

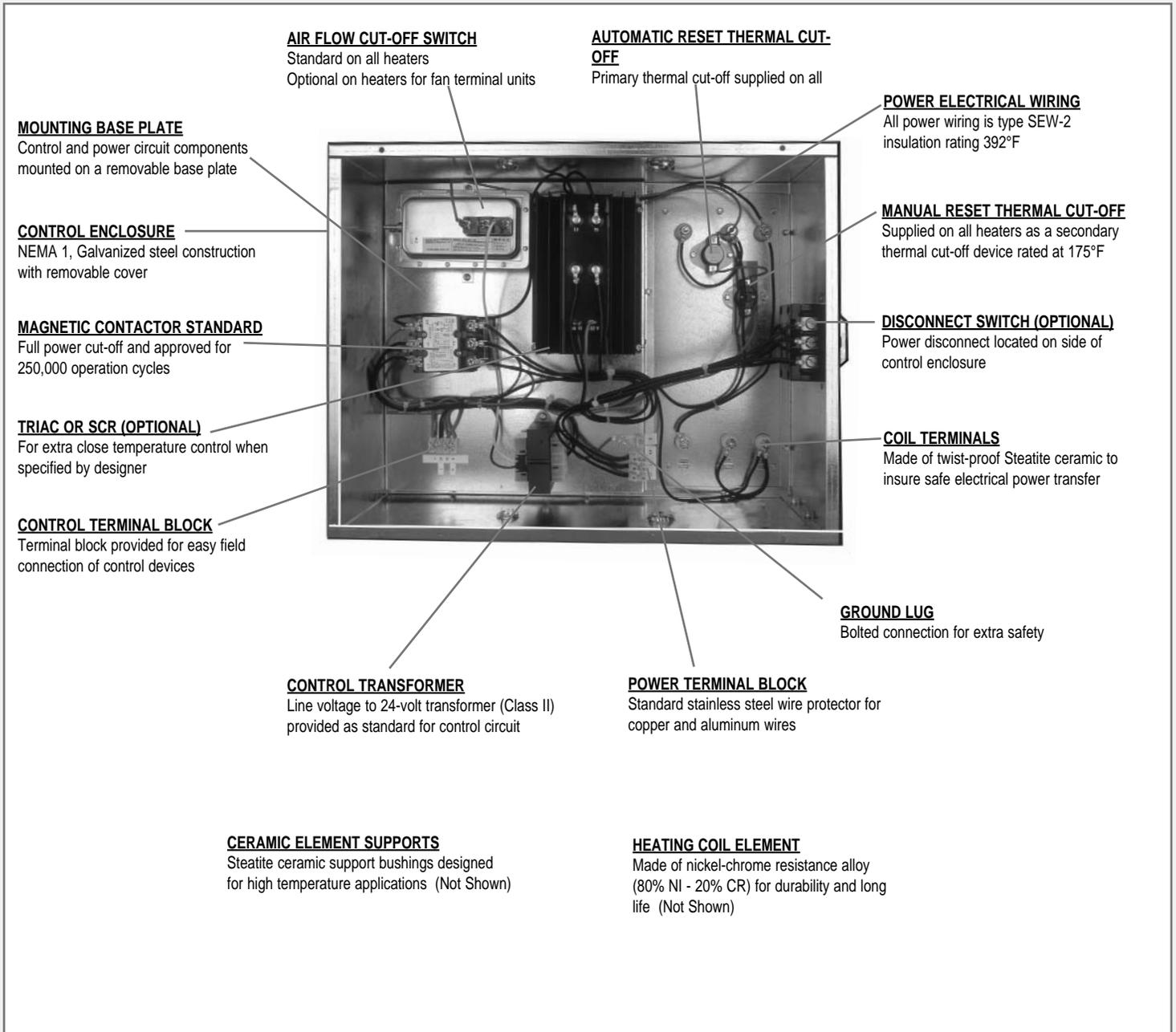
CARNES ELECTRIC DUCT HEATERS



RECOMMENDED SPECIFICATIONS

Provide open coil electric duct heaters of the size, capacity and performance shown on the job schedule. All duct heaters shall be tested and certified to both **UL** STD 1996 and **CSA** C22.2 standards by **ETL** laboratories. Heating elements shall be open coil type, 80% nickel 20% chromium, type A resistance wire. Other alloys are not acceptable. Coils shall be supported by steatite ceramic bushings securely fastened to the element support brackets. The duct heater frame, control enclosure and element support brackets shall be of 20 gauge (minimum) galvanized steel. The controls enclosure shall be **NEMA-1** construction with a removable cover. The electric heater frame will have flanged or slip-in duct connection. All heaters shall be furnished with a disc type, primary automatic reset thermal cut-off. A secondary manual reset thermal cut-off will also be provided. All heaters will have an integral air flow switch or a fan interlock relay (fan terminal units only). The electric supply wiring shall have insulation rating of 392°F (200° C). Terminal blocks and ground lugs will be furnished on all heaters for field wiring. A line voltage to 24 volt, class II transformer shall be provided and mounted inside the control enclosure. All heaters shall have a de-energizing magnetic contactor(s) with a 24-volt holding coil as standard. Pneumatic/Electric (PE) switches will be provided for pneumatic control systems.

PRODUCT FEATURES AND CONSTRUCTION



ELECTRIC DUCT HEATERS

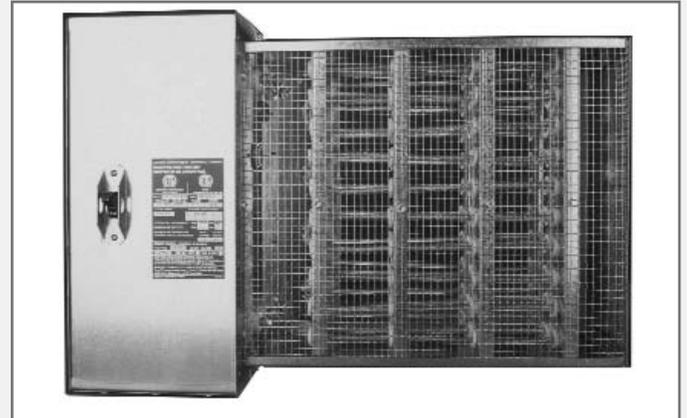
**TYPICAL CONTROL BOX PHOTO
SEVERAL OPTIONS ARE
AVAILABLE FOR SPECIFIC
APPLICATIONS**

ACCESS AND MAINTENANCE
*Easy access to all electrical components
when cover is removed. Minimum
inspection and maintenance
required*

NOTE: Control components and options subject to change without notice.

GENERAL INFORMATION

