominal "sum" of 16 psi. A thermostat pressure of 8 psi applied to port "3" or "S" yields 8 psi output of port "1" or "B". The output pressure decreases as the input thermostat pressure is increased and the output pressure increases as the input thermostat is decreased. The "sum" of the input and output pressures always totals 16 psi.

To check or re-set the reversing relay, the following procedure is recommended:

TOOLS NEEDED: (2), 0 psi - 30 psi control air gauges and a #2 slotted screwdriver.

1. Connect a 20 psi main control air supply to port "M" of the reversing relay. *(Figure 3)*

2. Monitor the input pressure at port "3" or "B" and the output pressure at port "1" or "B" with 0-30 psi gauges.

REVERSING RELAY
(Optional)

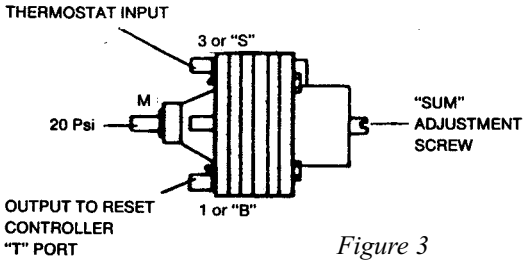


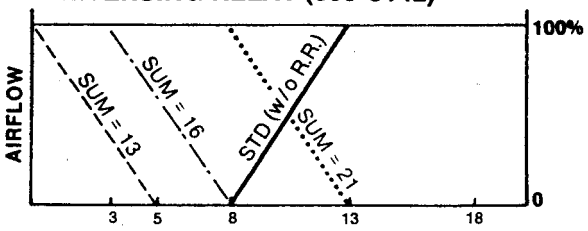
Figure 3

(Actual component may vary from that pictured above.)

3. Adjust the black adjustment screw, located on the end opposite of the port connections, to increase or decrease the "sum" value of the reversing relay.

4. Increasing the input-output "sum" moves the curve to the right on the airflow chart and decreasing the input-output "sum" moves the curve to the left on the airflow chart. *(Figure 4)*

DANO (999-2825) Reset Controller w/ REVERSING RELAY (999-3142)



RANC (999-2826) Reset Controller w/ REVERSING RELAY (999-3142)

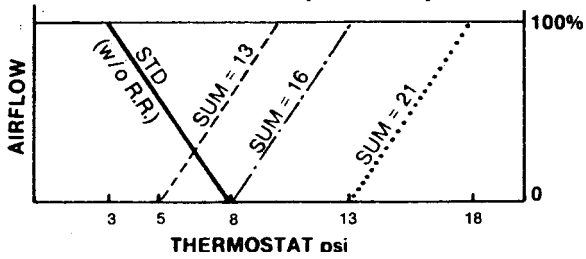


Figure 4

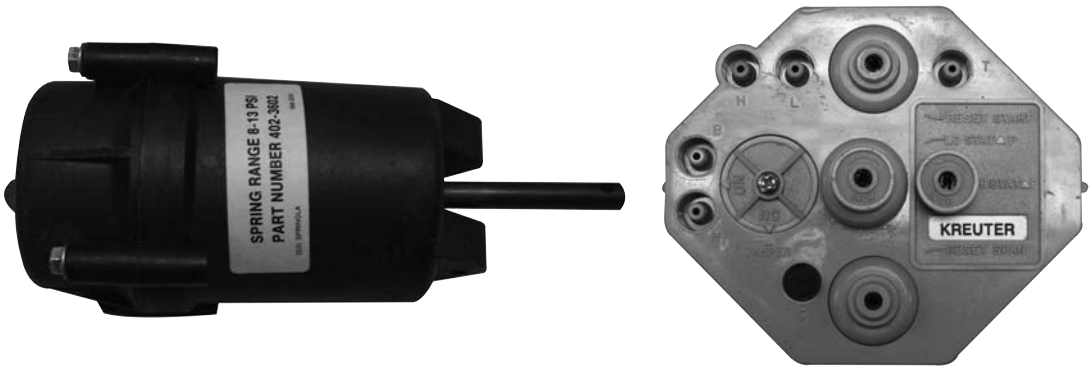
TROUBLESHOOTING

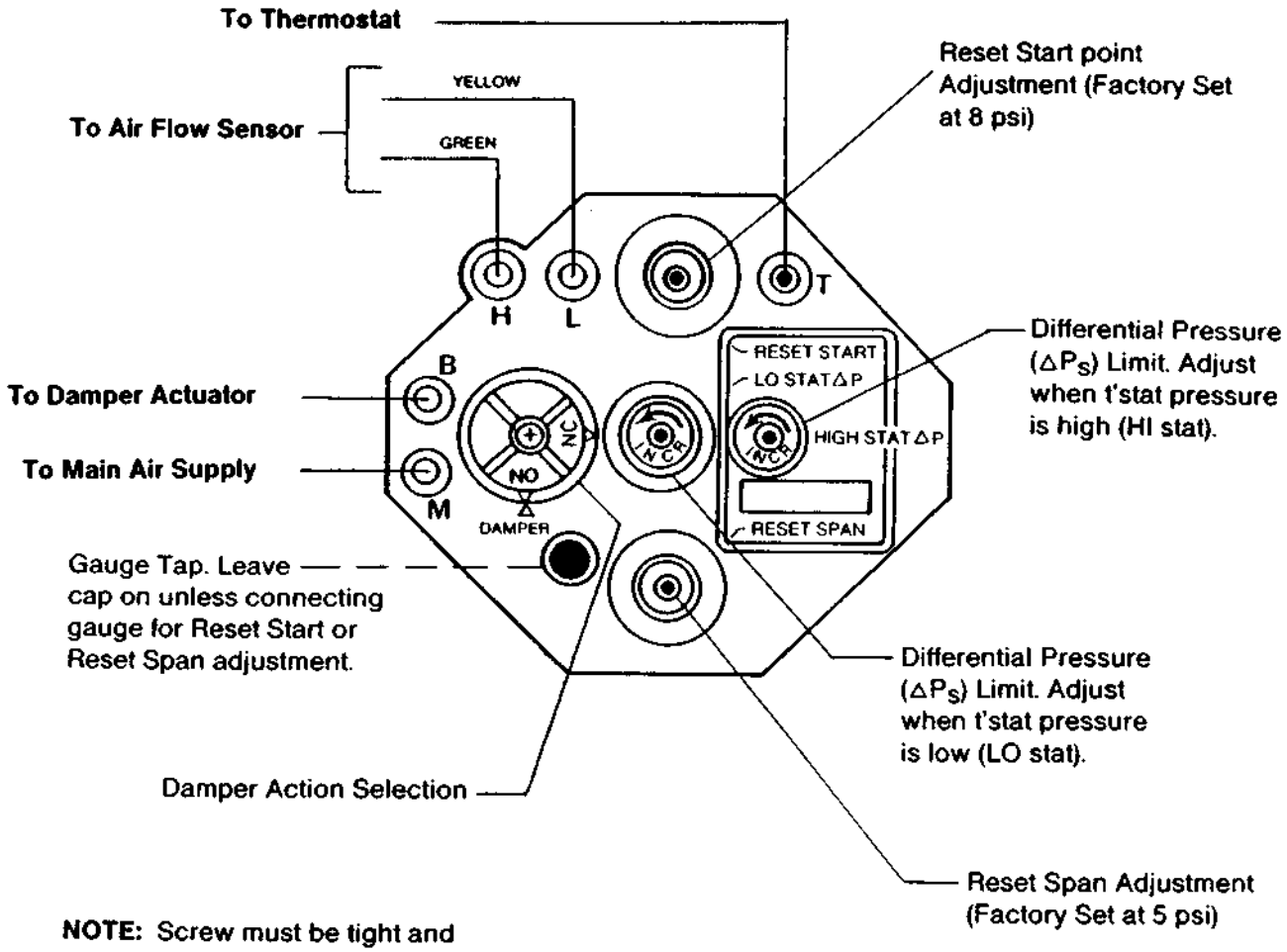
SYMPTOM	PROBABLE CAUSE	CORRECTION
Damper actuator will not stroke.	*1. Insufficient main air supply pressure.*	1. The controller must receive 15-30 psi compressed air from the main supply to port "M".
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low increase the system static.
	3. Leak in the control line.	3. Replace tubing.
	4. Leak in the actuator.	4. Apply 13-20 psi air to the actuator with a squeeze buld. 4A. If the actuator does not stroke, manually move linkage. If it is jammed, see 10 or 11 below. If actuator still does not stroke, replace actuator. 4B. If actuator strokes but does not remain fully stroked or bleeds faster than pressure can build replace actuator.
	5. Pneumatic control line connections reversed.	5. Be sure all connections are shown in the pneumatic control piping diagram on the side of the unit.
	6. Incorrect reset controller calibration.	6. Refer to calibration procedure.
	7. Wrong controller.	7. Be sure controller and thermostat match (i.e., Reverse acting controls with a reverse acting thermostat and direct acting controls with a direct acting thermostat.)
	8. High and Low pressure sensor tubes are reversed to the controller.	8. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	9. Caps missing from sensor tubes.	9. Replace caps. (Part No. 999-6505).
	10. Damper linkage jammed or binding.	10. Adjust linkage for free operation.
	11. Debris inside terminal unit.	11. Disconnect duct and remove debris from inside.
	12. Faulty controller.	12. Replace controller.
Damper actuator remains full stroked at all times.	*1. Low inlet static pressure.*	1. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low, increase the system static.
	2. Pneumatic control line connections are reversed.	2. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	3. High and Low sensor tubes are reversed to the controller.	3. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	4. Caps missing from sensor tubes.	4. Replace caps. (Part No. 999-6505)
	5. Incorrect reset controller calibration.	5. Refer to calibration procedure.
	6. Debris inside terminal unit.	6. Disconnect duct and remove debris from inside.
	7. Wrong controller.	7. Be sure controller and thermostat match. (i.e., Reverse acting controls with a reverse acting thermostat and direct acting thermostat with a direct acting thermostat.)
	8. Faulty controller.	8. Replace controller.
Low air flow through box on a call for max. CFM.	*1. Thermostat not set to call for maximum CFM.*	1. Adjust thermostat to call for full cooling.
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	3. Incorrect reset controller calibration.	3. Refer to calibration procedure.
	4. Debris inside terminal unit.	4. Disconnect duct and remove debris from inside.
	5. Wrong controller.	5. Be sure controller and thermostat match. (i.e. Reverse acting controls with a reverse acting thermostat and direct acting controls with a direct acting thermostat.)
	6. Faulty controller.	6. Replace controller.
Low air flow through box on call for min CFM.	*1. Low inlet static pressure.*	1. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	2. Incorrect reset controller calibration.	2. Refer to calibration procedure.
	3. Debris inside terminal unit.	3. Disconnect duct and remove debris from inside.
	4. Wrong controller.	4. Be sure controller and thermostat match. (i.e., Reverse acting controls with a reverse acting thermostat and direct acting controls with a direct acting thermostat.)
	5. Faulty controller.	5. Replace controller.
Reset controls unit but delivers incorrect CFM.	*1. Less than optimal unit installation.*	1. Refer to installation instructions.
	2. Incorrect reset controller calibration.	2. Refer to calibration procedures.
Unit does not respond to changes in thermostat setting.	*1. Low main air pressure.*	1. The controller must receive 15-30 psi compressed air from the main supply to port "M".
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	3. Improper tubing hook-up.	3. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	4. Incorrect reset controller calibration.	4. Refer to calibration procedure.
	5. Wrong controller.	5. Be sure controller and thermostat match. (i.e., Reverse acting controls with a reverse acting thermostat and direct acting controls with a direct acting thermostat.)
	6. Faulty controller.	6. Replace controller.

PNEUMATIC PRESSURE INDEPENDENT CONTROLS

Control Option

(CX)





NOTE: Screw must be tight and arrows in perfect alignment for device to function properly.

SPECIFICATIONS

Air Consumption:	1.0 scfh @ 20 psig (28.8 scim @ 20 psig)
Ambient Limits:	+40°F to +120°F operating
Damper Action:	Normally Open or Normally Closed (Field Adjustable)
Thermostat Action:	Direct or Reverse Action for Heating or Cooling
Differential Pressure Range:	0.0 to 1.0" water gauge
Main Air Pressure:	15 to 30 psig
Maximum Setpoint Range:	Minimum to 1.0" water gauge
Minimum Setpoint Range:	0.0 to 1.0" water gauge
Reset Pressure Span:	0.0 to 10.0 psig (Field Adjustable
Reset Start Point:	0.0 to 10.0 psig (Field Adjustable)
Weight:	11 Ounces (312 Grams)

MULTI-FUNCTION CONTROLLER SET-UP:

1. *Verify Controller Piping* — Repair any loose or kinked tubing.

Port B: Damper Actuator

Port M: Clean, Dry Main Air

Port T: Thermostat

Port H: Total Pressure Air Flow Tap (Green Tube)

Port L: Static Pressure Air Flow Tap (Yellow Tube)

2. *Check Main Air pressure (M)* 20 psig clean, dry air required.

3. To field select/change damper action of the multi-function controller, loosen the damper selection switch screw and align desired "NO" or "NC" pointer with the damper pointer and tighten screw.

CALIBRATION PROCEDURE:

1. Controller calibration may require readjustment if the controller orientation has been changed by either relocating the controller or changing the terminal unit mounting position from standard horizontal mounting.

2. Remove caps from the Inlet Sensor *(opposite side of tubing connections.)*

3. *Connect a different pressure gauge across the Inlet Sensor Tubes.* **Green Tube** *(or Black with Green Stripe) is the Total Pressure ("HI" Signal).* **Yellow Tube** *(or Black with Yellow Stripe) is the Static Pressure ("LO" Signal).*

4. Reference the Airflow Calibration Chart or on the unit for Delta P *versus* CFM values.

5. *Direct Acting Cooling or Reverse Acting Heating:*

A. Adjust **LO Stat** ΔP to the desired **minimum** airflow limit with zero (0) psi at port **T**. *(Thermostat set to full heat).*

B. Adjust **HI Stat** ΔP to the desired **maximum** airflow with twenty (20) psi at port **T**. *(Thermostat set to full cool).*

6. *Reverse Acting Cooling or Direct Acting Heating:*

A. Adjust **LO Stat** ΔP to the desired **maximum** airflow limit with zero (0) psi at port **T**. *(Thermostat set to full cool).*

B. Adjust **HI Stat** ΔP to the desired **minimum** airflow with twenty (20) psi at port **T**. *(Thermostat set to full heat).*

7. *When Calibration is complete,* Set zone thermostat to desired room temperature.

