AG-EHeat-00
June 4, 2001

Application Guide

Improved Electric Heater Design

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Introduction

Thermal comfort is the number one goal of an HVAC system. Cooling a zone from overhead diffusers is a relatively straightforward process. Overhead heating is a more difficult application. The relationship between volume of air (CFM), temperature of air (ΔT), and the kW required to satisfy the zone is a simple calculation. With the introduction of the new, improved electric heater, we are providing this Application Guide to assist in the selection of electric coils.

NEC Clearance Requirements

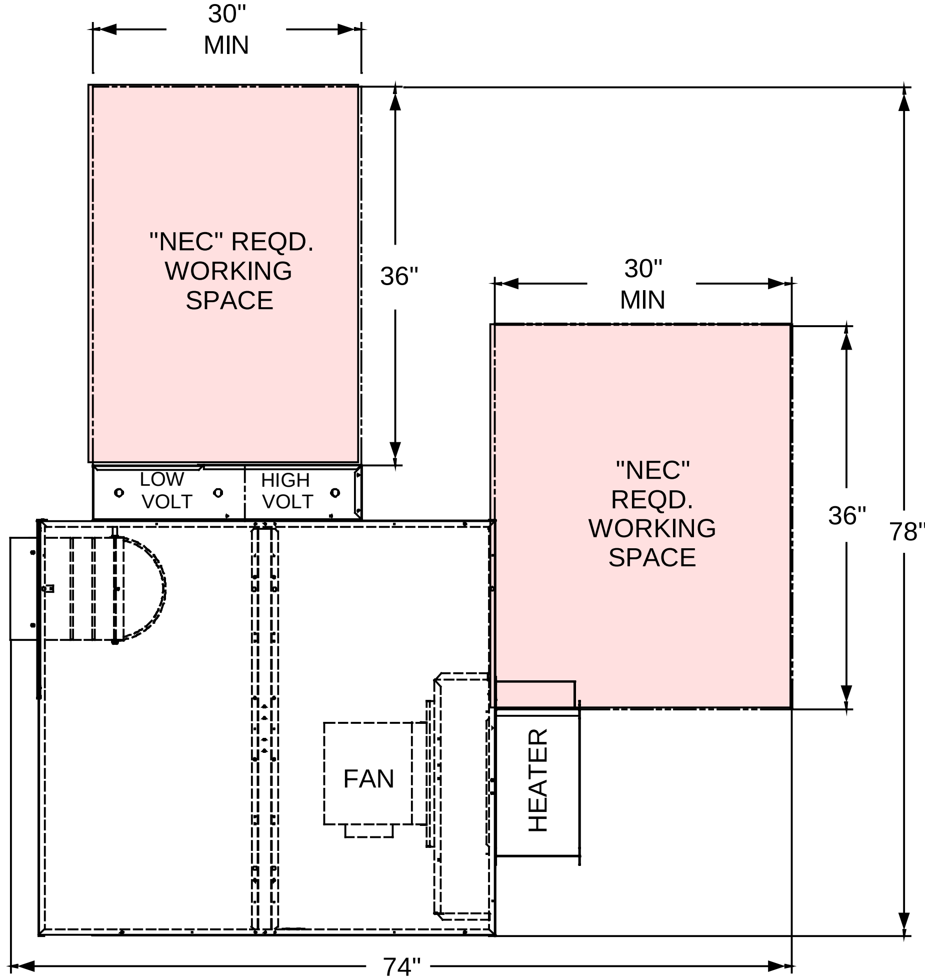
One consideration we took into account when we began the electric heater redesign, was NEC clearance requirements. We did not want to exceed the requirements of our old design, especially in the width dimension.

NEC states that "working space for equipment operating at 600 volts, nominal, or less to ground and likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the dimensions of (1), (2), and (3)…in this Code." (1) Depth of Working Space states that the minimum clear distance for 0-150 volt is 3 ft. and 151 to 600 volts is 3 ½ ft.. (2) Width of Working Space states that the minimum width of the space shall be the width of the equipment or 30 in., whichever is greater.

