

Electro-HELPS XIV

Useful Formulae

$$\mathbf{Btu = Watts \times 3.413}$$

$$\mathbf{Watts = \frac{Btu}{3.413}}$$

Example 1: 13.5 kW boiler $13500 \times 3.414 = 46,000 \text{ Btu}$

Example 2: 90,000 Btu Furnace $\frac{90,000}{3.413} = 26,000\text{W or } 26\text{kW}$

$$\mathbf{Watts = Volts \times Amps} \quad \text{Example: } 240\text{V} \times 56.25\text{A} = 13500\text{watts or } 13.5\text{kW}$$

$$\mathbf{Amps = \frac{Watts}{Volts}} \quad \text{Example: } \frac{13500\text{W}}{240\text{V}} = 56.25 \text{ amps}$$

$$\mathbf{3-Phase} \quad \text{Example: } \text{kW} = \frac{1.732 \times 208 \times 80 \times .95}{1000} = 27.4$$

$$\mathbf{Amps = \frac{Watts}{1.732 \times Volts \text{ (leg to leg)} \times PF}} \quad \text{Example: } \frac{27,379}{1.732 \times 208 \times .95} = 80$$

$$\mathbf{GPM = \frac{Volts \times Amps \times 3.413}{500 \times \Delta T}} \quad \begin{array}{l} \text{GPM} = \text{Gallons per minute} \\ \Delta T = \text{Temperature Rise} \end{array}$$

Example: 13.5 kW boiler, with 120 outlet and 90 return water temp

$$\frac{(240)(53)(3.413)}{500(30)} = 2.9 \text{ GPM}$$

$$\text{CFM} = \frac{\text{Volts} \times \text{Amps} \times 3.413}{1.08 \times \Delta T}$$

ΔT = Temperature Rise
1.08 = constant

Example 1: 20kW Plenum Heater

70 degree return
125 degree supply

$$\frac{(240)(83)(3.413)}{(1.08)(55)} = 1145\text{cfm}$$

Example 2: 75,000 btu gas furnace

70 degree return
130 degree supply

$$\frac{75,000}{(1.08) \times 60} = 1157\text{cfm}$$

$$\text{HEATING COST} = \frac{\text{Energy cost} \times \text{Heat load}}{\text{Heating Value} \times \text{Efficiency}}$$

Example 1: \$1.50 propane

$$\frac{(1.50)(50,000)}{(91500)(.9)} = \$0.91 \text{ per hour or } \$21.84 \text{ per day}$$

Example 2: \$.04 off peak electric

$$\frac{(0.04)(50,000)}{(3413)(1)} = \$0.58 \text{ per hour}$$

Comment: This is per hour continuous run, heating systems generally never run 24 hours in a day.

SIZING GUIDELINES

These values should be considered as a very rough estimate and may lead to oversizing. Proper sizing of heating equipment requires a heat load calculation of the area being heated.

Boiler Sizing.

In-floor radiant

10 watts or 34 Btu per square foot.

7 watts or 25 Btu per linear foot of radiant tubing.

Example: 900 sq ft basement $900 \times 10 = 9000$ watts or 9kW
 900 ft of tubing $900 \times 7 = 6300$ watts or 6.3 kW

Hydronic Baseboard

500 Btu per foot of baseboard.

Example: 27 ft baseboard $500 \times 27 = 13500$ Btu/h
$$\frac{13500 \text{ Btu/h}}{3.413} = 3955$$
watts or 3.9kW

PUMP HEAD

Sum of the boiler internal, piping, leader pipe, and longest loop (only one).

Example: $1 + 3 + 1 + 11$ (1/2", 300, 1 GPM per tube) = 16 ft. of head

2.34 ft. of head = 1 psia

Comment: The 1 for boiler is Electro only; smaller boiler can be up to 20 ft. of head.