8. *Remove Differential Pressure Gauge* from the Inlet Sensor.

9. *Replace Inlet Sensor Caps.*

10. *To Field Adjust Reset Start Point (Factory Set at 8 psi).*

A. Connect a 0-30 psi gauge to port **G**.

B. Regulate thermostat pressure, to port **T**, to the desired start point pressure.

C. Adjust Reset Start to indicate zero (0) psi to port **G** gauge, then adjust Reset Start to indicate a pressure slightly higher than zero (0) psi., i.e. 0.1 psi.

11. *To Field Adjust Controller Reset Span (Factory Set at 5 psi):*

A. Connect a 0-30 psi gauge to port **G**.

B. Regulate thermostat pressure, to port **T**, to 20 psi.

C. Adjust Reset Span to indicate the desired span on the port **G** gauge.

NOTES:

1. Reset Span adjustments will affect the **HI STAT** ΔP setting. The Reset Span adjustment must be adjusted first or the **HI STAT** ΔP will require readjustment.
2. **LO STAT** ΔP adjustment will affect the **HI STAT** ΔP setting. The **LO STAT** ΔP adjustment must be adjusted first or the **HI** ΔP will require readjustment.
3. Allow 2-3 minutes between **HI** and **LO** limit adjustments for controller and damper to stabilize.
4. Reset span effect range proportionally.

TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	CORRECTION
Damper actuator will not stroke.	*1. Insufficient main air supply pressure.*	1. The controller must receive 15-30 psi compressed air from the main supply to port "M".
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low increase the system static.
	3. Leak in the control line.	3. Replace tubing.
	4. Leak in the actuator.	4. Apply 13-20 psi air to the actuator with a squeeze buld. 4A. If the actuator does not stroke, manually move linkage. If it is jammed, see 9 or 10 below. If actuator still does not stroke, replace actuator. 4B. If actuator strokes but does not remain fully stroked or bleeds faster than pressure can build replace actuator.
	5. Pneumatic control line connections reversed.	5. Be sure all connections are shown in the pneumatic control piping diagram on the side of the unit.
	6. Incorrect reset controller calibration.	6. Refer to calibration procedure.
	7. High and Low pressure sensor tubes are reversed to the controller.	7. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	8. Caps missing from sensor tubes.	8. Replace caps. (Part No. 999-6505).
	9. Damper linkage jammed or binding.	9. Adjust linkage for free operation.
	10. Debris inside terminal unit.	10. Disconnect duct and remove debris from inside.
	11. Faulty controller.	11. Replace controller.
Damper actuator remains full stroked at all times.	*1. Low inlet static pressure.*	1. Measure the CFM delivered by the unit with the damper in the full open position. If the CFM is low, increase the system static.
	2. Pneumatic control line connections are reversed.	2. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	3. High and Low sensor tubes are reversed to the controller.	3. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	4. Caps missing from sensor tubes.	4. Replace caps. (Part No. 999-6505)
	5. Incorrect reset controller calibration.	5. Refer to calibration procedure.
	6. Debris inside terminal unit.	6. Disconnect duct and remove debris from inside.
	7. Faulty controller.	7. Replace controller.
Low air flow through box on a call for max. CFM.	*1. Thermostat not set to call for maximum CFM.*	1. Adjust thermostat to call for full cooling.
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	3. Incorrect reset controller calibration.	3. Refer to calibration procedure.
	4. Debris inside terminal unit.	4. Disconnect duct and remove debris from inside.
	5. Faulty controller.	5. Replace controller.
Low air flow through box on call for min CFM.	*1. Low inlet static pressure.*	1. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	2. Incorrect reset controller calibration.	2. Refer to calibration procedure.
	3. Debris inside terminal unit.	3. Disconnect duct and remove debris from inside.
	4. Faulty controller.	4. Replace controller.
Reset controls unit but delivers incorrect CFM.	*1. Less than optimal unit installation.*	1. Refer to installation instructions.
	2. Incorrect reset controller calibration.	2. Refer to calibration procedures.
Unit does not respond to changes in thermostat setting.	*1. Low main air pressure.*	1. The controller must receive 15-30 psi compressed air from the main supply to port "M".
	2. Low inlet static pressure.	2. Measure the CFM delivered by the unit with damper in the full open position. If the CFM is low, increase the system static.
	3. Improper tubing hook-up.	3. Be sure all connections are as shown in the pneumatic control piping diagram on the side of the unit.
	4. Incorrect reset controller calibration.	4. Refer to calibration procedure.
	5. Faulty controller.	5. Replace controller.

ELECTRIC PRESSURE DEPENDENT CONTROLS

Control Options

(EA, EB, ER, EK)

ELECTRIC CONTROLS

As a standard, the terminal unit is supplied with a 5 watt, 24 volt AC, 1 rpm (15°/minute), reversible drive damper motor. It is equipped with fully adjustable stops to restrict damper travel from 0° 90° and can be indefinitely stalled without damage. The motors may be provided with as many as two (2) optional microswitches (for reheat options) rated 1/2 amp at 125 VAC each.

TOOLS NEEDED: 0.0" - 2.0" Pressure gauge or incline manometer, a 1/4" nut driver, 1/8" Allen wrench, 9/64" Allen wrench, and a slotted screwdriver.

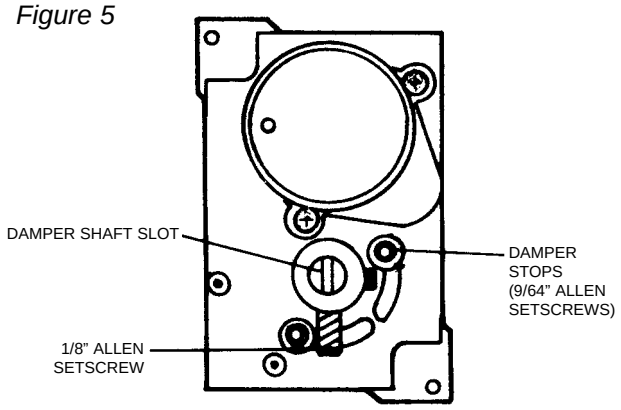
Remove the 1/4" sheet metal screws on the control enclosure cover to access the control components. Replace the cover and sheet metal screws upon completion of calibration.

ELECTRIC ACTUATOR (EA, EB) *(Figure 5)*

1. Calibrate the maximum and minimum airflows by monitoring the pressure gauge and adjusting the damper stops so that the damper travel is limited to the desired maximum airflows.

2. Disconnect pressure gauge and replace sensor tube caps.

Figure 5



ELECTRIC ACTUATOR WITH MICROSWITCH OPTIONS (ER, EK) *(Figure 6)*

Adjust microswitch settings after airflow balancing has been completed *(see above)*.

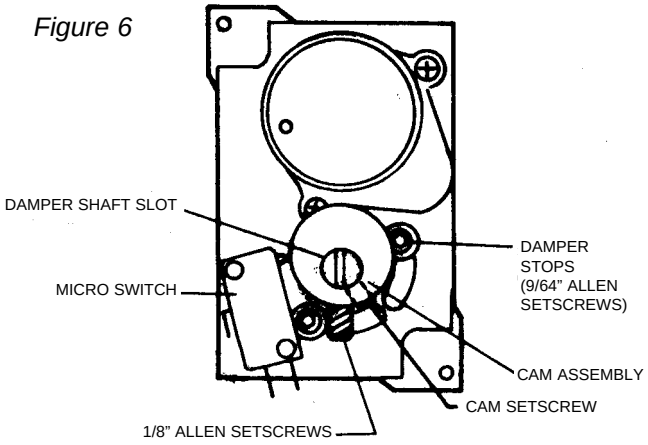
1. Set thermostat to call for desired airflow.

2. Loosen Allen head set screw securing the cam(s) on the actuator.

3. Rotate the cam(s) so that the cam energizes the switch(es) at the desired airflow.

4. Re-tighten the Allen head set screw to secure the cam(s).

Figure 6

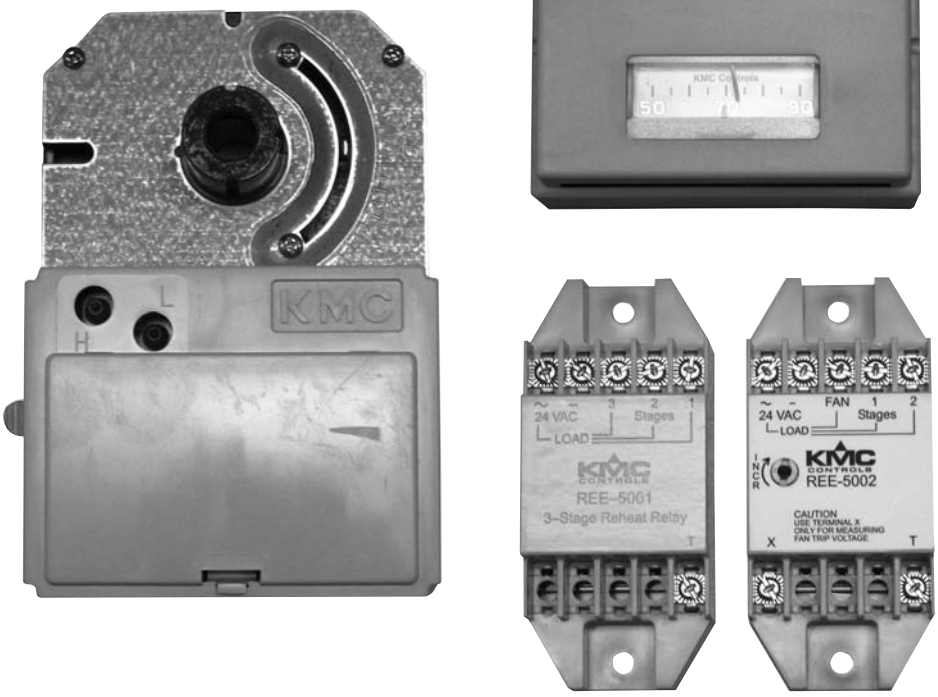


ELECTRIC CHANGE-OVER THERMOSTAT OPTION (EB)

The change-over thermostat option is used in conjunction with the zone thermostat. The change-over thermostat reverses the action of the zone thermostat when warm air is supplied to the unit. This option is used for morning warm-up and is field adjustable from 60°F to 80°F switching temperature.

ELECTRONIC (ANALOG) PRESSURE INDEPENDENT CONTROLS

Control Option (ET)



Installation Guide

Mounting

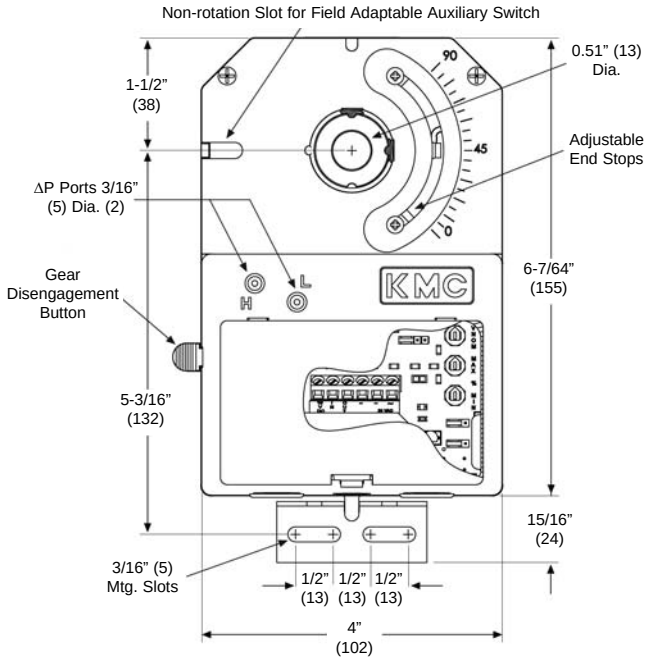
The CSP-5001 is designed to mount on a standard 1/2 in. (13 mm) diameter shaft or a 3/8 in. (9.5 mm) shaft using the HFO-0011 adaptor.

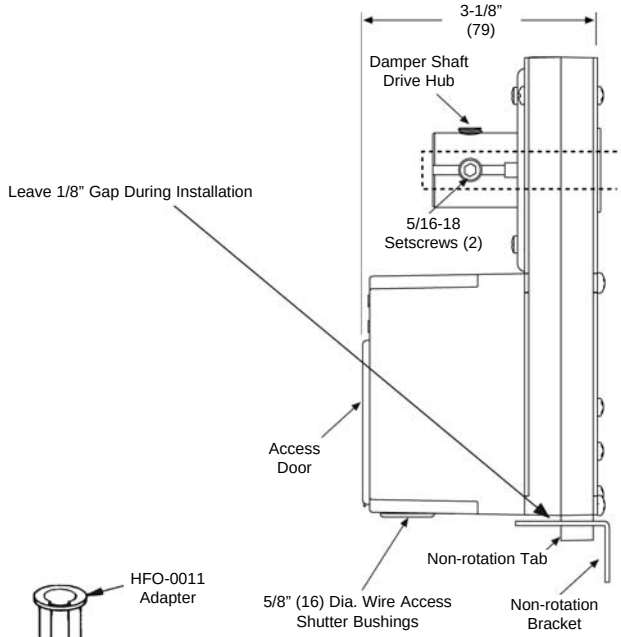
Standard Instructions

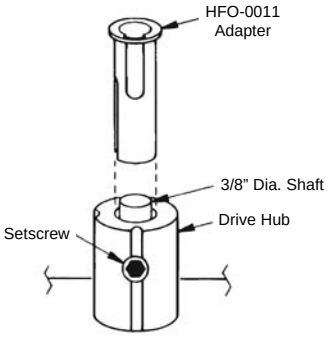
1. Slide the CSP-5001 directly onto the 1/2 in. diameter damper shaft. The shaft must extend a minimum of 1-3/4 in. from the mounting surface. (For a 3/8 in. shaft, see the HFO-0011 Adaptor section below.)
2. Place the non-rotation bracket (supplied) on the non-rotation tab. Leave a gap of 1/8 in. between the bottom surface of the CSP-5001 and the bracket to allow for play during operation (see illustration).
3. Attach the non-rotation bracket to the mounting surface using (2) #8 or #10 self-tapping screws (not included).
4. Depress the gear disengagement button and:
   A. Rotate the drive hub until the indicator stops at the “O” mark if the damper is clockwise to close.
   B. Rotate the drive hub to the “90” mark if the damper is counterclockwise to close.
5. Position the damper to full close.
6. Torque the two 5/16-18 setscrews to 75-85 in. lb.