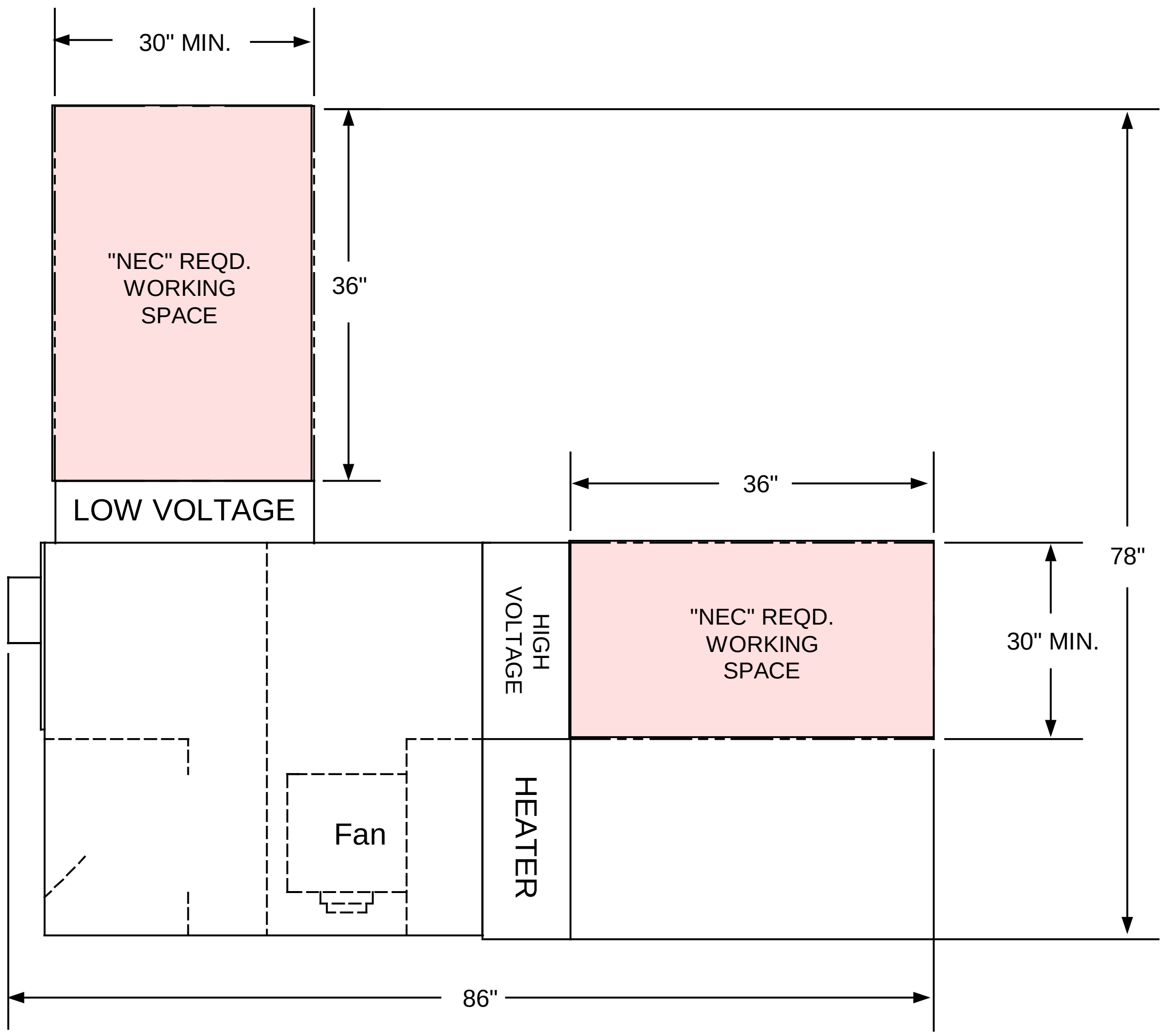
The following pages show the NEC required space of the Titus old and new design units and some of the competitions units. The series fan box sizes shown were selected to represent units with similar airflow requirements and therefore be comparable units for any given application. The units were selected for 1200 CFM.

The drawings are not submittal drawings, so they are not exact, but should give a basis of comparison. They are laid out one per page so that you may lay one on top of another and get an idea of the difference in NEC required clearance.

