

Finned Tubular Heaters

Design Guidelines

The major factors that need to be considered when specifying THF finned tubular heaters are as follows:

- Minimum FPM airflow velocity at heater inlet. Is it continuous or fluctuating
- Inlet air temperature
- Outlet air temperature and temperature rise through heating elements
- Selection of element watt density to keep sheath material within its temperature limits
- Sheath material selection
- Condition of air or gas to be heated
- Mounting & airflow restrictions around elements
- KW sizing and # of circuits required (48 amp max/circuit)
- Temperature sensors & flow controls

Heater KW Sizing

Once the inlet temperature, outlet temperature, process CFM, and operating pressure are known, the KW required for the application can be determined using the following equations. If the process is heating air & operating from ambient temperature and atmospheric pressure (70° +/- 10°F & 14.7 psi), the following formula can be used;

$$KW = \{[SCFM \times (T2-T1)] \div 3190\} + S.F.$$

Where:

T2 = °F outlet temperature

T1 = °F inlet temperature

SCFM = standard air flow in cu.ft./min. at atmospheric pressure and ambient temperature

S.F. = safety factor % to account for process losses

Converting CFM to SCFM

If the air heating process is pressurized or operating at an inlet temperature other than at or near ambient, the CFM at a point in the process with a known pressure & temperature must be used & converted to standard SCFM by the following formula;

$$SCFM = 35.4 \times CFM_2 \times \{(P_2+14.7) \div (T_2 + 460)\}$$

Where CFM₂ is cu.ft./min. air flow at process pressure P₂.

P₂ = process pressure (psig)

T₂ = inlet °F or temperature at point of measured CFM₂

Using the SCFM and the heater face flow area we can now calculate the air velocity in SFPM into the heater core as follows;

$$SFPM = SCFM \div A1$$

SFPM = inlet air velocity at standard conditions.

A1 = Sq.Ft. of inlet flow area at heater

An alternate method for calculating KW needed to heat air or other gas, from any inlet to outlet temperature can be done using the following general energy equation;

$$KW = \{[60 \text{ min/hr} \times SCFM \times \text{Density} \times \text{Sp Ht} \times \Delta T] \div 3412\} + S.F.$$

Where:

SCFM = standard air flow in cubic feet/min (@ 70°F & 14.7 psia)

Density = Gas density in lbs/cuft at standard conditions or if pressurized process at process pressure and inlet temperature. (see table)

Sp Ht = Specific heat of gas in Btu/lb-°F at standard conditions or if pressurized process at process pressure and inlet temperature. (values for air are shown in the gas density table)

ΔT = Process gas temperature rise -°F

3412 = conversion factor for Btu/hr to KW (1 KW = 3412 Btu/hr)

S.F. = safety factor % to account for process losses.

Using the inlet air velocity at the heater and the maximum outlet temperature desired the maximum sheath watt density can now be determined from the following charts for the type of heater being specified if a cataloged design is not suitable. The physical size and constraints of the application will dictate the final configuration and number of heaters required. For large installations, 3 phase circuits need to be balanced and all circuits limited no more than 48 amps per circuit. If voltages are higher than 250V, .375, .430, or .475 diameter elements are recommended.