Carnes electric duct heaters are designed for use in commercial and industrial HVAC duct systems. Our open coil heater design comes from closely evaluating the needs of design engineers, contractors and end users. Carnes duct heaters may be used to heat an entire building or as a supplemental heating source. Our duct heaters are tested as an integral component of fan powered and throttling type air terminal units for VAV systems. However, this heater design may be used as a stand-alone device in constant air volume systems. Standard and custom electric duct heaters are designed through a computerized program allowing quick and accurate production.



ETL LISTED AND APPROVED TO UL AND CSA STANDARDS

Carnes electric duct heaters have been tested and certified to both American Standard # **UL** STD 1996 and Canadian Standard # **CSA** C22.2 no. 155 by **ETL** Laboratories (recognized by OSHA). **ETL** control # 9700853.

PRODUCT QUALITY

Our electric heater components have been selected following stringent selection criteria to ensure long, safe and reliable operation.

- **Electrical Components**

All electrical components are approved to both **UL** and **CSA** standards.

- **Heater Elements**

All heater elements are constructed from a nickel-chrome alloy without joints except at connecting studs (80% NI - 20% CR, Grade A wire @ 45 watts/in²).

- **Power Wiring**

Electric power wire rating has been standardized to 392°F (200°C). This high-grade wire is used on all electric heaters.

- **Magnetic Contactors**

All duct heaters are provided with magnetic contactors as standard (mercury contactors optional). These devices provide full power cut-off and are rated for 250,000 duty cycles.

- **Construction**

The controls enclosure and element frame are built from 20 gauge (minimum) galvanized steel. Our standard **NEMA-1** control enclosure exceeds **UL** and **CSA** requirements.

STANDARD SAFETY DEVICES

- **Airflow Switch**

An airflow cut-off switch is provided on each heater to ensure airflow across the heating elements. Switch makes at .05" W.C. (fan interlock relay used on fan terminals).

- **Primary Thermal Cut-Off**

An automatic reset thermal cut-off is standard and will stop the unit when the high limit temperature is reached. The heater will re-start automatically when the temperature has dropped below the high limit of 125°F.