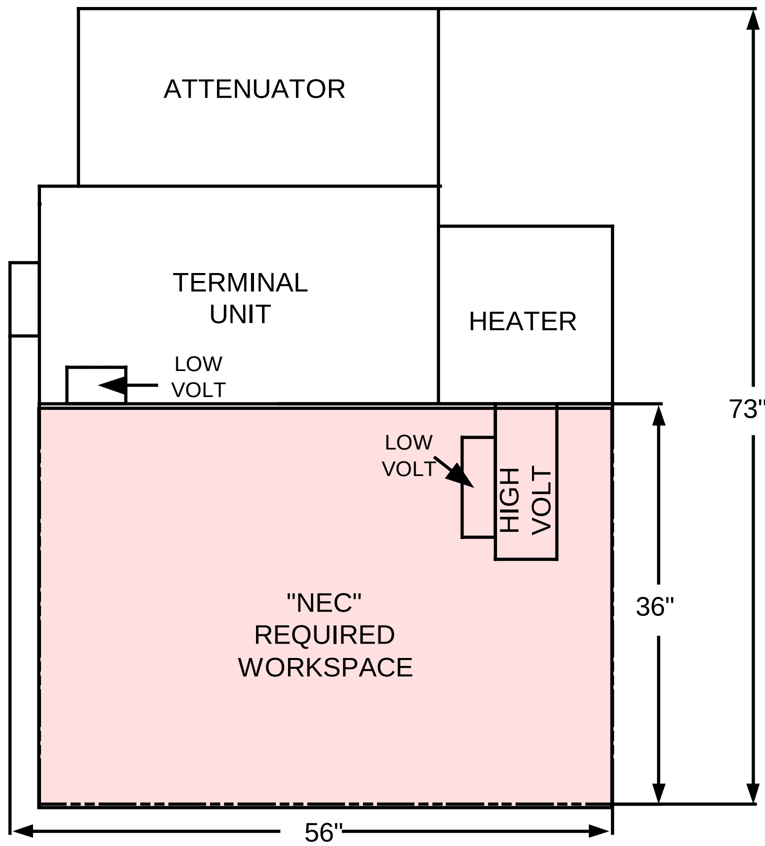
Titus New Heater Size 310



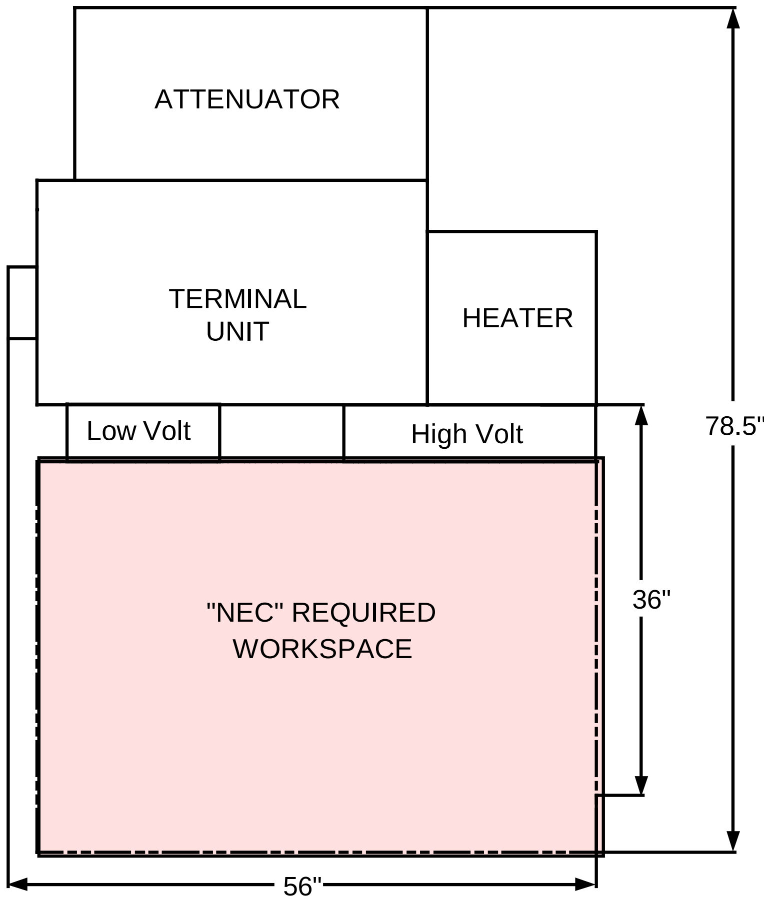
Titus Old Sytle Heater Size 310



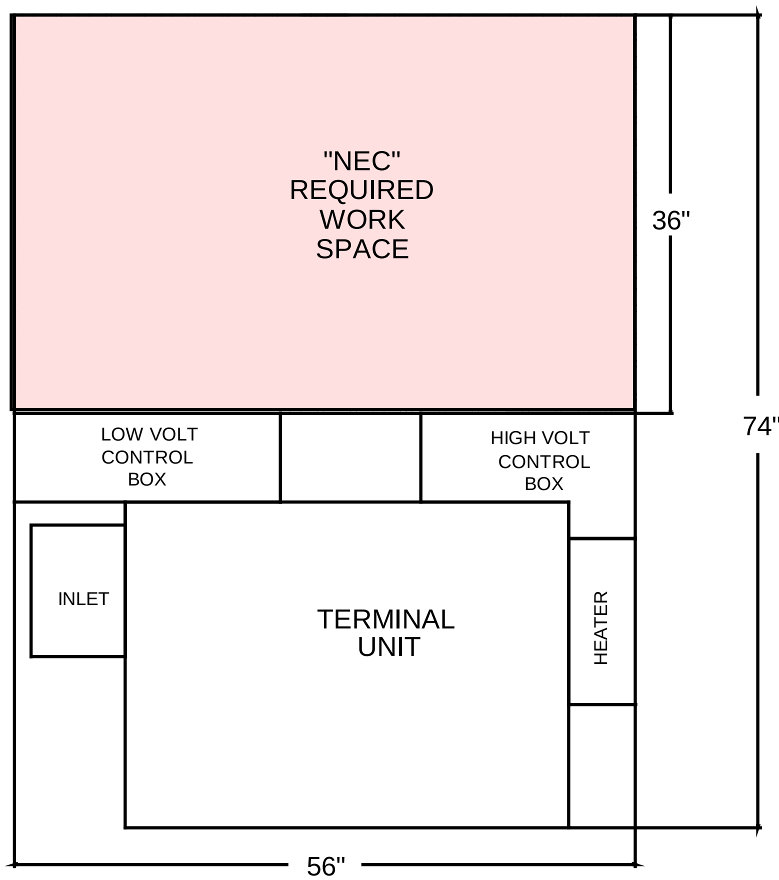
