PROCESS TECHNOLOGY

ENGINEERING DATA

Electric Heater Sizing

This chart provides an easy reference to estimate the kW required to heat a tank. Heat losses from the surface of the solution and from the sides of the tank have been taken into account. Find the gallons at the left, move to the right to the column with the temperature at which you will be heating the solution. The number indicated here is the kW required to do the heating job. This kW figure assumes a heat-up period of six hours; for a twelve hour heat-up time simply divide the kW figure in half.

GALLONS/LITERS	TEMPERATURE °F/°C											
	100°/38°	110°/43°	120°/49°	130°/54°	140°/60°	150°/65°	160°/71°	170°/77°	180°/82°	190°/88°	200°/93°	210°/99°
50/190	1	1	1	2	2	2	2	3	3	4	4	5
100/380	2	2	3	3	3	4	4	5	6	6	8	8
200/760	4	4	5	6	6	7	8	9	10	11	12	14
300/1135	6	6	7	8	9	10	12	14	15	16	18	20
400/1520	8	8	9	10	12	14	16	19	20	21	24	26
500/1890	9	10	12	13	15	18	20	24	24	27	30	32
600/2270	11	12	15	16	18	21	24	28	30	32	36	38
700/2650	13	14	17	18	21	24	28	32	36	38	42	44
800/3040	15	16	19	21	24	28	32	36	40	44	48	52
900/3400	17	18	21	24	27	32	36	40	44	48	54	58
1000/3780	18	21	24	27	30	36	40	44	48	54	58	64

To determine the heating requirement of a tank, first obtain the following information:

1) Total cubic feet of solution in tank: Multiply the inside dimensions of the tank in feet - length x width x solution depth. (One m^3 = 35.3 ft^3)
2) Total gallons of solution: Multiply by 7.48 the cubic feet of the tank occupied by solution. If the solution is normally 6" below the top of the tank, allow for this when figuring. (3.8 liters = one gallon)
3) Average ambient (room) temperature at which tank will be used in °F. (9/5°C + 32 = °F)
4) Temperature level at which solution is to be held in °F.
5) Heat up time desired in hours.

SURFACE LOSSES IN KILOWATTS FROM OPEN HOT WATER TANK WITH MILD AIR AGITATION/VENTILATION (120 FPM, °F/°C)					
80°/27°	.03	130°/54°	.30	180°/82°	1.10
85°/29°	.05	135°/57°	.35	185°/85°	1.30
90°/32°	.07	140°/60°	.41	190°/88°	1.60
95°/35°	.09	145°/63°	.45	195°/90°	1.95
100°/38°	.11	150°/65°	.51	200°/93°	2.35
105°/40°	.13	155°/68°	.58	205°/96°	2.80
110°/43°	.15	160°/71°	.65	210°/98°	3.25
115°/46°	.18	165°/74°	.73	212°/100°	3.70
120°/49°	.21	170°/77°	.83	-	-
125°/52°	.25	175°/79°	.95	-	-

Losses due to agitation, ventilation and work loads should be considered in calculating total KW requirements.

After this information is known, the following calculations can be made:

$$\frac{A \times 1.0^{*} \times 8.35^{**} \times B}{3412 \times C} = \_\_\_\_\_\_\_\_$$

$$D \times E = \_\_\_\_\_\_\_\_$$

Add the results of both calculations. The total is the Kilowatt requirement of the tank.

A = Total gallons of solution. (One liter = .264 gallons)
B = Difference from ambient temperature and desired solution temperature in °F.
C = Desired heat up time (hours).
D = Heat loss of tank. Refer to charts below
E = Square feet of top of tank. Multiply length x width.
* = Specific heat of water. Insert specific heat of your solution here.
** = Weight of water in pounds (8.35). Insert specific weight of your solution here. (One kilogram = 2.2 pounds)

SURFACE LOSSES IN KILOWATTS FROM OPEN HOT WATER TANK (°F/°C)					
80°/27°	.01	130°/54°	.16	180°/82°	.50
85°/29°	.01	135°/59°	.18	185°/85°	.55
90°/32°	.02	140°/60°	.21	190°/88°	.60
95°/35°	.04	145°/63°	.24	195°/90°	.66
100°/38°	.05	150°/65°	.27	200°/93°	.72
105°/40°	.07	155°/68°	.30	205°/96°	.80
110°/43°	.09	160°/71°	.34	210°/98°	.87
115°/46°	.10	165°/74°	.37	212°/100°	.95
120°/49°	.12	170°/77°	.41	-	-
125°/52°	.14	175°/79°	.45	-	-

Check Immersion Heater Solution Guide for proper sheath material.