- **Secondary Thermal Cut-Off**

A manual reset thermal cut-off is also standard and will stop the unit when the high temperature limit is reached. The heater must be carefully inspected prior to manual resetting of this thermal cut-off (cut-off temperature 175°F).

- **Fan Interlock Relay**

A fan interlock relay is used on electric duct heaters for fan terminal units. This device ensures that the fan is energized prior to the electric heater (used in lieu of an air flow switch).

- **Steatite Element Supports**

Heater element support bushings are made of a Steatite ceramic material designed for high temperature industrial applications. This material has high dielectric strength and resistance to thermal and mechanical shocks.

- **Steatite Coil Terminals**

Coil terminals are made of a Steatite ceramic material. These twist-proof insulators provide safe electrical transfer from the control panel to the elements.

- **Transformer Standard**

A line voltage to 24-volt class II transformer with internal overcurrent protection is provided with each electric duct heater. Primary voltages of 120-600 volts are available.

- **Terminal Block**

The power wiring terminal block is supplied with a stainless steel wire protector for copper or aluminum wires. A bolted ground lug is provided for added safety.

POWER FUSING (Optional)

- **UL** and **NEC** codes require supply fusing for all electric duct heaters that draw more than 48 amps. Heaters over 48 amps will be sub-divided into circuits not exceeding 48 amps and will be fused accordingly. Power fusing is available for units that draw less than 48 amps when specified (see electric heater price sheet for fusing options).

DISCONNECT SWITCH (Optional)

- A panel mount toggle disconnect switch is used to disconnect the electric supply from the outside of the controls enclosure prior to service or inspection. This safety feature is often specified and is available with or without power fusing (see electric heater price sheet for disconnect options).



ELECTRIC DUCT HEATERS

ENGINEERING AND PERFORMANCE DATA

Since an electric duct heater has a constant BTU/H output as long as the heater is energized, a minimum air velocity must be maintained through the heater. Proper airflow will prevent over-temperature causing nuisance tripping and will maintain element life expectancy. The velocity of air flow in the duct is determined by the formula:

$$\text{VELOCITY} = \text{CFM} \div \text{DUCT AREA}$$

and can be compared to the minimum airflow velocity indicated on each heater.

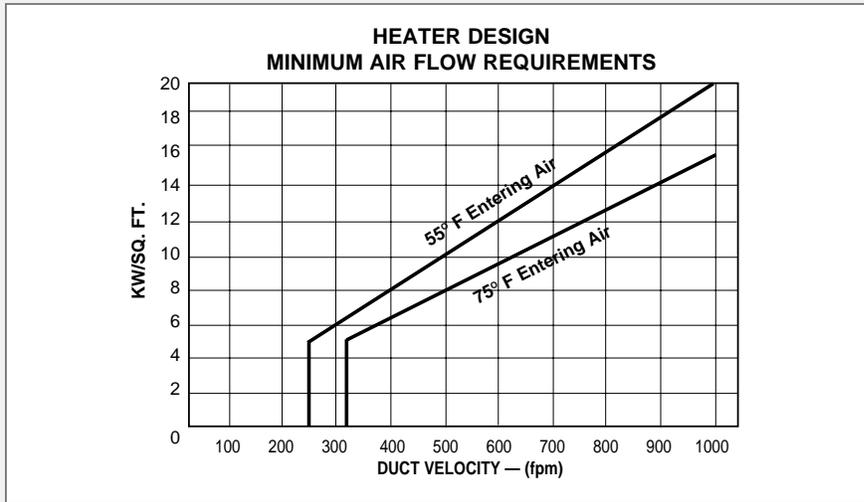
The electric heaters are suitable for zero clearance between the heater and combustible material. Electric heaters are shipped uninsulated with slip-in or flange connections for easy installation into duct work.

The inlet and outlet air temperature should be selected within the temperature limitations of the heater. The maximum discharge air temperature is 125°F. The electric heater is an open coil design and should be mounted in a horizontal position maintaining proper air flow direction.