Nailor 35S "Stealth" with Hines Discharge Mounted Controls Size 410



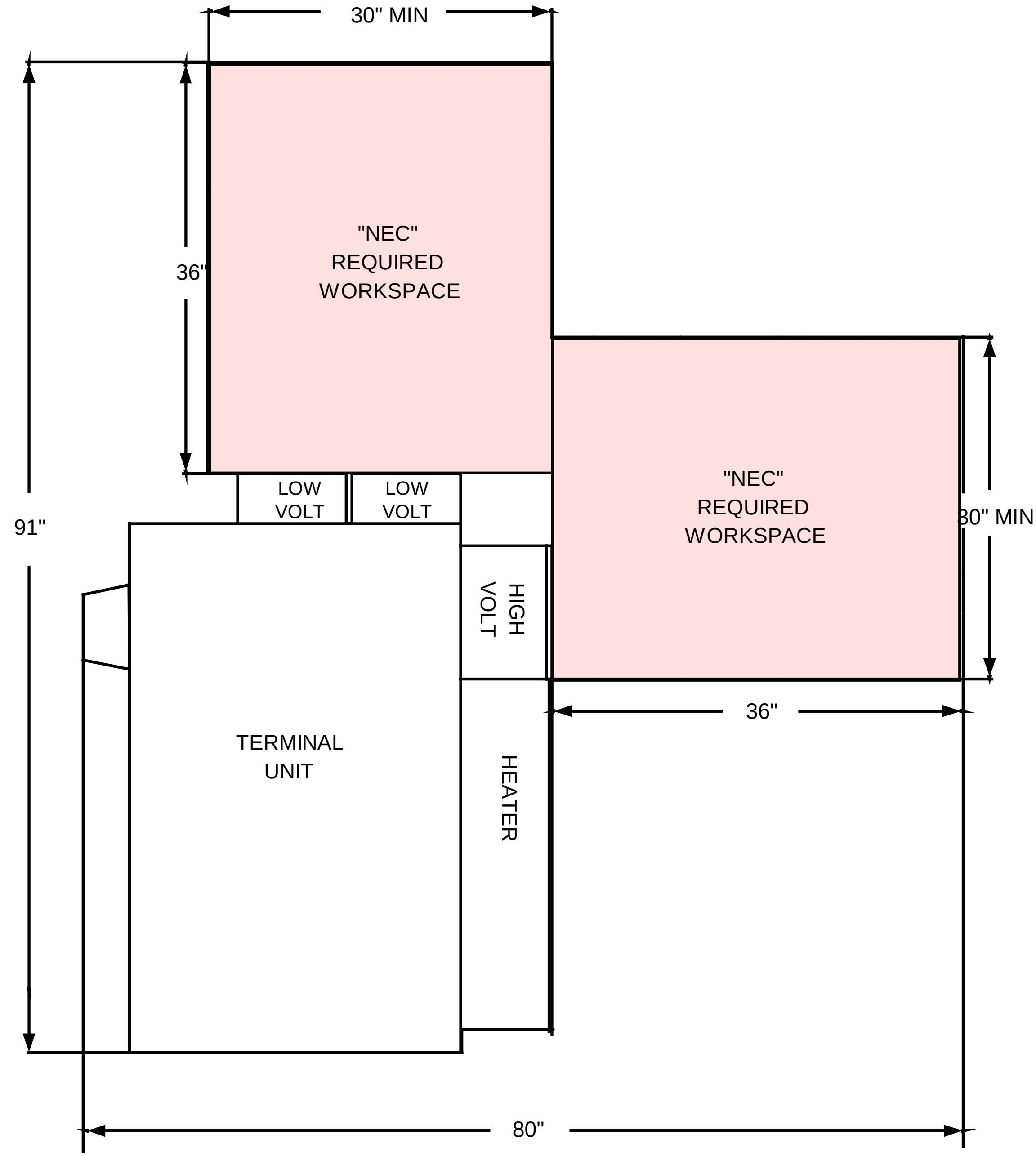
Nailor 35S "Stealth" with Standard Controls Size 410