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GENERAL ENGINEERING DATA

WATTS (W)

Watts = $\frac{Volts^2}{Ohms}$

Watts = $Amperes^2$ x Ohms

Watts = Volts x Amperes

VOLTS (E)

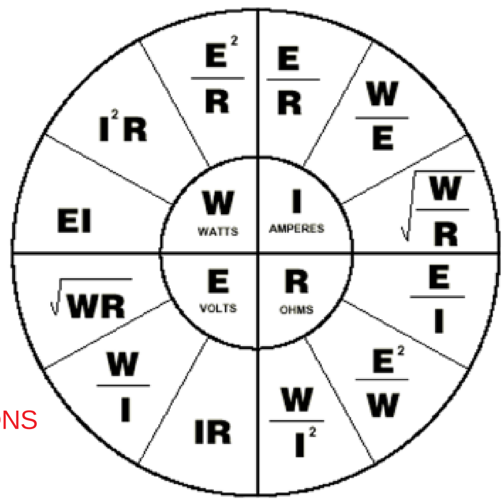
Volts = $\sqrt{\text{Watts x Ohms}}$

Volts = $\frac{Watts}{Amperes}$

Volts = Amperes x Ohms

ALL ELECTRIC HEATER APPLICATIONS SHOULD BE GROUNDED BEFORE OPERATION.

Ohms Law



AMPERES (I) (Single Phase)

Amperes = $\frac{Volts}{Ohms}$

Amperes = $\frac{Watts}{Volts}$

Amperes = $\sqrt{\frac{Watts}{Ohms}}$

AMPERES (I) (Three Phase)

Amperes = $\frac{Watts}{\text{Volts x 1.73}}$

OHMS (R) (Single Phase)

Ohms = $\frac{Volts}{Amperes}$

Ohms = $\frac{Volts^2}{Watts}$

Ohms = $\frac{Watts}{Amperes^2}$

AMPERAGE CALCULATION

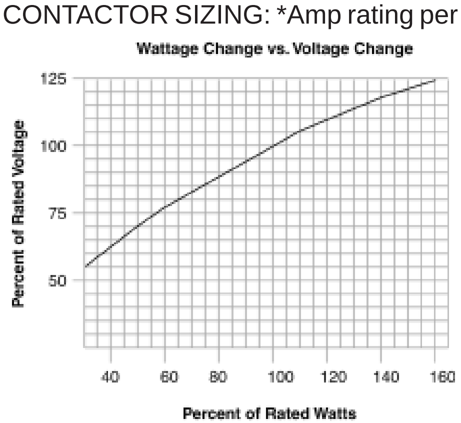
For **single phase** or two wire power supplies to heaters:

AMP RATING PER POLE* = $\frac{\text{Total capacity (watts)}}{\text{Line voltage}}$ Example : $\frac{\text{4000 watts}}{\text{240 volts}}$ = 16.67 Amps

For **three phase** balanced power supplies (Delta or Wye connections) to heaters using a three-pole contactor:

AMP RATING PER POLE* = $\frac{\text{Total capacity (watts)}}{\text{Line voltage x 1.73}}$ Example: $\frac{\text{4000 watts}}{\text{240 x 1.73}}$ = 9.63 Amps

CONTACTOR SIZING: *Amp rating per pole x 1.25 = contactor rating. Round up to nearest standard size.



Wattage varies as the square of the voltage. Graph on the left provides a quick method of finding the percent change in wattage caused by operating at various percentages of rated voltage. Heaters are designed to have a give wattage output at a specified voltage and operation at other voltages affects the wattage output considerably. The following ratio can also be used.

Watts (actual) = $\frac{\text{(watts [rated]) x (volts [actual])}^2}{\text{(volts [rated])}^2}$

W A R N I N G

IGNITION SOURCE

ELECTRIC IMMERSION HEATERS WILL IGNITE MANY PLASTIC TANKS SUCH AS POLYPROPYLENE AND POLYETHYLENE, AND SUBJECT PERSONNEL TO SHOCK HAZARD IF NOT PROPERLY INSTALLED AND MAINTAINED.

SHOCK HAZARD

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