HFO-0011 Adaptor

1. Mount the CSP-5001 actuator over the 3/8 in. shaft.
2. Slide the HFO-0011 over the shaft into the drive hub of the actuator.
3. Align the adaptor slots with the setscrews.
4. Partially tighten the setscrews.
5. Continue with Step 2 under the Standard Instructions section above.







Wiring

1. Remove the CSP's wiring access door by pulling back on the door's tab and lifting upward.
2. Access for wire or cable is via two 5/8 in. (16 mm) diameter snap-in shutter bushings located on the rear of the CSP's cover.
3. Connect conduit to the actuator if required (connectors are not supplied).
4. Refer to our website www.carnes.com for proper wiring.
5. Replace wiring access door.

Air Flow Sensor Connection

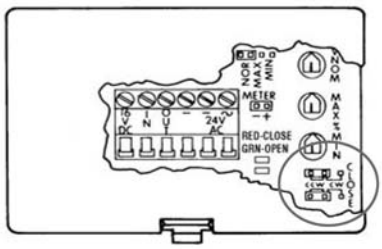
Using 1/4 in. OD control tubing, connect the CSP to the differential pressure flow sensor:

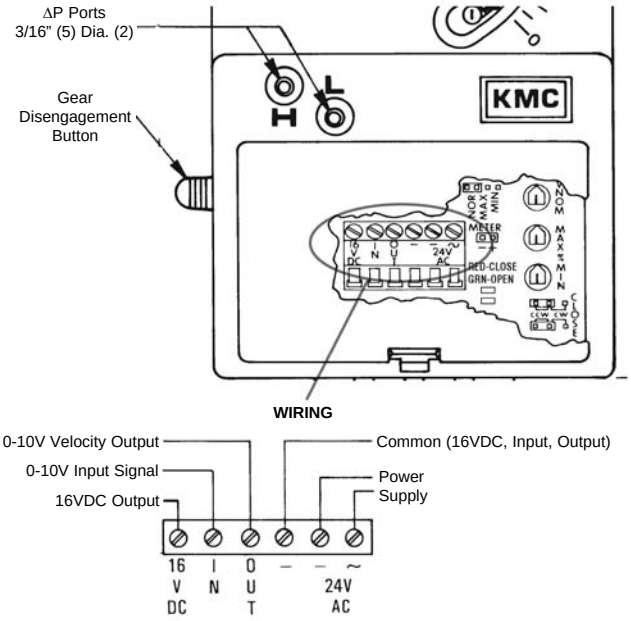
1. Connect the "H" port to the (high side) "H" of the sensor.
2. Connect the "L" port to the (low side) "L" of the sensor.

Rotation Setup

To set the rotation direction of the controller:

1. Remove the access door by pulling back on the door's tab and lifting upward.
2. Position **BOTH JUMPERS** in either the CW or CCW positions as needed. See the diagram.

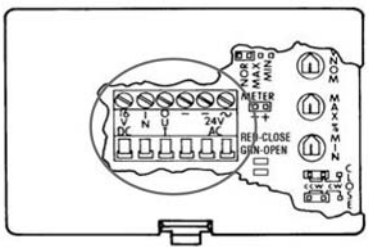




Controller Testing

Test the CSP actuator's motor operation:

1. Temporarily disconnect the thermostat reset connection at Terminal "IN".
2. Jumper "IN" terminal to the "16 VDC" terminal. The green Open LED should illuminate. The shaft drive hub should be rotating the damper open. The damper should go to full open unless the maximum limit was set at the CSP, and then the damper will only go to the maximum setting. If the damper is rotating closed, the "Close" jumpers must be changed. Refer to the Rotation Setup section.
3. Jumper "IN" terminal to the "-" terminal. The red Close LED should illuminate. The shaft drive hub should be rotating the damper closed. The damper should go to full closed unless the minimum limit was set at the CSP, and then the damper will only go to the minimum setting. If the damper is rotating open, the "Close" jumpers must be changed. Refer to Rotation Setup section.



Specifications

Supply Voltage	24 VAC — 15/+20%, 50/60 Hz
Input Power	4 VA max.
Output Supply	16 VDC (22 mA)
Output Torque	50 in. lb. min., 70 in. lb. max. (5.6 N•m min., 7.9 N•m max.)
Velocity Range	0 to 3300 fpm (16.76 m/s), dependent on DP pickup, tubing size/length, and connections
Velocity Output	0 to 10 VDC (0 to 100% flow)
Angular Rotation	0° to 95° (both end stops adjustable)
Stroke Time	18° per minute @ 60 Hz, 15° per minute @ 50 Hz
Reset Voltage	0 to 10 VDC
Reset Limits	Adjustable, 0 to 100%
Mounting	Direct to 1/2" (13 mm) diameter shaft or 3/8" (10 mm) diameter with adaptor
Connections	Wire clamp type, 14 to 22 AWG, Cu
Material	Flame-retardant polymer, UL94-5V plenum-rated, black housing with white cover
Weight	2.4 lbs. (1 kg.)
Temperature Limits	
Operating	32° to 120°F (0° to 49°C)
Shipping	-40° to 140°F (-40° to 60°C)

VNOM (CFM) Range Setting

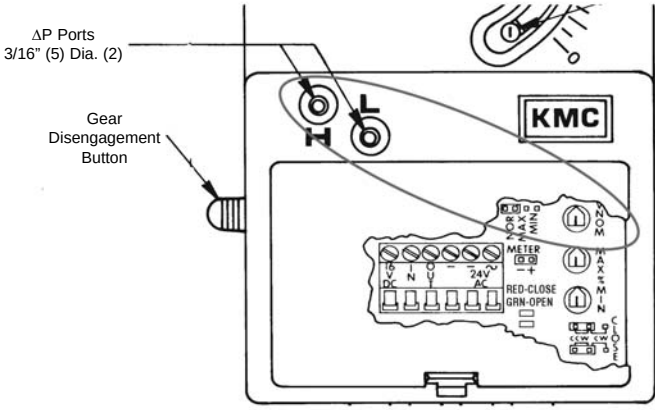
The CSP range is factory-calibrated with the VNOM potentiometer centered. The CSP will have a range of 0-3,300 fpm with a 0-10 volt DC reset control signal.

Leaving the VNOM at the factory setting is recommended! Changing the VNOM potentioment from the factory setting will alter the calibration between the "IN" and "OUT" voltages. However, the VNOM can be adjusted to match 0-10 volts to a specific velocity range if desired.

NOTE: In the controller, VNOM stands for "NOMinal Volumetric flow rate."

To set the VNOM range:

1. Remove the access door by pulling back on the door's tab and lifting upward.
2. Supply the desired velocity to the "H" and "L" ports.
3. Connect a voltmeter between the "OUT" and "-" terminals and adjust the VNOM potentiometer until the voltage equals 10 volts DC.



Maintenance

No routine maintenance is required. Each component is designed for dependable, long-term reliability, and performance. Careful installation will also ensure long-term reliability and performance.

CTE-5100 Series Thermostat Reference

Checkout and Calibration

The thermostat (CTE-5100 series) operates on a 16 volt DC power supply from the CSP controller and outputs a 0-10 volt DC signal on the T(x) terminals.

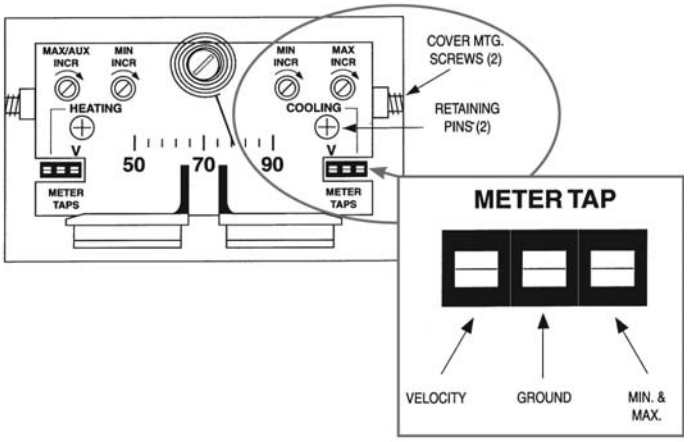
NOTE: **Limits may be set at the CSP or the CTE thermostat. If setting the min./max. limits at the CTE thermostat, the CSP's Min. dial must be set fully CCW to 0 and the Max. dial set fully CW to 100. This will ensure that the CSP will not have any effect on the limits.**

Except with special applications (dual duct, auxiliary reheat CFM, etc.), max. and min. limits are made on the Cooling side of the thermostat.

1. Required tools:
   - 1/16 inch hex key wrench
   - Small flat blade (1/8 inch) screwdriver
   - Digital voltmeter capable of displaying a 0-10 volt DC range which will display in hundredths of a volt
   - HSO-5001 test leads (optional for meter taps)
2. Remove the thermostat cover by loosening the setscrews on each side of the thermostat (see illustration). Using a 1/16 inch hex key wrench, turn the setscrews **clockwise** until the cover is loose.
3. Check voltages:
   A. Verify 16 volts DC between (+) and (-) terminals.
   B. Measure "T(x)" to "-" for output voltages. Use the calibration procedures below to adjust limits if desired. Adjust the setpoint above and below current room temperature and observe changes in appropriate "T" voltage. Remove setpoint slider stops (HFO-0027) if necessary.

NOTE: Always adjust minimum flow limits first.

4. Maximum limits will always be greater than minimum limits. (Maximum is additive to minimum.) If in doubt, turn maximum limit fully clockwise (increase) before proceeding.

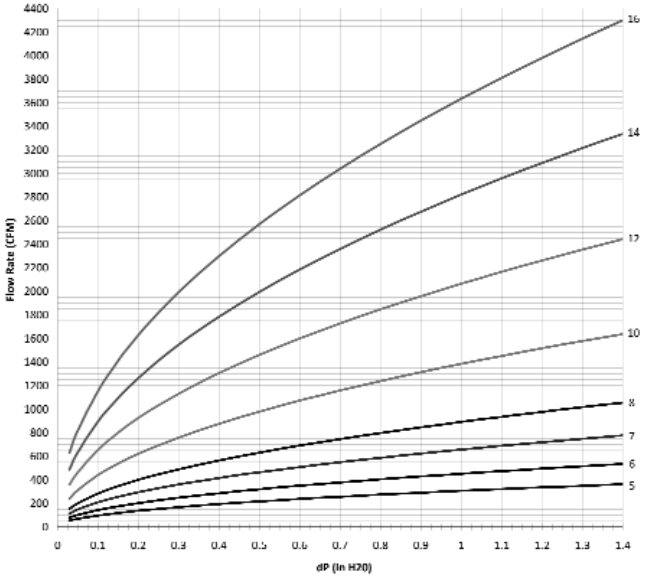


NOTE: Dials rotate approximately 200° (8:00 to 4:00). Turn clockwise to increase or counterclockwise to decrease. Do not use excessive force on dials. They should turn freely and effortlessly. **DO NOT force dial beyond a stop.**

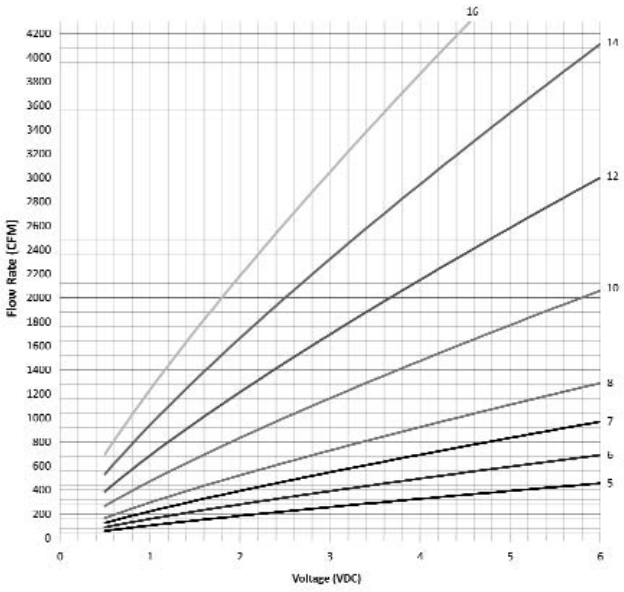
5. Connect voltmeter to the meter taps (using the HSO-5001 test leads adapter makes this easier).
   A. Connect to the middle and right terminal (see illustration) for the minimum and maximum reading.
   B. Connect to the middle and left terminal for measuring actual flow velocity. (The thermostat must be wired to a controller for this option.)
6. Adjust the minimum flow (on the **Cooling side** of thermostat).
   A. Push the cooling setpoint slider all the way to the **right**. (This requests minimum flow, and is normally for heating mode or cooling is satisfied.)
   B. Set the minimum flow voltage as desired using the Min. dial (on the **Cooling side** of thermostat).
7. Adjust the maximum flow (on the **Cooling side** of thermostat).
   A. Push the cooling setpoint slider all the way to the **left**. (This requests maximum flow, and is normally for full cooling mode.)
   B. Set the maximum flow voltage as desired using the Max. dial (on the **Cooling side** of the thermostat).
8. Adjust the cooling setpoint slider back to its original position and replace the cover.

