# Selection Guide

**Table I**

| Factor | Open Coil | Finned Tubular | Tubular |
|---|---|---|---|
| **Outlet Air Temperature** | 1200° F maximum | 600° F maximum | 1200° F maximum |
| **Weight** | The lightest of all three types. | Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters. | Heavier than open coil. Additional support required for horizontally mounted units, especially for extra long heaters. |
| **Coil Temperature** | Resistance coils, exposed directly to airstream, run cooler than coils imbedded in sheathed elements. | Coils run hotter than open coil, but cooler than tubular due to heat transfer effect of fins. | Coils run hotter than open coil or finned tubular. Temperatures are kept within safe limits by reducing watt densities. |
| **Pressure Drop** | Lowest pressure drop due to large percentage of open space. | Lower pressure drop than tubular, but higher than open coil. | Highest pressure drop because of high percentage of space occupied by tubes. |
| **Electrical Clearance** | Large clearances between live parts and ground enable open coil heaters to withstand severe applications. | Clearances between live parts and sheath are small, but filled with compacted insulation. | Clearances between live parts and sheath are small, but filled with compacted insulation. |
| **Safety** | Since element is electrically live, do not use if element may be touched by conductive material or personnel. | Because the coil is enclosed in a metal sheath, shock hazard due to contact is eliminated. | Because the coil is enclosed in a metal sheath, shock hazard due to contact is eliminated. |
| **Air Quality** | Use only with clean air free of conductive particles or water spray. | Can be used with air containing water droplets or conductive particles unless particles are likely to build up between fins. | Can be used with virtually any type of air quality. |
| **Mechanical Stability** | Open coil heaters are most susceptible to damage due to physical abuse. | Finned tubular heaters can with-stand more physical abuse than open coil. | Tubular heaters are least susceptible to damage due to physical abuse. |
| **Airflow Uniformity** | Airflow must be uniformly distributed to prevent hot spots. Pressure plates can help even out airflow. | Finned tubular heaters are most tolerant of nonuniform airflow. Hot spots tend to be dissipated by sheath and fins. | Less susceptible to hot spots than open coil, but more susceptible than finned tubular. |
| **Velocity** | Maximum air velocity of 2500 SFPM | Maximum air velocity of 5000 SFPM | Maximum air velocity of 8000 SFPM |
| **Controllability** | Open coil heaters respond quickly to step control because of low thermal inertia. This can produce temperature fluctuations if control system does not compensate. | High thermal inertia makes finned tubular heaters slower to respond, but can produce more uniform temperatures if control system is properly designed. | Thermal inertia is greater than open coil, but less than finned tubular. |
| **Cost** | For most applications, open coil heaters are more economical because manufacturing operations are simpler. | Generally more expensive than open coil, but less expensive than tubular because watt densities are higher. | Generally most expensive of the three because of conservative, high temperature design. |

## Choosing the Correct Watt Density

Watt density (watts/sq. in. of element surface area) is a critical factor in heater selection. If the watt density is too high for the application, the heater will fail prematurely. If the watt density is too low, the heater cost will be high. Proper watt density is a function of three variables: Heater construction, maximum outlet air temperature and air velocity. Having chosen the construction, watt density can be determined from Table II below, based on temperature and velocity.

The heater listings are labeled for various outlet air temperatures. The assumed minimum velocity and design watt density are shown at the top of each table. If the velocity in your application is lower than indicated in the heater listing, choose a lower watt density from Table II. If your velocity is substantially higher than shown in the heater listing, check it against the values in the table. You may be able to use a higher watt density at a lower price.

Table II

| Maximum Watt Densities At Outlet Temperatures And Velocities Shown | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Minimum Velocity In Standard FPM | Open Coil Construction | | | | | | | Finned Tubular Construction | | | |
| | Outlet Temperature | | | | | | | Outlet Temperature | | | |
| | 250° F | 400° F | 500° F | 600° F | 750° F | 1000° F | 1200° F | 250° F | 400° F | 500° F | 600° F |
| 300 | 55 | 45 | 35 | 30 | 25 | 15 | 10 | 45 | 40 | 35 | 30 |
| 600 | 60 | 55 | 50 | 45 | 30 | 20 | 10 | 55 | 50 | 40 | 35 |
| 900 | 65 | 65 | 60 | 55 | 35 | 25 | 15 | 65 | 65 | 55 | 45 |
| 1200 | 65 | 65 | 65 | 65 | 40 | 30 | 20 | 65 | 65 | 60 | 55 |
| 1600 | 65 | 65 | 65 | 65 | 55 | 40 | 25 | 65 | 65 | 65 | 65 |
| 2000 | 65 | 65 | 65 | 65 | 65 | 50 | 30 | 65 | 65 | 65 | 65 |