The minimum air velocity through the electric heater based on the duct area (ft²) is determined by:

$$\text{Vfpm} = \frac{\text{KW} \times 3160}{\text{Area} \times (T_2 - T_1)}$$

- Vfpm = Minimum air velocity
- Area = Sq. Ft. of duct area
- KW = Kilowatt of Heater
- T₂ = Discharge air (125°F Max.)
- T₁ = Entering Air Temperature



1. Conversion: **1 KW = 3413 Btu/h**
2. Load Requirement: **KW = $\frac{\text{Cubic Feet Per Min.} \times \text{Temperature Rise}}{3160}$**
3. *Temperature Rise: **TR = $\frac{\text{KW} \times 3160}{\text{Cubic Feet per Min.}}$**
4. Ohm's Law: **Watts = $\frac{(\text{Volts})^2}{\text{Resistance}}$ = Volts x Amps**
5. Line Current, 1 Phase: **Amps = $\frac{\text{Watts}}{\text{Volts}}$**
6. Line Current, 3 Phase: **Amps = $\frac{\text{Watts}}{1.73 \times \text{Volts}}$**
7. Pressure Drop: **Inches H₂O = $\frac{\text{KW/ft}^2}{760} \times \left[\frac{\text{Velocity in FPM}}{500} \right]^2$**
8. Maximum Discharge Air Temperature = 125°F

*** Maximum heater discharge temperature should not exceed 125°F to avoid nuisance tripping.**

ELECTRIC DUCT HEATERS

ENGINEERING AND PERFORMANCE DATA

MAXIMUM and MINIMUM ALLOWABLE ELECTRIC HEATER KW
FOR MODELS AVE, AKE, and AHE SINGLE DUCT THROTTLING UNITS

1 PHASE LINE VOLTAGE HEATERS

AKEC SIZE		MIN. KW ALL SIZES	--	05/06	07/08	10	12/14	--	--	16
AHEC SIZE			--	05/06/07/08	10	12	14	16	--	--
AVEC SIZE			05/06	07/08	10	12	14	16	18/24	--
H x W			7-1/2 x 12	10 x 12	12-1/2 x 14	15 x 16	17-1/2 x 20	17-1/2 x 24	17-1/2 x 32	20 x 24
120 VOLT 1 PHASE	1 STEP	.5	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
	2 STEPS	.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
	3 STEPS	1.2	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
MAXIMUM HEATER KW: 5.7 KW*										
208 VOLT 1 PHASE	1 STEP	.7	6.1	8.1	9.9	9.9	9.9	9.9	9.9	9.9
	2 STEPS	1.3	6.1	8.1	9.9	9.9	9.9	9.9	9.9	9.9
	3 STEPS	2.0	6.1	8.1	9.9	9.9	9.9	9.9	9.9	9.9
MAXIMUM HEATER KW: 9.9 KW*										
240 VOLT 1 PHASE	1 STEP	.8	6.1	8.1	11.5	11.5	11.5	11.5	11.5	11.5
	2 STEPS	1.5	6.1	8.1	11.5	11.5	11.5	11.5	11.5	11.5
	3 STEPS	2.3	6.1	8.1	11.5	11.5	11.5	11.5	11.5	11.5
MAXIMUM HEATER KW: 11.5 KW*										
277 VOLT 1 PHASE	1 STEP	.9	6.1	8.1	11.8	13.3	13.3	13.3	13.3	13.3
	2 STEPS	1.8	6.1	8.1	11.8	13.3	13.3	13.3	13.3	13.3
	3 STEPS	2.6	6.1	8.1	11.8	13.3	13.3	13.3	13.3	13.3
MAXIMUM HEATER KW: 13.3 KW*										
480 VOLT 1 PHASE	1 STEP	1.5	6.1	8.1	11.8	16.2	23.0	23.0	23.0	23.0
	2 STEPS	3.0	6.1	8.1	11.8	16.2	23.0	23.0	23.0	23.0
	3 STEPS	4.5	6.1	8.1	11.8	16.2	23.0	23.0	23.0	23.0
MAXIMUM HEATER KW: 23.0 KW*										

