Checklist — Selecting a High Temperature Tubular Duct Heater

Sizing the Duct Heater

To properly match a duct heater to an application, the wattage, air velocity and element watt density must be determined.

Formulas and graphs on the following pages that will aid you in your design include:

- Wattage calculation formulas and table
- Element Watt Density vs. Sheath Temperature and Air Velocity Graph
- Pressure Drop vs. Air Velocity Graph

In most applications the following design limitations should be adhered to:

- Maximum watt density of 40 watts/in^2 (6.2 watts/cm^2)
- Maximum element sheath temperature of 1400°F (760°C)
- Minimum air velocity of 200 feet per minute (61 meters per minute)
- Maximum voltage for UL certified heaters is 480V.
- Maximum voltage for CSA certified heaters is 600V.

Calculating Minimum Wattage Requirement

Calculating Minimum Wattage Requirement

Table is for quick-estimation purposes and is based on air under standard conditions (70°F inlet air temperature at 14.7 PSIA).

Note: If air flow is given in CFM at operating temperature and pressure it can be converted to SCFM (Standard Cubic Feet per Minute) with the following formula (use the equations to the right for compressed air):

$$\text{SCFM} = \text{CFM} \times \frac{P}{14.7} \times \frac{530}{T + 460}$$

P = operating pressure (gauge pressure + 14.7)

T = operating temperature

> Remember when calculating wattage to use the maximum anticipated air flow and to compensate for any heat losses.

For free air use equations:

$$\text{KW} = \frac{\text{SCFM} \times \text{Temperature rise (°F)}}{3000}$$

or

$$\text{KW} = \frac{\text{SCMM} \times \text{Temperature rise (°C)}}{47}$$

For compressed air use equations:

$$\text{KW} = \frac{\text{CFM*} \times \text{Density* (lbs/cu. ft.)} \times \text{Temperature rise (°F)}}{228}$$

or

$$\text{KW} = \frac{\text{CMM*} \times \text{Density* (kgs/cu. m)} \times \text{Temperature rise (°C)}}{57.5}$$

*At heater inlet temperature and pressure

Note: The free air equations include a 6% safety factor.

KWH to Heat Air at Selected Flow Rates

Amt. of Air	Temperature Rise (°F) 50	100	150	200	250	300	350	400	450	500	600
CFM	Kilowatt Hours to Heat Air										
100	1.7	3.3	5	6.7	8.3	10	11.7	13.3	15	16.7	20
200	3.3	6.7	10	13.3	16.7	20	23.3	26.7	30	33.3	40
300	5.0	10.0	15	20.0	25.0	30	35.0	40.0	45	50.0	60
400	6.7	13.3	20	26.7	33.3	40	46.7	53.3	60	66.7	80
500	8.3	16.7	25	33.3	41.7	50	58.3	66.7	75	83.3	100
600	10.0	20.0	30	40.0	50.0	60	70.0	80.0	90	100.0	120
700	11.7	23.3	35	46.7	58.3	70	81.7	93.3	105	116.7	140
800	13.3	26.7	40	53.3	66.7	80	93.3	106.7	120	133.3	160
900	15.0	30.0	45	60.0	75.0	90	105.0	120.0	135	150.0	180
1000	16.7	33.3	50	66.7	83.3	100	116.7	133.3	150	166.7	200
1100	18.3	36.7	55	73.3	91.7	110	128.3	146.7	165	183.3	220
1200	20.0	40.0	60	80.0	100.0	120	140.0	160.0	180	200.0	240

Note: For additional information or help with your application please consult TEMPCO.