| Maximum Watt Densities At Outlet Temperatures And Velocities Shown | | | | | | | |
|---|---|---|---|---|---|---|---|
| Minimum Velocity In Standard FPM | Tubular Construction | | | | | | |
| | Outlet Temperature | | | | | | |
| | 250° F | 400° F | 500° F | 600° F | 750° F | 1000° F | 1200° F |
| 300 | 22 | 20 | 18 | 16 | 13 | 6 | 3 |
| 600 | 28 | 24 | 22 | 22 | 22 | 12 | 7 |
| 900 | 32 | 28 | 25 | 25 | 25 | 18 | 12 |
| 1200 | 35 | 30 | 30 | 30 | 30 | 22 | 16 |
| 1600 | 45 | 40 | 40 | 40 | 40 | 30 | 22 |
| 2000 | 45 | 45 | 45 | 45 | 45 | 35 | 25 |

## Circuit Sizing

All standard heaters in the listings have circuits that draw a maximum of 48 amps. This enables the use of 50 amp contactors and 60 amp fuses which are generally less expensive than higher rated devices.

For certain applications, however, it may be desirable to have larger circuits – e.g. for use with large SCR controls or to reduce the number of incoming power conductors. In these cases, larger circuits up to approximately 300 amps can be provided. However, in the tubular and finned tubular constructions, circuiting must be consistent with the number of elements shown in the listings.

## Pressure Drop Curves

Static pressure drop as a function of air velocity is shown below. Open coil heaters have the lowest pressure drop. Smaller fan motors can often be used with this design. Pressure drop values provided in Charts A through C are based on the airflow being parallel to the heater C dimension.

For tubular design only, consult factory for pressure drop when airflow is parallel to the H dimension.