Flow Sensor and Calibration Charts

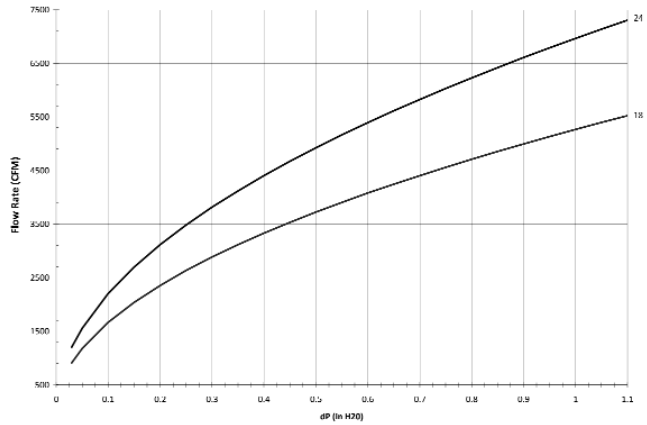
Calibration Chart for use with Models AV, AD, AR, AB and Fan Terminal Models AS and AC



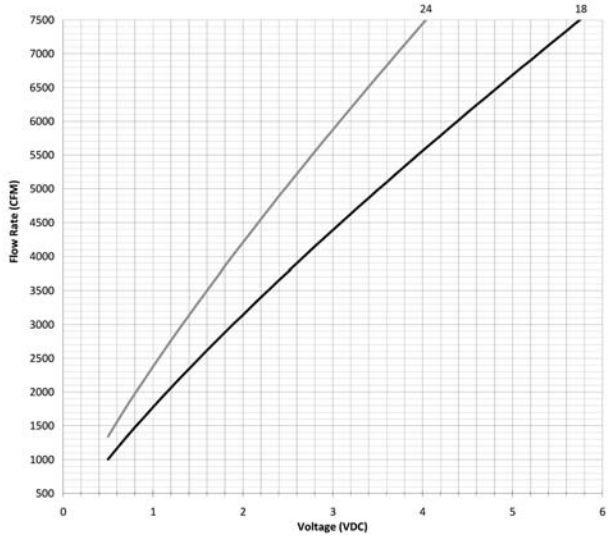
Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.



Calibration Chart for use with Models AV, AD, AR, AB and Fan Terminal Models AS and AC



Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.



Tri-Averaging Flow Sensor

INLET	AREA (sq.ft.)	C_V (Airflow "K")	K_p (Pressure "K")
5	0.130	305	3.2
6	0.188	451	3.0
7	0.258	655	2.7
8	0.338	891	2.5
10	0.532	1383	2.5
12	0.769	2063	2.3
14	1.05	2820	2.3
16	1.37	3633	2.4
16 x 18	1.875	5264	2.0
16 x 24	2.50	6963	2.0

$$\text{Flow (CFM)} = C_V \times \sqrt{\Delta P}$$

$$\Delta P \text{ (inches of } H_2O) = k \times \left[\frac{\text{FPM}}{4005}\right]^2$$

$$\text{FPM} = \frac{\text{CFM}}{\text{Area (ft}^2)}$$

$$CV = \text{CFM} @ 1" \Delta P$$

Standard Sensor - Old Design (Orders Shipped Before 09/09)

INLET	AREA (sq.ft.)	C_V (Airflow "K")	K_p (Pressure "K")
5	0.130	335	2.4
6	0.188	495	2.3
7	0.258	668	2.4
8	0.338	904	2.2
10	0.532	1487	2.1
12	0.769	2170	2.0
14	1.05	2973	2.0
16	1.37	4080	1.8
16 x 18	1.875	5200	2.1
16 x 24	2.50	6475	2.4

$$\text{Flow (CFM)} = C_V \times \sqrt{\Delta P}$$

$$\Delta P \text{ (inches of } H_2O) = k \times \left[\frac{\text{FPM}}{4005}\right]^2$$

$$\text{FPM} = \frac{\text{CFM}}{\text{Area (ft}^2)}$$

CV = CFM @ 1" ΔP

Cross-flow Sensor - Old Design (Orders Shipped Before 09/09)

INLET	AREA (sq.ft.)	C_V (Airflow "K")	K_p (Pressure "K")
5	0.130	323	2.6
6	0.188	474	2.5
7	0.258	690	2.2
8	0.338	950	2.0
10	0.532	1417	2.3
12	0.769	2120	2.1
14	1.05	2908	2.1
16	1.37	3700	2.2
16 x 18	1.875	5450	1.9
16 x 24	2.50	7400	1.8

$$\text{Flow (CFM)} = C_V \times \sqrt{\Delta P}$$

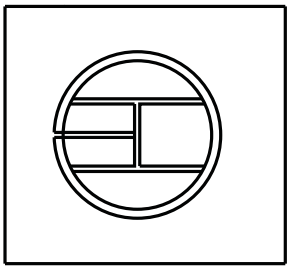
$$\Delta P \text{ (inches of } H_2O) = k \times \left[\frac{\text{FPM}}{4005}\right]^2$$

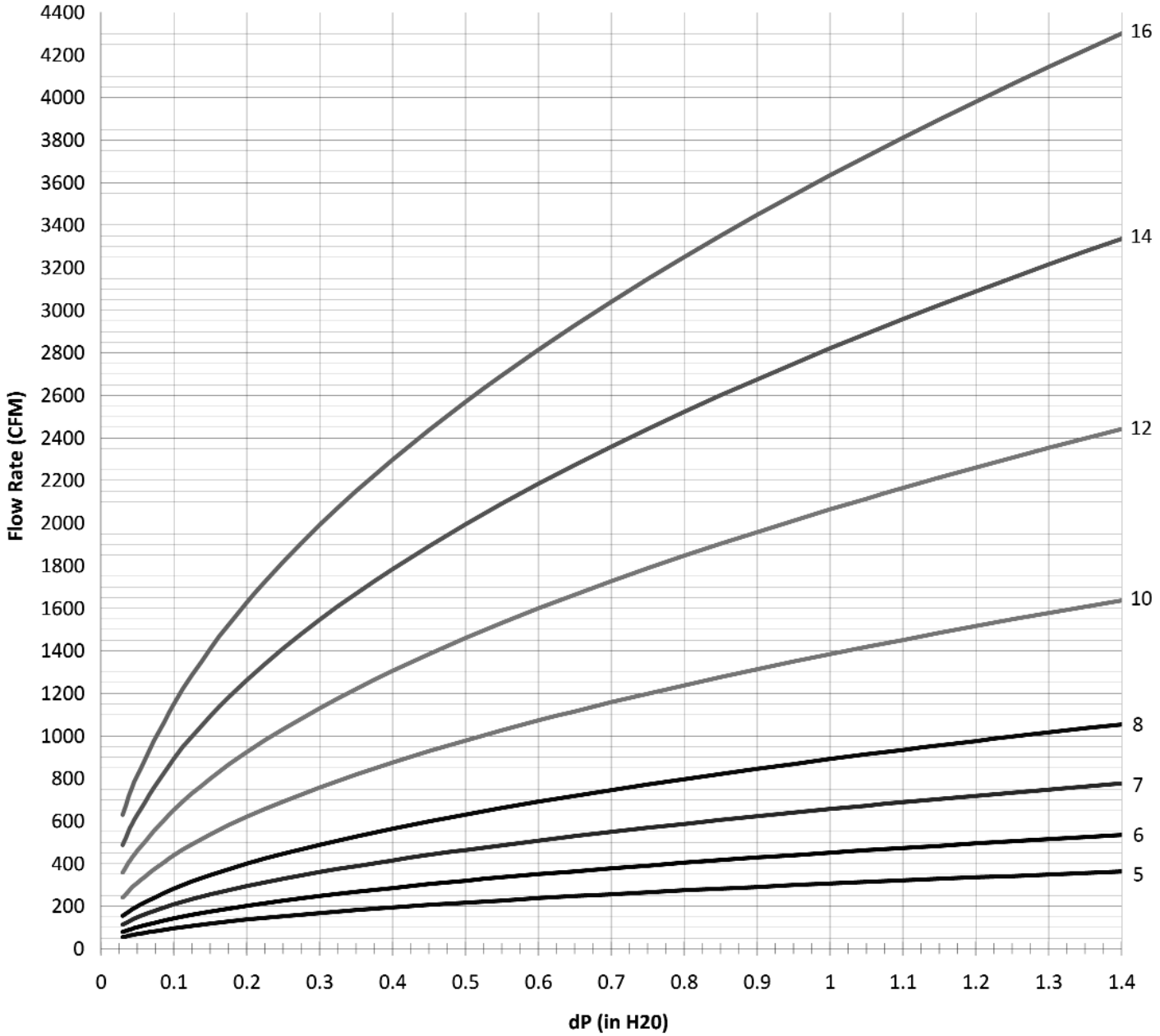
$$\text{FPM} = \frac{\text{CFM}}{\text{Area (ft}^2)}$$

CV = CFM @ 1" ΔP

PNEUMATIC/ELECTRIC CALIBRATION CHART
TRI-AVERAGING FLOW SENSOR (SIZES 5-16)

Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.

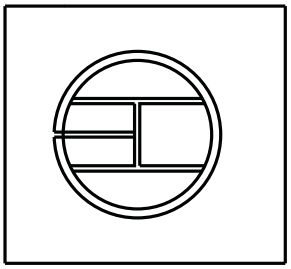


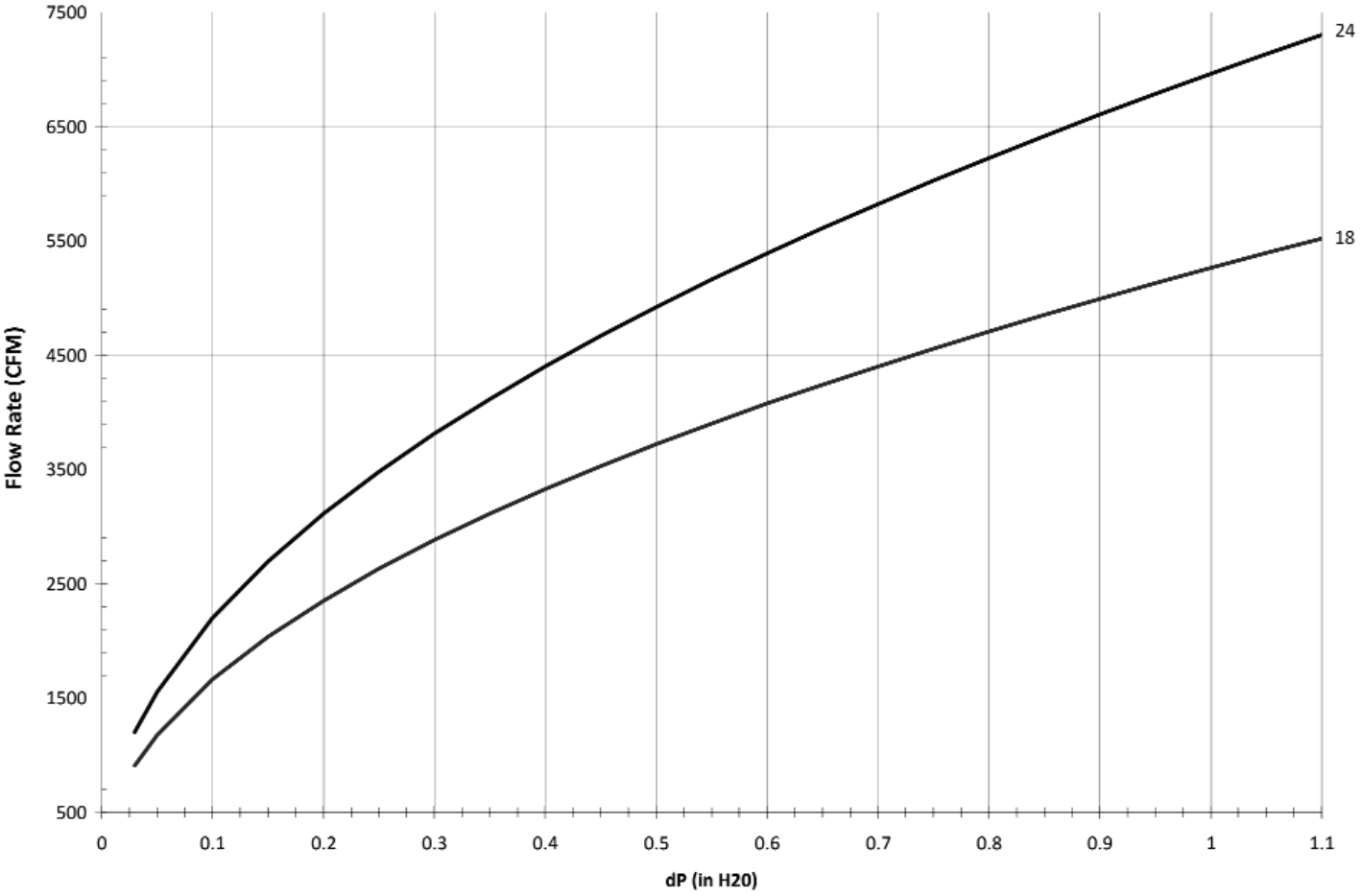


Duct Size	5	6	7	8	10	12	14	16
C_V	305	451	655	891	1383	2063	2820	3633
K	3.2	3.0	2.7	2.5	2.5	2.3	2.3	2.4

PNEUMATIC/ELECTRIC CALIBRATION CHART
TRI-AVERAGING FLOW SENSOR (SIZES 18 & 24)

Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.