3 PHASE LINE VOLTAGE HEATERS

AKEC SIZE		MIN. KW ALL SIZES	--	05/06	07/08	10	12/14	--	--	16
AHEC SIZE			--	05/06/07/08	10	12	14	16	--	--
AVEC SIZE			05/06	07/08	10	12	14	16	18/24	--
H x W			7-1/2 x 12	10 x 12	12-1/2 x 14	15 x 16	17-1/2 x 20	17-1/2 x 24	17-1/2 x 32	20 x 24
208 VOLT 3 PHASE	1 STEP	1.2	6.1	8.1	11.8	16.2	17.2	17.2	17.2	17.2
	2 STEPS	2.3	6.1	8.1	11.8	16.2	17.2	17.2	17.2	17.2
	3 STEPS	3.4	6.1	8.1	11.8	16.2	17.2	17.2	17.2	17.2
MAXIMUM HEATER KW: 17.2 KW*										
240 VOLT 3 PHASE	1 STEP	1.3	6.1	8.1	11.8	16.2	19.9	19.9	19.9	19.9
	2 STEPS	2.6	6.1	8.1	11.8	16.2	19.9	19.9	19.9	19.9
	3 STEPS	3.9	6.1	8.1	11.8	16.2	19.9	19.9	19.9	19.9
MAXIMUM HEATER KW: 19.9 KW*										
480 VOLT 3 PHASE	1 STEP	2.6	6.1	8.1	11.8	16.2	23.7	28.4	37.9	32.5
	2 STEPS	5.2	6.1	8.1	11.8	16.2	23.7	28.4	37.9	32.5
	3 STEPS	7.8	N/A	N/A	11.8	16.2	23.7	28.4	37.9	32.5
MAXIMUM HEATER KW: 37.9 KW*										

MAXIMUM and MINIMUM ALLOWABLE ELECTRIC HEATER KW
FOR MODELS ASE & ACE FAN TERMINAL UNITS

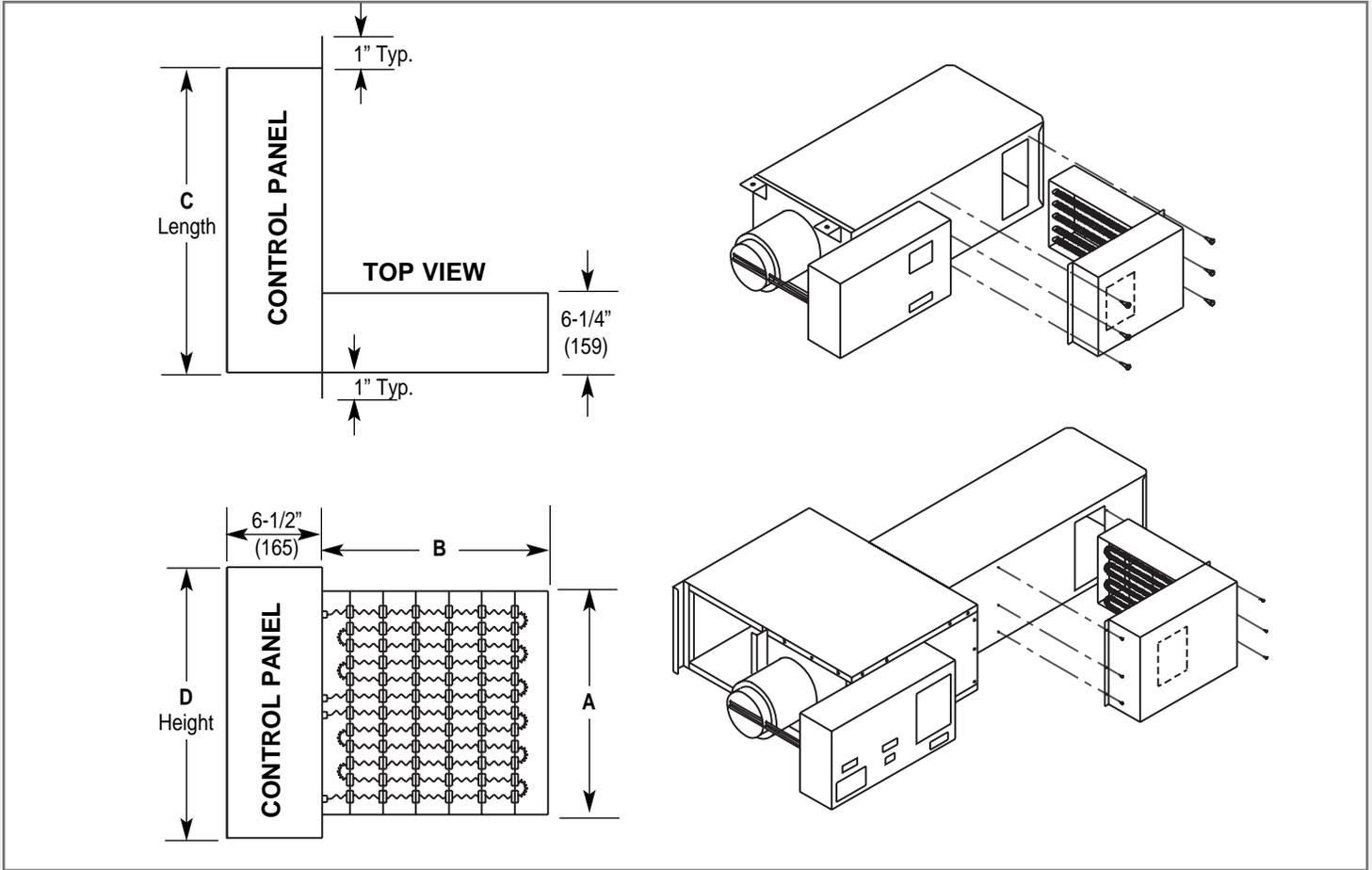
ASEG FAN SIZE		A, B, C		D		E, F		—	
ACEG FAN SIZE		A, B, C		D		E, F		G, H	
H x W (Flow Area)		10 x 14		12-1/2 x 14		15 x 16		17-1/2 x 32	
VOLTAGE/PHASE:		Min. KW PER STEP	*MAXIMUM HEATER KW*						
HTR	FAN								
120/1	120/1	.5	5.5		5.1		4.9		4.1
277/1	277/1	.9	9.5		11.9		12.5		11.6
208/3	120/1	1.2	9.5		11.9		14.8		12.2
480/3	277/1	2.6	9.5		11.9		16.3		34.9