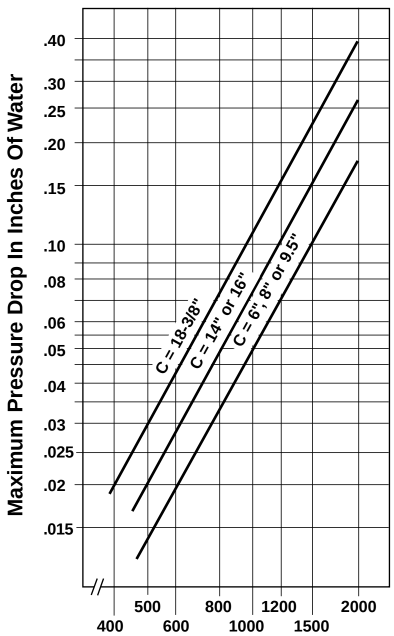


**Chart A**
**Open Coil Design**

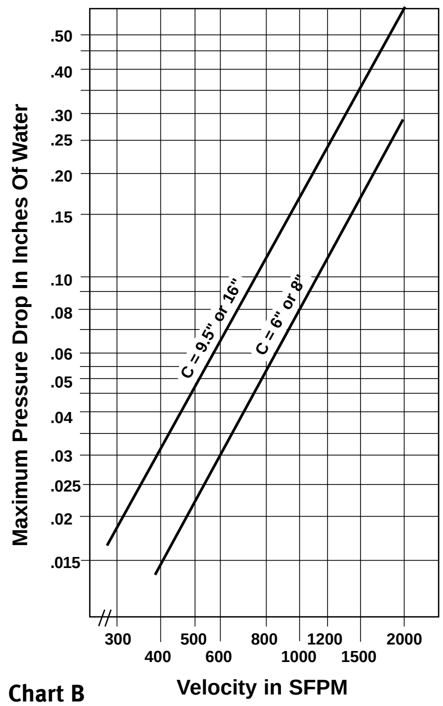


**Chart B**
**Finned Tubular Design**

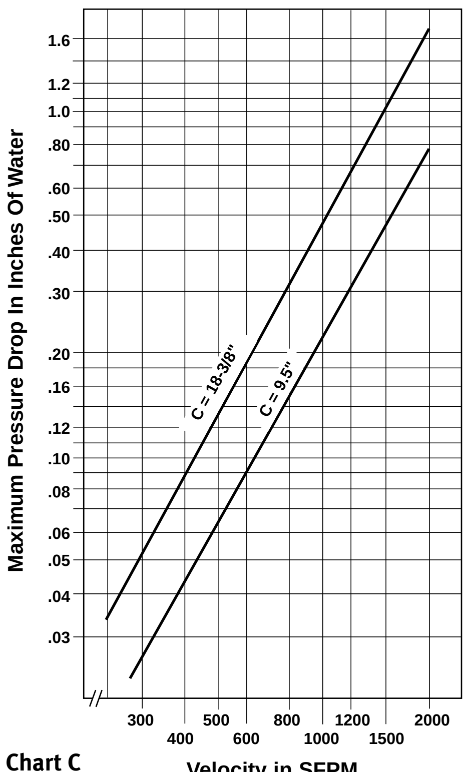


**Chart C**
**Tubular Design**

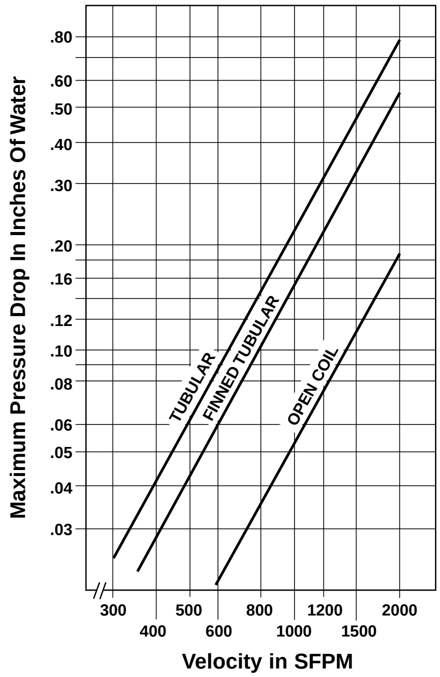


**Chart D**
**Comparative Pressure Drop Through All Three Designs at 9.5" C Dimension**

# Calculating KW Requirements

Once the volume of air in standard cubic feet per minute (SCFM) and the required temperature rise in °F (△T) are known, the required kilowatt rating (KW) of the heater can be determined from the following formula:

$$KW = \frac{SCFM \times \triangle T}{3193}$$

Note that CFM is given at standard conditions (SCFM): 80° F and normal atmospheric pressure of 15 psi. The CFM at a higher pressure (P) and inlet air temperature (T) may be calculated as follows:

$$SCFM = CFM \times \frac{P}{15} \times \frac{540}{(T+460)}$$

**Example:**

A drying oven, operating at 25 psia (10 psi gauge pressure), recirculates 3000 cubic feet of air per minute through a heater which raises its temperature from 350 to 400° F.

**To select an appropriate heater:**

**Step 1:** Convert 3000 CFM at 25 psia and 350° F to CFM at standard conditions using the above formula:

$$SCFM = 3000 \times \frac{25\ psia}{15} \times \frac{540}{(350°\ F + 460)} = 3333\ SCFM$$

**Step 2:** Calculate the required KW:

$$KW = \frac{3333 \times (400°\ F - 350°\ F)}{3193} = 52\ KW$$

**Step 3:** Calculate the maximum heater face area (WxH) that will result in an air velocity above the minimum required for standard heater listings:

The 400° F listing on pages 25 through 28 are based on 900 SFPM velocity. Thus, the

$$\text{Maximum Face Area} = \frac{3333\ SCFM}{900\ SFPM} = 3.7\ sq.\ ft.$$

**Step 4:** Select a heater rated for at least 52 KW with a face area of 3.7 sq. ft. or less.

On page 26 is a group of 54 KW heaters, the first of which has an area of 12" x 30" = 1.0' x 2.5' = 2.5 sq. ft. This item is therefore appropriate. Select either Catalog No. 166N-635-401U (finned tubular) or 165N-335-401U (open coil). Both are rated 65 watts/sq. in.

**Note:** If a larger face area is required, a lower watt density must be selected. For example, if the heater face is 24" wide x 30" high, the velocity will be:

$$\frac{3333\ SCFM}{24" \times 30"} = \frac{3333\ SCFM}{2.0' \times 2.5'} = 667\ SFPM$$

Per Table II, 400° F outlet air and 600 SFPM velocity require maximum watt densities of 55 watts/sq. in. for open coil and 50 watts/sq. in. for finned tubular. Since the 600° F listings on pages 29 through 32 are based upon watt densities of 55 and 45 for open coil and finned tubular respectively, a heater may be selected from this table. The 54 KW item, Catalog No. 166N-848-601U (finned tubular) or Catalog No. 165N-148-601U (open coil) may be used.