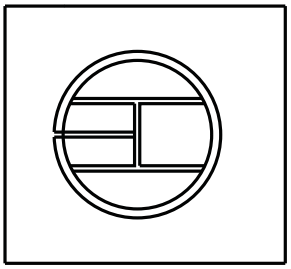


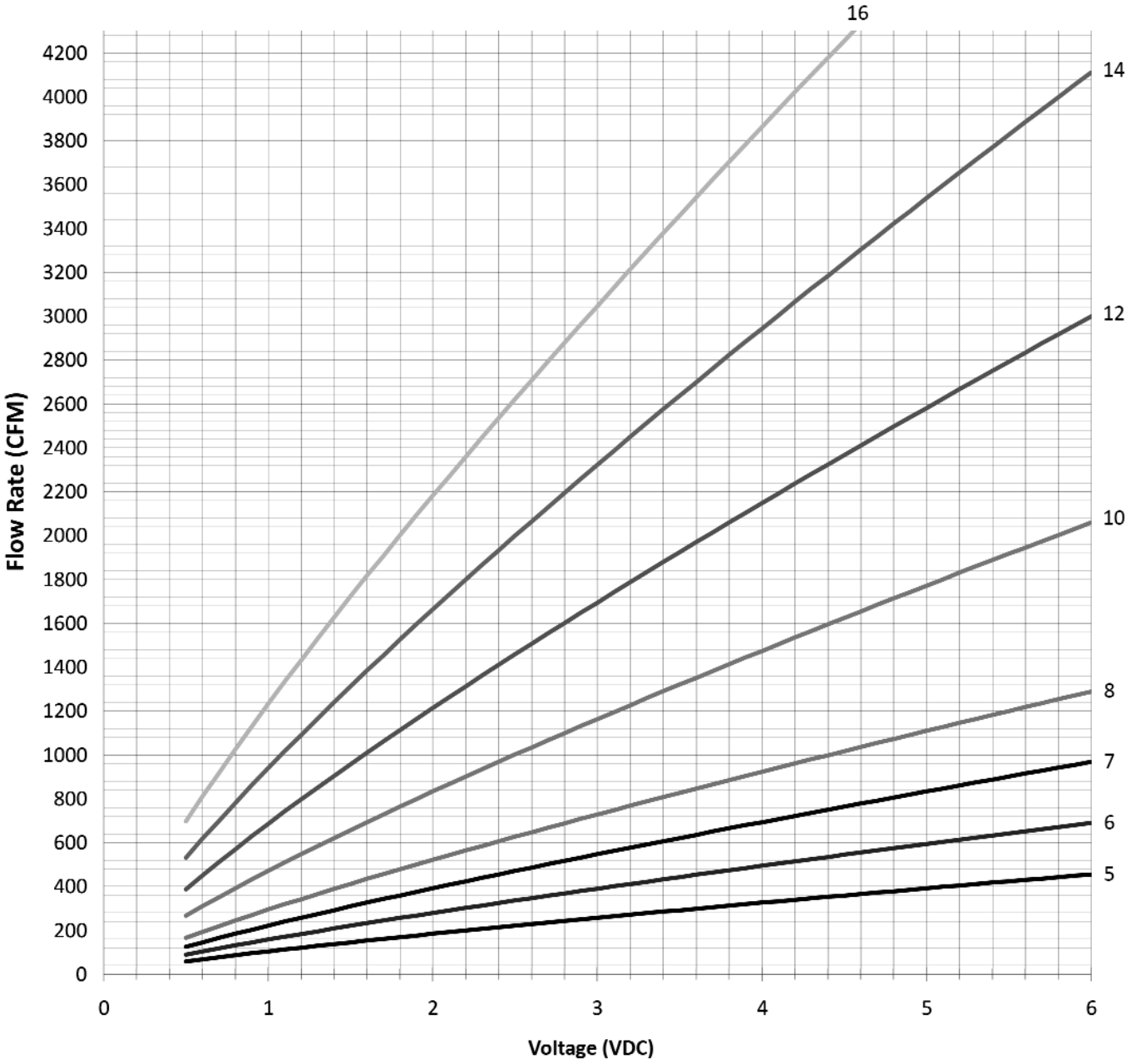


Duct Size	18	24
C_V	5264	6963
K	2.0	2.0

ELECTRONIC CALIBRATION CHART
CARNES (ET) CONTROL OPTION
TRI-AVERAGING FLOW SENSOR (SIZES 5-16)

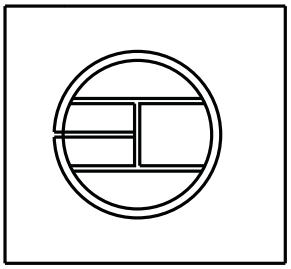
Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.

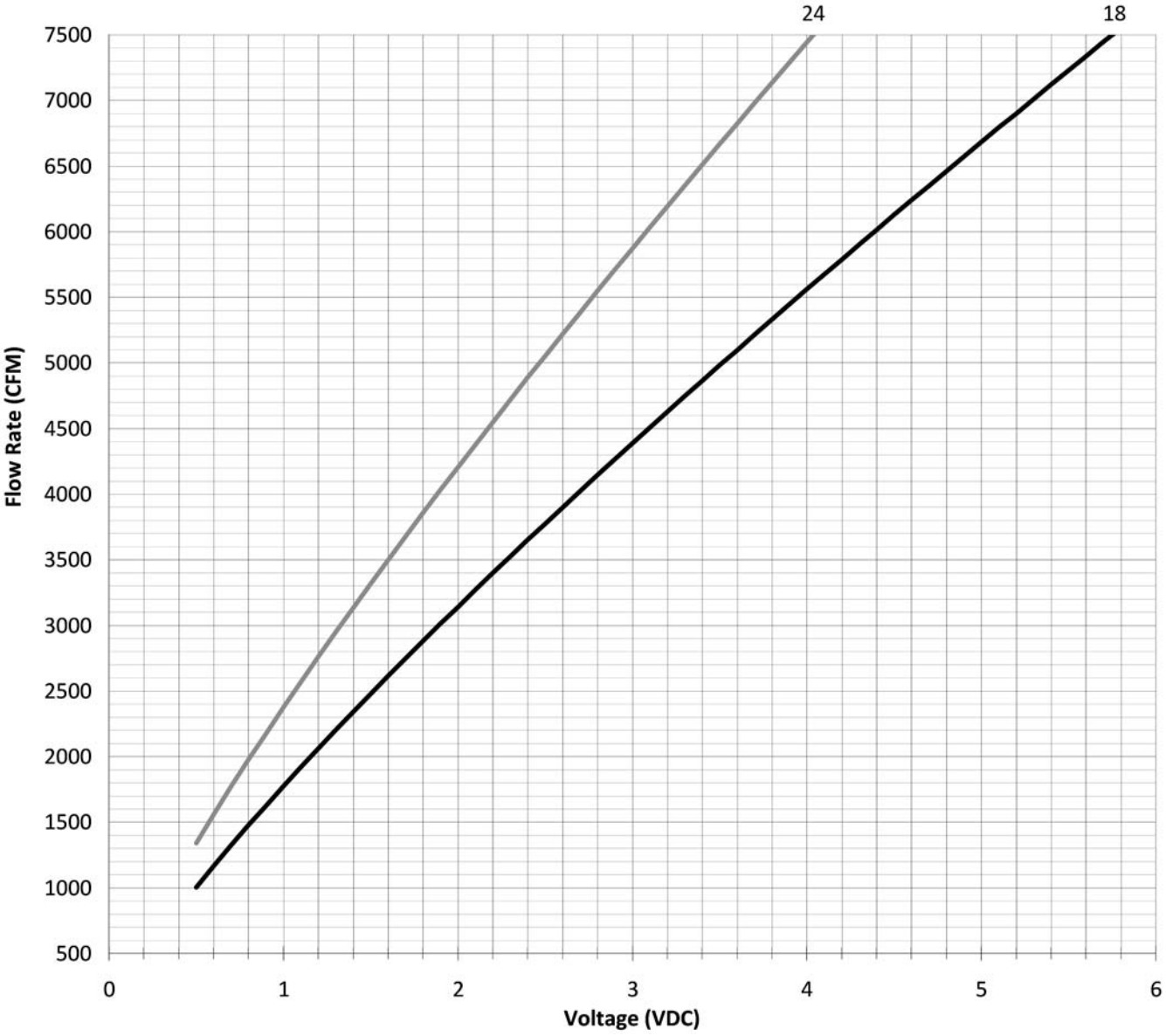




ELECTRONIC CALIBRATION CHART
CARNES (ET) CONTROL OPTION
TRI-AVERAGING FLOW SENSOR (SIZES 18 & 24)

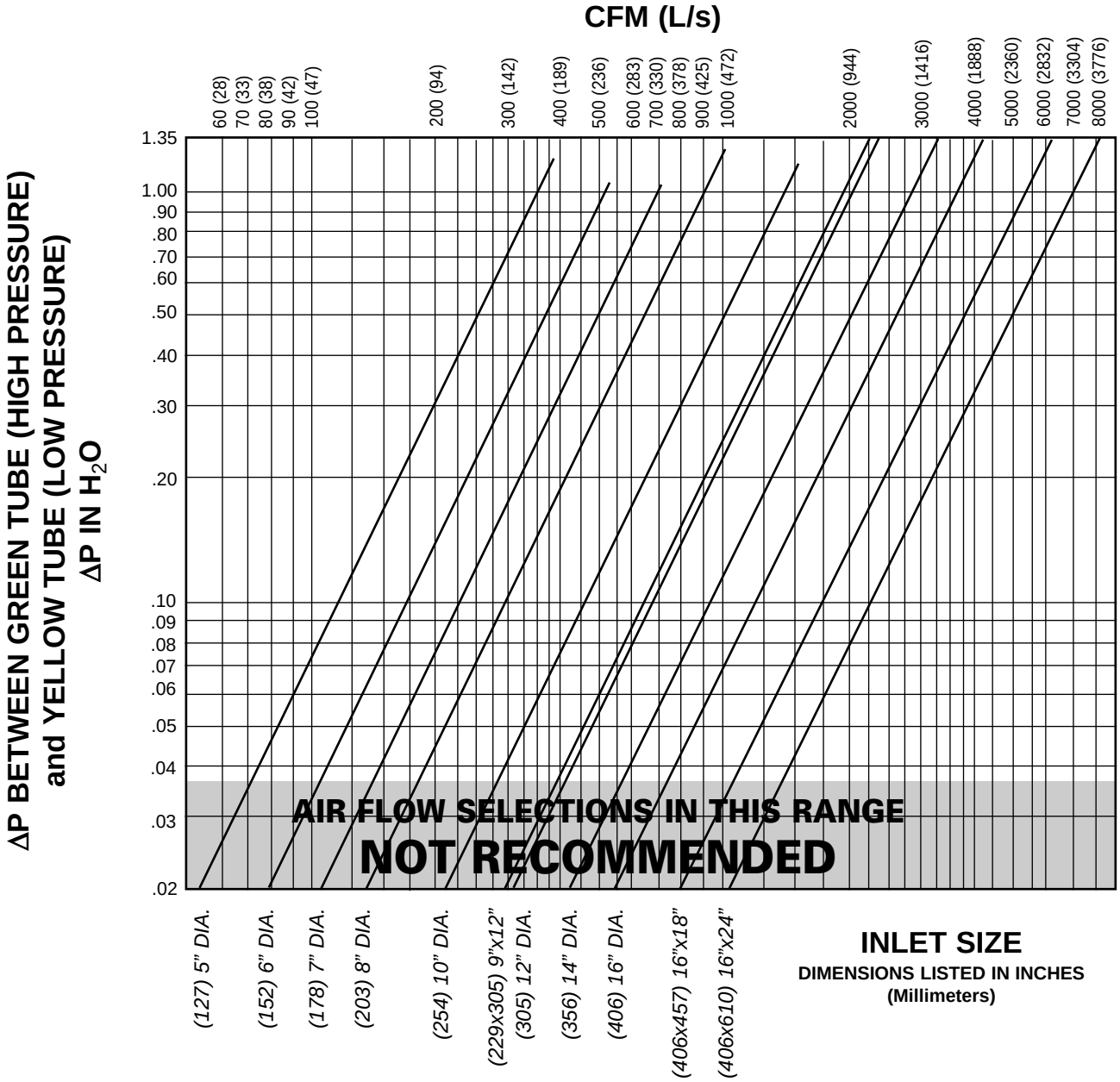
Calibration Chart for use with Models AV, AR, AD, AB and Fan Terminal Models AS and AC.





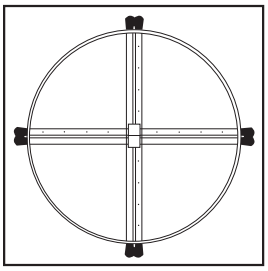
PNEUMATIC/ELECTRIC CALIBRATION CHART
STANDARD INLET SENSOR - Old Design (Orders Shipped Before 09/09)

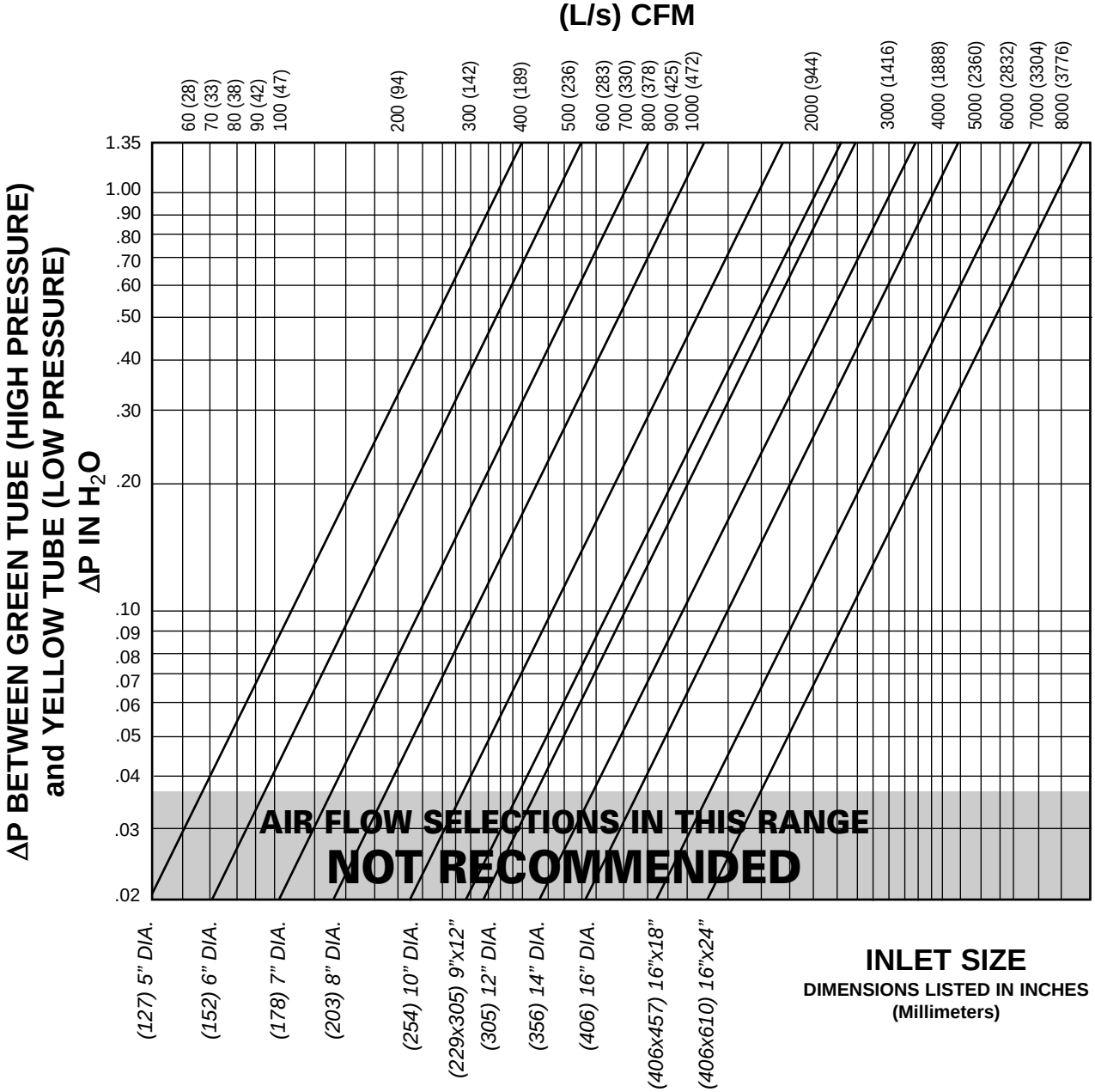
Calibration Chart for use with Models AV, AK, AH, AD, AR, AB and Fan Terminal Models AS and AC