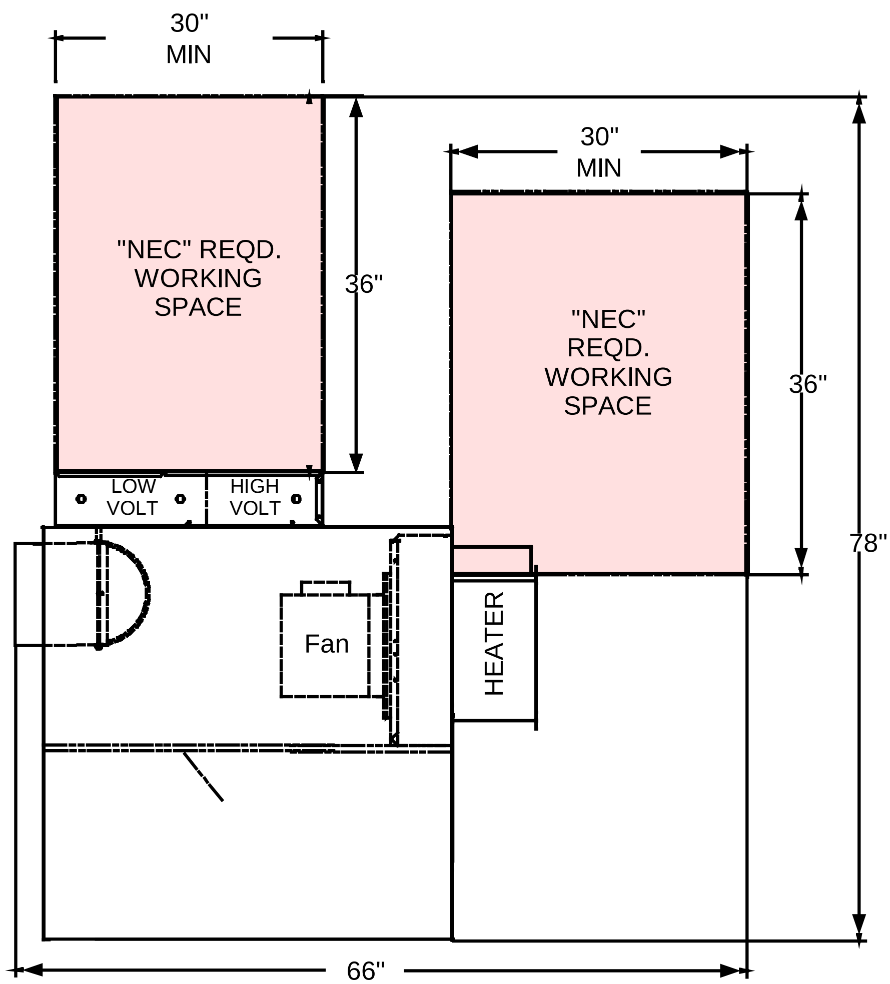
ETI CFR Size 1217



Trane VFPE Size 1715



Krueger KQFS Size 410



NEC Clearance Requirements Summary:

Model	Width Requirement	Length Requirement
Titus New	78”	74”
Titus Old	78”	86”
Nailor 35S “Stealth” with Hines Controls	73”	56”
Nailor 35S “Stealth” with Standard Controls	78.5”	56”
ETI CFR	74”	56”
Trane VFPE	91”	80”
Krueger KQFS	78”	66”

Note: The length dimension is in the direction of the ductwork. The width dimension is perpendicular to the direction of ductwork.

Airflow Considerations

As part of the design process, we reviewed our kW and low flow offerings and expanded their ranges whenever possible. You will notice that many of the kW ranges have been expanded and 480V heaters are now available on ESV sizes 4, 5, and 6.

The improved design allows for better low flow performance. You must still consider the minimum CFM per kW and ΔT temperature rise when selecting the electric heater. We typically recommend 70 CFM per kW for minimum CFM selection.

The absolute minimum CFM that will close the flow switch on an ESV electric heater is shown in the below:

Unit Size	Minimum CFM
4	55
5	85
6	105
7	135
8	190
9	225
10	300
12	425
14	575
16	750
24x16	1800

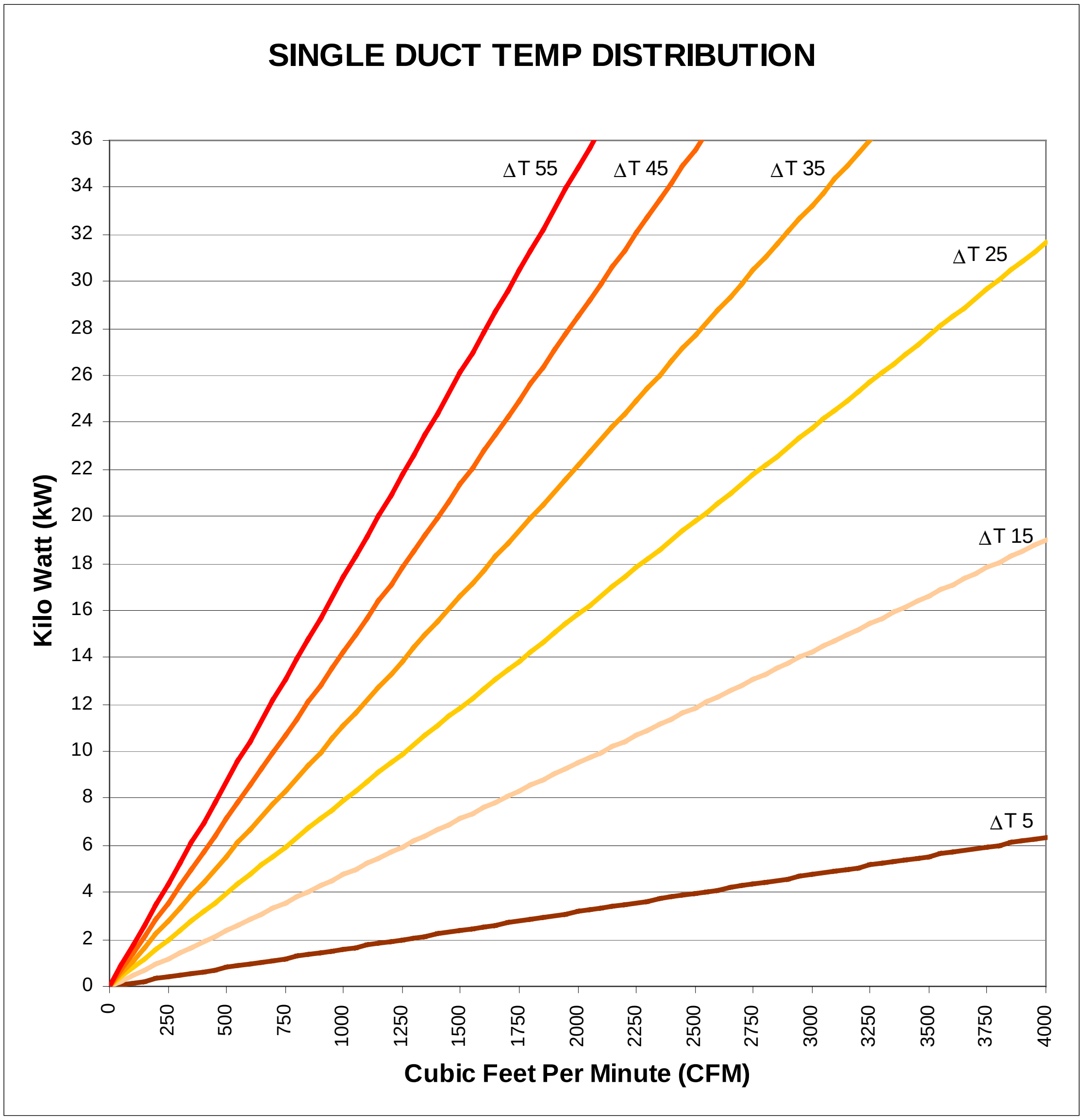
The following equation gives the relationship for CFM, ΔT, and kW:

$$kW = \frac{CFM \times \Delta T}{3160}$$

Although Titus publishes a minimum and maximum kW range and a minimum and maximum CFM range, you must determine the appropriate kW and CFM required for the specific application. Using the equation above, we have calculated the absolute minimum and maximum kW range for each size of ESV based on minimum and maximum CFM of the unit for temperature rise across the coil from 5^{o}F to 55^{o}F.

The recommended range of operation is between 15^{o}F and 45^{o}F temperature rise. The following chart should be used as a guide when selecting electric heat for ESV's. The chart shows the CFM vs. kW relationship for various ΔT values. As you can see, if you want a ΔT of 45^{o}F, and a 22 kW heater, you must have 1550 CFM across the coil.

CFM vs. kW Based on ΔT across the Coil



The most important criteria for selecting kW is diffuser mixing performance and thermal comfort. The ASHRAE Fundamentals Handbook, Chapter 31, states discharge temperature to the space should not exceed 15°F above the desired room temperature for thermal comfort. For a typical application where the space temperature is 75°F, the maximum discharge temperature would be 90°F.

Amperage Calculations for ESV's

The following table shows the amperage for various heater voltages and kW's.

AMPERES							
BTUH	kW	120V 1ϕ	208V 1ϕ	208V 3ϕ	240V 1ϕ	277V 1ϕ	480V 3ϕ
3413	1	8.33	4.81	2.78	4.17	3.61	1.20
6826	2	16.67	9.62	5.56	8.33	7.22	2.41
10239	3	25.00	14.42	8.34	12.50	10.83	3.61
13652	4	33.33	19.23	11.12	16.67	14.44	4.82
17065	5	41.67	24.04	13.90	20.83	18.05	6.02
20478	6	50.00	28.85	16.68	25.00	21.66	7.23
23891	7		33.65	19.46	29.17	25.27	8.43
27304	8		38.46	22.32	33.33	28.88	9.63
30717	9		43.27	25.01	37.50	32.49	10.84
34130	10		48.08	27.79	41.67	36.10	12.04
37543	11			30.57	45.83	39.71	13.25
40956	12			33.35		43.32	14.45
44369	13			36.13		46.93	15.66
47782	14			38.91			16.86
51195	15			41.69			18.06
54608	16			44.47			19.27
58021	17						20.47
61434	18						21.68
64847	19						22.88
68260	20						24.08
71673	21						25.29
75086	22						26.49
78499	23						27.70
81912	24						28.90
85325	25						30.11
88738	26						31.31
92151	27						32.51
95564	28						33.72
98977	29						34.92
102390	30						36.13
105803	31						37.33
109216	32						38.54
112629	33						39.74
116042	34						40.94
119455	35						42.15
122868	36						43.35

Formula for caclulating line currents of electric coils:
Convert kW to WATTS: kW x 1000 = WATTS

Single Phase 1ϕ

$$\text{AMPERES} = \frac{\text{WATTS}}{\text{Line Voltage}}$$

Three Phase 3ϕ

$$\text{AMPERES} = \frac{\text{WATTS}}{\text{Line Voltage x 1.73}}$$

208 x 1.73 = 359.8
480 x 1.73 = 830.4