Checklist — Selecting the Proper Duct Heater, *continued*

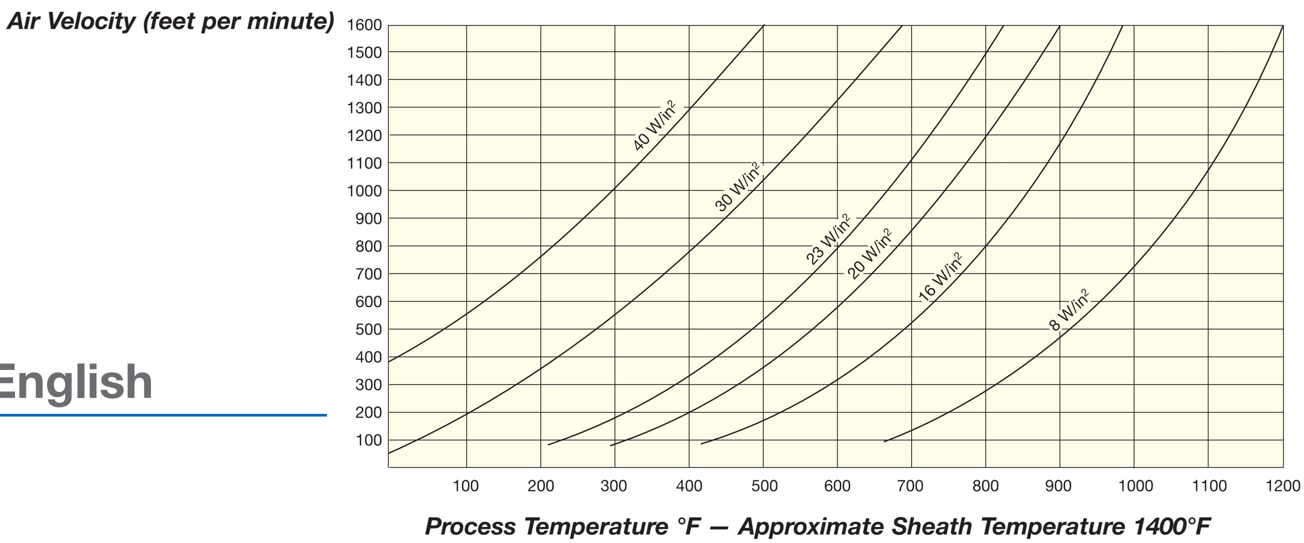
☑ Element Watt Density vs. Air Temperature and Air Velocity

Use graph (English or Metric) to plot

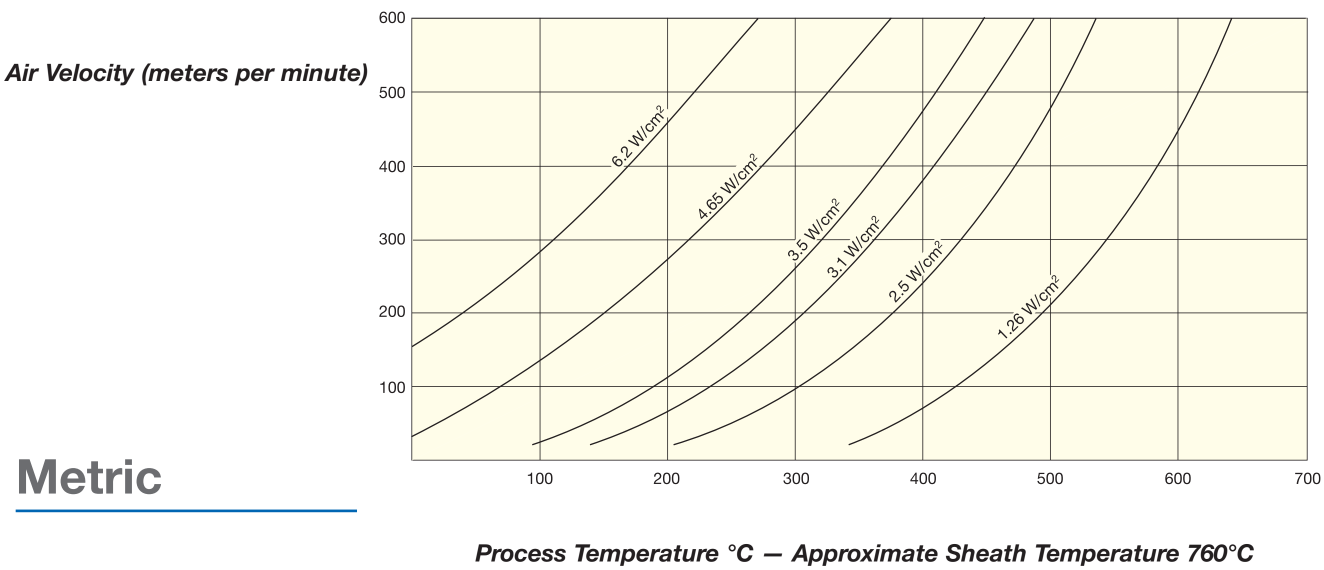
Outlet Air Temperature vs. **Outlet Air Velocity** to determine **Element Watt Density**

The recommended watt density is based on a maximum element sheath temperature of 1400°F (760°C). Air and other gases that are poor conductors of heat require watt densities matched to the velocity of the gas flow to prevent element overheating. Selecting a lower watt density for the heating elements will extend heater life expectancy.