*KW requirements above this maximum KW will require fusing.

- NOTES: 1. Maximum heater discharge temperature should not exceed 125°F to avoid nuisance tripping.
2. Discharge temperature = [(KW x 3160)/CFM] + entering air temperature (EAT).

ELECTRIC DUCT HEATERS

DIMENSIONAL DATA

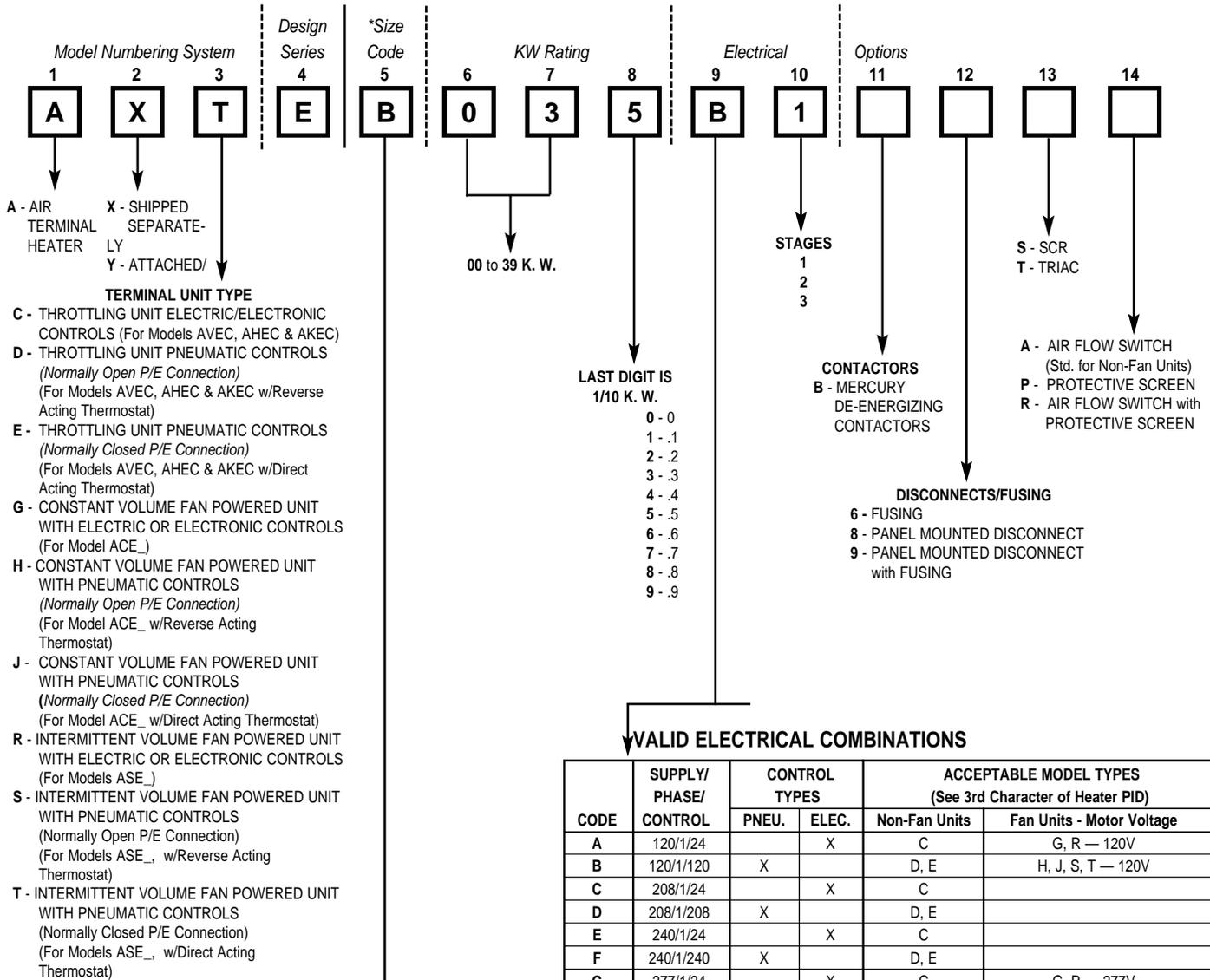


DIMENSIONS LISTED IN INCHES (Millimeters)

Coil Size Code	Duct Size		Heater		Control Panel	
	Height	Width	A	B	C	D
A	7-1/2 (190)	12 (305)	5-11/16 (145)	11-5/8 (295)	20 (508)	8 (203)
B	10 (254)	12 (305)	8-11/16 (221)	11-5/8 (295)	18 (457)	10 (254)
C	10 (254)	14 (356)	8-11/16 (221)	13-5/8 (346)	18 (457)	10 (254)
E, F	12-1/2 (318)	14 (356)	10-5/8 (270)	13-5/8 (346)	18 (457)	12 (305)
H, J	15 (381)	16 (406)	13-5/8 (346)	15-9/16 (395)	20 (508)	16 (406)
L	17-1/2 (445)	20 (508)	15-5/8 (397)	19-1/2 (495)	20 (508)	18 (457)
M	17-1/2 (445)	24 (610)	15-5/8 (397)	23-7/16 (595)	20 (508)	18 (457)
T, W	17-1/2 (445)	32 (813)	15-5/8 (397)	31-5/16 (795)	20 (508)	18 (457)
Y	20 (508)	24 (610)	18-1/2 (470)	23-7/16 (595)	20 (508)	22 (559)

