Duct Heater How To Size

To calculate the amount of heat required in Kilowatts (kW), knowing the volume of airflow in cubic feet per minute (CFM) and the temperature rise is in degrees Fahrenheit (ΔT) that is required for the application, the required kilowatt (kW) rating of the heater can be determined from the formula:

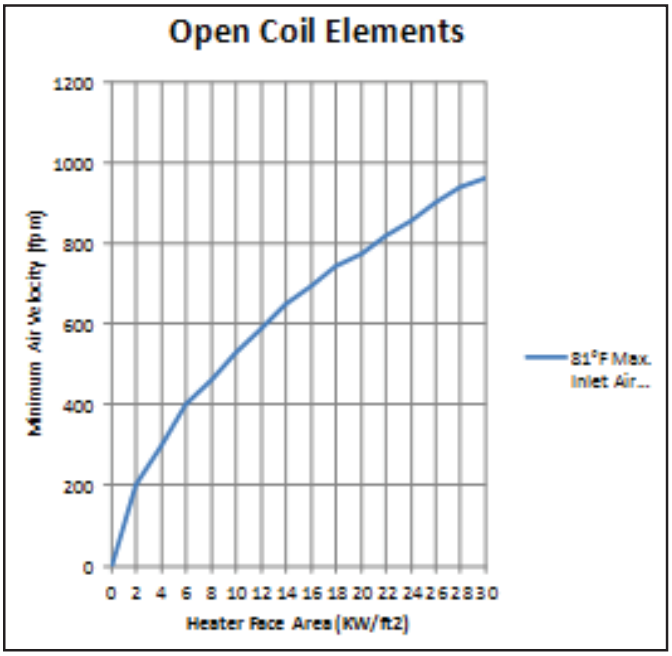
kW = (CFM x ΔT)/3160

For most comfort heating applications, the duct heater will be specified to provide heat in steps. These steps of heat will be specified by either the ΔT between the steps or the kW rating between steps. The table below shows the recommendations for both the ΔT difference and the kW difference between steps.

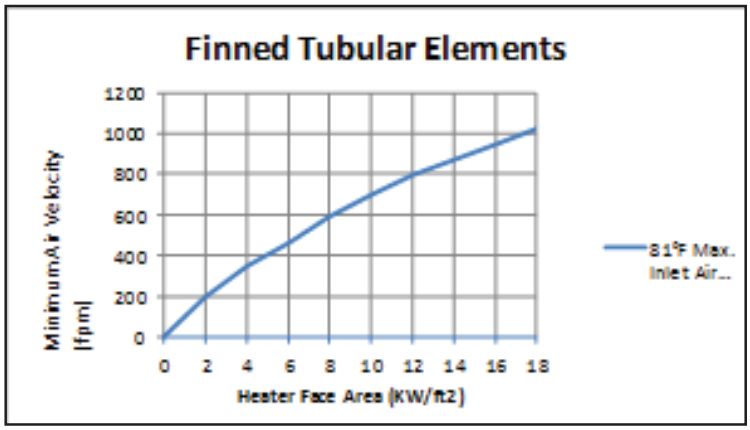
Standard Voltages

Common Nominal Voltages	110 115 120	208		220	230 240		277	318 332 347	380		416		440 460 480		550 575 600	
MEP Standard	120 1 Ph	208 1 Ph	208 3 Ph	220 1 Ph	208 3 Ph	208 3 Ph	277 1 Ph	347 1 Ph	380 1 Ph	380 3 Ph	416 1 Ph	416 3 Ph	480 1 Ph	480 3 Ph	600 1 Ph	600 3 Ph

Minimum air velocity required for the duct heater is determined from the charts below.



Maximum allowed watt density if 22.5 kW/Ft2



Maximum allowed watt density if 13.0 kW/Ft2

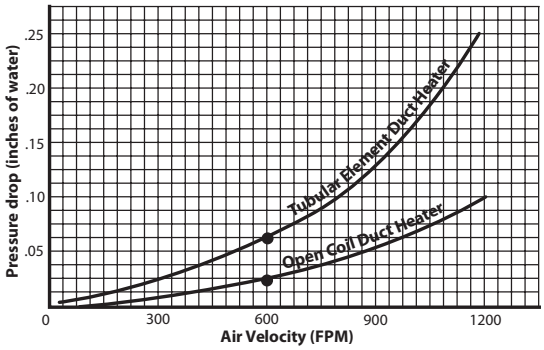
An example of calculating the Minimum Air Velocity needed: A 25 kW open coil duct heater is to be installed in a duct that is 12 inches high by 24 inches wide.
Face Area = ((H"- 2.5")(W" – 0.5"))/144 in2/ft2 = ((12" – 2.5")(24" – 0.5"))/144 in2/ft2 = 1.53 ft2
kW/ft2 = kW of heater/Face Area = 25/1.53 = 16.3 kW/ft2
From the Open Coil Elements chart (see above), a Heater Face Area of 16.3 kW/ft2 shows a Minimum Air Velocity for 81°F maximum inlet air temperature air to be 700 fpm.