English



Metric



Element Watt Density is the wattage dissipated per square inch of the element sheath surface and is calculated with the following formula.

$$\text{Watt Density} = \frac{\textbf{element wattage}}{\pi \times \textbf{element dia.} \times \textbf{element heated length}}$$

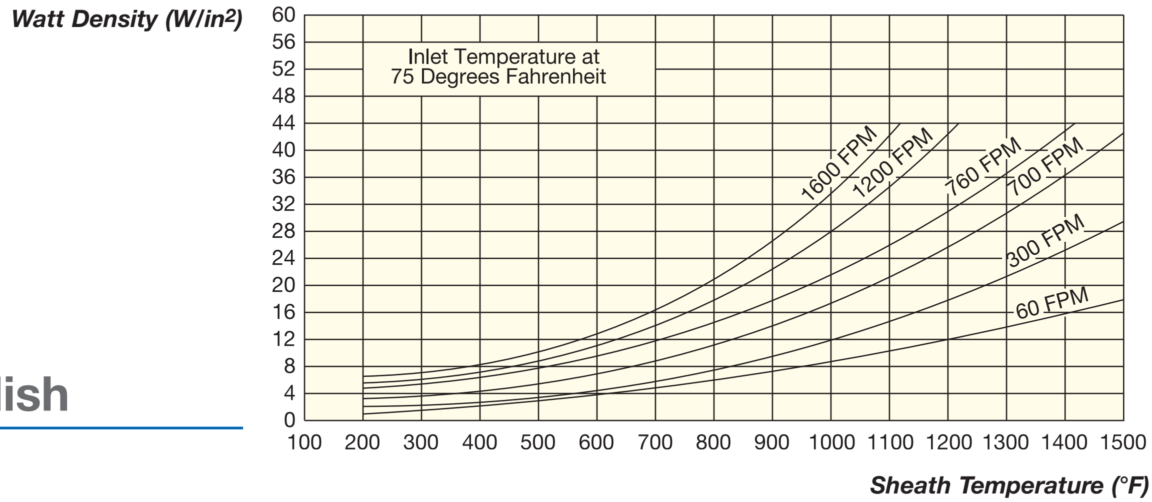
Checklist — Selecting the Proper Duct Heater, *continued*