ELECTRIC DUCT HEATERS — Model Numbering System

Models AX_E & AY_E



VALID ELECTRICAL COMBINATIONS

CODE	SUPPLY/ PHASE/ CONTROL	CONTROL TYPES		ACCEPTABLE MODEL TYPES (See 3rd Character of Heater PID)	
		PNEU.	ELEC.	Non-Fan Units	Fan Units - Motor Voltage
A	120/1/24		X	C	G, R — 120V
B	120/1/120	X		D, E	H, J, S, T — 120V
C	208/1/24		X	C	
D	208/1/208	X		D, E	
E	240/1/24		X	C	
F	240/1/240	X		D, E	
G	277/1/24		X	C	G, R — 277V
H	277/1/277	X		D, E	H, J, S, T — 277V
J	480/1/24	X	X	C, D, E	
K*	208/3/24		X	C	G, R — 120V
L*	208/3/120	X			H, J, S, T — 120V
M*	208/3/208	X		D, E	H, J, S, T — 120V
N	240/3/24		X	C	
P	240/3/240	X		D, E	
R*	480/3/24	X	X	C, D, E	G, R — 277V
S*	480/3/277	X			H, J, S, T — 277V

* COIL SIZE CODE SELECTION

COIL SIZE CODE	MODEL/SIZE			MODEL/FAN SIZE
	AVE	AHE	AKE	AC/AS
A	05/06	—	—	—
B	07/08	05 - 08	05/06	—
F	10	10	07/08	—
H	12	12	10	—
L	14	14	12/14	—
M	16	16	—	—
T	18/24	—	—	—
Y	—	—	16	—
C	—	—	—	A, B, C
E	—	—	—	D
J	—	—	—	E, F
W	—	—	—	G, H

* Requires 4-wire system.