

ENGINEERING INFORMATION

HOW TO DETERMINE WATTAGE REQUIREMENTS

Electric power is converted to heat with 100% efficiency at the rate of 3.412 BTU per watt hour. The power (watts) for an application is either: 1) Watts required for start-up, 2) Watts required for operation; whichever is greater.

$$\text{START-UP WATTS} = A + C + \frac{3}{4} D \quad \text{OPERATING WATTS} = B + C + D$$

- A = Watts absorbed in raising temperature of machine platen, tank, liquid, etc. in the required time.
- B = Watts absorbed in raising temperature of parts or material during working cycle.
- C = Watts absorbed in melting or vaporizing material in start-up or operation.
- D = Watts lost from surfaces by radiation, convection and conduction.

ABSORBED WATTS

$$\text{(Raising temp.)} = \frac{\text{LBS}}{\text{HRS}} \times \frac{c \times \Delta T}{3.412}$$

ABSORBED WATTS

$$\text{(Melting or vaporizing)} = \frac{\text{LBS}}{\text{HRS}} \times \frac{r}{3.412}$$

LOST (RADIATED)

WATTS = See Curve

LOST (CONVECTED)

WATTS = See Curve

LOST (CONDUCTED)

$$\text{WATTS} = \frac{k \times A \times \Delta t}{d \times 491}$$

$\frac{\text{LBS}}{\text{HRS}}$ = Total weight divided by total time allowed for start-up; or pounds processed per hour.

c = specific heat of material (see table)

ΔT = °F temperature rise of material

r = heat of fusion or vaporization (see table)

k = thermal conductivity (see table)

A = Area of conduction in sq. in.

Δt = difference in temp. (°F) across insulator (usually an estimate)

d = thickness of insulator in inches

Normally 10% is added to above total wattage for safety factor.

ENGINEERING CONSTANTS

1728 cu. in. = 1 cu. ft. = 7.48 gal.

1" = 2.54 cm.

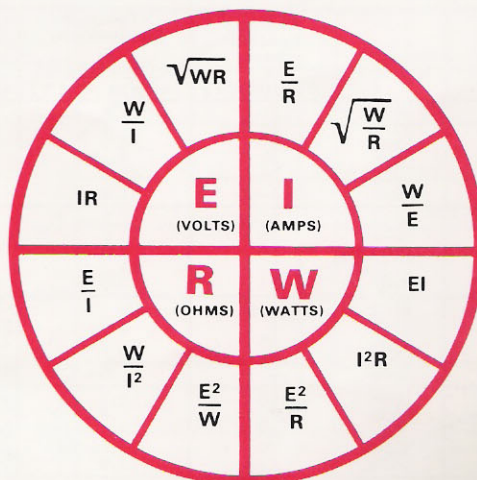
3412 BTU = 1 KWH = 1.34 H.P. hour

1 BTU/lb. °F = 1 gram-cal./gram °C = Specific Heat

lbs./in.³ = .0361 grams/c.c. = Density

$\frac{\text{BTU}(\text{in.})}{(\text{hr})(\text{ft}^2)(\text{°F})} = 2903 \frac{(\text{gram-cal.})(\text{cm})}{(\text{sec})(\text{cm}^2)(\text{°C})} = \text{Thermal Conductivity}$

$\text{watts}/\text{in.}^2 = 6.45 \text{ watts}/\text{cm}^2 = \frac{491 \text{ BTU}}{(\text{hr})(\text{ft}^2)} = \text{Heat Flux}$



VARIATIONS OF OHM'S LAW

Conversion Table

°C	TEMP.	°F	°C	TEMP.	°F
-17.8	0	32.0	565.6	1050	1922.2
10.8	50	122.0	593.3	1100	2012.0
37.8	100	212.0	621.1	1150	2102.0
65.6	150	302.0	648.9	1200	2192.0
93.3	200	392.0	676.7	1250	2282.0
121.0	250	482.0	704.4	1300	2372.0
148.9	300	572.0	732.2	1350	2462.0
176.7	350	662.0	760.0	1400	2552.0
204.4	400	752.0	787.8	1450	2642.0
232.2	450	842.0	815.6	1500	2732.0
260.0	500	932.0	843.3	1550	2822.0
287.8	550	1022.0	871.1	1600	2912.0
315.6	600	1112.0	898.9	1650	3002.0
343.3	650	1202.0	926.7	1700	3092.0
371.1	700	1292.0	954.4	1750	3182.0
398.9	750	1382.0	982.2	1800	3272.0
426.7	800	1472.0	1010.0	1850	3362.0
454.4	850	1562.0	1037.8	1900	3452.0
482.2	900	1652.0	1065.6	1950	3542.0
510.0	950	1742.0	1093.3	2000	3632.0
537.8	1000	1832.0			