☑ Element Watt Density vs. Sheath Temperature and Air Velocity

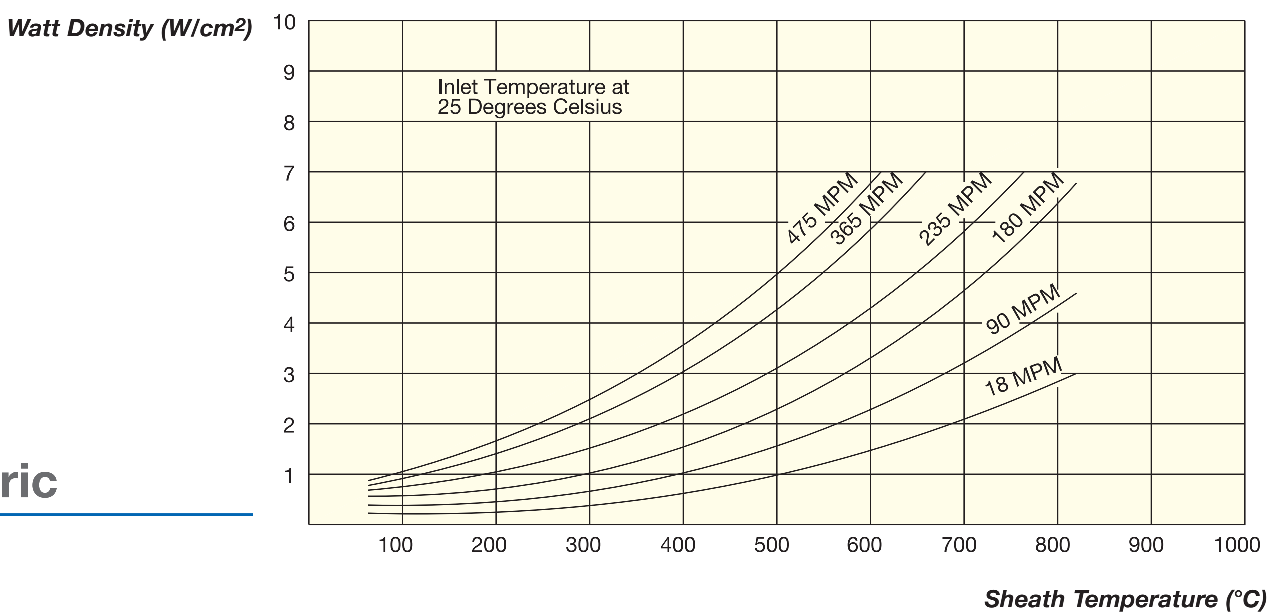
Use graph (English or Metric) to plot

Watt Density vs. **Air Velocity** to determine **Sheath Temperature**
or
Watt Density vs. **Sheath Temperature** to determine the required **Air Velocity**

English



Metric



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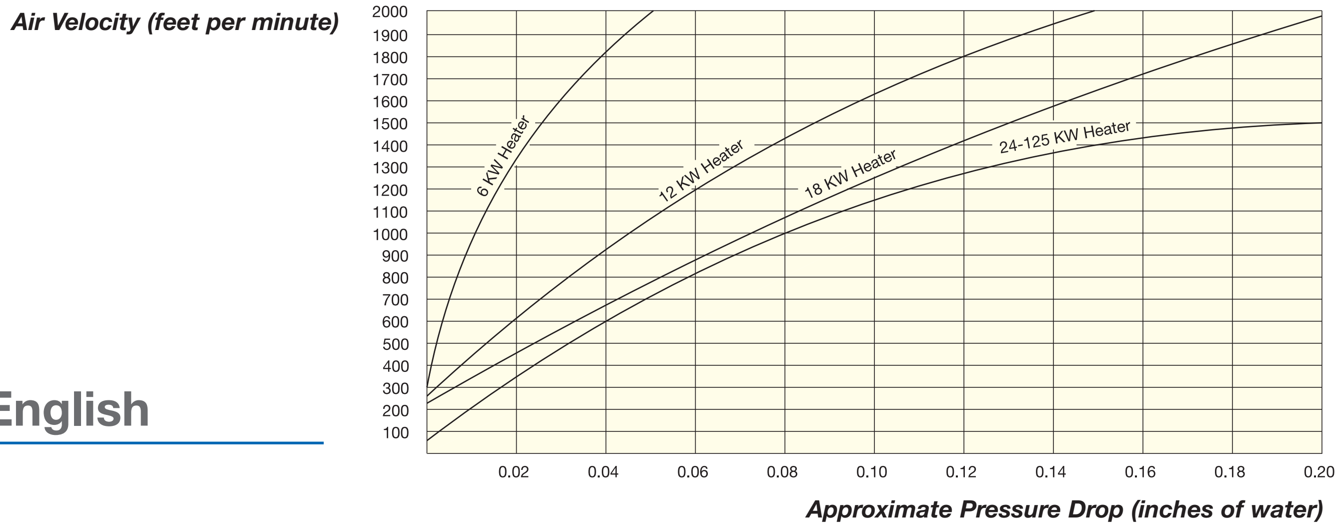
Checklist — Selecting the Proper Duct Heater, *continued*

☑ Pressure Drop vs. Air Velocity

Use graph (English or Metric) to plot

Pressure Drop vs. **Air Velocity** for standard duct heaters sizes used to properly **Size Blowers**

English



Calculating Air Velocity

$$\text{Velocity (feet/minute)} = \frac{\text{SCFM (CFM measured at standard conditions)}}{\text{Duct cross sectional area at heater in square feet}}$$

Metric