PNEUMATIC/ELECTRIC CALIBRATION CHART
CROSS-FLOW SENSOR - Old Design (Orders Shipped Before 09/09)

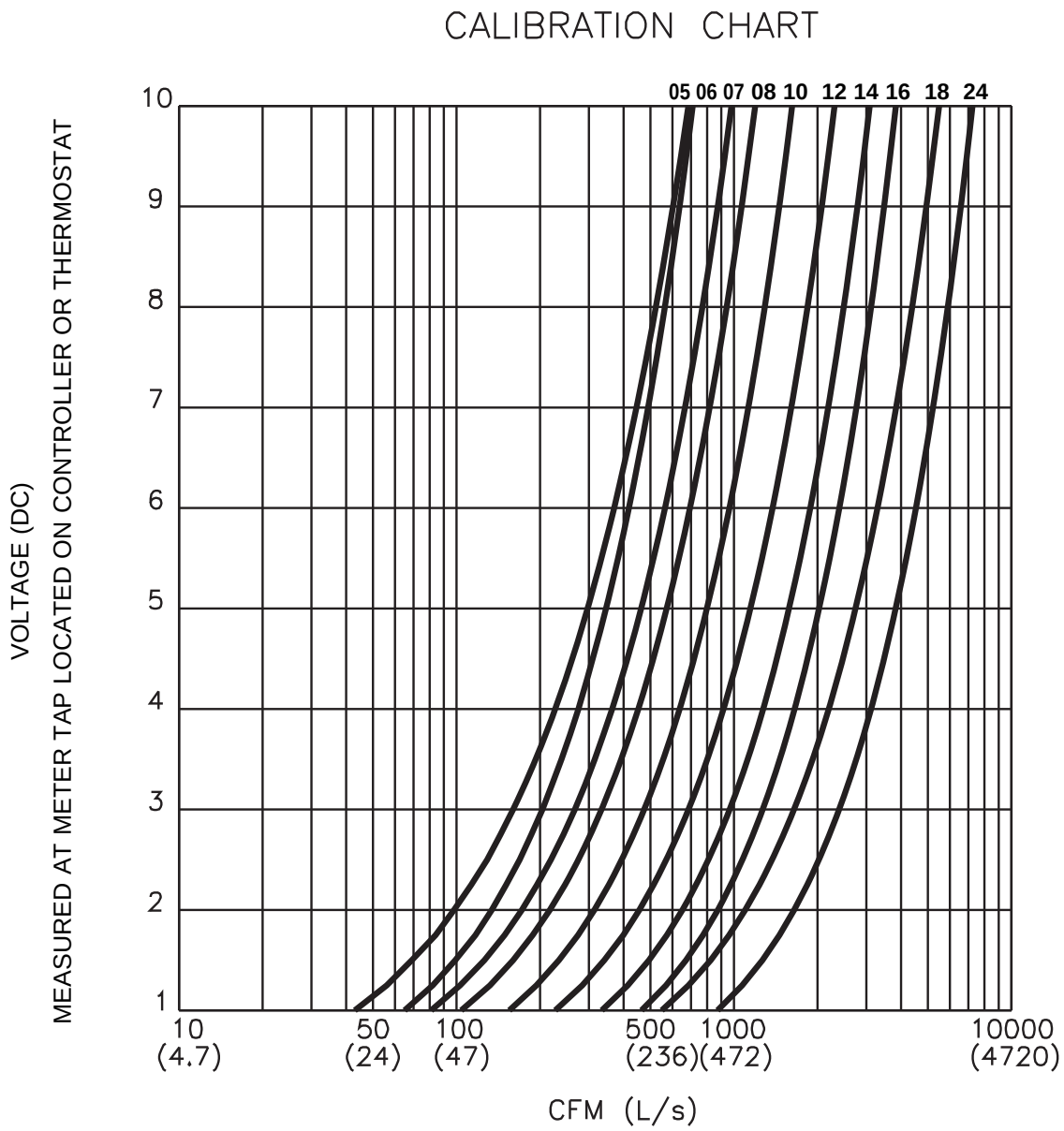
Calibration Chart for use with Models AV, AK, AH, AD, AR, AB and Fan Terminal Models AS and AC





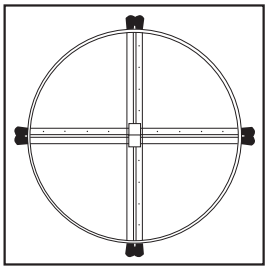
ELECTRONIC CALIBRATION CHART
CARNES (ET) CONTROL OPTION
STANDARD INLET SENSOR - Old Design (Orders Shipped Before 09/09)

Calibration Chart for use with Models AV, AH, AK, AR, AD, AB and Fan Terminal Models AS and AC.

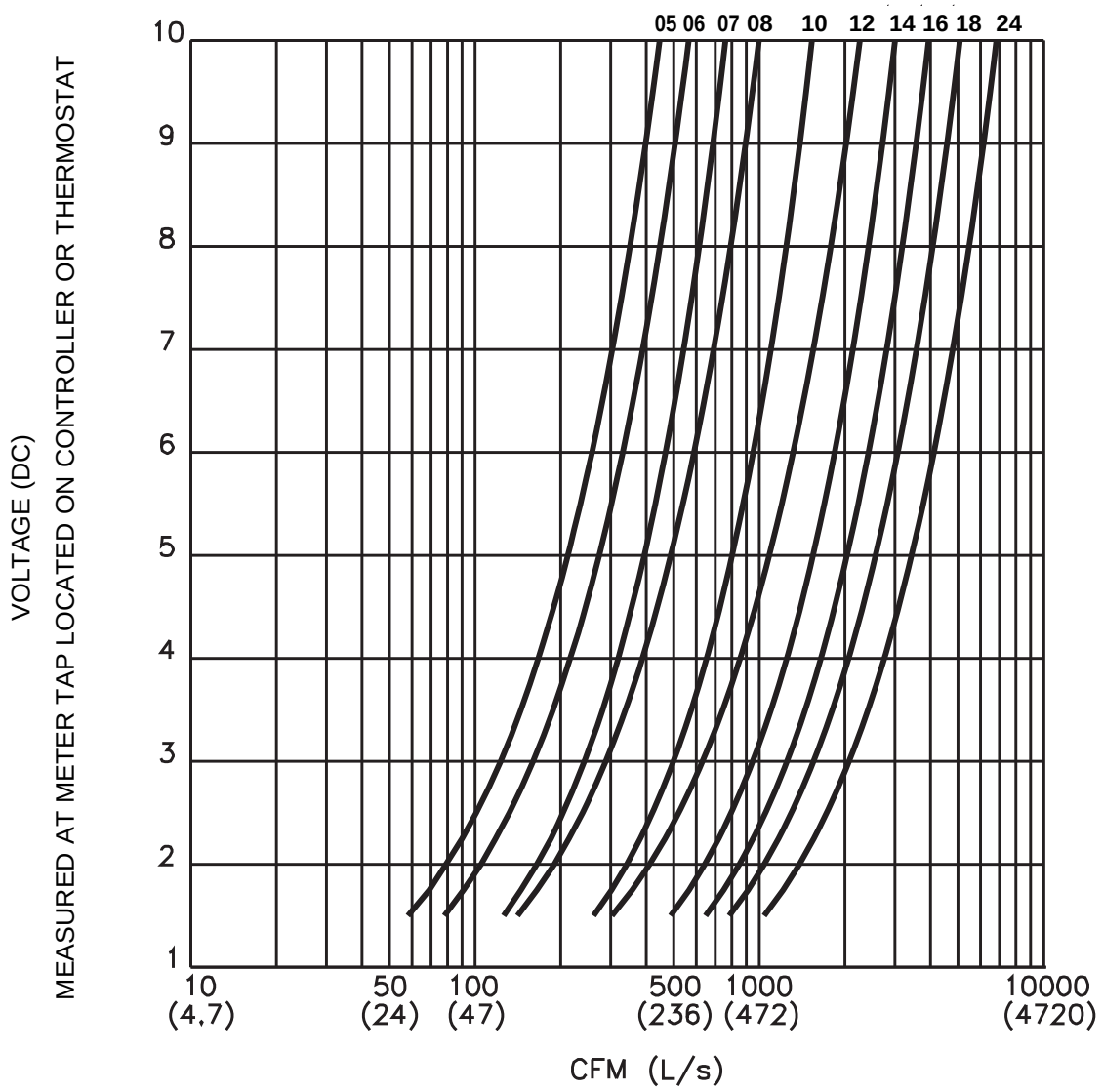


ELECTRONIC CALIBRATION CHART
CARNES (ET) CONTROL OPTION
CROSS-FLOW INLET SENSOR - Old Design (Orders Shipped Before 09/09)

Calibration Chart for use with Models AV, AH, AK, AR, AD, AB and Fan Terminal Models AS and AC.



CALIBRATION CHART



Variable Air Volume Terminal Units Replacement Parts

REPLACEMENT PARTS

PNEUMATIC CONTROL PARTS:

Part Description		*Part Number*	*Ship Status*
RESET CONTROLLER:			
Multifunction reset for CX Control Types	(CSC 3011)	A-999-2827	*STOCK*
Normally Open Type-Beige (8-13 PSI) used for Control Types CE/PE 1, 2, 5, 6 w/normally Open Damper	(CSC 2007)	A-999-2825	*STOCK*
Normally Closed Type-Gray (3-8 PSI) used for Control Types CE/PE 3, 4, 7, 8) w/normally Closed Damper	(CSC 2008)	A-999-2826	*STOCK*
Reversing Relay	(RCC 1112)	A-999-3142	*STOCK*
ACTUATOR:			
8-13 PSI Spring Range (used with all "CE" Control Options) Round Damper Series	(402-3602)	*AXBAG*	*STOCK*
3-8 PSI Spring Range: Round Damper Series	(402-3601)	*AXBAF*	*STOCK*
Pneumatic actuator mounting kit (Indicate normally open or normally closed)		*A-404-5360*	*STOCK*
Diaphragm (Used on Carnes Pneumatic Actuators)		*A-998-4264*	*STOCK*
TUBING:			
Black Plastic (1/4" O. D. x 12")		*A-999-6476*	*STOCK*
Black w/Red Stripe Plastic (1/4" O. D. x 12")		*A-999-6479*	*STOCK*
Green Plastic (3/8" O. D. x 12")		*A-999-6463*	*STOCK*
Yellow Plastic (3/8" O. D. x 12")		*A-999-6464*	*STOCK*
1/4" Pneumatic Tee Connector (Brass or Nylon)		*A-999-6492*	*STOCK*
Black Vinyl Averaging Sensor Cap (.207 I.D.)		*A-999-6505*	*STOCK*
Clear Tubing (1/4" O. D. x 12")		*A-999-6510*	*STOCK*
Brass Union Reducer (1/4" to 3/8")		*A-999-4037*	*STOCK*
Black w/Green Stripe Tubing (3/8" O.D. x 12")		*A-999-6478*	*STOCK*
Black w/Yellow Stripe Tubing (3/8" O.D. x 12")		*A-999-6477*	*STOCK*
Black w/Green Stripe Tubing (1/4" O.D. x 12") (Tri-Averaging Sensor)		*A-999-6461*	*STOCK*
Black w/Yellow Stripe Tubing (1/4" O.D. x 12") (Tri-Averaging Sensor)		*A-999-6462*	*STOCK*

ELECTRIC & ELECTRONIC CONTROL PARTS:

Part Description		*Part Number*	*Ship Status*
MOTOR (Electric Actuator):			
Actuator ("EA", "EB" Control Options)	(404-6701)	*AXBAA*	*STOCK*
Actuator w/1 End Switch ("ER" Control Option) - (Cam not included)	(404-6702)	*AXBAB*	*STOCK*
Actuator w/2 End Switches ("EK" Control Option) - (Cams not included)	(404-6703)	*AXBAC*	*STOCK*
Cam for use with above actuators (one per end switch required) (Cam Set Screw not included)		*A-998-8045*	*STOCK*
Cam Set Screw (one per cam required)		*A-999-1292*	*STOCK*
End Switch (used on Carnes Electric Actuators)		*A-999-7315*	*STOCK*
Electric Actuator (motor only) - Black base actuators only (NOT for silver base types)		*A-998-6094*	*STOCK*
TRANSFORMER:			
120 or 277 Primary, 24 Secondary (40 VA)	(999-9459)	*AXBAP*	*STOCK*
208 or 240 Primary, 24 Secondary (40 VA)	(999-9460)	*AXBAT*	*STOCK*
ELECTRONIC RESET CONTROLLER:			
Controller/Actuator (ET Option) - (Reducing bushing not included)	(CSP-5001)	*A-999-2661*	*STOCK*
Electronic Thermostat (ET Option)	(999-2662/CTE-5101-10)	*AXWCA*	*STOCK*
Electronic Thermostat (ET Option)	(999-2663/CTE-5103-10)	*AXWCB*	*STOCK*
Electronic Thermostat (ET Option)	(999-2664/CTE-5104-10)	AXWCC	*NS*
Electronic Relay Module (3-Stage Reheat)	(REE-5001)	*A-999-2671*	*STOCK*
Electronic Relay Module (Fan with 2-Stage Reheat)	(REE-5002)	*A-999-2672*	*STOCK*
Electronic Relay Module (HTG/CLG Change-Over)	(REE-1005)	*A-999-2665*	*NS*
Temperature Sensor (Used with HTG/CLG Change-Over)	(STE-1002)	*A-999-2668*	*NS*
Reducer Bushing—1/2" to 3/8" used with CSP-5001	(HFO-0011)	*A-999-2670*	*STOCK*
MISCELLANEOUS:			
Model AXWBE Electric Thermostat (for use with EA, EB, ER, EK Controls) (4 Wire)	(999-2844)	AXWBE	*STOCK*
Change-Over Thermostat (Component required as part of "EB" Control Option)	(998-1271)	AXBAJ	*NS*