Calculating Pressure Drop Through A Heater

The chart shown below is the approximate pressure drop through a heater based on the velocity of the entering air.

PRESSURE DROP THROUGH HEATER (INCHES WATER)*

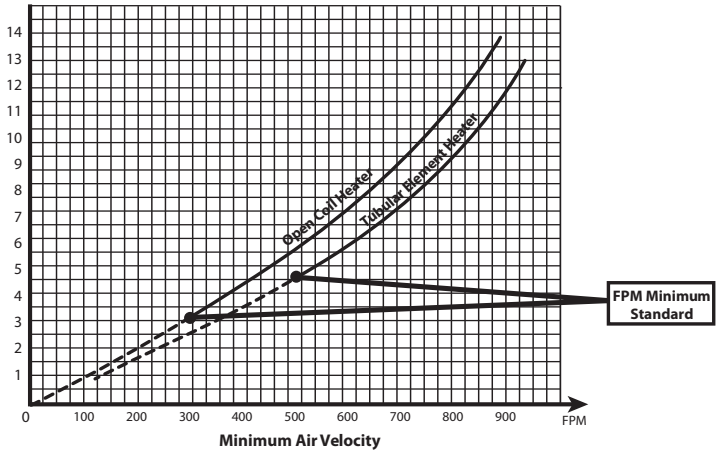
Open coil heaters cause a smaller static pressure drop than do tubular heaters. This may permit the use of a smaller blower with resultant energy savings. A typical tubular heater with 600 feet/minute face velocity has .60 inches of water pressure drop, while the same size open coil heater with the same face velocity has only .03 inches of water pressure drop.



* This is an estimate only and will vary with the specific construction of each heater. Actual pressure drops can only be found by performing pressure drop measurements on actual heater.

KILOWATTS PER SQUARE FOOT

Since tubular elements surface temperature lag behind the resistance wire temperature due to mass and insulation, and in order not to exceed the maximum temperatures allowed by UL, a tubular duct heater is not permitted to have the same concentration of wattage as an open coil heater. Open coil duct heaters have listing of 22.5 kW per square foot. For tubular duct heaters, the limitation is usually about 13kW per square foot.

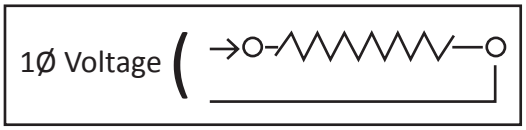


Calculating Line Currents

To determine the line current of a heater, use the formulas shown below.

Single Phase Units

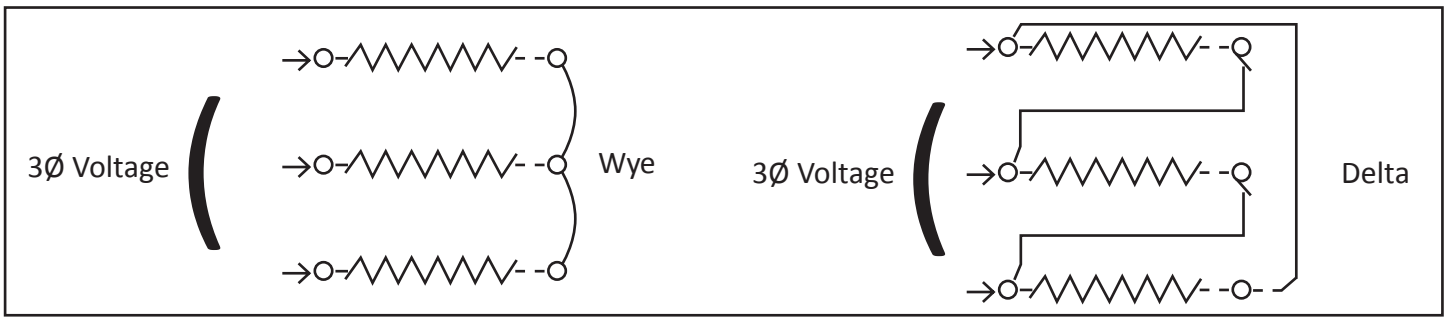
Line Current (I_L) in amperes = Wattage/Voltage



Three Phase Units

Line Current (I_L) in amperes = Wattage/(Voltage x 1.73)

Note: This is a calculation of the current flow in each of the three lines, regardless of whether the elements are connected in a wye or a delta.



Supply Wire & Terminal Sizing

UL requires the line terminals in duct heaters be sized to accept conductors which are rated to carry at least 125% of heater line current. Heaters are provided with properly sized terminals at no extra charge. Field supply wires must be sized to carry at least 125% of heater line current except when the heater is for space heating, is over 50 kW, and not more than 3 wires in the conduit. Under those conditions the conductors may be sized at 100% of the heater line current. Supply conductors must have insulation rated at 75°C (167°F) or higher.