TRI-AVERAGING FLOW SENSOR

Part Description	*Part Number*	*Ship Status*
Sensor Only (Size 5)	*A-998-2821*	*STOCK*
Sensor Only (Size 6)	*A-998-2822*	*STOCK*
Sensor Only (Size 7)	*A-998-2823*	*STOCK*
Sensor Only (Size 8)	*A-998-2824*	*STOCK*
Sensor Only (Size 10)	*A-998-2826*	*STOCK*
Sensor Only (Size 12)	*A-998-2828*	*STOCK*
Sensor Only (Size 14)	*A-998-2830*	*STOCK*
Sensor Only (Size 16)	*A-998-2831*	*STOCK*
Sensor Only (Size 18)	*A-998-2831*	*STOCK*
Sensor Only (Size 24)	*A-998-2831*	*STOCK*

NS = NON-STOCK

FAN TERMINAL UNIT PARTS: ("J" Standard Design Series)

Part Description	*Part Number*	*Ship Status*
CAPACITOR RELAY:		
24 Volt Coil (ACFJ/ACWJ)	*A-999-9958*	*STOCK*
24 Volt Coil (ACEJ)	*A-999-7389*	*STOCK*
AIR FLOW SWITCH	*A-999-9461*	*STOCK*
P/E SWITCH	*A-999-9952*	*STOCK*
DISCONNECT SWITCH 120/277V 20 AMP (Non-Fused)	*A-999-7323*	*STOCK*
DISCONNECT SWITCH 120V 10 AMP (Fused)	*A-999-7477*	*NS*
DISCONNECT SWITCH 120V 20 AMP (Fused)	*A-999-7479*	*NS*
DISCONNECT SWITCH 277V 10 AMP (Fused)	*A-999-7478*	*NS*

PSC FAN MOTORS

UNIT TYPE	FAN SIZE	HP	MOTORS(s) 120V/208V/240V *(Part Number)*	MOTORS(s) 277V *(Part Number)*	*Ship Status*
AC_J	B, C	1/6	*A-992-3010*	*A-992-3016*	*STOCK*
	D	1/4	*A-992-3011*	*A-992-3385*	*STOCK*
	E	1/2	*A-992-3012*	*A-992-3088*	*STOCK*
	F	3/4	*A-992-3013*	*A-992-3019*	*STOCK*
	G	1	*A-992-3014*	*A-992-3020*	*STOCK*
	J	3/4 (2)	*A-992-3013*	*A-992-3019*	*STOCK*

FAN BLOWER & WHEEL (Sold Complete Only) - PSC

UNIT TYPE	FAN SIZE	BLOWERS *(Part Number)*	*Ship Status*
AC_J	B	*A-999-2568*	*STOCK*
	C	*A-999-2563*	*STOCK*
	D, E	*A-999-2570*	*STOCK*
	F	*A-999-2573*	*STOCK*
	G	*A-999-2562*	*STOCK*
	J	*A-999-2573 (2)*	*STOCK*

ECM FAN MOTORS

UNIT TYPE	FAN SIZE	HP	MOTORS(s) 120V/240V *(Part Number)*	MOTORS(s) 277V *(Part Number)*	*Ship Status*
AC_J	B - D	1/3	*A-992-2994*	*A-992-2992*	*NS*
	E, F	1	*A-992-2993*	*A-992-2991*	*NS*
	H	(2) 1	*A-992-2993*	*A-992-2991*	*NS*
	J	(2) 1	*A-992-2993*	*A-992-2991*	*NS*

FAN BLOWER & WHEEL (Sold Complete Only) - ECM

UNIT TYPE	FAN SIZE	BLOWERS *(Part Number)*	*Ship Status*
AC_J	B	*A-999-2568*	*STOCK*
	C	*A-999-2563*	*STOCK*
	D	*A-999-2570*	*STOCK*
	E, F	*A-999-2573*	*STOCK*
	H	*A-999-2573 (2)*	*STOCK*
	J	*A-999-2573 (2)*	*STOCK*

SECONDARY INLET FILTER ("J" Design Series)

UNIT TYPE	FAN SIZE Disposable (Class II)	*(Part Number)*	*Ship Status*
AC_J	B, C	*A-999-8988*	*STOCK*
	D	*A-999-9004*	*STOCK*
	E	*A-999-9006*	*STOCK*
	F	*A-999-9008*	*STOCK*
	G	*A-999-9010*	*STOCK*
	H	*A-999-9012*	*STOCK*
	J	*A-999-9012*	*STOCK*
	FAN SIZE Reusable (Class I)	*(Part Number)*	*Ship Status*
	B, C	*A-999-8986*	*NS*
	D	*A-999-9005*	*NS*
	E	*A-999-9007*	*NS*
	F	*A-999-9009*	*NS*
	G	*A-999-9011*	*NS*
	H	*A-999-9019*	*NS*
	J	*A-999-9019*	*NS*

CAPACITORS - PSC

UNIT	FAN	CAPACITORS		
		120V/208V/240V	277V	
TYPE	SIZE	*(Part Number)*	*(Part Number)*	*Ship Status*
AC_J	B, C	*A-999-6286*	*A-999-6286*	*STOCK*
	D	*A-999-6313*	*A-999-6313*	*STOCK*
	E	*A-999-6283*	*A-999-6283*	*STOCK*
	F	*A-999-6291*	*A-999-6292*	*STOCK*
	G	*A-999-6293*	*A-999-6293*	*STOCK*

SPEED DIALS - PSC

UNIT TYPE	FAN SIZE	MOTORS(s)			
		120V *(Part Number)*	**208V/240V** *(Part Number)*	**277V** *(Part Number)*	*Ship Status*
AC_J	B, C	*A-999-6661*	*A-999-6666*	*A-999-6664*	*STOCK*
	D	*A-999-6661*	*A-999-6666*	*A-999-6664*	*STOCK*
	E	*A-999-6662*	*A-999-6666*	*A-999-6664*	*STOCK*
	F	*A-999-6663*	*A-999-6667*	*A-999-6665*	*STOCK*
	G	NA	*A-999-6667*	*A-999-6665*	*STOCK*
	J	*A-999-6663 (2)*	*A-999-6667 (2)*	*A-999-6665 (2)*	*STOCK*

FAN TERMINAL UNIT PARTS ("Q" Design Series)

FAN MOTORS

UNIT TYPE	FAN SIZE	HP	MOTORS		
			120V *(Part Number)*	**277V** *(Part Number)*	***Ship Status***
AC	A,B,C	1/6	*A-992-3368*	*A-992-3372*	*NS*
	D	1/4	*A-992-3370*	*A-992-3374*	*NS*
	E	1/2	*A-992-3376*	*A-992-3377*	*NS*
	F	3/4	*A-992-3366*	*A-992-3367*	*NS*

NS = NON-STOCK

FAN BLOWER & WHEEL (Sold Complete Only) ("Q" Design Series)

UNIT TYPE	FAN SIZE	BLOWERS	
		Part Number	***Ship Status***
AC	A,B,C	*A-999-2568*	*STOCK*
	D	*A-999-2570*	*STOCK*
	E	*A-999-2567*	*STOCK*
	F	*A-999-2588*	*STOCK*

SECONDARY INLET FILTER ("Q" Design Series)

UNIT TYPE	FAN SIZE Disposable (Class II)	*(Part Number)*	*Ship Status*
AC	A - D	*A-999-8966*	*NS*
	E	*A-999-8972*	*NS*
	F	*A-999-8973*	*NS*
	FAN SIZE Reusable (Class I)	*(Part Number)*	*Ship Status*
	A - D	*A-999-8963*	*NS*
	E	*A-999-8970*	*NS*
	F	*A-999-8971*	*NS*

FAN TERMINAL UNIT PARTS: ("H" Standard Design Series)

Part Description	*Part Number*	*Ship Status*
CAPACITOR:		
5.0 MFD 1/6 HP	*A-999-6286*	*STOCK*
7.5 MFD 1/4 HP	*A-999-6313*	*STOCK*
10.0 MFD 1/2 HP	*A-999-6283*	*STOCK*
CONTACTOR RELAY:		
24 Volt Coil	*A-999-9958*	*STOCK*
AIR FLOW SWITCH	*A-999-9461*	*STOCK*
P/E SWITCH	*A-999-9952*	*STOCK*
DISCONNECT SWITCH 120/277V 20 AMP (Non-Fused)	*A-999-7323*	*STOCK*
DISCONNECT SWITCH 120V 10 AMP (Fused)	*A-999-7477*	*NS*
DISCONNECT SWITCH 120V 20 AMP (Fused)	*A-999-7479*	*NS*
DISCONNECT SWITCH 277V 10 AMP (Fused)	*A-999-7478*	*NS*
SPEED CONTROL:		
120V 5AMP — For Fan Sizes A, B, C, D, E	*A-999-6661*	*STOCK*
277V 5AMP — For Fan Sizes A, B, C, D, E, F	*A-999-6664*	*STOCK*
120V 10AMP — For Fan Sizes F, G, H	*A-999-6662*	*STOCK*
277V 10AMP — For Fan Sizes G, H	*A-999-6665*	*STOCK*

NS = NON-STOCK

FAN TERMINAL UNIT PARTS ("H" Standard Design Series)

FAN MOTORS

UNIT TYPE	FAN SIZE	HP	MOTORS(s)		
			120V *(Part Number)*	**277V** *(Part Number)*	*Ship Status*
AC/AS	**A, B, C**	1/6	*A-992-3368*	*A-992-3372*	*NS*
	D	1/4	*A-992-3384*	*A-992-3385*	*NS*
	E	1/4	*A-992-3382*	*A-992-3383*	*NS*
	F	1/2	*A-992-3386*	*A-992-3388*	*NS*
AC	**G**	1/2 (2)	*A-992-3376*	*A-992-3377*	*NS*
	H	1/2 (2)	*A-992-3376*	*A-992-3377*	*NS*

FAN BLOWER & WHEEL (Sold Complete Only) ("H" Standard Design Series)

UNIT TYPE	FAN SIZE	BLOWERS	
		(Part Number)	*Ship Status*
AC/AS	**A, B, C**	*A-999-2568*	*STOCK*
	D	*A-999-2570*	*STOCK*
	E	*A-999-2567*	*NS*
	F	*A-999-2573*	*STOCK*
AC	**G**	*A-999-2567 (2)*	*NS*
	H	*A-999-2573 (2)*	*STOCK*

SECONDARY INLET FILTER ("H" Standard Design Series)

AC_H	**AS_H**		
Disposable (Class II)	Disposable (Class II)	*(Part Number)*	*Ship Status*
5A-8D	---	*A-999-8916*	*NS*
10E, 12F	---	*A-999-8972*	*NS*
14G, 16H	---	*A-999-8968*	*NS*
---	**5A-7C**	*A-999-8988*	*NS*
---	**8B-10C**	*A-999-8988*	*NS*
---	**10D-16F**	*A-999-8989*	*NS*
Reusable (Class I)	Reusable (Class I)	*(Part Number)*	*Ship Status*
5A-8D	---	*A-999-8930*	*NS*
10E, 12F	---	*A-999-8970*	*NS*
14G, 16H	---	*A-999-8965*	*NS*
---	**5A-7C**	*A-999-8986*	*NS*
---	**8B-10C**	*A-999-8986*	*NS*
---	**10D-16F**	*A-999-8987*	*NS*

FAN TERMINAL UNIT PARTS: "H" Standard Design Series (Low Profile/Underfloor)

FAN MOTORS

UNIT TYPE	UNIT SIZE LOW PROFILE	UNIT SIZE UNDERFLOOR	HP	MOTORS		
				120V *(Part Number)*	**277V** *(Part Number)*	***Ship Status***
AC/AS	L1A,L2A,L2B, L3A,L3B,L3C,L4C	U1-U3 (05-07)	1/6	*A-992-3001*	*A-992-3002*	*STOCK*
	L4D,L5D,L6D	U4 (08)	1/4	*A-992-3003*	*A-992-3004*	*STOCK*
	L6E	U5 (10)	1/2	*A-992-3005*	*A-992-3006*	*STOCK*

FAN BLOWER & WHEEL (Sold Complete Only) ("H" Standard Design Series) (Low Profile/Underfloor)

UNIT TYPE	UNIT SIZE LOW PROFILE	UNIT SIZE UNDERFLOOR	BLOWERS	
			(Part Number)	*Ship Status*
AC/AS	L1A,L2A,L2B, L3A,L3B,L3C,L4C	U1-U3 (05-07)	*A-999-2564*	*STOCK*
	L4D,L5D,L6D	U4 (08)	*A-999-2580*	*STOCK*
	L6E	U5 (10)	*A-999-2566*	*STOCK*

SECONDARY INLET FILTER ("H" Standard Design Series) (Low Profile/Underfloor)

UNIT TYPE	UNIT SIZE LOW PROFILE	UNIT SIZE UNDERFLOOR		
	Disposable (Class II)	Disposable (Class II)	*(Part Number)*	*Ship Status*
AC/AS	L1A,L2A,L2B, L3A,L3B,L3C, L4C,L4D	U1A - U4D	*A-999-8976*	*NS*
	---	U5E	*A-999-8977*	*NS*
	L5D	---	*A-999-8997*	*NS*
	L6D,L6E	---	*A-999-8999*	*NS*
	Reusable (Class I)	Reusable (Class I)	*(Part Number)*	*Ship Status*
	L1A,L2A,L2B, L3A,L3B,L3C, L4C,L4D	U1A - U4D	*A-999-8974*	*NS*
	---	U5E	*A-999-8975*	*NS*
	L5D	---	*A-999-8998*	*NS*
	L6D,L6E	---	*A-999-9000*	*NS*

ECM FAN TERMINAL UNIT PARTS

ECM FAN MOTORS "H" Design Series

UNIT TYPE	UNIT SIZE	HP	MOTORS		
			120V/220V/240V *(Part Number)*	**277V** *(Part Number)*	***Ship Status***
AC	B - D	1/3	*A-992-2994*	*A-992-2992*	*NS*
	E, F	1	*A-992-2993*	*A-992-2991*	*NS*

NOTE: Specify size and voltage on order.

ECM FAN BLOWER & WHEEL (Sold Complete Only) "H" Design Series

UNIT TYPE	UNIT SIZE	BLOWERS	
		Part Number	***Ship Status***
AC	B - D	*A-999-2570*	*STOCK*
	E, F	*A-999-2573*	*STOCK*

ECM MOTOR PARTS

PART DESCRIPTION	*Part Number*	***Ship Status***
Power Cable	A-999-5221	*STOCK*
Control Cable	A-999-5222	*STOCK*
VCU Speed Control (24 volt on/off)	A-999-5223	*STOCK*
ACU + Speed Control (0-10vdc for digital controls)	A-999-5224	*STOCK*
2 pole Terminal Block	A-999-8015	*STOCK*
Belly Band Belt	A-999-5241	*STOCK*
Belly Band Leg (Fan Sizes B – D) (3 per belt)	A-999-5242	*STOCK*
Belly Band Leg (Fan Sizes E – J) (3 per belt)	A-999-5243	*STOCK*

FAN TERMINAL UNIT PARTS: ("G" Design Series)

Part Description	*Part Number*	*Ship Status*
CAPACITOR:		
7.5 MFD 1/6 HP and 1/4 HP	*A-999-6313*	*STOCK*
10.0 MFD 1/2 HP	*A-999-6283*	*STOCK*
CONTACTOR RELAY:		
24 Volt Coil	*A-999-9958*	*STOCK*
AIR FLOW SWITCH	*A-999-9461*	*STOCK*
P/E SWITCH	*A-999-9952*	*STOCK*
DISCONNECT SWITCH 120/277V 20 AMP (Non-Fused)	*A-999-7323*	*STOCK*
DISCONNECT SWITCH 120V 10 AMP (Fused)	*A-999-7477*	*NS*
DISCONNECT SWITCH 120V 20 AMP (Fused)	*A-999-7479*	*NS*
DISCONNECT SWITCH 277V 10 AMP (Fused)	*A-999-7478*	*NS*
SPEED CONTROL:		
120V 5AMP — For Fan Sizes A, B, C, D	*A-999-6661*	*STOCK*
277V 5AMP — For Fan Sizes A, B, C, D, E, F	*A-999-6664*	*STOCK*
120V 10AMP — For Fan Sizes E, F, G, H	*A-999-6662*	*STOCK*
277V 10AMP — For Fan Sizes G, H	*A-999-6665*	*STOCK*

NS = NON-STOCK

FAN TERMINAL UNIT PARTS ("G" Design Series)

FAN MOTORS

UNIT TYPE	FAN SIZE	HP	MOTORS(s)		
			120V *(Part Number)*	**277V** *(Part Number)*	*Ship Status*
AC/AS	**A, B, C**	1/6	*A-992-3368*	*A-992-3372*	*NS*
	D	1/4	*A-992-3370*	*A-992-3374*	*NS*
	E	1/2	*A-992-3376*	*A-992-3377*	*NS*
	F	1/2	*A-992-3376*	*A-992-3377*	*NS*
AC	**G**	1/2 (2)	*A-992-3376*	*A-992-3377*	*NS*
	H	1/2 (2)	*A-992-3376*	*A-992-3377*	*NS*

FAN BLOWER & WHEEL (Sold Complete Only) ("G" Design Series)

UNIT TYPE	FAN SIZE	BLOWERS	
		(Part Number)	*Ship Status*
AC/AS	**A, B, C**	*A-999-2568*	*STOCK*
	D	*A-999-2570*	*STOCK*
	E	*A-999-2567*	*NS*
	F	*A-999-2573*	*STOCK*
AC	**G**	*A-999-2567 (2)*	*NS*
	H	*A-999-2573 (2)*	*STOCK*

SECONDARY INLET FILTER ("G" Design Series)

UNIT TYPE	FAN SIZE Disposable (Class II)	*(Part Number)*	*Ship Status*
AC/AS	**A-D**	*A-999-8966*	*NS*
	E, F	*A-999-8967*	*NS*
	G, H	*A-999-8968*	*NS*
	FAN SIZE Reusable (Class I)		
	A-D	*A-999-8963*	*NS*
	E, F	*A-999-8964*	*NS*
	G, H	*A-999-8965*	*NS*

FAN TERMINAL UNIT PARTS: (Older Design 1987-1999)

Part Description	*Part Number*	*Ship Status*
CAPACITOR:		
7.5 MFD 1/4 HP and 1/2 HP (Marathon)	*A-999-6313*	*STOCK*
5.0 MFD 1/6 HP and 1/5 HP (Marathon)	*A-999-6286*	*STOCK*
CONTACTOR RELAY:		
24 Volt Coil	*A-999-9958*	*STOCK*
AIR FLOW SWITCH	*A-999-9461*	*STOCK*
P/E SWITCH	*A-999-9952*	*STOCK*
DISCONNECT SWITCH (Non-Fused)	*A-999-7323*	*STOCK*

FAN MOTORS (Older Design 1987-1999)

UNIT MODEL/SIZE				**MOTORS(s)**		
AS__D/AS__E	**AT__D/AT__E**	**AC__B/AC__C**	**HP**	**120V** *(Part Number)*	**277V** *(Part Number)*	*Ship Status*
06/07/L1/L3	**08/10**	**06/07/L1/L3**	1/6	*A-992-3368*	*A-992-3372*	*NS*
08	**12**	**08**	1/5	*A-992-3369*	*A-992-3373*	*OBS*
10/L2/L4	**14**	**10/L2/L4**	1/4	*A-992-3370*	*A-992-3374*	*NS*
12	**16**	**12**	1/2	*A-992-3371*	*A-992-3375*	*NS*
14	**18**	**14**	1/4 (2)	*A-992-3370*	*A-992-3374*	*NS*
16	**24**	**16**	1/2 (2)	*A-992-3371*	*A-992-3375*	*NS*

NS = NON-STOCK

FAN BLOWER & WHEEL (Sold Complete Only) (Older Design 1987-1999)

UNIT MODEL/SIZE				
AS__D/AS__E	**AT__D/AT__E**	**AC__B/AC__C**	*(Part Number)*	*Ship Status*
06/07/L1/L3	**08/10**	**06/07/L1/L3**	*A-999-2568*	*STOCK*
08	**12**	**08**	*A-999-2569*	*NS*
10	**14**	**10**	*A-999-2567*	*NS*
12	**16**	**12**	*A-999-2565*	*NS*
14	**18**	**14**	*A-999-2567*	*NS*
16	**24**	**16**	*A-999-2565*	*NS*
L2/L4		**L2/L4**	*A-999-2580*	*NS*

NS = NON-STOCK

HOT WATER COIL ASSEMBLIES

NON-FAN POWERED UNITS

AVWE	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	8 x 12	*AXKAVJJ1*	*AXKAVJJ2*
06	8 x 12	*AXKAVKK1*	*AXKAVKK2*
07	10 x 12	*AXKAV071*	*AXKAV072*
08	10 x 12	*AXKAV081*	*AXKAV082*
10	12-1/2 x 14	*AXKAV101*	*AXKAV102*
12	15 x 16	*AXKAV121*	*AXKAV122*
14	17-1/2 x 20	*AXKAV141*	*AXKAV142*
16	18 x 24	*AXKAVMM1*	*AXKAVMM2*
18	17-1/2 x 32	*AXKAV181*	*AXKAV182*
24	17-1/2 x 32	*AXKAV241*	*AXKAV242*

AVWC/ AVWD	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	7-1/2 x 12	*AXKAV051*	*AXKAV052*
06	7-1/2 x 12	*AXKAV061*	*AXKAV062*
07	10 x 12	*AXKAV071*	*AXKAV072*
08	10 x 12	*AXKAV081*	*AXKAV082*
10	12-1/2 x 14	*AXKAV101*	*AXKAV102*
12	15 x 16	*AXKAV121*	*AXKAV122*
14	17-1/2 x 20	*AXKAV141*	*AXKAV142*
16	17-1/2 x 24	*AXKAV161*	*AXKAV162*
18	17-1/2 x 32	*AXKAV181*	*AXKAV182*
24	17-1/2 x 32	*AXKAV241*	*AXKAV242*

AHWD	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	10 x 12	*AXKAH051*	*AXKAH052*
06	10 x 12	*AXKAH061*	*AXKAH062*
07	10 x 12	*AXKAH071*	*AXKAH072*
08	10 x 12	*AXKAH081*	*AXKAH082*
10	12-1/2 x 14	*AXKAH101*	*AXKAH102*
12	15 x 16	*AXKAH121*	*AXKAH122*
14	17-1/2 x 20	*AXKAH141*	*AXKAH142*
16	17-1/2 x 24	*AXKAH161*	*AXKAH162*

ABWD	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
06	10 x 12	*AXKAV071*	*AXKAV072*
07	10 x 12	*AXKAV071*	*AXKAV072*
08	10 x 12	*AXKAV081*	*AXKAV082*
10	12-1/2 x 14	*AXKAV101*	*AXKAV102*
12	15 x 16	*AXKAV121*	*AXKAV122*
14	17-1/2 x 20	*AXKAV141*	*AXKAV142*
16	17-1/2 x 24	*AXKAV161*	*AXKAV162*
18	17-1/2 x 32	*AXKAV181*	*AXKAV182*
24	17-1/2 x 32	*AXKAV241*	*AXKAV242*

AKWD	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	10 x 12	*AXKAK051*	*AXKAK052*
06	10 x 12	*AXKAK061*	*AXKAK062*
07	12-1/2 x 14	*AXKAK071*	*AXKAK072*
08	12-1/2 x 14	*AXKAK081*	*AXKAK082*
10	15 x 16	*AXKAK101*	*AXKAK102*
12	17-1/2 x 20	*AXKAK121*	*AXKAK122*
14	17-1/2 x 20	*AXKAK141*	*AXKAK142*
16	20 x 24	*AXKAK161*	*AXKAK162*

FAN POWERED UNITS

ACWJ	Fan Size	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	B	12-1/2 x 14	AXKBC05A1	AXKBC05A2
06	B	12-1/2 x 14	AXKBC06B1	AXKBC06B2
07	C	12-1/2 x 14	AXKBC07C1	AXKBC07C2
08	D	12-1/2 x 14	AXKBC08D1	AXKBC08D2
10	E	15 x 16	AXKBC10E1	AXKBC10E2
12	F	15 x 16	AXKBC12F1	AXKBC12F2
14	G	17-1/2 x 24	AXKBC16G1	AXKBC16G2
16	G	17-1/2 x 24	AXKBC16G1	AXKBC16G2
14	H	17-1/2 x 42	AXKBC16J1	AXKBC16J2
16	J	17-1/2 x 42	AXKBC16J1	AXKBC16J2

ACWH	Fan Size	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	A	12-1/2 x 14	AXKBC05A1	AXKBC05A2
06	B	12-1/2 x 14	AXKBC06B1	AXKBC06B2
07	C	12-1/2 x 14	AXKBC07C1	AXKBC07C2
08	D	12-1/2 x 14	AXKBC08D1	AXKBC08D2
10	E	15 x 16	AXKBC10E1	AXKBC10E2
12	F	15 x 16	AXKBC12F1	AXKBC12F2
14	G	17-1/2 x 32	AXKBC14G1	AXKBC14G2
16	H	17-1/2 x 32	AXKBC16H1	AXKBC16H2
L1	A	10 x 12	AXKBCL1A1	AXKBCL1A2
L2	B	10 x 12	AXKBCL2B1	AXKBCL2B2
L3	C	10 x 12	AXKBCL3C1	AXKBCL3C2
L4	D	10 x 12	AXKBCL4D1	AXKBCL4D2
L5	E	12-1/2 x 14	AXKBCL5E1	AXKBCL5E2
U1	A	10 x 12	AXKBUU1A1	AXKBUU1A2
U2	B	10 x 12	AXKBUU2B1	AXKBUU2B2
U3	C	10 x 12	AXKBUU3C1	AXKBUU3C2
U4	D	10 x 12	AXKBUU4D1	AXKBUU4D2
U5	E	12-1/2 x 14	AXKBUU5E1	AXKBUU5E2

ASWH	Fan Size	Coil Size H x W	1 Row *Part Number*	2 Row *Part Number*
05	A	12-1/2 x 14	AXKBS05A1	AXKBS05A2
06	A, B	12-1/2 x 14	AXKBS06A1	AXKBS06A2
07	A, B, C	12-1/2 x 14	AXKBS07A1	AXKBS07A2
08	B, C, D	12-1/2 x 14	AXKBS08B1	AXKBS08B2
10	C, D	12-1/2 x 14	AXKBS10C1	AXKBS10C2
10	E	15 x 16	AXKBS10E1	AXKBS10E2
12	E, F	15 x 16	AXKBS12E1	AXKBS12E2
14	E, F	17-1/2 x 24	AXKBS14E1	AXKBS14E2
16	F	17-1/2 x 24	AXKBS16F1	AXKBS16F2
L1	A	10 x 12	AXKBSL1A1	AXKBSL1A2
L2	A, B	10 x 12	AXKBSL2A1	AXKBSL2A2
L3	A, B, C	10 x 12	AXKBSL3A1	AXKBSL3A2
L4	B, C, D	10 x 12	AXKBSL4B1	AXKBSL4B2
L5	D	12-1/2 x 14	AXKBSL5D1	AXKBSL5D2
L6	D, E	12-1/2 x 14	AXKBSL6D1	AXKBSL6D2

NOTES:

1. *Coils are provided with slip and drive connection.*
2. *All coils have 1/2" O. D. staggered copper tubes.*
3. *Fin spacing for all coils is 10 fins per inch.*
4. *Consult factory for Q Series.*
5. *Contact factory for 3 and 4 row coils.*